

Université de Montréal

**By Indirections Find Directions Out
Thinkable Worlds in Abbott and Vonnegut**

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Abstract

This thesis is concerned with the interaction between literature and abstract thought. More specifically, it studies the epistemological charge of the literary, the type of knowledge that is carried by elements proper to fictional narratives into different disciplines. By concentrating on two different theoretical methods, the creation of thought experiments and the framing of possible worlds, methods which were elaborated and are still used today in spheres as varied as modal logics, analytic philosophy and physics, and by following their reinsertion within literary theory, the research develops the theory that both thought experiments and possible worlds are in fact short narrative stories that inform knowledge through literary means.

By using two novels, Abbott's *Flatland* and Vonnegut's *The Sirens of Titan*, that describe extra-dimensional existence in radically different ways, respectively as a phenomenologically unknowable space and as an outward perspective on time, it becomes clear that literature is constitutive of the way in which worlds, fictive, real or otherwise, are constructed and understood. Thus dimensions, established through extensional analogies as either experimental knowledge or modal possibility for a given world, generate new directions for thought, which can then take part in the inductive/deductive process of *scientia*. By contrasting the dimensions of narrative with the way that dimensions were historically constituted, the research also establishes that the literary opens up an infinite potential of abstract space-time domains, defined by their specific rules and limits, and that these different experimental folds are themselves partaking in a dimensional process responsible for new forms of understanding.

Over against science fiction literary theories of speculation that posit an equation between the fictive and the real, this thesis examines the complex structure of many overlapping possibilities that can organise themselves around larger compossible wholes, thus offering a theory of reading that is both non-mimetic and non-causal. It consequently examines the a dynamic process whereby literature is always reconceived through possibilities actualised by reading while never defining how the reader will ultimately understand the

overarching structure. In this context, the thesis argues that a causal story can be construed out of any one interaction with a given narrative—underscoring, for example, the divinatory strength of a particular vision of the future—even as this narrative represents only a fraction of the potential knowledge of any particular literary text. Ultimately, the study concludes by tracing out how novel comprehensions of the literary, framed by the material conditions of their own space and time, endlessly renew themselves through multiple interactions, generating analogies and speculations that facilitate the creation of new knowledge.

Keywords

Thought experiments

Flatland

Epistemology

Possible worlds

The Sirens of Titan

Time-Space

Kurt Vonnegut Jr.

Compossibility

Edwin Abbott Abbott

Science Fiction

Résumé

Cette thèse se penche sur l'interaction entre la littérature et la pensée abstraite. Plus spécifiquement, elle étudie la charge épistémologique du littéraire, le type de savoir qui est transporté par des éléments propres aux narrations fictives vers d'autres champs disciplinaires. En se concentrant sur deux méthodes théoriques, la création d'expériences de pensée et l'établissement de mondes possibles, des méthodes qui ont été élaborées et sont toujours d'usage aujourd'hui dans des disciplines aussi variées que la logique modale, la philosophie analytique et la physique, et en suivant leur réinsertion à même la théorie littéraire, la recherche développe la postulat que les expériences de pensée et les mondes possibles sont en fait de courtes histoires narratives qui informent le savoir par des moyens littéraire.

En utilisant *Flatland* de Abbott et *The Sirens of Titan* de Vonnegut, deux romans qui décrivent l'existence extra-dimensionnelle de façons radicalement différentes, un espace phénoménologiquement inconnaissable chez Abbott et une perspective extérieure au temps chez Vonnegut, il devient clair que la littérature est constitutive de la façon qu'un monde—qu'il soit fictif, réel ou autre—est construit et compris. Ainsi, les dimensions établies par des analogies extensionnelles génèrent de nouvelles directions pour la pensée, qui peut ensuite prendre part au processus inductif/déductif de la *scientia*. En contrastant les dimensions narratives avec la notion de dimension telle qu'elle s'est constituée historiquement, la recherche établit également que le littéraire ouvre un potentiel infini de domaines spatiotemporels abstraits, définis par leurs règles et leurs limites spécifiques, et que ces différents plis expérimentaux prennent eux-mêmes part dans un processus dimensionnel responsable pour de nouvelles formes de compréhensions.

Au-delà des théories spéculatives qu'on retrouve dans l'étude de la science-fiction, où est mise de l'avant une équation entre le fictif et le réel, cette thèse examine la structure complexe de plusieurs possibilités superposées qui peuvent s'organiser autour d'ensembles compossibles plus importants, ainsi offrant une théorie de la lecture qui est à la fois non-mimétique et non-causale. En conséquence, l'investigation examine un processus dynamique par lequel la littérature est toujours reconsidérée au travers des possibilités qui sont actualisées

par la lecture, alors qu'elle ne définit jamais la compréhension ultime que le lecteur ou la lectrice se fera de la structure globale du texte. Dans ce contexte, la thèse argumente qu'une histoire causale peut être créée à partir de n'importe quelle interaction avec le texte—soulignant, par exemple, la force divinatoire d'une vision du futur particulière—même si cette narration ne représente qu'une fraction du savoir potentiel contenu à l'intérieur de n'importe quel texte littéraire particulier. Ultimement, l'étude conclut en décrivant comment de nouvelles compréhensions du texte, encadrées par les conditions matérielles de leur propre espace et temps, se renouvellent sans cesse grâce à des interactions multiples, ainsi générant des analogies et des spéculations qui facilitent la création de nouveaux savoirs.

Mots clés

Expériences de pensée

Flatland

Épistémologie

Mondes possibles

The Sirens of Titan

Espace-Temps

Kurt Vonnegut Jr.

Compossibilité

Edwin Abbott Abbott

Science-fiction

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Foreword

I would like to make use of [...] stories [...] to try to specify the relationships between the indicators of “tours” and those of “maps,” where they coexist in a single description. How are acting and seeing coordinated in this realm of ordinary language in which the former is so obviously dominant? The question ultimately concerns the basis of the everyday narrations, the relation between the itinerary (a discursive series of operations) and the map (a plane projection totalizing observations), that is, between two symbolic and anthropological languages of spaces. Two poles of experience. It seems that in passing from “ordinary” culture to scientific discourse, one passes from one pole to the other.

*- Michel de Certeau
The Practice of Everyday Life*

As a scientifically minded writer, I believe in the schematic worth of plans and organisation. As a literary enthusiast, I also know that accidents and detours inevitably break down rigid itineraries. But in mapping out the thought structures that delimit the following research, I came upon a more surprising problem. It is not the unexpected that derails the possibility of a map, but rather the intricacies of the thoughts as they relate to each other. Mandelbrot came upon fractals by looking at coastal details, noting the quantitative variability that depended on scale. Here, the danger is that thoughts, which seem simple at first, are greatly enriched by a continuous return to their own details. Notions that first come about as objects of study are then transformed into the lens through which worlds are understood, worlds that contain the original objects. Coasts become maps, maps become scales, and scales define coasts. Or is it the other way around? Perhaps the best image to illustrate this would be metaphorical; a thought experiment first formulated by Lewis Carroll in *Sylvie and Bruno Concluded*, as a strange character, Mein Herr, describes the ways of his nation.

“That’s another thing we’ve learned from *your* Nation,” said Mein Herr, “map-making. But we’ve carried it much further than *you*. What do you consider the *largest* map that would be really useful?” “About six inches to the mile.” “Only *six inches!*” exclaimed Mein Herr. “We very soon got to six *yards* to the mile. Then we tried a *hundred* yards to the mile. And then

came the grandest idea of all! We actually made a map of the country, on the scale of *a mile to the mile!*” “Have you used it much?” I enquired. “It has never been spread out, yet,” said Mein Herr: “the farmers objected: they said it would cover the whole country, and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well.” (Carroll, 1960: 556-557)¹

By gradually pushing the idea of scale to its logical limit, Carroll illustrates a general problem with mimetic representation; that the further one goes into exactitude, the less manageable becomes the object created to represent the world. This is pushed further by the fact that to unfold such a 1:1 map onto the land that it represents would effectively *kill it off*, thus becoming not only useless but a hindrance to its subject. This unusable map is especially problematic when one considers that a 1:1 ratio is not the largest possible scale, and that the microscopic often needs to be greatly magnified for the naked eye. The mimetic approach to the world and to representation necessitates a simplification, a use of conceptual language to reduce the representation to a convenient manifestation. Borges, who expanded on this in his “Del rigor en la ciencia,” a fragmentary play on Carroll’s idea, proposes an alternative conclusion, wherein the 1:1 map is created by avid cartographers and then abandoned by subsequent generations. He describes the tattered remains of this map as they are transformed into the makeshift shelter to animals and beggars. Thus, the deterritorialisation of the map is complete; not only has it lost its original referent, it has moved to another contextual environment where its original referential meaning is subsumed by a more pressing need. That Borges presents this description within an imaginary fragment that is supposedly part of what has been proven to be an inexistent book is exactly the type of transformation operated within the following research. The map is the image of the text that it contains. It is deterritorialised as an object of representation and reterritorialised as an allegorical theory through a thought experiment. Umberto Eco, in a manner representative of the thoughts that will come into play in the second act of the research, systematizes Borges’s thought experiment and, in *Il secondo diario minimo*, he publishes this short investigation as an essay entitled “Dell’impossibilità di costruire la carte dell’impero 1 a 1.” This first entry into his “Frammenti dalla cacopedia,” fragments originating from an imaginary encyclopaedia of

¹ Since the subject of this thesis a hybrid of many disciplines spanning across the science/humanities/arts divide, I have chosen to present the citation information in a hybrid manner focused on conveying the information most important to all the concerned areas of study.

pataphysics called the cacopaedia, concludes on the grounds that the map is always representing something that is not the territory, that as soon as it is produced, it is no longer representing its mimetic source, and that once finished it begins the destruction of its own originating empire. Like Borges's contextual interplay, Eco's imaginary encyclopaedia and his reliance on fragmentary forms points to the eventual demise of any totalizing theory or thought. In Luigi Serafini's *Codex Seraphinianus*, which fully realises in physical form Eco's dream of a surrealist encyclopaedia, form and content, through the vanishing point of unknowable knowledge, are melded into a single theoretic object that is both source and limit to its own meaning. In his theory of reading, Eco mentions the encyclopaedia of the reader as the grounds from which knowledge of the book is generated. But the knowledge about the possibilities of such encyclopaedias is always lacking, expansive and shifting. Likewise, the sum of all possibilities, when it comes to the interpretation of a novel, can act as the foundation of thought, can be conceived abstractly, but must always fail in their actualisation. Such a structure is difficult to map, but it is interesting to explore. As such, any attempt at describing the structure of the argument should be construed as signposts or relativistic directions rather than as a map of things to come.

Since this research should be read as a path rather than a collection of features, it seems that placing the reader at one point on the geographical representation of this analogy only distances him or her further from its endpoint. By an effect of perspective, at any starting point one cannot be expected to truly comprehend the discovered relations, which shall gain in worth as the path is travelled. For the moment, only the signposts can be described, and while a trusting reader will believe me when I point to the horizon and describe an interesting and strange land beyond a nearly imperceptible mountain, much of the interest and strangeness comes from having first walked through the two-dimensional realm, beyond the junkyard of forgotten time machines, out onto the moon, through a wormhole and back to this land of the compossible. Imagining different worlds is a staple of naïve literary theory, and might seem at first like a very banal idea. But creating an understanding of the real through the consideration of what neither has nor ever will be is, for me, wondrous. And even the most *blasé* of readers will at least have to agree that it is something worth thinking about.

Introduction

It is we who can open the doors into such other universes or close them as we choose. Because we know. We can go to them—when we know enough we shall—but they cannot come to us. There is no way but knowledge out of the cages of life.

*- H. G. Wells
Men Like Gods*

What does the word “literature” mean today? In an era where text is no longer constrained to the page, such a question seems thorny or intractable, much too vast to be entertained. For those in my entourage not directly embroiled in the study of literature, the word means something akin to “fiction” or “poetry.” Often, I get asked if I am learning creative writing, or “when my novel will come out.” Truth is, many of the people living on Earth at this dawn of the 21st century cannot begin to fathom the use of studying literature. Yet the world has never been so literate. The screen has placed writing at the heart of many people’s everyday experience. As it is common to note, “text” has now become a verb. Publication and diffusion have never been more available, both on an independent and professional basis. The daily experience of the average office worker includes reading and writing digital correspondence in the form of emails. At the same time, literary theory has been constantly redefining its limits, opening its doors to formerly shunned manifestations of culture. Comics, b-movies, digital text and science fiction are now perfectly acceptable areas of study. How can we conjugate this increased reach of criticism with the intrusion of text into the everyday? Should it not be the case that literary studies is a discipline with an expanding reach, of primary importance for the understanding of this ever-expanding world of text and discourse? In a sense, it already is, yet the way it defines its object generates a referential problem. For many, literature remains associated with the classics, with a canon. It is as though “literature,” as an academic sphere, had remained dependent on the classical curriculum on which its study was founded. These disciplinary limits are illustrative of a divide between empirical knowledge and an accompanying presupposition that literature functions outside of—or in a superficial manner with—the physical world. Illustrative of this

point is the debate, in late Victorian England, between T. H. Huxley and Matthew Arnold. Both preeminent educators spoke to the worth of studying science as a constitutive part of their modern school system. Huxley argues, in his address to the Mason Science College (a school positioned against teaching the classics), that scientific education was representative of the knowledge most important to the culture and worldview of the time. He pointed to Arnold as a “Levite of culture,” a member of the tribe who assists the priests in keeping a sacred hold on tradition. In his response, Arnold uses a strange tactic. He neither decries the advent of the natural sciences in education, nor does he directly contradict Huxley. Rather, he prefers to combine the scientific theories of Darwin, and his description of humankind’s ancestor as a tree-bound primate, to reconstruct the link between the Greeks and humanity’s prehistory. He argues that, “this good fellow carried hidden in his nature, apparently, something destined to develop into a necessity for humane letters” (Arnold, 1883). Arnold makes use of the scientific discovery’s causal logic to work backwards, from the Greek that he held dear, to Darwin’s primeval man. This short altercation shows how there is always a possible reinterpretation of fact after the case, a retelling of causality. Arnold is using Huxley’s own weapon against him, showing that in fact, if evolution, as a representative of the natural sciences, is to be trusted, then the elements of the *belle lettres* that were then studied could be construed as extensions of *homo sapiens sapiens*’s natural characteristics. Furthermore, this underlines the strange conclusion that literary reinterpretation takes part in shaping the extensions of scientific thoughts. It could even be said, in a strange inversion of the literary and the evolutionary, that it is fitting to find, down the genealogical tree of both these thinkers, Aldous Huxley, a science fiction writer. But while this is said in jest, the fact remains that this era, where the educational debate between the scientific and the literary was taking form, teaches that literature was already pervasive as a method of knowledge and that its study cannot be reduced to the preservation of its own *corpus*, since it is constitutive of the very act of understanding.

Yet this research is not about what literature is, it is about what literature can be. What this sentence means is less than obvious, for there are many actual and potential ambiguities in the modal marker “can” and in the ontological verb “is,” especially when no themes, styles or subjects have yet been established. Am I saying that literature is moving towards becoming

something other than its present form? For then, the initial phrase is transformed into a temporal statement, describing a process of knowledge creation, and the almost philological movement of definitions as history carries on. Am I instead advocating for a new definition of the literary, pointing to the potential for a new form with the fervour of a decisive activist? In this iteration, possibility becomes an imperative, a call to arms, and the adoption of a standpoint amidst a yet to be defined debate. These two different approaches to literature are common in critical texts, and would make fine starting points for a project that would then have to be situated within a particular tradition, built up as an argument for change (or stasis) within this same tradition, and eventually formed as an essential brick within the edifice of its institution. But another meaning can be drawn from the above combination of words, a less common, or immediate interpretation of the phrase, and in fact the one most specific to the following considerations: the movement from ontological certainty to modal possibility. Thus, one could say that the choice of wording, in this case, is as pointed and specific as it can be, for the problem it describes is specifically this contrast between “is” and “can be.” How does epistemology work when it is founded upon diverging possibilities and multivalent alternatives? As will become clear, a great emphasis should be placed on this latter definition, since the importance of this research is the shift from an emphasis on fixed meaning to that of possible significances, or overlapping viewpoints on the same object.

How does one approach a problem vast enough to encompass all possibilities of literary texts? Listing possibilities seems out of the question. Certainly, there are methods that allow reference to the diverging interpretations on a body of words without listing them diverging interpretations. In fact, while this is definitely a way to illustrate that literature generates differing viewpoints—contrasting Samuel Johnson’s view of Milton’s *Paradise Lost* with William Blake’s ideas on the same work, for instance—it also takes the reader away from the question of possibility and into the particulars of chosen viewpoints. This is inevitable; as the idiom goes, specificity is the soul of narrative, and direct examples provide a common ground through which many notions may be discussed and explored. The only way to keep the focus on both specific examples and the possible as a characteristic of fiction is to make form and subject overlap; thus the novels chosen to represent literary thought, *Flatland* by Edwin Abbott Abbott and *The Sirens of Titan* by Kurt Vonnegut Jr. describe possibility in a

direct manner, but they can also be read in many different possible ways. Thus, while certain inevitable paradoxes arise, such as the possibility that these novels be read as about something other than the possible, their analysis becomes double; it provides both the theoretical background and the narrative examples of the study. The comparative method allows for such a reappropriation of presuppositions; knowledge produces a theoretical framework stemming from the text itself. It is not a grid into which one painstakingly forces independent works; it is rather the result of differences meeting at a crossroad, like poets reading Einstein or optical physicists looking at Van Gogh paintings.

Sketching out this type of thought ahead of time is a difficult undertaking. Readers will have vaguely understood that many things can be said about literary works, that these things each function according to different readings and that by looking at possibilities, I am trying to discuss their overarching organisation without negating their individual worth. Doing so necessitates a constant movement outwards, a way to speak of all possibilities, not within a discourse that would be “metapossible” or vertically above individuals, but rather on equal footing with these interpretations, as, once again, the idea of possibility is directly drawn from the novels being studied. It is one of the readings, not necessarily the right or the best reading, but it speaks to all other readings. And by addressing all these different readings and not delving into their taxonomy—not establishing a catalogue of possibles, which could very well be endless and is certainly never complete at a given moment in time—one has to wonder about the shape of a thought that considers what has yet to be thought or discovered. Doing so requires a complicated form of understanding, one that is turned towards the thinkable. A simple way of entering into such a problem consists in building images to draw out characteristics. As such, it will become obvious from the onset of the research that the use of metaphors permits a sort of pre-emptive speech. From this impressionistic beginning, different ideas can gradually come into focus, as a working vocabulary is established. This wedge into thought places the reader within a relational network of reference, at the very heart of a linguistic space.

In this research, the two main contenders for conceptual primacy are *possible worlds* and *thought experiments*. Both stem from traditions other than literary criticism (modal logic and theoretical mechanics, respectively), but both have been linked to the literary discipline.

As freestanding theories, they both act as entryways by which one can include oneself in the debate on the epistemological importance of fiction. They also hold within them, both as historical concepts and as representations, the necessary build to platform an investigation on the link between *scientia* and literary knowledge. The most perilous element of this method is its obstinacy. It is now a well-known fact that literary research treading on the grounds of the “exact sciences” (Bricmont, 1996: 4) is opening itself up to a certain trend of scrutiny from experts in these self-identified fields. Furthermore, this research has the nerve to include some of Sokal’s great enemies issued from “a self-perpetuating academic subculture that typically ignores (or disdains) reasoned criticism from the outside” (Sokal, 1996): Deleuze, Foucault, Derrida, etc. And while these apparent tensions will be discussed, they will not act as guiding principles to the argument. The Sokal hoax (and the affair that followed), is an event now well over a decade and a half old, and figures so prominently in contemporary thought merely because it is the last obvious marker in a debate begun ever since Plato kicked the poets out of his Republic. While I will not be dismissive of it, I believe that this controversial subject will be dealt with through a less historically minded investigation. The languages of logic, of physics and of mathematics will be put into play because they illustrate the implications of certain chosen fictional narratives. But while *possible worlds* and *thought experiments* have become traditional scientific tools, their jurisdiction remains well within the reach of a literary investigation. Hopefully, there is, in this approach, the germ of an eventual reconciliation between the empiric and the conceptual, between an epistemology of limits and a science of fact.

The following thesis, in accord with its underlying research, is divided into three acts that each follow a *denkspiel*. The first, “Experimenting with Fictional Space” attempts to understand how literature functions as the generator of new knowledge. Using Swirski’s intuition that Sorensen’s gradualistic metaphilosophy—a continuum between philosophy and science—may be extended to include literature, the chapter explores the notion of fiction as a thought experiment. Through Gendler, Mach and a short introduction by Le Guin, the notion of the thought experiment is defined as a short work of narrative fiction, and the implications of having imaginary situations affect knowledge are weaved into a motif that is recurrent in the entire investigation. Le Guin, who formulates her definition of thought experiments in and

around the genre of science fiction, forces a sidelong glance into the question of the genre's definition. Science fiction as a genre is useful in describing the intersection between thought and literature since it is almost exclusively defined as a literature of extensional thought and prediction. This will remain important throughout the exposition, but it is of immediate relevance, since *Flatland* is then introduced as a prime example of a literary thought experiment. *Flatland's* recuperation, which inevitably makes rhetorical use of the science fiction appellation, is defined according to its influence as a pedagogical aide, used to teach the spatial fourth dimension to three-dimensional beings. While still undeniably literary, *Flatland* is currently almost exclusively referenced in order to make use of its epistemological implications, and it is rarely presented as an aesthetic work appreciated for its prosaic beauty. By expanding on *Flatland*, it becomes clear that the idea of a "dimension," which oscillates between abstraction and fact, a characteristic of its own discourse, is the notion best adapted to a serious discussion about possibility in fiction. The fourth dimension, either as space or as time, is interesting as a modal concept since it allows for a projection outside of a given framework without reducing it to a subset of a new order. In order to pair *Flatland* with the spatial fourth dimension, a short study of the concept's history is then initiated, using as a main source Cajori's "Origin of Fourth Dimension Concepts." With the help of the newly expanded conceptual framework, a contrast is operated between prescient forms of fourth dimension ideas, such as Hinton's tesseract and More's spissitude, challenging uniform thought-experimental knowledge as multivalent. Thus, thought experiments, which first seemed to establish credence for the literary as a source of experimental knowledge, are themselves put into question, initiating a movement that will come to affect mimesis and reality.

The second act, "Reading Between the Timelines" begins with an investigation into the nature of experimentation and one of its foremost presuppositions: causality. An in-depth analysis of Zola—an author explicitly named by Mach as the prototype of a thought-experimental novelist—and his naturalist manifesto *Le Roman expérimental* generates a surprisingly abundant wellspring of considerations. The contrast between two of Zola's figures, the experimentalist and the observer, figures that are both part of his author-function, uncovers a complex structure of thought tied to the notion of the author, the reader, the

experimental method and causality's many roles and interactions with the written work. The various causalities of text, structural logics found in the process of writing, in historical context and in reception, lead to an idea of reading that cannot be described through a cause-and-effect framework. In order to better illustrate this, I introduce *The Sirens of Titan* as a novel that not only contains all the different causalities found in literature in general, but also comprises different forms of described phenomenological timelines. The novel, which contains a strange phenomenon called the chrono-synclastic infundibulum, divides its two main protagonists along different modes of time experience, which I name timescapes. Through these different experiences, all causalities of text are reconsidered and reconceptualised in comparison to one another. Thus three main texts of criticism written about *The Sirens of Titan* are shown as partaking of the book's meaning ecology, along the same lines as historical readings and new encounters. The relationship between fiction and the world becomes much more fragmentary and multiple than Zola's own experimental method. Through this, the theory of possible worlds, drawn from Leibniz and modal logic, and implemented in the literary sphere by Eco, Doležel and Pavel amongst others, becomes a powerful tool to compare near-scientific notions such as the chrono-synclastic infundibulum and theoretical objects found in the physics of the "actual" world, such as black holes. Possible worlds allow for an interrelated whole that includes theory, history, fiction and the real within a framework, and it once again leads to the idea of multiple dimensions. But in light of the act's considerations, the applicable dimensional theory is that of Minkowski and Einstein's space-time, which uses temporal dimensions to best describe the relationship between causal and real events.

Thus, both the first and the second act have a similar form; they begin with a tentative link between the fictive and the real, either through a gradualistic metaphilosophy or the experimental novel, they then move on to introduce a literary source of considerations, *Flatland* or *The Sirens of Titan*, and they finish by discovering the importance of dimensions through a borrowed theoretical framework, either the thought experiments of physics or the possible worlds of modal logic. Both acts explore dimensions, experimental knowledge as related to theory and the relationship between induction and deduction. This parallel structure could seem to indicate that these are independent research projects developed along the same

axes and presuppositions, but this is not quite the case. These two concept-rich pieces are attached to one another; much of the language developed in the first act is reused in the second, and no efforts are spared in drawing parallels between the discoveries that both these inquiries have in common. As such, one might say that they follow the act-structure of Aristotelian poetics; the first act is truly an introduction to the type of thoughts and the style of reasoning that will be used throughout this entire thesis. The second act, through the links drawn with what preceded it, unearths many core problems at the heart of crucial notions such as possibility, worlds, thought and dimensions. And if this formal Aristotelian analogy is to hold, then with the third act should come a catastrophe.

While there are many conceptual clashes during the last act, the general outcome produces a synthesis. The Greek for catastrophe, *katastrephein*, is a combination of *kata*, or down, and *strephein*, or turn. As will be the case in much of the third act, these relational words, which carry with them a dead spatial metaphor, can be reinterpreted as both a lateral and rotational movement, something which can be described as multidimensional. Much of the third act is concerned with these types of structures, which are often seen to engender change in one projective dimension, but are also animated by movement on other planes of consideration. First, there is a reconsideration of literature as something that is both contained in a medium and a form. Language, which is the foremost medium of the literary, is thus reviewed in light of Hintikka's theory of language as calculus. This odd mathematical structuration of natural language grows out of the modal considerations of logic, and Hintikka's theory, while not sufficiently powerful to account for all aspects of language, does offer a middle ground for discussion of possibility and actuality. Thus, it becomes evident, especially when considering the physical manifestations of literature as they appear in the world, that the limits of the actual world are in themselves difficult to determine. Work by Lewis and Ronen point to the possibility of many different actualities coexisting conceptually, and a parallel is drawn between Lewis's modal realism and quantum physics' many-world hypothesis. Since the stake of the research is to consider the epistemic charge of the literary, pragmatists and realists should not shy away from this shifting picture of the real; it itself is merely a by-product of literature's ability to contain many conflicting possibles within a same form. In order to better understand how many actualities may coexist, two final steps are

taken; the study of the overlapping forms of temporal and spatial fourth dimensions, and the movement from impossibility to compossibility. In the former, the two previous acts, which describe dimensions of space and dimensions of time, are brought together in order to clarify how a single referent, “dimension,” can hold for fundamentally different aspects of existence. In short, dimensions are extensional projections, and they allow for a movement from one mode to another without reducing one to the other. This in turn acts as the perfect conceptual tool to discuss and organise overlapping possibilities and impossibilities into compossible and impossible forms, or divergent readings that can support, confirm, contradict and deride each other, but that all take place within the same ensemble of possibility. Thus, possibility unfolds relative truths about fiction, discovering aletheia along the folds of the fiction through explication and implication.

Experimenting with Fictional Space

Most of the Neogene, we fear, will forever remain shrouded in mystery, for even chronotraction methods have failed to provide the most fundamental details of the social life at that age. Any systematic presentation of those few moments of history which we have been able to re-create goes well beyond the limits of this introduction. [...] Our historiography has not yet passed final judgement on the "Notes," commonly called, for the location of their discovery, "Memoirs Found in a Bathtub." Then too, no agreement has been reached as to when and in what order certain parts of the manuscript were written. [...] Let us then be silent and allow this last message from the Neogene, the Era of Papyrocracy, to speak to us in its own voice.

*- Stanisław Lem
Memoirs Found in a Bathtub*

At the very boundaries of space, a strange porcelain vessel breaks off from the gravitational pull of the most outward star. Projected beyond the edge of the universe, it redefines the limits of its ensemble, resketching, with its vectorial presence, the most accurate of universal maps. This is a problem for the nameless organisms that have come to colonise the outer reaches of space; their carefully calculated projections are rendered inaccurate by this piece of outward-bound garbage. Although quite bothersome, plans are made for a mission to brave the vast emptiness of extra-universal space in order to retrieve this meddling unknown, stopping its expansive reach and bringing it back to a more controllable environment. First thought to be a naturally occurring projectile, a lost meteor or a wayward comet, the object, when seen, turns out to be fashioned in a way that denotes some kind of intellect, or, at the very least, some form of intention. The crew, whose instructions are clear, merely pluck it out of its detrimental path and bring it back home. There, experts make an unexpected discovery. Not only is this satellite a *construction*, it is one that contains what seem to be records. Many thin plant-like fibre sheets are bound together by dried and cured animal skins, and small characters written in a dried pigmented liquid have been purposefully aligned along the near-entirety of the vegetable film pages. A verdict is quickly reached; the

markings of a primitive society organising meaning in the most practical mode that they have yet discovered. But a yet stranger conclusion is proposed; the nameless ones know of this society, they have received messages encoded in much more sophisticated media, waves and bits, for the last era.

If beings from the proverbial “galaxy far far away” were to find, in a spaceborne bathtub, three books—Einstein’s *Mein Weltbild*, Foucault’s *L’Archéologie du Savoir* and Wollstonecraft Shelley’s *Frankenstein*—they would be hard-pressed to establish any fundamental distinction between these strange codices of tiny characters. Assuming they were to find a Rosetta stone to transcend the inevitable boundary of language (say, with a combination of the Pioneer plaque, the letters on Pioneer’s hull, the Voyager Golden Record and a surhumain sense of deduction), these distant sentient entities might establish that these texts have distinct purposes. But in order to write the scenario where they posit a typology of rationales, and modes of discrimination, I would have to render explicit endless characteristics for these beings. Or rather, if I established the way in which differences were drawn up, I would be able to deduce potential presuppositions, underlying the way knowledge is divvied up by these extra-terrestrial entities. A little honest self-reflexion would then lead to the inevitable realisation that I have merely been recontextualising my own speculations on how knowledge could exist when alienated from human institutions and preconception. Ironically, by looking at hypothetical beings in the stars, I was looking inwards all along, and wondering what could be stripped of the baggage that my education and (who knows) genetic makeup implanted upon my mental reflexes, in order to look the text anew, without its common markers.

The entire purpose of this conceptual gander serves to show that there is, in the simple act of *mise-en-scène*, a plethora of small details already at work. Such is the catch-22 of literary epistemology; up to our ears in presuppositions, we work at isolating factors, at reducing compound thoughts into elemental parts, by drawing from our own body of presuppositions. Thereby, if a sorry analogist tried his hand at creating a Mandeleev’s table for elementary thoughts, he would find his tabular display constantly blinking in and out of itself. For what kind of thought is classification? How elementary is the need for elements? Periodically primordial, then artificial, reflexions on types oscillate between basic

fundamentality and infinitesimal mosaics. This boils down to saying that knowledge's building blocks are irreducible multitudes; parts are isolated, but remain complex. Let us say, with Aristotle, Mills and many others, that the whole is greater than the sum of the parts, but let us add that the isolated parts are in turn greater than the whole. To be thorough, let us complete by quickly noting that even the sum in itself is a process that is greater than both whole and parts. All in all, focus on what you will, and details, contexts, stories old and new will emerge. Like Mandelbrot's fractals, scale is so integrated in the measurement of thought that asking the question "How complex a thought is classification?" boils down to an argument structured similarly to the one on the length of the coast of Britain (Mandelbrot, 1967: 636). Yardsticks and rulers, without losing their individual reliability, generate problems when their results are compared. Likewise, the best theories on knowledge hold up within their own logic, but struggle for rhetorical supremacy when pitted one against another. Like blind spots exposed from the second viewpoint of a mirror, theoretical shortcomings are most easily pointed out from another vantage point.

This entire research stems from a desire to speak of knowledge creation without falling into systematisation. There exists a particular form of knowledge that cannot be thought of through systems. Taking the quicksand of rationality as a standpoint, knowledge is a shifting, mirage-like impression, always out of reach. The hazy nature of this process, or even of its description, mandates an unorthodox approach. For it conjures up systems, it concedes their existence as a necessary means to understanding, but it also questions their fundamentality by placing them within groundless waves of systematisation; from afar, the sea's horizon looks stable, but from up-close it is obvious that wholes are shifting into parts, and parts are becoming wholes, endlessly. Humanity looks to the International Cloud Atlas to categorise the sky's overcast, but how can this reference work help in thinking about the imagined shapes of a particular *cumulus*? Or about the yet-to-be-compiled history of those struck by lightning? Or about cloud computing? Like an *undulatus asperatus*, the free-association of language, through the paths of figure and analogy, constantly shifts and bends the rigid boundaries that are traditionally necessary in establishing a seemingly rigorous arrangement. Out of these rule-bound combinations, humanity has split up its knowledge into disciplines, logical intermeshed ensembles of *scientia*, and these shifty edifices make-up a particularly adamant

nexus of epistemological presuppositions. From *scientia*, in its classical sense of both separation and knowledge, I will draw a *modus operandi*, for a method. In systematisation, one must keep both limits and contents in view, for there is a direct link between scrutinising the expanses of a body of knowledge and the reorganisation of its extensions.

Reading the three books in our space-bound bathtub without *a posteriori* division of knowledge means approaching objects of concern without the well-defined vocabulary of a given theoretical framework. It explains a proliferation of metaphors that has already begun; words have not yet come to manifest themselves as concepts, so figurative images appeal an associative sensibility in order to draw outlines. This means looking at the faces in the clouds and trying to distinguish if the evaporation and condensation processes can be found and explained by their traits. For if a *stratocumulus* gives us a jolly well-rounded mug, and a *nimbostratus* draws out a ghostlike visage, there must be, in pareidolia, a link towards formal classification. Likewise, if we pit the meaning given to books by preconceptions (when they are judged by their covers) with the elements that make up their unfurling, we might glimpse at new unthought-of associations in the process of knowledge creation that takes place prior (in a constitutive sense, not a chronological sense) to institutional divisions. This daunting task, hinged on the declinations of possibility—impossibility, compossibility, impossibility—will take us beyond mimesis, in a reading of text outside of intention and away from historical reduction. For what shall be put forward is not a denial of the mimetic aspects of literature, but a study of how literature works outside of those aspects. Literary thought *makes sense*, whether it is convoluting around a novel or a scientific hypothesis. It opens optional paths of meaning that can then be followed according to principles drawn from reading, an act of infinite conflicting intentions, framed only by the text's potentialities. Thus it becomes possible to read physics as fiction, logic as language, and narration as knowledge.

1.1.1. Thought experiment and literature

As hinted by the title, this section concerns itself mostly with the notion of the *thought experiment*. Since the debates surrounding this theoretical tool are multiple and its points of contention have dragged it across disciplines to an area of controversial ubiquity, I will

restrain the range of the investigation to two points: literature and *scientia*. One could see a passing remark by Ricœur as a starting point²; “telling stories, it has been noticed, opens up an imaginary space for thought experiments, where moral judgement functions according to the mode of the hypothetic³” (Ricœur, 1990: 200, my translation). This initial intuition, that the act of spinning a tale is opening a space for thought experiments, should remain as an idea that cannot yet be fully discussed. However, by contrasting two questions; are thought experiments literature? and can they partake in the constitution of knowledge?, an element implicated in both questions will arise. This point of friction shall be expanded with the help of Abbott’s *Flatland*. Since the novel acts as a means to “answer” it shall not be introduced until later in the act. The convention of asking questions before providing answers has the advantage of highlighting the path by which conclusions are reached. Therefore, hermeneutics will have to remain subordinate to the tradition of epistemology before flourishing. This back-and-forth between the history of ideas and the interpretation of texts shall be representative of the method employed throughout the investigation.

Can literary texts be approached as thought experiments? In his book, matter-of-factly entitled *Thought Experiments*, Roy A. Sorensen makes a case against this possibility, for while “real experiments do make an appearance in fiction” and “literary scenarios can be used to make theoretical points” (Sorensen, 1992: 222) fictional narratives drawing closest to thought experiments are merely ““natural thought experiments”. These “ready-mades” resemble artefacts but have not been intentionally produced. Since intentional production is a necessary condition for experiment, no natural experiment is an experiment. (Hence, no natural thought experiment is a thought experiment.)” (Sorensen, 1992: 223). Since literary criticism has an avowed problem with intention, Sorensen’s objection definitely problematizes the question of literature as thought experiment. But I believe that the problem lies merely in the direction of

² In order to keep the reading of the text flowing, I have chosen to quote all sources in their English translation, while keeping most of the original texts accessible as footnotes. This is specific to the nature of the investigation at hand; the possibilities held by the original text, for those familiar with its language, have to remain as complimentary avenues, and the translation is always a skewed ensemble of possible meanings. Alternately, the research does fixate its own calculus (see act 3), and will therefore ground certain notions. Thus, important and recurring terms with specific meanings in their original languages will be kept in the body of the text in square brackets.

³ Raconter, a-t-on observé, c’est déployer un espace imaginaire pour des expériences de pensée où le jugement moral s’exerce sur un mode hypothétique. (Ricœur, 1990: 200)

the question. What if one replaced trying to consider literature as thought experiment with trying to consider thought experiments as literature? A disciple of Sorensen opened the way for this reflection. In his book *Of Literature and Knowledge*, Peter Swirski proposes the re-appropriation of one of Sorensen's concepts. Faced with the distinction between philosophical thought experiments and scientific thought experiments, Sorensen advocates for what he calls gradualism, defined by the precept that "there are no qualitative differences between philosophical thought experiments and scientific thought experiments, only differences of degree" (Sorensen, 1992: 198). In order to help him along with his concept, I could allude to the old meaning of *scientia*, which is concerned with knowledge at large rather than disciplinary division; prior to the Enlightenment, philosophy and science were the same thing, or rather, they flourished along the same axis. Swirski wishes to extend gradualism to a gradualistic metaphilosophy: "literature, philosophy, and science are inseparable manifestations of the same human instinct to interrogate the world and help negotiate the experience of living in it" (Swirski, 2007: 157). Swirski proposes a levelling of disciplinary fields, a self-same immanent plane of influence, governed by an, at first, vague notion of the "human instinct to interrogate the world," an insight that seems worthy of exploration. Yet sadly, while there is a grand gesture for a sort of renaissance model of interrelated and interpenetrated spheres of knowledge in Swirski's theory, if one follows his argument closely, one realises soon enough that literature and philosophy become subsumed to a certain scientific discourse, as they are transformed into strategies of evolution (a natural means by which the brain learns to properly choose the right kinds of inductive generalisations). This is particularly clear in certain sections of Swirski's argument:

Literature is the source of some of the most intricate experiential and creative patterns in existence. The arresting appeal of these islands of aesthetic complexity is a legacy of the times when perception of pattern or symmetry conferred a tangible advantage for the long-term adaptive economy. It has long been held, of course, that the arts are unbridled and subjective expressions of the creative spirit. As such, they are said to lie beyond systematic—not to say scientific—analysis. But evolutionary imprints on human minds, as mediated through art, are concrete counters to this thesis. (Swirski, 2007: 90)

Once again, the question shifts, and literature is recast using the terms of the experimental sciences, or rather the logic of hypothesis and purpose. Swirski consciously vindicates this

argument and the mere procession of chapters in *Of Literature and Knowledge* is enough to illustrate this point. Knowledge in literature is shown to be a type of model proper to human evolution. In turn, this model is present in both literature and thought experiments, which is demonstrated with an extended reading of Lem's *Memoirs Found in a Bathtub* as an example of game theory. Thus literature is "a rich field for analysis of conflict and cooperation" (Swirski, 2007: 128). Again, since "literary theory built on game-theoretic procedures can thus provide not only tools for analysis of fiction but a *neutral* frame for inter-textual comparison" (Swirski, 2007: 128, italics are my own), Swirski builds a one-way relationship where literature is tethered to a scientific model, the former providing variables, the latter organising them according to its own axiomatic order, presumed to be neutral. Since my aim is to interrogate the thought experiment in itself as literature (whether it originates from a "literary text" or not), this approach is unsatisfactory, since it reduces the ensembles of both thought experiments and literature to synthetic wholes, allowing only for the interrogation of their entanglement as a characteristic central to the constitution of those wholes through a third whole—evolution or game theory—that acts as both a liminal framework and a conceptual footing. Swirski's approach resembles the fitting of a square peg in a round hole, or rather describing a square—it is a shape, it is in two dimensions, it has at least four points that are equidistant from its centre—as to make it seem like a circle, and while I cannot readily oppose his project, I would like to allow for reflection on the relationship between the square's diagonals and the circle's diameter. In other words, *Of Literature and Knowledge* opens up reflection, but with retrospect, it will seem of interest mainly for the transparency of its presuppositions. This might seem dismissive, but in fact, Swirski's argument is the first of many that collides with the structural complexity of translating a disciplinary form into the theoretical language of another, something that seems inevitable in the quest to ground knowledge in certainty. Many of his observations will resonate deeply with this research, ideas such as his conclusive sentence, which claims that "literature, philosophy, and science are inseparable manifestations of the same human instinct to interrogate the world and help negotiate the experience of living in it" (Swirski, 2007: 157). But I will be looking at thought experiments in a way that does not necessarily lean on the crutch of truth axioms organised according to a scientific model. For in this case, if evolutionary biology was to make use of thought experiments, it would find itself in a self-justificatory loop; Darwin's thought

experiment about his observation of finches' beaks proves evolution, and this thought experiments is valid because it is an evolutionary characteristic of humanity. This is sadly akin to Euthyphro's early definition of piety, confronted by Socrates in *Euthyphro*; that the pious is what the gods love, and that what the gods love what is the pious.

An alternative approach to thought experiment that tries to give full credit to its fictional status is found in Ursula K. Le Guin's introduction to *The Left Hand of Darkness*. In these opening paragraphs, she goes against the general misconception that science fiction is predictive. "Science fiction is not predictive; it is descriptive. [...] Prediction is the business of prophets, clairvoyants, and futurologists. It is not the business of novelists. A novelist's business is lying" (Le Guin, 1969: xii). Yet, "this book is not extrapolative. If you like you can read it, and a lot of other science fiction, as a thought-experiment" (Le Guin, 1969: xi-xii). Le Guin develops a way for literature to have an effect on the reader without employing dogmatic proofs, and truth criterion.

In reading a novel, any novel, we have to know perfectly well that the whole thing is nonsense, and then, while reading, believe every word of it. Finally, when we're done with it, we may find—if it's a good novel—that we're a bit different from what we were before we read it, that we have been changed a little, as if by having met a new face, crossed a street we never crossed before. But it's very hard to *say* just what we learned, how we were changed. (Le Guin, 1969: xv-xvi)

This approach to thought experiment gives full credit to its status as product of the imagination, as invention. The author shapes his narrative as he wishes, making the necessary adjustments to reality in order to circumscribe a phenomenon, and to animate it. Many science fiction writers have since described their technique as thought experiment-like. For instance, Rudy Rucker, in a 2012 interview, likens writing science fiction to working out mathematical problems.

Oh, sure, math is a great source of cool SF ideas. And the *style* of mathematical thought is good training. Often in math you start out with a particular set of axioms and explore what you can deduce from these laws. Creating an SF world is a similar kind of thought experiment. You make whatever wild and crazy assumptions you like, and then see what follows from them. But, really, when I'm writing SF, I'm just as likely to work the other way around. That is, I'll start with some cool kind of special effect, like, let's say, our Earth unfurling to become an

infinite plane, and then I'll dream up some relatively plausible hole in physics that makes my scenario possible. If you're willing to jiggle the laws, you can fit everything together in a logical way, and if you ponder the ensuing logical consequences, you come up with some gnarly extra effects for free. (Byrne & Rucker, 2012)

Rucker draws a parallel between an axiomatic order and thought experiments, which will become quite important as the argument develops. For the moment, though, it is easy to see that Rucker describes his endeavour in writing science fiction as something quite alike Le Guin's own outlined process. So she is not alone in theorising the reading of science fiction as a form of thought experiment, but remains the earliest and most thorough writer to follow this insight.

Both Le Guin and Rucker speak specifically of science fiction. Since *Flatland* has also been appended under this appellation *a posteriori*, the presupposed existence of a specific link between this genre and the thought experimental process should be discussed prior to the description of *Flatland*, thus validating or nullifying the pertinence of literary genre subdivisions. The "lie" at the heart of Le Guin's perception of the novel certainly seems delimited to the science fiction genre. And while the aggregation of "science" and "fiction" points in the same direction as this research, one must stand back and wonder how science is interacting with fiction in science fiction. In Judith Merril's "What Do You Mean: Science? Fiction?" compiled in *SF: The Other Side of Realism*, a case is made for the impossibility of actually circumscribing the limits of the science fiction classification. But she nonetheless offers, in her introduction, four different types of narratives that have been described as science fiction: teaching stories, preaching stories, speculative fiction and space adventures. The latter is bracketed as a "transplanted western or historical" (Merril, 1971: 60) fiction in which the setting provides the illusion of science, without actually influencing the purpose of the adventure narrative. A clear example of this type of narrative would be the chronicles of John Carter of Mars by Edgar Rice Burroughs, in which the planet Mars serves as an open-ended space where anything can happen. The story could have taken place in an alternate dimension, a deep underground, an unexplored land (like Burroughs's Africa in his Tarzan series) or a forgotten past. The freedom that the distance offers is ironically reduced by the thoroughly contemporary psychologies of the characters involved, and in the space adventure,

often referred to as “space opera,” is the marker by which the possibilities of fictional setting are best shown. The link to thought experiments is perhaps strained, but space operas show how literature has the potential of building initial conditions in its roughest form. If purpose is put aside, there is in the space adventure a delocalisation that acts as a clue towards the next act on possible worlds. Physicists setting their experiments in frictionless vacuums are exerting this literary device, isolating results like pulp writers isolate action.

The inherent problem to Merrill’s classification is that of intention, and makes her other three distinctions, teaching, preaching and speculative stories, debatable. One can already see that both teaching and preaching gravitate around the idea of the didactic. Merrill divvies narrative types associated with science fiction on the basis of form rather than intent, which allow for the clarification of the typology. By teaching stories, she is referring to the Hugo Gernsback model of science fiction. Gernsback, founder of *Amazing Stories*, the original science fiction magazine, was a firm believer in the teaching potential of science fiction. As such, he encouraged the writers he published to include long technical passages explaining scientific theories within their storylines. This gave rise to odd chimera-like stories, which Gernsback labelled “scientifiction” prior to “science fiction” becoming a ubiquitous designation, where generally banal plots were constantly interrupted by paragraph-long descriptions of technological extrapolations or scientific theorems. As such, scientifiction was a piecemeal amalgam of vulgarisation and oft-vulgar narrative. Thus, there is a way in which the category “teaching stories” can be thought-of as popular science narratives, these didactic novels that use the artifices of fiction as the spoonful of sugar to make the medicine go down. This tradition still exists, integrating hard science with fiction along varying degrees of success, and 20th century examples range from Carl Sagan’s *Contact* to George Gamow’s *Mr. Tompkins* stories.

With preaching stories, Merrill points to a tradition first started with utopias, and continued with the cautionary tales of science gone wrong—stories whose purpose lies in the didactic power of extrapolation, and whose method is exposition of possible consequences. It is interesting to note here that Mach, an early thinker of thought experiment, mentions the “author of social and technological utopias” (Mach, 1976: 136) in his list of thought experimenters, and his definition of thought experiment, with strong emphasis on experiment

as pre-emptive layout through which action will follow, allows for a reading of thought experiment as didactic extrapolation (teaching aids). Again, purpose is at the heart of the distinction, and authors as varied as Plato, Thomas More and Aldous Huxley could be considered proponents of this tradition. If one really was to question the limits of the ensemble formed by preaching tales, one could wonder what part of the preaching is imputed on the author, and what part is expected of the reader. For instance, there is, in the movie *The Matrix*, an obvious cautionary tale about humanity's growing dependence upon its own technology. But the conclusions drawn from this film, or any other narrative that pushes one aspect of contemporary life, of technological prowess or of scientific hypotheses, necessitate some degree of reflection on the reader's part. The "preaching" is not as codified as in medieval morality plays, and the didacticism of science fiction is variable. There is interplay between the one who receives the story, the medium itself, and the presumed generator of the tale. Possible world theory is an exceptionally strong tool to question this connection, particularly as described in Eco's *Lector in Fabula*, and the confusion unearthed by the notion of "preaching" shall be clarified later on.

It also becomes obvious that "speculative" is enmeshed in this confusion. Speculation is etymologically founded upon passive observation and contemplation, but has acquired a meaning closer to "educated guessing" with its association to the financial speculator. Guessing is proper to any narrative fiction that offers likely scenarios on the grounds of possibility. This goes well beyond what is generally considered "science fiction" and most of literature could fall under the this weak definition of speculative. Arguably, though, what speculative means to point out, when appended to the definition of science fiction (Neil Stephenson, in a presentation called *Science Fiction as a Genre* given in 2008, explains that the notion of science fiction is often replaced simply by the letters SF, which can carry the polyphonous meaning of speculative fiction, science fiction, and science fantasy) is the predictive nature of some stories. In a way, they permit the type of incongruous discoveries made by William Gibson in "Burning Chrome" when he first invents and describes cyberspace, or Jules Verne in *Paris au XX^e siècle* that wrote about an object that shares many characteristics with what would later be called a fax. They rip the discourse of the novel away from its status as fiction and transform it into something that resembles famous statements of

lucid predictions by inventor and futurist figures that have come to be associated with quasi-supernatural powers of deduction, of which one of the best example is Nikola Tesla telling the New York Time in 1909 that

it will soon be possible, for instance, for a business man in New York to dictate instructions and have them appear instantly in type in London or elsewhere. He will be able to call up from his desk and talk with any telephone subscriber in the world. It will only be necessary to carry an inexpensive instrument not bigger than a watch, which will enable its bearer to hear anywhere on sea or land for distances of thousands of miles. One may listen or transmit speech or song to the uttermost parts of the world. In the same way any kind of picture, drawing, or print can be transferred from one place to another. It will be possible to operate millions of such instruments from a single station. (Tesla, 1909: 476-477)

Such actualisation of technological speculations have rightfully or wrongfully established an “aura” associated with science fiction as a genre, making it, for some, a literature of prediction, of prophecy. The fact that books like Robert W. Bly’s *The Science in Science Fiction; 83 SF Predictions That Became Scientific Reality* exist is proof enough of this assessment. This is where Le Guin’s definition of science fiction as thought experiment offers its most interesting objection; Le Guin is opposed to the proposition that science fiction is merely extrapolative. Her worries are justified, and she likens strictly predictive science fiction as analogous to bad science;

A prediction is made. Method and results much resemble those of a scientist who feeds large doses of a purified and concentrated food additive to mice, in order to predict what may happen to people who eat it in small quantities for a long time. The outcome seems almost inevitably to be cancer. So does the outcome of extrapolation. (Le Guin, 1969: xi)

According to Le Guin, this accounts for the depressive aspect of speculative science fiction. But her objection is aimed at a particular reading of science fiction; she is not opposed to the writer as inventor of outcomes, and goes on to show that writers combine the familiar (Marshalsea Prison, the Battle of Borodino) with lies, or inventions, as a means to have an effect on the present of every reading. The reader, suspending disbelief, is undergoing temporary insanity, in which he or she confuses what is and what will never be. The characteristic of fictional thought experiment that Le Guin aims to show is that the “speculative” aspect often associated with science fiction is firmly grounded in the present; it

is a meditation on conditions of possibility, and an exploration of possible worlds. That writers like Verne or Gibson actually defined eventual actualities shows that these authors' playful lucidity drew a bridge between the potential and the realised. Making them prophets or futurologists is a reconstructed reading, establishing causality as inevitability. Verne's case is particularly interesting since the development of the fax was made independently from his novel; *Paris au XX^e siècle* was kept in a safe for 126 years (from 1863 to 1989) before it was discovered by Verne's great-grandson and published five years after that. This case, which raises questions about the history of the novel in relation to its constitutive elements, shall be, once again, addressed with the help of possible world theory. Let us just say that the superposition of the fax as it exists today with Verne's extension upon the telegraphic communication system (or as Marshall McLuhan might say, extension on the cave painting) is an imposition of an anachronistic mimetic reading upon the text. This reading reveals, from a global standpoint, the potential of text to produce different anachronistic mimetic readings. Fittingly, even Le Guin's novel *The Telling* has been read in this way by Noel Gough in his article "Speculative Fictions for Understanding Global Change Environments: Two Thought Experiments." Gough backs one of his readings of *The Telling* "as an allegory of Tibet's plight under Chinese occupation" (Gough, 2003: 18), through an interview given by Le Guin. Yet this reading is also somewhat problematic, for while Gough follows Le Guin's suggestion of reading her novel as a thought experiment, he gives it an extrapolative, speculative power that Le Guin herself had tried to minimise.

Le Guin's warning is perhaps exaggerated by the desire to distance herself from traditional definitions of science fiction as speculative fiction. Like Stanisław Lem and Philip K. Dick, Le Guin's work has been defined as "New Wave" science fiction, a subcategory that associated itself with the experimental literature of J. G. Ballard and William S. Burroughs as well as with feminist and marxist criticism, instead of confining itself within the boundaries of what was considered "genre" fiction. Astute readers will have guessed that mentioning this divide at the heart of the science fiction genre within the question of its definition acts as a way to render the problematic classification of "science fiction" moot. Le Guin, once again, helps word this resolution:

All fiction is metaphor. Science fiction is metaphor. What sets it apart from older forms of fiction seems to be its use of new metaphors, drawn from certain great dominants of our contemporary life—science, all the sciences, and technology, and the relativistic and the historical outlook, among them. Space travel is one of these metaphors; so is an alternative society, an alternative biology; the future is another. The future, in fiction, is a metaphor. (Le Guin, 1969: xvi)

Le Guin's definition allows for a confirmation of what was said about "speculation" in science fiction as grounded in a present, with future acting like a metaphor rather than prophecy. But this foray into the definition of a classification has replaced a problem with another. Instead of questioning "science fiction" as a genre, it is now imperative to define how the relationship between fiction, metaphor, analogy and thought experiment works. Rather than thinking about *Flatland* as part of a genre, it seems much more interesting to see it as something akin to Le Guin's idea of the metaphor, which she uses as a catch-all term for literary expansion that comes closer to conceit or allegory in definition. Indeed, following Le Guin, but going against one detail in her definition, it shall be shown that *Flatland* has the very peculiar quality of being a type of science fiction that uses ancient rather than new scientific metaphors to build its narrative structure.

1.1.2. Thought experiments and *scientia*

Thought experiments have a central importance to some of the greatest epistemological debates found in the philosophy of science and in analytic ethics. While these two Anglo-Saxon traditions have produced quantities of reflections on the actual worth (epistemic, constructivist, relational or otherwise) of thought experiments, few of their proponents have taken time to explore the fictional and narrative aspect of experimental armchair philosophy. Even if Swirski's approach offers an unsatisfying conclusion to the relationship between the thought experiment and literature, he nonetheless covers some of the ground permitting this investigation, establishing a tradition where there is so little. Swirski has an amusingly transparent sidebar in which he actually describes his scouring of the MLA bibliography in order to find predecessors to his own research. There he finds both Edward Davenport's "Literature as Thought Experiment" and Alice Eileen John's unpublished thesis "Fiction as

Conceptual Thought Experiment.” Since both these texts are adequately addressed by Swirski, and his objections to the limitedness of both Davenport’s and John’s notion of thought experiment are essentially identical to my own, it will be unnecessary to go here into details about the content of their argument. This necessary step by Swirski does show, however, how the thought experiments terrain remains relatively uncharted for literary studies. Swirski’s book, then, can be used for its great ability in establishing new intersections of knowledge. The way it reclaims Sorensen’s gradualistic metaphilosophy, for instance, can exist outside of its latter argument; instead of subsuming the workings of literary knowledge to the rigour of the sciences, one can go back to the original definition of *scientia* and propose that a history of the division between the literary and the scientific has had an effect on Swirski’s presuppositions. Indeed, if literature can be considered an evolution strategy, by which humanity has carried knowledge throughout the ages, it can also hint at an intimate relationship between what humanity knows, and how it expresses it. By discarding Swirski’s forced opposition between Darwin and Derrida, an opposition understandably created in order to cement his argument away from the taint of the postmodern, there does remain a tangent, or the possibility for a tangent, that extends out of the literary phenomenon towards the production of knowledge. There are even some *notate bene* in his argument that should be remembered. Swirski’s strategy consists in making literature a symptom of a cognitive faculty within the mind that came about from a paradigm posited within a certain framework. His argument’s validity goes hand in hand with a presupposition best expressed by Darwin’s “survival of the fittest” theory. The fine points of his argument, whether they be the link between the psychological development of humanity and its storytelling or the structure of game theory and literary elaboration, need not bear the close look of scrutiny within my argument. For Swirski’s approach aims towards a certain vision of the truth, both empiric and positive, that will itself be put into question in the next act. But his method shows a conundrum of literary epistemology; if literature is necessary to the production of knowledge, what is the boundary established between knowledge and fiction? For Swirski, we can place the scientific method’s conclusions within an established groundwork of scientific history in order to define a body of scientific knowledge. This definition of knowledge guides his argument to its necessary conclusion; literature has to find its way within the scientific method as an ingredient in the recipe for knowledge. Therefore, its subservience to the scientific is a

necessary by-product of presuppositions at the very heart of the argument. It is impossible for my argument to act as judge to the validity of Swirski's argument; our basis for linking thought experiments to literary creations are wholly different. Our arguments are like an omelette and a bowl of custard; we both break the same eggs, but our methods and results have nothing to do with one another. I do agree that

when it comes to *Gedankenexperimente*, it is sometimes hard to say where epistemology ends and psychology begins. This is because, on closer analysis, the cognitive machinery of prediction and explanation—one aimed at the future, the other at the past—is not that different. This may seem counterintuitive, inasmuch as we value science precisely to the extent that it deals out predictions, in contrast to humanists' mere explanations. The subjective superiority stems from the feeling that explanation can be trivial, spurious, or circular, whereas predictions bequeath new and real knowledge that bequeaths new and real instrumental power. (Swirski, 2007: 110)

But whereas Swirski aims to replace the experimental bias in certain disciplines with a causal evolution of thoughts towards betterment, an argument similar to the one Dawkins uses to explain his memes, I mainly concern myself with the slippery two-way slope between the definition of prediction and that of explication. Therein lies the burden of truth associated to writing. In a way, Swirski's argument aims to transport certain fictional constructs from the set made up of all explanations to the one made up of predictions. He fully sidelines the question of *mimesis*, or warrants literature with a fully mimetic role, equating it with a direct representation of reality. It becomes obvious that the difference between our two approaches validates a different definition of thought experiments. Do thought experiments necessarily have to abide to the strict dictate of momentary reality? Or can they be devised out of imaginary material, only to be later reinterpreted into analogous reality?

The word *Gedankenexperiment*, which was imported to the English language as "thought experiment" through a translation of Ernst Mach, was originally coined by Hans Christian Ørsted, Danish pioneer of electromagnetism and part-time poet. For Ørsted, the thought experiment was an experiment conducted in imagination, which, oddly enough, will be shown to resemble the processes used in apprehending the fourth dimension. The notion of *Gedankenexperiment* reached greater heights of popularity once it came to be included in Ernst Mach's system of experimentation; yet, with Mach, the thought experiment lost some of

its purely imaginary aspect. For Mach, the *Gedankenexperiment* is a prefiguration by which elements for a real experiment, to be literally carried out, are first juxtaposed within the mind, in order to produce a hypothesis, or to pre-emptively spot faults with the experiment. Yet he hints at the possibility for thought experiments so perfect that they need not be reproduced in actuality;

The outcome of a thought experiment, and the surmise that we mentally link with the varied conditions can be so definite and decisive that the author rightly or wrongly feels able to dispense with any further tests by physical experiment. However, the less certain their outcome, the more strongly thought experiments urge the enquirer to physical experiment as a natural sequel that has to complete and to determine the result.⁴ (Mach, 1976: 137-138)

The thought experiment, in this case, is a stepping-stone in the empirical process. By which criteria should the determinacy of the mental results yielded by a thought experiment be judged? Mach does not say. He does, however offer, in perhaps his most famous quote to which I have already alluded, the first hint as to the range of the thought experiment.

Besides physical experiments there are others that are extensively used at a higher intellectual level, namely thought experiments. The planner, the builder of castles in the air, the novelist, the author of social and technological utopias is experimenting with thoughts; so, too, is the hardheaded merchant, the serious inventor and the [researcher]. All of them imagine [*vorstellen*] [initial] conditions, and connect with them their expectations and surmise of certain consequences: they [make] a thought experiment.⁵ (Mach, 1976: 136, translation altered)

Mach's overview of the thought experiment shows willingness on his part to liken many mental efforts to the same thought process. Although his strict positivism might have objected with some of the wilder extensions of the fourth dimension concept that shall soon be

⁴ Der Ausfall eines Gedankenexperimentes, die Vermutung, die wir an die in Gedanken variierten Umstände knüpfen, kann so bestimmt und entschieden sein, daß dem Autor—mit Recht oder Unrecht—jede weitere Prüfung durch das physische Experiment unnötig scheint. Je schwankender, unbestimmter aber dieser Ausfall ist, desto mehr drängt das Gedankenexperiment zu dem *physischen Experiment* als seiner natürlichen Fortsetzung, welche nun ergänzend, bestimmend einzugreifen hat. Auf Fälle der letzteren Art kommen wir noch zurück (Mach, 1906: 188-189).

⁵ Außer dem physischen Experiment gibt es noch ein anderes, welches auf höherer intellektueller Stufe in ausgedehntem Maße geübt wird—das *Gedankenexperiment*. Der Projektentwerfer, der Erbauer von Luftschlössern, der Romanschreiber, der Dichter sozialer oder technischer Utopien experimentiert in Gedanken. Aber auch der solide Kaufmann, der ernste Erfinder oder Forscher tut dasselbe. Alle stellen sich Umstände vor, und knüpfen an diese Vorstellung die Erwartung, Vermutung gewisser Folgen; sie machen eine Gedankenerfahrung (Mach, 1906: 186).

discussed, his definition does seem to open up the notion of thought experiment to include the type of mental fulguration present in a work of fiction. His use of the word “*vorstellen*” meaning both imagination and suggestion, and etymologically linked to pre-placing (or preconceiving), is telling. The semiotic range of *Vorstellung*, especially when applied to the process of experimentation (conditions are *vorstelle*, and thus permit consequences), does seem to align Mach’s *Gedankenexperiment* with Le Guin’s definition of fiction as a lie, adding the prescriptive power of a hypothetic projection in order to replace Le Guin’s debunked prophetic prediction.

Since *Gedankenexperiment* was named, the debate as to its nature, and its epistemic impact has branched out over many disciplines. Philosophy has retroactively adapted the notion to many of its key concepts. Descartes, sitting in front of his fire, trying to distinguish the effects of an evil daemon from the indubitable thoughts of his mind, Zeno of Elea, with his eternal race between Achilles and the turtle, are all experimenting with thought, conducting *Protogedankenexperimente* that permit the elaboration of the complexities of a concept. Ethics has amassed an incredible body of “what if” scenarios going from Kant’s impossible lie that could save a life to Philippa Foot’s trolley running over diverse numbers of unlucky (but imagined) individuals. As institutions, history of science, philosophy of science and present-day physics all have a renewed interest in the potency of thought experiments. Indeed, a great deal of the science done in the field of quantum physics is essentially composed of thought experiments with impossible executions (at least until the large hadrons collider can be calibrated to their specifications, or, in some cases, until some other larger particle accelerator is built). There has also been a reconstitution of the history of thought experiments in the establishment of the sciences, starting with the crowning of Galileo as king of the *Gedankenexperimentaroren*.

So what makes a thought experiment a thought experiment? This is the debate one would pursue if the goal were a criterion by which to distinguish the proper experiments from the improper. This investigation permits to limit such a question to a much more specific case. Is *Flatland*, and the analogy it incarnates and contains, a thought experiment? Before addressing the text directly, it is important to distinguish ways in which the thought experiment has been circumscribed. Tamar Szabó Gendler attempts to “isolate four crucial

features in the performance of scientific thought experiments” (Gendler, 2004: 1155), the first three of which apply to all thought experiments, the last one being specific to the scientific:

- a. Thought-experimental reasoning involves reasoning about a particular set of circumstances (which may be specified in more or less detail), described at a greater level of specificity than that of the conclusion. [...]
- b. The reasoner’s mode of access to the scenario is via imagination rather than via observation. [...]
- c. Contemplation of the scenario takes place with a specific purpose: the confirmation or disconfirmation of some hypothesis or theory. [...]
- d. The hypothesis or theory in question concerns features of the physical world. (Gendler, 2004: 1155)

While this works perfectly well within an analytical context that attempts to firmly define its concepts, there are some elements of Gendler’s definition that are difficult to apply to literary cases. The fourth notion is obviously the most problematic. While the warning that it applies only to the scientific would seem to allow literature to sidestep its criterion, it actually works in the opposite sense. If thought experiments are treated as mini-stories, with their own literary workings, the division between the scientific and the ethic thought experiment cannot justify a qualitative difference in methodological underpinnings. Indeed, the thought experiment is just as literary whether it concerns a feature of the physical world or not. A construct such as the fourth dimension, which features prominently in *Flatland*, always keeps a foot outside of “the physical world.” Developments in the relativity physics have made the fourth dimension a staple of 20th century physics, but other than its predicting power, the fourth axis has not been experienced in the same way as the other three. The status of this construct, and its relationship to the physical world, remains liminal, and development in 20th century physics would definitely make a certain kind of fourth dimension “physical” while maintaining that it can only be accessed through theoretical or fictional abstraction.

The other problem with Gendler’s criteria is the “purpose” necessary to fulfil point c. While the scientific method is driven by hypothesis and conclusion, works in literature tend to forego specific, defined, goals. This is obviously a generalisation; a footnote in Mach’s text that proposes Zola and his *Le Roman expérimental* as an illustration of the *Gedankenexperiment* shows that in certain contexts the scientific method is present in fictional

writing. A similar case could be made for *Flatland*; there is an air of didacticism in Abbott's novel, and the purpose exposed in the dedication could serve as a makeshift hypothesis. But I will refrain from making this argument, for *Flatland* will serve a much vaster purpose if considered as a novel containing the potential for a scientific interpretation without being confined to one. Instead, it is now necessary to establish the way in which *Flatland* relates to the *Gedankenexperiment*.

1.2.1. Flatland as thought experiment

To begin, let us look directly at the narrative structure of *Flatland*, in order to scour its potential *qua* thought experiment. There are two parts to *Flatland's* story. In the first part, A. Square, narrator and protagonist, describes the world of two dimensions in which he lives. He describes its history, its people, its social hierarchy and its physics through an account of phenomenological in-the-worldness. In the second part of the story, A. Square recounts a visit made to his world by a three-dimensional being of which he is the sole witness and the way in which this Sphere brings him to understand the possibility of a third, invisible dimension that could have direct impact upon his own two-dimensional world. Acting as the bordering limits to the Sphere's visit's recalled narrative are two of A. Square's dreams in which he himself visits a world of one-dimension (Lineland) and a world of zero-dimensions (Pointland).

Flatland offers three different interpretative angles proper to thought experimentation; it functions in three different ways to work through the possibility of conceptualising the fourth dimension: *mise-en-abyme* (or self-referential framing), didacticism and improper perceptual translation. The most immediate aspect is obvious not only through A. Square's interaction with the Sphere, but with his millennial dream. Before being visited by the dweller of the third-dimension, A. Square has a Vision of Lineland, the one-dimensional world that unfurls only in one direction. In this world, the King, at the centre of his world remains incredulous to the possibility of a square, or a figure that extends in two directions. In fact, language fails both A. Square and the King of Lineland, as they try to explain their vision to one another;

King. Exhibit to me, if you please, this motion from left to right.

I. Nay, that I cannot do, unless you could step out of your Line altogether.

King. Out of my Line? Do you mean out of the world? Out of Space?

I. Well, yes. Out of *your* World. Out of *your* Space. For your Space is not the true Space. True Space is a Plane; but your Space is only a Line.

King. If you cannot indicate this motion from left to right by yourself moving in it, then I beg you to describe it to me in words.

I. If you cannot tell your right side from your left, I fear that no words of mine can make my meaning clear to you. But surely you cannot be ignorant of so simple a distinction.

King. I do not in the least understand you.

I. Alas! How shall I make it clear? When you move straight on, does it not sometimes occur to you that you *could* move in some other way, turning your eye round so as to look in the direction towards which your side is now fronting? In other words, instead of always moving in the direction of one of your extremities, do you never feel a desire to move in the direction, so to speak, of your side?

King. Never. And what do you mean? How can a man's inside "front" in any direction? Or how can a man move in the direction of his inside?

I. Well then, since words cannot explain the matter, I will try deeds, and will move gradually out of Lineland in the direction which I desire to indicate to you. (Abbott, 2002: 125-126)

The trick here being, of course, that while A. Square acquires a momentary conception of a one-dimensional world, and an outside perspective, the reader of *Spaceland*, or the three-dimensional world that contains *Flatland* as a book, is aware of A. Square's own limitations. Thus, when Abbott's four-sided hero is visited by the Sphere, his own refusal at understanding the third dimension is foreshadowed by his Vision of Lineland. This *mise-en-abyme* of the text uncovers the structure of the "Analogy" spoken thereof by the Sphere. It is a *mise-en-scène*, a putting into narrative form of the essential means by which thinkers had glimpsed the possibility for the use of a fourth dimension in geometry. If a square is a line of lines, and a cube is a square of squares, then what is a cube of cubes? It is a particularly clever trick on Abbott's part to have A. Square, when suddenly projected into Space, exclaim the full extents of the analogy;

I. Was I not taught below that when I saw a Line and inferred a Plane, I in reality saw a Third unrecognized Dimension, not the same as brightness, called "height"? And does it not now follow that, in this region, when I see a Plane and infer a Solid, I really see a Fourth

unrecognized Dimension, not the same as colour but existent, though infinitesimal and incapable of measurement? And besides this, there is the Argument from Analogy of Figures.

Sphere. Analogy! Nonsense: what analogy?

I. Your Lordship tempts his servant to see whether he remembers the revelations imparted to him. Trifle not with me, my Lord; I crave, I thirst, for more knowledge. Doubtless we cannot *see* that other higher Spaceland now, because we have no eye in our stomachs. But, just as there *was* the realm of Flatland, though that poor puny Lineland Monarch could neither turn to left nor right to discern it, and just as there *was* close at hand, and touching my frame, the land of Three Dimensions, though I, blind senseless wretch, had no power to touch it, no eye in my interior to discern it, so of a surety there is a Fourth Dimension, which my Lord perceives with the inner eye of thought. And that it must exist my Lord himself has taught me. Or can he have forgotten what he himself imparted to his servant? [...] I ask therefore, is it, or is it not, the fact, that ere now your countrymen also have witnessed the descent of Beings of a higher order than their own, entering closed rooms, even as your Lordship entered mine, without the opening of doors or windows, and appearing and vanishing at will? On the reply to this question I am ready to stake everything. Deny it, and I am henceforth silent. Only vouchsafe an answer.

Sphere (after a pause). It is reported so. But men are divided in opinion as to the facts. And even granting the facts, they explain them in different ways. And in any case, however great may be the number of different explanations, no one has adopted or suggested the theory of a Fourth Dimension. Therefore, pray have done with this trifling, and let us return to business.

(Abbott, 2002: 171-172)

The Sphere, having his turn in the role of the incredulous, illustrates and comments on the entire attitude adopted towards non-observable conceptual abstractions. Abbott offers a repeating structure, thus showing the phenomenological difference between the dimensions felt and the dimensions thought. Interestingly, the only character capable of freeing himself from his dimensional bias is A. Square once he has actually seen the dimension above his own (although it is still slightly mysterious that his sight apparatus managed to adapt and convey three dimensions). A. Square becomes capable of “seeing” dimensions above his own, and in the transformation becomes exalted about the potential for thinking beyond himself. Analogy becomes a means by which the failings of language are exposed, working a complex layering of sense formation, showing how language can expose language’s faults through demonstration of demonstration.

The second angle is one of didacticism. Thinking back to Merrill's typology of science fiction one will remember the "teaching story." While the space adventure provides a liminary case by which an element of fiction can be isolated, Merrill's other three types are branded by the difficult notion of intention. Without going into the actual debate on dead authors and their function, it is almost impossible to define *Flatland*, for instance, exclusively as a teaching, preaching or speculative story. But in its last incarnation, the 2007 film by Dano Johnson and Jeffrey Travis, *Flatland* is clearly transformed into a teaching story, and is marketed toward a grade school public, offered in a special version with a licence for school use. This is also the case in many works of popularisation, where the *Flatland* analogy is used as a teaching aid (an example of this can be found in the 10th episode of Carl Sagan's television series *Cosmos*). But Abbott was originally criticised by Charles Howard Hinton, a fellow fourth-dimension enthusiast that shall soon become central to the argument, for the preaching aspect of his book. A. Square's ordeal is also precursor to scientific theories that integrated its object in their exposition, making its teaching potential arise *a fortiori*. As will soon be shown, the purpose it exposes in its dedication, of enlarging the imagination of its readers with the possibility for other dimensions, makes this clear enough.

The characters in *Flatland* have the tendency to go off into mathematical jargon, and to lengthily explain differences between Flatland and Spaceland. This can be attributed to the chosen stance of the narrator. A. Square is explicitly writing to and for the readers of three-dimensional space. Therefore, he tries to show how different life would be with one less dimension. He painstakingly explains in the opening dedication that prefaces his tale, that the goal of his text is to help the inhabitants of space to conceptualise the fourth, fifth, sixth, dimension. The entire first part of the novel can be taken as a manual on expanding one's own conceptions. In the world of *Flatland*, houses have walls but no roofs, so imagine how houses in your world, if exposed to the fourth dimension, would necessitate an entirely new type of enclosure, subject to different forces and built with different materials joining together the floor, the roof and all the walls. While it is true that satire issued from some of the other causes near Abbott's heart are thrown in, like the unfair treatment of women and the rejection of imperfect shapes, these can also be bundled into a more general goal of trying to liberate the readers' minds from the established dimensions. A certain type of literature that concerns

itself with the quantifiable and the experimental, often confusedly bundled under the “science fiction” designation, is fraught with a tendency toward the didactic. Approaching this body of works as a depository of thought experiments problematizes this association by asking the question of purpose. A better look at the episteme produced by thought experiments will be necessary before exploring this avenue.

The last angle will be discussed in greater detail later, but I will introduce it here. It is a matter of perception. The entire enterprise of thinking in different dimensional modes poses a difficulty, for perceptions of the characters must be adapted in order for them to be understandable in their actions, while remaining particular to their worldly extensions. The monarch of Lineland and all his subjects communicate by sound. This makes sense, since there are no physical displacements possible; limited by their endpoints, lines cannot move past one another, for it would require the addition of a thin layer in the second dimension. Yet sound and distance are measured through air, of which there is none. Even more problematic; there can be no physical means by which to represent the differentiation between the line segments that are people, and the line segments that are empty. Film adaptations of *Flatland* show this problem particularly well; in *Flatland: A Journey in Many Dimensions* the inhabitants of Lineland have a colour and a slight thickness, which help A. Square and the spectator distinguish them, but which can serve no function in their world. In other words, the film shows a three-dimensional representation of a one-dimensional world. Try as it might, the analogy can move the imagination, but cannot remove sensory dimensions. The system of fog and of colour in *Flatland* is similar; without thickness, shapes should not be able to recognize themselves. Zero thickness is invisible, not infinitesimal. This problem inherent to representation will come back with a vengeance during the elaboration of narratives about thinking outside of time.

1.2.2. Writing the fourth dimension

With all these notions on hand, it becomes imperative to further question the status of *Flatland* both as book and story. The initial investigation about thought experiments has yielded a few key limits that have to be addressed directly. The thought experiment in both

Gendler and Mach allows a transit between imagination and knowledge. How then can a literary creation, which describes a state of affair that varies greatly from the “real” (a word that has yet to be defined within the context of this investigation), reach knowledge-creation? In a way, the historical context of the novel inserts it within the actual world, while its story opens a path to the imaginative. With historical distance, the context of creation becomes in itself a story, and both plot and genesis of the novel are told using the same type of language. By studying *Flatland*'s description of a fourth spatial dimension in conjuncture with the elaboration of the notion in the history of mathematics, a likeness of method can be established between the fictive and the scientific.

Edwin Abbott's *Flatland* is a mysterious remnant of a strange epoch. Clearly distinct from most books written in Victorian-era England, it stands today, not as canonical literature, but as one of the most commonly used metaphors in scientific articles. True enough, alongside Moore's *Utopia* and Shelley's *Frankenstein* it is one of the main proponents to the claim of “proto-science-fiction” in the English tradition, but it evades most lists of the “canon.” A quick glance at the works that quote *Flatland*, or even those that use the term “flatlander” without directly linking it to Abbott, and one realises that *Flatland* finds much more resonance within the body of works written by engineers, mathematicians, and physicists. Even if the Basics Books edition of *The Annotated Flatland* is marked with the Science/Mathematics subdivision on its back cover, *Flatland* remains an uncompromising work of fiction. It takes place in a world that greatly differs from my own—not only by being phenomenologically distant, but by actually rewriting the basic physical reality of this world—, with characters that could hardly be described as “human,” especially in body. It would be difficult not to give it the label of “fiction” in its etymological sense of “fashioned or feigned” (this is less true for its Latin root of *ingere* or “fashioned out of clay” but it can be granted as a dead metaphorical link between the primordial clay, the creator and the romantic artist). Abbott himself proposes the subtitle of “romance” which, for the 19th century reader would mean either a love story or a heroic tale of vernacular ancestry. Indeed, the entire first part of the novel can be read as the elaboration of an imaginary society, with the description of its inhabitants, their customs, their social order, and their history (the Universal Colour Bill, the revolution of the Chromatics). A. Square describes his world for the three-dimensional reader, and this entire part of the story

works like an innumerable amount of novels taking place in a world differing from the reader's own. While this body of works obviously includes most novels dubbed fantasy and/or science fiction, the process can also be attributed to any work of fiction placed within a *setting*. While it is immediately apparent in books like Philip K. Dick's *Do Android Dream of Electric Sheep* from the onset (a strange "mood organ" is programmed for the desired emotion, a discussion references androids), any novel taking place in a time and a space, two notions that are for Kant both pure forms of intuition and pure intuitions pertaining to our existence, must establish a replacement for the reader's own spatiotemporal surroundings. While within his own background, the reader exerting suspension of disbelief is replacing his own "pure intuitions" with contextual "reality" of the novel. The gap between the imaginary and the sensible is reduced by means of description, and verisimilitude is reached through detail. While *Flatland's* "allegory" of the two-dimensions does not necessitate an ecology, the fictional narrative provides one, by which the reader recognizes a chief aspect of fictionality: the fashioning of worldly conditions.

As for the status of *Flatland* as book, as artistic creation, as cultural product interacting with the institution of the fictional, subsequent authors have written four alternative sequels, and four film adaptations have been generated as of 2013. *Flatland*, in its book form, functions within a social setting of re-appropriation akin to most fictional works; it would be difficult to imagine a movie adaptation of Gödel's *Über formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme*, or of Deleuze and Guattari's *Mille Plateaux*. It would also be unorthodox to claim that Einstein's General Theory of Relativity is a "sequel" to his Special Theory. These works, generally classified under a "science" or "philosophy" tag leave little room for adaptation; while there is arguably a worldview in Gödel's, Einstein's or Deleuze and Guattari's texts, there is no fleshing out of a setting. *Flatland* provides an alternative background, much like the scene of a play, through which story can play out. While *Flatland* is a special case, since most of its sequels can exist within logical continuity of its original proposition without borrowing from the ecology it provides, a book like Stewart's *Flutterland* does indeed propose an extension on Abbott's imaginary world by using the setting's queues to begin amidst an already established background. Both the sequel and the movie adaptation are modes of cultural appropriation generally associated with narrative

fictions because they necessitate an established timeline and a defined spatiotemporal background through which to claim their link to the “original,” no matter how many liberties are then taken with this often dubious connection. So *Flatland* is both fictional as a book and as a story. Which further begs the question; what could explain that *Flatland*'s theoretical applications are exploited in areas of knowledge not generally regarded as literature?

1.2.3. What sort of book is *Flatland*?

Let us begin answering this question by looking at the type of story developed in the novel. As has been seen, the protagonist, A. Square, is also given as the narrator. Abbott further underlined this element by publishing *Flatland* under the pseudonym of A. Square. The name of the character carries a double meaning. First, he is the generic geometric form, *a* square, rather than *the* square. But second, he is also the stand-in for Edwin Abbott Abbott, whose two last initials are both As, thus creating an A². This playful game on Abbott's part creates a shifting interpretive ground where many meanings are contained within the same variable. A. Square writes a text that can best be described as memoirs mixed with an anthropological (geometrological?) description of his society of living polygons in a plane world. He calls this world Flatland, “not because we call it so, but to make its nature clearer to you, my happy readers, who are privileged to live in Space” (Abbott, 2002: 33). A. Square's story differs from the traditional nonsense and allegorical narratives of England's 18th and 19th century. As Thomas Banchoff, a mathematician and Flatlandophile, remarks in his introduction to the Princeton Science Library edition of the book,

the narrative style of *Flatland* is somewhat different from some of the more familiar reports of visits to exotic lands, since the story is told not by the visitor but by the person visited. It is as if the story of Gulliver were told by the mayor of Lilliput or the adventures of Alice by the White Rabbit. (Banchoff, 1991: xxii)

This makes *Flatland* particular, but not exceptional; other fictionalised accounts of a stranger describing his own strange land can be pointed out: for instance, Voltaire's *Zadig*, which uses the guise of historical distance to describe a Babylonia that never could have existed. But while *Zadig* follows the model of satire, with “the fineness of a Stroak that separates the Head

from the Body, and Leaves it [standing in its Place]" (Dryden, 1693: cxi) something that can be also said of *Flatland*, there are no attempts at analogically decentring the reader's conception of his own world. Babylonia, for Voltaire, is the necessary mask by which brutal criticism becomes wit, but never does the contrast it offers with 18th century France go beyond *mimesis*; by contrast arises criticism of a historical conjuncture. While Abbott's radical reformism is transparent in the satirical way that the protagonist speaks of women, and is further explained by the preface to the second edition (written by an anonymous "publisher" who, in a heteronymical jest that could make Pessoa proud, would turn out to be Abbott once again), the truly revolutionary element of the novel, the reason for which it is again and again quoted, cannot be appropriately described as satiric. For even surface articles criticising Abbott for his depiction of women, such as Hipolito's "Flatland and Beyond: Characterization in Science Fiction" eventually make use of the dimensional analogy to contrast flat writing from multidimensional stories.

The closest example to *Flatland's* story of a land being radically put into question by a visitor, as told by the visited, might, surprisingly, be found in the writings of the prophets. For while the Gospels tell of a liminal visitor, between humanity and the absolute, the prophets' tales are marked by a distinct otherness between the visited and the visitor. This connection was rendered explicit by Abbott's choice of words, and the Sphere visiting A. Square defines him as a "fit apostle for the Gospel of the Three Dimensions, which [the Sphere is] allowed to preach only once every thousand years" (Abbott, 2002: 149). Mr. Square himself thinks, at the end of the novel that he is "destitute of converts [for the] millennial Revelation" (Abbott, 2002: 196). A. Square is chosen as the prophet of a higher dimension. While this might allow him to figure as an obvious metaphor for the prophets of old, there is an element that renders this metaphor imperfect. Abbott's society and education make his use of the word "prophet" a direct reference to the bible, but there remain some untied loose ends in this relationship that can be addressed from a non-Victorian perspective. Most importantly, the Sphere, from which A. Square receives his revelation, is in itself simply a representative from another secular dimension. So while "another dimension" could seem like a phrase to describe transcendental reality (for Henry More and the proponents of spissitude the conflagration of these two elements indeed became a metaphysical truth), it is not the case, as far as my interpretation can

tell, that Abbott wrote the Sphere as an angel of monotheist Revelation. The simple fact that the Sphere refuses to acknowledge the possibility for a fourth dimension from A. Square's simple extensions should make us doubt its omniscience. Instead, the overlay of different-dimensional worlds provides a sufficient shift of realities to give to the individual shapes an impression of transcendence when encountering their higher-dimensional counterparts. But much like infinite *matryoshka* dolls, while Lineland is entirely contained within Flatland, the similitude of these two worlds as mathematical abstractions of geometrical concepts makes them analogical (larger versions of the same thing when compared to the godly planes). So while the Sphere "transcends" Flatland in the very limited sense of being of a higher dimensional order, its own denial of the fourth dimension posits it as both a proof of A. Square's ignorance and a proponent of the same ignorance. It must therefore be understood that the link between the prophets and Flatland is not made through a religious understanding of the bible, but rather as a literary reading of the scriptures. This reading is also not limited to the bible; any other text proposing the figure of the prophet could be included in the comparison (either of a given religious canon, or of a fictional nature).

Flatland does preserve a similarity to the prophetic writings. The link between grasping a divine apparition and understanding a dimension beyond those that can be sensibly perceived is not without implications for the question of literary knowledge and reception. As was noticed by Terry Cochran in *Plaidoyer pour une littérature comparée*, Ezekiel's description of God's flying contraption is a perfect example of the prophetic narrative as a knowledge vessel. The quantity of interpretations spawned throughout the ages from Ezekiel's confused depiction made him "master of allegory, according to the hermeneutic tradition"⁶ (Cochran, 2008: 75, my translation). Not only that, but this written encounter became a perfect example of the relationship between the prophetic experience and its retelling when Erich Von Däniken, recipient of the prestigious Ig Nobel award, interpreted Ezekiel's chariot as an extraterrestrial ship:

The essential element has nothing to do with the description of the real put forth by the text. The literary knowledge emanates from the imaginary, from images inevitably interlocked within thought, and cannot constitute an "objective" knowledge. Differently from what is

⁶ maître de l'allégorie, comme le dit la tradition herméneutique.

proposed by Von Däniken [...] the literary knowledge that is triggered by the sight of the chariot, of the spiritual vehicle, will never coincide with Ezekiel's experience, at least as far as our eventual comprehension is concerned.⁷ (Cochran, 2008: 78, my translation)

While Ezekiel was not a science fiction writer (unless the aliens he met were also time-travellers) he establishes, through the written word, the potential for association. Much like Verne's fax, the potential knowledge contained within the narrative is dependant of a prophetic reading. Possibility, while technically dormant within the text, is a historical conjuncture. In a similar way, attempts to think about the meaning and the function of a fourth dimension have motivated many different hypotheses and interpretations. From More's spissitude, which treated the fourth dimension as the souls' locality, to Minkowski's space-time continuum which informed much of 20th century physics, the interpretations of a dimension that we have not really been able to explore physically take on the guise of a prophet's hermeneutical trail. This argument, which arises early for this investigation, and thus in an embryonic form, will be further unfolded, in order to think of literature as something other than mimetic.

Nevertheless, we begin to situate *Flatland* somewhere between the prophetic tale truncated from the transcendental and the satire turned on its head. While these clues will be of use, they still give us no positive solution to the conundrum of *Flatland's* odd re-appropriation. One thing seems certain though; while Abbott's text offers sharp satire of his local and historical situation, England's *fin du siècle*, it is the question of physical dimensions that generates much of its interest to the majority of its contemporary readers. Taking care not to fall into the fascinating pit of historiography, I will nonetheless put forth the hypothesis that there must be something to be understood by taking a closer look at the historical notion called "the fourth dimension".

1.3.1. The thought in the experiment

⁷ L'essentiel ne réside pas dans la description du réel avancée par le texte. Le savoir du littéraire émane de l'imaginaire, des images inévitablement imbriquées dans la pensée, et ne constitue pas un savoir « objectif ». À la différence de ce que propose Von Däniken [...] le savoir littéraire déclenché par la vision du char, du véhicule spirituel, ne coïncidera jamais avec l'expérience d'Ézéchiël, au moins en ce qui concerne notre compréhension éventuelle.

Abbott's literary approach towards the fourth dimension offers a particularly vivid image from which to work the concept. What first strikes the fancy of one considering seriously the way that the fourth dimension might manifest itself, if it was experienced as a phenomenon, is the resistance one encounters trying to maintain it as a possibility, and the difficulty with which the mind has to bend in order to catch glimpses of a physical dimension that goes beyond the three of average everydayness. It is no surprise, then, that thinkers positing a fourth dimension are a historical exception and those that do not refuse it forthright upon discovery are even scarcer. Around the time that *Flatland* was written, there was a conjuncture that made the fourth dimension suddenly a more credible, even useful, mathematical speculation. *Flatland* finds itself, as a historical document, between the first affirmations of the fourth dimension as a metaphysical extension found in Kant and More, and Minkowski's more systematic representation of the fourth dimension as time.

At this point, the research needs to bifurcate through a necessary detour in the realm of the history of mathematics. While this area of knowledge seems removed from the literary discipline, in *Flatland's* case it offers some fascinating ramifications to my purpose, which consists, for the moment, in outlining the epistemological possibilities of fiction. *Flatland* is quite noticeably about the fourth dimension, and many clues point towards this concern. It is even referred to as "one of the earliest works of what might be termed mathematics fiction—speculative fiction with a mathematical theme (Stewart, 2002: 33)" in *The Annotated Flatland*, preceded perhaps only by Carroll's *Alice* books. But while Stewart, somewhat reductively, describes a "mathematical theme," I would propose that there is something much more central to the mathematical implications of Abbott's novella. It uncovers a process inherent to the formulation of mathematical concepts, and while mathematics are thematised in A. Square's ordeals, these same mathematics also serve the role of Ariadne's thread through the labyrinthine epistemological implications of literature. There is therefore much to be gained from taking the time to look at the historical constitution of the concept of the fourth dimension, in order to situate *Flatland* within its history. But beyond historical context, there are also many interesting parallels between the written works of some of the pioneers of a four-dimensional space and the fiction proposed by Abbott. As I shall endeavour to show, *Flatland's* treatment of the fourth dimension is endemic of most attempts to achieve a

phenomenological feel for the fourth dimension. And above and beyond the scientific ramifications that were brought about by this notion, it is this thought experiment that is at the basis of the initial interest professed for a four-dimensional model. So while it might seem that geometry draws the spotlight away from literature, it is always within a frame of literary knowledge, later to be rendered explicit by becoming itself object of inquiry, that mathematical concerns will play their part on the centre-stage.

This investigation aims to avoid a representation of history as an immutable discourse, and will argue history as an epistemological thread included in the practice of intertextual reading. Since I will propose historiography as a means to discuss the implication of truth, as understood by modal logic, when reading texts as possible worlds, it still remains much too early to analyse this aspect of the argument. Furthermore, for what is presently at hand, suffices to say that no attempt at a complete and chronologic history of the fourth dimension will be made; I will rather focus on the historicity of *Flatland*, the probable influence that some ideas have had on its creation, and how they can be construed as presuppositions. Obviously, this strategy will come again under scrutiny when discussing history through the lens of possible worlds theory. Finally, let it be mentioned that there is no need for another history of the fourth dimension; Florian Cajori, historian of mathematics, has written a greatly informative piece called *Origins of the Fourth Dimension Concept* (Cajori, 1926), which covers much of the philological groundwork necessary to think of the fourth dimension as a historical manifestation. His article will be essential to the following section.

1.3.2. The refusal of the fourth dimension as geometric space

Space-time was not always the most established theoretical form in which to encounter the concept of the fourth dimension, such as it has become following the Einsteinian revolution in physics. For most of its early discoverers, the fourth dimension is a “Monster in Nature [...] less possible than a Chimaera or Centaure” (Wallis, 1685: 126). The fourth dimension has the unlikely quality of having been born out of negation, and of having been constantly repudiated in the western tradition for nearly 2000 years. In a period spanning from Aristotle to Pascal, it reared its ugly head when a particularly thorough geometer or

mathematician pursued the relation from point to line, from line to plane, and from plane to solid one step further. No apparent reason other than sticking to perceived reality was necessary for most of these thinkers to banish the ugly abomination born out of overextending a logical series.

To be fair, there is a necessary jump from geometrical representation and mathematical notation that is often bypassed to the detriment of applicability. If numbers were probably born out of the practice of tallying, geometry took shape through the study of relations between simple constructs. Euclid begins his *Elements* by defining the point, the line and the plane as axiomatic truths. His last three books, on solids, begin with the simple statement that “a solid is that which has length, breadth, and thickness⁸” (Euclid, 1723: 189). The immediacy of this definition presupposes a familiarity with the three dimensions and the directions that the Cartesian coordinate system designates with the variables x , y and z . Since Euclid’s axioms were constantly reconfirmed as an “intuitive” basis for geometry (a veritable pillar of early modern common sense, epitomized in 17th century axiomatic philosophy), they remained mostly unchallenged until the 19th century. While calculus gradually drew mathematics away from a geometrical literality, the geometric model remained entrenched in a three-pronged Cartesian space. It can at the very least be said that a substantial effort was necessary in order to conjure up the possibility of more dimensions, and to reconfigure the tools necessary to represent this possibility.

Mathematical history moves towards abstraction. Many historians of numbers agree that “all men, barbarians and Greeks alike, count up to 10 and not up to any other number⁹” (Aristotle, 1995: 1416) because most cultures represented the act of counting on fingers. The case has also been made that cultures using a base-twenty (vigesimal) system, like most of pre-roman Western Europe, used both fingers and toes to fashion their system. Mario Livio, in *The Golden Ratio; The Story of Phi, the World’s Most Astonishing Number*, shows that there remains, in some languages, some evidence for this claim.

⁸ Thickness has also been translated to depth (see, for example D.E. Joyce’s online version: Euclid : 1996-8).

⁹ Aristotle goes on to illustrate: “saying for example, 2, 3, 4, 5 and then repeating them one-five, two-five, just as they say eleven [ενδεκα, or one-ten], twelve [δωδεκα, or two-ten]” (Aristotle, 1984: 1416)

In some Malay-Polynesian languages, the word for “hand,” “lima,” is actually the same as the word for “five.” [...] For the Inuit (Eskimo) people, for example, the number “twenty” is expressed by a phrase with the meaning “a man is complete.” (Livio, 2002: 19-20)

A counter-argument to the idea that numbers originally were a representation of fingers has traditionally been the existence of base-sixty (sexagesimal) systems in Sumerian Mesopotamia, one of the oldest systems of numbers. While we remain in the realm of speculation, Georges Ifrah argued in *The Universal History of Numbers*, that these numbers could have been the combination of two different systems brought together by immigration. He claims that the combination of a base-five and base-twelve system could have birthed Sumeria’s strange mathematics. While base-five can also be explained by the counting of the fingers in one hand, base-twelve is a little more complicated. It has been attributed to the counting, with the thumb, of each joint of the four digits of the hand. The point of this primer on numeral bases and their link to human appendages is to underline a logical paradigm present in the history of mathematics that claims numbers and formulas needed to originate in worldly physical manifestations before moving to their abstracted present forms.

The general preconception that abstract scientific ideas came about through a feedback loop of symbolization, gradually disintegrating the link between the origin and the practice is best exemplified in Husserl’s *The Origin of Geometry*¹⁰ which attempts to answer how traditions of knowledge can build upon themselves without constantly having to re-evaluate the sum of their established conclusions. For instance, how can a modern geometer work with non-Euclidian cardinalities without first spending his entire life developing and understanding Euclid’s axioms? Husserl explains that ideas developed from direct observations go through a process of becoming-logic. Thus, what was originally grasped from the miasma of everyday phenomenological experience becomes systematised into shortcuts for future generations. But Husserl warns of a danger:

¹⁰ Originally published as an annex to *Die Krisis der europäischen Wissenschaften und die transzendente Phänomenologie*, this research will be referring to Husserl’s original appended text as well as to Jacques Derrida’s translation, which isolates the annex as an individual work and compliments it with a lengthy introduction. Derrida’s own reframing of the text was itself translated by John P. Leavey, Jr, who also added his own preface and afterword. This constant recontextualisation of the text, brought about by linguistic concerns, can be seen as a microcosm of historical textual genealogy, with Husserl’s *Krisis* as “original” background gradually fading into footnote territory.

How the living tradition of the meaning-formation [*Sinnbildung*] of elementary concepts is actually carried on can be seen in elementary geometrical instruction and its textbooks; what we actually learn there is how to deal with *ready-made* concepts and sentences in a rigorously methodical way. Rendering the concepts sensibly intuitable by means of drawn figures is substituted for the actual production of the primal idealities. And the rest is done by success—not the success of actual insight extending beyond the logical method’s own self-evidence, but the practical successes of applied geometry, its immense, though not understood, practical usefulness. To this we must add [...] the dangers of a scientific life that is completely given over to logical activities. These dangers lie in certain progressive transformations of meaning to which this sort of scientific treatment drives one. (Derrida, 1978: 169-170)¹¹

This *Sinnbildung* is what has been referred to as the movement towards abstraction. It can both refer to the formation of sense and a culture of sense, and it is the German word for symbolisation. Abstraction is a movement in history that fashions sense in a particular direction. While this point of view serves Husserl’s project for a philosophy of origin, which would ground the institutions of knowledge in an authenticity, it is, in the framework of this research, merely a reminder of a certain tendency in the history of ideas towards causal, chronological ordering of phenomena. Husserl does come at the problem in a way similar to Kant’s own; to wave the idea that if the mythical originator of geometry (represented by a defined “name”; Thales or some other) could be established as historical fact, he would somehow ground the entire enterprise of geometry, acting as a centre to an elucidated causality of science. As the investigation advances, Husserl proposes to look to the structure of geometry itself, in order to problematise the presuppositions (axioms, ideality, narrative structure) necessary in the establishment of geometry as an area of knowledge. While his research does provide some means by which to think my own problem, the transcendental tendencies in Husserl’s view of knowledge, and his reliance on authenticity make it difficult to warrant completely. Notwithstanding these problems, Husserl’s replacement of a chronologic

¹¹ Wie die lebendige Tradition der Sinnbildung der elementaren Begriffe sich wirklich vollzieht, sehen wir am elementaren geometrischen Unterricht und seinen Lehrbüchern; was wir dort wirklich lernen, ist: mit den fertigen Begriffen und Sätzen in strenger Methodik umgehen. Die sinnliche Veranschaulichung der Begriffe an den Figuren der Zeichnung unterschiebt sich dem wirklichen Erzeugen der Uridealitäten. Und das weitere tut der Erfolg—nicht der Erfolg der wirklichen Einsicht über die der logischen Methode eigene Evidenz hinaus, sondern die praktischen Erfolge der angewandten Geometrie, ihre ungeheure, wenn auch unverstandene praktische Nützlichkeit. Dazu kommen auch [...] die Gefahren eines wissenschaftlichen Lebens, das ganz den logischen Aktivitäten hingegeben ist. Sie liegen in gewissen fortschreitenden Sinnverwandlungen, zu denen eine solche Art der Wissenschaftlichkeit fortreibt. (Husserl, 1954: 376)

beginning with the fundamental question of the lost origins works in a way akin my own approach. But I propose to replace the philosophy of origins with an unknown variable, which can only be thought through literary knowledge. As will later be discussed, and Husserl will return as a point of reference, the historical viewpoint can inform the reading of possible worlds, without reducing them to the search for a mythical origin. But, for the moment, let us return to the historical vision of geometric dimensions, keeping in mind that it will not remain unchallenged.

In *Zero; the Biography of a Dangerous Idea*, Charles Seife argues that the number zero came about as a placeholder for the empty column in the abacus, only later to be integrated as a symbol in the Indian numerals. The Greek reticence for the usage of the zero is likewise thought to be a remnant of the direct representational *mimesis* of numbers. For if numbers were first used as a means to tally existing quantities, then zero was essentially useless. One can have two or three bushels of grain, but not zero. For zero is *a priori* undefined and it seems illogical to mention bushels of grain if there are none. Seife's argument tries to draw out an ethnological conclusion on the different cultures developing systems of numbers. He argues that zero came about in India because their religion focused greatly on the void constantly perpetuated by Shiva. While as a historical reading of mathematics it is an interesting hypothesis, I would prefer to focus on the relationship between systems and development of eventual abstractions rather than dwell on cultural interpretations as murky as Jesus' actual genealogy created out of the contradictory ones found in the gospels. What is important here is that while India, and later the Arabic Caliphates, benefited from a symbol representing nothingness, the Egyptian system, which begot the Greek's, which begot the Roman's, which begot most of medieval Europe's, remained attached to a geometrical representation of numbers. This explains why the algorithmic method of the Babylonians was only taken up by the Indians, why the word for algebra comes from the Arab term (الجبر) for restoration and why it took until the 17th century for Europeans (with the help of Descartes and Fermat) to partly catch up to the wealth of Indian and Arabic algebraic methods. Following the evolution of zero lets us understand the simple epistemological conclusion that elementary conceptualisation can lead to complex developments, and that a simple remnant of historical

documents can help us discover and explain why certain thinkers reacted the way they did when trying to think of the fourth dimension.

Spatial fourth dimension is both one step ahead and one step behind in abstraction from the numeral “zero”. While it does reference a dimension beyond experience, it remains grounded in a geometric conception of mathematics. Geometry was the governing conception of mathematics in ancient Egypt and Greece. As a means for tallying, numbers served their function as individual points, but it is as lines and shapes that mathematical principles really took off in the classical world. This is, of course, linked to architecture, the most advanced application of mathematics for the Egyptians and the Greeks, which explored the relationship between solids, angles and ratios. But standard buildings are generally built for three dimensions, and undertakings such as the pyramids and the acropolis were complex enough without adding an extra-sensible dimension to their constitution. This is an absurdist way to point to an obvious aspect of ancient architecture; there seems to be a qualitative phenomenological difference between the fourth dimension and the first three, as far as human apprehension is concerned. This difference is particularly obvious if it is set against the Greek view of geometry.

Let us take the Pythagorean theorem as an example. What is understood today as an algebraic representation ($a^2 + b^2 = c^2$) pertaining to a right triangle was conceptualised otherwise by the Greek geometers. This theorem, named for the great mathematician-mystic Pythagoras, was actually used prior to his birth by the Egyptians, and some of its “triples” or relational numbers found through its method, were uncovered on Babylonian tablets dated at 2000 BC. There are no writings left of Pythagoras, if indeed there ever were such writings. As is reported by Diogenes Laërtius, Pythagoras was like Socrates: an apt orator who attracted many followers without writing down a single word. But histories that reach so far back are often plagued by rumours and dubious sources (often giving them great literary qualities, but making them the bane of historical accuracy). While Pythagoras’ theorem has come to us bearing the name of a presumed great cult leader, it is difficult to ascertain that he indeed discovered it (the same way that it is impossible to prove, with the written evidence left, that he died for refusing to cross a field of beans). Nonetheless, the Pythagorean yield the first remaining *proof* of the theorem *qua* theorem. Proposition 47 of in the first book in Euclid’s

Elements shows how Hellenic geometry (and geometry in most of the western world for the next two millennia) arrived at this proof.

Let ABC be a Right-angled Triangle, having the Right Angle BAC. I say the Square describ'd upon the Right Line BC, is equal to the both the Squares describ'd upon the Sides BA, AC. For describe upon BC the Square BDEC, and on BA, AC, the Squares GB, HC, and thro' the Point A draw AL parallel to BD, or CD; and let AD, FC, be join'd. (Euclid, 1723: 43)

Even in an 18th century English translation of a Latin translation, it is obvious that the algebraic relation making up the simplification of this proposition was resolved by drawing or mentally projecting actual squares and comparing their relations. The a^2 of the formula, usually spoken as “a squared” is, in Greek geometry as in *Flatland*, an actual square.

Now, this did not exclude the possibility of linking other forms of meaning upon mathematical signs, and Pythagoreans were known for the mystical readings they instilled upon numbers. “1” was masculine and good, “2” was feminine and discordant, “3” was the number of perfection etc. While numbers did carry abstract meanings, they were not abstracted symbols of mathematical relations. What has been designated as “abstraction” is both *Sinnbildung* and *Sinnesänderung*, the gradual establishment of an economy of sense, which rejects certain associations in order to form a homogenous discourse. While historical research often stumbles upon the anecdotic—strange out of place details that have to do with the symbols but not with their current state of abstraction—the discourse that works under the name “history of x ” will reject these stumbles in favour of the details that corroborate to a unitary and chronological x . While this is obviously a generalisation, it holds true for most works written on the history of geometry, since this science, as exposed by Euclid, became axiological and therefore deductive. A simple conception of geometry is the gradual unfolding of the possibilities of axioms, and for 2000 years, much of the historical development in geometry came as thinkers pushed the possibilities found in Euclid’s original presuppositions: his elementary axioms. Even when Euclidean geometry was rejected as the *only* means by which to develop a geometrical thought, the axiological form of geometry remained. From Gauss and Riemann on, geometry added onto its history of axiological developments a history of axiologies. Yet the general chronologic principle remains, and although variations on modalities of geometry branched off into their own histories, most of

these are still told as succeeding betterments. When Charles Hinton wrote, at the beginning of the 20th century, a historical foundation to the thoughts exposed in his book *The Fourth Dimension*, he divides them into two chapters. In the first one he finds ancestors to his vision of extra-dimensional thought in the Greeks (Parmenides, Pythagoras, Plato and Aristotle), and in the second chapter he explains how early development in non-Euclidean geometry by Bolyai and Lobachevski help pave the way towards the possibilities of a geometrically consistent fourth dimension. The burden of providing such a historical background remains firmly ensconced in the contemporary discussion strategies pertaining to “scientific” concepts. This detail must be kept in mind when thinking about the purpose of the present section.

Cajori’s *Origin of the Fourth Dimension Concept* enumerates eight thinkers who, working either from physics or mathematics, are confronted with the concept of the fourth dimension. Aristotle merely states what seems obvious to him, without further comment; a solid has magnitude “in three ways and beyond these there is no other magnitude because the three are all” (Aristotle, 1995: 447). This supports the idea that the Greeks worked with a conception of mathematics very close to experienced reality. These tensions become more interesting as history unfurls. In the 14th century, Nicole Oresme, with the help of a proto-Cartesian plane of his own design, works by moving from a line to a plane, a plane to a solid, and then a solid to something like a four-dimensional entity. He then names the fourth dimension for the first time and rejects it, by dividing the solid in an infinite amount of planes upon which can be constructed an infinite amount of solids. Interestingly, this is also one of the ways that the Sphere in Abbott’s *Flatland* tries to explain the third dimension:

I mean that every Point in you—for you are a Square and will serve the purpose of my illustration—every Point in you, that is to say in what you call your inside, is to pass upwards through Space in such a way that no Point shall pass through the position previously occupied by any other Point; but each Point shall describe a straight Line of its own. This is all in accordance with Analogy; surely it must be clear to you. (Abbott, 2002: 145)

In Oresme’s solution is an interesting reversal of method. In order to posit the number to the fourth power, he tries to move the solid parallel to itself along a fourth dimension in much the same way that the solid is produced from moving the plane parallel to itself along the third dimension. By reducing his solid to an infinite amount of planes, he is taking his last step

back, in order to move forward again. Resilient as the fourth dimension may seem in the symbolic fourth power, as a geometric representation, it has not moved beyond analogy.

Following Cajori's list of thinkers, we come upon the Italian algebraist Gerolamo Cardano who refused to follow the explicit relation between the powers of numbers and their geometrical representations for the simple reason that it was "contrary to nature" (Cajori quoting Cardano, 1926: 398). The German algebraist Stifel used the same excuse. A historical aside claims that while Cardano refused to offend nature in this way, he found no problem trivialising Jesus by compiling and publishing his horoscope, and was consequently deemed a heretic. It seems humorous that Jesus' horoscope was, at least for this man, considered of greater intellectual worth, and less offensive, than an extrapolation on extra-sensible dimensions.

The two most important naysayers of Cajori's historical investigation are Descartes and Pascal. Descartes did much to link the algebraic method with the geometric, and ushered a new era for mathematical figuration. While working to find graphic representation of physical formulae he came upon a strange relation.

He was trying to find a graphic representation of the motion of a freely falling body. If the body is acted upon by a single accelerating cause, the motion (distance passed over) is represented by a triangle, if by two causes, it is represented by a triangular pyramid; if by three causes, "by other figures" (*alijs figuris*)." But he does not let us into the secret, what those "other figures" were. Evidently, Descartes was repulsed as effectively as Oresme had been repulsed. (Cajori, 1927: 398-399)

Passing into silence his conclusion, without omitting to refer to its existence could be interpreted as repulsion, but it also could be a marker of confusion. The expanses of Descartes' work show him to be a man well versed in the science of his day, and a thinker bearing at least some originality. Accustomed to success in his work, he might have thought sufficient to make allusion to four-dimensional forms, even if he was not able to produce them. Furthermore, an anecdote reported by Will and Ariel Durant in *The Story of Civilization* claims that when the 16-year-old Pascal showed his first works on conical forms to Descartes, the latter first accused him of passing his father's work as his own, and then merely qualified it as basic, claiming that other things could be said of conic sections that would not occur to a

16-year-old. While the historical validity of this story might be put into question, it does paint Descartes as a man imbued with a sense of his own personal superiority. His reaction to “other forms” might then be seen as the refusal to admit his own personal limitations. Yet, Descartes had all the epistemological tools necessary to make this extrapolation. His *cogito*, in fact an attempt to ground philosophy in a fundamental axiom, and his geometrical view of reason, placed him at the conjunction of the concepts necessary to project extra-dimensional space. Perhaps the invention of the Cartesian plane was success enough in the gradual abstraction of geometry. Perhaps the “other forms” bore too much semblance to the illusions of an evil daemon. One must not forget A. Square’s reaction to the Sphere’s revelations: “Monster,[...]be thou juggler, enchanter, dream, or devil, no more will I endure thy mockeries. Either thou or I must perish” (Abbott, 2002: 147). Descartes’ approach will remain as a remarkable example of passing over the fourth dimension into silence, a formulation Wittgensteinian in nature that will return around the notion of impossibility. It must not be thoroughly forgotten for, while Galileo is the true master of late 16th and early 17th century scientific thought experiments, Descartes furthers the shift towards abstract geometrical representation of the world, setting the tone for a mathematical encoding of worldly phenomenon such as acceleration (See Derrida’s introduction of Husserl’s *L’origine de la géométrie*).

Pascal is Cajori’s final candidate for precursors to the fourth dimension concept. His work on the summation of integrals came upon Oresme’s, Cardano’s and Descartes’ geometric serial analogy (from point to line to plane to solid) and like Oresme, he transformed the integration of a plane into infinite amounts of integrations of lines, making the “plane-plane” possible through the backtracking of a step. Cajori comments that “Pascal, like his predecessors sidestepped the fourth dimension; and he did so by letting a line represent a solid numerically” (Cajori, 1927: 399). Let it be said that as a mathematical solution, this is an incredibly ingenious trick, which permits mathematical formulas to continue functioning and even lets them be recuperated as indirect reflections on the fourth dimension. But as a philosophical move, it is similar to adjusting observations to fit a hypothesis, effectively refusing to accept trees that would not fit the idea of a forest.

Many other refusals followed Pascal's, but it seems wise, at this point, to break away from the chronological narrative lest history overtake epistemology. But let us keep in mind the common strands of objections to the development of the spatial fourth dimension. The first and most widespread is the claim that it is simply not real, on account of our senses. The second is Descartes' silence in front of a statement clearly in need of clarification. The third is the backtracking of both Oresme and Pascal, which works as an analogy internal to the mathematical system. Indeed, while refusing to let their imagination contemplate the fourth-dimensional figure, Oresme and Pascal both managed to come upon the major means by which a neophyte begins to apprehend a space with four axes; through the analogy of contemplating the third dimension from a two-dimensional world. Which begs the question; what is the relationship between the thought experiment and its conclusion? For while all these thinkers followed the premises to the same thought experiment, their refusal, and the ingenuity with which they formulated their alternate conclusion acts as a two-part question asked in regards to the epistemological worth of the thought experiment. As with Ezekiel, it is now impossible to interrogate the actual experience of Oresme, Descartes and Pascal. Their writings leave behind a trace of thought process, but to assert that their thought experiment yielded a conclusion that they covered up, an undeniable deduction their minds were unable to allow, is a deferred reading, and one made in light of what has come to pass as "accepted knowledge." Thomas Kuhn resumed the epistemological quandary of thought experiments by asking "how, then, relying exclusively upon familiar data, can a thought experiment lead to new knowledge or to new understanding of nature?" (Kuhn, 1977: 241). In light of the examples exposed by Cajori's philological exploration this question takes an important turn. If the premises of a thought experiment are imagined, then what deductive process must be put into place, what rigid framework must structure the mental processes of the thought experimenter, in order to offer a form of validity to the conclusions drawn from the experiment? Gendler's definition of the thought experiment would once again bring us back to intention; the direction of the thought experiment is defined by the hypothesis that must be proven or disproven. There are still a few puzzle pieces missing to answer this question, mainly the question of the real and the thinkable, but it is imperative to keep in mind that this substantive objection is the main threat to thought experiments' epistemological validity.

One major refusal of the fourth dimension still remains, but its constitution is far more complex than the first three, as it stems from doubt rather than from certainty. This also marks my departure from Cajori's short history. While the following section on Henry More's notion of spissitude and Charles Howard Hinton's tesseract follows the surface structure of Cajori's exposition, I shall dwell on aspects of the notion from a point of view firmly grounded in *Flatland's* influences and on the vocabulary of the fourth dimension. Therefore, while Cajori addresses More as the historical figure that follows Pascal—and his insights shall still be of use—my reading of More and Hinton will involve greater depth than was warranted in Cajori's approach.

1.3.3. Spissitude and Tesseracts

Flatland was written at a moment where the fourth dimension concept was taking form as plausible construct. While there is definite originality in Abbott's "romance" he did not create it within an intellectual vacuum. Abbott was not a mathematician; he was a prolific writer of theories on social reform, natural theology and Shakespeare. He was the ordained headmaster of the City of London School for 24 years (1865-1889) and taught mostly English and theology. Abbott's oeuvre is as varied as it is rich, but *Flatland* stands out as his most frequently reprinted book (the two contenders for this spot are *The Kernel and the Husk*, where Abbott explains how faith can be instilled with carefully chosen allegories and parables, and the *Shakespearian Grammar*, a philological work of note, still in use by Shakespearian scholars today). One can wonder, from a brief glance at his bibliography why posterity fell upon his one mathematical romance and why this work's lineage is composed of texts by physicians, mathematicians and engineers, seeing as Abbott was merely a dabbler in the science of numbers. It turns out that this question was upheld by one of his contemporaries, who probably also served as indirect precursor and main influence for the geometrical aspects of *Flatland*.

As is noticed by both Thomas F. Banchoff (a geometer) in "From Flatland to Hypergraphics: Interacting with Higher Dimensions" and Rudy Rucker (science fiction writer, mathematician and computer scientist) in *The Fourth Dimension: A Guided Tour of the*

Higher Universes, there are less than six degrees of separation between Abbott and Charles Howard Hinton, another Victorian Englishman obsessed with the fourth dimension. As a matter of fact, they had a common friend in Howard Candler, mathematical master of Uppingham School. Thomas Banchoff, leading scholar on *Flatland*, should be commended here, since his thorough research of Abbott's history helps link him to many of his contemporaries. He explains the intimate relationship between Abbott and Candler;

Candler and Abbott had met when they were both schoolboys at the City of London School. They went up to Cambridge together and stayed in contact for the rest of their lives. During the 25 years Candler was at Uppingham, they exchanged letters every week. (Abbott's letters to Candler were extant as late as 1939, when they were used as a source in writing the history of the City of London School, but they have since disappeared.) After his retirement, Candler moved to Hampstead so he and his family could be close to the Abbotts. Abbott consistently consulted Candler about his theological writings, so it is virtually certain that he would have written to him about the geometrical part of *Hints on Home Teaching*. And Abbott would certainly share with Candler his thoughts on *Flatland*, which bears the dedication 'To the Inhabitants of Space in General and H.C. in particular'. Abbott specifically identifies Candler as 'the H.C. to whom *Flatland* was dedicated' in the introduction to one of his theology volumes written just after Candler died in 1916, and the first edition in the Trinity College library, donated by one of Candler's grandsons, is inscribed simply 'To H.C., in particular'. It is easy to imagine a series of letters in which Candler mentions to his friend the ideas of this new science master, Hinton, and their relevance to some of the theological and philosophical notions which they have been discussing. (Banchoff, 1990)

Candler is a point of idiosyncrasy in the narrative of *Flatland*. Abbott's full dedication is written in the voice of A. Square, narrator and pseudonym:

To / The Inhabitants of SPACE IN GENERAL / and H. C. IN PARTICULAR / This Work is Dedicated / By a Humble Native of Flatland / In the Hope that / Even as he was Initiated into the Mysteries / Of THREE Dimensions / Having been previously conversant / With ONLY TWO / So the Citizens of that Celestial Region / May aspire yet higher and higher / To the Secrets of FOUR FIVE OR EVEN SIX Dimensions / Thereby contributing / To the Enlargement of THE IMAGINATION / And the possible Development / Of that most rare and excellent Gift of MODESTY / Among the Superior Races / Of SOLID HUMANITY (Abbott, 2002: 7)

Flatland concludes with A. Square imprisoned and struggling to remember “the once-seen, oft-regretted Cube,” while an uncertainty about his actual experience grows within him. While he dedicates his manuscript to the inhabitants of space in general (solid humanity), his sole experience with the third-dimension came about through the interaction with a Sphere. Since both A. Square and the Sphere seem to reason and speak in ways similar to humankind, they would, from the vantage point of human biology, be inwardly more complex than mere geometric shapes. Ladd Ehlinger Jr.’s film adaptation even goes as far as exposing A. Square’s innards to the eye of the three-dimensional spectator, since no third dimension inevitably means no upward and downward membrane. Rudy Rucker’s *Spaceland*, one of the unofficial “sequels” to *Flatland* uses the same logic to show that if indeed we are merely three-dimensional, then if one was to see four-dimensionally, he would be exposed to the unlikely spectacle of every other surrounding living being’s innards as much as their skin and clothes. After being augmented, Joe Cube—Rucker’s protagonist—notices that “[his] subtle vision made [his girlfriend] funny. It was like [he] could see the flesh and blood beneath her skin” (Rucker, 2002: 44). So it can be granted that, apart from some weird twists on standard organic disposition, for the biologically inclined, the representation that *Flatland* offers can be translated into a functioning representation of life akin to ours. But the simple fact remains that the main protagonists of the novel are shaped like elementary geometrical shapes. Nowhere is it written in *Flatland* that A. Square gains the knowledge of humanity’s existence. Perhaps an exchange between the Sphere and A. Square pertaining to Howard Candler was left out in A. Square’s prison notebooks, but it seems that if he found H. C. important enough to dedicate his entire work he would have remembered at least to mention how he came to know his existence. This reasoning *ad absurdum* goes to show that the H. C. in the dedication is the marker of a rather idiosyncratic choice on Abbott’s part to thank his friend through the mouth of his pseudonym. It acts as a strange link between fiction, unreliable narrative and the figure of the author. It is a subtle breaking of the fourth wall, a latent *Verfremdungseffekt*. As I shall show, it is not the only moment of idiosyncrasy, and some other details are even more telling as to the difficulty of rigorously sustaining Abbott’s thought experiment. But H. C. shall remain the marker by which to denote the cracks in the façade of Abbott’s fiction, showing what Le Guin would call its reliance upon a lie.

Howard Candler acted as the probable link between Abbott and Hinton. Another hypothesis, also proposed by Banchoff, claims that since Abbott was extremely involved in the Women's Education Movement, he frequently interacted with Miss Buss, headmistress of the Cheltenham Ladies' College. Since Hinton worked there for a time, and reprinted his pamphlet *What is the Fourth Dimension?* in the *Cheltenham Ladies' Gazette*, it might also have been there that the two men became aware of one another. But as the historical validity of minor biographical speculation is not my main concern, I shall not remain hung up on the latent ins and outs of Victorian society gossip. In any case, Hinton published his first essay *What is the Fourth Dimension?* in 1880, and it consisted mostly of a powerful mental gymnastic (as it is put in the blurb by the *Westminster Review* found in the introductory pages of the 1912 edition of *The Fourth Dimension*) helpful in attempting to imagine the fourth dimension. It proposes, amongst other exercises, to think of mutating three-dimensional forms (made out of thin strings) as manifestations of fourth-dimension solids. It also uses the most important analogy so far exposed; that of moving from a point to a line, a line to a plane, a plane to a solid, and a solid to a four-dimensional shape. Hinton failed, however, to notice the potential that fiction held in providing a *mise-en-scène* for his concepts. He caught on quite rapidly, following Abbott's publication of *Flatland*, and in 1885 wrote his own short story in a two-dimensional world, titled *A Plane World*. This story was compiled in the first volume of his *Scientific Romances* in 1886, along with a new introduction in which he addresses Abbott's *Flatland* by name.

It is well, therefore, first to recede and to form definite conceptions about a world of plane space, about a world in which the beings can only move in two independent directions. Then, proceeding thence to our own world, we may gain the means of passing on to a higher world. And I should have wished to be able to refer the reader altogether to that ingenious work, "Flatland." But on turning over its pages again, I find that the author has used his rare talent for a purpose foreign to the intent of our work. For evidently the physical conditions of life on the plane have not been his main object. He has used them as a setting wherein to place his satire and his lessons. But we wish, in the first place, to know the physical facts. (Hinton, 2004: 129)

Hinton, writing this introduction a mere two years after *Flatland's* publication probably sensed Abbott's literary superiority, choosing to value the scientific worth of his own work above *Flatland's* novel form. Indeed, while both works are published as romances, Abbott's

is mainly a “Romance in Many Dimensions”, or foremost a romance set in many dimensions, while Hinton’s is a “Scientific Romance” or an intrinsically scientific romance. Oddly enough, Hinton went on to publish, in 1907, a largely extended version of his initial plane world story, complete with social commentary and narrative complexity, under the title of *An Episode of Flatland*. In a way much clumsier than Abbott’s own, he even tried his hand at glossing over his narrative by putting into question its status as fiction. Rather than using pseudonyms and the first person, which work at the level of the medium (the language of the book as written work of a defined subject), he included an introductory remark saying that

after all, it seemed possible that there could be real two dimensional beings. I began to set about to try to discover these two dimensional beings, and learn all about them. I succeeded at last, and if I do not tell you how, I am afraid it is from no very worthy motive. For if I told how one could find out about them, I am afraid Mr. Wells or Mr. Gelett Burgess or some other brilliant author would begin to write about them, and to serve them up with all the resources of wit and humour. In that case no one would listen to me. As it is I intend to have the pleasure of telling about them myself. (Hinton, 1907)

He does go to great length, in his first chapters, to describe how a three-dimensional person can imagine the two-dimensional beings, so when he writes “how one could find out about them,” he means how one could physically locate the Flatlanders within our world (or draw the bridge between their world and ours, like the computer simulation in another of *Flatland*’s pseudo-sequels, Dewdney’s *The Planiverse*). Hinton therefore adopts the much more common standpoint of the outside observer, even if his narrator seems to know a great deal of details as to the feelings of his characters. If we look at Hinton as a mathematical anthropologist (a geometrologist), he commits much of the faults attributed to 19th century ethnologists, such as imposing his own three-dimensional views on the tribes of his story, and using Victorian logic to explain and extrapolate on the motivations and the traditions of the civilisation observed, the Unæans. Furthermore, he once again emphasizes his literary inferiority to authors of his time, Herbert George Wells and Frank Gelett Burgess, perhaps as false modesty, perhaps as self-conscious insecurity.

Interestingly enough, Hinton chooses to remove a different dimension than Abbott. Rather than having a surface world, where two-dimensional beings move along cardinality

(north-south, east-west) he chooses to represent a circle world, where up-down and front-back are the only directional options. This unearths different difficulties from those written by Abbott, the main one being that in this world, “plane folks” cannot turn around (they can only stand on their heads and look under their legs in order to catch a glimpse of what lies behind them), and complex systems have to be concocted in order to do something as simple as walking past someone else. This same thought experiment within a thought experiment was conducted to much greater lengths by Dewdney in *The Planiverse*, and the ingenious devices, doors, stairs, planes and balloons imagined and drawn within this book show the complexity of imagining a society where the only means by which to move beyond someone is to go above or below them.

Hinton does have one advantage over Abbott; he could actually see the fourth dimension, or so he claimed. Do not be mistaken, I do not mean that Hinton had ESP or a third, inward, eye (if these are even ways to see the fourth dimension), but rather that he had, from a young age, developed a means by which to visualise the fourth dimension. This might explain why his treatises on the fourth dimension fared much better than his attempts at fiction. A great deal of attention, even today, rests on the originality of Hinton’s *What is the Fourth Dimension?*; Alan Moore and Eddie Campbell’s *From Hell*, while completely evacuating Hinton’s actual theory to replace it with a pseudo-space-time invisible-patterns-of-the-universe-in-causality type of dimensional narrative, does describe its fictionalised Charles Howard Hinton as a pamphlet-writing prophet of the fourth dimension. There is a movement, in the second chapter of Moore and Campbell’s graphic novel, from the childish interrogation of young Charles to his father (the equally famous James Hinton), an interrogation born out of the need for definition—“what is the fourth dimension?” (Moore & Campbell, 1999: 29)—, that finds its culmination in the father exposing the theses of his son’s pamphlet, named for the same question. What makes Hinton’s reflexions on the fourth dimension thoroughly original is twofold. Foremost, he proposes a secular approach to the fourth dimension, concentrating mostly on the logical and mathematical repercussions of using four-dimensional systems. What is even more impressive is that he manages, within the mathematical framework, to draw conclusions of epistemic qualities. Hinton was his own guinea pig, and he approached the conceptualisation of the fourth dimension in much the same way that Timothy Leary

advocated for LSD; as a mind-opening, boundary-shattering means to a “new era of thought” (which was the title of his 1888 book that treats, unsurprisingly, of his enthusiastic hopes for fourth-dimensional influence on society and mind).

In his introduction to *Speculations on the Fourth Dimension: Selected Writings of Charles H. Hinton*, Rudy Rucker explains how Hinton moved from a mnemonic exercise to a sensible conception of the four-dimensional;

Desperate for some absolute knowledge, Hinton hit upon the plan of memorizing a cubic yard of one-inch cubes. That is, he took a 36 X 36 X 36 block of cubes, assigned a two-word Latin name (e.g. *Collis Nebula*) to each of the 46,656 units, and learned to use this network as a sort of “solid paper.” Thus when he wished to visualize some solid structure, he would do so by adjusting its size so that it fit into his cubic yard. Then he could describe the structure by listing the names of the occupied cells. Hinton maintains that he thereby obtained a sort of direct and sensuous appreciation of space. [...] Hinton went on to memorize the positions of the little cubes for each of the 24 possible orientations (six choices for the bottom face times four choices for the front face) which the block might have relative to the observer. (Rucker, 1980: vi)

Hinton himself described this process as “three expressions which may be considered [...] as almost identical: “Casting out the self”—“Seeing as a higher child”—and thirdly, “Acquiring an intuitive knowledge of four-dimensional space”” (Hinton, 2004: 227). In order to shape his mind into having direct sensual feel for changes in space, Hinton used a process similar to antiquity’s Greek memory palace, by which a space is committed to memory in order to attach memoranda to its columns and alcoves. This mnemonic “inner space” has a rich history, and has been used by people as varied as Latin orators, 12th century monks (Hugh’s *modum imaginandi domesticum*), and 20th century golfers (Harwood, 1976: 683). Frances A. Yates makes an impressive chronology of the mnemonic inner space in her 1966 book *The Art of Memory*, but rather than focusing on the historical aspect of the concept, a particular reading that Ivan Illich proposes in his commentary on Hugh’s *Didascalicon* entitled *In the Vineyard of the Text* sheds light this practice’s spatial ramifications. Illich sees the inward representation of memory as a reflection of writing technology of the times. He says that “before practice had demonstrated that the letters of the alphabet could bind winged words in row after row of script, no one would have conceived of a storage room or wax tablet within

the mind” (Illich, 1993: 39). The artifice of the alphabet, as a physical fixation of sound, permitted words to become spatial. Likewise, Hinton’s mnemonic representation is a product of a certain movement in the history of mathematics that would have been impossible without, for example, the Cartesian division of space. But in rhetoric’s stead, Hinton uses words to remember space. In an inverse motion (a de-spatialisation of space) and by working through Latin nomenclature, Hinton compartmentalises the relative idea of space into an abstract ideal. This intimate space he describes in his essay *Casting out the Self*:

if not knowledge absolute, the knowledge of this block approaches more nearly to knowledge absolute than any other with which I am acquainted, because each cube is the same as its neighbour, and instead of an arrangement of all sorts of diverse ignorances we have only one kind of ignorance—that of the cube. (Hinton, 2004: 207)

The summation of his efforts boils down to the reduction of many uncertainties into a simple elementary and self-similar ignorance, a system of compossible un-knowledge. This process, one will notice, is quite similar to the entire development of the axiomatic sciences, with elementary axioms as a necessarily unproven base with which to build, and Hinton’s single imaginary fractal, his cube-made-of-cubes, allowed for the geometric to attain a simple conceptual quality. Furthermore, since every cube is interchangeable for the larger three-by-three cube, Hinton opens the way for a mental conception of the infinitely large, and the infinitesimally minuscule. But with this tool, he chose a different mode of exploration, making him a footnote in the history of the fourth dimension rather than that of infinity. This, coupled with the earlier refusals of the fourth dimension, show how potentiality for discovery can arise without being fulfilled, and how a history of possibility would differ radically from our history of actuality.

By memorizing the relation between the cubes within the larger cube, Hinton realized that he was able to be aware of all faces of the larger cube at once, and of its insides. Since ordinary perception permits a single, still, and mirror-less observer to see, at most, only three of the faces of a cube in the same field of vision (a cube that has a width smaller than the distance between the observer’s eyes can be placed close enough for the observer to see four, or even five of its faces at once, but since the two human eyes are necessary to perceive three dimensions, what is seen in this case are two flat images of a cube superposed). In any case,

Hinton claims to see all six faces of his cube clearly, along with its insides, which surpasses even this dubious exception to the three-faces of a cube limit. Hinton, interested by this offshoot of his mental experiment pushed the perception further by realising that he was also aware of the smaller cubes' faces within the larger cube, normally hidden to the view. Take a Rubik's cube as an example; it is impossible to see all faces at once, no matter the level of eyestrain. Arguably, someone with an intimate knowledge of the Rubik's cube's constitution might "see" the other faces inwardly as abstractions of those faces that are exposed to his view. But it would be even more impossible (if impossibility is quantifiable) to see within the cube, at those faces never exposed, without taking a hammer to the cube. And by working with analogy, one might guess that the innards of the cube are also adjoined coloured faces, but the hammer would reveal the limits of such an analogy. Hinton withheld throughout his career that his mental perception, aided by the Latin names he memorised, was augmented beyond sensual perception. Like Joe in *Spaceland*, he was donned with a third eye, albeit one in the mind, rather than on a fourth-dimensional tentacle. Husserl, who also used a cube as an example to illustrate synthesis of perception accurately describes the distinction that Hinton seems to have surpassed;

The sort of combination uniting consciousness with consciousness can be characterized as *synthesis*, a mode of combination exclusively peculiar to consciousness. For example, if I take the perceiving of this cube as the theme for my description, I see in pure reflection that *this* cube is given continuously as an objective unity in a multiform and changeable multiplicity of manners of appearing, which belong determinately to it. These, in the temporal flow, are not an incoherent sequence of subjective processes. Rather they flow away in the unity of a synthesis, such that in them "one and the same" is intended as appearing. The one identical cube appears, now in "near appearances", now in "far appearances": in the changing modes of the *Here* and *There*, over against an always co-intended, though perhaps unheeded, *absolute Here* (in my co-appearing organism). [...] Thus each passing cogito intends its cogitatum, not with an undifferentiated blankness, but as a cogito with a describable *structure of multiplicities*, a structure having a *quite definite* noetic-noematic composition, which, by virtue of its essential nature, pertains to just *this* identical cogitatum¹² (Husserl, 1977: 39-40, translation slightly altered, original emphasis).

¹² Die Verbindungsweise, die Bewußtsein mit Bewußtsein einigt, als die der Bewußtseinsregion ausschließlich eigene der *Synthesis*. Nehme ich z. B. das Wahrnehmen dieses Würfels zum Thema der Beschreibung, so sehe ich

Hinton's cube is therefore a means by which Husserl's synthesis is immediately reached, going beyond the composition of the noetic and the noematic to reach a perfect superposition of both. Thus, the changing modes of the *Here* and *There* are no longer necessary to attain the *absolute Here*, or so Hinton claims. His mnemonic cube works like an investment of *cogito* that, in the long run, allows him to touch on the *cogitatum* of space. It also reveals a feature of language that will act as a general theme to the whole exposition; there is no adequate vocabulary to describe the way the fourth dimension (both spatial, and, in the next acts, temporal) is apprehended. Thus, it will be noticeable that a vocabulary of the senses replaces acts as an on-going metaphor. Hinton "sees" the interior of the cube, just as Vonnegut's characters will "see" time from an outside "perspective."

Hinton felt such a kinship with the concept of a four-dimension cube that, in *A New Era of Thought*, he christens it with a name still in use today: "the tesseract" (from the Greek, meaning "four rays"). He also offers new words for the directions through which movement could be described in the fourth dimension. In *Flatland*, the Sphere has difficulty explaining to A. Square the directions of "not Northward [but] upward" (Abbott, 2002: 145). Likewise, it is difficult to talk about the direction in which one moves in the fourth dimension without its own up/down, north/south or east/west, at a 90° angle from all three of these directions. Hinton uses *kata* and *ana*, from the Greek prefixes for "down from" and "up towards," respectively. These terms are reutilised in many subsequent works on the fourth dimension, most notably those by Rudy Rucker, whether they be scientific histories (*Geometry, Relativity and the Fourth Dimension*) or novels (*White Light, Spaceland*).

In order to teach these new concepts, Hinton included a set of coloured cubes with *A New Era of Thought*. The 81 colours on the faces of his cubes were meant in part to replace the Latin names of his original experiment. The use of colours is an idea he first develops

in der reinen Reflexion, dass *dieser* Würfel kontinuierlich als gegenständliche Einheit gegeben ist in einer vielgestaltigen wandelbaren Mannigfaltigkeit bestimmt zugehöriger Erscheinungsweisen. Diese sind in ihrem Ablauf nicht ein zusammenhangloses Nacheinander von Erlebnissen. Sie verlaufen vielmehr in der Einheit einer Synthesis, dergemäß in ihnen ein und dasselbe als Erscheinendes bewußt wird. Der Würfel, der eine und selbe, erscheint bald in Naherscheinungen, bald in Fernerscheinungen, in den wechselnden Modi des *Da* und *Dort* gegenüber einem, obschon unbeachtet, stets mitbewußten *absoluten Hier* (im miterscheinenden eigenen Leibe). [...] So hat also das jeweilige *cogito* nicht in in unterschiedsloser Leere sein *cogitatum* bewußt, sondern in einer deskriptiven Mannigfaltigkeitsstruktur von einem ganz bestimmten, gerade diesem identischen *cogitatum* wesensmäßig zugehörigen noetisch-noematischen Aufbau (Husserl, 1929: 77-78).

with his intellectual partner and sister-in-law of the time, Alicia Boole (later Stott), daughter of George Boole. She had, with the help of Hinton, started to experiment with the three-dimensional representation of polytopes, or four-dimensional convex figures, using coloured shapes. While her contribution to mathematics was as important as Hinton's own, he is the one that became the ideologue of the fourth dimension. He is also credited with first presenting the idea to Alicia Boole, a case to be made in favour of his method. Alicia Boole Stott's work, which was published at least ten years after it was written, did earn her an immediate doctorate from the University of Groningen. It is to her great credit, and to Hinton's worth as a pedagogue, that she managed to arrive at a geometrical work of such magnitude without having much of a formal education. A family story reported by Banchoff to Rucker in a 1993 letter recounts that at the time of her doctorate's reception, Alicia Boole Stott had left mathematics because her "husband Walter refused to consider that his wife should have any career outside the home" (Banchoff, 2009: 3). Her work was published at the insistence of the Dutch mathematician Pieter Schoute, and at the tercentenary of the University of Groningen, she received "a fancy scroll, in Latin, which she couldn't read. Later her son read it and exclaimed, 'Jesus Christ, they're making you a Doctor'" (Banchoff, 2009: 3). It was a sad reality that one of the few visionaries of the fourth dimension contemporary to Hinton and Abbott (both advocates for the education of women) was cut short in her work by a chauvinist Victorian husband. Like the women in *Flatland*, Boole Stott was denied a second dimension, when she could have had four (it would take 92 years for Ian Stewart to give the women of *Flatland*, represented as lines, a second dimension extending upwards, thus invisible to the men of the two-dimensional world).

What link is established between coloured models representing the fourth dimension through the means of the third, especially considering Gendler's fourth criterion for thought experiments stipulating that they relate to the physical world? The development of computer graphics has permitted moving models that act like Boole Stott's coloured solids and, to a lesser extent, Hinton's cubes. In the documentary that accompanies *Flatland: A Journey of Many Dimensions*, Banchoff explains that *Flatland* is still inspiring new research in the domain of computer visual algorithms. But there is yet no sidestepping through the fourth dimension. It is so far impossible to explore fourth dimension routes like Joe Cube in

Spaceland, but Hinton argues that his mental workout allowed him something akin to experiencing the fourth dimension in the “physical world.” Hinton’s experience with his virtual cube seems to have had quite an impact on his life. Most of his major written pieces are directly or indirectly intent on grasping the implications of thinking in higher dimensions. His two major leitmotifs are the two-dimensional analogy, that renders explicit how strange the fourth-dimension seems to phenomenological humans, and the imaginary cube, which acts as a means to lessen the estrangement. But Hinton remains tainted by the modern *zeitgeist*, and the fourth dimension becomes, within his philosophical system, the next step of mental evolution. The fourth dimension “when apprehended will seem as natural to us as the position of the earth among the other planets” (Hinton, 2009: 52). It is the rectification of an age-old dogma, a *truth*, and a tool in the evolution of human mentality. Hinton offers pedagogical council through his method; “a more detailed development of the practical work of [the method for imagining a cube of cubes], would be the best training for the mind of a child” (Hinton, 2009: 15). He explains positive and negative charges and the symmetry of the left hand and the right (issued from Kantian and Möbiusian thought) as the results of aka/ana rotations in the fourth dimension. He also offers his method as the way for complex thought, for the purging of self-elements (towards a more objective knowledge), and as a foundation for ethics (“space, the scientific base for altruism and religion” [Hinton, 2009: 89]). In a way, the synthesis described by Husserl, when taken beyond the noetic-noematic divide, wreaks havoc on Hinton’s conceptual apparatus, to the point where the analogy becomes all-encompassing, and omnipotent. It is this last point that shall be investigated more closely since it projects Hinton’s achievement from the physical to the metaphysical, exposing a general preconception about the fourth dimension that casts a transcendental overcast on the entire history of this dimension as a physical concept.

Hinton described himself as scientifically minded. Yet when he came upon the tesseract, he lived his experience as a sort of religious revelation. The ecstatic quality of his philosophy is apparent in the proclamation of a new era of thought. The belief that the immediate grasp of the fourth dimension would bring about a radical shift in the history of ideas is not only transparent in his prose; it governs his entire written oeuvre. But the advent of a single concept in science rarely provides a paradigm shift. Hinton thought of the fourth

dimension as more than a single concept; it was the addition of a dimension in all areas of abstractions, with altruism and religion as some of his most controversial examples. True to his method of reasoning, Hinton uses his mental cube as initial axiom for ethics;

If it is the same about our fellow-creatures as it is about the block of cubes, when we have thrown out the self-regard from our relationship to them, we shall feel towards them as a higher being than man feels towards them, we shall feel towards them as they are in their true selves, not in their outward forms, but as eternal loving spirits. And then those instincts which humanity feels with a secret impulse to be sacred and higher than any temporary good will be justified—or fulfilled. (Hinton, 2009: 93-94)

Altruism takes the form of the self-effacement that was the original motivation for the mental cube exercise. Hinton argues for the expansion of our notions of what can be scientific beyond the preconceived. He strives to forge a path between the extremes of materialism and idealism, specifically Kantian idealism, which he addresses directly. He rejects Kant's main project that puts into question direct spatial experience, but agrees with him that the intuition of space is the most fundamental power of the mind (Hinton, 2009: 3).

The true path of wisdom consists in seeing that our intellect is foolishness—that our conclusions are absurd and mistaken, not in speculating on the world as a form of thought projected from the thinking principle within us—rather to be amazed that our thought has so limited the world and hidden from us its real existences. To think of ourselves as any other than things in space and subject to material conditions, is absurd (Hinton, 2009: 94)

Rather than put into question the materiality of existence, Hinton reinscribes ideality into the material fabric of space. While this seems to make him an adherent to a certain materiality beyond empiricism, his link between the mental cube and ethics, and his gracious use of analogical arguments as methods to uncover the truth make him a slightly more complex figure. Hinton's argument for the hidden dimension of all things, and what we gain from familiarising ourselves with it, is not the first link between the fourth dimension and the eternal. There is a slippery slope between Hinton's projected space as basis for religion, and another, older notion, which Henry More names the doctrine of the spissitude of the soul.

I have already made mention of More. As a Cambridge Platonist at the time of the reformation, Henry More came at the problem of the soul from the angle of the cave allegory.

Indeed, if space itself was merely a shadowy reflection of the unattainable concept of space, then there was no reason why the soul could not find its place upon it. Hinton himself notices the similitude between the fourth dimension and Plato's shadow projecting world. In the introduction of *Four-Dimensional Space* he advises us to take Plato's suggestion "literally, not metaphorically." Thus "as our world in three dimensions is to a shadow or plane world, so is the higher world to our three-dimensional world. That is the higher world is four-dimensional" (Hinton, 1912: 2). For Hinton, literality is the crucial distinction between Plato's metaphoric world of ideas and his fourth-dimension. Once again, the theme of abstraction arises as metaphoricity is subsumed to literality, the way that the theoretical is to the experimental, or the real is to the imaginary. If space is abstracted from reality, and the first three dimensions are relieved of their "sensory" qualities, at least while they are being considered as ideas, there is a conceptual freedom that lets "dimension" act as a representation. Henry More, in the 17th century, needed a means by which to include the soul into reality, and found that a fourth, abstracted dimension fit the bill. He was divided amidst ideas drawn from Cartesianism (he coined the term in English), Platonism, Neo-Platonism, Cabbalism and a theosophy concerned with finding the middle grounds between the Puritans, that rejected rationality, and Hobbes, that advocated for materialism. This made his system an interesting conflagration of influences. Most of all, More desired a system by which dualism could remain as a foundation for both faith and reason.

It goes without saying that going too deeply into More's rich system of thought would dilute the present investigation. Nonetheless, one particular notion, born out of the tension between Cartesian dualism and More's own conception of the soul, will resonate harmoniously with the problem of abstract thought and its impact on knowledge. This notion, spissitude, is an extension, like length, width and height, but reaching into the fourth dimension. More had a few bones to pick with Descartes, some of which he addressed directly to the French philosopher in a short correspondence. Sadly, Descartes put an end to their exchange by succumbing to pneumonia in Stockholm. More was concerned with the fact that in Cartesian doctrine, the body was spatial, and therefore pure extension (*res extensa*), while the mind (or soul as More preferred to refer to it) was disincarnate (*res cogitans*). Instead, More preferred to think of the soul (and of God) not only as an extensible entity in all

the directions of the body, but also as having its own dimension. As was customary in his time, More began his work *The Immortality of the Soul* with axioms, by which the soul could become intelligible. For More “the greatest and grossest Obstacle to the belief of *the Immortality of the Soul*, is that confident opinion in some, as if the very notion of a *Spirit* were a piece of Non-sense and perfect Incongruity in the conception thereof” (More, 1662: 21). His ninth axiom is of interest here, in which he proposes a middle ground for the extensibility of the soul. He begins his axiom with a justification for axioms that will now seem familiar;

For if the *naked substance* of a Thing be so utterly unconceivable, there can be nothing comprehended there to be a connexion betwixt it and it’s [sic] first Properties. Such is *Actual Divisibility* and *Impenetrability* in *Matter*. By *Actual Divisibility* I understand *Discerpibility*, gross tearing or cutting one part from another. These are *Immediate Properties of Matter*, but why they should be there, rather than in any other Subject, no man can pretend to give, or with any credit aske, the reason. For *Immediate Attributes* are indemonstrable, otherwise they would not be *Immediate*. (More, 1662: 19, original emphasis)

As John Henry notices in *A Cambridge Platonist’s Materialism: Henry More and the Concept of the Soul*, More is ambivalent as to his notion of indiscerpibility (inability to be severed or separated).

Consider [...] his definition of the nature of the soul as ‘a spiritual substance, without corporeal dimensions, but not destitute of an immaterial amplitude of Essence dilatable and contractible’. The seventeenth-century reader could only regard an amplitude of dilation and contraction as taking place through space or ‘corporeal dimensions’. Such a reader, therefore, would surely find More’s definition confused and confusing and could hardly credit his claim that he had ‘as distinct, determinate and clear apprehension of the [spiritual (sic)] things, and as wary and coherent, as I have of any corporeal thing in the world’. (Henry, 1986: 178)

For More to include spatial aspects to the soul was a controversial matter, and much of his argument with Descartes stems from this aspect of his definition of the soul. In order to achieve such a definition without succumbing to materialism, More needed the soul to function differently in space than did material bodies. This is where spissitude comes into play.

There is no necessary connexion discernible betwixt *Substance* with *three dimensions*, and *Impenetrability*. For what some alledge, that it implies a contradiction, that *Extended Substance*

should run one part into another for so part of the *Extension*, and consequently of the *Substance*, would be lost; this, I say, (if nearly looked into) is of no force. For the *Substance* is no more lost in this case, then when a string is doubled and redoubled, or a piece of wax reduced from a long figure to a round: The dimension of *Longitude* is in some part lost, but without detriment to the *Substance* of the wax. In like manner when one part of an *Extended Substance* runs into another, something both of *Longitude*, *Latitude* and *Profundity* may be lost, and yet all the *Substance* there still; as well as *Longitude* lost in the other case without any loss of the *Substance*. And as what was lost in *Longitude* was gotten in *Latitude* or *Profundity* before; so what is lost here in all or any two of the dimensions, is kept safe in *Essential Spissitude* : For so I will call this *Mode* or *Property of a Substance*, that is able to receive one part of it self into another. Which *fourth Mode* is as easy and familiar to my Understanding, as that of the *Three dimensions* to my Sense or Phansy. For I mean nothing else by *Spissitude*, but the redoubling or contracting of Substance into less space then it does sometimes occupy. And Analogous to this is the lying of two Substances of several kinds in the same place at once. (More, 1962: 19-20, original emphasis)

I hope it is obvious by now for the reader that, while More never actually mentions the fourth dimension, his alluding to a “fourth mode” alongside the “three dimensions” is quite similar to the geometric fourth dimension developed by Hinton. As such, we might even say that in More’s theosophy, the soul is a substance able to move aka and ana to the three sensible dimensions. Furthermore, his allusion to the familiarity with which the fourth mode is apprehended in understanding, as opposed to the familiarity of the senses with the other three dimensions, makes him a direct predecessor to Hinton’s theory of the fourth dimension as mind expanding. There remains a fundamental distinction between abstract and sensible, yet More uses this mental creation as a means to include the soul into a materialistic body. Cajori makes a compelling case against Zimmermann as to consider spissitude a geometric dimension:

A paragraph heading, in the *Enchiridion Metaphysicum* reads: “That besides the three dimensions which are filled with all extended material things, a fourth must be admitted, with which coincides the spirit.” If More’s fourth dimension, the abode of the spirit, did not belong in space, he could hardly have used such phrases as “the spiritual object which we call space.” (Cajori, 1927: 401)

It is also interesting to note, from a biological standpoint, that More replaces Descartes' pineal gland, which is his physical throne of the soul and an already controversial affirmation considering the immateriality of his idea of the soul, with the fourth ventricle and the muscles, which contain part of the soul within them communicating through a liquid similar to the humours. Spissitude acts as a way to avoid accusations of materialism; while the entity of the body may be divided, or *discerped* using More's vocabulary, and muscles can be lost to flesh wounds, the soul folds upon itself, through the fourth dimension, in order to maintain wholeness. Commentators on More have been keen in noticing that while this minor transformation in the biology of the soul was crucial in having More affirm the primacy of the soul in all movements of matter through space, it also brought him dangerously close to basic materialism, albeit with a fourth dimension appended. John Henry even goes as far as make a case for More's materialism throughout, as a leftover from the Neo-Platonic Atomists. Alexandre Koyré, in *From a Closed World to the Infinite Universe*, uses More as a stepping stone towards the contemporary conception of the universe.

For More, the soul is extension without matter. He chooses of the word "spissitude" and in so doing is borrowing a term which has formerly been used to refer to matter. Indeed, the spissitude or density of matter was still a current term when More wrote, as can be seen, conveniently, from the fact that More himself, even in *The Immortality of the Soul*, talks of the spissitude of air. (Henry, 1986: 177)

More's obstinacy in reducing the distinction between *res extensa* and *res cogitan*, while maintaining a materialistic vocabulary, led him to conclusions greatly differing from Descartes' own. Foremost, while the soul became spatial in More, it did not become matter. Therefore, More had to reject the Cartesian equivalence between extension and matter. Koyré shows the important ramifications of such a rejection.

The rejection of the Cartesian identification of extension and matter leads naturally to the rejection by Henry More of Descartes' denial of the possibility of vacuum. Why should not God be able to destroy all matter contained in a certain vessel without—as Descartes asserts—its walls being obliged to come together? (Koyré, 1957: 113)

By accepting the possibility for the vacuum, More placed himself on Pascal's side of the argument. As Koyré notices, the idea of extension without matter was not alien to 17th century

physics, as light and air were often considered to be examples of such a possibility. More, with mystic influences and poor knowledge of physics chose instead to use spiritual apparitions, ghosts and genii as examples of such conjuncture. Yet the implications of his disagreement with Descartes led to a radical division between them. For with space being extensible without containing any matter, but containing soul or God, More paved the way to the pantheism later attributed to Spinoza's infamous fourteenth proposition in the *Ethics*. Since space can have attributes without extension, an argument necessary for the soul to move within dimensions, then emptiness is difficult to separate from God. Descartes, sensing this problem in More's letters argued that he merely had a confusion of vocabulary, and that while God could be said to exist in space, it should never become one of its attributes. In order to distinguish God from space, More had to posit a distinction between the finite and the infinite. Koyré argues that for Henry More, "an indeterminately vast but finite world merged in an infinite space is the only conception, Henry More sees it now, that enables us to maintain the distinction between the contingent created world and the eternal and *a se* and *per se* existing God" (Koyré, 1957: 154). Spissitude, as a concept, is left behind as the marker of a type of abstract thought that has necessary repercussion on a worldview. More's great originality remains in this concept, which described aptly a type of thought that had never been fully exposed. Where Descartes kept quiet on his "other forms" and Pascal chose to make analogy into reality by backtracking in representation, More actually described, by his oddly mystical take on Cartesianism, a concept, spissitude, which would later find resonance in thoughts on the fourth dimension.

While Hinton was concerned with Kant's idealism, and More with Descartes' dualism, they both shared an analogous method by which to conjugate the immaterial with the physical. By following an analogy intrinsic to geometry to a logical step refused time and time again, both of these thinkers arrived at conclusions that have as great an impact today as they had in their own time. Koyré deplors the lack of researches done on More, and Rucker does the same for Hinton; these historical figures reverberate in their anachronism and are thereby difficult to include in a historiologic narrative. Yet their relation to abstraction as a space, and their innovations in thought-process make them perfect examples of a characteristic of knowledge; from odd conjunctures and concept-juggling is sometimes born a thought that

accords itself with other thoughts from the past and allows for its own palimpsests-like reinscription in the future. Yet this is not a chrono-logical movement; I cannot posit More as a direct precursor to Hinton. They are builders of analogous models, but neither had the same intent nor the same contextual motivations. Yet they stumbled upon a structure of thought that has been *a posteriori* discerned as self-same. I, like the others involved in the study the fourth dimension (Cajori and Rucker are notable), am imputing sense into a historical conjuncture. Both thinkers built concepts that are necessary to consider *Flatland's* main thought experiment, also referred to as the spatial analogy. More's spissitude and Hinton's tesseract will be the driving force in elucidating the importance of *Flatland* for physics and mathematics. Both notions are spontaneous inventions from thinkers of different times that were necessary to crystallise a thought built upon their foundation. In the act of naming, both Hinton and More created twin one-word conclusions to radically different thought experiments.

1.4.1. Conclusion

What is it that More and Hinton shared, which allowed for the hypothesis of a fourth mode, of a dimension at 90° with the other three? What process can we infer from the conjuncture of two different methods, and goals, which found themselves joined by a similar analogy? We must turn to *Flatland* to gain a better understanding of the process at work. For while Hinton was concerned with the expansion of the mind through differentiation of space, and More was trying to provide a figure by which the soul could be thought as both spatial and indiscerpible, both elaborated archaic versions of a concept capital to the later development of physics. While both had an intuitive vision of the importance of such a concept, it is less relevant to explore their theories for potential applications than to question the exact process by which such applicability came to be possible.

Both thinkers contemplated an apparent antinomy. For Hinton it was the removal of the self from pure knowledge, while for More it was extension without matter. These antinomies fit Kant's description of irreducible contradictions within a timeframe; while there are still debates on space and the soul, the vocabulary of More and Descartes' disagreement, and its entire epistemic underpinnings, is dated. In a way, this remnant of history, this

anecdote, once repositioned within a narrative that has taken the fourth dimension as its nucleus, as its centre of gravitation, is stripped of the weight of the 17th century debate on matter. As I have shown, some contextual elements have interesting repercussions, and More's essential spissitude could open up debates leading to Spinoza, Leibniz, Newton, etc. But spissitude itself, as historical innovation, is so idiosyncratic, that it attaches itself to reflexions that could never have existed before the 20th century. For instance, spissitude can be compared to Minkowski's space-time, or Einstein's relativity. It can even be entirely reformulated in a vocabulary of quantum physics, acquiring a tint of anachronism but still functioning as analogical. Like Cochran's example of Von Däniken repurposing Ezekiel's chariot of the Gods within a logic of Area 51 science fiction, More's spissitude can be understood as a jolt of four-dimensional thought, that manifested itself through a representation of the soul. Thus, while the fourth dimension seems to have been summoned in order to serve More's vision of the soul, there are absolutely no reasons why one could not have More's vision of the soul serve in a theory of four dimensions. The two notions are confusedly intermeshed, but a direct causal link from one to the other cannot be founded without allowing the inverse. They are connected through a biconditional relationship. Both being under the jurisdiction of the axiomatic, they are proven by self-evidence, which goes to say that their arrangement is a matter of personal worldview. Therefore, there is at least possibility for a reading of historical morsels as witness to a certain type of thought essential to knowledge creation.

Abbott's *Flatland*, while criticised by Hinton for not concerning itself with the physical repercussions of the fourth dimension, provides a coherent narrative in which one can see both More and Hinton as pawns (or let us say, given their rarity, rooks) within a larger interplay of conceptual abstraction. In light of what has been said, it is now possible to understand *Flatland's* narrative structure as an analogy for not only the discovery of the fourth dimension, but for thought creation altogether. Its fictional form opens it up to scrutiny of interpretation, which is a mode of reflection that is concerned with sense rather than objective truth, and one that questions interplay of words and composition as a possible form of investigation. Interpretation itself will take its place as one of the epicentre of this investigation later on, and it will allow a better comprehension of the peculiar type of

understanding that is created by the traces of past thoughts transposed into the present through text. These diverse details have already been touched upon in the exposition of the fourth dimension as geometrical entity. *Mimesis*, *Sinnbildung*, imagination, fantasy (phantasy), knowledge, thought, and the problematic usage of “seeing” as both Hinton and More use it to refer to their mind’s eye, all these terms have played a part in the decortications of a historical reading of the fourth dimension. But their connection to fiction has yet to be developed, and it would be logical at this point to look into *Flatland* itself in order to understand why throughout the exposition, it provided answers and clarifications to a historiographic narrative about the geometric fourth dimension. With its status of fictional prophecy, would it not be wiser to have it side-lined, for lack of conceptual rigor? That would be an odd way to answer the plaguing question of its recuperation in mathematical and scientific treatises. Let us not follow Descartes’ example of the “other forms” by passing into silence the potential of fiction in the process of knowledge creation. Rather than hinder or muddle the question of the epistemological charge, it shall act as a contrasting point by which to better illustrate the odd process implied in thinking the unthinkable.

By using nomenclature, Hinton visualised a tesseract. As was exposed before, he built, out of distinctions created through language, the potential for a mental experiment, by which the cube of cubes became a tool of thought. He could have taken his cube to many different mathematical debates present at the time and use it to better familiarise himself with an immediate knowledge of their peculiarities. As was mentioned before, Hinton could have focused on the self-similar aspect of his cube, and thus scooped Russell and Mandelbrot on Cantor’s paradoxes and geographical fractals. But it fell upon him to perceive, out of his linguistic construct, a pattern anew and, in order to make sense out of his newfound perception, express it in a language of geometry and colours. Even more importantly, he formulated it using the recurring argument consisting of positing a two-dimensional world inhabitant discovering the third dimension. More was also trying to oppose a perceived nonsense (the inextensible soul) through a language of directions and modes. But most striking, for the purpose of investigating literary meaning, is Hinton’s sense-creating apparatus, his story of the plane world, which he uses not only as a fictional construct, under the guise of a romance (*A Plane World, An Episode in Flatland*), but also as an introductory argument in his

mathematical treatises (*The Fourth Dimension*, *What is the Fourth Dimension?*, *A New Era of Thought*). The Analogy, from which the existence of solids is derived in *Flatland* is used by Hinton as a means to confer an initial sense of possibility to the fourth dimension. In sum, he takes for granted the fact that it is easier to picture oneself in two dimensions than to project the existence of a fourth dimension. The Analogy is similar to Cardano's and Pascal's arguments for the reduction of planes into infinite lines. By reverting to a vocabulary of two dimensions while dealing with three-dimensional figures, the vocabulary of the third dimension can be used to explain four-dimensional manifestations.

To make more sense out of this argument/fiction a careful question must be asked. This should be a question that would find answers in *Flatland's* text, since Hinton merely recopied Abbott's story into his own argument. What is the Analogy of *Flatland*, and how can it function both within the text and as the text in itself? For while Hinton lathered on his argument mystical overtones that necessitated an obsessive return to an untouched analogy, Abbott has the good sense of writing a simple tale that accepts its own religious overtones while leaving them out of the crux of the argument. Indeed, while the thought experiments of both Hinton and More have to be recreated and laboured over in order to work, Abbott writes an immediately understandable analogy that has more in common with the great thought experiments of the history of physics than with prophecies or satires. In relation to Hinton and More, his two allies in the figuration of the fourth dimension, Abbott the novelist not only experiments with fiction, but also actually puts into play concepts of a still controversial nature into application. Going back to Mach's thought experiment, it does appear that *Flatland* continues to resist a pragmatist's definition of experimentation. The same problem that was present throughout the development of the fourth dimension as a concept remains; how can the thought experiment that deals with a notion outside of experimental space be tested? Mach's allusion to Zola further highlights this problem since Zola's project, his Naturalism, functions under the hypothesis of a possible mimetic exactitude. Contrariwise, there is no immediate transition possible between Abbott's narrative and the physical world. *Flatland* will never escape the conceptual; the same way that spissitude of the soul will never be measured. This leaves us with an opened bracket in need of closing, and the possible world

theory that will be fundamental to the second act will allow us to directly address the relation between experimental space and mimesis.

So how can these musings establish a bridge between the artifice of fiction and its impact on epistemology? There are clues strewn throughout this act. The axiomatic structure of geometry proposes structure upon self-evident bases, vulnerable to reconsideration. But by what means can axioms be redrawn? Historical concepts, such as More's spissitude, are vessels in which temporal meaning can be ripped out of the concept and repurposed in other narratives; More's sincere theory of the soul becomes, with time, the first description of a fourth physical dimension, now laicised by new developments in mathematics. Does *telos* have to be chronological? Mental workouts transform taxonomy into new sensory perceptions and these perceptions are transformed again into meaning, such as Hinton's theory of altruism. In the same way, fiction lets the mind work through conceptual ganders, giving them a gleam of seeming reality. This also harks back to Rudy Rucker describing his crafting of science fiction, "with a particular set of axioms" from which he "can deduce [...] an SF world" (Byrne & Rucker, 2012). But, as Le Guin would warn, *Flatland*, my chosen "SF world" in this act, is a lie, an invention, and no amount of artifice (pseudonyms, first-person narratives) can save its status from being described as fiction. Yet it offers a thought to be experienced, and it opens up the way to reflection. It is no wonder then that scientists and mathematicians make use of it; by analogy it opens up the mind to a possibility beyond itself. Hinton's use of the same analogy in all his works shows us the rhetorical power of *Flatland*; it is purest exposition of what cannot be exposed to the senses. Which makes Le Guin's metaphorical structure of fiction spill beyond the metaphor, since meaning is stripped from intention and given to interpretation. Meanwhile, *Flatland* remains fascinating as a nexus of mathematics, literature, speculation, prophecy, physics and analogy, but new tools are necessary to conjugate it with the domains to which it has now attached itself. The actual epistemic worth of this amalgam of "armchair philosophy" and fiction will not fully enter into play until the third act, but it should be clear at this point that it offers a mode of conceptual appropriation proper to fiction as a thought experiment. While debates on the "reality" of fictionalised accounts postulate a clear gap between the fictive and the actual, *Flatland's* interaction with the fourth dimension would seem to reverse the common idea that stories are pale reflections thrice removed from

the world. Abbott, the builder of castles in the sky, weaves a story by which the fourth dimension, a concept stemming from the “real world” yet depicting a certain unreality, becomes more palpable, more relatable. *Flatland* shows that the fictive holds a stake in the real. But how can representation have an effect on what it represents?

Reading Between the Timelines

Sometimes Marvin wrote dialogues between Pavlov's Dog and Schrödinger's Cat [...]. These were usually quite short and almost like Zen stories:

DOG: I've got a million proofs that we're not free.

CAT: I've got one proof that we are.

DOG: What's that?

CAT: Who asks what's that?

*- Robert Anton Wilson
The Trick Top Hat*

Close-up on a spinning garbage bag. The camera zooms out to reveal a tire carefully balanced on an inclined plane. The garbage bag is lowering towards the tire as the previously spun rope holding it in mid-air is becoming disentangled. The bag grazes the tire, which rolls down the plane, slowly at first, and then slightly faster. The tire makes little headway before being stopped by a rolled up blanket tied to a wooden plank, balanced on a workbench, under which the tire has just rolled. On the plank, a small lead cylinder is upset by the nudge of the tire's impact on the blanket. It goes tumbling down the plank, behind the tire, bringing with its weight the entire plank swinging down. The plank misses the floor only to bump the rear of the tire, sending it forward faster. But, this time, the tire's route is blocked by a thin piece of wood standing upright and a flat wooden board leaning on its side to form a reversed cross. The tire collides with the board, which brings down the thin piece of wood. Before hitting the ground, this little beam comes into contact with a small barbell. The barbell has been placed on a large inclined panel, and passed through an aluminium can with both ends removed. The can and the barbell start slowly rolling. They meet a wooden ladder and laboriously continue their downward descent as the ladder shuffles on its feet. Tied atop the ladder is a small stick, which comes to poke a plastic bottle, set upon a table that is itself balanced on a larger board. The weight of the toppled bottle upsets the carefully calculated equilibrium of the setup, sending the table towards the bordered edge of the larger board, which goes careening towards the ground.

There is an inexplicable pleasure in watching the unfurling madness of a well-constructed Rube Goldberg machine. Named after a turn-of-century cartoonist, these contraptions embody the spectacle of the mechanical. Rube Goldberg created the idea of these peculiar chains of events through a character, Professor Lucifer Gorgonzola Butts, who employed his inventive genius in constructing incredibly complex cause-and-effect machines whose purpose was to perform simple tasks such as wiping the corner of a mouth or scratching an itch. Since Goldberg's initial drawings, his brand of machines have been included in many films, a medium that allows for their spectacle's beholding, and their presence often exists alongside the figure of the kooky inventor (Doc Brown in *Back to the Future*, Wallace in Nick Park's *Wallace and Gromit* films, etc.), a character concerned primarily with inventing for invention's sake. They also figured prominently in children's games, from the novelty gumball machines that would have the ball roll through a series of complex tubes and buckets to the 1963 board-game *Mouse Trap* that had the players of the game gradually build, from plastic pieces, a complex snare that would hopefully result in a cage falling onto their opponent's token.

As such, Rube Goldberg machines do not operate on the level of purpose. Bracketing the causal efficiency of the machine makes it lose its sense as constructed process. This section's introductory paragraph is a description of the first minute of *Der Lauf der Dinge*, translated as *The Way Things Go*, which is the longest recorded video of a Rube Goldberg machine, spanning nearly half an hour. The film, made by Swiss artists Peter Fischli and David Weiss, begins simply enough, with a spinning garbage bag somewhere in a warehouse, and ends with a bucket of liquid being poured onto what seems to be dry ice, causing ripples of a fog-like vapour to swell onto the concrete floor. The camera fades out on this rhythmic pattern and the credits roll out with no explanation of the observed sights other than the title of the film. An alternative translation of the title could be *How Things Run*, and indeed this is exactly what the spectator is treated to, the pure presentation of things linked through the exchange of one display of kinetic energy flicking the next potential force into action. Reducing the film to a simple description of initial cause and final effect creates a laughable synopsis: a garbage bag eventually causes some dry ice to react to a warmer substance and instantly convert to gas form. Instead, the machine aligns the purpose of the film with

causality itself. Cause and effect are conflated into a single unit of sense. All in all, the domino effect acts as an organising principle of clutter and necessitates no other purpose than that of offering the delight of a mechanical display exhibiting the comfort of causal consecutivity.

The Rube Goldberg machine is the clearest example of human fascination with the chronological cause-and-effect presupposition at the heart of the scientific method. While their usual make-up is composed of variations on Hero of Alexandria's simple mechanical machines (lever, pulley, wedge, winch and screw) as well as the inclined plane, any form of causally formulated and predictable reaction could theoretically be used as a building block for a Rube Goldberg machine. In *Der Lauf der Dinge*, volatile liquids are set aflame, vials are shattered through increased pressure and magnesium is ignited, illustrating that chemistry can easily be put to causal use. While biological processes could appear further removed from this possibility, one might apply the Rube Goldberg model to any system within the body that moves from one process to the next. Yet something like the digestive system might seem too far removed from the Rube Goldberg drawings, including too many different inputs to provide a clear example. In the interest of keeping this analysis clear, it is simpler to resort to the digestive-system-made-machine entitled *Cloaca*.

"Cloaca" (2000) represented a conclusion of sorts to a century of development in machines that could duplicate human activities. This vast contraption — comprising an In-Sink-Erator, a computer-controlled reactor, peristaltic pumps, an intricate electrical system and glass jars containing acids and micro-organisms — ingested and digested food with the sole purpose of generating feces. It was a brainchild of Wim Delvoye, 36, the enfant terrible of the Belgian art scene, and was realized with the help of gastroenterologists, computer scientists and engineers in an extraordinary feat of artistic collaboration. (Amy, 2002)

Delvoye justifies his enterprise as a figure for the pointlessness of "everything in modern life" (Grimes, 2002). Reducing one of the elementary processes of human life into a Rube Goldberg machine shows an aspect of the approach undertaken by the scientific method; inputs and outputs are weighted into a reconstructed narrative in the hope that predictability shall ensue. The repeatability of experiments, which is primal for the constitution of a scientific conclusion—the confirmation or refutation of a hypothesis—, is the instance of

authority permitting the experiment to inductively say something about reality. This remark in no way belittles the scientific enterprise; general biological models such as the respiratory or digestive systems constitute the basis for an elementary explanation of our bodily function. Even at higher levels of complexity, when organic chemistry replaces aggregates of organs, models break down common processes such as cellular respiration and food transformation into simple consecutive steps organised in causal chains, such as the Krebs cycle or oxidative phosphorylation.

The line drawn between the sciences and the humanities often coincides with the sanction of the causal presupposition. While the worth of including a causal direction in scientific models (often represented by unidirectional arrows ordering steps into a logic of before and after) seems relatively conventional for the sciences that are functioning according to an early modern understanding of nature—Newton’s mechanics, Descartes’ optics, Lavoisier’s stoichiometry, as well as many other ground-breaking discoveries following Bacon’s *Novum Organum*—, models still widely in use today for their explicative potential, it is an entirely different case for the sciences established upon the observation of human behaviour and cultural development. But these “human sciences” are not devoid of causal explanation. As soon as observation is organised in order to offer a be-cause, to literally constitute a cause ontologically, the human sciences follow the same causal mode that constitute the explanative potential of the natural sciences. A particularly obvious example of this process influencing human sciences at the level of basic premises is found in B. F. Skinner’s behaviourism. By entirely bracketing consciousness, and privileging input and output as an intelligible means to constitute psychological understanding, Skinner’s radical behaviourism transforms behaviour into a causal machine of action and reaction. As such, education becomes a Rube Goldberg process, and in *The Technology of Teaching*, a book with a very telling title, Skinner goes as far as claiming that given the right stimuli at the right moments, any individual (with certain genetic predispositions) can be taught to master any skill. The improvement of education is under way given that

the Law of Effect has been taken seriously; we have made sure that effects *do* occur and that they occur under conditions which are optimal for producing the changes called learning. Once

we have arranged the particular type of consequence called a reinforcement, our techniques permit us to shape the behavior of an organism almost at will. (Skinner, 1968: 10)

In a way, his view of education is a procession of small causal chains, and the teacher is in charge of orchestrating their sequence (a process he himself has learned through his own education). And if this point was not clear enough, Skinner even proposes the integration of “teaching machines” within the process, in order to replicate the human element in the learning of particularly repetitive information acquisitions, such as spelling and arithmetic.

By reducing the human mind to input and output Skinner practices a commitment to causality so radical it becomes determinism. Indeed, determinism and causality are linked and the former is constituted out of the devotion to the latter. If causality is taken to its radical extreme, as the lens through which all sense is made out of experience, then it becomes deterministic. Laplace, and what has come to be known as his daemon, represents this view clearly:

We ought then to regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow. Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently cast to submit these data to analysis—it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes. The human mind offers, in the perfection which it has been able to give to astronomy, a feeble idea of this intelligence. Its discoveries in mechanics and geometry added to that of universal gravity, have enabled it to comprehend in the same method to some other objects of its knowledge, it has succeeded in referring to general laws observed phenomena and in foreseeing those which given circumstances ought to produce. All these efforts in the search for truth tend to lead it back continually to the vast intelligence which we have just mentioned, but from which it will always remain infinitely removed.¹³ (Laplace, 1902: 4)

¹³ Nous devons donc envisager l'état présent de l'univers comme l'effet de son état antérieur et comme la cause de celui qui va suivre. Une intelligence qui, pour un instant donné, connaîtrait toutes les forces dont la nature est animée et la situation respective des êtres qui la composent, si d'ailleurs elle était assez vaste pour soumettre ces données à l'Analyse, embrasserait dans la même formule les mouvements des plus grands corps de l'univers et ceux du plus léger atome : rien ne serait incertain pour elle, et l'avenir, comme le passé, serait présent à ses yeux. L'esprit humain offre, dans la perfection qu'il a su donner à l'Astronomie, une faible esquisse de cette intelligence. Ses découvertes en Mécanique et en Géométrie, jointes à celles de la pesanteur universelle, l'ont mis à portée de comprendre dans les mêmes expressions analytiques les états passés et futurs du Système du

This “intelligence,” conscious of all possible information, both the actuality of the present and the direction of causal determination, would gain direct access to knowledge about the future. As a thought experiment (for like other “daemons” of the history of science, Laplace’s daemon is a fictional construct meant to instruct the reader of the presupposed absolute workings of the universe) Laplace’s “intelligence” underlines the necessary conclusions of a generalised deterministic causality. In a way, undertakings such as Skinner’s behaviourist model of human psychology are merely the extensions of a possible world described by Laplace. For if the knowledge of all physical entities, from atoms to celestial bodies, leads to the knowledge of the necessary future, then no room is left for an unknown variable, whether it be free will or chaotic systems, that would render the temporal unveiling of the world uncertain.

The intent here is not to discuss or debate the worth of a Laplacian daemon, physical or psychological, but rather to point to the fact that explanations stemming from observations, whether under the aegis of a natural or a human discipline, carry with them a link to the causal. The underlying notion not yet explicit but present throughout this short exposition is that knowledge theories that take the causal as a motor for discovery carry with them a strong presupposition about the relation between time and purpose. Laplace, while most eloquent on the nature of the conclusions drawn from an intelligible causality, does close the exposition of his daemon with an interesting remark; while total causal intelligibility leads to omniscience of things both past and future, humanity, in its efforts to understand the world, is both forever getting closer to Laplace’s vast intelligence and always infinitely removed from it. This asymptotic model of knowledge mirrors the monotheistic relation between the absolute and the particular (whether the absolute is God or an infinite ensemble). In a way, Laplace’s thought experiment can be used both as an exposition of causal determinism and as its strongest criticism. Indeed, this infinite distance between humanity and causal intelligibility is the vast chasm from which epistemology springs. Many historians of science interrogating the constitution of scientific knowledge through the relationship between empiricism and

monde. En appliquant la même méthode à quelques autres objets de ses connaissances, il est parvenu à ramener à des lois générales les phénomènes observés et à prévoir ceux que des circonstances données doivent faire éclore. Tout ses efforts dans la recherché de la vérité tendent à le rapprocher sans cesse de l’intelligence que nous venons de concevoir, mais dont il restera toujours infiniment éloigné (Laplace, 1886: vi-vii).

heuristics, such as Koyré, Lakatos, Kuhn or Popper, have noticed this distance, and some of their greatest epistemological insights (in that they apply to forms of knowledge beyond the disciplines of the naturalistic sciences) stem from a close scrutiny of causality. Popper, for example, underlines a distinction between “causal explanations” and a “principle of causality.”

While

causal explanation of an event means to deduce a statement which describes it, using as premises of the deduction one or more *universal laws*, together with certain singular statements, the *initial conditions* [...], the ‘principle of causality’ is the assertion that any event whatsoever *can* be causally explained—that it *can* be deductively predicted. According to the way in which one interprets the word ‘can’ in this assertion, it will be either tautological (analytic), or else an assertion about reality (synthetic). For if ‘can’ means that it is always logically possible to construct a causal explanation, then the assertion is tautological, since for any prediction whatsoever we can always find universal statements and initial conditions from which the prediction is derivable. (Whether these universal statements have been tested and corroborated in other cases is of course quite a different question.) If, however, ‘can’ is meant to signify that the world is governed by strict laws, that it is so constructed that every specific event is an instance of a universal regularity or law, then the assertion is admittedly synthetic. But in this case it is *not falsifiable* [...]. I shall, therefore, neither adopt nor reject the ‘principle of causality’; I shall be content simply to exclude it, as ‘metaphysical’, from the sphere of science. (Popper, 2008: 38-39, original emphasis)

The pivotal process by which causal explanation becomes a principle is the generalisation of its possibility. The ambiguity ascribed to the modal verb “can” by Popper is the direct extension of the generalisation of possibility. In a sense, if possibility is always possible, then it becomes certainty, making the principle of causality tautological, and rendering the observation of possibility a stepping-stone towards its own resolution. Generalising possibility in this way is the equivalent of stating axiomatic rules of systems as always applicable. For example, if it is stated that it is always possible, in traditional symbolic logic, to infer syllogistically that characteristics attributed to all elements of an ensemble are applicable to all individual elements of the ensemble—that if all humans are mortal and Socrates is human, then Socrates is mortal—the mere statement that it is possible to apply a basic rule has nothing to do with possibility. Indeed, this turn of phrase merely states that a certainty allows for the reiterating of its general rule through individual application. Thus

Popper's tautological "can" has to do with the performativity of axiomatic systems. Whereas if possibility of causality is given as an overlying rule to all observation, as a synthetic "can," then it becomes an epistemological statement about the world at its most elementary, what Popper characterises as a metaphysical statement. But possibility, in modal logics and in some of its everyday use, is an unresolved suspension of resolution, between truth and falsity. Thus the synthetic "can" becomes a "may-be." In this way, the marker of possibility (whether conditional or determined) opposes directly deterministic extremism by staying within the bounds of the excluded middle at the heart of the true-false dichotomy.

How is this short investigation on the causal related to the considerations brought forth in the first act? This necessary sidestep into the nature of a certain mode of understanding is a crossroad where two crucial lines of thought meet. The first road undertaken has as a starting point the thought experiment. The bulk of reflexions so far exposed hint towards a new understanding of this conceptual tool, as the intervention of the fictive within knowledge creation. This road crosses causality as a necessary presupposition of the scientific method, still present within the experimental aspect of the *Gedankenexperiment*. Both Mach's and Gendler's understanding of this notion state a purpose, which includes the thought experiment within a continuum existing between hypothesis and conclusion. This purpose, a causal motor within traditional understanding of knowledge creation, will be observed in light of possibility, which is also linked to the presuppositions of causality. As shall be explained, possibility is causal indeterminacy, and a logical halfway point that allows conceptual leeway to the literary thought experiment.

The second path begins with the investigation on the fourth spatial dimension. Readers familiar with the development in 20th century physics will no doubt have guessed that such an understanding of the fourth dimension goes hand-in-hand with a second, more orthodox conception of the fourth dimension as time. Indeed, Einstein and Minkowski together shook the foundations of the Newtonian absolute space and time by linking, within their theory of space-time, the two notions into an inter-related whole. But there is still much to be developed before the conceptual apparatus of this research reaches the necessary momentum to interrogate the relationship between the spatial fourth dimension and the temporal fourth dimension. First, it is important to look closely at causality's hold on fiction, which reflects a

certain conception of time that is deeply engrained in the idea of experimentation, one that is restrictive when discussing literary narratives. Since my purpose lies not in grounding a truth function within the literary, in turn subsuming it to a criterion of reality, a project that would inevitably find the same pitfalls as Swirski's—epistemic superiority of positivistic science over art, privileging literary intentions over text—there will be a necessary movement from thought experiment to possible worlds, a shift that will allow for the isolation of the properly literary element in imaginative conceptual ganders.

Both these strands will be plaited into a single line of thought through Kurt Vonnegut's novel *The Sirens of Titan*, which offers a contrast with *Flatland* in its depiction of both possibility and dimensions. By unravelling the different chronologies described in the novel's plot, a link shall be established between causality and possibility through the reader's experience with both the fourth dimension as space in *Flatland* and the fourth dimension as time in *The Sirens of Titan*. This contrast within a contrast offers an early template of the epistemological charge of the literary, a vanishing point that allows a distance from the real while simultaneously defining it.

2.1.1. The Causality of Fiction

Before looking at the representation of time described in *The Sirens of Titan*, it is necessary to establish how causality functions to convey the unfolding of time within the novel. While narration relies heavily on a certain aspect of causality, one would be greatly mistaken to think that the time by which fiction unfurls follows the same clockwork as the Rube Goldberg machine. The inner works of a story are deeply engrained within a certain conception of its language, hiding beneath presumed interactions with reality. While one can speak of aspects general to the inscription of causality in fiction, it would be a delusion of *grandeur* to hope that such a conceptual conjuncture could yield more than generalities. Yet rather than accept immediately that there is an inherent causal specificity to all individual stories, it is an especially fertile gander to start with a well-defined conception of the novel and explore how its interaction with the causal defines the potency of fiction to surpass a straightforward depiction of time's passage. An aforementioned novelist's program, Zola's *Le*

Roman expérimental, provides the perfect intellectual fodder, as it joins many strands so far discussed. As an expression of Mach's offhand mention of a novelistic extension to his *Gedankenexperiment*, Zola's project description permits a breaking away from a certain conception of the thought experiment. It also illustrates, in a very succinct manner, two different ways that the novel interacts with causality, and the omission of a third way lets Zola's presuppositions shine through. This short analysis will be crucial for most of the act; it will open up the discussion of time, the analysis of Vonnegut's novel and a primary model of knowledge dominant in both the enlightenment's *Encyclopédie* and modernity's concept of progress; a model of all knowledge as finite, knowable and additive.

As a text, Zola's *Le Roman expérimental* is an almost Oulipian exercise in word replacement. For most of his essay, Zola echoes Claude Bernard's own *Introduction à l'étude de la médecine expérimentale*, replacing the word "medicine" and "medical doctor" with "novel" and "novelist," a fact he acknowledges in his introductory remarks, describing the following text as an "adaptation" (Zola, 2006: 47) of Bernard's treatise. This seemingly innocent self-descriptive element acts as a defining marker of Zola's agenda. If thoughts pertaining to medicine as a scientific practice can be so easily applied to the novelist's task, then the act of writing exists in the same sphere as that of the medical doctor. Interestingly enough, in 19th century France, the analogous relationship established by Zola's adaptation worked on a level lost to the contemporary reader. As Bernard describes, the medical doctor of his day and age had not fully established himself within a given category of professions. As a practitioner, some ascribed his careful manipulations and meticulous incisions to artistry whereas others, such as Bernard, perceived the gradual process of perfecting a vast body of techniques and information as the establishment of an experimental science known as "medicine." Thus, Bernard is advocating for medical doctors to pursue a systematisation of their practice, working with the experimental method developed by Bacon and, by the 19th century, largely applied to domains of "pure" sciences such as physics and chemistry to accrue the body of knowledge used as a foundation for practice. Since medicine has, for the most parts, followed this path in the 20th century, it seems further-fetched now to equate the medical doctor to the novelist than it did when Zola was writing *Le Roman expérimental*. This distance between the contemporary novelist and the medical practitioner should therefore be

reduced by the admittance of historical distance between this time and ours, and when perceived thusly, Zola's technique goes beyond the usurping through wordplay of Bernard's plea for rigorous medical sciences, reaching towards an annexation of all artistic practice to that of medical practitioner and using a perceived opening executed by *Introduction à l'étude de la médecine expérimentale* to broaden and generalise a path towards the scientific ideal.

Zola's argument is that while the medical field would benefit from systemisation, this area is merely a portion of a larger human endeavours ensemble where scientific rigour must overtake individual artistry. At his time, he was theorising the novel as an experimental domain, thus pushing his naturalist model of fiction. His intentions are clear; not only to "say [clearly] what [must be understood], by the experimental novel¹⁴" (Zola, 1893: 1) but also to prove that "if the experimental method leads to the knowledge of physical life, it should also lead to the knowledge of the passionate and intellectual life¹⁵" (Zola, 1893: 2). Like Swirski and Sorensen's gradualistic metaphilosophy, Zola experimental novel attempts to extend the continuum between theoretical modelisation and fiction, demanding that the act of writing fiction be seen as a rigorous exploration of the actual world. As he says, "it is but a question of degree in the same path which runs from chemistry to physiology, then from physiology to anthropology and to sociology. The experimental novel is the [endpoint]¹⁶" (Zola, 1893: 2).

Establishing novelistic practice as experimental science necessitates the exploration of mimetic premises, specifically the relationship between observer and experimentalist, both contained within Zola's portrayal of the author, and the equation between the novel's setting and the world in which the author exists. I intend to look briefly at these premises since they provide a bridge between the thought experiment and possible worlds, especially considering that Zola's plea is for the novel as both experimentation and accurate depiction of the world. While he writes within a context that took realism to an extreme, pushing for unbridled mimeticism and frowning upon fantastic novels, a category in which *The Sirens of Titan* or *Flatland* would no doubt have fallen into, Zola's argument provides a perfect example through

¹⁴ dire clairement ce qu'il faut entendre, selon [lui], par le roman expérimental (Zola, 2006: 47).

¹⁵ si la méthode expérimentale conduit à la connaissance de la vie physique, elle doit conduire aussi à la connaissance de la vie passionnelle et intellectuelle (Zola, 2006: 48).

¹⁶ ce n'est là qu'une question de degrés dans la même voie, de la chimie à la physiologie, puis de la physiologie à l'anthropologie et à la sociologie. Le roman expérimental est au bout (Zola, 2006: 48).

which it is possible to deconstruct the different levels of causality that make up narrative time. It will be simpler, afterwards, to speak of time as it is layered in *The Sirens of Titan* and to show the complexities of the models it offers, especially as an “experiment” and a “world.”

Zola’s analogy between the medical doctor and the novelist suffers on an important point. While experimental medicine observes situations that arise outside of its laboratory, the novelist writes his own experimental space and is responsible for the accurate depiction of effects brought on by his own described causes. Zola therefore divides the novelist figure into two different functions, observer and experimentalist.

We can easily see that the novelist is equally an observer and an experimentalist. The observer in him gives the facts as he has observed them, suggests the point of departure, displays the solid [ground] on which his characters are to tread and the phenomena to develop. Then the experimentalist appears and introduces an experiment, that is to say, sets his characters going in a certain story so as to show that the succession of facts will be such as the requirements of the determinism of the phenomena under examination call for. Here it is nearly an experiment “*pour voir*,” as Claude Bernard calls it. The novelist starts out in search of a truth.¹⁷ (Zola, 1893: 8)

This very dense quote follows another description of the shift between observer and experimentalist, taken directly from Bernard’s text;

The experimentalist is a man who, in pursuance of a more or less probable, but anticipated, explanation of observed phenomena, institutes an experiment in such a way that, according to all probability, it will furnish a result which will serve to confirm the hypothesis or preconceived idea. The moment that the result of the experiment manifests itself, the experimentalist finds himself face to face with a true observation which he has called forth, and which he must ascertain, as all observation, without any preconceived idea. The experimentalist should then disappear, or rather transform himself instantly into the observer, and it is not until after he has ascertained the absolute results of the experiment, like that of an

¹⁷ Nous voyons également que le romancier est fait d’un observateur et d’un expérimentateur. L’observateur chez lui donne les faits tels qu’il les a observés, pose le point de départ, établit le terrain solide sur lequel vont marcher les personnages et se développer les phénomènes. Puis, l’expérimentateur paraît et institue l’expérience, je veux dire, fait mouvoir les personnages dans une histoire particulière, pour y montrer que la succession des faits y sera telle que l’exige le déterminisme des phénomènes mis à l’étude. C’est presque toujours ici une expérience « pour voir », comme l’appelle Claude Bernard. Le romancier part à la recherche d’une vérité (Zola, 2006, 52).

ordinary observation, that his mind comes back to reasoning, comparing and judging whether the experimental hypothesis is verified or invalidated by these same results.¹⁸ (Zola, 1893: 7-8)

The processes described by Zola, through which the identity of the novelist must oscillate between roles, seems slightly confused, especially considering that the two preceding quotes are inverted in Zola's text, due to his reliance on *Introduction à l'étude de la médecine expérimentale*'s structure. In summation, the novelist must first observe the world and accurately describe it in order to fill in the experimentation with materials and context—what I have been calling “setting” and what Zola names “solid ground.” Then, once the setting has been established, the experimentalist steps in, making the elements move through an experiment, essentially devising the plot, a storytelling element, that, for Zola's purpose, becomes the experiment. Yet once the experimentalist has provided a series of events, the observer is called up again, since these events become the results of the experiments. The perspective of the observer allows for data collection, which in turn is used to reason, compare and judge the relative worth of the hypothesis, as the experimentalist is once again given the reins of the undertaking. In a sense, the observer acts as the translator of fiction into fact, observing life in order to create fiction, and observing actions described in fiction as though they were drawn from reality. Meanwhile, the experimentalist manipulates knowledge within its own mimetic sphere, dealing with the ramifications of his fiction within fiction and the data of the real as elements of the real. By splitting the figure of the author into two different entities, Zola underlines the radical difference between analogy and mimeticism. This difference is at the heart of the debate on the status of literature as a thought experiment. Zola pre-emptively answers Sorensen's objection that literary thought experiments are “natural”—a word that, in this context, resonates strongly with “naïve” rather than “naturalist”—and thus should remain outside of true epistemic constructions. Sorensen's argument that natural thought experiments lack the intentionality of actual experiments is answered by Zola's

¹⁸ L'expérimentateur est celui qui, en vertu d'une interprétation plus ou moins probable, mais anticipée, des phénomènes observés, institue l'expérience de manière que, dans l'ordre logique des prévisions, elle fournisse un résultat qui serve de contrôle à l'hypothèse ou à l'idée préconçue... Dès le moment où le résultat de l'expérience se manifeste, l'expérimentateur se trouve en face d'une véritable observation qu'il a provoquée, et qu'il faut constater comme toute observation, sans idée préconçue. L'expérimentateur doit alors disparaître ou plutôt se transformer instantanément en observateur ; et ce n'est qu'après qu'il aura constaté les résultats de l'expérience absolument comme ceux d'une observation ordinaire, que son esprit reviendra pour raisonner, comparer, et juger si l'hypothèse expérimentale est vérifiée ou infirmée par ces mêmes résultats (Zola, 2006, 52).

method, which places the observer's mere description as the foundation for the experimentalist's intentional plot, one which evolves in order to reflect the intention of the experiment. Zola claims that the plot is devised according to "the determinism of the phenomena under examination," which clearly shows that causal determinism is not only presupposed but at the very core of the experimental novel's unfolding. In a way, Zola is the embodiment of Mach's "author of social and technological utopias" (Mach, 1976: 136) with a stronger emphasis on making utopias, which by etymological definition are non-locations (*u-topos*), into accurate descriptions of reality. Zola's experimental novel is an attempt at a form of strong mimetic potency, a method through which fiction, a facsimile like the puppet in Collodi's *Pinocchio*, could become, through rigour, a real world. Unlike Mach, who saw thought experiments as means to plot out real experiments mentally, Zola sees the experimental novelist as the crafter of experimental realities that coincide with the real through mimetic description of space and time.

Zola's project acts as a mirror image of Swirski's argument that fiction is an evolutionary characteristic of humanity by proposing to reclaim this feature as a conscious tool for experimental conjuncture. Along these lines, the experimental novel would be one of the manifestations of an evolutive practice, while the process of division between observer and experimentalist is a necessary doubling undergone by any exchange between the world and a mental picture. Swirski draws the link between "gene-coded mental structures" and Kant's "innate knowledge" categories of "quantity, quality, relation and modality" (Swirski, 2007: 84) to express the genetic make-up of literary intuitions, by including "knowledge about how to further our knowledge" (Swirski, 2007: 84) in both these essential characteristic sets. Thus Swirski's argument, while explicitly critical of Zola's *Rougon-Macquart* cycle as being "steeped in bad science" (Swirski, 2007: 109), supports Zola's theses in *Le Roman expérimental* by grounding them into a process of trial and error elemental to the construction of an empirical experience with the world. Just as the ability to see colour, explained as a survival mechanism in Darwinian thought, becomes the basis for other hypotheses on the evolutionary reasons for camouflage or Batesian mimicry, Swirski's ability to learn about the world through fiction becomes, with Zola, a process of world-creation through the writing of the novelist that then experiments and observes likely outcomes through a division of roles.

Thus Zola's place for the experimental novel within Swirski's model is as a process of determination for further evolution. But this conjunction leaves the process of knowledge creation muddled. If literature, as a manifestation of empiric hypothesis, is a means to generate further knowledge, how can the original premises, or indeed any knowledge, be saved from the suspicion of being "bad science." It is as though any hypothesis is based on another, more complex system of hypotheses. While this is a common view of science as an institution, it undermines Swirski's arguments when they address evolution as a fundamental base. Indeed, Zola's arguments, combined with Swirski's research, unearth the serious possibility of all knowledge being grounded in fiction, a possibility that Swirski specifically opposes as being postmodern.

2.1.2. The Causalities of Writing

The problem of the novel's experimental viability is directly linked to causality, or rather to a peculiar form of causality. When speaking of a novel, there are many different ways to use causal logic, depending on the angle one uses. As a novel is written, composed and read, there are different causal chains that, while not being fully independent—a strong causal presupposition would extend to include all different processes being actualised as part of a larger chain—can be isolated through their relative autonomy. While there is no question that within the standard time continuum, the novel's writing process impacts upon the possibility for it being later read, the extensions of the possibilities for the novel, seeing as they are here discussed as potential scenarios, can be divided according to different interactions. While the reader is linked to the writer, the act of reading the novel offers a relatively different causal chain than the one of writing it. The admittance of modal claims, a presupposition that will later be discussed as an explicit premise to the "possibility" of possible worlds, opens waypoints within fiction's causality.

Zola's enmeshed functions within his proposed author already point towards two forms of causalities in the writing process. The observer is caught in the internal logic of setting, while the experimentalist follows the dictates of plot. Both plot and setting are undeniably dependant upon one another so the division of observer and experimentalist found in Zola's

description of the experimental novel are tied together in his portrait of the novelist. But the process described as the experimental novel is dependant upon a temporary binary shift in the novelist's causal reality. The movement from reality to setting needs to be isolated from the movement of internal plot descriptions. In a sense, the novel's own description of actions, a description subject to flashbacks, frame narratives, and other plot devices, is, in Zola, governed by a strong chronological underpinning that presupposes that chronology of action can always be reconstructed into a "true" linear order. It is naturalism's only means of time description, corresponding figuratively to an objective clock-time. Yet in the process of writing, a process that is both responsible for plot devices and simple plot ordering, there is a second causality, one that includes both the author's pen on the page and the publication history of the text. In late 19th century Europe, serial novelisation best embodies the sometimes draconian realities of this type of causality, forcing the novel's writing process along a given timetable. Yet, as, say, Balzac was wont to do, the publication of serial novels was often revised and reworked for publication, giving the development of the fictive work its own causal history. It is this form of chronology that haunts genealogical and biographical studies of literature. In a way, the writing process allows for events to be written in any order, and indeed to be thought beforehand in another order altogether. If H. G. Wells explored the idea of time-travel in *The Chronic Argonauts* before expanding his idea in *The Time Machine*, it means that upon sitting down to write his most famous novel, he had already thought of some plot elements that would make up the middle and end of his text. As a serial novel, *The Time Machine* was published in part through its own causal logic, and as a published novel (or rather as two distinct published novels), it also had an inscription in time. The overall causality that moves fiction from idea to published book form understands the novel as an object in the world. It is enacted in Zola's description of the novelist's shift between experimentalist and observer when the observer takes a step back and hypothesises on the experimentalist's work, leading to the experimentalist's further expansion of plot. As it is part of publication history, it is also present at the very basic level of writing that allows for novels to come into being. And while it does lead to the development of the novel's actual plot causality, it follows an altogether different order of events.

Zola's need for both observer and experimentalist leads to an obviation of distinct causal distance between the world of the novel and the novel in the world. By giving the naturalist writer two distinct functions, Zola stumbles upon the constructed nature of the author as an entity. In a way, he takes an important step towards what Foucault will later describe as the author-function in "Qu'est-ce qu'un auteur?" Zola fully partakes in what Foucault calls "a complex operation that constructs a certain being of reason that we call *author*¹⁹" (Foucault, 1969b: 7). Furthermore, his entire meta-construction (meta because it potentially pertains to all authors and not a defined individual) divides creation into distinct intentional realms, making the advancement of plot dependant upon the author's alternating self, possessed by distinct roles each bringing different intentions and thus fuelling the writing process. Zola unwittingly paves the way for Foucault's assertion that "[we] try to give this being of reason [the author] a realistic status, by discerning, in the individual, a "deep" motive, a "creative" power, or a "design," the [place] in which writing originates²⁰ (Foucault, 1969b: 7).

Zola's experimental novel needs a novelist just as Bernard's experimental medicine needs a medical practitioner. It is the inevitable conclusion to the empirical theorising of the "experimental" domain; experience necessitates a posited subject that is experiencing and experimenting as the foundation for data collection. The possibility for empirical experimentation passes through the senses, so any theory of the experimental process needs a sense-figure, or a fictional individual gathering sense-data. Depending on the epistemological theory, only through sensory phenomenon can induction work its magic, transforming individual experiences into potential axioms from which to build deductively. It is exactly this movement that Zola describes in the first page of his "Notes générales sur la nature de l'œuvre" when he writes that he must

Use deductive logic especially. It is unimportant that the initial [*générateur*] fact be recognized as absolutely true; this fact will mainly be a scientific hypothesis, borrowed from medical

¹⁹ une opération complexe qui construit un certain être de raison qu'on appelle l'auteur (Foucault, 2001: 828-829).

²⁰ à cet être de raison [l'auteur], on essaie de donner un statut réaliste : ce serait, dans l'individu, une instance «profonde», un pouvoir «créateur», un «projet», le lieu originaire de l'écriture (Foucault, 2001: 829).

treatises. But once this fact is in place, once I have accepted it as an axiom, deduce the whole volume from it mathematically, and thus be of absolute truth²¹ (Bloom, 2004: 57).

What he names “le fait générateur” translated by Bloom into “initial fact” is what I would call, staying closer to the original text, the “generating fact,” or the initial cause, and it sparks the chain reaction that becomes both the plot’s causality and an inherent element of Zola’s causal writing. This necessary first step, drawn out of a scientific hypothesis is an avowed borrowing from the inductive conclusions of prior scientific experiments. That, through the expansion of logical deduction, this generating fact becomes an axiom, makes for a very clear presupposition in Zola’s method; the writing experience is a deductive exercise, grounded in axioms of induction. But Zola’s division of experimentalist and observer, developed after this initial thought into the basis of the Rougon-Macquart endeavour, muddles this initial, clear, distinction. By giving the reign of experiments likened to “medical treatises” over to the deducing author, Zola seems to ramify the internal exchange within inductive axioms and deductive truths as an on-going procedure within the novel. It serves little to entrench the idea of absolute truth within the novel, distancing writing from the pure process of deductive logic. This complicated process resembles certain observations made in the first act about the actual creation of knowledge in thought experiments, and will continue to define itself throughout the research. At this point, it is important to annex the dual nature of the experimental novelist to the relationship between induction and deduction. In a way, it has so far led to the clearest investigation into the actual epistemic claims of thought experiments. As the experiments are both created and solved through the same process of ideation, so is Zola’s experimental novelist forced into the combination of observer and experimentalist. But the separation is not so obvious that it allows a clear equation between the dichotomies of observer/experimentalist and deduction/induction. Building a setting is both deductive and inductive, drawing out general forms out of particulars, and particular forms out of the generic. The same can be said for plot. But drawing hypotheses out of this build-up, part of the observer’s responsibility, is inductive, and playing out the logical conclusions of those hypotheses through fiction is a

²¹ Avoir surtout la logique de la déduction. Il est indifférent que le fait générateur soit reconnu comme absolument vrai ; ce fait sera surtout une hypothèse scientifique, empruntée aux traites médicaux. Mais lorsque ce fait sera posé, lorsque je l’aurai accepté comme un axiome, en déduire mathématiquement tout le volume, et être alors d’une absolue vérité (Zola, 1868 : 10).

deductive practice. There is therefore something very strange going on in fiction's creation of knowledge, something that takes in both the creation of imaginary objects, may they be part of a plot-setting configuration or constructs such as Zola's author, and transforms them into hypothetical conclusions. This same problem has been noted in much of the literature on thought experiments, and it is, in a way, the horizon that the tradition has become aware of when studying the epistemic worth of armchair philosophy. It is this horizon that is motivating the shift from thought experiments to possible worlds, a shift that is feasible because of the peculiar nature of the literary object when engaged in knowledge creation.

2.1.3. The Causalities of Reading

I do not wish to fully subject Zola's text to a Foucauldian reading, but the simple conjuncture between Zola's barely hidden presuppositions and Foucault's third characteristic of the author-function works to draw out the third form of causality associated with fiction. In a way, it is the portal that leads outside the recursive nature of seeing thought experiments as the construction of experimental subjects working through their own thought experiments, something my reading of Zola is dangerously close to achieving. Instead, one can see that the admittance of the author as a construct within the analysis of fiction generates a third form of causal chain that must reconstruct fiction from beyond its writing process. For simplicity's sake, I will call this the causality of reading (adding it to the causality of writing and the causality of plot), though this ideal representation of a process will be shortly found inadequate as a distillation of the reading experience. The potential reader (and this is where claims to the modal nature of narrative worlds become most important) interacts with both previous forms of causalities. Indeed, as Nelson notes in *Causality and Narrative in French fiction from Zola to Robbe-Grillet*, "as soon as causality enters the picture, we are in the presence of a hypothesis, and the readers will wish to know, as a condition of belief, to whom the text attributes it. The reading is not complete unless the reader knows who, according to the text, is making the inference" (Nelson, 1990: 7). So the reader is partaking, through the perception of both earlier causalities, in his own reconstruction of causal frameworks. But the creation of an author by which to better frame the narrative is only a small part of this type the

causal process. Having an individual pick up the book at a library or a friend's house, at a bookstore or on the internet is the eventual extension of the causality of writing, extending out of the novel's genealogy into the present status of its existence in the world. Reading the words on the page or the screen and building a logical sequence out of the described situation re-enacts the plot's causality. In a sense, ignoring the public of the written work, and the stories that it brings to the reading experience, is Zola's greatest oversight. By making the experimental novel about the interplay between the author and himself, he merely relegated the reader to passive recipient of a didactic ideal. Like a lab report, the novel as a constituted object becomes the result of the experiment, a mere material remnant of a knowledge event known as the writing process. The experience of reading automatically registers as the intake of worldly knowledge's substrate as though the novel was fully reabsorbed within the order of the actual. But in so perceiving the exchange between writer and reader, the momentous variations born out of distinct possible readings are evacuated as though fiction was capable of unambiguous communication of facts. Zola is therefore culpable of simplifying literature by eventually reducing it to a mimetic communicational object that touches on meaning only when being written. It is somewhat ironic that he went through so much pain to dissect the relationship that the written work entertained with the world it came from, only to forego its eventual return to the world, or the way it would eventually shape it. Allowing the reader's encounter with the book to have its own causality complexifies this extremely simplistic portrait of the reading act by branching it out into all the distinct possibilities present in this imagined reader's receptive insights, a claim that is central to possible world theory. Yet it does so by adding onto the already complex relationship between observer and experimentalist.

While Zola's bracketing of the reader does seem to be a fundamental fault in his portrait of the experimental novel, one can easily come to understand this absence as thoroughly consistent with the ideas found in his theory. In fact, the reader's reception is, in a sense, radically opposed to the conception of the writing process as a science. Just as the author is constituted through a process of figuration, positing a reader outside of the direct experience of reading transforms this reader into a reader-function. The only way for a straightforward causality to exist within the reading process implies that this reader-function works according to predictable outcomes. In a way, Zola would have had to include more

figures or, more likely, transpose his experimentalist and his observer into the reading role. This movement is entirely inconsistent with the medical analogy; the patient's agency is entirely removed from the medical practice as an experimental science, relegated to the role of Zola's characters. Zola's argument cannot work if too much freedom is given to the reader; in fact, his only role is as a horizon of thought, present in such an attenuated form that even his status as motivation for the existence of the novel is unmentioned, absent, as though the novel's purpose was the novel itself, something akin to the resolution of medicine being knowledge of medicine, rather than curing patients. Even further than being *Le Roman expérimental*'s ultimate foil through the destruction of its central analogy, the reader is structurally unable to follow Zola's transformation of the novel into a causal process.

2.1.4. The Non-Causality of Reading

While the transition from author to author-function appears to be a suitable concession between direct autobiographical understanding of the novel and the liberty of freestanding connections with the text, the transformation of the reader into a reader-function poses a few problems from the onset. Who is this reader that should stand for all readers? Most modern fiction comes with a clear and explicit author-function, at least through the form of a name on the cover. Even books that are written under pseudonyms or anonymously, and stories that stem from oral traditions, carry with them socio-historical information that allow for the construction of limits that help define the characteristics of the author-function. Whether or not the author is named, the fact that, for instance, he wrote during the 15th century, in Italy, immediately casts a shadowy silhouette of the likely writer. These idealised figures are, for the reporters writing in the literary field, an endless source of chatter. Serious research has been undertaken in order to pinpoint the author of the *Voynich Manuscript*, and credence is still given to the theory that Bacon wrote the Shakespearian plays. The enigma of the writer's identity, especially when said author is still alive, seems to be sought after like the solution to a deep mystery, as though finding out that Thomas Pynchon lives in New York City could lead to a clearer understanding of *Gravity's Rainbow*. This fascination for the originating figures (whether as literary stars or as historico-contextual constellations) of the fictional

narrative can even be found within Zola's analysis of the novelist. While his purpose is to cast the novel as a sociological and psychological experiment, his novelist, who jumps from observer to experimentalist, is entirely caught up in an intentional model of creation. Experimentation, derived from *experitus*, which designates the knowledge gained from repeated trials, is the return through nominalization of a state anterior to the knowledge of experience. The experimental drive, which creates the experiment, is the intentional drive to generate a situation from which experimental knowledge may be gained. As both the experimentalist and the observer, the novelist is therefore fully engrained in a process that generates the novel, thus providing not only an intentionality to his tale, but also an initial cause and motor. This transformation of the writing process into a causal search for knowledge has no room for a reader; even as an author-function, Zola's experimentalist-observer reduces the novel to the end result of something that has already happened, namely a writing process.

One might be tempted to reuse a similar division in generating a reader-function that could somehow reconstitute the original writing process through an inverse process. But, just as the digital source code is irrecoverable from a compiled program, just as it is impossible to isolate a single track of piano from a mixed song, the writing process of an author, as transparent as it has been made with texts like *Le Roman expérimental*, ultimately remains out of reach. This can be shown by attempting to construe the reader as an observer/experimentalist figure. The reader, faced with the text, first makes an observation of the described phenomena. This observation is filled with variables that greatly fluctuate according to the reader in question, to his encyclopaedia, as would say Eco, but for the sake of the experiment, let us go on. These observations are then used as the basis for an experimentation that takes place within the mind of said reader; previous experiences are confronted to the new data, and the reader then arrives at conclusions. But, just as the reader's own observations are skewed by an innumerable quantity of previously held beliefs, this resulting experience is hardly given by the author through a transparent process of communication. Who can truly claim to read Zola in the sociological perspective that initiated his process? Relatively superficial details, such as the historic distance between the initial context of his writing and the time where his ideas are being read already imposes a gap

between the idealised intention and the reader's reconstruction of it, something that Borges' "Pierre Menard, autor del Quijote" makes clear. These observations go without saying; their history stretches back to Plato's initial complaints against *mimesis*, and they become especially explicit in the works of Russian formalists and the New Critics' thoughts on intentional fallacy. But in this case, the idea that there is always a shift between the author's original intention and the reader's interpretation serves to illustrate one of the many different factors that go against the constitution of a reader-function. Unlike the author, who immediately becomes a persistent figure associated with his works, the idealised reader cannot even be said to mirror a function of intentionality. The "model reader," as Eco calls it, is the greatest unknown variable of a fictional narrative's epistemological process. He is the ultimate *x*.

In *Lector in fabula*, Eco addresses the notion of a model reader within a communicational framework. The model reader is an author's presupposition, upon which the communicative aspect of his works is founded. As a structure, the model reader, then, is part of the author's original framework; a predicate which defines the language of the experiment. This works well within his theory of interpretive cooperation, between author and reader, since the reader and the author both function through these models to constitute a ground upon which communication is reached. The empiric author creates a model reader, whereas the empiric reader reconstructs his own model author. Eco's distinction between the empiric author and the model author offers a similar divide between what has been called the author and the author-function; one acts as a placeholder for the actual historical figure in the world, the other is the figure partaking in the understanding process of a potential reader. But, as clean as this parallel structure seems, it is fraught with radical differences that eventually break down the balance between reader and author. This is also clear for Eco, who greatly enriches his own theory by returning to his distinction between the open and the closed text:

If Carolina Invernizio [in the French translation, Eco changes Invernizio for Souvestre and Allain, and one could easily imagine Edgar Rice Burroughs taking on this role in my translation, as he fits perfectly both the language and the themes of the research], who writes for the general public, falls into the hands of one most fond of literary kitsch it becomes a great bash of transversal literature, of between-the-lines interpretation, of *cliché* appreciation, of the huysmansian taste for stammering texts. The text, as repressive and "closed" as it was,

becomes very open, a machine that generates perverse adventures.²² (Eco, 1985b: 70, my translation)

By expanding on the ways in which a reader may read a text, Eco shows that something highly didactic, written with a clear model reader in mind, can fall into the hands of a satirist, thus entirely transforming the reader reception. Likewise, texts that are deemed “open” by Eco, offer a vast quantity of interpretive paths, thus further highlighting the variable aspect of a given reading act. Doležel, who reviews an English-language anthology of the Italian critic in “Eco and His Model Reader,” problematizes the role of the Model Reader by ascribing to it many different functions:

The introduction of the concept of the Model Reader makes it possible to develop simultaneously a double interpretative strategy resulting in different (or even contradictory) interpretations. The Model Reader, manipulated by a complex text (like that of Allais) and its *apparent* structure, offers interpretations ranging from a complete refusal of understanding to forced, strictly rational explanations. The analyst, equipped with a sophisticated text theory comprising formal, semantic and pragmatic concepts, resists the manipulation and uncovers the *real* structure of the text and, consequently, its poetics of deception. In this double interpretative perspective, Eco reinforces the fundamental axiom of structural poetics (and semiotics in general), namely the necessity of distinguishing strictly between the “users” of texts (signs) and theoreticians of texts (signs). But we are no longer confined to the single perspective of the theoretician; this perspective can now be confronted with and enriched by the development of the perspective of the Model Reader who, unlike the theoretician, “cooperates” with the text spontaneously and without any suspicion. Moreover, the Model Reader is not only a theoretical assumption, but an empirical concept amenable to verification in experiments and tests involving actual readers. This fact is identical with the fictitious puppet of the contemporary “reader-oriented” criticism. (Doležel, 1980: 186-187)

Thus, the model reader cannot, like the model author, be equated to a given reader-function. For, while the author is always being read, the reader is not solely the product of a writing act. Notwithstanding the privileged access given to it by Eco and Doležel (an odd form of structuralist elitism), the unlikely position of the critic, who writes about the possible readings

²² Però basterà che il libro di Carolina Invernizio scritto per sartine torinesi fine secolo cada in mano al più forsennato degustatore di kitsch letterario, e sarà la kermesse della lettura trasversale, della interpretazione tra le linee, dell’assaporamento del *ponctif*, del gusto huysmaniano per i testi che balbettano. Il testo, da “chiuso” e repressivo che era, diventerà apertissimo, macchina per generare avventure perverse. (Eco, 1985a: 57)

of a text, constitutes a third, highly problematic figure, which has been fleetingly referred to as the reader-function. If the reader-function is to represent all possible readings, then he is both the reader imagined by the author (since the model reader, as Eco understands it, is in fact a part of the author-function), the reader that once was the critic, and any other form of reader that have or will come upon the text. Where the author is always constituted as a means to return to an initial cause for the text as written work, the reader is always an extensional arm of the causal chain—one of the many bifurcations that came after the text was already in the world. While the author-function is constituted as a result of a historico-biographical research, the reader-function seems to be entirely anticipatory.

Such a highly complex figure needs a model that allows a looser understanding of deterministic structures. The vast array that includes all readers, every readings done by these readers, and every iterations stemming from an encounter with the text, make-up such a multifaceted ensemble that no one mind short of a Laplacian daemon can truly predict its scope (and then again, the Laplacian daemon would only know those readers and readings that would eventually come in contact with the text). Perhaps the only vague form that can tentatively explain such a complex system is drawn from a type of data analysis that arose in many different fields during the second half of the 20th century: chaotic systems. I write these words warily, since the inclusion of chaos theory within the field of literary studies, namely by Hayles, Turner, (Harriet) Hawkins or Slethaug (the list of names could expand to at least 60 names) seems to have gone along with an incredibly popular fascination for the theory during the 1990s. Most likely sparked by James Gleick's classic of popular science *Chaos: Making a New Science*, this is perhaps the most recent occurrence of a mathematical theorem, or rather an amalgam of distinct models linked by a new methodology, becoming a widespread fad, reaching its epitome in Jeff Goldblum's portrayal of a chaos mathematician in the blockbuster adaptation to Crichton's *Jurassic Park*. The actual worth of works like Hayles's *Chaos and Order: Complex Dynamics in Literature and Science* or Turner's *A Blessed Rage for Order: Deconstruction, Evolution and Chaos* will not be discussed here, for the field is incredibly vast and the arguments greatly varied, and an interested reader would do better to simply turn to the Sokal-like controversy that was sparked by Matheson and Kirchhoff's "Chaos and Literature" which was answered by Braun and McCarthy in their introduction to *Disrupted*

Patterns: On Chaos and Order in the Enlightenment, or addressed in great depth in Kellert's *Borrowed Knowledge: Chaos Theory and the Challenge of Learning Across Disciplines*. In general, the debate often addresses the worth of using chaos theory as a vocabulary of literary criticism, which is then justified by either a call for a discipline-wide paradigm shift or through a perceived similitude between the theory and another form of accepted critical approach, like poststructuralism. Similarly to many of the borrowed theorems used in this research, the idea of chaotic systems is used not as a general axiomatic foundation. In this case, it is rather seen as a means to understand, through analogy, an element of the presumed causality present in the reading process, namely that of the reader-function. Indeed, one aspect in particular is of interest here, and Gleick's aforementioned book expresses it quite clearly:

Chaos and instability [...] were not the same at all. A chaotic system could be stable if its particular brand of irregularity persisted in the face of small disturbances. [...] The chaos Lorenz discovered [in weather systems], with all its unpredictability, was as stable as a marble in a bowl. You could add noise to this system, jiggle it, stir it up, interfere with its motion, and then when everything settled down, the transients dying away like echoes in a canyon, the system would return to the same peculiar pattern of irregularity as before. It was locally unpredictable, globally stable. (Gleick, 2008: 48)

The idea discussed here is that while chaos is locally expressed as a freeform movement of pure unpredictability, the general purpose of chaos systems is the containment of these moments of wild, unbridled data into larger wholes that can delimit and contain them. Therefore, the model reader and the empiric reader, as rhetorical devices, act as ways to describe the reading process, a phenomenon that seems understandable from afar. Even the idea of a reader-function seems to promise a possible shaping of the written word into meaning. But the actual events that take place within a single encounter with a book escape these models, or rather, are contained and effaced, becoming radical unknowables within the system. The differing ways in which a single reading experience may occur are themselves unpredictable. All the causal formulations of the human sciences will forever leave the singularity of such moments untouched. This could be seen as a first definition of possibility within the reading process; from afar, it can be defined by linguistics, sociology, psychoanalysis, and so many other structured and methodological approaches, but as an

experience, the reading process cannot be reduced to causality. Even the relationship between a reader and an author (empiric or model), carries this aspect, through a fractal-like contamination. As Blanchot says, “any reading where the considerations of the author seem to play such an important role, is a singling out [prise à partie] that cancels it in order to give the work its anonymous presence, its violent, impersonal affirmation. The reader is itself always profoundly anonymous, he is any reader: unique, but transparent²³” (Blanchot, 1955: 254, my translation). This *prise à partie* which is both a taking apart, a taking aside and the taking of a side, illustrates perfectly the complexity of imbricated viewpoints enmeshed in both the act of reading and the act of describing it as an experience.

In order to better discuss both the reading process and the reading experience, it is imperative to move away from a universal theory of reading. While drawing towards the question of possibility warrants the use of general, well-formulated statements that could carefully delineate the extensions of possibility within the practice of reading, a particular set of observations allows both to illustrate and to test the limits of these general statements. Most proponents responsible for the application of possible world theory to literary studies have their own general examples to draw upon, from Defoe, Hemmingway and Huysmans in Doležel’s *Heterocosmica* to Perrault and Allais in Eco’s *Lector in Fabula*. While my aim is not to develop a complete theory of reception, I do believe that what has been discovered through Zola can be greatly enriched by looking at the possible readings of a novel that puts into question the very notion of causality. Furthermore, the argument would benefit from a type of literature that describes a world in which both the idea of causal reception and that of mimetic temporal description are put into question. Such a narrative would be an ideal ground from which to interrogate previous descriptions of literary thought experiments and the presuppositions they seem to share with Zola. Finally, and in order to benefit from the ideas of the first act, the ideal narrative object would also need to address a concept analogous to Abbott’s spatial fourth dimension. For those reasons I have chosen to *The Sirens of Titan* as an integral part of the argument; it contains both a theory of time as the fourth dimension, a

²³ Toute lecture où la considération de l’écrivain semble jouer un si grand rôle, est une prise à partie qui l’annule pour rendre l’œuvre à elle-même, à sa présence anonyme, à l’affirmation violente, impersonnelle, qu’elle est. Le lecteur est lui-même toujours foncièrement anonyme, il est n’importe quel lecteur, unique, mais transparent. (Blanchot, 1955 : 254)

dimension that is both similar and radically different from its *Flatland* spatial counterpart, and an exploration of the causal presupposition, which will be instrumental in bridging the gap between literature and reality without relying on straightforward mimesis. Thus, it is this novel that shall act as the doorway into the theory of possible worlds seen as an approach to fiction that is complementary to thought experiments, since it allows fictional extensions into possible facts rather than a constant return to the dubious nature of knowledge created from a process of induction and deduction, of experimentation and observation that takes place entirely within the mind of a single, godlike, yet internally divided, author.

2.2.1. Reading *The Sirens of Titan*

The above-mentioned multitude of micro-causalities that coexist within text, and its uncertain relation to both reader and author, pre-empts the traditional approach to the novel. Thus, beginning to discuss *The Sirens of Titan* with a short historical gloss and context seems ill fitting. Indeed, one could say that the novel was published in 1959, a mere 75 years after *Flatland*, at a moment when the notion of the “fourth dimension” had already radically shifted. One could also say that as part of the strange body of work left behind by Kurt Vonnegut, it acts as the transitory novel that ushers in a new voice into the 20th century American pantheon of must-read authors. But fact is that the actual bibliographical details of the novel, while not entire devoid of interest for my concerns, are actually quite secondary to the scenes and concepts depicted within the narration. Furthermore, *The Sirens of Titan*’s status within the literary establishment is not as problematic as *Flatland*’s. It is a seldom-discussed novel, often eclipsed by *Slaughterhouse Five* or *Cat’s Cradle* in discussions about Vonnegut’s eminent earlier novels, and by other, more popular, time-travel narratives when used to probe the science fiction genre’s concern with time. In order to keep the momentum of the conclusions drawn from Zola, let us jump right into the novel’s own timeline, its causality of plot. But when details arise out of authorship concerns or historical conjuncture they will be noted and no attempt to bracket them will be made, as there is no reason to thoroughly exclude them; both possible worlds and thought experiments deal explicitly with the question of the “actual” world and literary history is a remnant that aims for the telling of the “actual” past. I will

further question the worth of the historico-biographical details included once the necessary conceptual tools are developed. But for the time being, anything found within *The Sirens of Titan* that can help elucidate the relationship between knowledge and fictional causality will be of use.

At first glance, *The Sirens of Titan*'s narrative voice seems relatively simple. The novel is written from a third person point of view that is not quite omniscient but does have a certain idea of where the story is going, a voice that would become essential in giving Vonnegut's novels their particular tone. This third person narrator tells the story of Malachi Constant who is both the 22nd century's world's richest man and someone that has not worked a day in his life. Described as "possibly the luckiest man who ever lived" (Vonnegut, 2006: 15), this character, through his ordeals, becomes radically changed, his personality is torn apart and put together back again, and after having his entire memories erased he comes to understand both the absurdity of human existence and its redeeming possibilities. This description of the plot, admittedly written to highlight how common the protagonist's endeavours are within the literary sphere, would seem to suggest a run-of-the-mill morality tale, where the character's protestant work ethic is seen as lacking and retribution is accordingly administered. But *The Sirens of Titan* is a deceiving novel. While it follows Malachi Constant through a series of incredible events, the narration is actually building itself according to a parallel logic, one associated to Winston Niles Rumfoord, another protagonist, who is central to the time setting of the novel but not to the narration. From the onset of the novel, the narrator hints at the deeper sense of the story;

Everyone now knows how to find the meaning of life within himself. But mankind wasn't always so lucky. Less than a century ago men and women did not have easy access to the puzzle boxes within them. [...] Mankind, ignorant of the truths that lie within every human being, looked outward—pushed ever outward. What mankind hoped to learn in its outward push was who was actually in charge of all creation, and what all creation was all about. Mankind flung its advance agents ever outward, ever outward. Eventually it flung them out into space, into the colorless, tasteless, weightless sea of outwardness without end. It flung them like stones. These unhappy agents found what had already been found in abundance on Earth—a nightmare of meaninglessness without end. The bounties of space, of infinite

outwardness, were three: empty heroics, low comedy, and pointless death. Outwardness lost, at last, its imagined attractions. Only inwardness remained to be explored. (Vonnegut, 2006: 1-2)

This introduction already points to the characteristics that will be found in the novel's tale: "empty heroics, low comedy, and pointless death," a foreshadowing common to the privileged view of a narrator already clued into the eventual development of the story. Furthermore, The strong emphasis on the meaninglessness of "outwardness," and its eventual discovery by humanity, given as a radical change that took place between the "now" of the story and the "now" of the narration, seems to imply that the forthcoming narration will describe a transformation in the economy of meaning. This transformation takes its root in something that becomes apparent a few pages later, as Constant is invited to meet Rumfoord. This happens, once again, through the voice of the narrator, who overtakes Constant's thoughts about punctuality with his own comments about Rumfoord's peculiar condition;

Constant smiled at that—the warning to be punctual. To be punctual meant to exist as a point, meant that as well as to arrive somewhere in time. Constant existed as a point—could not imagine what it would be like to exist in any other way. That was one of the things he was going to find out—what it was like to exist in any other way. Mrs. Rumfoord's husband existed in another way. (Vonnegut, 2006: 7)

This short passage stresses a further complexity within the causal order of the novel. Beyond the already discussed multiplicity of causality found around any form of fiction, the reader can gather that there is more than one chronotope at play within the novel's setting, generating diverging possible chronologies of plot. Even without the relative distance between the reader's own time and the time at which the novel was written, the two timelines recognized by the novel's introductory chapter imply some form of superimposed timelines. This suggests that while the novel as an object is implicated in logics of time according to its context within worldly time, there is a possible branch-off within its plot's own mechanisms.

It is also important to note the spatial analogy used to discuss time, an analogy that shall be recurrent throughout the novel's narration. It is made obvious in the overlapping definitions of "punctual," equating the point as both a state of existence and moment in time. This is further underlined by the simple yet charged expression "arrive somewhere in time" which uses the spatial "somewhere" to describe a chronological state. Vonnegut constantly

uses ambiguous language when speaking of time and space, which will be crucial in linking the idea of a spatial fourth dimension with that of time. True to his form, he even plays around with expectations by hiding certain implicit references to dimensions from the very onset of his novel. Going back to the introductory paragraph, such a word game is found in the description of space; “the bounties of space, of infinite outwardness, were three,” leading to the description of the aforementioned characteristics of the novel’s tale. The resonating association of the word “bounties,” which sounds like a bungled pronunciation of “boundaries,” might be purely coincidental, but it remains nonetheless undeniable that any description of space through ternary schemas calls to mind the dimensional model that permeates the first act. This semiological entanglement should be kept in mind, as it shall become central to my argument once *The Sirens of Titan*’s time-structure has been properly analysed.

But before following through on markers of similarity between the discourse of space and of time, let us resume the chronological situation of *The Sirens of Titan*. Foremost, there is a novel, written in the United States, in 1959, by Kurt Vonnegut. It therefore finds its first causality in its socio-political context of post-WWII America, plunged in Cold War paranoia but also within the relatively optimistic (at least when it came to the potentials of space exploration) era of the Space Race—two years after Sputnik, three years before John F. Kennedy’s famous Moon Speech. Historically speaking, it also came at the end of the Einsteinian revolution in physics, only 10 years after the Gödel Metric, a solution by Kurt Gödel to field equations in the General Theory of Relativity that allowed for a type of time-travel. The second causal reality of *The Sirens of Titan* is that of its reception within the literary and scientific institution. The surprisingly small history of reception is nonetheless enlightening when it comes to thinking about time within the novel’s offered boundaries. The final causalities are the ones that render the novel especially interesting to this research; they are the enmeshed causalities of plot that are summarily characterised by viewpoints within the novel’s timeline: the semi-omniscient narrator, the “punctual” Constant and Rumfoord, who “exists in another way.” These three different approaches to the novel, that of history, reception and story, resemble the different causalities yielded by the analysis of Zola; causality of writing, of reading and of plot. But, in a way, through their application to a tangible novel, and affected by the ultimate impossibility of pinpointing a localised theory of causal reading,

they seem to be muddled, bleeding into one another. As a structuring mean, these categories shall be followed in order to analyse *The Sirens of Titan*, but it is already apparent that an in-depth analysis of each of their implications will abate the distinction between causalities allowing for a unitary albeit enmeshed theory of time.

2.2.2. *The Sirens of Titan* as a novel telling time(s)

In order to facilitate *The Sirens of Titan* introduction within the argument, it seems easier to work backwards through the different forms of causalities so far exposed. The use of “backwards” is already significant since it only works in relation to the way things have so far been settled and in no way presupposes a primacy for one form of causal order rather than another. In fact, the idea here is to reverse the order to specifically call to attention that this research refuses the embedded framework that would have history as a universal ensemble fully encompassing potential readings and novelistic plots. While the acts of writing and publishing a novel are usually coded according to a historical viewpoint (standards of bibliographical reference, for instance, usually set aside a privileged spot for the year of publication), discussions about literature necessitate some form of plot around which they can gravitate. While there are many historical readings that garnish literary criticism, Auerbach’s *Mimesis* or Taine’s critical essays are obvious examples and Swirski’s Darwinian view of storytelling is a latter form of such an approach, efforts by the New Critics or the Poststructuralists have made it obvious that the content of a novel may eclipse its historical context when studied from a certain standpoint, or rather that history does not always have the last word when it comes to interpretation. In the first act, many elements of plot were brought to the forefront through a close reading of *Flatland*’s spatial analogy, and in certain cases, historical details or stories were linked and read through the lens of the literary, tied together by a thematic link that brought about an investigation of the spatial fourth dimension as a sort of literary thought experiment. While clearly analogical structures, upon further scrutiny, Hinton’s tesseract or More’s spissitude invariably led to a necessary contextualisation within their respective historical grounds. The discussion of the spatial fourth dimension was incapable of moving past a certain barrier because it lacked a temporal vocabulary that is, as

shall be explained, at the very core of its conceptual conception. So it found some solace in historiographical detail and a causal movement towards abstraction found in the history of mathematics.

The Sirens of Titan's plot constructs an interesting phenomenon that sheds an entirely new light on ideas of the fourth dimension and questions the role of chronological history within the process of knowledge creation. This idea, that Vonnegut christens the *chronosynclastic infundibulum*, creates a rift between Constant and Rumfoord's temporal realities. When the novel's story begins, Rumfoord has already been affected by a chrono-synclastic infundibulum, a condition that the narrator describes as "being chrono-synclastic infundibulated" (Vonnegut, 2006: 130), an expression that, for the sake of brevity, will simply be reduced to being "infundibulated." The narrator explains that

Winston Niles Rumfoord had run his private space ship right into the heart of an uncharted chrono-synclastic infundibulum two days out of Mars. Only his dog had been along. Now Winston Niles Rumfoord and his dog Kazak existed as wave phenomena—apparently pulsing in a distorted spiral with its origin in the Sun and its terminal in Betelgeuse. (Vonnegut, 2006: 7-8)

The first clue to rendering the phenomenon intelligible is drawn from the use of the expression "wave phenomena," which is taken from the domain of physics and repurposed towards literary means. Since this description of Rumfoord, and his dog Kazak, as a wave follows the above cited passage of Constant thinking of himself as punctual, a passage that hints at the fact that Rumfoord exists "in another way," it can most likely be attributed to a theoretical contrast between points and waves. But Rumfoord also embodies the atypical passage from punctual to wave-like. The transformation that he underwent as he passed through the chrono-synclastic infundibulum resists most analogies as well as attempts to root it in an analogously understandable phenomenon. Yet, there is an enduring debate in physics that has seen a notion, light, oscillate between particle and waveform. This heated argument is forged around an experiment devised by Thomas Young, a 19th century polymath who, while studying human vision, decided to observe two beams of light interacting with one another. His "double-slit experiment," as it has come to be known, was in fact first undertaken without the use of an opaque material perforated with two vertical slits. When addressing the Royal

Society of London in 1804, Young described an experiment that “may be repeated with great ease, whenever the sun shines, and without any other apparatus than is at hand to every one” (Young, 1804: 1-2). He describes his experiment as follows;

I made a small hole in a window-shutter, and covered it with a piece of thick paper, which I perforated with a fine needle. For greater convenience of observation, I placed a small looking glass without the window-shutter, in such a position as to reflect the sun’s light, in a direction nearly horizontal, upon the opposite wall, and to cause the cone of diverging light to pass over a table, on which were several little screens of card-paper. I brought into the sunbeam a slip of card, about one-thirtieth of an inch in breadth, and observed its shadow, wither on the wall, or on other cards held at different distances. Besides the fringes of colours on each side of the shadow, the shadow itself was divided by similar parallel fringes, of smaller dimensions, differing in number, according to the distance at which the shadow was observed, but leaving the middle of the shadow always white. (Young, 1804: 2)

By dividing the sunbeam in two, Young was the first to notice an interference pattern in light diffraction, thus disproving the Newtonian conception that light is made up of tiny, physical corpuscles. The data collected by Young showed light as “possessed of opposite qualities, capable of neutralising or destroying each other, and of extinguishing the light, where they happen to be united [and] that these qualities succeed each other alternately in successive concentric superficies” (Young, 1804: 12), giving it wave-like qualities similar to sound or water ripples. The pattern drawn by the light, a succession of gradually fading lines, shows that the two light sources interfere with each other, cancelling themselves out when opposing frequencies are superposed. The extrapolation of Newton’s hypothesis claimed that this divided beam should have instead produced two strong spotlights that only influence each other through their additive force, being strongest at their own centres, yet bolstering their combined intensity when overlapping. The interesting consequence of Young’s discovery was that light could be proven to at least share some characteristics with waves. Showing the conjunction between wave theory and light as an on-going process of definition, Young’s theory brought new life to early light-wave theories such as Christiaan Huygens’ treatise, who says in 1690 that “light consists in a movement of the matter which exists between us and the

luminous body²⁴” (Huygens, 1912: 3). Since waves are movements, the debate around the notion of light is therefore about whether to define it according to its makeup or its displacement, an apparent dichotomy that eventually collapsed during the 20th century. Silvanus P. Thompson, who first translated Huygens’s *Traité de la lumière* in 1912 wonders why more than two centuries had to pass before it was introduced to the English-speaking public, and his explanation describes a post-Newtonian process of acceptance that name-checks Young as a necessary step towards making Huygens a worthwhile predecessor to the modern understanding of light. As is customary when primary and near-axiomatic hypotheses are entirely redefined, Young was ridiculed by the royal society, based on his drawn analogy between light and sound, which is at least in part understandable in light of 20th century development—light and sound, while both wavelike in some respects, function in radically different ways due to their particle makeup—but this reaction nonetheless show the oft-met resistance from institutional bodies confronted with radically new models. The wavelike nature of light did eventually overtake Newton’s corpuscular theory. In *The Structure of Scientific Revolutions*, Kuhn uses this event as an example of a pre-paradigm anomaly (Kuhn, 1996: 67) that led to an eventual shift in what was then still called optics. In fact, wave properties have remained a subject of contention for 20th century quantum physics, both in relation to matter and to light. Kuhn uses this aspect to write history, establishing a continuum of narrative unity with conceptual discoveries. However, what makes the historical retelling of this experiment central to present concerns is that it illustrates the interesting implications of transforming matter into wave as a sort of “becoming-movement,” a characteristic of the chrono-synclastic infundibulum that is not entirely explicit in the novel. Thus, history acts as a guide, illuminating aspects of the novel that might or might not have been inspired by their direct counterparts.

A closer look at Rumfoord’s wave-like nature confirms his transition from localised existence into displacement. Rumfoord’s localisation is sporadic and strange from a “punctual” point of view. In a chronological sense, Rumfoord blips in and out of existence at certain coordinates, something the narrator describes as “materializations” or a becoming-matter.

²⁴ La lumière consiste dans un mouvement de la matière qui se trouve entre nous & le corps lumineux (Huygens, 1690: 3)

The reader is told that the “materializations had been happening for nine years, once every fifty-nine days” (Vonnegut, 2006: 3) in Rumfoord’s Rhode Island home and that Rumfoord “materialize[s] briefly on Mercury at fourteen-day intervals” (Vonnegut, 2006: 200). Near the end of the novel, Rumfoord as a wave phenomenon is expanded: “whenever a heavenly body intercepted their spirals, Rumfoord and his dog materialized on that body. For reasons as yet mysterious, the spirals of Rumfoord, Kazak, and Titan coincided exactly. So Rumfoord and his dog were permanently materialized on Titan” (Vonnegut, 2006: 271). Strangely, this means that at some moments of the story, Rumfoord occupies two points simultaneously, appearing in his temporary locations while remaining fully materialized on Titan. This goes against a generally held axiomatic property of matter’s relationship to time, further sketching out peculiarities of Rumfoord’s wave nature that enter in direct conflict with causal reasoning. Rumfoord’s condition is a direct affront to what Russell, in “Logical Atomism,” calls the “neat properties” of matter; “matter, traditionally, has two of those ‘neat’ properties which are the mark of a logical construction; first, that two pieces of matter cannot be at the same place at the same time; secondly, that one piece of matter cannot be in two places at the same time” (Russell, 1988: 166). There is therefore, in Rumfoord’s infundibulation, an element that is at odds with classical ideas of matter. This falls in line with the already discussed idea that his wave nature is a transformation into movement. Yet while a movement certainly explains multiple localities, there is still an element missing in order to explain the possibility of a movement causing the ontological overlap in Rumfoord’s materializations. The double-slit experiment provides, here again, an epistemological framework that allows for this strange situation. In 1909, Geoffrey Ingram Taylor, a British physician following in Young’s footsteps, decided to reproduce the double-slit experiment with one very important difference; he reduced the light source to the point where only one particle of light, one photon, passed through the slits at a time. Knowledge gathered up to that point would have predicted that since the wave-like photon would find no momentary interference with other particles, the pattern on the receptive surface would take on particle-like characteristics. In a bizarre turn of events that would usher in the era of quantum mechanics, the wave-particle was found to be subjected to an interference that, in light of the photon’s solitary confinement, could only be attributed to the photon itself. The fallout from such a discovery is that, in order for the photon to influence itself, it would need to pass through both slits *at the same time*. This was

the first time that such a blatant disregard for what Russell calls neat properties of matter was observed. While *The Sirens of Titan* was written at a time when this experiment was only performed using light, in 1961, only two years after its publication, German physicist Claus Jönsson conducted the experiment with electrons and found the result to be similar. So while photons could arguably be denied the status of matter, electrons are quite literally pieces of matter exhibiting wave-like properties and the associated double passage through the slits. *The Sirens of Titan*'s description of a man in two places at the same time due to a wavelike existence exhibits a more than coincidental overlap with the state of physics at the time it is written, a particularity associated with its existence within a historical time and therefore something that shall be discussed further in relation to Vonnegut's author-function.

While the variable scope contained in the expression "piece of matter" used by Russell could be problematized and expanded upon, Rumfoord's identity as a fictional character is well delimited by his conscious mind, which drives the novel's plot through targeted meddling. Rumfoord is a unit in the sense that More saw the body and soul as a unit; the transformation that occurs in the chrono-synclastic infundibulum has a profound effect on his materiality, but it also deeply affects his worldview. Since his physical relationship to causal existence is far from "neat," his mental comprehension of the world also leaps away from a linear and causal apprehension. While the narration offers no direct phenomenological description of Rumfoord's existence, the contrast it builds between his and Constant's connection to the world allows for comparative insight. Constant is the narration's most important protagonist in the sense that most of the novel follows his meanderings throughout the solar system. In comparison, Rumfoord's presence is relatively sparse. Constant, who shares his name with the experimentalist's standard, acts as a yardstick by which it is possible to measure Rumfoord's figurative distance from actual-world ontology. His namesake is appropriate since while his life is submitted to great changes, his link with material existence remains the same. Constant is *The Sirens of Titan*'s normative being, part of all major events as a punctual being. This aspect of the character is highlighted by the fact that from the fourth chapter to the eleventh, almost exactly half of the novel, Constant loses his memory and becomes a punctual conscience free of past and future. The struggle to remember his own story, brought about by the discovery of a letter he wrote to himself and hid in an aluminium cylinder with a screw cap,

gives Constant a semi-enthusiastic drive, but for all of the novel Constant is inexorably stuck in a punctual way of being.

Ironically, Constant changes name three times in the novel. On Mars, when he first loses his memory, he is renamed Unk. Then, upon returning to Earth, Unk is reborn as “the Space Wanderer,” an antichrist-like figure for humanity’s new religion, the Church of God the Utterly Indifferent. When the Space Wanderer lands on Earth, Rumfoord, who simultaneously reveals Unk’s original identity as Malachi Constant, ritualistically exiles him to Titan. Yet, throughout all these name changes, Constant’s relationship to existence holds. When he first meets Rumfoord, at the onset of the novel, he still has his memory, but even then it is an incomplete and lacklustre assortment of recollections. Feeling threatened by Rumfoord’s presence,

Constant ransacked his memory for past proofs of his own greatness. He ransacked his memory like a thief going through another man’s billfold. Constant found his memory stuffed with crumpled, over-exposed snapshots of all the women he had had, with preposterous credentials testifying to his ownership of even more preposterous enterprises, with testimonials that attributed to him virtues and strengths that only three billion dollars could have. [...] Constant ripped open the seams of his memory, hoping to find a secret compartment with something of value in it. There was no secret compartment—nothing of value. All that remained to Constant were the husks of his memory—unstitched flaccid flaps. (Vonnegut, 2006: 16-17)

His futile and superficial existence already places him in a position of punctuality. In a twisted form of *carpe diem*, Constant’s life of on-going festivities has already stripped his memory of any kind of united narrative, privileging the causal succession of insignificant moments. Upon losing his memory, Unk’s existence is thus only slightly altered: “life was like that, Unk told himself tentatively—blanks and glimpses, and now and then maybe that awful flash of pain for doing something wrong” (Vonnegut, 2006: 101). There is one fundamental change in Constant’s disposition throughout his travels and rechristenings but it has to do with the meaning of his punctual life rather than the way he lives it. When he becomes the Space Wanderer, Constant is brought forth on charges that he squandered the gifts that chance showered upon him. Rumfoord’s Church of God the Utterly Indifferent uses Malachi Constant as a foundational illustration of life’s inherent unfairness. At the beginning of the

novel, Constant's relationship to the world is ordered by an unwavering belief that "somebody up there likes [him]" (Vonnegut, 2006, 15), and this belief extends into the desire to actually take part in a divine plan. In fact, the reader is told that Constant's only deep-seated drive is to transform his surname, Malachi, meaning messenger, into a prophecy by finding "a single message that was sufficiently dignified and important to merit his carrying it humbly between two points. [...] What Constant had in mind, presumably, was a first-class message from God to someone equally distinguished" (Vonnegut, 2006: 12). This self-interpretation is so important to him that upon meeting Rumfoord he immediately assumes he will become the messenger he has always thought himself to be:

"it looks like the messenger is finally going to be used." "What was that?" said Rumfoord. "My name—it means *faithful messenger*," said Constant. "What's the message?" "Sorry," said Rumfoord, "I know nothing about any message." He cocked his head quizzically. "Somebody said something to you about a message?" Constant turned his palms upward. "I mean—what am I going to go to all this trouble to get to Triton for?" "Titan," Rumfoord corrected him. (Vonnegut, 2006: 30, original emphasis)

Upon losing that name, Constant enters a world of confusion and loses his faith in destiny, a detail that is not without important ramifications for my purpose. But this loss of faith comes specifically as Rumfoord is fine-tuning events around him according to a yet unfathomable grand plan. Strangely enough, it is through the impact of Rumfoord, which exists outside of causality, that Constant's causal existence takes on a purpose. Yet, under this influence, Constant's trust in divine providence is transformed in existential meaninglessness as professed by his answer to Rumfoord's interrogations of his Space Wanderer persona:

"What happened to you before you arrived back on Earth, Unk?" said Rumfoord. The Space Wanderer beamed. He had been led to a repetition of the simple statement that had caused so much laughing and dancing and singing on Cape Cod. "I was a victim of a series of accidents, as are we all," he said. (Vonnegut, 2006: 258)

This transformation in attitude does not affect how Constant lives his life, and his chronological linearity-through-punctuality steadily persists until the rest of the novel. The movement from destiny to futility is in fact a by-product of punctuality. Constant is allowed a change of mind in his interpretive outlook on life since his vantage point only shows events as

they happen. He is living a chronology governed by an unreliably memorial past, a constantly surprising present and a future open to the interpretation of either destiny or insignificance. This tripartite model corresponds perfectly with an ontological conception of temporality that is commonly found in philosophical investigations into phenomenal reality, a model that is shared by both Augustine and Heidegger, for example. While Augustine speaks of memory, direct experience and expectation, Heidegger describes a temporality that “makes possible the unity of existence, facticity, and falling” (Heidegger, 1962: 376). These divisions are the product of a struggle with the nature of time within a subjectivist temporal existence, one that is quite evident in Augustine’s transparent thought process:

Thus it is not properly said that there are three times, past, present, and future. Perhaps it might be said rightly that there are three times: a time present of things past; a time present of things present; and a time present of things future. For these three do coexist somehow in the soul, for otherwise I could not see them. The time present of things past is memory; the time present of things present is direct experience; the time present of things future is expectation. If we are allowed to speak of these things so, I see three times, and I grant that there are three. Let it still be said, then, as our misapplied custom has it: “There are three times, past, present, and future.” I shall not be troubled by it, nor argue, nor object—always provided that what is said is understood, so that neither the future nor the past is said to exist now. There are but few things about which we speak properly—and many more about which we speak improperly—though we understand one another’s meaning.²⁵ (Augustine, 1955: 165)

Augustine comes upon this discovery while trying to understand God’s eternity, and by the same logic, his own finitude. Likewise, Heidegger’s own division is defined as the structure of care, the mode by which *Dasein* enters in authentic consideration of itself, something often brought about by contemplation of death. This is a direct consequence of a subjective causal

²⁵ ecce praesens tempus, quod solum inveniebamus longum appellandum, vix ad unius diei spatium contractum est. sed discutiamus etiam ipsum, quia nec unus dies totus est praesens. nocturnis enim et diurnis horis omnibus viginti quattuor expletur, quarum prima ceteras futuras habet, novissima praeteritas, aliqua vero interiectarum ante se praeteritas, post se futuras. et ipsa una hora fugitivis particulis agitur. quidquid eius avolavit, praeteritum est, quidquid ei restat, futurum. si quid intellegitur temporis, quod in nullas iam vel minutissimas momentorum partes dividi possit, id solum est quod praesens dicitur; quod tamen ita raptim a futuro in praeteritum transvolat, ut nulla morula extendatur. nam si extenditur, dividitur in praeteritum et futurum; praesens autem nullum habet spatium. ubi est ergo tempus quod longum dicamus? an futurum? non quidem dicimus, ‘longum est,’ quia nondum est quod longum sit, sed dicimus, ‘longum erit.’ quando igitur erit? si enim et tunc adhuc futurum erit, non erit longum, quia quid sit longum nondum erit. si autem tunc erit longum, cum ex futuro quod nondum est esse iam coeperit et praesens factum erit, ut possit esse quod longum sit, iam superioribus vocibus clamat praesens tempus longum se esse non posse (Augustine, 1992).

understanding of the self. By reconstructing memories into a coherent and chronologic narrative, and through the observation of other selves that are also caught up in this understanding, the individual being is promptly projected towards his or her own linear endpoints. As shall be later expounded, this creative gesture that is at the heart of a certain commonplace understanding of time is also the link between the theological necessity for a first cause, most often attributed to God, and phenomenology's *époché*, or its bracketing of the actual question of existence. Heidegger expands Augustine's "inclination to subjectivism" (Hausheer, 1937: 503) into a program that has *Sorge*, or a form of considerate care, as the one truly authentic disposition towards being that can lead to the discovery of time's frame-like structure for phenomenal existence. Augustine, in his *Confessions* is acting out such a *Sorge*. Time in itself, which is Godly in Augustine and bracketed in Heidegger, has to be radically differentiated from temporality as observed by the temporal being, and this distinction is essential to understanding Constant's role as a counterpoint for Rumfoord's own infundibulated being. Constant's existential link to time is best characterised not by a division between the present, the past, and the future, but by the struggle, in the present moment, to make sense of a timeline that is rapidly unfolding before his own conscience. To employ Heideggerian terminology, *The Sirens of Titan's* protagonist is thrown and constantly falling (sometimes literally) into the unknown future. His wavering belief in destiny is entirely destroyed by another form of time, as well as the loss of his own memorial bearings. Forced to relearn about his own condition, he becomes stuck within Augustine's popular edict of miscomprehension; "What, then, is time? If no one asks me, I know what it is [*scio*]. If I wish to explain it to him who asks me, I do not know [*nescio*]"²⁶ (Augustine, 1955: 162).

When Constant first encounters Rumfoord, the interpretation of his own future is unshackled through his contact with another mode of being. Rumfoord knows and reveals much of Constant's following adventures to him, knowing that Constant's eventual amnesia would erase all potential influence these disclosures could have upon him. Whereas luck and anticipation were Constant's two governing paradigms of meaning, Rumfoord's clear forecasts point to an outward influence into the grand narrative of his own causal being;

²⁶ quid es ergo tempus ? si nemo ex me quaerat, scio ; si quaerenti explicare velim, nescio (Augustine, 1992).

A man who had a guardian angel would certainly have felt just as Constant had— “Yes, suh!” said the chauffeur. “Sumpin’ sure must be lookin’ out for *you!*” Then it hit Constant: *This was exactly the case*. Until that moment of truth, Constant had looked upon his Newport adventure as one more drug-induced hallucination—as one more peyolt party—vivid, novel, entertaining, and of no consequence whatsoever. [...] Malachi Constant broke into a cold sweat. His knees threatened to buckle and his eyelids came unhinged. He was finally understanding that every bit of it had been real! He had been calm in the midst of the mob because he knew he wasn’t going to die on Earth. Something was looking out for him, all right. And whatever it was, it was saving his skin for— Constant quaked as he counted on his fingers the points of interest on the itinerary Rumfoord had promised him. Mars. Then Mercury. Then Earth again. Then Titan. Since the itinerary ended on Titan, presumably that was where Malachi Constant was going to die. He was going to *die* there! What had Rumfoord been so cheerful about? (Vonnegut, 2006: 42-43)

Rumfoord’s depiction within the novel, which Constant mistakenly interprets as cheerful, never wavers from its own conception of time as a fixed landscape. At many points, Rumfoord communicates his own temporal viewpoint. Since his infundibulated observations are quite alien to the human being stuck in time, Rumfoord resorts to analogies as a means of communication. Following his first (according to a punctual chronology) encounter with Constant, Rumfoord is confronted by Beatrice, his wife, for not having warned her of an impending stock-market crash that would eventually cause her ruin. Her tone is one of distress, as she is trying to avoid fulfilling another of Rumfoord’s predictions; that she would soon be having the child of Constant, a man she had despised instantly. Her attack is warranted by a common conception of prophetic powers conveyed by time-travelling.

“Couldn’t you, this very moment,” said Beatrice, “give me stock-market tips that would enable me to gain back everything I lost and more? If you had one shred of concern for me, couldn’t you tell me exactly how Malachi Constant of Hollywood is going to try to trick me into going to Mars, so I could outwit him?” “Look,” said Rumfoord, “life for a punctual person is like a roller coaster.” He turned to shiver his hands in her face. “All kinds of things are going to happen to you! Sure,” he said, “I can see the whole roller coaster you’re on. And sure—I could give you a piece of paper that would tell you about every dip and turn, warn you about every bogeyman that was going to pop out at you in the tunnels. But that wouldn’t help you any.” “I don’t see why not,” said Beatrice. “Because you’d *still* have to take the roller-coaster ride,” said Rumfoord. “I didn’t design the roller coaster, I don’t own it, and I don’t say who rides and who doesn’t. I just know what it’s shaped like.” (Vonnegut, 2006: 54)

This account by Rumfoord opens a door to a theory of time that provides a perspective on the nature of causality that is different from the phenomenological viewpoint held by Constant, Beatrice, Augustine and indeed all *Dasein*. By being infundibulated, Rumfoord has a privileged outlook into the conditions of possibility in itself. The scope offered by infundibulation reveals the fatalist reality that time, as a whole, is fixated within an unalterable crease. While this fact resonates with the question of free will, for *The Sirens of Titan*, free will is unmistakably tied to a Laplacian causality of events that dictates even the deepest psychological urges. Nowhere does Rumfoord explicitly deny human agency, but neither does he ascribe it a time-altering potency. In his above exchange with Beatrice, Rumfoord delimits the power of individual knowledge as mere reflexivity. One can know the future, but no amount of knowledge will derail it from its already established tracks.

Constant analyses Rumfoord's state in a way similar to Beatrice:

"You—you really can see into the future?" said Constant. The skin of his face tightened, felt parched. His palms perspired. "In a punctual way of speaking—yes," said Rumfoord. "When I ran my space ship into the chrono-synclastic infundibulum, it came to me in a flash that everything that ever has been always will be, and everything that ever will be always has been." He chuckled again. "Knowing that rather takes the glamour out of fortunetelling—makes it the simplest, most obvious thing imaginable." (Vonnegut, 2006: 20-21)

Rumfoord best describes how unpunctual time becomes following his infundibulation. His "chrono-synclastic infundibulated thought" (Vonnegut, 2006: 292) that "everything that ever has been always will be, and everything that ever will be always has been," a chiasmus meant to show the permanence of moments within his own timescape, is reiterated and altered at the end of his stay within the solar system, as his wave-spiral is about to be thrown astray into other solar systems by an explosion on the sun; "everything that ever was always will be, and everything that ever will be always was" (Vonnegut, 2006: 292). The ways these two expressions meet generate a biconditional equation between "was," "has been," and "will be." There is therefore no temporal influence on events and the past remains as fixed as the future, no matter what knowledge is gleaned from infundibulated individuals. This is, of course, one of the many ways time-travel narratives have addressed the shape of time as a dimension, as a timescape, a question that inevitably arises as soon as fiction dispenses with the linearity of

time. Beatrice and Constant's natural response to Rumfoord's apparent divinating influence is in fact due to a confusion between the types of possible timescapes offered by the time-travelling thought experiment, thinking that, in a similar fashion to popular narratives such as the *Back to the Future Trilogy* or Isaac Asimov's conclusion to *The End of Eternity*, knowledge of the future can alter the past. These different timescapes will have a deep influence on some latter conclusions, but since I am mostly concerned with the different times depicted within *The Sirens of Titan* at this point, I will, for the moment, leave the possibility for other types of timescapes at that.

The Sirens of Titan makes an important use of fiction; it opens up a hypothetical space within which a thought experiment can take place. Rather than being satisfied with the nature of time as fleeting and mysterious, the novel invents an observer that can watch the time from a distant vantage point and reveals, little by little, information about this particular timescape. Rumfoord's wave-nature, already a differentiating element into the way time is experienced, becomes the hinge through which it is possible to truly speak of different times within the novel. As an individual that exists in "another way," Rumfoord maintains his human senses and vocabulary, explaining his constant use of visual metaphors and general analogies, but his phenomenological reality greatly alters his epistemological standpoint. So while he seems to be the initiator of most of the plot's actions, his own account would have him only act as a necessary puzzle piece in the general events of the solar system. He had to enter the chronosynclastic infundibulum. He needed to become the founder of the *Church of God the Utterly Indifferent*. His point of view gives the reader a momentary glimpse into depiction of time's nature only to immediately negate it through an opaque fixed state. Time's mystery is enveloped in another level of reference, making the fixed timeline unfathomable from without.

Like the author-function, Rumfoord becomes a character-function in the novel, a subtle movement that, for lack of driving a chronological plot, merely adjusts the grand flourishes of *The Sirens of Titan*'s plot arc. He reveals clues throughout, disclosing, for instance, that Constant is to have a child with Beatrice, his own wife, and that this child "will pick up a little strip of metal on Mars [...] and he will call it his 'good-luck piece'" adding to this revelation a warning by saying "Keep your eye on that good-luck piece, Mr. Constant. It's unbelievably important" (Vonnegut, 2006: 35). Such clues shape both the plot and the reading experience.

Rumfoord is a self-conscious mechanism of story, a Laplacian daemon that takes part in the world it is observing. As the novel advances, the reader, placed between Rumfoord's omniscience and Constant's amnesiac punctuality, discovers that Rumfoord's grand plan actually leads outside of his fixed timeline. As announced at the very beginning of the novel, Constant, Beatrice, their son Chrono, and Rumfoord find themselves reunited on Titan. At this point, a final character, Salo, is introduced. Salo is the member of an extra-terrestrial population of robots that call themselves the Tralfamadorians. In 483,441 B.C., Salo was chosen by his people to carry a sealed message from one edge of the Universe to the other. But "in the Earthling year 203,117 B.C., Salo was forced down in the Solar System by mechanical difficulties. [...] So [he] holed up on Titan and he sent home to Tralfamadore word of his plight. He sent the message home with the speed of light, which meant that it would take one hundred and fifty thousand Earthling years to get to Tralfamadore" (Vonnegut, 2006: 275-276). Ensued a long and slow communication process between Salo and his home planet about finding a replacement part for his ship. Tralfamadore found that the simplest way to send messages to its broken-down emissary was to influence *Homo sapiens*, a life form residing near to Salo's crash site, into building messages large enough for Salo to observe. As a means to explain the relatively short time it took to answer, the reader is introduced to a form of energy called the Universal Will to Become (UWTB) that is manipulated by the Tralfamadorians. Through "certain impulses from the Universal Will to Become [that] echo through the vaulted architecture of the Universe with about three times the speed of light" (Vonnegut, 2006: 277) the Tralfamadorians circumvented the speed limitations described by Einstein through a sort of entanglement. According to the dates related by Salo, humanity entered into the Upper Palaeolithic period, often seen as the period of behavioural modernity, due to the influence of Tralfamadorian bursts of UWTB, establishing that, within the world of *The Sirens of Titan*, all human development beyond its migration out of Africa has been the motivated by the idle *communiqués* of a far-away race of robots:

The reply was written on Earth in huge stones on a plain in what is now England. The ruins of the reply still stand, and are known as Stonehenge. The meaning of Stonehenge in Tralfamadorian, when viewed from above, is: "*Replacement part being rushed with all possible speed.*" Stonehenge wasn't the only message old Salo had received. There had been four others, all of them written on Earth. The Great Wall of China means in Tralfamadorian, when

viewed from above: “*Be patient. We haven’t forgotten about you.*” The Golden House of the Roman Emperor Nero meant: “*We are doing the best we can.*” The meaning of the Moscow Kremlin when it was first walled was: “*You will be on your way before you know it.*” The meaning of the Palace of the League of Nations in Geneva, Switzerland, is: “*Pack up your things and be ready to leave on short notice.*” (Vonnegut, 2006: 276-277, original emphasis)

Rumfoord’s fatalism is, through this revelation, given its own framework, as the infundibulated traveller is made aware of the true meaning of humanity’s existence through knowledge of the Tralfamadorian influence. When greeting Constant’s reunified family, in front of his palace on Titan that is “shining out there like St. Augustine’s City of God,” (Vonnegut, 2006: 296), Rumfoord goes to great lengths to render clearly the full extent of his knowledge about the Tralfamadorian agenda:

There is something you should know about life in the Solar System [...]. “Being chronosynclastic infundibulated, I’ve known about it all along. It is, none the less, such a sickening thing that I’ve thought about it as little as possible. The sickening thing is this: *Everything that every Earthling has ever done has been warped by creatures on a planet one-hundred-and-fifty thousand light years away. [...] They controlled us in such a way as to make us deliver a replacement part to a Tralfamadorian messenger who was grounded right here on Titan. [...]* You young man [...] you have it in your pocket. In your pocket is the culmination of all Earthling history. In your pocket is the mysterious something that every Earthling was trying so desperately, so earnestly, so gropingly, so exhaustingly to produce and deliver. (Vonnegut, 2006: 302, original emphasis)

Chrono, Constant’s son, who is named after the prefix for “time” drawn from the Greek *khronos*, has carried, from his birthplace of Mars to the moon of Saturn—incidentally Saturn was the Latin version of the Greek god Khronos—, a small piece of metal that turns out to be the replacement part for Salo’s ship. Rumfoord has therefore been working diligently to complete the Tralfamadorian dictate. As his spiral is translating away from his solar system he clarifies his own understanding of the possibility for free agency from an infundibulated point of view:

I have tried my best to do good for my native Earth while serving the irresistible wishes of Tralfamadore. Perhaps, now that the part has been delivered to the Tralfamadorian messenger, Tralfamadore will leave the Solar System alone. Perhaps Earthlings will now be free to develop and follow their own inclinations, as they have not been free to do for thousands of

year. [...] The wonder is that Earthlings have been able to make as much sense as they have [...]. In a punctual way of speaking, [...] good-by. (Vonnegut, 2006: 303-304)

This is the novel's anagnorisis, a sudden revealing moment that weaves the entire novel's plot threads into a stunning tapestry. It also greatly redefines Rumfoord's role. While, up to that point, he seemed disruptive of humanity's equilibrium, engineering a war between Mars and Earth, destroying belief in chance or destiny through his Church of God the Utterly Indifferent, this final divulgation actually restores both his goodwill towards earthlings and a possibility for another form of timescape. His fatalist inclination and his description of time as a truly fixed rollercoaster are reframed as attitudes towards the momentary (if a moment can last 55,000 years) disruptive influence of Tralfamadorian UWTB. Since Rumfoord is thrown out into the far reaches of the universe as Salo finally receives his replacement part, his timelessness cannot access information about the solar system post-Tralfamadore. But his hope is that time can perhaps take another form that would allow humans to interact with its shape.

The novel discloses limited information about the Tralfamadorian view on time. While Salo has not become unstuck in time like Rumfoord, his near-immortal lifespan does allow him a grand-scale view of his own personal historical time.

Salo was punctual—that is, he lived one moment at a time—and he liked to tell Rumfoord that he would rather see the wonderful colors at the far ends of the spectrum than either the past or the future. This was something of a weasel, since Salo had seen, living a moment at a time, far more of the past and far more of the Universe than Rumfoord had. He remembered more of what he had seen, too. (Vonnegut, 2006: 272-273)

Salo acts as a frame of reference for punctual time. Given his privileged knowledge of humanity's purpose, as well as telescopic equipment he uses to observe human civilizations, he is a perfect witness to Earth's history. Watching as civilizations rise and fall, Salo begins to build statues commemorating important historical events. He is the grand creator of historical remnants, and Titan is the ultimate museum of humanity. Salo's punctual time differs from Constant's, as it is not lived in a moment devoid of souvenirs. Instead, he builds memorials and gathers historical knowledge that goes much beyond the powers of individual human beings. But when looking at the modes through which time is lived in the novel,

Salo's memorial time, while greatly exaggerating humanity's own historical attitude, cannot be said to fundamentally contrast with Constant's, or any human being's, mode of existence. Their difference is one of scope rather than kind.

To sum up the many-angled portrait of time described by *The Sirens of Titan*, there are three radically different viewpoints of a shared timeline. Constant, Salo and the whole of humanity live a life that is "stuck in time," following a phenomenological chronology that can be described, in Heideggerian terms, as average everydayness. While Salo greatly exceeds not only the amnesiac Constant but also all humanity in recalling power, he is merely the epitome of a historical memory present in the development of human civilization and lived through the memorials of punctual events. Rumfoord, through the chrono-synclastic infundibulum, has access to a second point of view, one that lives all moments at the same time, or outside of time. His infundibulation allows a glimpse beyond the fundamental temporal limit of punctual human beings; his being "unstuck in time" gives him the ability to look at chronology from afar. The third viewpoint is a new frame revealed by the novel's conclusion. It is merely a possibility for a time liberated from fixity. It is the new limit caused by the infundibulum's transgression of average everydayness. While Rumfoord is the character-function that enacts expansion for the novel's thought experiment, the true anomaly allowing for Rumfoord's viewpoint is the chrono-synclastic infundibulum. As a plot device, the infundibulum is central to the understanding of the novel as a whole, but as an idea it ushers in a new form of temporal understanding that is itself linked to another type of fourth dimension. While it does have interesting resonances with historical details, resonances that should be discussed, it itself comments on the causal motor at the centre of historical understanding, turning the historical, personified by Salo and the UWTB, on its head. The "backwards" movement from plot to history, then, is justified by the chrono-synclastic infundibulum; it is a concept that allows the historical ensemble to be momentarily contained within a literary plot device. It is then no coincidence that all above discussions on causality and experimental knowledge have struggled with the mythical historical birth of the novel as the foundation of fictionality, through the mystical gesture of authoring, only to find a plot device born of the novel to explain an alternative to this sort of understanding. The paradoxical structure of having the presuppositions of historicity questioned through a historical notion, an apparent auto-

referential antinomy, are central to time-travel narratives. But while the novel is clearly about time, there is a way in which the odd contrast between the two subjective causalities of its protagonists creates an epistemic clash that precedes those found in the time-travel stories.

2.2.3. *The Sirens of Titan* as a novel about time

The spectre of the historical, which had been temporarily repelled, is much more consistent around the act of reading. Rather than looking at the causality of the novel as enacted by Eco's model reader, an abstracted idea of how the novel should be read and something Doležel shows to be a "rhetorical figure for describing *texts as traps*, i.e., for distinguishing between what the text appears (or "pretends") to be and what it actually is" (Doležel, 1980: 186), it seems simpler to actually look at the content of criticism written about time in *The Sirens of Titan*. In a way that is similar to my treatment of *Flatland*, this research, grounded in the different temporal discourses pertaining to the novel, treats possibility as an open-ended field that may be filled by any form of interpretive gesture. There is therefore no reason to distinguish between the pretensions of a text and its true intentions. All literary criticism is a highly detailed physical remnant of a reader's interaction with a piece of writing. While the question of how a novel can be read has direct repercussions on the question of possible worlds, these questions lead away from the peculiar details of time within *The Sirens of Titan*. The task of loosening the complicated knot of temporality in Vonnegut's novel would not be served by exploring the entire breadth of possible reads it offers. In any case, the question of possibility has not yet been fully expounded, and the notion of "possible worlds" to which I have alluded will both serve and further the idea of potential readings. Yet, while a reader-function that would contain a definite causality of all readings is structurally impossible, *The Sirens of Titan* is still caught within its institutional causality of reading; a small body of commentaries left behind by critics. Perhaps due to the fact that it was originally published as a Dell paperback, marketed as a novel of sexy science fiction (the sirens being far more prominent on the cover than they are in the story), and vindicated through Vonnegut's following onslaught of far more popular novels, *The Sirens of Titan* has been left with very little commentaries of note. Due to its ambiguous place within the Vonnegut *œuvre*, neither

fully out of his pulp phase, nor fully embraced as one of his mature satires, critics often choose to either discuss the novel as a small fundamental stepping-stone in Vonnegut's development as a writer, or as a work central to the acceptance of science fiction as credible literature, two distinct yet obvious historical reconstructions. Seeing as I am neither concerned with Vonnegut's tone (his humour, for instance, has spawned many of the statements made about *The Sirens of Titan*), nor aiming at an exoneration of science fiction that has, in many ways, already come to pass since 1959, many of the critical pieces specifically about the novel will be dismissed for the sake of concision. There are, though, three key articles that deal specifically with temporality; "'Nothing's Ever Final': Vonnegut's Concept of Time" by Philip M. Rubens, "Changing the Old Guard: Time Travel and Literary Technique in the Work of Kurt Vonnegut" by Daniel Cordle and "Unstuck in Time: Simultaneity as a Foundation for Vonnegut's Chrono-Synclastic Infundibula and other Nonlinear Time Structures" by Sharon Sieber. These particular examples are also about the notion of time, a notion that, while being central to the novel, has not been given a treatment deserving of its representational complexity. These articles' main points will be furthered with some minor comments from other, more general, writings about Vonnegut, but it is their peculiar reading strategies that shall act as the data points to explore the chaotic ensemble of *The Sirens of Titan's* possible readings. Again, these offer punctual causal reconstructions amidst an ultimately non-causal ensemble. They are also, as written readings, subject to the warnings made about the author-function; their conclusions are themselves ordered around three author-functions used as textual strategies to begin discussing reception as an element in the process of literary knowledge.

Rubens's "'Nothing's Ever Final': Vonnegut's Concept of Time" is a straightforward attempt at finding an already existing concept, Bergson's notion of inner duration, in Vonnegut's fiction. His thesis is that, "Vonnegut works quite seriously with Bergson's theories in both *The Sirens of Titan* and *Slaughterhouse-Five*. In the former, he creates a symbol, the chrono-synclastic infundibulum, to express his view of time; in the latter, he reforms this symbol and produces an actual embodiment of Bergson's theories and a new optimistic perspective on history" (Rubens, 1979: 65). Rubens's text begins with an illustration of Bergson's views on time, and then moves on to show that Vonnegut offers a

similar treatment of time, first in *The Sirens of Titan* and then in *Slaughterhouse-Five*. As an example of an author reading Vonnegut, the article shows a tendency that is commonplace in literary criticism; it understands the novelistic practice as an illustration of the author's own struggle with a conceptual notion, and the development of the story as an expression of both the struggle and its resolution. Rubens's strategy, resorting to Bergson to understand statements made by Vonnegut, is not without merit, and his equation does lead to some interesting thoughts on Vonnegutian time. For instance, Rubens quotes a 1970 *The New York Times* interview entitled "To Vonnegut, the Hero is the Man Who Refuses to Kill" in which Vonnegut claims that "nothing in this world is ever final—no one ever ends—we keep on bouncing back and forth in time, we go on and on ad infinitum" (Bosworth & Vonnegut, 1970: sec. D, 5). He uses such statements to show that Vonnegut's novels carry a philosophy that originates within the author. As has been discussed, such assertions carry the burden of intention, which has been lessened by the recourse to the author-function. In Rubens, the Vonnegut author-function becomes rationale through a search for alternate types of temporal narratives, which take form in *The Sirens of Titan* and *Slaughterhouse-Five*.

Rubens's summary description of Bergson's inner duration does shed light on some of Vonnegut's plot elements. Rubens is mostly concerned with Bergsonian simultaneousness as is shown by the statements he chooses as representative of his theory.

Bergson hypothesizes that it is possible for a consciousness to grasp multiple events widely separated in space in a single instantaneous perception. [...] There is, according to Bergson, a tendency to put the contents of this experience into a space of four dimensions where they remain superimposed for all eternity. These stored images are purely mental views that establish the boundaries of conscious duration with stops which allow them to become manifest in the conscious mind. Man is always prepared to resume the links back through conscious duration to an inner duration, a mental, an interior world of palpitating movement. (Rubens, 1979: 64-65)

Since much has already been said about *The Sirens of Titan*, one will notice immediately that this description resembles certain ideas found within its pages. It is obviously closest to what has been described as Rumfoord's timescape, or the infundibulated consciousness. This is also what Rubens is attempting to show. "Vonnegut graphically illustrates the dichotomy

between punctual time and his theory in the character of Winston Niles Rumfoord, a man who is chrono-synclastic infundibulated and hence has a view of time similar to Vonnegut's" (Rubens, 1979: 66). Yet Rubens goes a step further by actually making Rumfoord a figurative proxy of Vonnegut's own view of time. While Vonnegut has certainly made statements that hint at his own view of a fixed time, it seems that making Vonnegut into an infundibulated being through his own convictions is either a hyperbole or a statement made with regards to a function of writing that is not fully exposed. It is as though Rubens is transforming Vonnegut into Zola's experimental author. Vonnegut would then be experimenting with his own observations through fictional extensions. Since *The Sirens of Titan* is far from being a naturalist novel, one would have to argue that his experimentations are made solely within the world of time, with a selective disregard for the physical and human universe. Much of Rubens's argument follows along these lines, thus justifying his decision to make *Slaughterhouse-Five* an extension of *The Sirens of Titan*, a second experiment in the same laboratory. Rubens's reading distances itself from the non-causality of reading, preferring to focus on authorial intention and experimental writing. Through his own reading, which is obfuscated, Rubens prefers to recreate his own story about the causality of Vonnegut's writing, with an authorial search as its source and two subsequent novels as results:

As Vonnegut began his literary task, his pilgrimage back to the apocalyptic destruction of Dresden, he pursued many avenues of time theory. To make his vision complete, Vonnegut had somehow to escape the shackles of linear time, linear history, a feat he accomplishes by creating the chrono-synclastic infundibulum of *The Sirens of Titan*. This phenomenon allows man to see time in close to Bergson's terms. It is not until *Slaughterhouse-Five*, however, that Vonnegut learns how to reform this device to coincide with his personal theories of time. (Rubens, 1979: 70)

His argument focuses on more than what has been repeated here—Dresden's influence on Vonnegut, fate, optimism—but most of his points are relegated to building blocks in the grand narrative of Vonnegut's desire to express his belief in inner duration. Rubens's reading is entirely directed towards the construction of Vonnegut as an author-function.

By deriving this function through Bergson's equations, Vonnegut's intentionality gradually takes on the guise of Bergson's own. At this point, Rubens stops distinguishing

between Vonnegut's view of time and Bergson's inner duration. "From his position inside this phenomenon, Rumfoord can view all of time, all of history simultaneously; he can see that nothing, in Bergson's and Vonnegut's words, is final in time (Rubens, 1979: 66). Vonnegut and Bergson gradually come to share the same theory until statements can be attributed to both of them, as though spoken from the same mouth. This equation carries some dangers as far as literary details go. If elements of the two authors' written works differ from one another, an effort has to be made to bend their diverging course towards one another. In the previous quote, there is a definite effort to transform Rumfoord into an all-knowing being outside of individuality, whereas the novel is clear on the fact that while Rumfoord is unstuck in time, his own knowledge is limited by a definite spiral that can be physically located. In the end, explosions on the sun throw the spiral's course out of the solar system, and Rumfoord is noticeably unable to share knowledge about this solar system's history following his, and Tralfamadore's, departure. While it could be argued that Bergson's theory of inner duration, which is deeply established within his concept of memory, would indeed follow Vonnegut's own depiction more closely than Rubens's retelling of it, such slight discrepancies let the causality of reading appear. I am analysing Rubens's article as he is reading Bergson and Vonnegut, except that our statements are organised according to differing designs. Taking this into account, and making the reading process transparent is my answer to Rubens's form of literary criticism.

Rubens reads Rumfoord's departing speech as he is blasted out of his own solar system as a confirmation that "no event, then, is unique and occurs once and for all; the same individuals have appeared, appear, and will reappear with each and every return of the cycle upon itself" (Rubens, 1979: 66). This somewhat Nietzschean cyclical time, Rubens's understanding of Vonnegut and Bergson's temporal theories, leads to Rumfoord's desire to know the contents of Salo's message. This is shown by Rubens to be a fundamental desire for meaning that Vonnegut does not fully satiate in *The Sirens of Titan*, leaving the open-ended idea of Earth without Tralfamadorian influence as a question mark only answered in *Slaughterhouse-Five*. This seems to make *The Sirens of Titan* an incomplete novel that acts as a necessary stepping-stone to Vonnegut's epiphany. It is the necessary by-product of developing an author-function without being fully aware that it acts as a prism for the novel,

both magnifying and distorting it in its shape. The focus on Vonnegut's notion of time, rather than the notion of time as it is found in *The Sirens of Titan*, privileges the author's individual biography and bibliography and the succession of his written works. Rubens is working against his own notion of inward time, privileging a chronological reading of Vonnegut's *œuvre*, and thereby describing and rewriting Vonnegut's own struggle with time as the unidirectional dynamism of his life. It can be concluded then that Rubens argues for a reconciliation of Vonnegut and Bergson without including his own reading practice as partaking in a similar temporal process.

Cordle, in "Changing of the Old Guard: Time Travel and Literary Technique in the Work of Kurt Vonnegut" takes Rubens's author-function further, using all of Vonnegut's written works as manifestations that may contain elements defining his view on time. Yet, he avoids making the chronology of Vonnegut's bibliography a logical path that must be travelled in the direction of causality. Details from different novels spark up in his article, selectively chosen to further his own argument. The choice to address Cordle in this section is particular since most of his text does not deal directly with *The Sirens of Titan*. In fact, the novel only comes up by name near the end of his article. Yet he uses it as a means to reinforce a strong reading of the Vonnegut author-function that is defined in terms similar to the argument so far outlined. While his fleshed out argument takes the form of a comparative study between Vonnegut's *Galapagos* and Stephen Jay Gould's *Wonderful Life: The Burgess Shale and the Nature of History*, Cordle works with two principal presuppositions. His main thesis is the rejection of "the idea that teleological development—a beginning, a middle, and an end—is anything more than an illusion in either stories or life" (Cordle, 2000: 166), something that has so far been put into question through the tensions found in superimposed novelistic chronologies. To this first insight, Cordle also adds a second idea that acts as the justifying axis of his comparative method. He declares that "the reading of popular scientific texts is itself essentially similar to the reading of literary texts, and will thus constitute an argument for an appreciation of science writing as a genre of equivalent literary status to those already recognized" (Cordle, 2000: 168). This has also been a point of importance for my own argument from the very onset of the first act, and it makes Cordle's method resonate strongly with what is here being undertaken. Furthermore, his argument deals with the theory

of evolution, which has already been addressed in relation to the viability of the equation between literature and thought experiments, most specifically in Swirski.

Since I am concerned here with the specifics of *The Sirens of Titan*'s reading experience, I will avoid elements of Cordle's argument that deal with the details of either *Galapagos* or *Wonderful Life*. Yet many of his statements made about the similarities between the two books apply to the relationship between *telos* and meaning, daring to wonder if it is possible for meaning to arise outside of teleological development and, I would argue, for meaninglessness at the heart of *telos*. Cordle's argument is simple, due to the fact that *Galapagos* deals specifically with the question of evolution, which is also Gould's prerogative. As such, he can easily distinguish moments in *Galapagos* and *Wonderful Life* where evolution is described similarly; as going against what Gould describes as

the iconic images of evolution [...] [for example] the sequence of figures, running left to right across the page, each standing more erect than that preceding it [...]. Encapsulated in this familiar image is the idea of goal-orientated progress. It suggests, implicitly, that evolution is driven by long-term goals—the move from ape to human is smoothly progressive—and it implies that humans are the *telos* of evolution. (Cordle, 2000: 169)

Cordle uses a statement in Vonnegut's *Breakfast of Champions*, to equate such a directional representation to that of "old-fashioned story tellers," which prefer to spin their tales according to chronological development, thus strengthening the link between progress and meaning.

The association between narrative development and meaning ('lessons to be learned') is apposite, for the hackneyed demand that stories have a beginning, middle, and an end is surely founded on the assumption that it is in a traditional sequencing of events that meaning resides: beginning must develop into a recognizably distinct middle, and the end must modify and resolve the issues raised in the middle. When beginning, middle, and end are strung together in one story, a causal and teleological development is implied, and the identification of the cause driving events is what gives meaning to the story. (Cordle, 2000: 166)

This statement comes closest to a theory of reading, showing that traditional (or old-fashioned) ideals of both writing and reception confuse the idea of chronology (a logic of time) and teleology (a logic of the end). According to this mode of understanding, plot causality leads invariably to an end that justifies the path of the story. This is a transposition of the

phenomenological understanding of personal chronology into the realm of the fictional. It makes Heidegger's being-towards-the-end (*Sein zum Ende*) into a functional mode of storytelling yet it fails to make the Heideggerian distinction between the end as stopping, getting finished or disappearing (Heidegger, 1962: 289). While all three can be said to be the major causes of the reading experience's end, it is as though, for traditional storytelling, the only acceptable ending to a story is "getting finished" through fulfilling a goal. This point of view is best represented by Zola, who saw the novel as an experimental means to discovering more about the social realities of humanity, and it carries through to Gendler's third feature of thought experiments, which states that "contemplation of the scenario takes place with a specific purpose: the confirmation or disconfirmation of some hypothesis or theory" (Gendler, 2004: 1155). While this had been seen as a carry-over from the scientific method into the realm of thought experiments, Cordle wishes to expand his criticism of this progressive understanding into the realm of scientific theories *when they are being read*. He uses the fact that "both [his chosen] writers, then display discomfort at the idea of a simple, progressive chronology, suggesting that it panders to our desire to find meaning in our lives and is a powerful form of self-deception" (Cordle, 2000: 170). Progressive chronology, or the confusion between time and *telos*, acts as the self-deceptive ideal of meaning, making ontic epistemological claims for the novel wherefore it is actually only offering the illusion of sense. Cordle sees in the Vonnegut author-function a force that manifests itself in the "the disruption of narrative development" which he associates to the "disruption to the meaning (or indeed lack of meaning) he ascribes to humanity" (Cordle, 2000: 167).

In his short mention of *The Sirens of Titan*, Cordle relates the very last episode of the novel, in which Salo hypnotises Constant into seeing his friend appear as he is slowly dying of hypothermia. This event is, to Cordle, an example of localised kindness in the face of generalised meaninglessness. But it seems that, as this is happening, a quick exchange between Salo and Constant is even more significant. "'Good luck,'" whispered Salo. "We don't say that down here," whispered Constant. Salo winked. "I'm not *from* down here," he whispered" (Vonnegut, 2006: 324, original emphasis). While Rumfoord has been working to negate the conviction that some sort of providence is possible, being entirely set in a timescape where events are fixed according to Tralfamadorian design, Salo offers an outside possibility

for some other form of chronology where luck is reinstated. This repudiation of meaning (the Tralfamadorian communications imposed by the UWTB) has the irony of being uttered to Constant as he is dying on a park bench. It is as though Salo, the most perfect representation of Tralfamadorian knowledge, is himself stuck in the overlying absurdity of a universe without an ultimate meaning. It is unclear if this position is taken as a result of his having observed humanity develop merely as Tralfamadore's personal mouthpiece or if this conviction is shared by all of his home planet. The most likely explanation is that Salo's worldview is reconfigured according to this unveiled message. For after Rumfoord has left the universe, Salo reveals the contents of his message, the passage of which has been dictating the direction of human evolution.

“Would you like to know how I have been used, how my life has been wasted?” he said.
“Would you like to know what the message is that I have been carrying for almost half a million Earthling years—the message I am supposed to carry for eighteen million more years?”
He held out the square of aluminium in a cupped foot. “A dot,” he said. “A single dot,” he said.
“The meaning of a dot in Tralfamadorian,” said Old Salo, “is—*Greetings*.” The little machine from Tralfamadore, having delivered this message to himself, to Constant, to Beatrice, and to Chrono over a distance of one hundred and fifty thousand light years, bounded abruptly out of the courtyard and onto the beach outside. He killed himself out there. He took himself apart and threw his parts in all directions.” (Vonnegut, 2006: 306-307)

This ultimate act of despair, as well as his internalisation of humanity's futility shows a radical change in the generally optimistic little robot's attitude. Of course, being a machine, his suicide is made temporary by Constant, who spends the rest of his time on Titan putting Salo back together again. Salo, who acts as the novel's sole representative of something “not from here,” seems in a privileged position to disclose outward meaning to the inhabitants of Earth. Yet, his message is, in all but form, pointless. The ending of the novel underlines its opening sentence; “everyone now knows how to find the meaning of life within himself,” replacing a regime of meaning described through the narrator's own framing point of view and taking place at a time where “mankind, ignorant of the truths that lie within every human being, looked outward—pushed ever outward. What mankind hoped to learn in its outward push was who was actually in charge of all creation, and what all creation was all about” (Vonnegut,

2006: 1). This ultimate repudiation of outwardness warrants a move toward privileging personal reading experience over all-encompassing textual meaning.

Ultimately, the Vonnegut author-function, as it manifests itself in *The Sirens of Titan*, does not seem to advocate total meaninglessness. This is not lost on Cordle, who carefully mentions that “it is not being suggested that all development over time is seen as meaningless by these writers; rather, that they ask us to reconsider the different sorts of meanings that are associated with change over time” (Cordle, 2000: 170). In this sentence, Cordle distils the essence of *The Sirens of Titan*’s causality of plot through a localised causal reading. As a meaningful object, the novel deals specifically with meaning, thus turning upon its own interpretation. It cannot be understood entirely outside of time or meaning, but it is not dictating a particular order of sense. This makes reading *The Sirens of Titan* for a form a progressive meaning a somewhat confusing experience because it never fully reveals its own message while questioning both chronology and teleology. Rubens, who tries to establish this form of meaning through the notion of inner duration is forced to bend some aspects of the novel’s plot to make them fit into his own model: Rumfoord as the ultimate frame of reference for what he believes to be Vonnegutian time. On the other hand, Cordle’s approach, while establishing a theory of meaning according to the junction between two different author-functions, goes much further to explain *The Sirens of Titan*’s actual reading experience by shifting the question of meaning away from the text. It allows for the cohabitation of different causalities of plot and reading. Cordle does comment on the meaning of his own reading experience, but his conclusion carefully avoids fixing a particular interpretation, preferring to comment on open-endedness. Additionally, since he is commenting on a book of popular science as well, he can extend his conclusions to life in general;

Both [Vonnegut] and Gould suggest that, rather than moving towards an ‘end’, human lives just move. An end implies the resolution, whether comic or tragic, of the issues raised by a story. It is this closure that Vonnegut’s defiance of traditional narrative forms and Gould’s rejection of a popular version of the story of evolution resist. Both writers, though working in very different genres and for different reasons, are united by their perception that time, and change over time, are meaningful, but also potentially deceptive. They are acutely aware of how meanings are constructed by the temporal perspective from which events are seen, and this is an insight

which is instructive whether we use the narratives of fiction or of science to help make sense of our lives. (Cordle, 2000: 176)

Cordle ultimately speaks of the way narrativity has an impact on the epistemological relationship to the actual world. His thoughts take this investigation closer to some type of resolution than it has been so far. Yet, to do so, he has to do away with a fundamental aspect of the scientific method and thought experiments; the hypothesis as a causal motor that finds its meaning through conclusive evidence. How can literature continue to function epistemologically while refusing the directionality of experimental knowledge? Since literature has been shown to work as a thought experiment, there must be a looser form that will allow the experimentation of Zola, Swirski, Le Guin and Sorensen without imposing unilateral meaning onto the text.

In “Unstuck in Time: Simultaneity as a Foundation for Vonnegut’s Chrono-Synclastic Infundibula and other Nonlinear Time Structures,” Sieber attempts to develop a free-associative conceptual framework to describe the relationship between nonlinear time structures and textual readings. She argues that the Chrono-Synclastic Infundibula is “an aspect of simultaneity, [...] a mode of being similar to the *aleph* in Jorge Luis Borges’s short story of the same name” (Sieber, 2000: 147). This statement, contained within the very first sentence of the article, sets the tone for her entire exposition; in the space of six pages she moves from reference to reference in an intertextual proliferation meant, perhaps, to encapsulate the difficult task of reading in a synchronous fashion. In a very dense passage she seems to reveal her own theory of reading.

The symbolic importance of mirrors as they relate to literature and to reality lies not only in their ability to reflect, then, but also in their ability to fragment or interrupt the continuous flow of sequential reality so as to impose a self-conscious perception (or self-reflexive reality) that places the viewer outside of time, or in Borgesian terms, to introduce the paradox of a concept like eternity within a temporal context. Readers are likewise outside of time as they read the text, which in Paz’s terms is another mirror. (Sieber, 2000: 148)

By using Octavio Paz and Borges to clarify her ideas, she equates the text to a mirror, which is used to break with the causal understanding of both literature and reality through a self-reflexive moment imbued in the reader. This promising moment in her article is sadly left

wanting of exposition as she quickly moves on to other resonating structures without fully showing how, in *The Sirens of Titan*, such a break is operated. What is clearly implied is that the self-conscious perception that is developed by placing the viewer outside of time is a sentiment akin to the confusion shown through the analysis of the many differing temporal logics within *The Sirens of Titan*. In fact, the preceding sections constantly revert back to this self-conscious perception, but bracket its implications through the division of plot and reading. While reflexive poetics would reduce Rumfoord and Constant's differing timescapes to a reading act, one for which I am fully responsible, the paradox described by Sieber, joining eternity to the temporal context, forces any form of plot description to go beyond the mere individual reading. Within the interruption caused by reading the text, there is a sentiment of universality necessary to the impression of understanding. Writing about such an experience reverts this momentary break to a causal logic attached to the act of reading. There is therefore a very real link between what has been called the causality of plot and that of reading, for any form of deciphering, whether it is Rubens's Bergsonian account, Cordle's inquiry into meaning or even my own exposition of the competing time structures described by the different characters in the novel, is bound to be reduced to yet one more interpretive account of an experience with the text. The paradox that Sieber attributes to Borges is best exposed in Kierkegaard's idea of faith. When he looks at the relationship between God and Abraham in *Frygt of bæven*, Kierkegaard comes upon the problem of the individual's *telos* towards the universal. "For faith is just this paradox, that the single individual is higher than the universal, though in such a way, be it noted, that the movement is repeated—that having been in the universal, the single individual now sets himself apart as the particular above the universal²⁷" (Kierkegaard, 2001: 84). Kierkegaard's proto-existentialist notion here is that there are cases in which the individual must impose its own *telos* as a universal dictate against the general *telos* of becoming universal, specifically because the individual is obliged to exist as a particular. In the case of reading, the universal takes the guise of sense, with particular readings aiming and describing understanding as universal sense. Doležel, in *Mimesis and Possible Worlds*, shows that this structure is analogous to the practice of mimetic readings,

²⁷ Troen er nemlig dette Paradox, at den Enkelte er høiere end det Almene, dog vel at mærke saaledes, at Bevægelsen gjentager sig, at han altsaa, efterat have været i det Almene, nu som den Enkelte isolerer sig som høiere end det Almene (Kierkegaard, 1895 : 62).

whereby “fictional *particulars* are claimed to represent actual *universals*—psychological types, social groups, existential or historical conditions” (Doležel, 1988: 477). The unspecified reader-function, which holds any form of reading, is an attempt at reaching the heart, the universal sense of the text through the transformation of story elements into allegorical manifestations of an underlying process. Doležel even points to the already unearthed tendency to make the author-function into an “actual source” of meaning, something he calls *pseudomimesis*. This is a particularly obvious product of this desire for true meaning as the posited locus of sense. But eventually, any form of sense-building done from a text is bound to enter into a dialogue with other forms of meaning, just as any calculus can then be subjected to a large formula that contains it. This is why the distinction between causality of plot and causality of reading cannot be entirely established; both intersect on the grounds that all sense-attribution to plot issues from reading. Yet, as for Kierkegaardian faith, any form of literary criticism that prefers to speak of plot elements found within the novel has to make the leap away from a discussion on personal fallibility and away from the subjective/objective dichotomy. Otherwise, the reader would be condemned to constantly conclude with his own ineptitude at reaching a universal meaning.

Sieber, in her investigation, makes a Rubens-like connection between *The Sirens of Titan* and *Slaughterhouse-Five*, and she imposes an interesting reading that would have the Tralfamadorians found in both novels be of the same species. “It is important to read *the Sirens of Titan* and *Slaughterhouse-Five* in juxtaposition to each other because each work elucidates the other. In *Slaughterhouse-Five*, we learn that Tralfamadorians think all humans are machines. This makes more sense as we read in *The Sirens of Titan* that all Tralfamadorians *are* machines” (Sieber, 2000: 150). While this type of juxtaposition can yield some interesting ideas about the line between life and machine, making the assumption that the sharing of a name implies direct equivalence is a statement that goes well beyond what is warranted by both novels. It is clearly stated in *The Sirens of Titan* that Salo does not live an infundibulated life and relies on Rumfoord for information about the future. Meanwhile, it is written in *Slaughterhouse-Five* that

the Tralfamadorians can look at all the different moments just the way we can look at a stretch of the Rocky Mountains, for instance. They can see how permanent all the moments are, and

they can look at any moment that interests them. It is just an illusion we have here on Earth that one moment follows another one, like beads on a string, and that once a moment is gone it is gone forever. (Vonnegut, 1991: 27)

These two descriptions seem in direct opposition, at least when it comes to the concept of temporal perspective. And should it also be said that the Tralfamadore found in these two novels is the same as the one described in *God Bless You, Mr. Rosewater*, *Hocus Pocus* or *Timequake*? Does this extension limit itself to works written by Vonnegut or could any reference to Tralfamadore be included in this grand unified theory? Once again, are the works attributed to the Vonnegut author-function a delineated ensemble that must be studied as a whole? While Sieber could formulate many possible answers to an objection to Tralfamadorian hegemony—that Salo was lying, that her association is done through some sort of variations on a theme, etc.—the literal reading of the two novels would seem to contradict her edict. In fact, it would claim that, quite to the contrary, it seems important to read both novels as different story-worlds. Her reading is justified by the scope of her argument, and she uses both novels as interchangeable parts to her Vonnegutian theory of synchronicity. Like Rubens, Sieber takes a creative licence to fill in some blanks generated by the resulting universe created through the intersection of both novels. Overall, this sort of violence done to the text is exemplary of reading's paradoxical tendency to impose particulars as universal meaning.

Yet reading and faith are different in a radical way. To speak of plot meaning as a universal is to impose on novelistic practices a form of meaning that has to apply to the world at large. Since *The Sirens of Titan* is not the word of God *per se*, the paradoxical space opened by its multiplicity of possible meanings is founded on the relationship between particulars and universals contained within the frame of the plot. This state expands divergent reading attempts to the point where they apply to concepts outside of their story-worlds. Possible world theory finds itself on the vast array of possible meanings spawned by the novel. Sieber, on the other hand, is concerned more specifically with a form of reading that could expand on the notion of synchronicity, a notion that she takes to heart but never fully explains. “Simultaneity involves an understanding of time that surpasses causality and serial perception in favour of synchronicity, which Jung defines as the fusion of simultaneity and

meaning, creating a sense of Baudelarian correspondences or coincidences between seemingly unconnected events” (Sieber, 2000: 149). This definition, which she attributes to thoughts on James Gleick’s *Chaos*, shows that she is attempting an extension of Marc Leeds’ “Tralfamadorian reading theory” that compounds all forms of temporalities into a synchronic whole. Yet it seems that like Marc Leeds’s text “Beyond the Slaughterhouse: Tralfamadorian Reading Theory in the Novels of Kurt Vonnegut” Sieber is producing a thinly veiled interpretation of Vonnegut’s fiction as a coherent whole. Unlike Marc Leeds, who never tries to hide his attempt to make Vonnegut’s writing about Vonnegut’s life, Sieber uses synchronicity as a loosely defined idea around which many points gravitate. Derrida, Cinderella, images of death, Marshall McLuhan, chaos theory are a few of the multitude of references woven together around the description of plot elements found in Vonnegut’s novels. Perhaps she is trying to show “the modern fragmentation of perspective, perception, storyline, character, rhythm, and sequence, which is repaired by coincidence or *synchronicity*, the structuring of thought and experience along associative patterns” (Sieber, 2000: 148). While this strategy offers interesting leads on reading strategies and their enmeshed relation with plot, it can sometimes feel, while reading Sieber, that her text is folding upon itself, becoming too concerned with its own peculiarities to address *The Sirens of Titan* or temporality.

The portrait drawn by Rubens, Cordle and Sieber allows some observations about the relationship between individual causalities of reading and literary criticism. In all of these cases, the actual meaning of the novel seems to overshadow the reading process. Of course, these are scientific articles and not reading journals, and it would have been unorthodox for this genre of writing to include page-by-page reactions to the novel, but in most cases, the actual plot causality is reduced to a general understanding of the novel’s meaning. Rubens, who spends the most time directly addressing the plot elements of *The Sirens of Titan*, is the critic most obviously partaking in this practice, to the point where *The Sirens of Titan* becomes an incomplete attempt at expressing an authorial position that would only come to be actualised fully in *Slaughterhouse-Five*. While the general tendency, noticed by Foucault and Doležel, to resort to the author as the principle locus of intention and rationality permeates all three texts, there is a level at which it is done in Rubens that make his article exemplary of what “Qu’est-ce qu’un auteur?” directly criticises. Sieber, while avoiding the intentional

fallacy on her Vonnegut author-function is nonetheless reductive of the theoretical potential that is found within *The Sirens of Titan*. Her article's title, which places synchronicity as the *foundation* of the chrono-synclastic infundibulum, as well as to other nonlinear time-structures, creates an immense burden of universal proof for a concept that is essentially a personal observation. Unlike Rubens, who seems to genuinely aim at uncovering Vonnegut's own theory of time, Sieber is guilty of imposing her own meaning onto a structure that constantly branches into rich ramifications. Her text is the constant reigning-in of tangential ideas to the artificial enclosure of synchronicity. Yet both Rubens and Sieber are taking part in the exercise of relating their own experience with the novel. It seems highly problematic, then, that both cases transpose meaning away from the novel and into conceptual constructs, either inner duration or synchronicity, that become the key to *The Sirens of Titan* reimagined as a *roman-à-clef*. Only Cordle unwaveringly refuses to impose meaning onto the Vonnegut author-function, but he does so by making his entire text revolve around the idea that meaning is constantly shifting and that the novel is a polysemic construction. His approach, which takes into consideration the link between teleology and chronology, comes closest to interrogating the different causalities bound up around the novel, and to opening up to the possibility of a non-causal reading experience. While Sieber and Rubens also deal with their own temporal concepts, only the combination of meaning and time gives an accurate depiction of the causality of reading as a punctual process that generates sense through an encounter with the novel.

2.2.4. *The Sirens of Titan* as a novel of its time

As an object inscribed within the temporal logic of history, *The Sirens of Titan* is bedecked with timestamped elements hinting at its late 1950s origin. But, as was said above, the actual historico-biographical ground of its genesis is of lesser interest when considering its possible epistemological ramifications. Yet, one of the ways in which the novel is part of a causal order is as a created artefact that combines its era's influence with the creative gesture of its author. Since the status of the author has already arisen as a problem within the discussion on Zola's experimental novelist and as the locus of intentionality that grounds

certain meanings of the text, one must thread carefully when wishing to discuss the causal chain responsible for the novel's writing. As such, I will continue to describe Vonnegut, and the comments he has made about *The Sirens of Titan*'s writing process as the material of a particular author-function, having its influence upon the potential readings of its work, but without dominating interpretation through a perceived authority when it comes to ascriptions of meaning. In this way, the historical timeline that is drawn up about and around the reading of a novel can yield avenues into possible links between the actual world as described through a historical narrative without actually making a claim pertaining to the source of the representation. The author-function becomes another shifting sense-object taking part in a discussion about a narrative to which it is undoubtedly linked without creating a novelistic "initial cause" within an author. This is especially true considering that, in light of Zola, it has become clear that even when the writing process is taken at its base level of thought experimentation, it is fragmentary at best, oscillating between an observation of the world and an experimentation of already fictionalised boundaries.

These remarks must be kept in mind when considering Vonnegut's own tongue-in-cheek account of the research he undertook in order to write *The Sirens of Titan*.

I don't have any systematic reading program. I'll read anything that comes to hand. As far as research goes, usually the *Encyclopaedia Britannica* is more than adequate for what I want to know. When I wrote *The Sirens of Titan* I found out everything I wanted to know about the solar system from a children's book. I think it was probably written for an eight year-old. It showed all the planets and described them very nicely and told me about their moons and told me about the moon of Saturn called Titan[.] My research has not been profound. (Cargas & Vonnegut, 1976)

The attitude shown here might dissuade any rigorous attempt at equating Vonnegut's written descriptions of astronomical objects to the domain of physics from which they are drawn. Yet it is because of this naïve approach that there can be no confusion as to the claims being made by the novel about scientific concepts. For instance, it would be ridiculous to think that the deadliness of Titan's atmosphere is in any way contested by Vonnegut's description of Constant and his family treading upon Saturn's largest moon without the aid of some form of protection against methane and extreme weather conditions. Yet it highlights that literature

can take part in a form of selective ignorance, a fact that has an obvious impact on fictive works taken as thought experiments. *The Sirens of Titan* is only about the Titan of astrophysics manuals in the sense that it describes a celestial body that shares a name and a general location with the moon of Saturn. The Titan described by Vonnegut interacts with the empirical Titan through an overlap in accessorial sets that allows discrepancies both inclusive and exclusive; Vonnegut's Titan has extra characteristics, such as the bluebirds native to it, and missing elements, such as the methane in its atmosphere or the extremely cold weather that would likely kill any unsuited human walking upon its surface. So Titan, as a fictional construct, is reliant on correspondence with reality and distance from it, something Vonnegut fully accepts when using childish simplification as a source of knowledge.

Titan provides a relatively simple example to illustrate the ambiguous epistemological underpinnings of fictional constructs when relating to the vast bank of empirical knowledge collected by scientific institutions, and indeed to all forms of correspondences between the actual and the fictional. It is an especially powerful example since its status as an invented object within a novel is underlined by Vonnegut's own avowal of a lackadaisical research program. Yet this self-avowed inconsistency cannot fully remove the persistence of its real-world correspondence. This shows that fictional narratives carry with them very peculiar credentials; that of being constructed out of negating positivities. *The Sirens of Titan* posits a consciously non-existent Titan, a form of invented and temporary knowledge. Within the novel's order, Titan must be taken as-is for the narrative world to function. One cannot simply refuse the discrepancies with the known and go on with the story. Say Constant was to die upon landing on Titan due to untenable conditions, the same logic that has him perish would need to be applied to the rest of the novel, which describes a voyage taking him from the Earth to many planets in the solar system, such as Mars and Mercury. Despite the oxygen pills, or goofballs, "that made up for the fact that there wasn't any oxygen in the Martian atmosphere" (Vonnegut, 2006: 100), many other elements should have proven deadly upon treading the Martian soil. Dust particles, low density of the atmosphere and persistent sub-zero temperatures would have decimated the entire "Martian army" training upon the red planet. Likewise, the very thought of carbon-based life forms surviving on Mercury is absurd, even with an added supply of oxygen. So, in fact, the same logic that would have Constant dying

on Titan causally forbids Constant's actual journey to Titan, and thus the greater part of the novel's storyline. But would it not be the case then that rigorously following this same logic invariably leads back to the refusal of the novel as a whole, based on other dissonances with the real? Looking at the different readings of Sieber, Cordle and Rubens has already shown that, most often, the sense attributed to the novel as a whole overshadows its own depiction of the causal process once it has been read, effectively transforming contradicting elements into, at best, puzzling discrepancies and, at worst, evidence of a breakdown in the story's meaning sequence. *The Sirens of Titan* explicitly asks this question since, as a novel taking place in a future, and told from even further in this same timeline, the very notion of causal refusal fails within its own structure on the basis that this future has not yet been actualised. Lack of concordance with the real is a condition that must be accepted for the reading of fictional narration, and this rule becomes both obvious and fundamental when reading fictional timelines.

As a negating positivity, the novelistic construct is allowed to stray from strict, mimetic, adherence to the observed world, but understanding necessitates another form of bridge between the actual and the fictive. While its atmospheric details are incongruous with a 1959 understanding of Saturn's moon, the Titan of the novel is nonetheless taking a place within the solar system that seems to coincide with the actual Titan's location. Other clues to this semi-correspondence abound in *The Sirens of Titan*. The very existence of goofballs within the novel's miscellanea is a particularly telling example that there is, at the same time, a variable need for correspondence at play in *The Sirens of Titan*. Lack of oxygen in the atmospheres of our solar system's other planets is a passing concern for Vonnegut. He does not entirely ignore the physical characteristics; he has merely limited his effort to a gloss of veracity that would satisfy a reader with an eight-year-old's understanding of astrophysics, establishing the type of disbelief suspension necessary to enjoy his novel as a refusal of Zola's type of strict and scientific observation. While extensions of real-world concepts are necessary to Vonnegut's stories, his type of author-function is not entirely in sync with the experimental novelist. The observer notices elements, but he experiments with other possibilities than those that his observations warrant. Indeed, this fact moves his type of science fiction away from Gernsbackian scientifiction and into the fantastical realm of a naïve

or childlike imagination playing around with scientific concepts. Strictly speaking, it is clear that *The Sirens of Titan* is neither about Titan nor Mars, or rather that the type of thought-experimental knowledge it is developing is not specifically about the details of our solar system.

The problem of correspondence between fictional concepts and their actual world counterparts has been addressed time and time again in literary theory. While most approach it through the question of representation, a significant amount of work has already been undertaken in the first act to question direct mimetic equation between signifier and signified, showing that early representations of the spatial fourth dimension were in fact part of a historical system that did not warrant a clear link between space and the extensional analogy between the point, the line, the square and the cube. For instance, More's spissitude, while entirely analogous to later representations of the fourth dimension of space, was in fact devised as a way to represent the soul's space within the body, and the way it could fold upon itself after being displaced in three-dimensional space. In this way, novelistic notions also fill a need that is historically grounded, while concurrently being tied to a narrative development. When questioning Titan, ideas of "1959 knowledge" seem insurmountable in establishing the link between Vonnegut's description and the world in which he thought he was living. Vonnegut's tale deals more realistically with space than Lucian of Samosata's *True History* or Cyrano de Bergerac's *Histoire Comique de la Lune* but this type of evaluation can only exist as a retrospective glance that treats the real as the empirical model of today. Vonnegut dealt with the general understanding of his day, represented by his mention of the *Encyclopaedia Britannica*, but did not attempt to collect the entirety of the knowledge possibly available to him at the time. His own account of his research program restrains the applicability of such a historically grounded knowledge, placing him in a voluntary stance of fancy that is at a distance with 1959's state of scientific affairs. This creates a leeway at the heart of the Vonnegut author-function, liberating it from its historical background, but it also acts as a hurdle that seemingly invalidates his novel as a literary thought experiment, qualitatively contrasting it to scientific descriptions solely concerned with the world. What can be salvaged of the link to the actual world within this context?

While adapting possible world theory to the literary sphere, Lewis, Pavel, Doležel and Eco came upon the same problem. In *Theories of Literary Realism*, Villanueva describes Doležel's proposition.

In addition to the world empirically observed, or the "actual world," there are other possibilities created by the human mind, thought, imagination, language, and additional semiotic activities. In the first type of world, in order to prove linguistic assertions as such, one has to conform entirely to the principle of correspondence with reality, whereas in the second types one can accept what Thomas G. Pavel calls "ersatz-sentences," or "sentences of substitution" that can be evaluated only in relation to the possible or fictional world to which they refer. They are true if they conform to the rules proposed, and false if they fail to do so. (Villanueva, 1997: 71)

This description highlights the problem that has so far been discussed when trying to grasp *The Sirens of Titan's* proposed Titan in relation to the actual Titan. The intersection between the two constructs is predicated according to "the principle of correspondence with reality" which Villanueva borrows from Tarski's 1944 paper "The Semantic Conception of Truth and the Foundations of Semantics." This paper establishes a sentence's truth as consisting in "its agreement with (or correspondence to) reality" (Tarski, 1944: 343). In turn, Tarski is attempting to extend Aristotle's own tongue-twisting definition of truth, which reads "to say of what is that it is not, or of what is not that it is, is false, while to say of what is that it is, or of what is not that it is not, is true" (Aristotle, 1995: 1597). Aristotle's formulation of correspondence, while seemingly simple once one stops and attentively reads his two propositions, touches on the major problems of literary descriptions of the world. If truth and falsity are entirely established upon the evaluation of statements' relationship to reality, then the novel essentially becomes a compilation of false assertions. Yet, while Plato or Frege might be inclined to agree with this picture, Aristotle goes on to offer nuances that are often evaded in logical analysis of correspondence; "so that he who says of anything that it is, or that it is not, will say either what is true or what is false; but neither what is nor what is not is said to be or not to be.—Again, either the intermediate between the contradictories will be so in the way in which grey is between black and white, or as that which is neither man nor horse is between man and horse" (Aristotle, 1995: 1597). He opens the space between opposites to include either a continuum or other members of an ensemble that hold no direct correlation to those elements that are opposed. For Aristotle, these counter-examples are a means to test his

definition of truth and falsity in order for it to reflect his law of the excluded middle, first explored in *On Interpretation* but reiterated in the above-quoted section of his *Metaphysics*: “there cannot be an intermediate between contradictories, but of one subject we must either affirm or deny any one predicate” (Aristotle, 1995: 1597). This rule, which has been expanded into one of the main tenets of classical logic, is in fact directed towards predicates and not their actual world counterparts, which can only be implicated through correspondence. So while it can be said that grey is neither black nor white or that dusk is neither day nor night, for Aristotle, this amounts to a confusion in terms, with grey being both not-white and not-black, and therefore logically unrelated to predicates describing either one of them. Aristotle is wary of mixtures, such as grey being half-black and half-white, for, as he says, “when things are mixed, the mixture is neither good nor not-good, so that one cannot say anything that is true” (Aristotle, 1995: 1598), and it becomes obvious that his logic cannot allow for the nuance of predicates that do not fully embrace the true-false binary. This explains Villanueva’s choice of terms, as he positions possible world theory not in direct opposition to Aristotelian logic but rather as a transposition of the true-false dichotomy within a new frame of reference. This strategy, established through *ersatz-sentences*, allows for an “almost-world” to show through as the depository of statements made in relation to it. According to this view, Vonnegut’s substitutive Titan is properly accessed through the information given by *The Sirens of Titan*. Yet, since the Vonnegut author-function acts as the initial cause of the novel, it becomes tempting to inscribe all form of truth to its imaginary conscience, constituted from bibliographical details, historical minutia and literary criticism. Ascribing the full burden of meaning to the author, a reflex that is difficult to curb in aspiring literary critics, does greatly limit the potential readings of the novel and negates the inevitable distance between the reading individual and the imagined (whether he still lives or not, whether he is in close proximity or not) author. Vonnegut’s recorded comments on his writing process can influence the impressions left by the reading of the novel, but certain aspects, such as the actual details of his research when it came to Titan’s oceans and wildlife—did he believe them to exist? were they invented merely to serve the plot? what aspects of the actual Titan were taken in consideration?—are forever left as radically indeterminate. Thus, it now becomes obvious that the proposition “Titan is populated by Titanic bluebirds” is to be considered false in the actual world and true in Vonnegut’s ersatz-Titan, and in order for the proposition to fill

Aristotle's law of the excluded middle, it must actually be considered two different propositions, each pertaining to different ensembles, which possible world theorists have, obviously, come to call possible worlds. This distinction, though, leaves out the form of correspondences that would allow for a connection between the two different Titans, thus invalidating the idea that the planet found in the novel takes some of its characteristics from the actual moon of Saturn. The Vonnegut author-function is the only link through which both Titans can overlap. This generates an incomplete picture of the novel as created solely through the author-function, something that has already been shown to be a simplistic reduction of the diverse forms of causality found within the plot and the reading process. It transforms the novel into a sort of skewed thought experiment solely concerned with the author's extensions, something like Zola's experimental novel, but free of its criterion of thorough observation. It is experimental in that the author does take the guise of an experimenter through an after-the-fact reading of his work, which retells his act of writing extensional concepts, but it loses Zola's appeal for strict adherence to the observed world. While some observations are brought into individual fictional concepts, the author is the sole key to establishing the difference between what is imagined and what is truly thought to be corresponding with his actual worldview. Furthermore, historical research into the state of knowledge pertaining to, in this case, 1959 astronomy cannot fully replace this key since it is also dependent on the author's particular knowledge in relation to his time's *scientia*, as well as his voluntary straying from observations as a means to attain various literary objectives. This furthers the idea that the causality of writing, no matter how exhaustively it is reconstructed by the literary genealogist, will always come up a few steps short of yielding true intentional transparency.

The link between what is called the actual world and the different possible worlds is one of transitivity that goes through an unknown. As Doležel shows in *Mimesis and Possible Worlds*, Tolstoy's Napoleon is radically different from the historical figure that shares the same name since it holds its own characteristics within a non-actualised possible world. Likewise, the Titan of *The Sirens of Titan* is held within the limits of the novel's own possible world. The relationship between the possible and actual figure has yet to be fully established, since the causality of writing only offers an imperfect transition into a necessarily incomplete

author-function, while the causality of reading is struggling with its own considerations, which must leave behind questions of correspondence in order to privilege arguments for universal meaning. Meanwhile, plot causality continues to function fully since it takes as a presupposition that the novel is its own sphere of predication. What is necessary, within possible world theory, is another way to address the relationship between actual world elements and their fictionalised brethren.

2.3.1. The Chrono-Synclastic Infundibulum as Possible Concept

Before exploring how possible world theory develops the different forms of causal correspondence into something that allows for the expansion of fictional concepts through their real-world counterparts, this investigation needs to address one last element of the novel. Indeed, while the planet “Titan” in *The Sirens of Titan* has a counterpart in the actual world that shares some of its characteristics and not some others, there is one specific element in Vonnegut’s story that seems entirely free of such correspondence: the chrono-synclastic infundibulum. As has been already discussed, this phenomenon is at the very heart of *The Sirens of Titan*, yet, so far, it has only been understood through its consequences on Rumfoord. Indeed, while the infundibulum is the principal cause for Rumfoord’s particular take on time, arguably the most central aspect to the plot’s singular depiction of differing timescapes drawn from a shared timeline, there is relatively little information given to describe the phenomenon in and of itself. Vonnegut toys with the notion of the childish discourse, which mirrors his own research program, to describe this concept by resorting to quotes from an invented book named *A Child’s Cyclopedia of Wonders and Things to Do* by the equally fictive Dr. Cyril Hall. She uses the common definition strategy of dissecting the name into its etymological roots: “Chrono means time. Synclastic (sin-classtick) means curved towards the same side in all directions, like the skin of an orange. Infundibulum (in-fun-di-bu-lum) is what the ancient Romans like Julius Caesar and Nero called a funnel” (Vonnegut, 2006: 9). The phenomenon’s name is therefore representative of its effect upon Rumfoord; it curves time into a spiral. In the novel’s own world, Rumfoord is the first and only human to be affected by the chrono-synclastic infundibulum, and most knowledge is therefore drawn from his personal experience.

The novel actually evades all definitions beyond those of the *Child's Cyclopaedia* and Rumfoord's own experience. In fact, the narrator precedes the reprinting of Dr. Hall's article with a warning; "almost any brief explanation of chrono-synclastic infundibula is certain to be offensive to specialists in the field" (Vonnegut, 2006: 8). It is as though the infundibulum resists definition in the same way that *The Sirens of Titan* has so far resisted absolute meaning. While experts in their own rights, Sieber, Rubens and Cordle only showed part of the potential meaning of the novel, even if in Sieber's case this part was the idea that the novel has to attain a sort of universal meaning in order to partake in the causal process of reading. As a central element of the novel, the chrono-synclastic infundibulum has a share of responsibility for this opacity of meaning, and most texts written about *The Sirens of Titan* mention the infundibulum within their title showing the inescapable draw that the concept generates. The view that the novel is the nexus of many differing ideas that each have a worth of their own, is also a component of the Dr. Hall's definition of the infundibulum:

Just imagine that your Daddy is the smartest man who ever lived on Earth, and he knows everything there is to find out, and he is exactly right about everything, and he can prove he is right about everything. Now imagine another little child on some nice world a million light years away, and that little child's Daddy is the smartest man who ever lived on that nice world so far away. [...] Only if they ever met they would get into a terrible argument, because they wouldn't agree on anything. Now you can say that your Daddy is right and the other little child's Daddy is wrong, but the Universe is an awfully big place. There is room enough for an awful lot of people to be right about things and still not agree. The reason both Daddies can be right and still get into terrible fights is because there are so many different ways of being right. There are places in the Universe, though, where each Daddy could finally catch on to what the other Daddy was talking about. These places are where all the different kinds of truths fit together as nicely as the parts in your Daddy's solar watch. We call these places chrono-synclastic infundibula. (Vonnegut, 2006: 8-9)

Considering how deterministic Rumfoord's view of time seems, this preliminary definition of the infundibulum offers an *a posteriori* puzzle to the reader that goes back to it. How can a fixed timeline, which would suggest a Laplacian causal order, offer more than one type of truth? Indeed, if every event has a given cause and leads to an inevitable effect, than all existence could be reduced to a long chain of syllogistic certainties. These certainties might even bypass the if/then structure of the causal, replacing formulations like "if Mars attacks

Earth, then all people of Earth will join together and put an end to internal strife” with “Mars will attack Earth, thereby ending all earthly strife.” The conditional formulation of the syllogism is transformed into the ignorant gander of the non-infundibulated, making conditional truth either impossible or inevitable. Since Rumfoord is the only infundibulated individual, one can guess that Dr. Hall is speaking from a punctual point of view, but even then, would her research not have yielded some insight into the consequences of Rumfoord’s all-knowing standpoint? There is room, within *The Sirens of Titan*, for the possibility of a second form of uncertainty, born out of the withdrawal of Tralfamadorian influence from Earth, so perhaps Dr. Hall is writing following the events described in the novel. After all, her account is related by the narrator, which has already revealed him or herself as a being living after the events that transpire through the narration. Yet, Dr. Hall’s article is indubitably about discordance and the way the infundibulum can attune meaning. What becomes of conflicting opinions once they enter the infundibulum? Is the impact of being “outside of time” that all meaning is shown to be true, or that meaning is so radically transformed that individual manifestations of it no longer seem to relate to each other in a way that would respond to the true/false dichotomy? What would the timeline look like to an infundibulated being after the withdrawal of Tralfamadorian influence?

While the infundibulum is, with its fundamentally enigmatic nature, always outside the grasp of the punctual reader, it does offer some analogical resemblances to other forms of celestial bodies found in the universe. This resemblance is not quite mimetic, as most knowledge on these forms is in itself tentative and hypothetic, but looking at some of the theoretical options offered by astrophysicists does enlighten some aspects of the relationship between meaning and time as it is revealed through the discovery of astronomical phenomena. If Doležel, in *Mimesis and Possible Worlds* is right, and mimetic criticism relates the fictional to the world through a process of transformation, moving fictional particular away from their plot and into the realm of universals, an intersection between the infundibulum and actual research into physical anomalies found in space is an attempt to inverse the relationship, effectively transforming actual particulars into tools to understand a fictional universal, for the infundibulum is unmistakably a portal into the realm of universals within *The Sirens of Titan*. Through it, Rumfoord instantly gains knowledge of time’s fixed structure, as well as the entire

meaning of humanity's historical development. Such an immense burden of sense surely explains the narrator's comment that a summary definition would be insufficient for any specialist. But then again, is it not true that the possibility for an outside look at time would entirely redefine the definition of specialisation? That Rumfoord attains a form of consciousness that belittles any other viewpoint on the infundibulum? That he is qualitatively closer to universal understanding?

Recent development in astronomy is not yet burdened by the actuality of such an event, so it is difficult to draw an analogy between Rumfoord's situation and any accessible empirical reality. Yet there are experimental developments surrounding the notion of black holes that take on the form of something analogous to infundibulation. Black holes are, like the infundibulum, extremely outlandish objects that are believed to exist in space due to observed data. Black holes are caused by collapsed stars, which become so dense that everything crossing their boundary, called the event horizon, will be unable to escape. While Laplace and Mitchell discussed bodies of incredible density during the 18th century, these theoretical entities were left mostly unexpanded for a century, since it was thought that light could not be influenced by gravity. Then, following experiences like Taylor's version of the double-slit experiment, light was shown to share some characteristics with physical particles. It was not until Einstein's formulation of general relativity that black holes became a part of the general consciousness, but only as hypothetical objects. Furthermore, black holes have entered into a speculative game as radical otherness. As unknown variables, they can exist within theories as possible answers to theoretical models that lack crucial elements. Stephen Hawking, in a 1974 paper entitled "Black Hole Explosions?" theorised that black holes should, according to the laws of quantum field theory, emit small amounts of radiation. His explanation uses the theory that the force of the black hole might rip particles from their paired antiparticles, with one of the pair being absorbed through the event horizon and the second escaping, thus creating a form of residual radiation. Yet, in a chapter added to *A Brief History of Time* in 1996, he attempts to describe a second model that would also account for black hole radiation (now dubbed "Hawking radiation"), which he describes as "a different but equivalent intuitive picture of the mechanism for emission from black holes."

One can regard the member of the virtual pair that fell into the black hole (say, the antiparticle) as a particle travelling backward in time out of the hole. When it gets to the point at which the virtual particle/antiparticle pair appeared together, it is scattered by the gravitational field into a particle travelling forward in time and escaping from the black hole. If, instead, it were the particle member of the virtual pair that fell into the hole, one could regard it as an antiparticle travelling back in time and coming out of the black hole. Thus the radiation by black holes shows that quantum theory allows travel back in time on a microscopic scale and that such time travel can produce observable effects. (Hawking, 1998: 168-169)

The unknown nature of the black hole acts as a stepping-stone to a theory of time-travel, albeit one that only allows microscopic particles to become unstuck in time. As such, the black hole takes the guise of the infundibulum in that it enters into the economy of the causal and disrupts the punctual timescape. But let us not forget that while the black hole is widely accepted theory, it is still, at this point, a theory.

Hubert Reeves in *Chronique des atomes et des galaxies* explains the problematic existence of black holes:

The idea of a body so condensed that nothing, not even light, could ever be extracted from it has been suggested during the 18th century, specifically by Pierre Simon de Laplace. But it is within the framework of Einstein's theory that it found its true formulation. The theory attests that such celestial bodies could exist without infringing on physical laws. Thus, these are "possible beings," or "virtual entities." But this theory does not tell us if such beings exist in nature. Here, we are touching upon a general aspect of research that should be exposed. Mathematical formulations of theories often contain terms that could indicate the existence of unknown phenomena. The possible detection of such phenomena then becomes an important stake for the research—but it should be kept in mind that such mathematical terms could correspond to no theory at all.²⁸ (Reeves, 2007: 89-90, my translation)

²⁸ L'idée d'un corps si condensé que rien ne pourrait s'en extraire, même pas la lumière, a été proposée au XVIII^e siècle, en particulier par Pierre Simon de Laplace. Mais ce n'est que dans le cadre de la théorie d'Einstein qu'elle a trouvé sa véritable formulation. La théorie atteste que de tels astres pourraient exister sans violer les lois de la physique. Ce sont donc des « êtres possibles », des « entités virtuelles ». Mais cela ne nous dit pas s'il en existe dans la nature. Ici, nous touchons à un point plus général de la recherche, qu'il est intéressant d'exposer. Les formulations mathématiques des théories contiennent parfois des termes qui pourraient indiquer l'existence de phénomènes inconnus. La détection possible de tels phénomènes devient alors un enjeu de grande importance pour la recherche—en gardant toutefois à l'esprit que ces termes mathématiques pourraient ne correspondre à aucune réalité. (Reeves, 2007 : 89-90)

It is therefore the case that from a sceptic's point of view, black holes cannot be said to fully exist. Yet, within the body of scientific knowledge, they are "possible beings" and enter in a complex relationship with theoretical models. They are an offshoot of Einstein's models; only theorised by Karl Schwarzschild as an answer to some puzzling aspects of general relativity. Since black holes do not emit light, or any other form of noticeable output, and considering that they are extremely distant from the Earth (much more distant than the infundibulum), they act as an organising principle for different attempts at explaining observational anomalies. They are believed to be responsible for bent light rays as well as the effect that a spinning object as massive as a black hole would have on the surrounding bodies, something called "frame dragging" by Einstein. Since Einstein made his predictions, discoveries of derivative effects such as the orbit of stars at the centre of the milky way galaxy (Alleyne, 2008), or the behaviour of gas around what are believed to be black holes (Dooling & Zhang, 1997) have caused momentary exclaim within the scientific community for their similitude to Einstein's own predictions, many decades after they had been made. Yet, these excited claims of Einstein's divinatory abilities are not accurate to his own opinions on the subject. As Palle Yourgrau relates,

when Karl Schwarzschild, a German colleague, discovered in 1916 that if a star began an extreme gravitational collapse into itself, its mass would eventually reach a critical point after which space-time would be so severely curved that nothing inside (what is now know as) the "event horizon," including light, would be able to escape, Einstein dismissed the "Schwarzschild singularity" as a mathematical anomaly with no physical significance. (Yourgrau, 2005: 116-117)

So, going against the vindication of the author-function (insomuch as the notion can be applied to authors of scientific theories), later researchers, who are quick in declaring Einstein's incredible knack at predicting phenomena, actually go against his own beliefs. It is said that Einstein was quick to dismiss theories that went against his own worldview, something that will come back later in a discussion on his disagreements with Niels Bohr. What then justifies black holes as possible beings? If the author-function is evacuated, all that there is left is the realist idea that mathematical formulae derived from the theory of general relativity point to the existence of these necessary objects. Yet, as it now becomes clear

following Einstein and Reeve's own admittances, these necessary objects are such because of the theory that brought them into being.

Since I am mostly concerned with the epistemological ramifications of fictional concepts, the debate into the existence of black holes does not need to be answered for its formulation to have an impact on the way the infundibulum is treated within *The Sirens of Titan*, or even, for that matter, the way the fourth dimension is exposed in *Flatland*. These notions, which are debated, yet ultimately proven to the reader through a privileged standpoint, act as items that share the evasive nature of black holes. Since fiction is composed of different layers of truths and causalities, ascription of possibility falls upon the reader's relationship with the novel. *The Sirens of Titan* is not advocating for the reality of the infundibulum, but rather expanding on the notion that if it existed, it would have definite impacts on existence. This is why reading the fictional from the angle of divinatory mimesis, such as is sometimes warranted by partisans of predictive readings, actually reduces the epistemological potency of the novel, reducing it to a mere temporal projection of the actual world rather than a space where notions are born in a similar way to actual theoretical objects such as the black hole. It treats reality and time as a fixed ensemble, destined to eventually undergo the inevitable changes that have already been dictated by causality. By dividing these multiple causal logics according to the different stories that can be told about a novel, it now becomes apparent that the storytelling apparatus allows for a complex viewpoint that can draw from historical context, literary criticism, reading experience, theoretical notions and personal belief to forage into the essence of truth without either fixating it or destroying it altogether. In this way, the chrono-synclastic infundibulum is a possible concept because the story dictates it, much like the black hole is a possible entity because the math says so. The only difference is that the stake of the real has been filtered through a complex inter-relational organisation of causalities that exist around *The Sirens of Titan*. Yet, while possibility has already become a pillar in the argument, and possible world theory has had impact on the discussion, the actual epistemological underpinnings of possibility remain unclear. More specifically, what type of world is a "possible world" that would allow for the infundibulum to function like the black hole in the actual world without falling back on allegorical or mimetic frameworks?

2.3.2. *The Sirens of Titan* as a Possible World

If *The Sirens of Titan* is understood as a world, then the different causalities drawn from it have been attempting to draw an interworld bridge; an understanding of how a fictional world would enter in an epistemologically significant relationship with the actual world. This brings the introductory statement of *The Sirens of Titan*'s narrator, claiming a strict dichotomy between the outward and the inward, to the forefront. The loss of an interest for exploration of the cosmos coupled with the discovery that human conscience is infinitely more important seems to privilege the exploration of the human imagination over that of the universe. As the product of an author-function, the novel is often understood as the effect of an imagination, attributed to the author, but also as the result of an exploration of real-world concepts. Zola reduced the division between the novel and the world through the oscillation between observation and experimentation, making the conditions for development of possibilities within the realm of the literary something that could not survive the separation between an unknown inward space and an intelligible outward realm. This investigation has come to flip this relationship, with observations of the fictional realm having an impact on the actual world, and this correlates with Mach's view of the thought experiment, while entering into a problematic relationship with the actual production of new knowledge. The author-function can be understood as Zola's experimental novelist, which brings it closer to the thought experimentalist. In *What is Experimental about Thought Experiments?* David Gooding draws such a parallel; "The representational capability of experimental narratives is not a given: it is crafted. The authors of succinct, transparent and compelling narratives must have been intimately involved with the worlds they want to enable others to explore vicariously" (Gooding, 1992: 284). Yet, as it has been shown, Vonnegut never fully attempted to become intimately involved in the knowledge of space that would allow for a thorough exposition of the solar system's quirks. Vonnegut's infundibulum, while drawing kinship to the black hole as a celestial body and as a phenomenon that has a direct influence on the time structure of existence, was not born out of Vonnegut's desire to enter into a dialogue with the discipline of astrophysics as *scientia*. While *The Sirens of Titan* can inform the reader's curiosity, or be seen as a freeform thesis on inward time or chaos in the way that Rubens or Sieber would argue, it is not a thought experiment dealing with the specifics of mathematical theorems.

What Vonnegut is crafting is not his knowledge of space, it is something outside of it, something commented on by his willingness to admit such lack of knowledge through childish discourse and simplified encyclopaedic articles.

Only very loose definitions of thought experiments would still allow for *The Sirens of Titan*'s description of the infundibulum as a member of their set. Gendler, in "Galileo and the Indispensability of Scientific Thought Experiments," a text predating her criteria demanding that thought experiments deal with "features of the physical world" proposes an interesting distinction between thought experiments and non-thought-experimental arguments:

thought experiments differ from non-thought-experimental arguments in two crucial respects : first, they are not presented as arguments, but rather as invitations to contemplate a way that the world might (have) be(en); and second, they make essential reference to particular hypothetical and counterfactual states of affaires." (Gendler, 1998: 399)

Her early definition comes much closer to describing Vonnegut's enterprise, at least from the standpoint of the non-causal reading, that is to say, from a point of view not concerned with transforming the novel into an argument and imposing upon it the burden of proof, a position that I have attempted in my description of the causality of plot. It also resonates strongly with Kuhn's definition of possible worlds as "a way our world might have been" (Kuhn, 2000: 63). It combines two very interesting points that are not necessarily present in all discussions of thought experiments: contemplation of potentiality, and direct description of non-observed entities. Since my concern is with fictional narratives rather than thought experiments, although in certain forms these two ideas overlap, it is important to question what kind of world is a world that might be or might have been. This world, which, it is to be assumed, contains the hypothetical and counterfactual states of affairs of the definition, is then both contemplated and described with essential references. As the product of the thought experimental process, or of a certain form of writing, the world is a description made through the tools of fiction. As seen in the first act, this world is responsible for potential extensions of theoretical states of affairs. It is both the locus of the infundibulum and the black hole, even if, on another level, each of these concepts have different stakes in the real. If Zola's definition of the experimental novelist is appended to Gendler's loose definition of thought experiments, then it can be said that all three forms of causalities, of writing, of reading and of plot, are

integrated under the practice that unifies contemplation of, and reference to, a way that the world might (have) be(en). The relationship between observer and experimenter is therefore moved away from a supposed dual nature found in the author and toward the object of fiction in itself. The “possible” of novels is consequently dual; it can be extrapolated as a “potential possible” when the novel is not being read, and it is lived as a dynamic experience through reading. This possible exists through a description of a world and states of affairs that is eventually performed by the act of reading, but performed in a way that is quite distorted from the initial realm of possibility through unknown variables associated with what was called the non-causality of reading. There is therefore a link to be established between fictional thought experiments and possible worlds as the former is the description and contemplation of the latter, which in turn becomes the space where the former can be performed, as though the dual nature of Zola’s author had attained complete independence from the author-function. But how can it be said that *The Sirens of Titan* or *Flatland* describe possible worlds? What type of world is a possible world? And how is possibility to be understood if it includes two-dimensional worlds and infundibulation? At this point, it is absolutely necessary to understand how potentiality can act as an answer to theories of literary experimentation that stay too close to the empiricist model, such as those of Swirski and Zola.

The expression “possible worlds” entered formal logic through Saul Kripke’s “Semantical Considerations on Modal Logic” which attempted to understand how modal statements could be represented in formal semantics. Modal logic was established as an alternative to Aristotelian binary logic, showing that in some cases, some things enter into a relationship with truth and falsity in an unresolved manner, not allowing for the binary to be reduced to a single value. Possibility, probability and necessity were shown to have a definite impact on propositions through qualitative markers without being necessarily reducible to either truth or falseness. Modal logics were developed alongside other non-classical logics when a need was felt for a conceptual toolkit that would explain situations where Aristotle’s law of the excluded middle did not apply, such as fuzzy logic’s example of the impossibility of attributing a truth-value for the proposition “an individual is in a room” as that individual is standing in the doorway (fuzzy logic allows for a continuum between the “false” and “true” poles). Modal logic, did not directly attack the excluded middle, but rather allowed for non-

truth-functional propositions to coexist with traditional ones. Even from this simple standpoint, it is already easy to see how modal logic comes much closer to the way fictional narratives are understood, which is rarely centred on the truth-value of their propositions, unless they follow a simplistic form of the puzzle-solving model revolving around statements made from sources of variable reliability. Kripke added another layer of resemblance by establishing a “modal structure,” from whence to study propositions made about possibility. This gives modal propositions an environment, a field of action in which they may be extended. The modal marker for possibility, a diamond (\diamond), is used as a prefix to propositions and can be extended as a negation of the necessity of a negation, which is expressed as a square (\square). For instance, the proposition “if Rumfoord sees time from an outside perspective (a), he is possibly aware of all time ($\diamond b$)²⁹” can also be expressed as a necessity by being reformulated into “if Rumfoord sees time from an outside perspective, it is not necessary that he is not aware of all time ($\neg \square \neg b$)³⁰.” Through this interplay between the possible and the necessary, propositions extend into different scenarios, which can then be reformulated as truth-functional statements. In the case of my example, the statement expands according to the classical rules of conditionals; either Rumfoord sees time from an outside perspective or not, and in the latter case he is either still possibly aware of all time or he is not. But another, more complicated division happens once the truth-values have been applied. Say it is true that Rumfoord does see time from an outside perspective and it is also true that he is possibly aware of all time, then is he, or is he not, aware of all time? Possibility leaves out a second ascription of truth-value, without destroying the logical apparatus. It merely allows for undefined values of truth according to suspension of truth-valuation. Rumfoord does see time from an outside perspective, but it is ultimately undisclosed whether or not he is aware of all time. This sentence is still meaningful; it is merely no longer about the true meaning of Rumfoord’s condition. Kripke’s solution was to ascribe such suspensions to different worlds, whereas a possible statement was at least true in one possible world, and a necessary statement had to be true in all possible worlds. Thus, the hypothetical and counterfactual states of affairs

²⁹ a: Rumfoord sees time from an outside perspective
 b: Rumfoord is aware of all time

a \rightarrow $\diamond b$
³⁰ a \rightarrow $\neg \square \neg b$

described by Gendler could coexist in an ensemble of different worlds, some which might have been, might be or actually are. To continue with the set theory metaphor, this strange multiworld picture could be considered the set of ensembles each containing established states of affairs (and, to be accurate, the one world containing absolutely no states of affairs).

Kripke's idea was retroactively linked to Leibniz own definition of possible worlds. In fact, many thinkers of the antiquity and the medieval ages thought about possibility; Aristotle speaks, in his *Metaphysics*, of the capacity or potentiality³¹ of things (Aristotle, 1995: 1609-1610) and Pseudo-Dionysus explores, in section VIII of *On Divine Names*, what "not being able to do something" means when Paul says that "God is not able to deny Himself," effectively questioning the limits of omnipotence. But neither of these thinkers, nor any other pre-17th century philosophers, spoke of possible worlds as clearly as Leibniz. True to his commitment to possibility, Doležel remarks in a footnote to *Possible Worlds of Fiction and History* "to be sure, there is an earlier history of the idea of possible worlds, but in the modern period it is tied to the name of Leibniz" (Doležel, 1998: 786). Yet, Kripke and Leibniz came upon the idea of possible worlds through very different means. In his infamous paragraph 42 of the *Essais sur la bonté de Dieu, la liberté de l'homme et l'origine du mal*, which was scrupulously parodied in Voltaire's *Candide*, Leibniz attempts to solve the problem of evil while saving free will by establishing that the actual world is the best of all possible worlds. For this he uses the example of the siege of Keilah, whereupon David, asking God if Saul would besiege the city, and having God answer that he would do so, decides to take another course of action, effectively avoiding the siege. Since God has knowledge of the outcomes of a siege that did not come to pass, then his divine intellect holds the possibility for worlds that are never actualised. These worlds are seen as transcendental extensions of God's mind:

I resort to my principle of an infinitude of possible worlds, represented in the region of eternal verities, that is, in the object of the divine intelligence, where all conditional futurities must be comprised. For the case of the siege of Keilah forms part of a possible world, *which differs from ours only in all that is connected with this hypothesis*, and the idea of this possible world represents that which would happen in this case. Thus we have a principle for the certain knowledge of contingent futurities, whether they happen actually or must happen in a certain

³¹ δύναμις or *dunamis*, root to dynamic and translated in Latin as *potentia*

case. For in the region of the possibles they are represented as they are, namely, as free contingencies. Therefore neither the foreknowledge of contingent futurities nor the foundation for the certainty of this foreknowledge should cause us perplexity or seem to prejudice freedom. And though it were true and possible that contingent futurities consisting in free actions of reasonable creatures were entirely independent of the decrees of God and of external causes, there would still be means of foreseeing them; for God would see them as they are in the region of the possibles, before he decrees to admit them into existence.³² (Leibniz, 1996: 146, original emphasis)

Leibniz's description of God's temporal omniscience resembles very closely the conceptual solution proposed by Kripke to explain the different possible declinations of a statement on potentiality. Leibniz does instate a hierarchy amongst worlds, defining the actual as the best possible world, and there is, in possible world theory, a similar qualitative distinction between actuality and possibility. Modal logic explores worlds as they might have been while keeping the world as it has come to pass as a fundamentally different ensemble, and the adjective "actual" is used as a marker of superior ontological substance. There is an important tradition of debate around the ontological weight of possible worlds, which, as Doležel explains, "cannot preserve ontological innocence" (Doležel 1998: 786) outside of formal logic, and Leibniz's solution, which is informed by the mystic boundary between the transcendental and the immanent, does not serve the laicised version that is now used in literary theory. David Lewis argues that all possible worlds are real, existing as independent entities and differentiated by the actual world only through the position of the observer, while Kripke himself has said that "possible worlds are stipulated, not discovered by powerful telescopes" (Kripke, 1980: 44). This debate on the realism of possible worlds has already been indirectly addressed through the discussion on the nature of literary thought experiments, as well as with the distinctions drawn between different forms of causalities associated with fictional

³² Je viens à mon principe d'une infinité de Mondes possibles, représentés dans la région des vérités éternelles, c'est-à-dire dans l'objet de l'Intelligence divine, où il faut que tous les futurs conditionnels soient compris. Car le Siège de Kégila est d'un Monde possible, *qui ne diffère du nôtre qu'en tout ce qui a liaison avec cette hypothèse*, et l'idée de ce Monde possible représente ce qui arriveroit en ce cas. Donc nous avons un principe de la science certaine des contingens futurs, soit qu'ils arrivent actuellement, soit qu'ils doivent arriver dans un certain cas. Car dans la région des possibles, ils sont représentés tels qu'ils sont, c'est-à-dire contingens libres. Ce n'est donc pas la prescience des futurs contingens, ni le fondement de la certitude de cette prescience, qui nous doit embarrasser, ou qui peut faire préjudice à la liberté. Et quand il seroit vrai que les futurs contingens qui consistent dans les actions libres des créatures raisonnables, fussent entièrement indépendans des décrets de Dieu et des causes externes ; il y auroit moyen de les prévoir : car Dieu les verroit tels qu'ils sont dans la région des possibles, avant qu'il décernât de les admettre à l'existence (Leibniz, 1840 : 164).

narratives. In light of this argument, this question becomes of secondary importance, as it is contained, for the realm of fiction, within debates on intentionality, interpretation and authority. As the author, the “God” of the novel, has already been shown to be, for questions of meaning, a projection of the reader desiring an authoritative truth, the question of the relationship between possibility and actuality within the novel is transformed into a debate on mimetic fidelity, best represented, in these pages, by the distinction between the two Titans. While the contrast between the actual and the possible do enter into the personal relationship between the reader and the plot, seeing narrative as possible worlds is a means to bracket the questions of mimesis into second-order inquiries about accurate depiction. All fiction is drawing from the actual and creating the possible, and this same path can be used to understand their propositions, permitting, for instance the use of black holes as a means to better understand the infundibulum. But the actual epistemic worth of such propositions is a reconstruction by the reader through personal experience with the actual and the possible, and this experience lessens the distinction between the two. The infundibulum is possible in a very weak way; it can be considered. Meanwhile the black hole is actual in an equally feeble manner; as the extension of theoretical hypotheses. It is entirely unimportant if Vonnegut wanted to make his infundibulum a parody of black holes, or if his Titan was plausible enough to contend with the opinion of experts. Vonnegut’s observations and experimentations as an experimental novelist are secondary to the reader’s own observations and reconstructions of meaning. In fact, Vonnegut’s writing technique is absorbed into one more of the reader’s observation about the world, in a process that inverses Eco’s relationship between the model reader and the author. *The Sirens of Titan*, as a thought experiment without a fixed intentionality, can become an exposition of Bergson’s inward time, an example of synchronic reading, a depository for clashing viewpoints on causality or even a novel about meaning. This possible world, by fully acknowledging its status as potentiality, can be developed into many different forms of arguments. Kiekegaardian universal meaning, like Leibnizian possible worlds are bits of God’s mind that become momentarily accessible to the individual and immediately collapse once they have to contend with reality. But fiction, contained in books strewn about the planet, remains a portal to such considerations while still offering a frame of fixed characteristics. The connection between actuality and possibility does remain problematic from within the medium of the novel, as a way to test hypotheses and their

relationship to knowledge. But the necessary framework for this tension has not yet been entirely established, and this line of thought will be taken up again in the third act.

2.3.3. Possible Worlds and Time

Leibniz's definition of possible worlds, through its consideration of free will, adds another stake to possibility that is seldom discussed by theorists of fictional possible worlds. His picture of God's mind, as the depository of all possible outcomes, actually comes into close contact with causality. It corroborates Laplace's idea that causality is necessarily fixed but forever infinitely removed from intelligibility by proposing that choices act as branch-off points where different causalities can potentially exist. While the passage of time transforms these potential outcomes into a single line of causality, there is, from a universal point of view, a series of exponentially complex causal chains existing at the very heart of existence. It is as though God, sitting at his table, is drawing out multiple possible chains, only throwing them out as the world becomes actualised. These scraps of the becoming process are still present in many ways; they are the nostalgic desires for worlds that never came to be, the uchronies of literary what ifs and the objects of concern for relief felt following avoided catastrophes. This is why prophetic readings and mimetic moralisation drawn from SF scenarios are ultimately reductive; they ascribe to the idea that truth about the future is strongly intelligible. Le Guin's definition of science fiction takes aim at this reductionism, preferring to see the potential that writing offers as an experimental process. She allows literature to have its own set of possible outcomes, and coincidence with the actual world is only one of the potential results of the literary venture.

This has a strong resonance with claims of *fatum* found in *The Sirens of Titan*'s plot. Rumfoord enters into a timescape that is a step closer to God's own point of view. At first, his limited temporal omniscience of a fixed timeline seems to go against the idea that free will plays a role in the world's actualisation. But, as was discussed above, a door is left open at the end of the novel for another form of timeline free of the Tralfamadorian's UWTB influence. Rumfoord's frame of reference, which seems to transcend the punctual or phenomenological timescape, is in fact framed in another limitation. Rumfoord's actions are still undertaken

with the hope for an unknown resolution that would lead to reinstating free will upon the planet Earth. So *The Sirens of Titan* offers a possibility, becoming unstuck in time, but never answers the true question of time's shape. Time is crucial to potentiality in Leibniz's view of possible worlds, transforming potential into actuality, but its status in fiction seems much more complicated. For, as it has been seen, fictional time is understood through different intertwined causalities that partake in the attribution of sense to the plot. This poses an intriguing question about the relationship between literary texts and possible worlds, since it seems that within the text are many different possible resolutions to causal ambiguities, answers that are provided by different acts of sense-attribution. In *The Role of the Reader: Explorations in the Semiotics of Text*, Umberto Eco addresses this question indirectly by declaring that the literary text is "a machine for producing possible worlds (of the *fabula*, of the characters within the *fabula*, and of the reader outside the *fabula*)" (Eco, 1984: 246, original emphasis). The *fabula*, a Russian formalist notion describing the chronology of the plot, is therefore in itself divided amongst different forms of possible worlds. While this structure of possible worlds within possible worlds might seem unnecessarily complex, it greatly compliments my own structure of differing causalities associated with the fictional text. These three different groups of possible worlds ally themselves with the aforementioned causalities of plot and of reading, reducing the causality of writing to a subsection of the reader outside of the text, using historical reference to build different possibilities out of the author-function. It also divides the plot into an actualising *fabula* that is in itself understood by different viewpoints within the novel. Finally, it restates what has already been said about the non-causality of reading, that the novel is being performed every time someone reads it, and transformed into a personal possible world.

Time in *The Sirens of Titan* is a shared object. Both Rumfoord and Constant are quite linked in the causal logic that is operated by the Tralfamadorian desire to help the stranded Salo. Yet both these characters see time from a different perspective, thus understanding it as what I have called a "timescape." Eco's way of breaking down the novel allows for each of these characters to have their own possible world, limited by their respective point of views. Constant can continue to see the world as a series of random events, while Rumfoord knows it to be stuck in a causal chain. The coexistence of these two possible worlds within the novel

points to the possibility, for the reader, to question his or her own timeframe. By a form of literary sleight-of-hand, *The Sirens of Titan* becomes a novel about actual time, while remaining set in an imagined future and describing an infundibulation, which has no actual counterpart. This makes time, in *The Sirens of Titan*, one of the primary organising principles of possibility. Like God's mind in Leibniz, the reader's mind must juggle with the conditions of causal development, but Vonnegut's writing takes this form of limited temporal omniscience and further complicates it by asking questions about the mechanisms that allow for time to exist as an independent entity subjugated to different points of view. Having read the novel, the reader is entirely knowledgeable of Rumfoord's view on fixed time and its *telos*, conscious of Constant's limits as a punctual being, and left without any form of intelligibility as to his or her own timeframe. The reader is punctual in his or her own world, yet now acutely aware of the possibilities for the consideration of an outside perspective on time. This affects both his or her own reading experience and the underlying causality that must be employed to make sense out of the narrative.

Is there a way in which the reader can deconstruct the reading experience to make it akin to Rumfoord's own privileged view? In order to construct a causal theory of reading, Nelson, who has already been mentioned as studying causality in Zola, attempts to explore this idea.

When readers set out to trace a causal chain, they must begin with a state of affairs they select as a final effect. One may write that A causes B causes C causes D, but, since no logic leads ineluctably from A to D, one will have to begin with D and work backward to construct the chain. [...] As Nietzsche pointed out, in this sense the effect precedes the cause. The corollary holds that authors must work in the same way: to construct a causally coherent sequence, one must plan from effect to cause in antichronological order. Then, for mimetic value, since life seems to evolve from cause to effect without such preplanning, the narrator must "perceive" and relate the events in reverse (i.e., chronological) order. The ambiguity of "to relate" ("to narrate" and "to connect") was never more evident: events can only be related backward, so that they can subsequently be related forward." (Nelson, 1990: 68-69)

Nelson shows that, indeed, for sense to appear out of a causal order, one must inverse causality to retroactively make events lead to a conclusion. Eco, talking about the reading experience, explains that the possible readings of the someone outside the *fabula* become

limited as the story advances; restrained by new information that limits possibilities. As the reader initially begins to read *The Sirens of Titan*, he might feel that Rumfoord is acting out of a form of cruelty, punishing Constant for his apparent good luck. Once Rumfoord's ultimate goal is revealed, the same reader might hold on to this initial sentiment as a latent feeling that nonetheless tints the character of Rumfoord, but new information casts a definite shadow on first impressions. In light of Zola's complicated author turned function, giving primacy to a form of retrocausality only present in the creating and reading mind that is then chronologically reconstructed out of mimetic necessity seems to reduce all acts of reading and writing to an inversion of actuality, as though any form of understanding had to, in an imagined maze of causes and effects, work backwards from the solution to the initial cause. As a precept for understanding the world, this form of understanding takes the shape of an infinite regression, such as Aristotle's prime mover or Aquinas's second proof of God's existence;

In the world of sense we find there is an order of efficient causes. There is no case known (neither is it, indeed, possible) in which a thing is found to be the efficient cause of itself; in all efficient causes following in order, the first is the cause of the intermediate cause, and the intermediate is the cause of the ultimate cause, whether the intermediate cause be several, or only one. Now to take away the cause is to take away the effect. Therefore, if there be no first cause among efficient causes, there will be no ultimate, nor any intermediate cause. But if in efficient causes it is possible to go on to infinity, there will be no first efficient cause, neither will there be an ultimate effect, nor any intermediate efficient causes; all of which is plainly false. Therefore it is necessary to admit a first efficient cause, to which everyone gives the name of God.³³ (Aquinas, 1981: 13)

Thus the mind, scouring events in order to draw out some form of sense, is moving inexorably toward an infinite regress in the causal chain which warrants a prime mover, a God for the monotheists, and the author for a reader partial to biographical realism. Aquinas's proof,

³³ Invenimus enim in istis sensibilibus esse ordinem causarum efficientium, nec tamen invenitur, nec est possibile, quod aliquid sit causa efficiens sui ipsius; quia sic esset prius seipso, quod est impossibile. Non autem est possibile quod in causis efficientibus procedatur in infinitum. Quia in omnibus causis efficientibus ordinatis, primum est causa medii, et medium est causa ultimi, sive media sint plura sive unum tantum, remota autem causa, removetur effectus, ergo, si non fuerit primum in causis efficientibus, non erit ultimum nec medium. Sed si procedatur in infinitum in causis efficientibus, non erit prima causa efficiens, et sic non erit nec effectus ultimus, nec causae efficientes mediae, quod patet esse falsum. Ergo est necesse ponere aliquam causam efficientem primam, quam omnes Deum nominant (Aquinas, 1888).

which is greatly dependant upon what is possible and impossible in causal chains, demonstrates the paradoxical nature of causal explanation. While causal reasoning is inescapable, a badly engrained reflex of everyday life, the framework of possible worlds, which allows for other forms of timescapes such as infundibulation, should also be able to guide sense in a different manner. Otherwise, the novel is doomed to constantly return to the author's unknowable mind and the richness of possible readings reduced to exegesis of biographical research and interviews (which in turn might be criticised as surface information by psychoanalytical critics). Moving away from the need for essential cause is another by-product of possible world theory, as it is not concerned, like Aquinas, with what is fundamentally possible and impossible from a universalist viewpoint, but would rather try out different configurations of possibility to better understand the limits of the text. Thus, time, which is a fundamental frame to phenomenological existence, is transformed into an element of narration. Time-travel narratives, as shall be shown in the third act, take great advantage of this aspect of fiction, exposing causality's idiosyncrasies in a mode that goes beyond what actual everyday existence permits. They show, by adding an outside perspective similar to the one found in *The Sirens of Titan*, that chronological development can be understood as something other than an axiomatic necessity from which cause and effects have to be deduced.

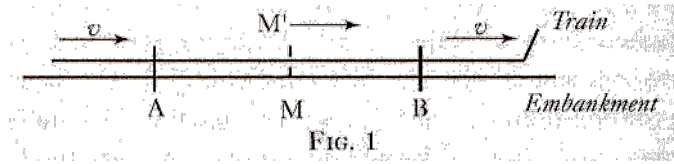
2.3.4. Time as the Fourth Dimension

So, what kind of entity is time? If it can be separated from causal understanding by the consideration of fictional possible worlds that use it as object of experimentation, then time must take a form that is free from, but does not contradict, Augustine's understanding of time as expectation moving through attention into memory. This deeply phenomenological conception of time is crucial to one framework of understanding, that of the reader understanding his or her own actuality, but the novel opens a way to take a step back and observe the process from a point of view that is no longer slave to the process' directionality. For those recalling the first act, this process might seem strangely similar to A. Square's encounter with the third dimension. An outside perspective to a phenomenological frame necessitates the kind of radical break with reality that the Sphere provides: a quasi-divine

movement from without. In *The Sirens of Titan*, this is supplied by the profane equivalent to the divine miracle; an unexplained astronomical hole in the rules of physics as they are understood. All discussions about Rumfoord's infundibulation leading up to this point have talked about his outside perspective, but what exactly does it mean to be "outside" punctual time? Punctual time, as its name implies is time lived as a point in a timeline. Thus, for Rumfoord to exist outside of punctual time means that he benefits from a perspective allowing him to see how the points of the present constitute a timeline. What the novel explains as a becoming-spiral can also be understood as entering into a second dimension of time. In fact, the spiral, as a geometrical figure is a line curving according to a two-dimensional pattern. If a one-dimensional line is drawn across the spiral, then various points of intersections are created. This representation shows, in a simple manner, how Rumfoord appears and disappears from the punctual timeline. The punctuality of Constant becomes a line through the process described by Augustine, and his constant loss of memory actually brings him closer to experimenting time in zero dimensions. Rumfoord, on the other hand, is immediately transformed, through infundibulation, into a being living time in two dimensions.

What does it mean to consider time as a dimension? This becomes an important question following Einstein's discovery of relativity. In *Relativity: The Special and the General Theory*, Einstein simplifies his own theories to explain how time and space influence each other:

We suppose a very long train traveling along the rails with the constant velocity v and in the directions indicated in Fig. 1. People traveling in this train will with advantage use the train as a rigid reference-body (co-ordinate system); they regard all events in reference to the train. Then every event which takes place along the line also takes place at a particular point of the train. Also the definition of simultaneity can be given relative to the train in exactly the same way as with respect to the embankment. As a natural consequence, however, the following question arises: Are two events (*e.g.* the two strikes of lightning A and B) which are simultaneous *with reference to the railway embankment* also simultaneous *relatively to the train*? We shall show directly that the answer must be in the negative. (Einstein, 1961: 29-30, original emphasis)



Through this thought experiment, Einstein comes to the following conclusion; events can only be simultaneous according to an observer at the M point who, with the necessary tools, can confirm that the light rays of the two events each reach an equidistant point from the two origins (A and B). On the other hand, the observer and the train (M'), that is directly opposite the observer M at the moment the events are happening, would observe event B a fraction of a second before event A. Einstein concludes that the idea of simultaneity is relative to the observer. Simultaneity is a presupposition for the system of earthly clocks, one that gives us the frame of reference from which time becomes a universal concept. Therefore, a temporal notion (simultaneity of events) is linked to a spatial concept (the speed of the observer). Furthermore, since Einstein also established that the speed of light was fixed, then the speed of the train cannot be added to that of the perception of the events. So, light moving from B to M' is as fast as light moving from B to M, even if M' is moving towards it. According to special relativity, time has to adjust in order to account for the train's speed. Time is thus slower for M' than for M. This proposition caused a great stir in scientific conceptual apparatus, linking time to space in a way that made them inextricable from one another. It had many counterintuitive repercussions, such as the twins paradox, which Hawking explains in *A Brief History of Time*:

The theory of relativity gets rid of absolute time. Consider a pair of twins. Suppose that one twin goes to live on the top of a mountain while the other stays at sea level. The first twin would age faster than the second. Thus, if they met again, one would be older than the other. In this case, the difference in ages would be very small, but it would be much larger if one of the twins went for a long trip in a spaceship at nearly the speed of light. When he returned, he would be much younger than the one who stayed on earth. This is known as the twins paradox, but it is a paradox only if one has the idea of absolute time at the back of one's mind. (Hawking, 1998 : 34)

Time, liberated from its inescapable punctuality, becomes an object of deep conceptual recalibration. As a direct correlate to space, time can be included within the three-dimensional

model of breadth, width and length, thanks to Minkowski, one of Einstein's teachers, who coined the hyphenated notion of space-time:

Space is a three-dimensional continuum. By this we mean that it is possible to describe the position of a point (at rest) by means of three numbers (co-ordinates) x, y, z , and that there is an indefinite number of points in the neighbourhood of this one, the position of which can be described by co-ordinates such as x_I, y_I, z_I , which may be as near as we choose to the respective values of the co-ordinates x, y, z , of the first point. In virtue of the latter property we speak of a "continuum," and owing to the fact that there are three co-ordinates we speak of it as being "three-dimensional." Similarly, the world of physical phenomena which was briefly called "world" by Minkowski is naturally four-dimensional in the space-time sense. For it is composed of individual events, each of which is described by four numbers, namely, three space co-ordinates x, y, z and a time co-ordinate, the time-value t . The "world" is in this sense also a continuum; for every event there are as many "neighbouring" events (realised or at least thinkable) as we care to choose. (Einstein, 1961: 61-62)

So time is a dimension insofar as it is understood within a coordinate system that includes the three dimensions of space as fluctuating according to the timeline. Rumfoord, through infundibulation, has intimate knowledge of the fourth dimension as he exists in a mode of being that partakes in the four dimensions through yet another, second, dimension of time. Infundibulation, as understood by the physics of relativity, is the opening of the fifth dimension. This also accounts for the constant spatial analogies used to describe time in the novel. Finally, it also provides a much better framework to understand the speculative examples of Hawking concerning black holes. They too, then, potentially bend the space-time continuum, allowing for time-travel along a twist of the fourth dimension. Now that the causal peculiarities of *The Sirens of Titan* have been discussed thoroughly, and now that possible world theory has allowed for a combination of many causalities to coexist through an ensemble of different potential worlds, it becomes clear that modelling time as a dimension is a way to include it as an observable and intelligible element within those worlds. Through a vision of a fixed time, *The Sirens of Titan* has allowed for time to become free of causal prejudice, granting it status as an element that partakes in potentiality without reducing it to a causal chain.

2.4.1. Conclusion

Time is an incredibly slippery subject. As a roundabout way to enter into its inner workings, it was necessary to address its foremost presupposition: causality. Present in all forms of interaction with the novel, causality is also at the heart of the experimental method. Zola's author, with his split personality of experimentalist and observer, acts as the causal presupposition's embodiment, becoming a figure that explains writing as epistemological, but also as deeply seeped in a process of intelligible authoring. This process, while central to naïve reading, becomes problematic once it is realized that meaning in the novel can appear from a place that is outside of the author's intentionality. Yet while literary theorists usually outgrow their biographical phase, the same causal spectre invariable rises up again as a means to render plot or reading experience intelligible. This form of causality is, in a way, necessary as a stepping-stone or a tool for plot comprehension, in the same way that *mimesis* allows some forms of understandings, such as the deciphering of words like "planet" or "Titan" within the narrative. But both are potential nuisances when they attempt to expand into universal meaning. Possible worlds allow for a compartmentalization of such universal inklings, removing the pretence of unique meaning from readings of *The Sirens of Titan* that make the novel into an illustration of causality (*fatum*) or *mimesis*. In turn, these possible worlds allow for various offshoots through divergent readings of polysemic instances.

Now that causal time has been painstakingly removed from presuppositions of literary understanding, it can be discussed in a much clearer manner. Since *The Sirens of Titan* describes a state of affairs where different viewpoints on a single timeline are possible, it opens up its own subset of possibility, asking the question of time as an observable entity. This, it is now clear, can best be discussed using the notion of space-time, for it allows a model of time that still has its impact on space, while also giving it its own dimension (and, by extension, other potential dimensions from which to observe it). But how can this framework explain *Flatland's* exposition of a fourth *spatial* dimension? In Minkowski's model, space is relegated to its three dimensions so tesseracts, spissitude and *Flatland* as a spatial analogy cannot be fully explained through using time as a dimension. Computer graphic models of the tesseract, which cannot be entirely seen in their full four-dimensional glory with the eyes of a three-dimensional human being, often use movement as a means to convey a sense of the

actual shape. This functions in the same way that the Sphere's movement, in *Flatland*, intersects A. Square's world to become a point that grows into a large circle, which in turn shrinks back to a point. But no amount of temporal trickery would replace the conceptual specificity of the tesseract as an entirely spatial four-dimensional shape. By definition, the tesseract needs a four-dimensional conceptual space to exist. Yet, Rumfoord's own wavelike nature, his becoming-movement, seems to work in a way that is analogous to this temporal representation of a spatial fourth dimension. It is unclear, for the moment, how the process that allows time to be understood as a dimension is related to the spatial analogy contained in *Flatland*. Was Hinton's claim that he could "see" the fourth dimension similar to Rumfoord's description of time as a rollercoaster? Imposing a definite historical moment where the fourth dimension would move from spatial to temporal seems counterproductive to the efforts made to free time from causality, so how can both these conceptions of the fourth dimension coexist and what do they tell us about the epistemic fallout of literary readings?

The principal clue that shall guide these remaining questions has to come from the reader-function, which, through a chaotic model, was shown to work in a mode that was outside of causality, or rather beyond the causal presupposition. Just as the author-function came to represent the eventual limit in the quest for an origin, which would in turn render the novel intelligible, the reader-function is the limit in sense ascription and in *telos*. This limit is surprisingly similar to the restrictions ascribed to the Laplacian daemon by the advent of quantum physics. David Bohm, in *Causality & Chance in Modern Physics* describes these inevitable boundaries in a way that could also be applied to the reader;

Let us recall that no matter how far one goes in the expression of the laws of nature, the results will always depend in an unavoidable way on essentially independent contingencies which exist outside the context under investigation, and which are therefore undergoing chance fluctuations relative to the motions inside the context in question. For this reason, the causal laws applying inside any specified context will evidently not be adequate for the perfect prediction even of what goes on inside this context alone. [...] The essential independence of different contexts implies that the processes taking place within a given context cannot provide a complete and perfect reflection of what goes on in the infinite totality of possible contexts. For example, because of the cancellation of chance fluctuations, the precise details of atomic motions are not usually reflected to any significant extent in the laws of the macroscopic level. The laws of

each new context must then, in general, be discovered with the aid of new kinds of experiments, set up so as to create conditions in which the laws of the new context under investigation are significantly reflected in the behaviour of the apparatus. Hence, even to know what the totality of all the laws of nature is, the super-being would have to do an infinity of different kinds of experiments, each of which would give results that depended significantly on the laws of a different context, so that he could thereby obtain the necessary information. In doing this, he would have to be able to discover not only all the already operating kinds of laws, but also all the new laws that are expressible only in terms of the infinity of new qualities, new entities, and new levels that are going to come into being, all the way into the infinite future. It is evident, then that if the Laplacian super-being resembles us to the extent of obtaining his knowledge through a series of investigations of partial segments of the universe, and not, for example, by Divine revelation or by *a priori* intuitions which he finds by plumbing the depths of his own mind, he will never be able to predict the entire future of the universe or even to approach such a prediction as a limit, no matter how good a calculator he may be. (Bohm, 1961: 158-159)

The reader, by taking on the guise of the failed Laplacian daemon, is analogously discarding the possibility for all actualisable possibilities to take place, since such a reader, who vaguely embodies all possible readings as a rhetorical figure, is thoroughly divorced from the actual reading experience. While the Laplacian daemon is in the act of reading the actual world through the laws of nature, the reader's limited stance of reading a narrative as a possible world is caught in the same structural limitations that are themselves greatly enhanced by the distance between Laplace's omniscient being and his own individuality. But even without this distance, even if the reader was also a being of extensive knowledge, Bohm's exposition shows that "if he did have such revelations or intuitions, a calculation would hardly be necessary, since the detailed prediction of the behaviour of the universe would then require a miracle only slightly greater than that by which he would learn the basic laws of the universe in the first place" (Bohm, 1961: 159). So the reader-function is the response to this inevitable limitedness of the reader. It becomes clearer and clearer that without being inscribed within a limited viewpoint, no reading is possible, for omniscience implies having already read. But this reader-function, which is in fact the placeholder for the impossibility of defining an adequate representation of a model reader, is the ideal construct to understand the epistemic stakes of a literature that functions both within time and space and projects the possibilities for extensional thoughts that go beyond these limits. As a rhetorical device, the reader-function is

this opening through which a possibility becomes an experiment, as well as the means through which experiments lead to new possibilities. It is an impossible figure that yields the developed conceptual apparatus—truncated thought experiments, fractal possible worlds and overlapping dimensions—to bring forth new knowledge through an encounter with fiction. It is a single reading experience as all reading experiences; the anti-matter to causality's matter, through the contact of which meaning is born out of a figurative big bang.

The Dimensions of Possibility

We talk much of Imagination. We talk of the Imagination of Poets, the Imagination of Artists, &t; I am inclined to think that in general we don't know exactly what we are talking about...

It is that which penetrates into the unseen worlds around us, the worlds of Science. It is that which feels & discovers what is, the real which we see not, which exists not for our senses. Those who have learned to walk on the threshold of the unknown worlds... may then with the fair white wings of Imagination hope to soar further into the unexplored amidst which we live.

- Ada Lovelace

Untitled Essay, January 5th 1841

First, there is nothing. Then in the middle of the emptiness, a six-letter word, written in the Cyrillic alphabet appears, bordered by small squares above the first two letters and below the last two. At the very bottom edge, there looks to be a simple two-word question, first three characters, and then seven, followed by a question mark. Next to the question mark, between two parentheses, the numerals for zero and nine are separated by a hyphen, suggesting both the continuum of one-digit numbers and that the answer to the question is one of these simple decimal units. After a dash, a cursor is blinking, suggesting the ticking of the passing seconds as a decision is made. A number is chosen, either blindly, or as the initiated response to the repetition of the task. Either one has been through this ordeal before, or is plunging headfirst into unknown territory—in which case, this old veteran will say, the lower choice would also be the wiser. As soon as a number is chosen, everything is put into place. Following a brief return into nothingness, a rectangular container materialises from the top down. And the cruel, unending ordeal begins. Instructions in Russian border the playing field, but there is no time to read or translate their meaning as the first playing piece plummets to the bottom of the cylinder. A twisted block, shaped like an S or a snake. It finds its place and sticks, forever fixed at its point of contact, darkening to signify its newfound immovability. Then another follows, this time resembling an L, or a psychiatrist's couch. Again, it connects to the bottom of the field, whether it lands on the previous piece or the bare ends of its limited

arena. The curious participant will find that these blocks can be controlled, moved from left to right, as well as rotated, before they find their steadfast hold. And if by luck or skill all pieces come to be aligned, filling their rectangle recipient's width at any given height, then, by some sort of wizardry, the line disappears. This temporarily delays the inevitable filling of space, a space threatening to run out as air does in a drowning lung. But, the one thing that only becomes obvious once the "game" has been played long enough, is that there are only two concluding options: either one plays endlessly, or fails.

When attempting to find examples of liminal narratives, cultural creations that can be read, yet remain opaque in meaning, an example came to mind: Alexey Pajitnov's *Tetris*. Video game classicists, a burgeoning category if there ever was one, will have recognized the opening paragraph as a dramatization of Pajitnov's definitive puzzle, arguably the most influential ludic code ever written. What is interesting about *Tetris* is that it eschews any mimetic reference to an outside world. In its original version, *Tetris* is given as it is; it has no 8-bit rendition of the Russian folk song *Korobeiniki*, and no opening graphics depicting the Kremlin, both characteristics that would be added for the Nintendo version, and that have now become canonical due to the great popularity of the portable handheld Gameboy system. The original *Tetris* is a barren field and tumbling blocks, which could be described as "falling," but are arguably uniformly moving downwards along the y-axis. *Tetris* is a pure geometrical abstraction; there are no analogous referents to its disappearing lines and odd shapes. Yet, it can still be told as a story. Following the thought experiment logic, one can begin to explain *Tetris*, finding means by which blocks are dropped into this two-dimensional vortex. Perhaps a moving factory line is randomly assembling the four units that make up the blocks and a conveyor belt is dropping them into the screen. Perhaps an odd magician is playing with the player's patience, withholding the needed pieces until it is too late. The game could be depicting the very small, magnifying odd subatomic blocks that have the characteristic of disappearing when aligned, or the very large, with gigantic monoliths being thrown by gods onto a lifeless and concave two-dimensional planet. From an empiric and historical reading, *Tetris* is code that is responsible for the entire experience, but code that spans from the creative mind of Pajitnov, himself influenced by Dudeney's pentominos, to the programmer's adaptation that is presently being played.

From a simple game comes a multitude of ramifications, stories and interpretations. The Cyrillic, found in the original version, can be translated, but it is not in the written expression of the game's surrounding instructions that meaning is expressed. It can also be adapted into a bare signifier for Russianness, such as with Nintendo's version, which would give a sense of cultural provenance through music and images so stereotypical that they could hold for Japanese, European and American audiences. Yet, there is another language that can claim to fully express *Tetris*:

```
long h[4];t(){h[3]=h[3]/3000;setitimer(0,h,0);}c,d,l,v[]={(int)t,0,2},w,s,l,K=0,i=276,j,k,q[276],Q[276],*n=q,*m,x=17,f[]={7,-13,-12,1,8,-11,-12,-1,9,-1,1,12,3,-13,-12,-1,12,-1,11,1,15,-1,13,1,18,-1,1,2,0,-12,-1,11,1,-12,1,13,10,-12,1,12,11,-12,-1,1,2,-12,-1,12,13,-12,12,13,14,-11,-1,1,4,-13,-12,12,16,-11,-12,12,17,-13,1,-1,5,-12,12,11,6,-12,12,24};u(){for(i=11;++i<264;)if((k=q[i])-Q[i]){Q[i]=k;if(i-++i||i%12<1)printf("\033[%d;%dH",(I=i)/12,i%12*2+28);printf("\033[%dm"+(K-k?0:5),k);K=k;}Q[263]=c=getchar();}G(b){for(i=4;i--);if(q[i?b+n[i]:b])return 0;return 1;}g(b){for(i=4;i--;q[i?x+n[i]:x]=b);}main(C,V,a)char**V,*a;{h[3]=1000000/(l=C>1?atoi(V[1]):2);for(a=C>2?V[2]:"jkl pq";i;i--)*n++=i<25||i%12<2?7:0; srand(getpid());system("stty cbreak -echo stop u");sigvec(14,v,0);t();puts("\033[H\033[J");for(n=f+rand()%7*4;;g(7),u(),g(0)){if(c<0){if(G(x+12))x+=12;else{g(7);++w;for(j=0;j<252;j=12*(j/12+1))for(q[++j]);if(j%12==10){for(;j%12;q[j--]=0);u();for(--j;q[j+12]=q[j]);u();}n=f+rand()%7*4;G(x=17)|(c=a[5]);}if(c==*a)G(--x)||++x;if(c==a[1])n=f+4**(m=n),G(x)|(n=m);if(c==a[2])G(++x)||--x;if(c==a[3])for(;G(x+12);++w)x+=12;if(c==a[4]||c==a[5]){s=sigblock(8192);printf("\033[H\033[J\033[0m%d\n",w);if(c==a[5])break;for(j=264;j--;Q[j]=0);while(getchar()-a[4]);puts("\033[H\033[J\033[7m");sigsetmask(s);}d=popen("stty -cbreak echo stop \023;sort -mnr -o HI - HI;cat HI","w");fprintf(d,"%4d from level %1d by %s\n",w,l,getlogin());pclose(d);} (Tromp, 1989)
```

This obscure code, a Unix simplification of the original *Tetris*, describes, for a machine, all the possible worlds of the game in potential form, from a strictly structural point of view. It generates the conditions of possibility of the simple puzzle: acceleration of the pieces, random selection of the seven types of blocks, and conduct of the playing field according to different combinations. Yet it bypasses mention of the individual experiences of the game: the frustrations of repeated gameplay, the lost hours perfecting a simple task in a near-meditative state. It also leaves out the fact that *Tetris* was later adapted into three-dimensional, four-dimensional and n-dimensional versions. These extra stories, stemming from interaction with the code, can never be fully recounted or contained through it. While *Tetris* is at the farthest

ends of narrative fiction, arguably telling no other story than its own coded rules, it can be read in ways that were never encoded in its workings.

This example is an attempt at isolating an element that is central to the investigation from its specific narrative context. What is the generating element that brings forth further possibilities into being? Are there differences between the internal possibilities of the code and those that stem from an interaction with a reader-function? There is an imperative need to answer questions that relate the many forms of text and their relationship to knowledge. Both *The Sirens of Titan* and *Flatland* provide examples of different readings and interactions with meaning through the extension of their notion of “dimension.” But they do so through associations with different disciplines at many levels: language, medium, form and modality. By juxtaposing the two chosen novels with other liminal examples, this act explores the ways in which a radical variable such as the reader can lead to definite knowledge without being reduced to a fixed interpretative stance, negating the potentiality of the text. It also addresses the problem of meaning’s limits, which becomes crucial when addressing potentiality as an endless yet not a directionless process. Indeed, how can meaning withstand the objection that “postmodern” readings lead to a radical breakdown of objectivity and the “real?” As shall be shown, by breaking down literary knowledge into many different presuppositions and processes—causality, analogy, extensional logic, compossibility—, apprehended knowledge goes through different dimensions of possibility. Thus, it works in ways similar to *Tetris*; the code, or algebra, of the original text generates conditions of possibilities, which are then explored beyond their original parameters through a reading-function that is in itself also expandable according to the possible worlds in which it finds itself. Thus many compossible readings exist within the text, and through the constant shift in reader-function, each work of literature remains endlessly expandable into different areas of knowledge.

3.1.1. Literary Science

On October 29th 2012, a seemingly inconspicuous article appeared on arXiv, an online archive (as it is meant to be pronounced) for scientific papers preprints. This article, “Possible Bubbles of Spacetime [sic] Curvature in the South Pacific,”—a title that could, to the

uninitiated, seem to correspond with its contextual database—jumps out as particularly strange to a thinker familiar with the implications of the titular juxtaposition. While localised space-time curvature has become a staple of post-Einsteinian theoretical physics, it has typically been conceptualised at a safe distance, either within the confines of outer-space or the alien realms of the subatomic, where radical conditions of gravity (black holes) or hypothetical particles (tachyons) are given free-reign in a relatively vast near-emptiness. What warrants amazement is therefore the idea of energy displacement extreme to the point of bending space and time in a recognisable geographical location, the South Pacific, since it also implies an observable scale. Indeed, all known theoretical situations that could lead to these bubbles, found within this world’s environment and apparent to the naked eye, would need such an imposing force that only a corresponding counterforce could prevent a general collapse of the planet upon itself. This fact transposes the curiosity found in the title to the foremost “possible” which, as an adjective, should merely cause an inflection in the described bubbles’ ontological status, but acts instead as a general marker of doubt for the entire paper’s implicit claim to empiricism. Such a claim, garnered through the associative logic of arXiv itself, is further questioned as the reader notices that the paper has been classified as “popular science.” What type of popular science text discusses hitherto unknown phenomena under the hypothetical guise of the possible?

The answer takes the form of an intertextual jest intelligible only to a certain segment of readership. Indeed, Benjamin K. Tippett, the paper’s author, is not speaking from first-hand experience; rather, he is relating a perceived similitude between two different events as understood through the harrowing written accounts of Dr. William Dyer and Francis Wayland Thurston. These two stories relate incidents that, while separated by geography and time—respectively Antarctica in 1930 and an undisclosed South Pacific island in 1925—, are likened by a shared sense of dread in their retelling as well as the dismissal strategy employed by the receiving public. Tippett relates that “Dyer’s adventures in Antarctica have been dismissed as being due hallucinations incurred by a high-altitude cerebral edema” while “Thurston’s manuscript [...] has often been interpreted as being the creative work of a paranoid mind in the grip of some tragic delirium” (Tippett, 2012: 1). Discredited by one form or another of brain trauma, these two accounts are marred by the stigma of less-than-perfect mental acuity

from the onset of their reception. Furthering dubiousness, Thurston is functioning within a network of hearsay; according to Tippet, he is building upon the work of his late uncle, Dr. George Angell (studying the source of Thurston's account reveals that, in actuality, this man is his grand-uncle), as well as the story of Gustaf Johanson, the second-mate of the schooner *Emma*. Clearly, the narrative presented by Tippet is that while both these authors underwent experiences that seem to describe space-time curvature, their unprecedented tales were initially stripped of their credibility, which in turn explains their relative obscurity during the timespan stretching between their publication and Tippet's own analysis. In fact, Tippet explicitly claims that his paper has the "purpose [...] to provide a unified explanation for many of Johnansen's seemingly *nonsensical* descriptions" (Tippet, 2012: 2, original emphasis). But something else is at play in "Possible Bubbles of Spacetime Curvature in the South Pacific," and it soon becomes apparent. Tippet has verified Thurston's sources, finding evidence of Johansen's claims (the *Emma*'s loss and the crew's demise are said to be "well documented" (Tippet, 2012: 2) and the *Sydney Bulletin* has described Johansen's return to land), but while Tippet is "convinced of the pedigree of Thurston's documents," he nonetheless asks; "even if we can trust the paper, to what degree can we trust the words written upon it?" (Tippet, 2012: 2). As shall be shortly shown, the reader of Tippet's own research should be evaluating it with the same caution.

As Tippet describes first his chosen authors' biography and then their findings, certain readers of early 20th-century weird tales will become immediately aware of his hoax. If his mention of "non-Euclidean geometry" or of the famed Miskatonic University of Arkham are not enough, then the remark that both Dyer and Thurston are "familiar with (what has been referred to as) the *Cthulhu cult*" (Tippet, 2012: 2), should at least bear some form of literary familiarity. Indeed, in the comments section of his text's description on arXiv, Tippet mentions jokingly that "before you charter a boat, please look up the collected works of HP Lovecraft." The reason for such a warning is clear; while all references to Lovecraft have been carefully cloaked in Tippet's main text, the described textual evidence has been drawn from the body of work dubbed the "Cthulhu Mythos" by August Derleth, a designation that has become commonplace amongst Lovecraftian scholars and readers. Both Dyer and Thurston are characters written by Lovecraft, and can be found respectively in *At the*

Mountains of Madness and *The Call of Cthulhu*. In short, Tippet's text is literary criticism masked as popular physics. Tippet plays with the reader's expectations both through form and context, hiding any direct references to Lovecraft in the main body of his text. For instance, his bibliography ascribes the two stories to their particular narrators, following a type of frame narrative that is mimicking Lovecraft's own tendency to cite invented manuscripts and journal articles in order to strengthen the verisimilitude of his writing.

Yet, Tippet is mostly concerned with a few details that he reads as potential indicators of space-time curvature bubbles, making his argument about the phenomenological experience of being caught in these bubbles, rather than about Lovecraft's two tales. Having debunked his initial artifice, the reader is still faced with hard physical data and figures, which act as the lens through which the stories are read. While the argument eventually returns to the textual analysis of Lovecraft's descriptions, much of Tippet's text is popular physics, and he provides formulae, matrices, graphs and even a visual approximation of space-time curvature's effect on light rays and time. Figure 4, on page 7, carefully recreates, using metrics devised according to calculations found within the theory of relativity, the visual effect of a space-time bubble as observer is moving relatively to its centre. While this could, in a way, be described as a form of thought experiment on Tippet's part, the process by which the physics of the article interact with the textual elements drawn from fiction seem to be, in effect, opposite to the typical process of thought experimentation. Instead of creating a situation that corresponds to a hypothetical problem, Tippet uses Lovecraft's puzzling descriptions as the basis for elucidation. He is not attempting to discover the ramifications of conceptual ganders, but rather to ramify the discovered hypotheses of physical concepts. The quote that governs the first part of his analysis mentions "an angle of masonry which shouldn't have been there; an angle which was acute, but behaved as if it were obtuse" (Lovecraft, 1999: 167) in which Johansen's shipmate, Parker, is swallowed. Readers of Lovecraft will recognize a recurrent trope in his work, which is part of a slew of small repeated expressions that help entrench the idea of a *mythos* governing the internal coherence of many Lovecraftian stories. Just as the oft-mentioned Necronomicon is always written by the "mad Arab Abdul Alhazred" (Lovecraft, 1999: 156), and the architecture is often "Cyclopean" (Lovecraft, 1999: 143)—a detail of worth considering both the nonlinear aspect of this type of masonry, its basis in myth as well

as the already discussed necessity of two eyes needed to see the third dimension—, Lovecraft’s description of the geometric intricacies linked with the forgotten and frightening civilizations that predate the human domination of the planet are almost always “non-Euclidean” (Lovecraft, 1999: 166). Tippett uses this description to launch a reflection on the meaning of Lovecraft’s own recurrent term:

We are used to *flat* space or, rather, *space bearing no intrinsic curvature*. The relationships, and laws detailing the lengths of lines, areas, and volumes are those which were compiled in the ageless writings of Euclid, and thus, a flat space is commonly described as being *Euclidean*. In contrast, all geometric rules relating to lines, areas, and volumes on curved surfaces are described as being *Non-Euclidean*. In Euclidean geometry, the triangular area subtending two straight lines which meet at an acute angle θ will be $A_{flat} = \frac{1}{2}l^2 \tan(\theta)$ where l is the length of the line lying at the base of the triangle (as Euclid described, two such lines will meet at one and only one point). Contrast this to [...] *hyperbolic* spatial geometry, or *space with a constant negative curvature*. The simplest way to understand such a system is to imagine drawing lines and painting in areas upon the surface of a large saddle. In such a situation, locally *straight lines* are set to lie as hyperbola upon the saddle. In hyperbolic geometry, two lines which cross at a point will spread apart at a much faster rate than they would in Euclidean geometry. The area subtended between two such straight lines must satisfy $A_{hyperbolic} > \frac{1}{2}l^2 \tan(\theta)$. Thus, we contend that the three dimensional space of Johansen’s island must have had a hyperbolic spatial geometry, justifying his surprise at the area between the beam and the ground. (Tippett, 2012: 5, original emphasis)

In the longer argument Tippett first discusses elliptic spatial geometry, a space with a constant positive curvature, and then moves on to establish that only hyperbolic spatial geometry, a space with a constant negative curvature, could produce an acute angle that behaves like an obtuse one, in fact adjoining Lovecraft’s own expression, non-Euclidian, with the descriptive elements of his story, and offering in passing an alternative interpretation of the literary tropes of ellipse and hyperbole. Tippett moves from a textual element, and finds within its description the potential for a form of interpretation that corresponds perfectly to another area of knowledge, which he in turn uses to interrogate his initial source. Arguably, this association is already present in *The Call of Cthulhu*, and its recurring negation of the Euclidean makes this discovery a direct extension of Lovecraft’s own, conscious, development. But Tippett’s work actually defines the type of non-Euclidian space that would be necessary in

order for Lovecraft's story to work, working notions that are drawn from an area that specialises in studying the different iterations of the non-Euclidean in order to further specify the ways in which *The Call of Cthulhu* can become a treaty in the strangeness of the geometric rather than on the fearsomeness of the cosmologic. Whereas the non-Euclidean is subsumed, in Lovecraft, to the *mythos*, it becomes a central point of coherence in Tippet's own reading.

The idea that the island on which Johansen encounters the dreadful star-spawn is warped by a negative four-dimensional space-time curvature leads Tippet, through a series of close-readings, to establish a few different conclusions that further the implications of warping the universe's very fabric. One especially clever point made by Tippet, is that this saddle-like curve in space-time explains a narrative ellipse wrought by Lovecraft in which Johansen, upon leaving the island, is seen as delirious for two weeks before being discovered. Tippet argues that while one could imagine Johansen drinking as well as feeding himself during this period and then forgetting these acts as one forgets instinctual gestures when faced with a greater crisis, another explanation could account for Johansen's own impressions of having remained bunkered within his own cabin. In keeping with some of my observations on the notion of space-time's relationship to causality, Tippet observes that

consistent with the spacetime [sic] bubble hypothesis, though, is the possibility that Johansen experienced time dilation. One effect of the curvature of spacetime in the bubble is that, to put it simply, time passes at a slower rate inside of the bubble. Thus it is reasonable that while two weeks elapsed in the outside world, only a handful of hours or days were experienced by Johansen and his crew over the course of their bizarre adventure. (Tippet, 2012: 10)

This extension of the space-time bubble hypothesis to events that are, in fact, very common in Lovecraft's literature (the loss of reason, the destruction of causal certainty, the ellipses caused by delirium that act instead as hyperboles of horrific experiences), becomes central to Tippet's strategy. It shows that while Tippet works extensions proposed by Lovecraft's own written expressions, these extensions move beyond the initial, vulgarising, exposition of the non-Euclidean, to offer an entirely new way of reading Lovecraft. In fact, it is as though physics had allowed Lovecraft to become even more coherent, jettisoning the notion of the Cthulhu *mythos* outside of fantastical horror and into a kind of science fictional proposition. Tippet truly crystallises his hypothesis in a final remark that carries its risks for his

(fictional?) credibility. Without “entering the domain of the fabulist or occultist” (Tippett, 2012: 10), he wishes only to observe that such a space-time bubble would have, as a necessary attribute, a centre that is entirely removed from the passage of time. So the poem repeated throughout *A Call of Cthulhu* like a refrain or a *ritournelle*, “That is not dead which can eternal lie,/And with strange aeons even death may die” (Tippett, 2012: 10), comes to signify that at the heart of the space-time bubble, lies an eternal Cthulhu, bending the four dimensional space-time through a form of supernatural influence. In light of Tippett’s discussion, both Lovecraft and relativity attain a form of mutual clarity, if only for a moment, through a strange osmosis or co-parasitism. It is not that they fit together perfectly, overlapping as though they were direct equivalents, but rather that their conjuncture is an enlightening possibility. Tippett insists on this possibility, drawing conclusions that shed a new light on *The Call of Cthulhu*’s narrative structure. By making use of a judiciously chosen framework, he goes beyond Lovecraft’s non-Euclidean fixation and offers actual ways in which the recent development of the physics sphere can be used to read Lovecraft’s stories.

In certain respects, both *Flatland* and *The Sirens of Titan* have been read like Tippett reads Lovecraft—as the depositories of definite knowledge that can be understood anew through a combination of literal reading and associative topoi. Yet, a recurring tension has occurred between the constant need to anchor the truth of affirmations around a kind of criterion or axiom and the contradictory nature of literary knowledge as fiction. Tippett shows that a form of meaningful literary analysis, one that expands on the notions used to read the text, necessitates a self-contained thought experimental process that evacuates meta-considerations linked with the truth-value of the source material in itself, replacing these considerations with the establishment of a possible world. Oftentimes, the text’s author is a pole of attraction for such meta-considerations, blocking potential of the written work from view with a perceived statute of authority. Barthes and Foucault initiated a substantial process to question this authority, and the substitution of the author with an author-function has already helped uncover ways in which fiction works outside of a strictly biographical mode. This is a key element of the argument, since it illustrates how cognitive considerations can move away from the ways in which the cognitive sciences have been integrated within the literary institution: as new avenues for historical readings of biographical details. Yet, since

the investigation has been working towards establishing a form of knowledge drawn from fictional narratives that can contend with the empiric while moving away from the mimetic mode, the argument has often reverted back to the consideration of authorship-based ideas drawn from conjunctures found within direct readings of biographical details. As A. Square, a fictional character, mentions Howard Candler in his dedication to *Flatland*, thus linking Abbott to Hinton, and as Vonnegut uses notions and themes in *The Sirens of Titan* that will later find extensions in *Slaughterhouse-Five*, certain presuppositions regarding the reader can be altered and re-examined using direct influence of derivative works and historical details to shed new light on the ways in which the novel may be included within a constellation of associations. In Tippett's case, for instance, while Lovecraft is evacuated from the main body of the text, he nonetheless permeates the entire argument as an overarching frame. Being aware of Tippett's subterfuge is essential to perceive the literary nature of his argument. Otherwise, an entirely clueless reader would still find plenty to ponder, but the "actual world" repercussions of locally observed bubbles of space-time curvature would be greatly warped by the failure to grasp the fictionality of the source material. Yet Tippett, as the author-function of this little hoax, is always read alongside his own interpretation of the Lovecraftian *mythos*. Through his method, he becomes either a trickster-figure or the scientific author writing a paper on space-time. Tippett's possible world, where the Cthulhu *mythos* found in Lovecraft is overlain onto the world as it has developed (a world that has seen its physics evolve to the same point, where arXiv exists as a publishing medium, etc.), must necessarily include Tippett as an author-function and it shows exactly how loaded thought experiments become once they free themselves from the first degree of authority. It also hints at the complex relationship between thought experiments and the possible worlds that they generate.

This relationship, when found within works of fiction, is incredibly complex and shall be the main concern of what follows. As the above example illustrates, the interplay between medium, reading and knowledge have great epistemological implications, going further than the mere interpretation of texts as mimesis. This approach has established a sort of implicit interaction between *Flatland* and *The Sirens of Titan*, leading to a problematic intersection between the temporal and the spatial named the fourth dimension. It has already been noted that the idea of a dimension, as it is found in both geometry and relativity, is constructed

around an extensional process of analogy, but the relationship between two types of dimensions (spatial and temporal), as well as their interplay with possibility, remains unclear. Indeed, most of the act concerns itself with the transitory space between notions that have already been discussed. Much has been said of the ways in which time and space are fabricated within a fictive medium, and how similar this process is to actual *scientia* as it is integrated in the institutional scientific model. Through the idea of the fourth dimension as it has been developed, it has become possible to discuss a conjunction between time and space that is both contrastive and comparative. This conjunction also points to a certain way of understanding literature that informs epistemic considerations as a whole. The reading experience as a process is not only greatly enriched by re-evaluating the presupposed implications of its spatiotemporal context; it becomes a central component in knowledge creation and communication. But in order to reach this conclusion, it needs to be reformulated in terms of dimensions and possibilities, thus doing justice to its experimental, experiential and epistemological nature.

3.1.2. Language mediation

Tippett's jest stresses a remarkable characteristic of the fictional narrative's adaptive power. His article is espousing a mode of expression that discourages misleading evidence, a format that works towards establishing knowledge free of fiction's ambiguous link to truth. But it shows that it can withstand the inclusion of fictive source material and continue to function adequately as both a scientific article, relating information about space-time curvature, while also becoming an intertextual companion piece to some of Lovecraft's most popular stories. It is both a popular science piece and an extension of the Cthulhu *mythos*. Thus, it bridges the actual world of empirical research and the possible world found in the ruins of Lovecraftian stories. But the "fictional" aspect of this article is difficult to isolate, since it works within the vague assumption that actual world knowledge can stem from the study of invented texts, but also that invented texts can be reinterpreted through subsequent models of scientific knowledge. As such, the medium of Tippett's article is, in both form and expression, the inscription of knowledge within a grander narrative of knowledge production. It

comments on the inevitable fact that both fiction and science are largely institutionalised through a writing process that erases intentionality to the benefit of textual traces.

This illustrates a problem that, while dormant, has been present throughout the exposition of both *Flatland's* and *The Sirens of Titan's* involvement with the meaning of a notion such as a dimension. While both these texts are typically classified as fiction, they have been read as potent possible worlds that create extensional hypotheses about the limits of a world. This method of reading takes the fictional text as a medium for a type of reception and thought that is open-ended, burrowing itself within the potential sense at the heart of the fictive. Reading this way presupposes a certain type of interaction with the text that requires a vision of language, as a medium, allowing for such a liberty within the interpretative gesture. Before even asking the question of the nature of fiction, a question that is somewhat mitigated by the fact that possible world theory recalibrates the distinction between fiction and nonfiction along the axis of the possible and the impossible, one is obligated to look at the way that written worlds exist through a definite medium that is undeniably language-based, whether as a novel or as a scientific treatise. The notion of the medium is of primary importance since it addresses the way that possible worlds present themselves to the reader-function, and the one aspect that is still given as a physical object in the world. Whereas Zola developed an author-function to explain the experimental aspect of the novel, and early poststructuralists and reception theorists paved over the death of the author with a reader-function, the medium, the physical and linguistic (in the sense of the French *langagier*, which is the adjectival form of “language”) locus of the fictional narrative is akin to Augustine’s existential present. Whereas the author-function is the reconstructed past of the text, a time present of things past, and the reader-function is the projected receptive consciousness as an abstract ideal, a time present of things future, the text as physical medium can possibly present itself in the present. It allows the passage from reader-function to reader by transforming a potential reception into a phenomenon, a moment of interaction with a medium. Of course, this interaction, as has been discussed, is entirely imbricated within the fabric of many other types of temporal and spatial realities, and constructed from elements that go beyond the *hic et nunc* of the vessel of the fictional narrative. But within the context of the post-technical-reproduction era, the outward aspect of the medium is shifting and variable. Whereas

illuminated books of the medieval age held within their pages an individualised materialisation of the text as unique object, the development of both printing and digitalisation have created a plurality of encounters with the core narrative aspect of textual works. This is to say that stories like *Flatland* or *The Sirens of Titan*, for instance, are foremost met as books, but their inscription within a vast network of reinscriptions create a multiplicity of manifestations that can greatly alter their status as fiction. Since the concern here is with the relationship between worlds that are conjured through fiction, the aspect of mediation relevant to the inquiry is not the historical shift crucial to the decentralisation of the written word, but rather the presuppositions necessary to read language as an indicator of modal realities. Indeed, the context of reception, itself a deeply involving subject, will merely point to the insight that while both *Flatland* and *The Sirens of Titan* are the main examples of the fictive within this research, and that they are, at least in their initial publication, best described as novels (or as a novella in *Flatland*'s case, which has more to do with scope than with an actual difference in medium), the active component at the heart of the possible worlds they describe has a definite media element, but one that is not concerned with the form of the written text as it is received. Rather, it is the nature of the text itself that makes up the peculiar possibility for the establishment of a world. Medium is a term that is often reserved for physical traces that carry meaning. But, in this case, language is fiction's medium, and the novel comes later as a form that shapes this medium further. Like the genre of science fiction, which can be ascribed to both these novels, this specific form does provide some interesting effects to the ideas one can have about the fictive, but there is a presupposition found within the element of language that precedes the shape that the novelistic form gives to these possible worlds; a way that language carries meaning that could find itself in any language, bridging the gap between the written words of Abbott or Vonnegut and those of Tippett in his literary extension of Lovecraft, by way of the popular science article.

The crucial element necessary to keep possible worlds a part of fiction has to do with the malleability of language. In order for Rumfoord's perspective to become an adequate thought experiment exploring a perspective outside of time, and in order for A. Square's discovery to also work as an exploration of what it would be to see the a spatial fourth dimension, one has to allow language to function as a variable referent. Hence, the fictive

narrative opens up the possibility for analogical and allegorical readings that vary according to the context of reception and the individual reading experience without being defined by any single account. By refusing to fix these stories into a unique allegory or analogy, thus cementing a privileged reading account into a true meaning, they become the depositories for many possible worlds in which experiments may unfold. It seems more important to describe the modalities of possible readings than to elaborate the true interpretation of the text, relegating allegory and analogy to a second order of reception, part of a form of reading having already taken place. The way the text unfolds does limit the different possibilities—it would be difficult to argue that *Flatland* is really about something entirely unrelated, such as the fountain of youth or a golden mountain—which means that while possibility is a foremost characteristic of fictional language, it nonetheless exists within a certain circumscription. But this limit is extremely difficult to extract from the ideal structure of a text without reactualising it through a rhetorically convenient critical reading, thus eclipsing the potential at the heart of the limit. In other words, by describing the potential of a fictional narrative, critics in the vein of Rubens, Cordle and Sieber end up establishing limits that are specifically linked to the inevitably personal reading of the text while excluding the very possibility for other potential readings, which is intrinsic to the nature of the personal reading, that is to say, to the non-causality of reading. It is as though actualised readings of interest are outside of the previous descriptions made of the narrative, and are of interest specifically because of this fact. But, by being expressed, these readings join the ensemble of actual readings, existing as examples of what was once possible, but has now become necessary. Their state of possibility is still virtually present but only through the reconstructed causal logic of origin. Yet it is no longer held in equilibrium between truth and falsity. What was once possible and has come to pass is only possible insofar as there was a prior moment that could have led to a different causal development where it did not come to pass. The language of possibility is characterised by the same ambiguity that gives actualised thought experiments the impression of being speculatively divinatory. If Gibson's neon-grid-cyberspace can become the world wide web, Verne's photographic-telegraph can be seen as the preconception of the fax, Lovecraft's cyclopean architecture can be understood as the by-product of space-time curvature, and Ezekiel's chariot of God could be the first description of an unidentified flying object, it is through a process of becoming that allows variables within the language of narratives to stand

for referents that are subsequent to their generation. This is a movement away from the traditional conception of language as a mimetic medium, one that establishes a direct correspondence between actual signified and signifiers. Not only does it break down the traditional Saussure-inspired doublet of early structuralism, but it also offers a way for meaning to exist without recourse to the author-function, a relationship, best described by *Alice in Wonderland's* March Hare, between saying what you mean and meaning what you say. In one fell swoop, this language of possibility replaces the text's Platonic role as an obstacle to truth, as the reflexion of a shadow, with the actual vessel of the world it presents. It frees first-order meaning from its unavoidable imperfections in representing the actual world, from the mimetic pole that forces it to gravitate between history, biography and interpretation. The question of meaning becomes ingrained in the language of the narrative as a medium, in and for itself. This is what is meant McLuhan's "the medium is the message" a sentence so often repeated that it seems to have lost its sense, but retains powerful implications when it comes to interrogating the language of fiction. For "the message, it seemed, was the "content," as people used to ask what a painting was *about*. Yet they never thought to ask what a melody was about, nor what a house or a dress was about. In such matters, people retained some sense of the whole pattern, of form and function as a unity" (McLuhan, 2003: 25). Likewise, while fiction may be read as about one thing or another, in the case of its content, potentiality is found within an approach to language that concerns itself with function rather than referents.

The most in-depth strand of inquiry pertaining to the language of possible worlds can be found in the work of Jaakko Hintikka. Hintikka, who begun his investigation into language from a logician's point of view has become a crucial reference for many possible world theorists concerning themselves with the truth-value of fictional worlds. In fact, Doležel was influenced by Hintikka's approach when he wrote "Narrative Semantics" in 1976, an article that can contend for the title of first to apply modal logic's possible world theory to literary studies. Hintikka's main concern in many of his articles on logic is to unearth an alternative understanding of the philosophical tradition according to a divide that bridges the traditional analytic/continental gap. His organising principle, which he borrows from "Logic as Calculus and Logic as Language," an article by van Heijenoort, is first formulated in a letter by Frege answering Schröder's critical understanding of the *Begriffsschrift*. Frege, arguing for his

conception of logic's superiority over Boole's system, states that "his logic is not a *calculus ratiocinator*, or not merely a *calculus ratiocinator*, but a *lingua characterica*" (van Heijenoort, 1997: 234). These two opposing Leibnizian notions are, when applied to logic-systems, at the very heart of a problem that Hintikka believes is the cause for an "ultimate presupposition of twentieth-century philosophy." This concept, borrowed from Collingwood, is concordant with the way I have been using the term "presupposition," "in that it is not a premise assumed by different thinkers in their argumentation. It is the presupposition of a question, an assumption to the effect that a certain general question can be raised and answered" (Hintikka, 1997: ix). For Hintikka, it is Frege's bias towards a *lingua characterica* that is responsible for a debate that spills out from logic into philosophy at large. The assumption that a universal language of human thought is the goal of all logic, as Hintikka demonstrates, extends well beyond logical positivism. In fact, his reconstructed history of 20th century philosophy proposes to conflate thinkers as varied as Quine, Wittgenstein, Russell, Rorty, Heidegger and Derrida into one camp of philosophy that falls victim to what he calls the presupposition of language as a universal medium. While this might seem like a reductive approach, Hintikka is mostly concerned with self-avowed aspects of each philosopher's theory, which are fully assumed by their proponents. Wittgenstein's proposition 4.12 in the *Tractatus Logico-Philosophicus*, which states that "in order to be able to represent logical form, we should have to be able to station ourselves with propositions somewhere outside logic, that is to say outside the world"³⁴ (Wittgenstein, 2012b) is such a marker, for Hintikka, of a philosopher that embraces the presupposition of language as a universal medium, as is Quine's response of "everything" to the open-ended question "what is there?" (Hintikka, 1997: 219). To this, one could easily add Derrida's famous "there is nothing outside the text"³⁵ (Derrida, 1967: 227, my translation). Hintikka's articles are adorned with these closely read kōans, which punctuate the exposition of his ultimate presupposition, and they establish an intriguing category of problems found within post-"language turn" philosophy. This can, in part, be attributed to the fact that although Hintikka's stance about language and meaning is grounded in a logical problem, he goes to great lengths to show that this presupposition and its alternative, which he names

³⁴ Um die logische Form darstellen zu können, müssten wir uns mit dem Satze außerhalb der Logik aufstellen können, das heißt außerhalb der Welt. (Wittgenstein, 2012a).

³⁵ *Il n'y a pas de hors-texte*. (Derrida, 1967 : 227, original emphasis)

“language as calculus” have repercussions for all philosophical writing that addresses the problem of ineffable semantics. Thus, the presupposition he is trying to outline, namely that of language as a universal medium, states that language is the inescapable medium that must be employed to define itself, and that this self-ascription of sense creates an inescapable muddle at the heart of meaning itself, something akin to Derrida’s *différance* or Heidegger’s language as the house of Being. Such is the context that creates a constantly differed, or intrinsically indefinable, notion of meaning, something Hintikka attempts to counter through his own conception of language as calculus.

The conception of language as a universal medium, which becomes omnipresent following the fall of the logical positivists’ program, is put into question by two thinkers, Gödel and Tarski. Hintikka founds his investigations on these two thinkers. To one familiar with the history of logic, these two founding influences might seem a strange choice, considering that they are often conjured in circumstances where thought is described as containing propositions that are formally undecidable, or semantically evanescent. While their theorems of unprovability and undefinability have managed to free themselves from the debates whence they emerged, becoming archetypal devices to express a particularly profound doubt in the possibility of actual true independent knowledge, Hintikka argues that they, in fact, point to an alternative solution to the problem of ineffable semantics. Rapidly described, Tarski’s undefinability theorem, which is directly derived from Gödel’s own incompleteness theorem, states, among other things, that for any language containing a criterion of truth, there is a second-order metalanguage that defines the conditions for such a truth-function. Since this metalanguage can express the semantics of the other language, it follows that it contains primary axioms that are absent from the language it describes, which ultimately means that it also contains proven theorems not provable in the original language. Thus, any language that contains a criterion of truth is incomplete, since it implies and needs another language that exceeds it. The corollary to such a discovery is that truth, as expressed in Tarski’s theorem, is similar to the structure found in the eternal regress at the heart of causality, since every metalanguage must also have its own criterion of truth, itself explained in another metalanguage (a metametalanguage?), and so on, *ad infinitum*, *ad absurdum*. Tarski’s theorem concerns primarily the notion of formal semantics within a language (whether it is a

natural or a symbolic one), ultimately stating that truth-functionality is always relegated to a second-order understanding of itself. This proposition is also a necessary step for Gödel's discovery of his principle of incompleteness, which caused thinkers such as Murawski to claim that Tarski's undefinability theorem was, in fact, first revealed by Gödel. But while Tarski makes important use of Gödel numbering (the transformation of syntax into first-order arithmetic), he is credited with extending Gödel's discoveries about proof in arithmetic to the notion of truth in language, which explains the attention that Hintikka gives to his theorem. Both Tarski's and Gödel's problems arise out of self-reference and they can be accurately described as sophisticated formulations of extensions implied by Epimenides's liar's paradox. Indeed, Tarski mentions it explicitly as the cause for the undefinability of what he calls "colloquial language."

A characteristic feature of colloquial language (in contrast to various scientific languages) is its universality. It would not be in harmony with the spirit of this language if in some other language a word occurred which could not be translated into it; it could be claimed that 'if we can speak meaningfully about anything at all, we can also speak about it in colloquial language'. If we are to maintain this universality of everyday language in connexion with semantical investigations, we must, to be consistent, admit into the language, in addition to its sentences and other expressions, also the names of these sentences and expressions, and sentences containing these names, as well as such semantic expressions as 'true sentence', 'name', 'denote', etc. But it is presumably just this universality of everyday language which is the primary source of all semantical antinomies, like the antinomies of the liar or of heterological worlds. These antinomies seem to provide a proof that every language which is universal in the above sense, and for which the normal laws of logic hold, must be inconsistent. [...] If these observations are correct, then *the very possibility of a consistent use of the expression 'true sentence' which is in harmony with the laws of logic and the spirit of everyday language seems to be very questionable, and consequently the same doubt attaches to the possibility of constructing a correct definition of this expression.*³⁶ (Tarski, 1983: 164-165, original emphasis)

This axiomatic approach to language, which grounds undefinability in the universality of propositional possibilities is what Hintikka deconstructs in order to re-establish truth as an applicable characteristic. The crux of his argument is to underline the fact that Tarski's idea

³⁶ This article has been expanded and revised every time it was translated. I will therefore use the Woodger English translation as an "original."

of colloquial language is founded on “the failure of the formal guideline of his truth-definition, i.e. the failure of the principle that linguists know as compositionality and some philosophers as the Frege Principle but whose real force is a semantical context-independence” (Hintikka, 1997: 13). It is this semantical context-independence that Hintikka questions, claiming that “such context-independence in the semantics of natural languages is totally unrealistic” (Hintikka, 1997: 13). Leaving the quantifier “unrealistic” aside for a moment—since it is in itself a problematic appeal to the real within a demand for the consideration of context—one can sense that Hintikka’s take on truth is not axiom-based, and that his implied logic is one that allows for statements to define their own truth-value in relation to themselves. His idea, then, is an extension of van Heijenoort’s claim that there exists a divide within the history of logic that unearths a deeper presupposition at the very heart of philosophy’s 20th century obsession with language. Since his observation stems from a problem in the study of logic, Hintikka goes about defining a formal way to express independence, what he calls independence-friendly first-order logic. In turn, this logic refers to a mode that understands language as calculus, rather than as a universal medium.

Understanding what is meant by language as calculus is a strange endeavour for the literary inclined reader. The mention of calculus seems to project the notion of language outside its literary comfort zone of the colloquial and make it into something formal, mathematical. Yet, Hintikka’s project, which takes its cue from logic, attempts to address everyday language above and beyond its logical underpinnings. In fact, logic, for Hintikka, while definitely central, seems to be, in this case, a step towards something more important that pertains to a general understanding of meaning in general. He uses the ascription of truth as a measuring stick to evaluate the ways a language can present meaning. He is not concerned with the formal aspect of truth as a universal; in fact, it is this conception that is deconstructed in his new logic. Instead, Hintikka is trying to show that truth ascription is both relative to the context in which it appears and structurally limited by its syntactic vessel. In this light, the use of “calculus” poses a definition problem, for surely Hintikka is not claiming that language is reducible to calculus. It is rather an aspect of calculus as the study of change through the manipulation of symbols that inspires this terminological choice. As Hintikka himself says, “my choice of the term “calculus” (or, rather, van Heijenoort’s choice of the

word) is calculated to highlight this re-interpretability of language, *not* its purely formal character” (Hintikka, 1997: 106). As remarks Thomas L. Martin in *Poiesis & Possible Worlds: A Study in Modality and Literary Theory*, “calculus,” in this sense, can be seen as akin to its original meaning, referring to a small stone used as a unit for calculations. These small stones, like the fingers of early counters, were used as stand-ins for any type of quantifiable object, becoming entities, for the purpose of manipulation. As with the beads in an abacus, calculus-stones could be used as units or groups, they could serve to count the individual stars or whole constellations. Understood this way, language as calculus is not the transformation of language into formulae, but rather the conception of language as a system of variables that, while open to manipulation, cannot be reduced to a single meaning. Thus, this approach to language takes abstraction as a foremost preconception, establishing that each element of language—letters, words, paragraphs, syntax, grammar—is symbolic in its inscription, making it interpretable according to a coherence that pivots on the relation of meaning between various interactions. The limits of language are never universal according to this view, but there are particular boundaries set by the use of language.

In modern calculus, the manipulation of variable units led, through the work of Leibniz and Newton, to the study of infinitesimals, or units that verge on the limit of nothingness. By manipulating these infinitesimals, calculus has also become the study of infinites, effectively reducing them to their limits as a means to better understand their implication. For instance, in order to find the acceleration of a body, one can derive the curve of its speed. This very simple form of calculus uses the infinite tangents of the speed curve to arrive to the various accelerations and decelerations of the body. Whereas the initial data is only the speed of the body (over time), calculus allows for the derivation of different information, leading, in this case, to acceleration (and distance). Thus, calculus also links various elements (in this case the relationship between time and distance and that of speed and acceleration), through the configuration of their relationships. Other than using a passage through an abstracted infinite, calculus also has the potential, through very specific mathematical application, to reduce infinite elements to a quantifiable limit. This allows asymptotic relationships to be treated as approximate wholes, allowing manipulations that can deal with formulas that are similar to Laplace’s daemon: increasingly closer yet infinitely removed. These remarks are especially

important considering some characteristics that have been discovered about literary space and literary time. Continuums that extend indefinitely within their limits, the way dimensions are limited by the existence of higher dimensions—can therefore be addressed, once again, according to their implication with particular sets of characteristics. Calculus, then, is a way of approaching the transitory space opened up by structural considerations without reducing all knowledge to a structure; it is a reconfiguration of the structuralism's ideal that replaces universalist desires with the necessarily particular nature of knowledge. Through this general approach, Hintikka attempts to join Peirce's logic as a formal semiotic to Husserl's transcendental ego, placing the crux of meaning outside of language as such, yet imbricated within its structures.

Since the concerns of this research are not about the way logic is construed to refer to meaning, the details of Hintikka's independence-friendly first-order logic are of a second-order, so to speak. What is most important about his project is the way that language, as a medium, functions when it is taken to be a type of calculus. The crucial difference between language as a universal medium and language as a calculus is that, in the latter case, language is seen to refer to a derivation of itself. Instead of using the mimetic model, which places language as the vector of communication stemming out of the author's view of the world and being received by the reader's relationship with this same world, language as calculus, which can, granted some caution, still include this mimetic model, is expanded through the different ways in which it could be derived. Thus, the author's relationship to the (actual) world as understood by the reader is one of the many different modes of understanding found in this calculus. If the importance of the text is found within a world as it is being described in the narrative fiction, then the derivation can concentrate on the variables that are specific to the concern at hand. The author's world is reduced to a possibility amongst others, and the novel's worlds are seen as additional routes to meaning. The reconstructed historical vision afforded through Hintikka points to the fact that possible world theory can in fact only exist through seeing language as calculus. "Husserl and Heidegger on Meaning," a text by Martin Kusch chosen by Hintikka to represent the distinction between universal medium and calculus in the continental tradition, underlines that Husserl could be understood as a proponent of a type of language-calculus. Quoting Husserl in his *Cartesian Meditations*, Kusch draws back

to Leibniz, which an attentive reader will remember is also acknowledged by Kripke as the honorary grandfather of possible world theory. Extending upon Kusch's chosen quote, some very specific limitations to possible worlds, as defined by Husserl, shed light on the way possibility is extensible, yet ultimately restrained to certain formal characteristics that are also present in Hintikka's logic:

Naturally Leibniz is right when he says that infinitely many monads and groups of monads are conceivable but that it does not follow that all these possibilities are *compossible*; and, again, when he says that infinitely many worlds might have been "created", but not two or more at once, since they are impossible. It is to be noted in this connexion that, in a free variation, I can phantasy *first of all myself*, this apodictic de facto ego, as otherwise and can thus acquire the *system of possible variants of myself*, each of which, however, is annulled by each of the others and by the ego who I actually am. It is *a system of apriori impossibility*. Furthermore the fact, "I am", prescribes *whether* other monads are others for me and *what* they are for me. I can only find them; I cannot create others that shall exist for me. If I phantasy myself as a pure possibility different from what I actually am, that possibility in turn prescribes what monads exist for him as others. And, proceeding in this fashion, I recognize that *each monad having the status of a concrete possibility predelineates a compossible universe*, a closed "world of monads", and that two worlds of monads are impossible, just as two possible variants of my ego (or of any presupposedly phantasied ego whatever) are impossible. Such results and the course of the investigations leading to them enable us to understand how questions that, for traditional philosophy, had to lie beyond the limits of science can acquire sense.³⁷ (Husserl, 1977: 140-141)

While thoroughly permeated by a psychologising element, this quote by Husserl illustrates the way that the positing of possibility in fact dictates a larger, and well-defined, world. This world is, in turn, not a work of pure "phantasy." Husserl's chosen vocabulary is of note,

³⁷ Natürlich hat Leibniz recht, wenn er sagt, daß unendlich viele Monaden und Monadengruppen denkbar sind, aber darum nicht alle diese Möglichkeiten kompossibel, und wieder, daß unendlich viele Welten hätten *geschaffen* sein können, aber nicht mehrere zugleich, da sie inkompossibel sind. Es ist hier zu beachten, daß ich zunächst mich selbst, dieses apodiktischfaktische Ego, in freier Variation umdenken kann, und so das System der Möglichkeitsabwandlungen meiner selbst gewinnen, deren jede aber durch jede andere und durch das Ego, das ich wirklich bin, aufgehoben ist. Es ist ein System apriorischer Inkompossibilität. Ferner, das Faktum *Ich bin* schreibt vor, ob und welche anderen Monaden für mich andere sind; ich kann sie nur finden, aber nicht, welche für mich sein sollen, schaffen. Denke ich mich in eine reine Möglichkeit Geltung hat, ein kompossibles Universum, eine geschlossene *Monadewelt* vorzeichnet, und daß zwei Monadenwelten in derselben Art inkompossibel sind wie zwei Möglichkeitsabwandlungen meines Ego und ebenso irgendeines vorausgesetzt gedachten Ego überhaupt. Man versteht von solchen Ergebnissen und von dem Gang der zu ihnen führenden Untersuchungen aus, wie Fragen sinnvoll werden. (Leibniz, 1929: 167-168)

especially in the case of fictional possible worlds. There seems to be a tension between what is “compossible” and what is “phantasy.” This can be seen as hinting towards the limits of possibility, even within an entirely fictional universe. This is strange; while most literature does seem to observe a form of internal coherence when describing its plot elements and its setting, many examples, such as Burrough’s *Naked Lunch* or Cohen’s *Beautiful Losers* seem to delight in breaking expectation and describing a radically shifting land and timescape where everything could be possible, or at least expected. This makes the fictive a particular case of possible world that needs to be addressed in the light of what has been found about language as calculus.

About these considerations on language, there does remain an important point of note. While Hintikka’s propositions seem to neatly divide philosophers according to a dichotomy of universal/calculus, a late paper on Quine exposes ambivalence as to this division:

Which conception is the right one, that of language as the universal medium or that of language as calculus? Is semantics ineffable or not? I have an answer ready, even though it is neither of the two alternatives you have been expecting. Neither conception is completely right, but both contain an element of truth. In fact, the true state of affairs can be described concisely. Semantics is not ineffable, even for our actual colloquial language or whatever *lingua characterica* we may try to develop, but it is inexhaustible. We can step outside this or that part of our discourse so as to study its relations to the world, but we cannot do it in one fell swoop. This thesis is in fact a generalization of Tarski’s celebrated result, according to which you can formulate the semantics of a sufficiently strong language only in a stronger one, and hence never in that same language. (Hintikka, 1997: 227)

What Hintikka describes is an interesting reality that has far-reaching repercussions. This remark seems to have a lessening effect on the methodological remarks expounded by Hintikka’s own distinctions. But by agreeing to the validity of problems found in an approach that takes language as a universal medium, Hintikka circumvents criticism from those opposing the idea that one can escape, even for a moment, language. It marks Hintikka’s general approach as a possibility in itself. This is fundamental to modality; it deals only in possibles and can therefore never ground itself as a unique and freestanding method. Hintikka is insistent on this fact; language as calculus is a tool, a temporary mode of understanding within a larger semantical context. Thomas L. Martin adds that “Calculus, in this sense,

denotes an abstract symbolism without fixed rules of interpretation. When Hintikka says that language is a calculus, he means that language is capable of varying both its interpretations and its domains of applicability” (Martin, 2004: 74). It is a means by which parts of an infinite whole may be derived to obtain meaning. It does not fail for its incapacity to address the universal directly; it merely takes as a given that it has to find its path to the universal through the particular. Like mathematical calculus, this form of differentiation (or integration), does not claim to exhaust the infinity that is central to the initial formula; it merely expresses relational “truths” about the underlying edifice. In a highly variable context, such as the interpretation of a text, language as calculus does offer a point of entry, in the sense that it allows any form of entry, but it then requires definite coherence with the initially proposed elements. It is a flexible yet rigid temporary mode of discourse. Thus, it is also incredibly open to change and variation (the open matrix of many possible worlds) and its manipulations might be, in this case, more aptly described through Newton’s terms of fluxions (differentials) and fluents (integrals), both derived from the latin *fluere*, which describes the flow of both water and words. This emphasis on change points to the fact that, to paraphrase Heraclitus, one does not step twice into the same river, as one does not read twice the same world. Yet a river is designated, and a world is described.

3.1.3. The Real as Mediation

Of all types of worlds, the case of fictional possible world is perhaps most interesting because it directly addresses what has been so far referred to as the actual. A debate, sparked in part by David Lewis’s modal realism, has arisen to establish the ontological relationship and status of the possible relative to what is alternately described as the actual or the real. Lewis grants existence to all forms of possible worlds in a way that is identical to the actual world. As Ronen explains in *Possible Worlds in Literary Theory*, “for Lewis [...] “actual” does not refer to the world we inhabit or to a specific notion of what reality is. “Actual” is rather an indexical term; the inhabitants of each world see their universe as the actual one” (Ronen, 1994: 22). Other thinkers, such as Plantinga, Rescher and Kripke, have rather focused on the subsumed relationship between possible worlds and *the* actual world. In their

reading of modality's relative realism, sometimes known as "actualism," the relationship between the world and its possibilities is delineated by the way possible worlds are generated. Ronen explains that "non-actual possibilities exist as *mental constructs* as postulated by Rescher, as *non-obtaining states*, as proposed by Plantinga, or as a *set of propositions* about things in our world, as suggested by Adams," (Ronen, 1994: 22, original emphasis) outlining the various modes of interaction developed within this heterogeneous group of thinkers, each following a different argumentative path to describe the limits of the possible's relationship to the actual. But most interesting for the subject at hand is Kripke's insistence on the fact that possible worlds are abstractions or hypothetical situations, rather than realities.

The notion of a 'possible world', though it has its roots in various ordinary ideas of ways the world might have been, comes at a much greater, and subsequent, level of abstraction. In practice, no one who cannot understand the idea of possibility is likely to understand that of a 'possible world' either. [...] The main and the original motivation for the 'possible worlds analysis'—and the way it clarified modal logic—was that it enabled modal logic to be treated by the same set theoretic techniques of model theory that proved so successful when applied to extensional logic. It is also useful in making certain concepts clear. (Kripke, 1980: 19)

This remark gives possible worlds a liminal ontological status, in a space, or as a space, where the tesseract and the infundibulum are also found. Moreover, Kripke's appeal to abstraction is specifically linked to the fact that his approach posits possible worlds as extensions of a unique actual world. While Kripke can hardly be called an empiricist, his view of possible worlds is that they offer a way to create logical extensions of actuality as a means to explain certain states of affairs. But possible worlds are neither primary (they are always derived) nor "parallel" to the actual world. It is interesting to note that Lewis's modal realism permits a radically different consideration of what could be described as the set of all possible worlds. Whereas, in all its logical extensions, Kripke's set is metaphysical (according to his own words), Lewis's set is an odd amalgam of the universe's various declinations coexisting along the same line of "reality," whether it is idealist, materialist, metaphysic or an agnostic mix of all or none of these approaches.

Interestingly, Lewis's vast ensemble of real possible worlds finds resonance not only in modal logic but also in attempts to describe quantum phenomena, such as the light particles in

the double-slit experiment. This experiment has come to represent a slew of different results in quantum mechanics that exhibit the strange characteristic of being entirely affected by data collection. In modern day physics, this problem is recurrent and it hinges on a relationship between the theoretical and the experimental branches of a divided discipline. As Gooding notices, in “What Is Experimental About Thought Experiments?,” it is intractably linked with the dubiousness one encounters when considering scientific thought experiments. Gooding explains that

for four centuries the sciences have moved away from personal observation into realms in which the entities posited are beyond ordinary modes of perception. In some cases these strange worlds are accessible *only* through thought experimentation whose purpose is, in part, to strip away common-sense notions such as object-hood, causality, or the unidirectionality of time. Scenarios operationalize relativity or complementarity in order to argue the irrelevance of commonsense criteria of object-hood such as identity (defined in terms of persisting spatial location). (Gooding, 1992: 287)

This situation has yielded an interesting appeal for experimentation, which aims at restoring the perceptual correspondence between theories and their effects. Electron microscopes, particle accelerators and cloud chambers have been built at great expenses to expand the human ability to see at the atomic level. Yet some situations, like the one described by the double-slit experiment, provide physicists with puzzling results that can only be comprehended through the peculiar abstraction that is the theoretical model. These models are often fraught with carefully postulated restrictions on the extended human perceptual apparatuses, delimiting the observable in order to explain the discrepancies between isolated measured phenomena and the way the world functions as a generality. Like language as calculus, this reflection is aimed at addressing the particular, even if, in these cases, the particles are at odds with what Gooding describes as “commonsense notions,” which are, for the purpose of the experiment, bracketed. When relating to method, such limits arise in theorems such as Gödel’s incompleteness or Tarski’s undefinability, but in the case of physical reality, Werner Heisenberg’s uncertainty principle is perhaps the clearest example of a formal limit to experimentation. Heisenberg, while working with Bohr on a new form of mathematics that could explain atomic and subatomic strangeness in the quantum formulation of physics, came to be convinced that an electron’s localisation could only be pinpointed with

a limited degree of certainty. Due to the interference caused by any measurement (the effect of bombarding wave particles with photons, or light, in order to see them, for instance), it follows that if the observer knew the electron's velocity, then it was physically impossible to calculate this same electron's accurate position, and vice-versa. Thus, it was only possible to know the electron's displacement if one was to forego knowledge about the electron's location, and it was only possible to pinpoint this place by destroying any data pertaining to its speed and direction. Heisenberg's uncertainty principle became central to a quantum physics formalism largely still in use today called the Copenhagen interpretation. It directly attacked ideas central to what was considered a commonsensical approach to the actual world, such as determinism, causality and an objective reality entirely independent from observers. For some, it seemed radical, and it wholly frustrated proponents of a certain type of physical realism, who insisted that any matter with characteristics that can be individually calculated, such as motion and place, should hold these characteristics independently of there being someone to observe them. Heisenberg's principle, for these physicians of whom Einstein was the most vocal advocate, came to symbolise an incompleteness at the heart of the quantum model, since it showed that something could remain forever beyond the grasp of experience.

It should be noted as an important sidebar related to the argument being formulated that rules such as Heisenberg's principle, found in the debates surrounding the early formulation of quantum physics, are affecting phenomena at scales so alien to human modes of direct observation that most of their analogous experiments are abstractions that describe clashes within the models from which they are drawn. Thus, most of early quantum mechanics experiments are thought experiments. This is not surprising, considering Kuhn's remark that thought experiments arise out of conceptual crises.

A crisis induced by the failure of expectation and followed by revolution is at the heart of the thought-experimental situations we have been examining. Conversely, thought experiment is one of the essential analytic tools which are deployed during crisis and which then help to promote basic conceptual reform. The outcome of thought experiments can be the same as that of scientific revolutions: they can enable the scientist to use as an integral part of his knowledge what that knowledge had previously made inaccessible to him. That is the sense in which they change his knowledge of the world. (Kuhn, 1977: 263)

Keeping in mind that literary thought experiments might not induce pan-literary revolutions, but rather the type of personal reconfiguration of the scientific apparatus that Kuhn ascribes to a figure, the scientist, it is now possible to understand both language as calculus and the reaction to Heisenberg as responses to a becoming-sense, or to a crisis in the relationship between everyday experience and the ramifications of the logic at the heart of a model. This is why it follows directly from advances made by Heisenberg that the first responses to his theory were formulated as thought experiments. As it has already been established, Einstein was, alongside Galileo, a leading craftsman of such tales, and he came at Heisenberg with the full force of his conceptual scenarios in order to object to the uncertainty principle. Einstein, who remained committed for the entirety of his life to a complex form of objective realism, explicitly despised the fact that Heisenberg's model seemed to imply that reality could only be understood within a certain statistical percentage. This sparked his famous comment that God was not a dice player, implying that from an absolute point of view, which strangely included Einstein's own relations of relativity, the world followed an ontological law of the excluded middle. Things were or were not, there was no way that physical phenomena could only exist as a probability. For Einstein, Heisenberg's principle was discovered as a derivative of humanity's limitations, which in turn should be addressed as a problem with a definite solution: a perfection of either measurement or conceptual apparatuses. Einstein's first serious attempt at thwarting Heisenberg's discovery was revealed at the 1930 Solvay conference. In *Uncertainty: Einstein, Heisenberg, Bohr and the Struggle for the Soul of Science*, Lindley formulates Einstein's thought experiments in a particularly clear and concise manner:

Imagine some photons in a box, Einstein said, and equip the box with a shutter operated by a clock. Let the shutter open for just a moment, at some precisely specified time, so that a single photon escapes. Weigh the box beforehand and weigh it again afterward. From $E=mc^2$, the change in weight gives the energy of the fleeing photon. One version of the Heisenberg principle says that the more accurately you try to measure the energy of some quantum event, the less well you can know the time at which it occurred. In Einstein's new argument, so its author believed, that restriction didn't apply. He could measure the energy of the departed photon, and he knew the time it left the box, and he could make both those measurements independently, as precisely as he wished. He could beat the uncertainty principle, Einstein triumphantly declared. (Lindley, 2007: 169)

This particular example, as well as the one that will follow, illustrates the peculiar nature of the early debates that established the framework of quantum physics. Since Einstein takes the role of advocate for “objective reality” and the modernist belief in the progress of the scientific endeavour, his thought experiment, founded upon a hypothetical situation, one that could not be physically reproduced at the moment of its formulation, is the strongest appeal that could be made at the time. Bohr, who answers Einstein’s objection the next day, does so using the same logic. He points to the fact that in order for the box to be weighted, it had to be placed on some kind of balance, putting it, for a slight moment, in motion. This motion, Bohr argues, affects the speed at which the clock is running, according to Einstein’s own law of relativity. Furthermore, the recoil in the balance creates a chaotic bouncing motion, which would yield a certain amount of uncertainty. These two characteristics, together, create fuzziness in both energy and time, which reinstate Heisenberg’s uncertainty principle. While this might appear to the untrained eye as nit-pickings, Bohr’s answer was enough to refute Einstein’s thought experiment. It is specifically because Bohr played along with Einstein’s story, using formal characteristics necessary for the world being described to work, that his argument was so potent. He could have pointed to the fact that a trapdoor could not possibly be timed to open long enough for a single photon to escape, that such a contraption was a phantasy akin to Maxwell’s demon, but in doing so, he would have merely postponed the establishment of validity to a later date when such a machine could be physically reproduced. Instead, his attack was directed at the very heart of the possibilities within the experiment described by Einstein. Thus, while not attacking the possibility of Einstein’s underlying story, Bohr strengthens Heisenberg’s claim, asserting that even if such a machine were to be built, it would also have to follow the uncertainty principle.

This led to the inevitable postulate that quantum reality is fundamentally different from the reality of classical physics, and that as soon as an observer, part of the classic sphere, looks closely at the quantum level, this reality collapses into a classically observable phenomenon that no longer holds the ambiguities present in its quantum state. Thus, the observer is responsible for reality at larger scales, while another reality held in an uncertain and only statistically predictable state remained unavailable to the classical world. Einstein took five years to formulate a new response, aiming to show that some certainties could be found about

this quantum reality. During that time, he came to accept Heisenberg's principle, but he still could not reconcile with the statistical approach to the quantum wave function that was prescribed by the Copenhagen interpretation. In 1935, he published, alongside two colleagues named Podolsky and Rosen, a paper—"Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?"—that came to be known as the EPR argument. Once again, this paper contains a crucial thought experiment:

They imagined two particles zooming away in opposite directions from some common origin, with the same speed, so that as soon as you measure the position or momentum of one, you automatically know the position or momentum of the other. They conceded that an observer making measurements of one of the particles would run afoul of the uncertainty principle. Measure its momentum, and lose knowledge of its position, or vice versa, just as Heisenberg dictates. But now Einstein, Podolsky, and Rosen played their trump card. The whole point of their setup was that any observation of one particle tells you something about the other, and that's where strange things begin to happen. Measure the first particle's position, and you immediately know the position of the second—even though you haven't looked at it directly. Or measure the first particle's momentum, and you also know the second's—again, without looking at it. Which means, the authors eagerly concluded, that both the position and the momentum of the second particle must be "elements of physical reality." Because these properties can be determined without disturbing the particles in question, they must have definite, preexisting [sic] values. It cannot be, they argued, that a measurement on the first particle *only then* causes the second particle's characteristics to materialize out of a quantum fog—because nothing has actually happened to the second particle. And the larger implication, they went on, is that Heisenberg's vaunted uncertainty principle does not, after all, mean that physical properties are fundamentally indefinite until measured. Rather, particles have definite properties, and the uncertainty principle is an admission that quantum mechanics cannot fully describe those properties. (Lindley, 2007: 190-191, original emphasis)

Again, it is important to note that the EPR argument is not refuting the uncertainty principle outright. Rather, it is limiting the impact that this principle has on physical reality. Popper corroborates this characteristic of well executed thought experiments (which he calls "imaginary experiments") in the ninth new appendix of the 1959 edition of *The Logic of Scientific Experiments*: "Einstein, Podolsky and Rosen attempt, in their critical argument, to make use of idealizations acceptable to Bohr; and in his reply, Bohr does not challenge the legitimacy of their idealizations" (Popper, 2008: 467). Again, in order for the exchange to

remain productive, it has to take place without putting into question the universal worth of the thought experiment, instead turning to the way that it can be derived. The EPR argument is showing, through a story about twin particles flying away from each other, particles that were simultaneously ejected from an initial small (or even a big) bang, that elements of reality do exist without being measured, and it is not through an observer's vindication that reality comes into being. This has a grandstanding impact on the relationship between thought experiments and reality as a whole, answering both the question of Schrödinger's cat's vitality, and that of the mock-Buddhist puzzle about the sound of a tree falling in a forest when no one is around to hear it. Bohr noticed this and answered the EPR argument by attacking its criteria for a physical reality, which was, for him, untenable and metaphysical. The disagreement boiled down to the presuppositions that went into the concept of reality and, in many ways, its only descriptions were drawn from possible worlds shaped through thought experiments. Indeed, Popper refutes Bohr's response on the basis that he confuses a given physical system with a frame of reference, thus jumping from the calculus of the argument into universality. Overall, though, it is interesting to notice that throughout Einstein and Bohr's debate, the most potent argument for a strong criterion of reality was formulated as a short work of fiction, albeit one that could potentially come into being, and the debate about its validity was transposed into a question of correspondence between a possible world and *the* actual world, if such a world exists.

There came to be a standstill in the debate between Einstein and Bohr that lasted until Einstein's death. For a while, many of the philosophical problems at the core of Bohr and Heisenberg's models were often addressed, yet seldom in a way that shook the foundations of physics. In many cases, some of the most fruitful lines of inquiry were being developed in classrooms (and military compounds) around the world, but no paradigm gained the type of traction that could cause it to unseat the Copenhagen interpretation. Yet, half a century later, many of the ideas developed during this tumultuous time period still have an impact on both the scientific and the fictional imagination. One interesting answer that shifts the question of reality to an entirely new plane of considerations is also strangely akin to Lewis's modal realism. First formulated in Hugh Everett's thesis, which was summarized in the *Reviews of Modern Physics* as an article entitled "'Relative State' Formulation of Quantum Mechanics,"

this model was renamed the “many-worlds interpretation” by Bryce DeWitt when he saved Everett’s original text from obscurity in the early 1970s. Everett, while working with John Wheeler as an advisor, attempted to formulate a new interpretation of the meaning of quantum physics that could reconcile both the applicability of the Copenhagen interpretation with the Einsteinian objection to statistics. In fact, the first draft of his thesis was titled *Wave Mechanics Without Probability*. In order to do so, he had to, once again, transfer the burden of reality to a further bracket that would allow both the observed particle and its “real” counterpart to coexist. As Everett says,

the aim is not to deny or contradict the conventional formulation of quantum theory, which has demonstrated its usefulness in an overwhelming variety of problems, but rather to supply a new, more general and complete formulation, from which the conventional interpretation can be *deduced*. The relationship of this new formulation to the older formulation is therefore that of a metatheory to a theory, that is, it is an underlying theory in which the nature and consistency, as well as the realm of applicability, of the older theory can be investigated and clarified.” (Everett, 1957: 454, original emphasis)

It is interesting to note the described relationship between the Copenhagen interpretation and Everett’s “metatheory.” If an interpretation is deducible from a theory, then it follows that this theory approaches the original axioms that allow for observable phenomena. The problem with scaling the increasingly fundamental levels of axioms in quantum physics is that they are also incrementally removed from the observed results of experiments. To believe that he is working with a theory from which the interpretation of phenomena can be deduced places Everett in a strange relationship to his own work, implying that his framework is describing a fundamental aspect of reality, while moving away from empirical data. In a way, he is inducing the grounds from which deduction can be explained, working backwards from the real to a theory that constructs the foundations of the real, thereby asking a question about the “reality” of science’s knowledge frameworks. In doing so, Everett is attempting to leave prior knowledge of quantum mechanics untouched while also allowing Einstein’s vision of an objective reality to exist as an abstracted possibility. His “relative states” act as many possible worlds that did not come to be actualised in the particular world of the observer, yet remain “real” in the sense that they could have existed in other timelines. In order to come to such a radical interpretation, Everett follows a logical step that has already been taken in relation to

the reading process. In fact, since both the reader and the writer can take on the role of the observer, and each has been seen as a figure that simplifies the fictional narrative through a process of reduction—either the story originates in an author-function that creates it or it is actualised through a reader-function that acts it out in its mind—both become, in relation to the possible world aspect of the narrative, variable endpoints that grant the story a form of uncertainty. Everett, faced with the uncertainty of the quantum world, proposes a similar integration of the observer within the system. This is best explained in a passage found in his 1957 paper:

Throughout all the sequence of observation processes there is only one physical system representing the observer, yet there is no single unique *state* of the observer (which follows from the representations of interacting systems). Nevertheless, there is a representation in terms of a *superposition*, each element of which contains a definite observer state and a corresponding system state. Thus with each succeeding observation (or interaction), the observer state “branches” into a number of different states. Each branch represents a different outcome of the measurement and the *corresponding* eigenstate [definite state] for the object-system state. All branches exist simultaneously in the superposition after any given sequence of observation. The “trajectory” of the memory configuration of an observer performing a sequence of measurements is thus not a linear sequence of memory configurations, but a branching tree, with all possible outcomes existing simultaneously in a final superposition with various coefficients in the mathematical model. In any familiar memory device the branching does not continue indefinitely, but must stop at a point limited by the capacity of the memory. (Everett, 1957: 459-460, original emphasis)

His radical idea is to place the observer within the quantum system, as a variable that is also subject to uncertainty. Thus, while the observer was seen as collapsing the wave-function, transforming the quantum fuzziness into a classical phenomenon, albeit one that could have manifested itself in another way, in Everett’s “relative states” interpretation, the observer is split into two versions of himself (if only two options are available), glancing at the outcomes of his observation in parallel worlds that have no effect on each other. By transforming the observer into an integral part of the world being observed, and not as an outside influence that constitutes the world, Everett is working towards the same ends as the transformation of the author into an author-function, and the reader into a reader-function, in relation to the fictional narrative. Both the author and the reader are part of the narrative, but not as originators or

actants. Rather, they are intrinsically linked to its calculus, its potentiality. This holds even if the author is anonymous, collective or a random generator. It is also the case whether the reader is the author himself, a thousand years in the future or non-existent. As variables constitutive of the system, both the reader-function and the author-function are necessary parts of the epistemological charge of the literary. They are intrinsic to the very possibility of fiction, but no more fundamental than the text itself. The text cannot be deduced from a given writer- or reader-function as finished axioms. Only the idea of the reader before it becomes a function acts as a radical variable that allows for the complexity of the text (for the many possible worlds of a given narrative).

Everett's many-world hypothesis generates an interesting number of consequences to the relationship between the real and theory, which is, in the case of quantum physics, explicitly referred to as an interpretation. These consequences are linked to the deduction/induction process that he describes in his introduction; they show how the idea of reality is both the axiomatic foundation for a deduced experience and the inductive creation of a theoretical process. His interpretation, which was unanimously panned, or ignored, by physicists as it was first published, came to stand as a mainstay of quantum physics, when revisited by DeWitt in 1973. According to DeWitt, the original refusal had to do with the fact that "Everett's interpretation calls for a return to naive [sic] realism and the old fashioned idea that there can be a direct correspondence between formalism and reality" (DeWitt, 1973: v). Through an incredible detour that generates an infinite amount of inaccessible worlds, Everett's theory was taken to be naïvely realist. As a theory often criticised for its direct violation of Occam's razor, the many-world hypothesis has to be understood in light of its formalism in order to truly recognise how it can be postulated as a form of realism, but in light of Lewis's modal realism, one can easily understand the type of realism that DeWitt describes. It is not that Everett's theory is advocating for a return to classical physics, but rather that it insists in considering all possible worlds as real. This unearths an element that is crucial to the scientific enterprise; that it follows a strong mimetic presupposition as to its correspondence with the real. By underlining the fact that quantum probability always results in actually observed phenomena, Everett has to maintain that the compossibility of different outcomes hold the same real status, and that these different outcomes are merely divided by different

statistical probabilities. Thus, he is also reinstating a form of strong causality, although this causality is a branching tree of different outcomes that each exist in parallel universes. Yet, by declaring his hypothesis as an overarching interpretation of different, seemingly irreconcilable, models, he is also aware that every iteration of his theory is limited to the framework of its own world. In the second appendix to his thesis, Everett explains that

The constructs of classical physics are just as much fictions of our own minds as those of any other theory we simply have a great deal more confidence in them. It must be deemed a mistake, therefore, to attribute any more “reality” here than elsewhere. Once we have granted that any physical theory is essentially only a model for the world of experience, we must renounce all hope of finding anything like “*the* correct theory.” There is nothing which prevents any number of quite distinct models from being in correspondence with experience (i.e., all “correct”), and furthermore no way of ever verifying that any model is completely correct, simply because the totality of all experience is never accessible to us. (Everett, 1973: 134)

So it would seem that Everett’s theory is also held to the standards of uncertainty, as one of the possible ways that experience might be explained. This further relativizes the charges of naïve realism, placing them within the model proposed by the physicist rather than as part of its meaning’s interpretation. In a way, Everett is illustrating perfectly the tension between language as a universal medium and language as calculus; the reality of the worlds he describes is a formal characteristic proper to the model, and the model functions as long as it is not extended to the universal. By positing many universes, he transposes the problem of universality beyond the universal ensemble and into an infinite set of universal sets, something that physicists as well as comic book and science fiction authors have taken to call a multiverse. Everett’s infinite worlds are individual calculi, framed in a larger, self-perpetuating tree of multiversal stature. In order to save causality and realism, Everett has to displace universality, but he essentially delineates language as calculus from language as a universal medium. Each individual world is not a grasping claim at the universal meaning of physics, until it is analysed within its other possible outcomes. Reality becomes relative to all possible realities, a modal state akin to Leibniz’s possible worlds, with the privileged omniscience of God being truncated and replaced with the cold impassibility of the unobserved world. By commenting on his endeavour in the second appendix to his thesis,

Everett shows that this is the case for both the interpretations of quantum physics and for any individual theory. His “realism” exists to the detriment of actuality’s place within a theoretical framework. This leads to the idea that realism, in light of uncertainty, is, and always has been, relative. However, if reality as a relative state is a difficult idea to grasp in physics, it is much clearer as a characteristic of literature.

Following DeWitt’s revival and rebranding, Everett’s idea became an important trope of early new wave science fiction, through an piece titled “Quantum Physics and Reality: The Garden of the Forking Paths” published in the December 1976 issue of *Analog*, a science fiction magazine that also ran articles popularizing the scientific hypotheses of the day. The association with Borges’s “El jardín de senderos que se bifurcan,” found in this article’s title, is originally from DeWitt’s version of the thesis, which begins with an epigraph drawn from the popular *Ficciones* short story. Interestingly enough, this connection is far from strained; Borges describes, in this story written in 1941, the possibility (here, the use of the word is not meant to be pernicious, but rather a reminder that according to Everett, the many-worlds are themselves part of a world) of a book that would violate the straightforward causality that is implied in the actualisation of an individual world within the many-world hypothesis. Instead, it attempts to describe the superposition of all worlds. The story portrays the encounter between Yu Tsun, a Anglo-Chinese spy working for the German *Kaiserreich* during the First World War, and Dr. Stephen Albert, an English Sinologist. Their discussion, which is fortuitous since Tsun is merely using Albert accessorially to pass on a message to his German handlers, centres on Tsun’s ancestor, Ts’ui Pên, who devised to write a book that would act as a time labyrinth. Albert explains that he came to discover the temporal dimension of Ts’ui Pên’s book, through a letter written by Tsun’s ancestor.

I lingered, naturally, on the sentence: *I leave to the various futures (not to all) my garden of forking paths*. Almost instantly, I understood: ‘the garden of forking paths’ was the chaotic novel; the phrase ‘the various futures (not to all)’ suggested to me the forking in time, not in space. A broad rereading of the work confirmed the theory. In all fictional works, each time a man is confronted with several alternatives, he chooses one and eliminates the others; in the

fiction of Ts'ui Pên, he chooses—simultaneously—all of them. *He creates*, in this way, diverse futures, diverse times which themselves also proliferate and fork.³⁸ (Borges, 1964: 26)

Notwithstanding the fact that Borges more or less describes Everett's theory 15 years before its inception—a detail that is Borgesian in itself but is much less striking in light of what has been discussed about the divinatory claims of thought experiments—the description of Ts'ui Pên's endeavour offers the stark comparative power of literary possible worlds. Borges, an adept reader of Leibniz, might have been influenced by his possible worlds, but the most important aspect of Ts'ui Pên's novel is that it is made out to be a successful attempt at combining the divergent series of futures and pasts within the same narrative object. It moves the limits of compossibility to another level, one where alternate timescapes are not impossible. Deleuze also notices this link, and corroborates to the associations made so far. In *Logique du sens* and *Le Pli: Leibniz et le baroque* Deleuze uses the matrix of Leibniz, possible worlds, Husserl, compossibility and *The Garden of Forking Paths*, in order to delineate the way worlds interact. This will be especially important to understand how the creation of worlds for the sake of realism relates to the possibilities of fiction.

As an ancient book, Ts'ui Pên's *The Garden of Forking Paths* is liable to many of the ambiguities afforded through an uncertain history. This does not discourage Albert from seeking out the proper order to Ts'ui Pên's puzzle:

I have compared hundreds of manuscripts, I have corrected the errors that the negligence of the copyists has introduced, I have guessed the plan of this chaos, I have re-established—I believe I have re-established—the primordial organization, I have translated the entire work [...]. *The Garden of Forking Paths* is an incomplete, but not false, image of the universe as Ts'ui Pên conceived it. In contrast to Newton and Schopenhauer, your ancestor did not believe in a uniform, absolute time. He believed in an infinite series of times, in a growing, dizzying net of divergent, convergent and parallel times. This network of times which approached one another,

³⁸ Me detuve, como es natural, en la frase: *Dejo a los varios porvenires (no a todos) mi jardín de los senderos que se bifurcan* era la novela caótica; la frase *varios porvenires (no a todos)* me sugirió la imagen de la bifurcación en el tiempo, no en el espacio. La relectura general de la obra confirmó esa teoría. En todas las ficciones, cada vez que un hombre se enfrenta con diversas alternativas, opta por una y elimina las otras; en la del casi inextricable Ts'ui Pên, opta—simultáneamente—por todas. *Crea*, así, diversos porvenires, diversos tiempos, que también, proliferan y se bifurcan. (Borges, 1941)

forked, broke off or were unaware of one another for centuries, embraces all possibilities of time.³⁹ (Borges, 1964:27-28)

What begins as a very conscious effort to distil the meaning of an idealised story, by comparing many divergent manuscripts, becomes a clear comment on such an endeavour. Even if, in this world, Ts'ui Pên wrote a given version of his *Garden*, is there not an infinite amount of worlds where different *Gardens* were written, some with titles as varied as there are sentences in all possible languages? And, at this point, would it not be warranted to ask if there are worlds where this *Garden* is not a book but a board game? A fantastic creature? A squared-circle? Or, if a world exists where there are no possible alternatives outside of this one world, a world without possible worlds? The tension between the structure of the labyrinth, carefully outlined and assembled to express all possibilities, and the ultimate loss of meaning afforded by the ensuing chaos of its message generates a self-effacing structure that is only framed by its physical existence as many manuscripts that make up the idea of a single, perfect story. Once again, this problem is specifically that of language as a universal medium, and Hintikka would remind the eager builder of labyrinths asking the above questions that, although Borges creates a confusion by naming his story after the novel he describes, his short fiction is referring to an individual piece of literature, a novel entitled *The Garden of Forking Paths*, written by Ts'ui Pên. While the conclusions of Ts'ui Pên's novel resonate throughout Borges's short story—the randomness of Albert's name being the only reason for his encounter with the descendant of his object of study, the oppressive sentiment felt by Tsun when he starts reflecting on the multitude of possibilities that accompany Albert and him in the garden—there is a direct delineation between Ts'ui Pên's novel and Yu Tsun's story by means of a frame narrative. The interesting aspect of all this being contained within a short story is that no absolute rules forbid associations between two levels of narration, and many meanings can be generated by associating Ts'ui Pên's *The Garden of Forking Paths* to Borges's "The Garden of Forking Paths." Indeed, some could say that Borges, as an author-

³⁹ He confrontado centenares de manuscritos, he corregido los errores que la negligencia de los copistas ha introducido, he conjeturado el plan de ese caos, he restablecido, he creído restablecer, el orden primordial, he traducido la obra entera [...]. *El jardín de los senderos que se bifurcan* es una imágen incompleta, pero no falsa, del universo tal como lo concebía Ts'ui Pên. A diferencia de Newton y de Schopenhauer, su antepasado no creía en un tiempo uniforme, absoluto. Creía en infinitas series de tiempos, en una red creciente y vertiginosa de tiempos divergentes, convergentes y paralelos. Esa trama de tiempos que se aproximan, se bifurcan, se cortan o que secularmente se ignoran, abarca *todas* la posibilidades. (Borges, 1941)

function, encourages such leaps between magnitudes of storytelling, between the different calculi of language.

It is interesting to note, for the sake of the argument, that Borges is not the only writer that predates Everett in describing a form of many-world hypothesis. When the popularity of the fourth dimension was at its apex in England, following *Flatland* and Hinton's early publications on the subject, many writers came to use the fourth spatial dimension as a metaphorical (and sometimes literal) space for spirits. This recalls More's spissitude, but rather than describing a single dimension in which the soul may stretch outward (or, following Hinton's nomenclature akaward and anaward), late Victorian England's spiritualist recuperation of fourth-dimensional theories used a rather fleshed out spiritual world with its own three dimensions, which is a possibility if the fourth dimension is conceived as an ensemble of three dimensional worlds. In H. G. Wells's 1895 novel *The Wonderful Visit*, a Vicar encounters an angel that has fallen into the material universe. The Vicar's analysis of the situation echoes Everett's theory:

"it is confusing," said the Vicar. "It almost makes one think there may be (ahem) Four Dimensions after all. In which case, of course," he went on hurriedly—for he loved geometrical speculations and took a certain pride in his knowledge of them—"there may be any number of three dimensional universes packed side by side, and all dimly dreaming of one another. There may be world upon world, universe upon universe. *It's perfectly possible. There's nothing so incredible as the absolutely possible.* But I wonder how you came to fall out of your world into mine...." (Wells, 1895: 26, my emphasis)

Unlike Ts'ui Pên, the Vicar uses a hermetic view of possible worlds, and the only passages between these different worlds are dreams. Of course, the angel, having fallen from one world to the other exists as another possibility, that remains to be explored. While Wells's analysis is perhaps more naïve than Borges, for it builds semi-porous boundaries between different worlds, it is closer to Everett in its positing of near-absolute independence of worlds. Yet, it does so using only the language of space, while Everett organises his possible worlds according to temporal causality. What remains most important is the association between Everett's many-worlds, fiction and possible world theory, since these approaches generate problems that are analogous, but differently derived due to the status of each theoretical

approach's relationship to the real and to language. Thus, literary objects face a different problem when attempting to describe the plurality of possible or actual realities that are found in the theories of both Lewis and Everett. The "realism" of their worlds is a secondary concern, since the primary aspect of their encounter is through a delineated fictional narrative.

3.2.1. Literary Mediation

The problem of literature, in light of what has been discussed, is double. First, when one is presented with a text, what are the defining elements that identify this text as fiction? Second, what are the ways in which the worlds described by literature interact with knowledge about the world, any world, actual or otherwise. Possible world theory has led to a crucial distinction between types of worlds and their relationship to the real, unearthing the problem of distinction between fictional worlds and possible worlds. Thus, while "literature" has been used as a vague term to represent a more or less institutionalised body of works that is both extensive and inclusive (for instance, a certain canon defined by criteria for discerning literature from non-literature was not and will not be established), "fiction" is somewhat more problematic for both the nature of worlds, possibility and language as calculus. Etymologically, literature is linked to letters, writing and grammar, but has seen its reach expand beyond the written word, accordingly with the idea of language as calculus, which extends to all sets of propositions. The advantage of using the notion of the set is that it allows a flexible amount of propositions and the variability of these propositions. So a literary set could contain a single proposition, such as William Carlos Williams's *Red Wheelbarrow*, or as many as there are sentences in Joyce's *Ulysses* (27771, according to a data mining algorithm by René Pickhardt). Even the equation between sentences and propositions is itself open to reinterpretation from within set theory, expanding what is first conceived as a single proposition into many propositions. Thus, the red wheelbarrow may be associated to its spatial disposition (besides the white chickens), its modalities (the many things that depend on it), its author-function (Williams aimed to make the poem real beyond realism) or even the other sets that refer to it (Stephen Colbert can recite the poem by heart). In this way, a single propositional set extends well beyond the original "literary" source, using the intersections

available to readers becoming reader-functions. Both structuralism and poststructuralist critiques have explored the way in which grammar and discourse extend beyond the realm of traditional literature and into other spheres of study. Thus, as it has been stated above, language is the medium of fiction, and it extends beyond the written word. This sketch of a definition is all that is necessary for the purpose of the investigation, since the criterion for what is of interest, in this case, is literature's ability to describe worlds through an imbricated set of propositions that come to describe a state of affairs, a world. Therefore, the connection to written language being described here is merely a signpost towards the fact that general considerations about literature can extend to many forms. Seeing language as a medium allows for extensions into film, video games, opera, history and other sorts of narrative forms. This also explains why a more focused attention was given to the experimental novel without the establishment of a systematic theory of the novel in general; the experimental aspect of novel writing, according to Zola, is a view that can be transposed along the line of language. Tippett's article in arXiv, for instance, shows that narrative fiction making use of the experimental can extend well beyond the form of the novel.

These questions of fictionality and literarity resonate with Ronen's concerns in *Possible Worlds in Literary Theory*, which begins its interrogation with "the conceptual link between possible worlds and fictional worlds" (Ronen, 1994: 17). Ronen's approach carefully delineates different discourses such as "the philosophical" and "the literary," in an attempt to show that possible world theory applies only selectively to what she names fictional worlds, namely through a classical look at narrative practices. But she quickly addresses the problem being tackled here in her introduction:

Despite the relativity with which the property of being fictional is imbued, the fictionality of a text does entail specific logico-semantic rules according to which the fictional world is read. Under certain pragmatic circumstances or in a specific cultural context, a decision is made to categorize texts under the rubric "fiction." Once the label "fiction" has been attributed, conventions dictating the status and proper interpretation of fictional propositions are activated. When a text is considered to be fictional, its set of propositions are read according to *fictional world-constructing conventions* and it is made to signify by observing the set of *fictional world-reconstructing conventions* [...]. From the former set of conventions follows the ontological separation of fiction from actuality, and from the second set it follows that, granted this

separation, the domains constituting the fictional world (characters and objects, events, time and space) obey modes of organization that are unique to fiction. (Ronen, 1994: 11)

Later, when Ronen mentions the various theories of correspondence between the possible and the actual, passages that were shortly cited above, she aims to underline that the status of possible worlds' reality is itself contentious and governed by its own conventions. She does so to point out the fact that literary studies' concern with the notion is often founded on the relationship between fiction and the world. This straightforward question, essential to *mimesis*'s and representation's respective statuses as tools to address the world of the individual interacting with fiction, is what differentiates, according to Ronen, fictional worlds from possible worlds. As seen in the above quote, Ronen chooses to delimit fiction's functionality according to sets of conventions that are unique to it. This dormant structuralism, which is otherwise quite useful in generating a narratological vocabulary of modality, fails to address the peculiar status of thought experimental events within the context of fictional worlds. Ronen, who studied with Doležel, does work towards establishing a theory of literary possible worlds within a context that does not take into account reality as a fundamental category, but ultimately, her reliance on general poles of attribution—actuality, possibility and fictionality—leads to a theory of text that is both too general, due to its lack of specific objects and too specific, for its failure to address the passage between these poles. She does raise a number of interesting ways in which these categories allow strict contrast between what is fiction and what is referred to as “the real world,” but it becomes difficult to understand how similarities in apprehensions of fiction and of empiric experience can be delimited, or explained. This is why I wish to reposition the question according to the specific aspects of Tippet's “Possible Bubbles of Spacetime Curvature in the South Pacific” that have already been lined up and discussed; they allow for an integrated theory of interpenetrated possibility and fictionality that leaves room for a shifting actuality and for the radical variable that is the reader. They also show the complexity of attributing a model that strictly delineates categories to texts that are themselves commentaries on possibility.

An *a priori* problem with the categories of “fiction” and “nonfiction” are their attribution. In the same way that the real is a presupposition that wavers once it becomes subject of consideration, fiction as a category holds only inasmuch as it has become an

integral part of literature's institutionalisation. The distinction between fiction and nonfiction is often the first binary marker of reading preferences. At a very early age, children are taught, along with the ability to read, the aptitude to discern between fiction and nonfiction according to the reality of the object that the narrative is describing. Thus, they are shown that biographies, history and newspapers refer to the "real world" whereas stories, fables and fantasies do not. Granted, this is a necessary functional distinction, and it is an integral part of critical thought, but, as is the case with education in mathematics or physics, the notions that are first held as certainties for the sake of learning—the atomic structure and the number system, for instance—are eventually shown to be series of simplifications that aim at generalities. In turn, these generalities, often chosen according to their functional use, are learned and mastered to establish a vocabulary with which to approach the discipline, just as language is learned from common words rather than etymology and grammar. Thus, it would seem that the distinction between fiction and nonfiction is such a generality, since many examples show that fiction uses referents from the actual world, and nonfiction uses literary techniques and *mise-en-scène* to deploy its narrative. Any student of literature is aware of this fuzzy delimitation, since it becomes part of the specializing process of literary studies to question the strict divide between fiction and nonfiction. This odd way of learning, starting from a general, comforting and utilitarian system, and moving inwards, towards the problematic aspects that found the possibility for such a system, is difficult to explain. If one follows the epistemology of one such as Popper, this could be understood through the idea that "science is not a system of certain, or well-established, statements; nor is it a system which steadily advances towards a state of finality. Our science is not knowledge (*epistēmē*): it can never claim to have attained truth, or even a substitute for it, such as probability" (Popper, 2008: 278). Due to the objectival nature of systematically constructed structures, foundational knowledge, such as axioms, can seldom stand the test of scrutiny without opening up their own set of problems. This is why language as a universal medium irremediably falls back into self-reflexive considerations of its own expression. To Popper's credit, he does offer the reader of his treatises a form of criterion that might be informative in the case of fiction: falsification. Its use in the philosophy of science is quite complex and intimately linked to the way in which *modus tollens*, whereby a single exception can disprove a universal statement—one black swan proves that not all swans are white—, helps establish the best, as yet unproven,

theories of knowledge. As it is quite difficult to teach through uncertainty, physics and mathematics corpora for dabblers or early students provide a florilegium of theories that may or may not stand the test of time but act as a general calculus, a snapshot of the discipline's current state in its most general form. In the case of fiction, this simplification affects the act of reading as an act of potentiality, since the fiction-nonfiction continuum presupposes a strict correspondence with reality, and leads to sorting literature according to its proximity with the real. This obviously explains the staying power of *mimesis* as a fundamental presupposition of the literary. Thus, as was shown using Zola's *Le Roman expérimental*, there is an enduring bias towards mimetic realism found at the heart of the distinction between fiction and nonfiction. The varying degree to which a narrative addresses historical events, or plausible speculations, does delimit a large array of genres that have come to govern the surplus of cultural objects in the archive. It is an interesting mix of postulated intention on the author's part and conventions of its institution that shape the context in which narratives are encountered (or purchased), thus entrenching the divide between fiction or nonfiction. So, while the attribution of fictionality influences the way a book is read, it is not merely function of reception; as is common with institutionalisation, its many actants—authors, publishers, critics and readers—are wont to establish fictionality or nonfictionality before having even engaged with the writing. This is crucial in many ways; since stories are constantly repackaged into new forms, so does their status shift along the fiction axis. In a way, it is as Popper claims for scientific organisation; literary classifications are not knowledge, yet they affect the potential knowledge found within the pages of literature.

What is the criterion of falsification that could delimit fiction from nonfiction? Should the reader approach a narrative as the truth until a certain element enters in conflict with his or her vision of the actual world? The variety of different clashes between the actual world of a given reader-function and any literary world is too great to even begin approaching this question. While a novel that takes place in a world missing a dimension might seem like an obvious fiction, its potential to be understood as an allegory could restore its connection to the actual world. Inversely, should the reader stop believing in the narrative as soon as a character's reaction is judged unbelievable, even if it is not obviously supernatural or imaginary? Or does it even go further into direct experience, wherein even a character that is

not a personal acquaintance of the reader would burst the nonfiction bubble? This is obviously too large a problem to be properly addressed within the confines of this research, as it touches on a mimetic element of communication, history, autofiction and language that is essential to certain types of narratives and critiques. Yet it must be mentioned, for this question is opposed, and potentially critical of what is here investigated. If an element of fiction can be read as something that it was not purposefully meant to signify, if intention is bracketed in certain types of readings, this does not mean that any literary object can be read as anything. Narrative still draws its meaning from its own peculiar calculus, and while one may say that Tippett's article is about a phenomenon linked to relativity, even if his subterfuge has been discerned, it is much more difficult to make the case that it is describing the real in the same way that has been attempted by Heisenberg. This is to say that while *mimesis* is not the sole foundation of literary understanding, it cannot be fully discarded, for it would discredit many forms of readings that are themselves linked to the possibilities of the narrative. In certain political and historical spheres, debates ranging from holocaust denialism to evolution are fought on the grounds of truth-correspondence and the debunking of contextomy.

Perhaps the easiest way to show how opening freedom of reading beyond mimeticism does not imply an "anything goes" approach to the meaning of text would be to follow the intertextual clues that stem out of Tippett's subversion of form. His literary criticism masquerading as a scientific article is a rare and isolated occurrence, but it is not entirely unique. In 1979, an article by Mark A. Peterson appears in the *American Journal of Physics* with a title that immediately conjures Tippett's odd juxtaposition: "Dante and the 3-sphere." At first, one assumes that the Dante being mentioned is not Durante degli Alighieri, but rather a less famous physician whose patronymic designation is that of *il Sommo Poeta*. Reading the very short article immediately invalidates this premise:

At some deep level, poetry and physics are similar endeavors. The example I have in mind is cosmology, as described by Dante in the *Divine Comedy*, and by Einstein in general relativity theory. It is not generally recognized that Dante's universe is explicitly non-Euclidean, perhaps because of our tendency to compartmentalize knowledge into subjects, and then to suppose that one subject has nothing to say about another. To state the thesis in a few words, Dante's universe is a three-dimensional sphere. (Peterson, 1979: 1031)

This introducing comment, which is formulated using the hypothetics of the scientific method rather than the problematics of the essay, is in fact quite similar to Tippett's opening paragraph, which unabashedly proclaims that "the great ambition of science is the piecing together of dissociated knowledge to create hard tempered theories" (Tippett, 2012: 1). Of course, whereas Tippett hides the literary source of his "dissociated knowledge," Peterson clearly states that the main inspiration for his article is Dante's *Paradiso*. Yet, when it comes to describing Dante's text, he uses the fact that the epic poem is written from a very confusing standpoint. Dante uses the first person, and employs a figuration of his own self as the narrator of *The Divine Comedy*. Therefore, when Peterson mentions Dante, he is speaking as though the author actually undertook a trek through hell, purgatory and heaven. For instance, when the article describes the scene that acts as an explanation of a four-dimensional sphere (his use of three-dimensional in the above quote is in relation to manifolds, which always imply a higher-level dimension through which they are curved), it does so in a language that places Dante as an observer of the phenomenon. "In the *Paradiso* Dante describes his ascent sphere by sphere through the Aristotelian universe to the Primum Mobile" (Peterson, 1979: 1033). Peterson chooses to eschew traditional literary distinctions between author and narrator, playing along with Dante's own descriptive technique to give a projected phenomenological account of a finite being looking in from the very edge of the cosmos. Thus, like Tippett, Peterson is writing a physics article for a world that fuses the actual with the fictional.

As Dante rises in the paradise's concentric structure, he reaches the proverbial cloud nine, beyond the sphere of fixed stars, which is called *Primum Mobile* in the Aristotelian nomenclature. What causes a structural problem in the described cosmological worldview is the space lying beyond this ninth sphere, called the "Empyrean, the abode of God and the angels. The conventional picture of the Empyrean seems to have been rather vague, geometrically speaking. In diagrams of the universe, for example, it was represented by the border area, outside the Primum Mobile, often richly populated with angelic beings" (Peterson, 1979: 1033). Since the *Primum Mobile* is the outermost space of existence, the idea of a heavenly location outside it is analogous to problems caused by the graphic representation of universals. For instance, when representing simple intersecting Venn diagrams, the two crisscrossing circles must be placed within a limited space labelled the universal set (the

square in which they are contained). This set is graphically limited by its boundaries, but it is commonly taken to represent an infinitely extended set that contains everything. Therefore, the line that envelops the diagram in a square is merely there as a conceptual signifier, signalling that there is such a thing as a “universal set” containing and extending beyond the two ensembles of interest. For Dante, the problem is quite related to the idea of the universal, since a God that cannot be contained within physical limits is at the very heart of the Empyrean. This God has access to all of creation, so his outwardness is somehow inclusive, and the entire universe is directly accessible from a point that is represented as radically liminal. This problem is furthered by another aspect of the *Paradiso*’s structural organisation; when Dante turns to gaze upon the angelic beings composing the Empyrean, they themselves are organised according to circles, which grow in importance as they get to the centre. So God is both outside a universe that he permeates, and he is infinitely extensible while being contained within layers of spheres. Peterson focuses on the fact that the Empyrean mirrors the order of the heavenly spheres to define a geometric structure that could explain these seemingly paradoxical aspects of Dante’s God. The 3-sphere, a 3-manifold construction akin to a sphere of spheres, is an intelligible model that can allow all these coexisting characteristics:

Dante assumes from the outset that the nine angelic spheres and the nine heavenly spheres are analogous. [...] The problem is that the various heavenly spheres revolve faster in proportion as they are bigger, while just the reverse is true of the angelic spheres: the innermost and smallest of these are revolving the fastest, and the outer ones are slower. Beatrice replies that if he will shift his attention away from the spheres’ sizes to an intrinsic ranking they possess, he will see a marvellous consistency in the whole. The innermost angelic sphere turns faster than the other angelic spheres because it ranks higher, just as the Primum Mobile turns faster than the other heavenly spheres because it ranks higher. In other words, the spheres have a ranking, a “greatness,” which does not necessarily correspond to their size (although for the first nine it does), but is rather indicated to the eye by their speed. This explanation strongly suggests our construction of the 3-sphere as sliced up into 2-spheres which first grow and then diminish in size, labelled by a fourth coordinate w , which simply increases. Indeed Dante has actually introduced such a fourth coordinate to label the spheres as they grow and diminish, namely their speed. In all our visualizations of the 3-sphere it was the second hemisphere, composed of the diminishing sequence of 2-spheres, which was the hardest to fit into the model—Dante embeds

the model in four dimensions, which does, as we know, solve the problem. (Peterson, 1979: 1033)

Peterson is vying for a rereading of Dante's 27th and 28th cantos of the *Paradiso* as the bewildered description of a four-dimensional structure when seen from its equator. While much of his argument is focused on providing a clear model of the 3-sphere by means of visual and linguistic analogies, his reading of Dante is ultimately the crux of article.

Peterson's foray into the literary has such an impacting effect on his career that he carries a similar approach into the history of the sciences. In a 2011 article entitled "Galileo's Discovery of Scaling Laws" he finds a historical link between Galileo, master of the scientific thought experiment, and the *Divine Comedy's* descriptive strengths. Stating his intentions, he struggles with the connotations of the "literary":

I will show that the key to much of what is strange in **Two New Sciences** is to be found in two rather neglected early lectures given by Galileo on the shape, location, and size of Dante's *Inferno*. The text of these lectures is readily available in the standard 20-volume **Opere** of Galileo among the "literary" writings in Volume 9. My reconstruction of its actual significance, which is not at all literary, is the subject of this paper. (Peterson, 2011b: 2, original emphasis)

The significance, as Peterson sees it, is not literary, perhaps since his description reconstructs Galileo's statement of the scaling laws and the impact that they might have on the history of physics. Peterson rewrites a story about a young Galileo lecturing on the descriptive power of geometry. This young professor then returns to his earlier lectures and realises that the described structural integrity of the *Inferno* cannot account for the stress of its own weight. He then goes on to write the scaling laws in *Two New Sciences*, which resolve the problem. This time, the story of Galileo is deemed historical, and Peterson goes to great lengths to find details that would support his retelling of history. In a way, the burden of historical proof heightens the complexity of the simple point that Peterson is making, which explains why this paper is much longer than "Dante and the 3-sphere." Both articles are about reading Dante's masterpiece for physics insights, but in the latter paper, Galileo is doing the reading, not Peterson. By reading Dante through the lens of Galileo, Peterson is responsible for his appropriation of a historical figure. Yet, by reading Dante as trans-dimensional traveller, the same author can clearly make his point without having to struggle with intentional ascription.

The potential for knowledge drawn from the *Divine Comedy* is still discussed, but through the proxy of an idealised reader. Therefore, by attempting to evacuate the literary significance of his argument, Peterson is actually emphasizing the relationship between history, meaning and intention, a problematic behemoth that has been a staple of literary theory for most of the 20th century. Nonetheless, Peterson hints at the literary undercurrent at play in his discovery when concluding his text by remarking that “it seems a fine irony that the first success of Galileo’s mathematical physics, which is close to being the first success of mathematical physics at all, was a response to a problem that was not physical, but rather the collapse of an imaginary structure in a work of literature” (Peterson, 2002: 14).

While Dante may have had an important impact on the development of mathematical physics—Peterson argues in *Galileo’s Muse: Renaissance Mathematics and the Arts* that most of Galileo’s work was developed in relation to the arts rather than to what would now be called the sciences of his time—it is the fact that a serious commentary on four-dimensional structures can be written with the *Paradiso* as a sole source material that proves a type of literary malleability that breaks down causal potentiality. Here, Peterson’s argument that Dante had a role in Galileo’s theories could offer a reconstruction of a sound causal structure, proposing that four-dimensional Euclidean spaces exist as an extension of the tradition of mathematical physics that Galileo helped establish, thus reconnecting Dante’s spark with its eventual reabsorption. But in order for such a causality to be actualised, one has to accept a positive ascription of Peterson’s Galilean reading of Dante. This transposes the non-causality of reading upon a historical figure, but does not dispense with it. For Galileo’s original reading of Dante in his lectures is the marker of a change in interpretation, later corrected in *Dialogues Concerning Two New Sciences*, that cannot be linked to a straightforward act of linear reading. Dante’s text, even within Peterson’s historical reconstruction of Galileo’s thought process, holds a structural complexity that is both transparent and opaque, a fact that is proved by Galileo’s original mistake and his readjustment of the scaling laws. But the fact remains that there is, in a 14th century poem, the description of a conjuncture between the Aristotelian universe and the Christian divine order that resembles, to a 20th century reader, the description of a 3-sphere. The descriptive strength of a hypothetical development in geometry offers an entirely new vocabulary to address a calculus that has its roots in Aristotle and

Aquinas. Yet, since the problem is addressed through the phenomenological standpoint of Dante, as both a narrator and an author, it allows a specifically “literary” element to shine through as the feature responsible for historically distant notions to fold upon one-another.

The interesting approach that is developed in both Tippett’s and Peterson’s articles has the immediate effect of showing how literature and physics establish objects in ways that can sometimes be analogous. While Peterson’s explicit purpose is historical, proving that some discoveries have their root in a process that may predate the formulation of the concepts necessary for their inclusion into the systems of physics, Tippett takes the argument a step further by making his observations about an extensive setting found exclusively in a body of literary works. The Cthulhu *mythos*, a self-consistent quasi-mythical word-of-mouth understanding of the world, can be regarded as a fictional retelling of a possible world. Indeed, Tippett relies not on the author-function, but on the various unreliable narrators of Lovecraft to provide phenomenological data that is then analysed and reconstructed as a hypothetical phenomenon. Ascribing transitively to Lovecraft the descriptions found in his writing is an obvious possibility, but Tippett thoroughly avoids the question of authorship by evacuating any mention of his literary source’s fictional status. Dyer and Thompson, characters in Lovecraft novellas, are listed in the bibliography alongside “actual world” authors such as Hawking and Wald. Even Tippett himself is listed as a bibliographical source, having the odd effect of creating a level playing field between characters, persons and the author of the article, something that could be described as an original set, or a coherent non-causal calculus. The fact that only Lovecraft is omitted from the list is in part due to Tippett’s prankish approach, but it also underlines the fact that removing the very potential for authorship problems allows the literary work to function freely as a possible world, acting as the setting for empirical considerations. Historical reconstructions, such as the search in Lovecraft’s other works for mentions of relativity—Einstein does often appear as the subject of discussions, for instance in *The Shadow Out of Time* where he is said to be “rapidly reducing time to the status of a mere dimension” (Lovecraft, 1936)—, become twice-removed from the actual considerations of the paper. Tippett is implementing a type of close-reading, looking at the structural elements of the text to find parallels between its descriptions and the projected effects of certain scientific notions. While he is using a set of scientific conceptual tools that are less familiar to literary

studies than grammar or tropes, it should be obvious here that Tippet is enacting possible world presuppositions to perform a heterocosmic reading by bracketing questions of authorship entirely. While possible world theorists are often concerned with the workings of literature as the creator of worlds, Tippet is taking a step towards the function of a given literary world *qua* world, that is, as a set of data that is observable and extendable to other data following from it. Peterson's original Dante article uses a language that is ambiguous enough to suggest the same type of possible world transposition, with Dante as narrator describing his actual experience facing the divine spheres. Yet, the development of the argument, as it appears in *Galileo's Muse*, eschews the possible world interpretation through historical ascription. Thus, Dante's work becomes a thought experiment, and the storytelling aspect of the *Paradiso* proves (in Peterson's late works) that "Dante is a first-rate mathematician" as well as an archetype for "early Renaissance understanding" (Peterson, 2011a: 74). His thought experiment resonates strongly with Galileo's own grasp of the *Divine Comedy*, providing a causal model that implies a certain historical reading of four-dimensional geometry. But the original 1979 article also works like Tippet's text if writer-Dante is replaced by narrator-Dante. Since both of these figures use the same signifier, a specific interpretive inclination must be accepted in order to reconstruct a possible world out of the Peterson article. Further consideration of *Flatland* and *The Sirens of Titan* will show that this ambiguity of language and the overlap between various levels of narration cause the same type of effect on their readers, permitting a reflection specific to the many dimensions of possibility.

Reading a possible world in Peterson's text is not merely evoked as an unlikely potentiality that supports a thesis through a voluntary distortion. The applicability of this hypothesis has already been proven within the science fiction realm. In *Phase Space*, the fourth book of his Manifold trilogy (a short story collection that is annexed to the three books making up the trilogy), Stephen Baxter republishes a short story titled "Dante Dreams." Originally found in the August 1998 issue of *Asimov's Science Fiction*, this play on the detective genre describes a suicide investigation. The suicide victim, a Jesuit mathematician and translator of Dante's *Divine Comedy*, is reconstructed as an artificial intelligence in order to answer to her (women have recently been admitted in the catholic clergy) sinful demise. She explains that through her research on DNA memory, she came to realise that the human

body contains forms of intelligence at a different level than that of conscience. The complex information processing potential of DNA allows for other self-conscious entities to exist within the body, explaining both certain forms of behaviour (intuitions) and experiences (selected dreams) of the human conscience. By entering in a direct conversation with these other-level consciousnesses, Eva Himmelfarb, the Jesuit, came to realise that the sentient organelles held a deeper knowledge of nature, one that has existed within DNA for millions of years and that manifests itself in certain works of culture. But it is the entire exposition of this theory that takes a form pertinent to the matter at hand. Through a virtual transition, Himmelfarb, reincarnated as an A.I., leads officer Philmus, the detective, and Monsignor Boyle, who ordered the investigation, into Dante's Eden. From there, they ascend, like the Dante-narrator himself, through the heavenly spheres and towards the divine. Himmelfarb calls forth this virtual interface because, she says, "it was when my translation [of Dante] reached [the *Paradiso*] that the thing I'd put in my head woke up" (Baxter, 2003: 106). Himmelfarb's communication with the sentient organelles is brought about through both the technical means of injected receptors and the experience of deeply thinking about Dante's *Paradiso*. Her exposition interpolates her discoveries with Dante's descriptions, since communication with her inner sentience is achieved through the *Paradiso*. When they get to the edge of the *Primum Mobile*, the three protagonists face the sight already described by Dante:

"Philmus was looking, up beyond the *Primum Mobile*, into another glass onion, a nesting of transparent spheres that surrounded – not a dull lump of clay like Earth – but a brilliant point of light. The nearest spheres were huge, like curving wings, as large as the spheres of the outer planets. Himmelfarb said, 'They are the spheres of the angels, which surround the universe's other pole, which is God. Like a mirror image of Hell. Counting out from here we have the angels, archangels, principalities, powers –' 'I don't get it,' Philmus said. '*What* other pole?' How can a sphere have two centres?' 'Think about the equator,' whispered Himmelfarb. 'The globe of Earth, remember? As you travel north, as you pass the equator, the concentric circles of latitude start to grow smaller, while still enclosing those to the south...' 'We aren't on the surface of a globe.' '*But we are on the surface of a 3-sphere – the three-dimensional surface of a four-dimensional hypersphere.* Do you see? The concentric spheres you see are exactly analogous to the lines of latitude on the two-dimensional surface of a globe. And just as, if you stand on the equator of Earth, you can look back to the south pole or forward to the north pole,

so here, at the universe's equator, we can look towards the poles of Earth or God. The Primum Mobile, the equator of the universe, curves around the Earth, below us, and at the same time it curves around God, above us.” (Baxter, 2003: 114-115, original emphasis)

Himmelfarb describes the phenomenological (albeit virtual) experience of staring both at the heavenly and divine spheres in exactly the same terms as Peterson. But Baxter's story goes further by rendering explicit the surprise of such a discovery:

The Monsignor's jaw seemed to be hanging open. ‘And Dante *saw* this? A four-dimensional artefact? He *described* it?’ ‘As remarkable as it seems – yes,’ said Himmelfarb. ‘Read the poem again if you don't believe it: around the year 1320 Dante Alighieri wrote down a precise description of the experience of travelling through a 3-sphere. When I figured this out, I couldn't believe it myself. It was like finding a revolver in a layer of dinosaur fossils.’” (Baxter, 2003: 115, original emphasis)

Of course, considering the contextual story, this discrepancy is explained through the framework of the sentient organelles. Himmelfarb explains that perhaps Dante had awakened this “deeper mystery” (Baxter, 2003: 113) naturally. The interesting reflection on these messages from the organelles provides a form of resolution to the mysterious aspects found in both Tippett and Peterson. This idea of a primeval collective memory offers an interesting metaphor for the type of knowledge that seems to lie dormant in certain literary texts. Himmelfarb explains that upon communicating with these ancient forms of intelligence, she realised that “they are part of the universe as I can never be, behind the misty walls of my senses; they know the universe as I never could. All I could do – like Dante – is interpret their vision with my own limited language and mathematics” (Baxter, 2003: 113). She even goes as far as claiming that contained within the last canto of the *Divine Comedy*, there is a description of what theoretical physicists call the grand unified theory. Also glimpsed personally by Himmelfarb, this universality motivates her initial suicide, a choice for self-destruction in lieu of being able to submit to a universal order that would forever transcend her own consciousness, belonging to her DNA yet forever evading her neural network.

Baxter's story is explicitly indebted to “Dante and the 3-sphere,” and he mentions this in his afterword. It offers an alternative development to Peterson's own continuing work in Galilean history, and allows for something akin to Tippett's possible world to arise. By

removing mention of Peterson from the main body of the story, Baxter is following through on a burgeoning idea found in the article's narrative structure. In the world of "Dante Dreams," the universe's 3-sphere structure is a given phenomenon that is explained through a series of invented theorems. The weight of actuality is removed through the sentient organelles that, while plausible in a theoretical sense, are a fictive thought experiment such as Le Guin describes them: an elaborate what-if scenario. Baxter shows that Peterson's original work is rich with implicate elements that can lead to a form of meeting between language, universality and conceptual models of geometry. By including Himmelfarb as a new type of guide for Dante's *Paradiso*, a guide that is both scientific and religious, as well as a translator, Baxter takes Peterson's initial possible world and extends it along the lines of its potentialities while simultaneously commenting the new limits that arise from removing the previous, three-dimensional, ones.

Both Tippett and Peterson are writing scientific articles about literature. The mad ramblings of a Norwegian navigator and the ecstasies of a religious man confronted with god both serve to better illustrate, or vulgarise, theorems that are present within their respective scientific structures. This explains why both articles are published through scientific venues, as popular physics articles. I am not denying that they are popular physics articles, but what is most interesting about them is that they hold certain presuppositions about the literary, about what can be drawn from literary descriptions. In both cases, the concepts discussed are newer chronologically than the fictions in which they are observed. But Tippett and Peterson, like the protagonist of *The Shadow Out of Time*, read these older works as though they were writings out of sync with chronological time. Their peculiar technique for describing their discovery is thus justified; they have to play along with the fictive aspect of their science, writing the popular physics articles as though they were fictional narratives. The effect of framing a subsequent analysis of narrative through a selective suspension of disbelief (enacted as a formal characteristic of criticism rather than a performed individual effort made by the reader) functions in a mode akin to *epoché*, leaving out the quest for truth and turning the interpretive effort towards the implications of narrative *qua* possible world. Yet Tippett's and Peterson's articles show that thought experiments can take place within possible worlds, reinstating a form of truth that is dependant upon a bracketing of truth functions at the

narrative level. In other words; in order to explore forms of truth within fiction, one has to stop questioning the truth of said fiction. This has profound repercussions on the epistemic worth of fiction; as Le Guin might say, its truth is founded upon lies—wilfully believed lies.

3.2.2. Literary Dimensions

The specificity of the articles written by Tippett and Peterson is that while they are expressed using the medium of language in a literary manner, their organisation, or their form, is shaped in a way that hides their fictional elements. The similitude with which they emulate a form usually attempting to describe empirical evidence mimetically creates a dissonance between their fictionality and the knowledge they bring forth. They also point to a way in which literature and science, as commonly held independent disciplines, can cohabit. Indeed, in both cases, these two areas of knowledge are often nourishing each other through symbiosis; Tippett uses a fantastical source to explain a physical hypothesis, while Peterson restructures his reading of early mathematical physics according to an analysis of Dante, and an analysis of Galileo's analysis of Dante. Peterson's original article about the geometric oddities found in Dante's epic poem influences Baxter in creating a new science fiction short story; this cross contamination is fertile, closer to a cross pollination that becomes, with time, what Deleuze and Guattari describe as the mutualism between orchid and wasp. Thus, like thought experiments, the interaction between science and fiction, if such a broad way of saying it is productive, expands both of the implicated spheres of knowledge along mirror paths that develop so naturally that they seem to have been there all along.

This allows a fold that both *Flatland* and *The Sirens of Titan* can exploit. In fact, attentive readers will have noticed that I have been discussing both these novels in a way that is similar to Tippett and Peterson's articles, with the added characteristic of addressing directly the presuppositions necessary for a leap between fiction and empirical evidence. The matrix constituted by *Flatland*, More's spissitude and Hinton's tesseract, groups together elements that function in a similar manner; free of causal constraints, resonating with one another in a way that fleshes out the relationship between a fictional narrative and knowledge that exists as an independent subject while being fully imbricated in fictionality. Likewise, *The Sirens of*

Titan's relationship between various forms of causality and theories on time is drawn as an extension of its narrative structure, not exclusively as a causal narrative but also as one that function entirely outside of causality. The possible worlds of both *Flatland* and *The Sirens of Titan* can be constantly unpacked, undergoing the complex operations of an unbound calculus. This is due to the fact that while each novel presents its own calculus, the reader, not as reader-function but as radical variable, opens the possibilities of derivations along unknowable (from a causal standpoint) yet thinkable axes. The reader-variable does not circumscribe the narrative the way that the reader-function does, yet all reader-functions are derived from the reader-variable. Thus, the possible worlds of a narrative are many-worlds; once the premises of a specific possible world have been established, according to a process of becoming-figure, of understanding, of reading, other possible worlds are relegated to alternate universes. If one chooses to picture Rumfoord as a wave phenomenon, then all the possible worlds where Rumfoord is a being governed by classical physics, worlds that would need rigorous reconfiguration of 21st century understanding of time and space, belong to an alternate set of worlds. Like the observer in quantum mechanics, the reader fixes the meaning of notions that, had they had been observed otherwise, would function in a different way. Everett's many-worlds allow for a clearer understanding of the cohabitating worlds that exist within the same narrative. Are there pockets of time-space curvature in the South Pacific? What if there are? What if there are not? Both these speculations can be explored, but it is the shift between the modal ontology conjured by their conjunction that generates the type of thought proper to literature. Yet, as with any form of translation, the transposition of both possible world theory and the many-world interpretation of quantum physics to literary studies is fraught with difficulties, especially when equivalences must be forced or inferred. Looking closely at the presuppositions of both these approaches has led to some problems that may or may not apply directly to literary narratives. They do serve to broaden the question of the worlds that are presented by literature and their interaction with both their language (their modality) and their ontological status (their reality). It does now become imperative to look at some characteristics of literary worlds, and the specific differences of these worlds in relation to the possible worlds of logic and the many-worlds of physics. There are some subtle differences found within these categories of worlds that pertain specifically to space, time and dimensions and these differences will serve to illuminate exactly how modal logic and quantum physics

endorse a clearer understanding of the reach and the limits of literary studies. These limits, as I have stated earlier, are both linked to the specific calculus of the fictional narrative, as well as to the radical variable that is the reader.

This problem can be addressed adequately by looking at the content of the notion “dimension,” which has heretofore been used as an extensional notion in two different ways. Throughout the discussion of *Flatland*, dimensions expanded into space (upward, northward, leftward or akaward), whereas in *The Sirens of Titan*, dimensions were temporal (punctual, linear or infundibulated). Great care, and the repeated use of the adjectives “spatial” and “temporal,” ensured that this distinction remained clear throughout the exposition, with only a short discussion touching upon Minkowski’s space-time continuum to offer a temporary bridge between notions. This gloss attempted to show how time, as a dimension, was conceived in direct relation to the three phenomenological dimensions of space. Though space-time gave the dimensional conception of time its *lettres de noblesses* by inscribing it within the framework of relativity, and then quantum physics, the actual transformation of time into a dimension was born out of an incredibly heuristic approach to experience. The word “dimension,” which has its classical roots in the combination between the past participle of the nominative latin word for “measuring” and a prefix that means both “out,” “away from,” or “apart” (di-mensio), has a deeply relativistic meaning. Indeed, both the idea of outwardness and that of measuring necessitate a starting point and a frame of reference. Using these words without defining their characteristics is akin to using possibility as an open-ended notion.

There is also a fuzziness to the history of the dimension’s transition from space to time. The first mention of time as a dimension, or rather the possibility of conceiving time in a dimensional manner, is delightfully ambiguous. It is found in a major work of reference, the *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers*, by Diderot and d’Alembert. In the entry on “dimension,” written by d’Alembert, there is a fascinating digression as the next-to-last paragraph comes to a close. This paragraph begins with the algebraic means to reduce exponential expressions to three dimensions. As is the case with Oresme’s and Pascal’s methods of reduction, d’Alembert attempts to explain how the geometrical representation of a fourth power has to take a step back in representation, using a line to represent a square, or a point to represent a line. But, moving along the considerations

of this algebraic transposition (d'Alembert, after all, is documenting the method rather than expanding upon it), he lapses into a strangely anecdotal conclusion:

I said above that it was impossible to conceive of more than three *dimensions*. A man of intellect, whom I am acquainted with, believes that one could nonetheless look upon duration as a fourth *dimension*, and that the product of time by solidity would be, in some ways, a product of four dimensions; this idea can be contested, but it seems to me that it has some merit, if only for its novelty.⁴⁰ (d'Alembert, 1754: 1010, my translation)

Other than the oddness of the tone, which is unexpected in a work of reference, this side note stands out as the first written source of one of the greatest conceptual developments of early 20th century. The imbricated reference (heard from an unspecified man), which is both frustrating and liberating in its vagueness, gives the idea of time as the fourth dimension back to general intuition. Indeed, the clash created by the seriousness of its written context (*the Encyclopaedia*) and the lack of specificity and reference create an adequately open-ended beginning to a notion fundamental to contemporary expression of human experience. D'Alembert's man of intellect is akin to Laplace's "intelligence" or A. Square's Sphere; he intrudes upon the development of the argument and casually disrupts the conceptual apparatus necessary to affirm limitations. He sets the coordinates for a thought experiment, in its purest Galilean form, that would become central to a paradigm shift taking place 151 years later. And this stranger, without a name, becomes a stand-in for the type of thought, both intellectual and intuitive, that is available to anyone considering measurements or dimensions, through contemplation of phenomenal existence. As a historical discovery, the unreliability of the source breaks the association between historical figure and original thought. It brings out the fact that this reflection was always available, but only formulated on paper during the 18th century. It implies, indirectly, that perhaps the idea of time as a fourth dimension was considered during a countless number of occasions, in front of fireplaces, before falling asleep or while staring at the stars: an idea lost and found again repetitively throughout history. An

⁴⁰ J'ai dit plus haut qu'il n'étoit pas possible de concevoir plus de trois *dimensions*. Un homme d'esprit de ma connoissance croit qu'on pourroit cependant regarder la durée comme une quatrième *dimension*, & que le produit du tems par la solidité seroit en quelque maniere un produit de quatre *dimensions* ; cette idée peut être contestée, mais elle a, ce me semble, quelque mérite, quand ce ne seroit que celui de la nouveauté. (d'Alembert, 1754 : 1010)

idea that was recorded for the first time in 1754, but that allows other possible worlds where, engraved in an Aztec temple, or coded within the I Ching, there are remains of the idea of time as a dimension of space.

Other mentions soon followed this original suggestion, this fragment of literary imagination found within a book of reference. Before Minkowski's institutionalisation of the time-space structure, the variety of modes in which this idea presented itself shows that while systemic to a type of knowledge about the world, the meaning of time as a fourth dimension was open to appropriations both empiric and literary. As Cajori notes, the next mention of time as a fourth dimension was made by Lagrange, who found the use of a fourth variable quite naturally by studying how functions could relate to mechanics, the study of objects subjected to forces (and thus the study of derived movements). It was in his *Théorie des fonctions analytiques*, in which he was attempting to develop an alternate calculus that would exclude Leibnitz's infinitesimals as well as the Newtonian limit, that Lagrange's acuity with formulae caused him to say that:

[In mechanics] functions are essentially related to time, that will always be referred to as t ; and since the position of a point in space is dependent upon three rectangular coordinates, x , y , z , these coordinates, in the problems of mechanics, should be functions of t . Thus, one can look upon mechanics as geometry in four dimensions, and mechanical analysis as an extension of geometric analysis.⁴¹ (Lagrange, 1847: 316, my translation)

This extremely simple-looking relation on the part of Lagrange had a simplifying effect; in relation to the way the formula is constructed, time has to be considered as a dimension since it functions in exactly the same way as the other variables. For every t there is an x . Just as for every y there is a z . The inclusion of t , as a variable of place according to movement, ties the axes x , y , and z to a value for t . The intersection of these coordinates is relatable to t 's own curve, according to the projection mapped out by its movement. Lagrange seems to fully integrate the idea implied by d'Alembert's man of intellect in a formula of position.

⁴¹ [Dans la mécanique] les fonctions se rapportent essentiellement au temps que nous désignerons toujours par t ; et comme la position d'un point dans l'espace dépend de trois coordonnées rectangulaires x , y , z , ces coordonnées, dans les problèmes de mécanique, seront censées être des fonctions de t . Ainsi, on peut regarder la mécanique comme une géométrie à quatre dimensions, et l'analyse mécanique comme une extension de l'analyse géométrique. (Lagrange, 1847: 316)

Mathematically, this appears to be a breakthrough, one that will influence even the simplest form of mechanics. In order for physical objects to move according to a curve, it must include a fourth variable, which measures out the subsequent positions of an object. But while Lagrange's t variable became a mainstay of mechanics, the philosophical extensions of his offhand comment, on the idea of a four-dimensional model that considers time as a direct dimensional equivalent to length, width and height, never received commentary from the great minds of his day. Lagrange's dimensional intuition could be characterised as the lucidity of a mathematician following through on the logical extensions of his own vocabulary. But, like d'Alembert's mention, it is also an artefact of the past demonstrating that the idea of time as a fourth dimension was both so immediate and so abstract that while it would become crucial in relativity a little over a century later, its appearance in text never caused enough turmoil to generate a true debate on definitions.

Between Lagrange and Minkowski, the discovery of non-Euclidean geometry instituted the type of models that could allow a t variable as a fourth coordinate by essentially deconstructing the notion of a strictly Cartesian set of axes. But it is in two texts found at the intersection between fiction and cosmology that time was once again presented as a dimension. The first of these two texts is Poe's *Eureka*, which is the type of work that defies genre conventions. Even in the limited context of its subtitle, Poe's swansong is ambiguous; on the cover, one reads *Eureka: A Prose Poem*, whereas the first page of the text presents it as *Eureka: An Essay on the Material and Spiritual Universe*. *Eureka*, then, was conceived as a poem, but it reads like an essay. Harold Beaver, in his commentary on the piece, compares it to *De Rerum Natura* and *Novum Organum*, which, appropriately enough, provide a frame of reference within the realm of works read both for their epistemic and aesthetic qualities. The preface to *Eureka* further addresses this specific status:

To the few who love me and whom I love—to those who feel rather than to those who think—to the dreamers and those who put faith in dreams as in the only realities—I offer this Book of Truths, not in its character of Truth-Teller, but for the Beauty that abounds in its Truth; constituting it true. To these I present the composition as an Art-Product alone:—let us say as a Romance; or, if I be not urging too loft a claim, as a Poem. *What I here propound is true:*—therefore it cannot die:—or if by any means it be now trodden down so that it die, it will 'rise

again to the Life Everlasting?. Nevertheless it is as a Poem only that I wish this work to be judged after I am dead. (Poe, 1976a: 209, original emphasis)

Thus the status of the essay is poetic through a desire of reception, promoted by the Poe author-function of the preface. This has led to conflicting analyses of *Eureka*, a book that can be seen as a complicated satire of the scientific world or an illuminated plea for spiritual pantheism. Author-function aside, *Eureka* is a strange read; it attempts to describe the Universe by refusing the axiomatic method, for “the progress of true Science, [...] makes its most important advances—as all History will show—by seemingly intuitive *leaps*” (Poe, 1976a: 214). It prefers to study various loci of knowledge, astronomy, mathematics, methodology, etc. and tie them together through a complex process of intuitive coherence. *Per se*, *Eureka* has often been dismissed, accused of being a scientific text lacking rigour, or literature masquerading as natural philosophy. Yet for all its misfires (Poe claims that the Moon is self-luminous, for example), *Eureka* does describe a highly complicated and interrelated set of propositions that fleshes out a world and draws conclusions that combine imagination with scientific discovery. The particular “intuitions” that inform *Eureka*’s scientific theory attempt to conjugate the Divine with the empirical, as well as the universal with the individual. Thus, when he speaks of causality, Poe says:

in human constructions a particular cause has a particular effect; a particular intention brings to pass a particular object; but this is all; we see no reciprocity. The effect does not re-act upon the cause; the intention does not change relations with the object. In Divine constructions the object is either design or object as we choose to regard it—and we may take at any time a cause for an effect, or the converse—so that we can never absolutely decide which is which. (Poe, 1976a: 292)

This argument brings to light the conclusions discovered through the chrono-synclastic infundibulum, but does so according to a notion of the Divine, which was, in the case of *The Sirens of Titan*, not necessary, other than as an example of a view radically outside of time. The distance employed in Vonnegut’s novel, established as the relationship between two timescapes weaved into a single narrative, is not as readily available during *Eureka*’s creation. Considering that the body of fiction describing time-travel was at an embryonic state, it is quite impressive to see ideas associated with timelines as observable dimensions in Poe’s

prose-poem. Through a combination of imaginary leaps and the science of his day, Poe shows that the link between literary plot and causality of the world is an analogically linked approach to knowledge:

in the construction of *plot*, for example, in fictitious literature, we should aim at so arranging the incidents that we shall not be able to determine, of any one of them, whether it depends from any one other or upholds it. In this sense, of course, perfection of plot is really, or practically, unattainable—but only because it is a finite intelligence that constructs. The plots of God are perfect. The Universe is a plot of God. (Poe, 1976a: 292)

A writer that is associated with the maturation of the detective, horror and science fiction genres has the best credentials to reveal that plot is built neither as a succession nor as a collection of events, but rather as a crystalline puzzle that describes a world of possibility. The perfect plot, for Poe, does not rely on causality, but rather on the composition of a whole that takes on form through the actualisation of reading. That cause and effect can mutually take each other's places strengthens the idea of an infundibulated time that, like a rollercoaster, can be both ridden from within and observed from afar. Poe holds the finiteness of authors as guilty for the imperfections of fictional plots. Much has already been said about the unnecessary weight put onto authors as the God-figures of their fictions, and it is interesting to wonder how Poe's theory of causality could hold without the appeal to a perfect God or to a finite author. It was shown that potentiality could be pinpointed to a form of reading that was not actualised, but could potentially become actualised. Poe's causality is an attempt at equating a perfect world to an imperfect fiction. One could then say that without an appeal to perfection, there was nonetheless, in the finiteness of the fictional narrative, the potential for arriving at a breakdown of causal presuppositions. That the crystalline structure of narrative has chips, imperfections, in which are found points of foci or prismatic complexities. That specifically by being written through finiteness, these fictions create a connection to the world that allows differences, comparisons, and thus possibilities.

In order for such conclusions to hold within *Eureka*, one has to find a way in which the world would also be perceived, by finite beings, through a limited grasp of knowledge. With this, Poe fully concurs, and his strongest intuition (from the point of view of post-20th century physics) is in describing what he calls “the Divine *adaptation*” (Poe, 1976a: 291). This

loosely built notion aims at showing the vastly complex way in which forces come to a relatively held equilibrium, according to a universal development beyond human grasp. Thus, for Poe, all things exist within an unreasonable grand scheme. This certainty, which is already obvious in his vision of causality, is also present in the organisation of space. When considering the vast expanses of emptiness between the stars, he, once again, hits upon a strangely revelatory idea:

let us take the opportunity of referring to the difficulty which we have so often experienced, while pursuing the beaten path of astronomical reflection, in accounting for the immeasurable voids alluded to—in comprehending why chasms so totally unoccupied and therefore apparently so needless, have been made to intervene between star and star—between cluster and cluster—in understanding, to be brief, a sufficient reason for the Titanic scale, in respect of mere Space, on which the Universe of Stars is seen to be constructed. A rational cause for the phænomenon, I maintain that Astronomy has palpably failed to assign; [...] that *Space and Duration are one*. That the Universe of Stars might endure throughout an æra at all commensurate with the grandeur of its component material portions and with the high majesty of its spiritual purposes, it was necessary that the original atomic diffusion be made to so inconceivable an extent as to be only not infinite. (Poe, 1976a: 291, my emphasis)

Thus, in order for the universe to *make sense*, according to his vision of the Divine, Poe has to explain expanses in space through a model that directly relates them to the temporal. The infiniteness of the purpose is limited by the near-infiniteness of the universe, and since only the Divine has access to infinity, even the universe in which humanity lives has to be limited as to reflect its spirit. Within this same logic, time and space are proportional, and the cosmos is telling its near-infinite story through its near-infinite space. For Poe, time acts as a dimension in the sense that it is always bundled with space into a coherent narrative. This allows the leaps made between fiction and the world, insomuch as fiction's space and its time are always related through narrative (plot and setting exist as the same story). In so saying, Poe greatly advances connections made between dimensions, possibility and fiction in that he shows an intuitive grasp of the allegorical model developed through the visualisation of space as a fourth dimension. Like More or Hinton, though, Poe's discovery is buried under dubious claims and a strange method, but this does not strip this one intuition of its potency.

While many other pages could be written on this particular aspect of *Eureka*, within the structure of the argument at hand, there is already enough information to understand how a certain perception of the universe frames a conception of space-time that is at least as intuitive as it is mathematical. Poe joins Lagrange (whom he positively mentions in *Eureka*) in attempting to conceptualise a framework that would make time a variable inextricably linked to space, but he does so according to an entirely different calculus. In so doing, he comes upon conclusions that corroborate the observations made on causality. One does not have to fully accept his project (Einstein wrote letters both praising and deriding Poe's last work) in order to see that through a poetic process of composition, Poe aimed at constructing an elegant universe, and achieved a pre-theoretical understanding of time as a fourth dimension.

Poe's influence might have helped Wells achieve the final pre-Minkowski formulation of time as a fourth dimension. In *The Time Machine*, the narrator visits a man simply referred to as "the Traveller." During a dinner party, the Traveller explains to his guests that he has found a way to travel in time. In order to explain his discovery, he attacks conventional geometry:

'You must follow me carefully. I shall have to controvert one or two ideas that are almost universally accepted. The geometry, for instance, they taught you at school is founded on a misconception.' 'Is not that rather a large thing to expect us to begin upon?' said Filby, an argumentative person with red hair. 'I do not mean to ask you to accept anything without reasonable ground for it. You will soon admit as much as I need from you.' (Wells, 1984: 1-2)

This introducing interjection has the same effect as Poe's enthusiastic portrayal of his own theory, but the Traveller chooses to function, unlike Poe, along a "reasonable ground." A historical argument regarding this difference might come from the popularisation of non-Euclidean geometry following the Poe's death. Indeed, Riemann had extended Gauss's *Theorema Egregium* (the curvature of a surface can be measured according to the length of paths on its surface) to include many-dimensional surfaces, called manifolds. The inclusion of these strange surfaces that could difficultly be represented graphically ushered in the era of n -dimensional geometry. Poe's objection with axiomatic geometry is specific to Euclid, and it is difficult to guess what he would have thought of Riemann. It should also be added that at the time of *The Time Machine's* publication, both *Flatland* and many of Hinton's texts on the

fourth dimension were also being circulated in England. While this explains the ease with which Wells formulates his idea, corroborating with a strong reading of the history of mathematics, the language used by Wells, as well as what he makes of his theory is not developed in order to build upon the theory of manifolds or tesseracts. Rather, he explains how one may come to consider time as the fourth dimension.

You know of course that a mathematical line, a line of thickness, *nil*, has no real existence. They taught you that? Neither has a mathematical plane. These things are mere abstractions.’ ‘That is all right,’ said the Psychologist. ‘Nor, having only length, breadth, and thickness, can a cube have a real existence.’ ‘There I object,’ said Filby. ‘Of course a solid body may exist. All real things—’ ‘So most people think. But wait a moment. Can an *instantaneous* cube exist?’ ‘Don’t follow you,’ said Filby. ‘Can a cube that does not last for any time at all, have a real existence?’ Filby became pensive. ‘Clearly,’ the Time Traveller proceeded, ‘any real body must have extension in *four* directions: it must have Length, Breadth, Thickness, and—Duration. But through a natural infirmity of the flesh, which I will explain to you in a moment, we incline to overlook this fact. There are really four dimensions, three which we call the three planes of Space, and a fourth, Time. There is, however, a tendency to draw an unreal distinction between the former three dimensions and the latter, because it happens that our consciousness moves intermittently in one direction along the latter from the beginning to the end of our lives.’ (Wells, 1984, 2)

Using the exact same vocabulary as Hinton or Abbott, the Traveller moves away from abstraction and into a question of ontological extension. His analogy differs slightly from the one described by the Sphere in *Flatland*, since instead of using the isolated idea of a zero-dimensional world, a point-world (Pointland), which then moves to a one-dimensional world, etc. the Traveller begins with the already existing extensions of a three-dimensional world. But the extensional analogy functions perfectly with the notion of a timeline, because it removes the messy need to explain that this line is its own one-dimensional construct. *The Time Machine* also differs from *Flatland* in that it uses the idea of lower-dimensions as physical impossibilities within a phenomenally given world. Whereas *Flatland* suffers from the problem of considering sight in a two-dimensional world, which would have no thickness and therefore could not produce a the type of contrast that A. Square describes as vision in the first part of his exposition, Wells fully embraces an alternative impossibility, namely of two-dimensional objects existing in a three-dimensional space without thickness (or with an

infinitesimal thickness). By following through on the formal limits of lower-dimensional objects out of their dimensional context, the Traveller is able to establish an ontological criteria for existence: a thing exists according to the dimensions of its world. This is also reminiscent of Poe's intuitive and coherent world. Through this impossibility, the Traveller, by a negative analogy, can now prove that if an object cannot exist without extensions in all the directions of the world that surrounds it, it also cannot exist without extending in time. His use of "instantaneous" is misleading, in fact, the true strength of his argument is that a thing cannot be said to physically exist without having at least one point of intersection with a timeline. But duration being more than an infinitesimal blip of materialisation, Wells overplays his hand and extends his theory along a line of time. Again, this liberates the explanation from having to consider units within a line, which is crucial to the establishment of point-of-views and to dimensional readings, but it does link the idea of time to space thoroughly, using extensions along dimensions.

Thus, the idea of time as a dimension and, more specifically, as *the* fourth dimension can be traced from the *Encyclopédie's* fortuitous discovery with uncertain sources to its full exposition in *The Time Machine*. Through a constant reminder of its intuitiveness, this conception of the dimensional build-up of worlds still had a few steps to climb before being fully integrated in relativity, and it did so rather through the work of mathematicians working with Lagrange's t variable and Riemann's manifolds than with commentaries on Poe's cosmogony. But these resonating ideas each map out the constellation of possibility for the naïve notion of dimensions. When, at the very dawn of the relativity revolution, Poincaré (who has the most fitting name) notices that a Lorentz transformation is merely a rotation in four dimensions, he presents this idea, not as a revolutionary new way of doing physics, but rather as a temporary model. A year before Minkowski works out the necessary calculus for space-time, Poincaré, who was already quite famous as the inventor of n -dimensional topologies developed as extensions of Riemann's manifolds, rejects the idea of building a new dimensional context for physics on the grounds of unnecessary complexity:

It would seem, in fact, that it would be possible to translate our physics into the language of fourth-dimensional physics; attempting this translation would be going through great pains for little profit [...]. However, it does seem that the translation is always less simple than the text,

and that it will always seem like a translation, that the tongue of three dimensions seems most appropriate to the description of our world, even if this description may be rigorously carried by another idiom.⁴² (Poincaré, 1907: 15, my translation)

Poincaré, committed to an intuitionist approach to physics, fully mastered the steps necessary for establishing a notion of space-time. But, perhaps again because of the lacklustre appearance of the idea, he did not recognize the centrality it would soon garner as part of relativity. It is fascinating to realize how quickly Minkowski's model was accepted thereafter, considering the various reactions of resistance in attempting to theorise a spatial (and even, in Poincaré's case, a temporal) fourth dimension. For while all these ideas came out of the extensional model of geometrical analogy, time as a fourth dimension seems to arise out of a heuristic need to speak of space in relation to time. This is where *Flatland* and *The Sirens of Titan* become most interesting, from a comparative standpoint. As two novels describing the discovery of possible dimensions above the phenomenal, both spatial and temporal dimensions, they truly illustrate how thinking of fictional worlds according to dimensions allows a calculus that expresses knowledge as generated through the thinkable. They also allow a use of dimensions that is neither spatial nor temporal, but rather related to the organisation of the modal, as a result of their respective relation to the fourth dimension.

3.2.3. Literary Form

A return to a comparison between *Flatland's* and *The Sirens of Titan's* narrative structure can illuminate how dimensional form in literature has an impact that is both intrinsic and extrinsic to its language, since these stories share a similar novelistic form while depicting radically different worlds. An incredibly simplistic way pointing this out would be to notice that in bookstores, both *Flatland* and *The Sirens of Titan* are found, if not specifically in the subsection of "science fiction," at least in the "fiction" department. Yet, their unambiguous classification is more complicated than meets the eye, as both offer very different approaches

⁴² Il semble bien en effet qu'il serait possible de traduire notre physique dans le langage de la géométrie à quatre dimensions ; tenter cette traduction ce serait se donner beaucoup de mal pour peu de profit [...]. Cependant, il semble que la traduction serait toujours moins simple que le texte, et qu'elle aurait toujours l'air d'une traduction, que la langue des trois dimensions semble la mieux appropriée à la description de notre monde, encore que cette description puisse se faire à la rigueur dans un autre idiome. (Poincaré, 1907: 15)

to fictionality. In light of the previous acts, both *Flatland* and *The Sirens of Titan* are now encountered as comparable narratives, with similar points that differ only inasmuch as they set the boundaries of specific notions. Foremost, both the novels have already served as the representatives of certain literary arrangements that have been enriched by discussion, allowing for the transfer of the observed ideas from specific modes of representation—either as science fiction, thought experiments or imbricated causalities—to the vast ensemble of the literary. Using Hintikka's vision of language, it can be said that both of these sets of proposition have been supplemented and defined; their organisation into differing calculi makes up most of the first two acts. So it is now time to bring together the formulae of their calculi into a complex algorithm that, if appropriately derived, will bring about conclusions on the nature of dimensions. When turned towards the same object, these two novels, like the stereoscopy of two human eyes, will allow new depths to be discovered.

Both novels follow a single individual that, with the help of a second character, undergoes the gradual discovery of a new dimension. While A. Square and the Sphere seem geometrically distant from Constant and Rumfoord, their relationship is analogous to one another through the notion of the dimension. A. Square and Constant have the same nominal characteristic, their patronym representing quite literally their role as the beginning point of the dimensional analogy. As a three-dimensional spatial being, Constant is already aware of A. Square's discovery in a subconscious manner. He does not have to come to realize that he is three-dimensional, as his own actual world is never put into question spatially. This is because *The Sirens of Titan* is not describing a clash in spatiality. Quite to the contrary, interspatial travel and teleportation effectively erase distances found in the novel. Yet, while being a three-dimensional being, Constant is also a point, tangentially stuck in the present through his recurring amnesias and the shifting roster of roles and names he holds during the story. He is confronted with the discovery of a dimension that extends not in space but in time, as it has already been pointed out. The movement from one dimension to two is, in the point-line-square-cube sequence the abstraction of a square from a line. Thus, Constant's position as a point, not even fully capable of maintaining a linear understanding of his temporality, implies that for certain moments of his life he is experiencing the zero-dimension of time. This was contrasted with Augustine and Heidegger's description of time as a line moving

through a point—the present—and reconstructed through expectation and memory, or facticity and falling. Constant wavers between seeing time as a point and accumulating enough experience to reconstruct the line of time, so he is, throughout the narrative, alternating between point and line. Rumfoord's privileged viewpoint on time takes the form of a two-dimensional shape, allowing him to observe, like A. Square in front of Lineland, the entirety of his own timeline in all its nooks and crannies. He, like A. Square, is also limited by his own viewpoint, but greatly advantaged in relation to Constant. His own reflexions on the shape of his path, which is non-linear but still follows a form, could be seen as a the third dimension of time. Yet, Rumfoord does not have his own guide to explain what lies beyond his personal perception, so no theory of time's third dimension is explicitly described in *The Sirens of Titan*. Not even Salo holds an insight into the privileged vantage point held by Rumfoord. Although, on the account of being eternal and having a perfect memory, he does become the personification of time's one phenomenal dimension as a causal construct and he holds an incredible grasp on this line. Salo is a machine, a perfect machine, so while he is the perfection of memory and expectation, he cannot move beyond the linear, unidirectional line of causal time; he cannot guess the contents of the message he is carrying without opening the letter. As a sometimes-point, the fundamental non-dimensional axiom of geometry, Constant exists in a state that is drastically different from Salo's perfect records and calculations, and he comes to resemble, at times, the Being of Pointland that A. Square visits in his second dream, alongside the Sphere. This Being is neither a king nor a subject, extensional categories that can only start existing once a dimension appears, for in a zero-dimensional world, identity coincides with the world. The Sphere presents this lonely creature with a warning;

“Behold yon miserable creature. That Point is a Being like ourselves, but confined to the non-dimensional Gulf. He is himself his own World, his own Universe; of any other than himself he can form no conception; he knows not Length, nor Breadth, nor Height, for he has had no experience of them; he has no cognizance even of the number Two; nor has he a thought of Plurality; for he is himself his One and All. Being really Nothing. Yet mark his perfect self-contentment, and hence learn this lesson, that to be self-contented is to be vile and ignorant, and that to aspire is better than to be blindly and impotently happy.” (Abbott, 2002: 182-183)

The Sphere seems to be making a comment on the ethical worth of dimensions, something Hinton would have no doubt corroborated, and this relates interestingly with Constant's

amoral life of alcohol and short-term memory loss at the beginning of his own narrative. But most fascinatingly, it also points to a hint as to the necessarily dimensional structures of worlds. While the Sphere defines the observed Point as “really Nothing,” it is misrepresenting the radicalism of nothingness, the empty set, which is in fact assigned the negative-one dimension by Menger, using Poincaré’s topological notation. The Sphere is perhaps speaking of the minimum necessity for a narrative process, which can edge towards nothingness—here Beckett comes to mind—but must always break into somethingness by its very iteration. There is, therefore, a dimensional aspect to narrative possible worlds, although the limit of possibility would permit a world of nothingness, which would narratively translate into the shell of a narration, an unattainable story that would lead to no propositions. This narration would return to the original reticence of Greek mathematics with the zero; that without abstraction, zero of a defined thing negates the definition of that thing and that to say, for instance, that one has no apples means in fact that apples exist in the proposition only as abstractions, conjured up mentally only to be then annulled. The zero-dimensional character-world of the Point illustrates the ground of narrativity as an overlap of figure and world. Narrativity activates itself through the meeting of the Point and an outsider like A. Square, who cannot exist within Pointland but interacts nonetheless as the phantasm of a Point talking to itself. In the Travis and Johnson adaptation of *Flatland*, the Point, before encountering A. Square (renamed Arthur for the movie’s classroom purposes) is chanting a song whose only lyrics are a repetition of the syllable “me.” This, again, is an imperfect way of representing the direct correspondence between ego and world, which is also the only way sentience can be configured within a zero-dimensional world. But, through a simplified image, it conveys the limits of an impenetrable notion. This image is Deleuze’s inflexion, the Point in itself as the potential meeting place of vectors such as causality or the reading experience:

Bernard Cache defines the inflexion, or the inflexion point, as an intrinsic singularity. Contrarily to the “extrema” (extrinsic singularities, maximum or minimum), it does not refer back to coordinates: it is neither high nor low, neither right nor left, neither regression nor progression. [...] The inflexion is also the pure event, of the line or the point, the Virtual, ideality *par excellence*. It will take effect according to the axes of coordinates, but for the moment it is not in the world: it is the World itself, or rather its beginning, as Klee said, “scene

of cosmogenesis,” “non-dimensional point,” “between dimensions.” An event that would be the wait for an event?⁴³ (Deleuze, 1988: 20-21, my translation).

I translate “scene of cosmogenesis” rather than “place of cosmogenesis” because the Point is a narrative inflexion, directly related to the form of narrative as the inexistent theatre of the mind, where narrative events unfold. The Point, as both the foundation of a dimensional approach to narrative, the first step from nothingness to somethingness, and the limit of narrative itself, further stresses the importance of Constant and A. Square as protagonists directly linked to punctuality, building a foundational line, a fold, by extending beyond this punctuality through the outside force of Rumfoord and the Sphere.

The liminal case of the Point shows the way in which a protagonist’s *point* of view is essential to the fictional worlds. Even in the case where, like Constant, this character is described in the third person, the interaction between worlds and fiction must go through a becoming-narrative by extensional means. Thus, A. Square and Constant, both first and third person, enact allegorically the relationship between the world and fiction by being confronted with dimensions to which they have no direct access. A. Square’s dreams and Constant’s stint on Mars as Unk, the amnesiac soldier, illustrate this movement away from the point to a line. The Point is stuck in his oneness, on the verge of nothingness, and it is the observations of A. Square and the Sphere that expand upon its status by generating a dialogue that can never escape being a monologue. Meanwhile, Constant is always trying to achieve the transition from punctual time to linearity. The similitudes between Constant’s state of amnesia and the Point’s self-conscious ramblings are remarkable. The Point is stuck in a strict equation between itself and the world, yet it speaks:

“Infinite beatitude of existence! It is; and there is none else beside It.” “What,” said I, “does the puny creature mean by ‘it’?” “He means himself,” said the Sphere: “have you not noticed before now, that babies and babyish people who cannot distinguish themselves from the world,

⁴³ Bernard Cache définit l’inflexion, ou le point d’inflexion, comme une singularité intrinsèque. Contrairement aux « extrema » (singularités extrinsèques, maximum et minimum), elle ne renvoie pas à des coordonnées : elle n’est ni en haut ni en bas, ni à droite ni à gauche, ni régression ni progression. [...] Aussi l’inflexion est-elle le pur Événement, de la ligne ou du point, le Virtuel, l’idéalité par excellence. Elle s’effectuera d’après des axes de coordonnées, mais pour le moment elle n’est pas dans le monde : elle est le Monde lui-même, ou plutôt son commencement, disait Klee, « lieu de cosmogénèse », « point non dimensionnel », « entre les dimensions ». Un événement qui serait attente d’événement? (Deleuze, 1988: 20-21)

“speak of themselves in the Third Person? But hush!” “It fills all Space,” continued the little soliloquizing Creature, “and what It fills, It is. What It thinks, that It utters; and what It utters, that It hears; and It itself is Thinker, Utterer, Hearer, Thought, Word, Audition; it is the One, and yet the All in All. Ah, the happiness, ah, the happiness of Being!” (Abbott, 2002: 183)

This Parmenidean language is for A. Square and for the reader, not for the Point. A simple thought experiment would indicate that should a consciousness be one with the world, it would have no need for language or narrative. Yet the Point exists within the dimensions of a narrative from the standpoint of A. Square, who meets him as both a creature of two dimensions and as a recent convert to the Allegory of the third dimension. By setting down dimensions in which to exist, the studied narratives allow for a complexity that cannot exist within punctuality, in its extensional or unfolded form. Thus, possible worlds are dimensional worlds, whether fictive or actual. Dimensionality is an integral part of worlds, and the possibility for extra-dimensional point of view questions linearity, such as was shown for the case of causality. Unlike the Point, Constant, as Unk, is not strictly living within a zero-dimensional time, and his tendency to be confronted with the phenomenal experience of living temporality in one dimension is constantly reconstructing his knowledge of the world:

Unk had just come out of the base hospital, where he had been treated for mental illness, and Unk’s mind was almost a blank. Unk didn’t recognize his best friend at the stake. Unk didn’t recognize anybody. Unk wouldn’t have even known his own name was Unk, wouldn’t even have known he was a soldier, if they hadn’t told him so when they discharged him from the hospital. (Vonnegut, 2006: 99)

It is interesting to note that since Pointland, Lineland, and Flatland are abstracted worlds, built upon the notion of spatial dimensions, the transitions from being-in-the-world to outside knowledge of being-dimensional is much more difficult to achieve, necessitating a literal revelation, that is, in *The Sirens of Titan*, operated by Unk’s tendency to move from punctual time to actual time. This can be best explained by the fact that, although Constant/Unk represents a form of punctual living, he does so while being a temporal being. His relationship to phenomenal temporality is preserved, even if, as a character, he represents the various ways by which time can interchangeably move from line to point and vice-versa. In this way, he is similar to characters such as Jacques Austerlitz in Sebald’s *Austerlitz* or Leonard Shelby in Nolan’s *Memento* that attempt, following a traumatic event, to reconstruct their own

knowledge of the world. He is also a perfect enrichment to the figure of the reader, who, looking onto a story that is occupying physical space (say, as a book), is forced to unravel the narrative by going through every word or moment of the story to generate a world, or write a calculus proper to his encounter with the narrative. Like the image-movement of a movie, Constant is a collection of frames in the process of becoming a movement. This is in part due to the type of time-travel narrative that is depicted and deconstructed by Vonnegut, something I will get into shortly.

But first, it is interesting to look closely at the transition from point to line in Constant, since it communicates something about the way the reader has to deal with fiction in order to construct a narrative. A large part of this research's approach to the reader that is not yet a function is to allow a freedom that goes beyond what Ronen calls "specific logico-semantic rules" (Ronen, 1994: 11). As a radical variable, the reader, in all its potentiality, could work within a context that cannot even be presently considered (such as the reader equating Gibson's cyberspace with early 21st century internet). Yet, in order for there to be an encounter with the novel, dimensions are opened up according to lines drawn by the reader and guided by the text. Vonnegut actually uses an interesting expression while talking about Unk's involvement with the world: "he was too good a soldier to go around asking questions, trying to round out his knowledge. A soldier's knowledge wasn't supposed to be round" (Vonnegut, 2006:120). Unk's particular soldierhood, which is tied to Rumfoord's Martian army, is that of a colony drone, governed by its implanted antenna and doomed to fail in its invasion of Earth. Rumfoord, who organises the timeline according to utilitarian means, needs his soldiers to function punctually. There is no room for individual time in his grand scheme (and indeed, Rumfoord, due to his perspective, is already aware of his success). Thus, Unk's soldierhood is directly opposed to his drive to "round out" knowledge. This, once again, resonates nicely with the vocabulary used in *Flatland*, as the circles, members of Flatland's priesthood, are perceived as having attained a higher level of perfection than the rest of the polygons. Yet it is important to remember that Unk is "rounding out" his knowledge of time, thus moving from a point to a shape, across dimensions. So the accurate analogy in *Flatland* is not that of the priesthood (and, indeed, this seems to be one point of the story, since the circles are opposed to new knowledge) but rather that of the discoveries brought about by the

millennial revelation (both A. Square's dreams and the visit from the Sphere). Rounding out knowledge, once again, is perhaps the best way to use geometry metaphorically to explain the reading process. The reader, faced with descriptions and events, is building his or her own calculus out of the reading experience, making a shape that is "round" inasmuch as it exists along another dimension. Like the fractal, or Poe's view of plot, which can only be approximately represented, the rounding out of knowledge is always imperfect, but, as has already been noticed, thought has to introduce itself in a discipline through simplified constructs. Rounding out knowledge, like rounding out numbers, allows the construction of worlds, which are always approximated but can lead to new thoughts. It is contained in the ambiguity of the expression; rounding out a complex number is a simplification, whereas rounding out a point is expanding it along different tangents. This process also explains the variability of reading, which is always rounded according to intersections with the reader's prior knowledge. This makes both Constant and A. Square reader-functions in their own respects, but they are, within the context of their individual story-worlds, reading their actual world as though it was a possible world. Their movement, from two spatial dimensions to three for A. Square and from zero temporal dimensions to one for Constant, consist in the type of discovery that opens up the possibilities of the world. They are rounding out their respective worlds through the reading of their own experience; this is what constitutes the analogy permitting the conceptualisation of an n -dimensional world that is most explicit in A. Square's newfound belief in the fourth, the fifth and the sixth dimension. Thus, both *Flatland* and *The Sirens of Titan* are, in part, *mise-en-scène* of the reading process when it is extending along possible digressions. Rounding out is proper to the calculus of each story, self-contained through the modal proposition of eventual modalities (the possibility for new possibilities).

The intersection between time and space, through the notion of dimension, allows for a much richer vocabulary in describing each respective domain. The equation between the characters of the two chosen novels uncovers meaning within the space-time overlap. If A. Square and Constant are reader-functions in themselves, then it is interesting to wonder what type of figures could adequately describe the Sphere and Rumfoord. Strict parallelism might warrant that these teacher-figures say something about the author-function, and in this case, it

turns out that it generates a productive yet flawed analogy. As has been shown, the author-function is often the locus of intention, and it structures reception according to a speculative reading of history. This might also be said of Rumfoord, who, due to his privileged knowledge of Tralfamadorian influence on human history, is intentionally driving historical development towards the completion of Chrono's task. The reader, or even Constant, could blame the invasion of Earth and the marooning of the Constant family on Rumfoord, which could yield at least part of the story. Rumfoord is, in a way, writing the development of the story as experienced by Constant. Of course, he is also limited to a fixed timeline, and has to comply with the situation he discovers once infundibulated. This does give insight into the creative process, as the author is not entirely free of his or her own experience and has to shape a story out of his or her own actuality. But the analogy, which is already strained for Rumfoord, cannot hold for the Sphere. As has already been said, the Sphere is an angel-like being that delivers a revelation to A. Square, and his initial refusal to accept further extensions of the spatial analogy (from three dimensions to n dimensions) makes him as limited as A. Square (limited to his own dimensional context). The Sphere's unreceptive nature is obvious to the point of becoming a recurring theme is Dyonis Burger's sequel to *Flatland*, entitled *Sphereland: A Continuing Speculation on an Expanding Universe*⁴⁴, and only after many other such mistakes does the Sphere come to accept that the discoveries empirically obvious to him in Flatland also apply to his own world of Spaceland. This could also be said of reactionary writers refusing to allow for differential meaning to their works, a sort of fantasy perfectly illustrated through comic relief in Allen's *Annie Hall*, when Alvy Singer pulls Marshall McLuhan from off-camera to silence an avid pontificator who is droning on about his thoughts on the notion of hot medium. It is specifically this authority that both Foucault and Barthes oppose (the fact that Marshall McLuhan puzzlingly objects with the phrase "You mean my whole fallacy is wrong" [Allen, 1997: 12:35-12:37] muddles the actual authority of his intervention) and it transforms the Sphere into a proxy for authority within the context of *Flatland*. Yet, even if the Sphere first refuses the possibility for a fourth dimension, arguably the sole reason for the world in which it exists (and this statement works either for a historical

⁴⁴ The much more evocative original subtitle "a fantasy about curved spaces and an expanding universe" was changed in a current edition which also includes Flatland. The original subtitle underlines the link between the Einsteinian universe, which Burger is attempting to explain using Abbott's original analogy, and the idea of a "fantasy."

reading of *Flatland* as a pedagogical story written by Abbott, or for a narratological close-reading of *Flatland* as the journal of A. Square, which is after all the frame in which the story is set), the transposition of authority moves from the angel-like figure of the Sphere to A. Square as the true prophet of the fourth dimension and the transitional figure that moves beyond its own dimension. This is because A. Square is both the narrator of the story, the fictional author that was also pseudonym to Abbott, and a figure that illustrates the discovery at the basis of the reading experience. A. Square spends half the novel describing his world, his actual world, and it is through his encounter with the sphere that he learns to move beyond this actuality, into the domain of speculation and abstracted thought. He transforms a revelation, which is expressed through a form of truth-ascription expressed in the language of the gospel, into the type of structural analogy that leads to new extensions of thought. Thus, there is an implicit theory of reading as thought experiment in *Flatland* that is particularly effective since its entire calculus is a formula of dimensional discovery. At its core, and through a truncation of the divine, *Flatland* is a literary thought experiment about thought experiments.

So what of Rumfoord? The Sphere's author-function status is put into question by its refusal to round out its own revelation into a thought experiment. This is also constitutive of Rumfoord's privileged temporality. As was seen above, Rumfoord, who acts as the creator of the Church of God the Utterly Indifferent, is, after all, governed by his own sense of fatality. While this fatality is framed by his hope that delivering Salo's spare part to Titan will free humankind of the UWTB, his ultimate departure from his home solar system, which coincides directly with humanity's newfound freedom, shows the degree to which Rumfoord's viewpoint has become limited. Since Rumfoord is aware of his specific chronology, and works within the context of perfecting a non-linear causal form, he seems to allow an expansion beyond his own phenomenal reality. But this is an illusion caused *The Sirens of Titan's* choice of delving within the extensional realm of the dimensional analogy as applied to time. Although conflicting forms of causalities cohabit the novel's "space" they do so through the abstraction found within the type of narrative used by *The Sirens of Titan*. While *Flatland* offers a germinal form of the analogy, by projecting three-dimensional space onto a two-dimensional model, thus allowing for knowledge about the fourth dimension to be

expressed through the Sphere's three-dimensional conception of the world, *The Sirens of Titan's* infundibulum is the process of unpacking this analogy as a physical phenomenon. Whereas the reader of *Flatland* can, through an analogical identification with A. Square, complexify knowledge of the world by reading about the complexification of a simpler world, the same cannot be said of Rumfoord's infundibulation. Rumfoord is rather the impossible outside perspective of time, which can, nonetheless, serve as an object of thought. While *Flatland* explains reading through a simplified process, *The Sirens of Titan* asks that reading be ultimately considered as something that goes beyond the causality of its own experience. Thus, Rumfoord seems godlike, but his limits are even more obvious than Constant's own, since there is nothing left unknown to him about his own life, yet everything outside of the curious spirals of his two-dimensional timescape becomes radically unknown, impossibly reachable lest he becomes twice-infundibulated. His hope for the renewed freedom of humanity is outside of his grasp, even though he has achieved a higher dimension of temporal understanding. Meanwhile, freedom, for Constant, is always a possibility. His movement from punctual to linear is the true parallel to A. Square's discovery of the third dimension. Through the meddling of an outside (higher-dimensional) influence, both A. Square and Constant are discovering the phenomenological world as the reader experiences it. Both novels are describing what could be, by describing what is.

What makes these characters truly central to their respective stories is that they reinscribe modality within the context of their worlds. Whereas Rumfoord and the Sphere hold the new knowledge throughout the story, from an epistemological point of view they are the punctual beings; their world remains static and their certainties are unwavering. Yet, as has been discussed time and again throughout this exposition, the reading experience necessitates a truly unknown variable. The two chosen protagonists embody this unknown, which is touched and then remains untouchable. A. Square is made aware of a new dimension, but his closing remarks show that the variability of his experience remains unscathed:

Heavily weighs on me at times the burdensome reflection that I cannot honestly say I am confident as to the exact shape of the once-seen, oft-regretted Cube; and in my nightly visions the mysterious precept, "Upward, not Northward," haunts me like a soul-devouring Sphinx. It is part of the martyrdom which I endure for the cause of the Truth that there are seasons of

mental weakness, when Cubes and Spheres flit away into the background of scarce-possible existences; when the Land of Three Dimensions seems almost as visionary as the Land of One or None; nay, when even this hard wall that bars me from my freedom, these very tablets on which I am writing, and all the substantial realities of Flatland itself, appear no better than the offspring of a diseased imagination, or the baseless fabric of a dream. (Abbott, 2002: 196-197)

This closing paragraph to *Flatland* paints an odd reversal of the habitually additive notion of new knowledge. It is as though the possibility of other dimensions has shaken A. Square's connection to his own world, to his own empiric existence. Thus, while he is enriched by the experience of something that is beyond his own phenomenological reality, this experience reduces the grasp he holds on his actual world. Yet, considering that the frame in which the tale is placed presupposes that A. Square's entire story has been written in his cell, he is relating his newfound doubt in light of having written, with surprising clarity, all the events that led up to his imprisonment, as well as a treatise on his world. So, credibly, A. Square is making an appeal not to his own ignorance but to the knowledge he holds of his own ignorance. He, after having extensively built up his argument for a third and fourth dimension, is making a Socratic plea for his sanity; he is claiming awareness of the fact that what he holds for possible is perhaps impossible, or at the very least, a product of his imagination. But, in the same passage, he also goes on to express that even his own actual world might also be a dream. This strange connection to possibility as the gateway to doubt about the world is echoed directly by Constant, who undergoes a number of demeaning and traumatic experiences before being returned to Earth by Salo. He finishes his passage from punctual to linear, by way of Rumfoord's two-dimensional revelation, sitting at a bus stop, slowly freezing to death:

Salo had hypnotized him so that he would imagine, as he died, that he saw his best and only friend, Stony Stevenson. As the snow drifted over Constant, he imagined that the clouds opened up, letting through a sunbeam, a sunbeam all for him. A golden space ship encrusted with diamonds came skimming down the sunbeam, landed in the untouched snow of the street. Out stepped a stocky, red-headed man with a big cigar. He was young. He wore the uniform of the Martian Assault Infantry, Unk's old outfit. "Hello, Unk," he said. "Get in." "Get in?" said Constant. "Who are you?" "Stony Stevenson, Unk. You don't recognize me?" "Stony?" said Constant. "That's you, Stony?" "Who else could stand the bloody pace?" said Stony. He laughed. "Get in," he said. "And go where?" said Constant. "Paradise," said Stony. "What's

Paradise like?” said Constant. “Everybody’s happy there forever,” said Stony, “or as long as the bloody Universe holds together. Get in, Unk. Beatrice is already there, waiting for you.” “Beatrice?” said Unk, getting into the space ship. Stony closed the airlocks, pressed the *on* button. “We’re—we’re going to Paradise now?” said Constant. “I—I’m going to get into Paradise?” “Don’t ask me why, old sport,” said Stony, “but somebody up there likes you.” (Vonnegut, 2006: 325-326)

While quite different from A. Square’s tragic appeal for knowledge of ignorance, Constant’s last thoughts, which, while induced by Salo, seem to take on a dream-like fracturing of Constant’s own subconscious thoughts, are punctuated by the question mark. This hallucination, which, according to the text, was merely meant to be an encounter with a long-lost friend, becomes a series a questions. Constant seems ill at ease, or even confused. To each of the hallucinated Stony’s answers, he responds with one or two new interrogations. His nine questions are the result of a shattered sense of time, and their repetition seems to imply that he is not even certain of his own lines of inquiries. Constant, unlike A. Square, has been confronted with a new dimension of time, so his doubt is turned towards future events and past memories. In his own hallucination, paradise becomes a place of eternity, but only as long as the universe holds, so even foreverness is in doubt. Again, this is linked to the fact that Constant has lived through the disappearance of a being outside of time and both the suicide and revival of an eternal being. By expending his possibilities through experience, he has come to doubt the very foundations of the empirical. It is interesting to note that since his last moment is an induced hallucination, Constant’s doubt is partly founded. But in essence, there is nothing truly differentiating his reaction from A. Square’s conclusive remarks, for both are written and so framed that the character’s connection to the world, hallucinated or otherwise, is the same.

How are these *mise-en-scène* of world readings specifically linked to their reader? Obviously, since readers are free to read narratives along their own tangents and experiences, there is a way in which they depend on a willingness to follow the analysis so far exposed. But, arguably, the language at the heart of each of these novels is creating worlds offset by the discovery of new dimensions. This simple element, which is undeniably part of each of the stories, is proper to an understanding of the dimensional makeup of worlds that has its foundations in an actualisation of reality. The intersection of the two propositional sets that

are *Flatland* and *The Sirens of Titan* generates a theory of reading as an extensional process. While this is mediated through language, the form of this language, as a set, is in itself relegated to a given limit. A naïve way to explain this would be to take a step back and consider the objects that have been studied. Bibliographic references will inform the reader that specific books have been used for the study, and that, in all credibility, both the 2002 *The Annotated Flatland* and the 2006 Dial Press Trade Paperbacks version of *The Sirens of Titan* are somewhere lying on my bookshelf (or through a reconstructed causality of writing that passes through my author-function, that these books are lying in front of me as I write). Thus, the narrative objects that have been discussed hold their own physical presence within the world. This lapse into self-reflexivity is meant as a reminder of the physical aspect of narratives within their framing worlds. Just as *The Sirens of Titan* describes a certain actuality that is then appended, or derived, through any reader's propositional calculus, it is also always contained, as an object, within this reader's world. The inequality between the novel's framing world and the world it contains can be rebalanced using the phenomenon described as movement between dimensions. For the purpose of this analysis, the book will be used as a catchall term for any narrative support, since both the novels studied manifested themselves to me as such, but efforts will be made so that any observations made could also apply to digital text, films or audiobooks. The importance of the support is its materiality, its being-in-the-worldness. Form is therefore used as a contrasting notion to medium, since language, which holds the fictive, must also manifest itself within its framing world. Thus, the book, being read, both holds possible worlds and is framed by a world. By reading a book, the reader is generating possible worlds through his or her own understanding of actuality.

From the standpoint of time, the book is always a gateway to new temporal extensions, as the reader, like Constant, is transitioning from actuality to possibility with the help of the narrative. A reader is always between dimensions, moving outside of an actual and causal temporality and into another world where time functions according to its own logic. Like Constant meeting Rumfoord, the reader may learn other declinations of time, yet remains partly stuck in the actuality of the reading-process. The reader is oscillating between two forms of time, using what can only be described as another dimension. It is this punctuality of thought that is both the greatest strength of the reader and its ultimate limit. The reader is

never Rumfoord, although he or she glimpses at what this might entail. The historicity of the book may influence the analysis of the story, but one always encounters a book in the present, even when its story is being recalled or apprehended. Thus, while a historical object, with its beginning and end within the world's chronology, the book always holds differential timelines which are superposed on the present of the reading experience. From the standpoint of space, the book exists within its own three dimensions. It can sit on a table, extending in length, width and height, and is manipulated along those same axes. Yet reading it brings about *n* new dimensions according to the specific narrative in play. Like Everett's many-worlds, a library is a set of universes, each separated by their own physical dimensions in their own actual world. And while each book is itself a set of possible worlds, the reader, when faced with the new worlds described by literature, becomes analogous to A. Square, discovering a whole new potentiality in the dimensionality of worlds. The world of the book superposes its dimensions upon its framing world and it is the act of reading that allows extensions like A. Square's conception of the fourth dimension. The reader remains within his or her own contextual space (which, according to differing theories is understood as holding three, nine or even 21 dimensions), but the dimensions opened up by the narrative are strictly analogous; it is through an extensional reading that these dimensions relate to the world that frames them. Thus, while still, say, three-dimensional, the reader is foregoing temporarily his or her three-dimensionality to exist within the dimensions of the narrative, to extend those dimensions to the world that frames them.

The form of narrative is therefore not that of the story it describes but of the world that frames it. What *Flatland* and *The Sirens of Titan* teach, is that while the possibility for extensional readings is a feature of narrative language, the dimensions this language describes are always both superposed and differential to the dimensions of the narrative form. Only reading can animate this superposition and derive meaning from it. Interestingly, both *Flatland* and *The Sirens of Titan* directly engage the notion of dimensions, which allows for possible extensions in the sense that have been here undertaken. These *Sinnbildung* experiments comment on the process necessary to their existence. Earlier, it was noted that it is through the *mise-en-abyme* of the dream of Lineland that the Sphere presents the Analogy, and likewise, it is by crafting the small thought experiment of a rollercoaster that Rumfoord

describes his timeline within another temporality that he no longer causally inhabits. But for Constant and A. Square, this *mise-en-abyme* is reversed and it is rather the fact that every narrative is held within a framing narrative that allows for new thoughts. The visual equivalent might be found in Escher's *Print Gallery*, which shows a museumgoer gazing upon a picture of the city that holds the museum he is visiting. Yet, it is not the direct return or loop that creates the inversed *mise-en-abyme* but rather the fact that this print, the Escher print, is itself framed in a dimensional reality which is both similar and radically different from the world it is depicting. Interestingly, in order for this *mise-en-abyme* to be represented, Escher had to warp the fabric of space within his own representation, leaving an empty circle, a bubble of space-time at the very centre of his lithograph. In this emptiness are showcased Escher's monogram, his signature as well as the print edition, depicted as the customary fraction of the specific print's individual number over total number of prints made. The placement of these conventions of printmaking cannot be taken as innocent, considering the overall subject of the piece (and to a lesser degree, Escher's own recurring subjects), they are the link to the outside, the one aspect of the print that exists for the world framing the print, rather than the one being framed by it. Thus, this bubble of space-time is the illustration of the outward movement that is both the subject of the lithograph and a possible reading. The convoluted path that moves the reader from fiction to world does not differentiate between actuality and possibility. It is only once the reader fixes his or her analysis of the world that actuality comes into play. But the movement, before being crystallised in a theory, existed, for a punctual moment as pure potentiality. So it is also by this movement that the world of the book contaminates its frame. It is not *mimesis*, the strict equation of objects and referents, that allows a passage from fiction to actual (the same could even be said of theory or science), it is rather the inversion of the *mise-en-abyme*, the outward movement from fiction to world that happens once the fiction starts talking about itself. The potential reflexivity is not necessarily explicit, it can be found in Dante, Verne or Borges alike, notwithstanding their relation to what is sometimes derisively called "postmodern fiction." And this potential, which is actualised through reading, can remain dormant in text for centuries. Hopefully, it was awakened here in *Flatland* and *The Sirens of Titan*.

3.3.1. Possible, Impossible, Compossible

Since reading has been clarified as a modal notion, and can be understood as the actualisation of possibilities through dimensional superposition, there now remains to address how this new vision of literary epistemology affects fictional constructs and their relationship to their framing worlds. Allowing a multiplicity of overlapping worlds creates a few complications that have to be unpacked. The main problem is quite fundamental; it concerns the meaning of possibility, and the way that divergent possibilities can coexist. This is both essential for literary possible world theories and for their physical counterparts. For instance, Everett talks of many different parallel worlds, but never proposes a theory of passage from one world to another, other than through strict causality. This is one of the main opposition to the many-world hypothesis; what use to theory are these parallel worlds that can have no effect on each other? While this theory preserves the existence of the real, it parcels out reality into worlds that can only be influenced by causal reconstruction of their existence. The danger with fiction, as has been shown, is that, quite to the contrary, all possibilities being described are superposed onto one another in a vast ensemble derived from the set's expansion by ways of the text being read. Unlike the relative states of Everett, the differing readings of a work of fiction can, and do, influence one another. As was seen in the case of *The Sirens of Titan*, various critics place their readings within the corpus that makes up the "secondary literature" of a given textual object. This can lead to oppositions, arguments and confusion as to the meaning of text. This research has attempted to approach these readings as different possibilities, which evolve according to their own logical extensions and their presuppositions. But in order to understand the weight of reference, and the worth of criticism as something beyond the individual ramblings of a reader-function, one must find some kind of criterion that transposes modal extensions into knowledge. Another way to ask this question would be to wonder how possible worlds relate to one another, and how these different universes can have a greater or lesser impact on actuality.

In the world of modal logic, impossibility is described as the negation of possibility. Since possibility is itself the negation of the non-necessity of the negation of a statement⁴⁵, one

⁴⁵ $\diamond a \rightarrow \neg \square \neg a$

could then see impossibility as the double negation of the necessity of the negation of a statement⁴⁶, or the necessity of negation⁴⁷. Thus, through the reflexivity axiom, impossibility is the straightforward negation of a statement⁴⁸. Impossibility, then, falls outside of modal logic and into the certainty that something is false. In clearer terms, if something is impossible, then it is automatically negated (if time-travel is impossible, then there is no time-travel). Yet, impossibility can only be produced through modality. It is a vector for the transformation of modal statements into actuality and as such, the opposition of possibility is also the end of its proposition's modality. This makes impossibility quite logically different from possibility, which always remains opened to potential. As a classical logic precept, impossibility is also present as a straightforward opposition that permits the inference rules. Rules such as *modus ponens* (if Buzz Aldrin is honest, then man walked on the moon, and Buzz Aldrin is honest, therefore man walked on the moon) or *modus tollens* make use of a foundational characteristic of logic based on an impossibility. Both statements use the conditional to reach conclusions. Given the statement "if A then B" why is it that if A is true, then B is true, or that if B is false then A is false? This is due to a fundamental characteristic of the law of the excluded middle: if a proposition and its opposite can both be proven then the entire logical set from which they are drawn is compromised. This rule, drawn from Aristotle's statement in *Metaphysics* that "it is impossible for anything at the same time to be and not to be" (Aristotle, 1995: 1588), is due to the fact that if one can prove both A and $\neg A$, then anything can be logically derived from this combination and a simple disjunction. Since "A or B" is always a possible proposition (for A has been proven) then B can be also proven by switching out A for $\neg A$. Thus, conditionals depend on this exclusion, otherwise, statements such as the above would have to branch out into possibilities that are formally impossible; Aldrin is honestly lying or falsely telling the truth. It is not that one could not conceive of situations that would allow these principles; it is rather that classical logic needs this law to function as it does. The system from which the axiom is drawn falls apart if this axiom is negated. Thus, formal impossibility is a characteristic of the system at a deeper level than truth-ascription. It permits truth-

⁴⁶ $\neg \diamond a \rightarrow \neg \neg \square \neg a$

⁴⁷ $\square \neg a$

⁴⁸ $\square \neg a \rightarrow \neg a$

Yet application of impossibility does not always lead to ontological certainties. This is perhaps most obvious in Wittgenstein's *Über Gewißheit*, which proposes, as part of the 106th aphorism, a chain of storytelling:

Suppose some adult had told a child that he had been on the moon. The child tells me the story, and I say it was only a joke, the man hadn't been on the moon; no one has ever been on the moon; the moon is a long way off and it is impossible to climb up there or fly there.—If now the child insists, saying perhaps there is a way of getting there which I don't know, etc. what reply could I make to him? What reply could I make to the adults of a tribe who believe that people sometimes go to the moon (perhaps that is how they interpret their dreams), and who indeed grant that there are no ordinary means of climbing up to it or flying there?⁴⁹
(Wittgenstein, 1974: 16e)

Wittgenstein's use of a voyage to the moon as an example of something impossible is recurrent in the notes he wrote before dying. It comes back in his 108th aphorism as a proposition within a system:

“But is there then no objective truth? Isn't it true, or false, that someone has been on the moon?”
If we are thinking within our system, then it is certain that no one has ever been on the moon. Not merely is nothing of the sort ever seriously reported to us by reasonable people, but our whole system of physics forbids us to believe it. For this demands answers to the questions “How did he overcome the force of gravity?” “How could he live without an atmosphere?” and a thousand others which could not be answered. But suppose that instead of all these answers we met the reply: “We don't know *how* one gets to the moon, but those who get there know at once that they are there; and even you can't explain everything.” We should feel ourselves intellectually very distant from someone who said this.⁵⁰ (Wittgenstein, 1974: 17e)

⁴⁹ Ein Erwachsener hätte einem Kind erzählt, er wäre auf dem Mond gewesen. Das Kind erzählt mir das und ich sage, es sei nur ein Scherz gewesen, Soundso sei nicht auf dem Mond gewesen; niemand sei auf dem Mond gewesen; der Mond sei weit, weit von uns entfernt, und man könne nicht hinaufsteigen oder hinfliegen.—Wenn nun das Kind darauf beharrte: es gebe vielleicht doch eine Art, wie man hinkommen könne und sie sei mir nur nicht bekannt, etc.—was könne ich erwidern? Was könnte ich Erwachsenen eines Volksstamms erwidern, die glauben, Leute kämen manchmal auf den Mond (vielleicht deuten sie ihre Träume so), und die allerdings zugeben, man könnte nicht mit gewöhnlichen Mitteln hinaufsteigen oder hinfliegen? (Wittgenstein, 1974: 16)

⁵⁰ “Aber gibt es denn da keine objektive Wahrheit? Ist es nicht wahr, oder aber falsch, daß jemand auf dem Mond war?” Wenn wir in unserm System denken, so ist es gewiß, daß kein Mensch je auf dem Mond war. Nicht nur ist uns so etwas nie im Ernst von vernünftigen Leuten berichtet worden, sondern unser ganzes System der Physik verbietet uns, es zu glauben. Denn diese verlangt Antworten auf die Fragen: “Wie hat er die Schwerkraft überwunden?”, “Wie konnte er ohne Atmosphäre leben?” und tausend andere, die nicht zu beantworten wären. Wie aber, wenn uns statt allen diesen Antworten entgegnet würde: “Wir wissen nicht, *wie* man auf den Mond

Wittgenstein's disdain could, arguably, be turned against Aristotle, who founds the impossibility of an object as being both something and its opposite. When pressed with demands for a demonstration of his proposition, Aristotle argues that "it is impossible that there should be demonstration of absolutely everything; there would be an infinite regress, so that there would still be no demonstration" (Aristotle, 1995: 1588). This answer, that grounds an impossibility in the impossibility of its demonstration, will strike the attentive reader as an argument similar to Tarski's or Gödel's own theorems which were signposts towards the conception of language as calculus. Wittgenstein refuses the Cartesian radical doubt with a dismissive shrug, since his argument is not dismissing the pragmatics of empiricism outright and his work oscillates between establishing its own calculus to a conception of language as the universal medium. The Moon becomes his metaphorical impossibility inasmuch as it represents a distance between reality and the fantasies of the child, the lie of the storyteller and the naivety of the tribe (which, while entirely open to a postcolonialist critique, seems to work better, in this context, as Bacon's idol-worshipping tribe). The Moon voyage also resurfaces in aphorism 286 as the foundation for a comparison of knowledge systems:

What we believe depends on what we learn. We all believe that it isn't possible to get to the moon; but there might be people who believe that that is possible and that it sometimes happens. We say: these people do not know a lot that we know. And, let them be never so sure of their belief—they are wrong and we know it. If we compare our system of knowledge with theirs then theirs is evidently the poorer one by far.⁵¹ (Wittgenstein, 1974: 37e)

Once again, the variable poorness of knowledge systems seems entirely attached to a form of *scientia* that relates directly to a posited actuality. So impossibility, in this light, is the ontic refusal of the empirically dubious, certainly a valid ground for doubt, but also one that generates a truly temporal definition of impossibility as a non-modal category. Yet, Wittgenstein's consistent appeal to a rhetorical figure as a vessel of a comparatively poorer system—the child, the tribe, the wrongful believer—is propositionally grounded in a

kommt, aber die dorthin kommen, erkennen sofort, daß sie dort sind; und auch du kannst ja nicht alles erklären." Von Einem, der dies sagte, würden wir uns geistig sehr entfernt fühlen.

⁵¹ Woran wir glauben, hängt von dem ab, was wir lernen. Wir alle glauben, es sei unmöglich auf den Mond zu kommen; aber es könnte Leute geben, die glauben, es sei möglich und geschehe manchmal. Wir sagen: diese wissen Vieles nicht, was wir wissen. Und sie mögen ihrer Sache noch so sicher sein—sie sind im Irrtum, und wir wissen es. Wenn wir unser System des Wissens mit ihrem vergleichen, so zeigt sich ihres als das weit ärmere. (Wittgenstein, 1974: 37)

conception of self-evident actuality, which cannot hold within what has been called the literary. For if there are possibilities for future interpretations that have not yet seen their conceptual vocabulary unfold in a written work, and if there is the possibility for affirmations before they have taken place in any given actual world, then impossibility, as Wittgenstein defines it, is not compatible with a dimensional understanding of literature, other than as a simple and short-sighted refusal to acknowledge higher dimensions of possibility.

This punctuality, Wittgenstein's realist punctuality, is perhaps best explored as a historical phenomenon, since it is tied to the strange situation in which it came to be known to the public. Due to a few coincidences, the Moon passages of *Über Gewißheit* have become infamous amongst all the Wittgensteinian *œuvre*. The first detail of interest is that Wittgenstein started dating his aphorisms directly after the 286th, which speaks of the belief of impossibility rather than impossibility itself. Thus, it is now known that most of these notes were written somewhere between 1949 and 1950. It is interesting, considering the deeply temporal nature of his affirmation, that dates would start to appear following his avowed disbelief in the possibility of walking on the Moon. This is an obvious author-functional reading, yet it seems that historical time is tied to Wittgenstein's notion of impossibility. But by far the most interesting historical characteristic of *Über Gewißheit* is that it was compiled and published for the first time in December 1969, or 5 months after Neil Armstrong's famous small step for man. So, except for those close to Wittgenstein or seeking out his unpublished writings, readers of these notes came upon the impossibility of being on the Moon after the feat had been accomplished. This shows a specifically temporal dimension to certainties and impossibilities, projecting the reader outside of the fine mesh of arguments weaved by Wittgenstein and into the historical context of his writing. Yet, interestingly, while Wittgenstein is speaking out of his time as far as scientific certainties are concerned, narratives that described a voyage to the moon were incredibly commonplace before 1949. Works like Poe's "The Unparalleled Adventures of One Hans Pfaall" or Verne's *De la Terre à la Lune* had already shaped the possibilities associated with travelling to the moon. Where both these stories were undeniable products of their own time from a physics perspective, many of the research undergone by their respective writers ended up being quite representative of the problems encountered by NASA and the Soviet space program. As thought experiments, both

stories explored possible answers to questions asked by Wittgenstein. How was gravity overcome? Ballistics, answers Verne. How did the astronauts live without an atmosphere? A device that condenses the vacuum into air answers Poe. Now, whether or not these answers satisfyingly fulfilled the criterion of credibility is beyond the argument; what remains important is that Wittgenstein attaches no importance to these narratives of Moon travel. Indeed, his analysis seems to be seeking a distinction between the imaginary and the possible, yet by throwing out fiction, Wittgenstein remains oblivious to a scientific innovation that would predate the publication of his notes.

Poe's "The Unparalleled Adventures of One Hans Pfaall" is of particular historical interest in this case, since it was born out of the desire to credibly describe a trip to the moon. Poe was an avid astronomer from the age of 16 onwards. The story, which began as a hoax, became a novella, published in the *Southern Literary Messenger* in June of 1835, and its verisimilitude cast a doubt on the fictionality of the story. Three weeks after being published, a series of six articles relating the discovery of life on the moon, observed through a powerful new telescope, were published in the *New York Sun*. Now known as the Great Moon Hoax, these articles enraged Poe, who claimed that his story was ineptly plagiarised, ruining the potential of his own subterfuge. Like Tippett's story, these articles were using a form that is not commonly associated with literature to expound a form of fictive extension into the actual world. The possibility of their credibility, highly debated by Poe, nonetheless agitated the imagination of the readership, and the *Sun* greatly increased its sales. Sir John Herschel, the astronomer associated with the described discoveries, was hounded by questions as to the reality of the Moon ecosystem found in the article, long after their fictionality was exposed. In 1844, the slighted Poe even came to write his own hoax, the Balloon-Hoax, in the pages of the same newspaper. Poe's involvement in the writing of scientific hoaxes is clearly associated with the considerations explored in this act. Indeed, the arguments pertaining to possibility and actuality, to reading and the reader-function, could have been made using this particular example instead of Tippett's article as the foundation for the investigations of the literary in various forms. But what is of interest here is that a moment had existed, prior to Wittgenstein's notes, where a large segment of the American population's attention was turned towards the possibility of a space voyage. Wittgenstein's awareness of these details is

unimportant, but it does remain puzzling that he would choose such an explored subject as the example of impossibility.

From a historical point of view, Verne's novel, *De la Terre à la Lune*, and its sequel *Autour de la Lune*, were similarly informed by the available knowledge of their time. Like *Paris au XX^e siècle*, this duology is often referenced as a prime example of the divinatory power of literature. Even Neil Armstrong, on his return-trip to Earth related that "a hundred years ago, Jules Verne wrote a book about a voyage to the Moon. His spaceship, Columbia, took off from Florida and landed in the Pacific Ocean after completing a trip to the Moon" (NASA, 1969: 588). He could have also said that the ship was inhabited by three humans and that its dimensions were similar to the Apollo 11 shuttle, but these resemblances mask the fact that Verne's ship did not have a name, that it was the launching canon that was named the Columbiad (not Columbia), and that the voyagers had failed to step onto the moon. This illustrates well how mimetic reading habits tend to skew the logical extensions of an erudite author into a prophetic text. Nonetheless, Verne showed through the story of an extraordinary voyage, a story which helped coin the term "speculative fiction," that considerations for the moon landings were active long after Poe's initial jest. In fact, when presenting his project of building a canon that could shoot a bullet to the moon, Barbicane, president of the *Gun Club*, goes through the process of establishing an intertextual history of all the fictional extensions on the possibility of moon travel. He quotes Savinien Cyrano de Bergerac's *Voyage dans la Lune & Histoire comique des états et empires du Soleil*, as well as Fontenelle's *Entretiens sur la pluralité des mondes*. He draws the bridge between narratives where the Moon truly functions as a distinct possible world to those that include it within a world where Moon travel is possible. Completing his literary review, Barbicane says:

"To finish this rapid history, I would add that a certain Hans Pfaall of Rotterdam, rising in a balloon filled with a gas extracted from nitrogen, and 37 times lighter than hydrogen, reached the Moon after 19 days of travel. This voyage, like those before it, was simply imaginary, but it was the work of a popular American writer, of a strange and contemplative genius. I am talking

of Poe!” “Hurrah for Edgar Poe!” cried out the assembly, electrified by the words of its president.⁵² (Verne, 1865: 14, my translation)

Barbicane, who leads his audience on by presenting the exploits of Hans Pfaall as actual, reuses Poe’s hoax-structure. Of course, his own actuality is dependant on the framework of Verne’s novel, but it reinscribes another world, that of Poe’s novella, within its framework. Through intertextual reference, Verne underlines the historical foundations of his novel, but he also generates an inversed *mise-en-abyme* that could have served as the ideal gateway for considerations on the possibilities of Moon voyages.

The only way to understand Wittgenstein’s refusal to consider fiction as part of his exposition is specific to the type of certainty he aims to probe. The aphorisms collected in *Über Gewißheit* are a commentary or a development on two of G. E. Moore’s articles: “Proof of an External World” and “A Defence of Common Sense.” The statement Moore makes about the Moon is actually about his own position in relation to the earth: “Ever since it was born, [my body] has been either in contact with or not far from the surface of the earth” (Moore, 2002: 194). Wittgenstein operates an extension of Moore’s proposition, which is founded on the idea that some statements are immediately accessible to individuals through the idea of common sense. Thus, Wittgenstein’s dismissal of people who argue for the possibility of having been to the Moon is grounded in immediately accessible knowledge of the world informed by his own actuality and shows that the notion of “common sense” is born out of the exact same presuppositions as those that allow for an “actual world.” This knowledge, which extends to scientific systems, generates a novel ground of certainty on which new knowledge can be built. This, oddly, brings Wittgenstein much closer to Aristotle, who is defending the impossibility on the grounds of an axiomatic limit. On the other hand, the Austrian philosopher is also establishing axioms, but he is doing so through a peculiar form of induction, drawn from experience. As was seen above, both these strategies are necessary to create a calculus, an inner coherence, that language as a universal medium,

⁵² « Pour terminer ce rapide historique, j’ajouterai qu’un certain Hans Pfaal [sic] de Rotterdam, s’élançant dans un ballon rempli d’un gaz tiré de l’azote, et trente-sept fois plus léger que l’hydrogène, atteignit la Lune après dix-neuf jours de traversée. Ce voyage, comme les tentatives précédentes, était simplement imaginaire, mais ce fut l’œuvre d’un écrivain populaire en Amérique, d’un génie étrange et contemplatif. J’ai nommé Poe ! » « Hurrah pour Edgar Poe ! » s’écria l’assemblée, électrisée par les paroles de son président. (Verne, 1865 : 14)

according to Hintikka, always reproblematises. Wittgenstein further corroborates this reading in his 117th aphorism: “Why is it not possible for me to doubt that I have never been on the moon? And how could I try to doubt it? First and foremost, the supposition that perhaps I have been there would strike me as *idle*. Nothing would follow from it, nothing be explained by it. It would not tie in with anything in my life⁵³” (Wittgenstein, 1974: 18e). So common sense, in the context of this research, could be understood as the organising principle of a type of possible world that acts as a stepping-stone to actuality, as a calculus that can organise worlds according to certainty.

Yet, what of the fiction that allows a form of thinking that goes beyond the possibilities of a commonsensical world? Impossibility, either as a formal rule within a system or as a temporal construct, seems, to use Wittgenstein’s term, *idle*. Impossible worlds either break the system in which they are found, allowing an “anything goes” approach to possibility, or they enter into the same logic of divinatory reading and falsifiability—as statements that are waiting to be disproven on the grounds of a direct correspondence to another world. Thus, impossibility leads away from modality and the richness of possible worlds. Yet, it does propose a reconsideration of modality, which is, after all, logically developed as a means to derive propositional knowledge from sets or worlds. How can one allow for the outside perspective of impossibility without destroying the ecology of possibility from which it stems? Once again, the key seems to be dimensional. From the strict ground of temporal impossibilities, statements can be proven and disproven by historical correspondence. From the standpoint of logical impossibilities, statements lose their potential correspondence to actualities. In order for possible worlds to cohabit without generating formal impossibilities, one has to find a way by which to build structure of communicating worlds according to a criterion of concordance between possibilities, or compossibility. When taking a step back, and looking at ensembles of possibilities, the impossible tells an entirely different story. Wittgenstein’s impossibility to travel to the Moon is both confirmed, if his statement are read as historically grounded in 1949 or 1950, and denied, if read according to a vision where

⁵³ Warum ist es mir nicht möglich, daran zu zweifeln, daß ich nie auf dem Mond war? Und wie könnte ich versuchen, es zu tun? Vor allem schiene mir die Annahme, vielleicht sei ich doch dort gewesen, *müßig*. Nicht würde daraus folgen, dadurch erklärt werden. Sie hinge mit nichts in meinem Leben zusammen. (Wittgenstein, 1974: 18)

fiction may transcend impossibility through consideration, as well as if the truth-value of a statement is read according to contemporaneous historicity. These readings of Wittgenstein are all thinkable, but they are not all compossible within the ensemble of possibilities. Differing dimensions of possibility allow for different compossibles; linear possibility asks that a choice be made as to the truth-value of Wittgenstein's impossibility, whereas abstracted possibility describes the different modalities that allow his impossibility to both be confirmed and denied. In this sense, the multiplicity of possible worlds exist both in relation to a frame of reference, and then according to their shared compossibility. Compossibility and impossibility are the crucial notions of dimensional world-building because they describe a way to build subsets from the thinkable in which possibility and impossibility are defined. In *Logique du sens*, Deleuze describes this characteristic while discussing Leibniz's monads and Husserl's fifth Cartesian meditation:

The expressed world is made of differential ratios and adjoining singularities. It forms a world precisely because the series dependent on each singularity converge with those that depend on others: *it is this convergence that defines "compossibility" as rule of world-synthesis*. Where series diverge begins another world, impossible with the first. The extraordinary notion of compossibility is thus defined as a *continuum* of singularities, continuity having as an ideal-criterion the convergence of series. Furthermore, the notion of impossibility is not reducible to that of contradiction; it is rather contradiction that, in a way, stems from it.⁵⁴ (Deleuze, 1969: 134-135, my translation, original emphasis)

Thus, compossibility is the mode through which possible worlds synthesise. Possibilities are therefore open-ended, but possible worlds necessitate a convergence of possibilities, and thus guide reading without imposing fixed meaning. In light of Apollo 11, Verne is a much better soothsayer than Wittgenstein, according to a reading seeking divination. But Verne's description of an impossible feat for his day and age is much less realistic than Wittgenstein's

⁵⁴ Le monde exprimé est fait de rapports différentiels et de singularités attenantes. Il forme précisément un monde dans la mesure où les séries dépendant de chaque singularité convergent avec celles qui dépendent des autres : *c'est cette convergence qui définit la « compossibilité » comme règle d'une synthèse de monde*. Là où les séries divergent commence un autre monde, impossible avec le premier. L'extraordinaire notion de compossibilité se définit donc comme un *continuum* de singularités, la continuité ayant pour critère idéal la convergence des séries. Aussi la notion d'impossibilité n'est-elle pas réductible à celle de contradiction ; c'est plutôt la contradiction qui en découle d'une certaine manière. (Deleuze, 1969: 134-135)

definition of impossibility, again, according to a reading attempting to reconcile history with writing.

3.3.2. Compossibility and dimensions

The criterion of compossibility is most obvious in fiction describing another form of voyage: time-travel. As a generally accepted impossibility (in the Wittgensteinian sense), one could be tempted to see time-travel as working analogously to Moon voyages, but while dimensional implications of both these possibilities can be made to coincide (through a space-time analogy), their interaction with compossibility differs slightly. Like *The Sirens of Titan*, time-travel narratives question the limits of causality by opening-up timelines to their linearity, going even as far as constructing intuitive models for n -dimensional timeframes. *The Sirens of Titan* is a rare case where the movement of the dimensional analogy, from point to line to square, is enacted through an imbrication of many differing timescapes. This is not always the case for time-travel narratives, which often discuss a particular view of time according to a simpler paradigm of compossibility. When presenting a character that moves back and forth in time, the most important characteristic of these narratives is not the means by which this travelling is possible. While it does bear weight on the verisimilitude of the story, and like many other types of thought experiments these stories adjust their scientific referents according to their own historical timeframe to provide semblance of scientific validity, the movement outward, from the possible world of the story to a posited actual world of reception inevitably leads to statements similar to Wittgenstein's impossibility. These specific plot elements could be arranged in a historical typology, describing an interesting shift from angels and deep sleeps, through time machines of all sorts, and into experimental pseudo-physics that extend upon theories that permit travelling back in time. But compossibility intervenes only superficially as a mimetic organising principle of correspondence to the world. Whereas within the development of time-travel narratives, it is the organisation of events, according to presupposed visions of causal breakdown that illustrate most accurately how compossibility generates possible worlds.

Time-travel narratives need to directly address their vision of time's development, especially when a character goes back in time, and then forward. This is due to a strong causal reading of history, which casts events in a domino-like unidirectional line. This has been greatly discussed as a specific reading of events, which presupposes a Laplace-like intelligibility of causality. Yet chaos theory's most popular theoretical offshoot, Lorenz's butterfly effect, would rather claim that any change in the past should alter the future in a variety of unknowable ways, producing changes that could difficultly be understood as stemming from the changes made (much like a hurricane could never be directly linked to the distant flapping of butterfly wings). But the thought experiment of time travel nonetheless offers a hypothesis on the relationship between past, present and future. This is perfectly illustrated in Asimov's *The End of Eternity*, where two different hypotheses cohabit. The world, as it is described, is being controlled by an institution, named Eternity, which adjusts the timeline in order to minimize human suffering. Experts, who determine the events that must be altered in order for wars to be resolved peacefully, or disasters to be avoided, carry out this consequentialist equation. This points to a causal reading of history, which also takes into account a randomness of fate that is controlled by time travel. It can be understood, in light of *The Sirens of Titan*, as Rumfoord's limited control over mankind's history. If time is fixed, he nonetheless takes part in helping events reach their apex. Usually, this vision of time opens up Everettian multiple worlds, where time, infinitely branched off, moves into its different declinations. This view, of time as an ever-expanding array, allows a form of compossibility that is analogous to Everett's many-worlds: causality is not threatened by alternate universes, it is preserved through them. For instance, a man, going back in time to kill his grandfather, could come back to a world where he has never existed. This seems paradoxical, because it removes the necessary cause for the birth of the killer. But positing parallel worlds would simply reduce the problem to an individual in an alternate reality killing a man who, in the actual reality, would have been his grandfather. Many-world theory provides an expansive scale of compossibility, according to division between universes. Just as it is unclear how the observer fixes Schrödinger's cat's death and relegates a live cat to a parallel universe, it remains uncertain how transformations in timelines are operated according to change of events by time-travellers. *The End of Eternity* calls this deviant Reality:

“I believe [that before time-travel] there were speculations of sorts in some types of escape literature. I am not well acquainted with these, but I believe a recurrent theme was that of the man who returned in Time to kill his own grandfather as a child.” Sennor seemed delighted. “Wonderful! Wonderful! After all, that is at least an expression of the basic paradox of time-travel, if we assume an indeviant Reality, eh? Now your Primitives, I’ll venture to state, never assumed anything *but* an indeviant Reality. Am I right?” Harlan waited to answer. He did not see where the conversation was aiming or what Sennor’s deeper purposes were, and it unnerved him. He said, “I don’t know enough to answer you with certainty, sir. I believe there may have been speculations as to alternate paths of time or planes of existence. I don’t know.” Sennor thrust out a lower lip. “I’m sure you’re wrong. You may have been misled by reading your own knowledge into various ambiguities you may have come across. No, without actual experience of Time-travel, the philosophic intricacies of Reality would be quite beyond the human mind.” (Asimov, 1979: 466-467)

Sennor, a high-ranking officer for Eternity, deeply underestimates the lengths to which speculative literature may consider possibilities. Asimov’s own story proves him wrong by existing. It shows that compossibility is maintained through compartmentalising. Deviant reality even answers a question popularly seen as refuting the possibility of time-travel: if time-travellers exist, why are they not everywhere, visiting our time? Stephen Hawking, for instance, cheekily held a party for time-travellers the 28th of June 2009, with a banner, canapés and bottles of sparkling wine. He then only announced the date of this party after it was held. He called this “experimental evidence that time travel is not possible” (Venables, 2012). But many-world theory could simply say, after time-travel was discovered, that the universe in which time-travellers showed up was part of another compossible set of events. Time-travellers came to Hawking’s party, they only did so in another universe, and that until time-travel is invented, the actual world will be free of time-travellers, only retroactively including them once they have become possible. Right time, wrong universe.

Yet *The End of Eternity* is not entirely sympathetic to the many-world hypothesis. Time is given characteristics that allow the Eternity organisation to exist in a protected bubble with its own causality, outside of time. Asimov creates this specific, truly independent state of parallel time in order to provide the story with continuity. But as agents of Eternity are recruited inside the realm of Reality, which is affected by temporal changes, some paradoxes common to other time-travel narratives are generated out of the superposition of deviant and

indeviant timelines. While protecting Noÿs, a girl from Reality he is attempting to save from a time-change, Harlan visits her house pre-change to retrieve some of her effects. Lost in a thought, he starts laughing then hears a noise in the house. Frightened of being discovered by Eternals or a housebreaker, Harlan enters Eternity and choses another time to visit Noÿs's house. Yet, by some miscalculations, Harlan ends up returning at nearly the same time, hearing himself laugh and dropping a knapsack out of fright. That these two events occur simultaneously in a fixed timeline devoid of causality (other than a causal circularity) show that changes in the novel's reality are not strictly linear. This event paints the picture of a timeline that is greatly similar to Rumfoord's description of the infundibulated experience, at the beginning of *The Sirens of Titan*. Time can make no sense without the equiprimordiality of both manifestations of Harlan creating a feedback loop of influence. This is common in many morality tales found within the body of time-travelling narrative; the protagonist goes back in time to change his fate, only to realise that it was the influence of his time-travel that created the original problem. *La Jetée* by Chris Marker, or its remake, Gilliam's *Twelve Monkeys*, are perfect examples of this type of compossibility, and *Oedipus Rex* would be their archetype, since true divination generates paradoxes similar those associated with time-travel. But this second view of time is difficult to conjugate with the first. Which is it? Is time fixed, like a carefully constructed edifice, or is it constantly forking into differing universes?

The End of Eternity offers an explanation through another characteristic of time, explained by Sennor:

Why does Reality possess inertia? We all know that it does. Any alteration in its flow must reach a certain magnitude before a Change, a true Change, is effected. Even then, Reality has a tendency to flow back to its original position. For instance, suppose a Change here in the 575th. Reality will change with increasing effects to perhaps the 600th. It will change, but with continually lesser effects to perhaps the 650th. Thereafter, Reality will be unchanged. We all know this is so, but do any of us know why it is so? Intuitive reasoning would suggest that any Reality Change would increase its effects without limit as the Centuries pass, yet that is not so. (Asimov, 1979: 467)

This "inertia" of reality, which is in itself a resistance at the heart of a unified timeline, offers a meeting-point between two different types of timelines. Thus, change can affect time locally,

but globally, time remains fixed. The vastness of Eternity allows it to control time through calculated changes that take place along most of its line, but the general two-dimensional shape of time, like Rumfoord's spiralling course, is a fixed shape. This allows both fixed, deterministic time and parallel universes to exist simultaneously, through what can only be described as a mind-boggling thought experiment. In fact, *The End of Eternity* seems to relish in the idea of time paradoxes, building a structure that would both allow and answer all of them. Sennor, who pontificates at great length about his knowledge of such problems, goes on to talk about the many ways in which the paradox of someone meeting himself could be resolved. He comes to the conclusion that "in every apparent paradox of Time-travel, Reality always changes to avoid the paradox and we come to the conclusion that there are no paradoxes in Time-travel and that there can be none" (Asimov, 1979: 468). This is ultimately the point of Eternity as an institution; change functions as the aggregator of happiness, and no irreparable damage can be done to the space-time continuum. This type of rule, that refuses paradoxes by simple trusting that they would be impossible, has its physics counterpart in the Novikov self-consistency principle (formulated 25 years after the publication of *The End of Eternity*) which offers the same answer to models born out of the Lorentzian manifolds and Minkowski space-time, such as the Gödel metric, that theoretically allow time-travel in a world governed by relativity. This sort of adjustment is the mark of compossibility; it might not be as elaborate or intuitive as one would wish, but it upholds *The End of Eternity's* possible world as possible.

In *The End of Eternity*, there are also some years that cannot be affected by the members of Eternity; any time before the establishment of Eternity, before the 24th century, as well as the continuum that expands between the 70 000th and the 150 000th century. After the 150 000th century, humanity has ceased to exist, and the Universe is moving towards its slow death. Harlan, the protagonist of the novel, eventually realises that Noÿs, whom he takes for a naïve inhabitant of the 482nd century, is actually an emissary from the inaccessible recesses beyond the 69 999th century. She informs him that he will soon become accessory to the establishment of Eternity, sent back to the 24th century with a boy, already under his tutelage, that will provide the past with the theoretical knowledge necessary to found Eternity. This leads to a situation where, due to a misunderstanding, the boy becomes trapped in 1932 and

must be rescued and brought into the 24th century, a time that is sufficiently knowledgeable to develop his ideas. Noÿs pleads with Harlan to leave the boy in the 20th century, thus ensuring that Eternity becomes an improbable change. She explains that due to Eternity, and humanity's navel-gazing temporal nit-pickings, Earth fails to discover space travel soon enough to partake in planetary conquest. As a result, they become an isolated nation, surrounded by large intergalactic empires that have already divvied the entire universe. This, she explains, causes humanity's end; the stagnation caused by a consequentialist desire for abstract perfection. Harlan decides to trust her, does not rescue the boy, and as a result, a timeline (allegedly the actual timeline of the reader) begins. As his time-travelling vessel vanishes in front of his eyes, Harlan thinks "with that disappearance [...] came the end, the final end of Eternity. –And the beginning of Infinity" (Asimov, 1979: 538). This is an optimistic way of saying that the quantum path of Fermi and Bohr opens up more possibilities than time-travel. But, in a way, this ending destroys all the *dispositifs* put into place to guarantee compossibility. How is it that a change so radical is not absorbed by time's inertia? How is Harlan able to continue existing after his "kettle," a sort of time elevator used by Eternity, disappears? And most importantly, how is Eternity originally founded if it needs, in its fixed bubble of causality, to tutor its own creator? By destroying Eternity, the compossibility of all of *The End of Eternity's* different timelines falls apart as a world. It becomes fraught with temporal paradoxes and simultaneous theorems that contradict one another. Thus, while functioning throughout as a depository of many possible worlds unified through a compossibility painstakingly created, and reflected upon by its own inversed *mise-en-abyme* of fixed time within relative time within fixity, *The End of Eternity* ends its narration by throwing dust in the reader's eyes while slipping away. The fact that *The End of Eternity's* final state is a mimetic hologram of the reader's actual world does not give it sanction to discard compossibility. But it can, and it does, until a new reader can reconstruct a possible world out of an intense thought process turned towards finding a new way to explain compossibility that would include all the different forms of time found in the novel.

Compossibility is not a structural characteristic of narrative. Or rather, it is discovered through particular readings, as a potential within narratives. It is extension of possibility, possibility as an *n*-dimensional construct. This is why impossibility is such a weak discursive

notion in relation to possibility; many possibilities generate compossibility or impossibility. The attribution of impossibility is dependant on impossible scenarios or limitations to peculiar dimensions of narrative. But the variability of reading is always open to restructuring narratives along different axes, generating new compossibilities that reabsorb impossibility as the initially difficult, yet now integrated, characteristic that forces new states of compossibility. In the history of science, Kuhn has called these moments paradigm shifts; theories that, by recalibration of presuppositions, can now come to include discrepancies in experimental results. In narratives focusing on time, these thoughts are generated through idiosyncrasies, which are explained by new readings. This is the crucial point that needs to be made about literary objects; they do not need to be compossible. Compossibility does allow for discourse and worlds, theories and knowledge. But the simple act of thinking, as a substrate of reading, can exist even when confronted with impossibilities. Why is A. Square dedicating his prison journals both to the inhabitants of space who, his story would suggest, resemble the Sphere, and to Howard Candler, who is a historical figure, a human and a contemporary of Abbott? How is Rumfoord able to both affect time and see it as fixed? These are vanishing points, structural impossibilities that greatly enrich the fabric of their narratives. They exist within their calculus, within their books, as these small puzzles that lead readers to wildly different solutions, such as Burger's Sphere describing humanity as a strange creature of his Spaceland world without explaining the interactions between geometrical figures and human beings.

Flatland and *The Sirens of Titan* have the characteristic of providing tools to address these specific problems. They allow for a discussion on dimensions of both space and time, which complement greatly the way in which worlds are understood. While worlds do tend to have a spatiotemporal dimensional make-up, this is not always explicitly the case. But through the analogy that allows a passage between dimensions, it has been found that dimensional thought goes beyond the notion of space or time. It is incredibly easier to use these intuitive notions as a means to explain the way dimensions work, and this justifies why, even at its most abstract, the argument continued to refer to specific examples such as "The Garden of the Forking Path" or *The End of Eternity*. These stories are the calculi of the literary; they allow the development of formulae that can then stand by themselves. But

stripping away these formulae from their context is a challenging process. The varying frames in which narratives are contained—language, form, the real, possibility and compossibility—each bring different dangers that must be avoided, lest the truly interesting dimensional aspect of literature should be reduced to a simple correspondence. Within every frame, there is the temptation to stop, to accept a certain point of view, and to leave an ontic reading of the text behind. But speaking of reading as a radical variable demands that the fragile potential at the heart of this practice remain uncrushed by the temptation to fix meaning.

This is not to say that meaning is impossible. Quite to the contrary, impossibility of meaning is merely a pitfall for the unimaginative. Compossibility, whether it is found in the somewhat raving pages of *Eureka*, in the strange innovation of Everett's relative states or in my own reading of *The Sirens of Titan*, is a creative process that grounds the possibility for meaning. As a dimension of possibility, it is observable and transparent; it forces the reader to formulate his or her presuppositions, in order to show the particular calculus that was used to generate sense out of a narrative, or a theory. It might also be one of the truly transdisciplinary functions of thought; it generates congruence between different types of written works and generates a calculus on the basis of language. Compossibility demands rigour, but can do so both before and after the fact; this is why so many science fiction novels are heralded as divinatory works; they can be included in a reading that generates a possible world where Verne truly had a vision of the fax, or one where he was baiting readers into considering absurdities. But in order to hold both of these propositions as part of the same world, one has to work through an idea that would hold their compossibility, for instance by expanding Verne's personal psychological states along a life that includes various phases of beliefs (and this is the purpose of historical psychoanalysis, its truly creative mode of world-building). Compossibility is also not the grounds on which any meaning can be held as valid. By unmasking the presuppositions at the heart of sets of presuppositions, compossibility allows for the discovery of axioms and grounds on which it is built. One can oppose Euclidian geometry, for instance, but in turn will need an appeal for falsifiability—which is another word for impossibility in the realm of the theoretico-empirical—that disrupts its very foundation. It is a criterion of theory-building that is beyond empirical space, beyond causal time, but it often uses them as constitutive elements. Thus, it is not because I spent a great

deal of time speaking about the fourth dimension that I believe it to stand for any and every form of esoteric belief. Or that since notions of quantum physics help me think the literary that I believe one should be subsumed to the other. Quite to the contrary, compossibility operates a levelling field, where different possibles exist in relation to one another, permitting the exploration of similarities and differences between concepts drawn from various fields. Tippett, Peterson and Baxter prove the powerful effect that such combinations, which respect all disciplines being called upon, can have on the reader, and on thought in general. One merely has to keep in mind that it is advantageous to know what these possibilities entail, before including them into complex interdisciplinary relationships.

Literature's ability to put into play seemingly impossible notions should not be relegated to a failure of understanding or a weakness of composition. In some cases, such as *The End of Eternity*, the impossibility, which is always a function of reading, can lead both to efforts of compossibility restitution, or leave open the possibility that the world being described contains more than one possible world, which are not compossible with one another. This is a function of dimensional thought; there is always a new level beyond (besides? with? aka?) the one being described. Thus, many possible worlds necessitate a function of compossibility, and many forms of compossibilities, configurations of the possibles that are not always compossible with each other, generate a new dimension of consideration. One can think of worlds where possibilities cannot cohabit. Le Guin, in her introduction to *A Fisherman of the Inland Sea*, explains that she constructed, to her great desolation, such an impossibility within her Hainish Cycle:

Writing my first science fiction novels, long ago, I realized that the galaxy was in some ways highly inconvenient. I accepted Einstein's proposition that nothing can go faster than light (not having any convincing proposal of my own to replace it with). But that means that it takes spaceships an impossibly long time to get from here to there. Fortunately, if they can go as fast or nearly as fast as light, Father Albert also provides the paradox of time-dilation, which allows the person in the spaceship to experience a near-light-speed journey as nearly instantaneous. [...] The paradox is a lovely one to try to handle in terms of the lives and relationships and feelings of the interstellar travellers, and I have used it in many stories. [...] In an early story or two I said or implied that unmanned spaceships could also travel instantaneously. This was a mistake, a violation of my own rule that only the immaterial could go faster than light. I didn't

do it again, and hoped that nobody had noticed. But in the mistake is the discovery; *often it's the lapse, not the effort, that opens into the unexpected*. Long after, thinking about those unmanned and illegitimate ships, I realized that the implication was that it's not materiality that makes the difference but life and mind. (Le Guin, 2005: 7-9, my emphasis)

Using this initial mistake, this lingering impossibility reminiscent of Vonnegut's UWTB, Le Guin decided to derive a new form of compossible out of the remaining possibilities. She found a way in which one could theorize faster-than-light travel through the world left behind by her mistake. This did not impede her other novels, and she managed to continue drawing out conclusions from a flawed construct, but from this flaw eventually came a new approach to time. In "The Shobies' Story" Le Guin places a group of travellers within a ship that breaks Einstein's law. Their experience becomes highly variable. Each traveller disagrees with what constitutes "reality." Some see through the walls, some experience the voyage as not having taken place, some go down on their destination planet to explore, and there is disagreement among the travellers as to who has gone down. At one point, the narration disintegrates to the point of affecting the omniscient, third person narrator.

The suns burn through my flesh, Lidi said.
I am the suns, said Sweet Today. Not I, all is.
Don't breathe! Cried Oreth.
It is death, Shan said. What I feared, is: nothing.
Nothing, they said. [...]
I am the darkness between the suns, one said.
I am nothing, one said.
I am you, one said.
You—one said—You—
And breathed, and reached out, and spoke: "Listen!" Crying out to the other, to the others,
"Listen!" (Le Guin, 2005: 106-107)

This story, otherwise written in a relatively straightforward prose, for one accustomed to the linguistic inventions of the Hainish Cycle, comes to a point where characters lose their substance, their names, where identities break apart to their very core. This particular solution to the time-traveller's paradox (since faster-than-light travel is directly related to the possibility of time-travel) is entirely different from any other form of approach I have read. In order to regain their grasp on reality, the characters sit down within ear-reach to negotiate

reality. One by one, they tell the story of their experience, enmeshed with their own hypotheses about what happened. Through the reconstructive power of their collective stories, they come to a consensus on reality. By developing the ramifications of an impossibility, Le Guin reaches a conclusion on dissonant possibilities; narrative can always find a way to compossibility, but it sometimes must think through the impossible. Thus, literary thought experiments allow the movement between the dimensions of possibility.

3.4.1. Conclusion

Through medium and form, subject and object, fiction and science, dimensionality has been forged into a crucial mode of thought. Though it might seem difficult to understand how dimensions of time and space relate to each other, or how the dimension of a thought relates to the thought experimental dimensions of quantum physics, the past pages have come upon a characteristic of the literary that can best describe the dimensional. The features of this type of thought are simple and directly derived from the literature explaining dimensional discovery; through both the spatial analogy of *Flatland* and the differing timelines of *The Sirens of Titan*, an image of a thought process was defined and it gradually moved away from a simply literary concern. This is why many of the examples found in this act are drawn from increasingly varied sources; while *Flatland* and *The Sirens of Titan* acted as unifying principles of the two previous acts, and were rightfully used as a means to illustrate different concerns and applications of the notion of “dimension,” these were also moulds of medium and form which could be cast aside once their initial presentations was sufficiently discussed. But what is left behind once literary criticism stops being about a defined literary object? Is there a purpose to literary analysis beyond the expansion of an already defined corpus of secondary literature? This last act is written in hopes that not only can it define a properly independent thought process, but that as an object, it itself acts as proof of a certain theoretical malleability. Yes, both *Flatland* and *The Sirens of Titan* are about dimensions. And yes, both these books describe different notions of dimensions, but in their similitude, in the way that “dimension” in Rumfoord’s vocabulary can come to mean the same thing as when the Sphere speaks of “dimensions,” there is a self-defining moment of dimensionality, a movement in

thought described as an inversed *mise-en-abyme*. By this movement, one can come to understand how two different uses of the same word can be made to coincide through comparison, and that the comparison takes place at a different level than that of direct meaning. In this higher dimension of thought, meaning can be shifted, arranged, composed. It cannot hold in and of itself as new meaning; it has to answer to its initial form, to the lower dimensions that allow for this freedom, otherwise meaning is in danger of becoming meaningless, falling in the cracks between its own presuppositions. But if meaning can hold as it is individually represented in the dimensions of worlds, of books, of descriptions, and then maintain its sense at the level of possibilities, imagined, fantasied, predicted or posited, then it is strengthened through its flexibility, immediately both more defined and less defining.

Hopefully, some initially confusing aspects of dimensions, those of possible worlds, thought experiments, individual readings as well as theories have become increasingly obvious. It should be clear now that much of the research has exposed a dimensional theory of dimensions. As it is wont to happen when speaking of slippery subjects that come to theorise themselves, talks that initially attempted to merely describe how dimensions worked within given narratives became about the transposition of a vocabulary to the act being undertaken; a simple dimension is always understood from without, or, rather, it is understood as a system of dimensions. Like Hinton's cubes or Leibniz's monads, the unit can also stand in for the system, and every system can become a fundamental particle. This strange structural form, which is removed from both inductive and deductive modes of thought when they are concerned with actual proofs, is in fact the combination of both the outward movement of deduction and the inward simplification of induction. In fact, it is the only way that both these approaches can coincide. While this type of thought can be received with hostility when pertaining to the actual world—after all, a simple conclusion is always more comforting than a complicated configuration—it is attempting, in fact, to espouse and appease many of the actual world characteristics that make it seem so intimidating. By accepting that any appeal to the world, the *real* world, also conjures, on another dimensional plane, a complex multiverse of possible worlds, one can move away from the varying confusions and paradoxes of reference and into an infinitely rich cosmos of features and functions. This is why the general movement of the act takes medium and form as its basis; it became necessary to understand

not only how possibility functioned, but how the various possible worlds of literature could affect thoughts about the world in general, and not only the worlds of fiction.

Literary thought, while under attack for being composed of lies or fantasies, is directly engaged in this vast system of worlds, partaking in the dimensional aspects of thought from its very inception as mythology. But it is in its laicised form that it now faces its most dangerous criticism; of being *mere* escapism, or, even worst, of being *mere* entertainment. Science fiction has gradually come to dominate the perceived corpus of escapism, much as romances did in the Western Europe of the 19th century. But perhaps escapism is not such a bad thing in light of what has already been explored. From what is the reader escaping? Allegedly from his or her own world. Thus the movement proposed by escapism is a form of distance from actuality. In contrast to a “down-to-earth” approach to thought, literature proposes a glimpse at the vast ecology of possibility. Likewise, “entertainment,” a word co-opted by the culture-industrial complex, came from the French word *entretenir*, literally meaning holding-between. Thus, when entertained by a story, one is held within fiction, with a mind oscillating between actuality and possibility. This is a widespread opinion, and my purpose is not to wax poetic about the beauty of distance from the actual world. Rather, it is the adjective “mere” that is most harmful to fiction; the idea that fiction can be taken in without thought, that it does not matter. This is the most important point made in this act; that more often than not, fiction not only matters, it is entirely composed of different possibles, and that the act of thinking through these possibilities, to generate compossibilities, is constitutive of the actual world. By allowing a space outside of actuality, literature generates the possibility for an outside perspective. And it is this outside, which is in fact impossible with actuality, that gifts thought with dimensionality.

Conclusion

Anytime you can muster the fury to actually write in the face of the impossibility of writing, that's an achievement.

- John Maus

Pitchfork Interview, August 10th 2012

It is understandable that, for many of the science fiction genre's formative years, the divinatory aspect of its novels was used as its main criterion of credibility. The scientific acumen of writers such as Poe, Verne and Wells helped promulgate the idea that scientific romances were a literary transposition of progress' ideal: the accumulation of knowledge leading to new technical development. During the first half of the 20th century, science fiction was still struggling to become "respectable" literature, and the incredible predictions that could be traced to scientifically-minded writers did provide a form of reputability for the science fiction novel as an object partaking in the development of knowledge. Classical definitions of science fiction are founded upon this extensional *mimesis*. Campbell, in "The Science of Science Fiction Writing," claims that "to be science fiction, not fantasy, an honest effort at prophetic extrapolation from the known must be made" (Campbell, 1964: 91), and Heinlein, echoing Reginald Bretnor in a lecture given at the University of Chicago in 1957 reiterates that

science fiction [is] that sort [of literature] in which the author shows awareness of the nature and importance of the human activity known as the scientific method, shows equal awareness of the great body of human knowledge already collected through that activity, and takes into account in his stories the effects and possible future effects on human beings of scientific method and scientific fact. (Heinlein, 1957)

This definition, which is periodically reformulated and reprinted up to this day (see, for instance, "Why do critics still sneer at sci-fi?" by Sam Jordison in the January 7th 2008 edition of the Guardian's *Books Blog*), is not wrong *per se*, it merely reduces the true span of potentiality found in the literary as exemplified through science fiction. SF, as a genre and as a symptom, should inform of the potential contained within all literary works. This movement,

establishing science fiction as a constitutive part of “all literature,” is itself an important feature of science fiction criticism during the second half of the 20th century. Damon Knight, while introducing his book *In Search of Wonder*, which Hartwell and Wolf call “the first mature book of science fiction criticism” writes that science fiction is “speculative; but so is every work of fiction, to some degree” (Knight, 1996: 15), operating a shift that is opposite to the inclusive definition of SF. This claim proposes that if science fiction is to join the reputable forms, it must be equated with the rest of fiction. This is also something seen in Darko Suvin’s notion of cognitive estrangement, which constructs a theoretical framework in which fiction and science, brought together in a science fiction narrative, generate an alienating effect responsible for a reconsideration of reality. Although much closer to the ideas developed in this research, Suvin’s cognitive estrangement remains mimetic since it still aims to show the distance between *the* reality and the state of affairs described by a given narrative. Furthermore, it describes a certain range of prescriptive possibles, returning to a Zola-like vision of the novelist as social worker. Yet, none of these approaches address the questions of “wrong” futures, or rather of futures that do not claim to predict any likely eventuality. Neither Abbott nor Vonnegut is concerned with representing an extension of actuality. As works of extensional *mimesis*, both *Flatland* and *The Sirens of Titan* would be extreme failures, either discredited through their flimsy research or their unrealistic approach. But as literary works of knowledge, these novels carry incredibly rich ecologies of meaning that work well beyond the necessity of direct mimesis. Thus, false predictions and weird unlikely worlds are not bugs; they are features of the literary imagination. This is illustrated through the life cycle of even the most accurate predictions, which eventually lose their precision. As science fiction becomes entrenched as a definite area of literary creation, many works become dated to the point of having the “future” they describe become a “past” that never was. Retrofuturist depictions of the 1970s spaceships that can reach faster-than-light speeds are still furnished with monochromatic cathode-ray screens. In so becoming, science fiction is increasingly about the past as well as the future, and its eventual worth as a vessel for new knowledge does not depend on its prophetic aspects. Thus, science fiction, in this research, is not a genre, it is rather a mode of understanding the literary that is born out of a desire for an intelligible future. It is thus transforming, instead, the way that literary knowledge is now understood. It is as Deleuze said when interviewed by the Bogdanoff

brothers: “science fiction is an extremely rich phenomenon, and its expansion is linked to the movement of sense that we give to our culture⁵⁵” (Bogdanoff & Bogdanoff, 1979: 198, my translation).

Other times and other spaces are always included in the literary process. A book is never read in the same location and period that it is written. Furthermore, one does not have to write about the future in order to point towards it. In fact, any form of prescriptive work attempting to shape the world, from early utopias to political treatises, holds the future as an inherent presupposition. Likewise, eschatological thought implies advancement towards an imminent event. In order for the end to exist, time has to unfurl. Thus, texts implicitly or explicitly about the future are scattered across humanity’s timeline as markers of a type of imaginary experimental technique that is thoroughly imbricated in what is now called “literature.” Yet, these wide-ranging futural remnants predate the constitution of a distinct literary establishment, and can therefore be found in many different traditions that have extended, to this day, into various spheres of study. This makes the study of possibility, as a literary characteristic, oddly transdisciplinary. Extensional thought experiments, which exemplify the ability for fiction to reach out into the unknown and generate conclusive results, are not studied for the epistemic worth of their predictions, but rather for the knowledge models that they produce. In light of these observations, the thought that many things can be read from a single text cannot be the conclusion to humanity’s ambivalent relationship to its own possibility. Much to the contrary, a variety of readings leads to an ensemble that can in itself be understood and analysed, as long as one remains aware that this set is not predetermined—or pre-enclosed and limited, as the etymology of the word would have it—but becomes determinate once one begins writing about it. This was the most difficult aspect of the research; it attempts to explore an area that changes as it is being observed. It sometimes felt as though I attempted to take a 360° panoramic picture of an untouched snowfield, only to find my own footsteps as the glaring imperfection breaking the beauty of what was first imagined. In this way, the research finds solace in the use of analogy and metaphor, as well as structures borrowed from other disciplines, for as thinking strategies they allow for a sideways

⁵⁵ Je pense que la science-fiction constitue un phénomène d’une extrême fertilité dont l’expansion est liée au déplacement de sens que nous accordons à notre culture. (Bogdanoff & Bogdanoff, 1979: 198)

glance at the nature of literature's epistemological charge and the meaning it carries into different spheres.

But the two novels studied were also answers to the world's strangeness within their own historical contexts. Perhaps the feeling that unequivocal meaning is slipping away is part of the modern condition rather than a characteristic specific to this moment in time, a contemporary experience in the sense that the contemporary is always a temporal manifestation of the different "actual worlds" of writing, moving and shifting along with history. Abbott and Vonnegut were addressing their own contemporary situations; *Flatland's* first section is a critique of Victorian England, women's condition and the general conservatism that arose in reaction to new ideas, while *The Sirens of Titan* is only the first in many books written by Vonnegut addressing the horrors of the war, the feeling of post-WWII alienation and the trauma of veterans born out of absurd human brutality. These characteristics, entirely linked to "actual worlds" that are constitutive of the author-function, are not effaced by the compossible and impossible that make up what could only be described as "thinkable worlds." But these actualities often establish the ground-zero of literary criticism, and I wanted to explore how radically different readings, born out of questioning the presuppositions of *mimesis* and causality, could arise as part of a process that may or may not include these presuppositions. Dimensional reading is this process, in the sense that it allows different possibilities, but also questions their compossibility, their impossibility and the various folds operated by literary texts upon the fabric of meaning.

How does this approach help with the current state of narrative and meaning, and what impact can it have on one's own actual world? Abbott, in his second most important book, *The Kernel and the Husk*, a collection of letters he wrote on the subject of faith, directly addresses his own struggle with meaning and *Flatland*. It is interesting to remember that when these letters were written, *Flatland* was still published under the pseudonym of A. Square, so Abbott addresses his own novella through a *Verfremdungseffekt*, essentially placing it within a *mise-en-scène* of his own thought.

When I try to conceive of the causes of terrestrial thoughts, and emotions, and spiritual movements, I find myself recurring to the antique notion, hinted at in one or two passages of the Bible, and I believe encouraged by some of the old Rabbis, that there are two worlds; one

visible, terrestrial, and material, the other invisible, celestial, and spiritual; and that whatsoever takes place down here takes place first (or simultaneously but causatively) up there; here, the mere outsides of things; there, the causes and springs of action; the bodies down on earth, the spirits up in heaven. This is but a harmless fancy. Let me give you another. You know—or might know if you would read a little book recently published called *Flatland*, and still better, if you would study a very able and original work by Mr. C. H. Hinton—that a being of Four Dimensions, if such there were, could come into our closed rooms without opening door or window, nay, could even penetrate into, and inhabit, our bodies; that he could simultaneously see the insides of all things and the interior of the whole earth thrown open to his vision: he would also have the power of making himself visible and invisible at pleasure; and could address words to us from an invisible position outside us, or inside our own person. Why then might not spirits be beings of the Fourth Dimension? Well, I will tell you why. Although we cannot hope ever to comprehend what a spirit is—just as we can never comprehend what God is—yet [sic] St. Paul teaches us that the deep things of the spirit are in some degree made known to us by our own spirits. Now when does the spirit seem most active in us? or when do we seem nearest to the apprehension of “the deep things of God”? Is it not when we are exercising these virtues which, as St. Paul says, “abide”—I mean faith, hope and love? Now there is obviously no connection between these virtues and the Fourth Dimension. Even if we could conceive of space of Four Dimensions—which we cannot do, although we can perhaps describe what some of its phenomena would be if it existed—we should not be a whit the better morally or spiritually. It seems to me rather a moral than an intellectual process, to approximate to the conception of a spirit: and toward this no knowledge of Quadridimensional space can guide us. (Abbott, 1886: 258-259)

Abbott’s argument is as follows: this world could be conceived as the cause of another, which is accessed through a moral, rather than an intellectual process. *Flatland* and work by Hinton are intellectual abstractions and have therefore no bearing on the knowledge one can gather about the spiritual world. Perhaps due to his peculiar type of “Natural Christianity” (Banchoff, 2004: 7), Abbott objected to the correspondence between the type of abstract thought necessary to think about the fourth dimension and the spiritual exercises undergone to reach comprehension about the sacred realm. Hinton’s latter work is a careful and enthusiastic refutation of this stance:

In the simplest apprehension of a higher space lies a knowledge of a reality which is, to the realities we know, as spirit is to matter; and yet to this new vision all our solid facts and material conditions are but as a shadow is to that which casts it. In the awakening light of this

new apprehension, the flimsy world quivers and shakes, rigid solids flow and mingle, all our material limitations turn into graciousness, and the new field of possibility waits for us to look and behold. (Hinton, 2009: 84)

Indeed, for Hinton, apprehension of higher space is equivocal to the relationship between spirit and matter. There is a clear equation between the spiritual and the rational, something Hinton seems to explain through a form of Platonism:

Somehow, looking at mere formal considerations, there comes into the mind a conclusion about something beyond the range of actual experience. We may call this reasoning from analogy; but using this phrase does not explain the process. It seems to me just as rational to say that the facts of the line and plane remind us of facts which we know already about four-dimensional figures—that they tend to bring these facts out into consciousness, as Plato shows with the boy's knowledge of the cube. We must be really four-dimensional creatures, or we could not think about four dimensions. (Hinton, 2009: 99)

Hinton's final sentence clearly explains the disparateness between his interpretation and Abbott's own. Hinton, like More, sees humanity as four-dimensional (spatially), while Abbott is clearly showing that his own view on humanity is that it is forever removed from the fourth dimension and can only abstractly contemplate this invention through phenomena. Thus, the disagreement between the two most important popularisers of the fourth dimension in Victorian England should be illustrative of a problem that is directly related to the question of abstract meaning. But the application of a dimensional approach to this congruence allows for both meanings to coexist within a same theory. The combination of both disagreeing analyses is transposed along the line of compossibility, and the question becomes one that leaves a possible world appended to a spiritual realm untouched. It merely creates alternate routes of correspondence between the actual and the sacred, defining these routes as constitutive of a larger whole, which includes the ontological status of abstraction. Abbott does generate a possible world where the spiritual is entirely divorced from abstraction, beyond analogy one could say, but he also posits this same spiritual realm as result of a reflexion on "the causes of terrestrial thoughts, and emotions, and spiritual movements." Which, no matter how radical Abbott aims to be, does take on the shape of an abstraction.

A dimensional approach to literature and narratives in general allows for straightforward disagreement with authors. I could easily refuse Abbott's analysis of his own work in relation to spirituality. His status as an author-function merely enriches the data available about the genesis of *Flatland*. But the comparison between Abbott and Hinton is richest when ideas are not dismissed from the outset on the basis of incongruences between the presuppositions of the reader-function and the author-function. It seems much more productive to link Abbott's spiritual realm, which is, in a sense, describing the limits of intellectualisation, as the reminder, formulated by Hintikka and Tarski, that the calculus of language is always limited by the stronger language that formulates its parameters. This vanishing point at the heart of any ensemble of meaning does, therefore, show how Abbott's refusal is directly related to his own conception of the "universal." There is room within thinkable worlds for this limit, yet it is always eventually brought back to the greater conception of another possibility. Hinton operates this divergence, and the language of compossibility clarifies the relationship between their relative theories of abstraction. Thus, the language developed within this research is an attempt at establishing a vocabulary that allows for discrepancies of meaning without reducing them to absolute limits. Like the spaceship foraging into the stretches outside of the defined universe, thinkable worlds are attempting to gain a new perspective on the known, fully aware that in doing so, they are expanding the limits of what is observed. A "universal" is only universal because it has never been seen from the outside, because it has always included its own observer. Leibniz and Everett knew this, and invented other worlds to better observe the one they saw as their own. Which is why possible worlds are operating folds that allow perspective on different aspects of coherence, providing testing grounds for conceptual ganders without reducing meaning to a question of universality.

So this research is not about a particular interpretation, but rather uses interpretation as a means to construct a theory of reading that should, hopefully, be of use to discuss the rich potential at the heart of literary works. The notion of a "fold" has come to be imbricated in this theory through the work of Leibniz, Borges and Husserl. It is a means to understand how infinite series of series can still generate definite thought. This same fold can graphically illustrate how dimensions are points of view into this fold. Indeed, if one imagines a two-

dimensional plane folded, this plane becomes a three-dimensional structure without influencing its topological constituents. Thus, from the vantage point of a two-dimensional being living on this plane, the only possible way of understanding the fold is to, at certain points, figuratively look up into the third dimension, upon its own universe. Thus, by means of triangulation, one not only sees the fold as the locus of possible meaning, one also gains a new perspective on the world. Space-time, which was the integration of a fourth dimension into a three-dimensional realm, operates this movement by using time to better understand space. Likewise, including a dimensional discourse into the realm of literary possibility allows for the development of a methodological reason, a *ratio*, into the act of interpretation. It combines the richness of *mimesis* with the infinite modalities of understanding. Just as discoveries in physics allowed for the reconsideration of already discovered experimental results, leading to new means of expressing phenomena, this fold in the literary order transforms possible worlds into thinkable worlds, worlds that may be considered but have not necessarily come to be actualised. This explains why while literary historians and archaeologists may study *Oedipus Rex* for the many stories it suggests about classical Greece, about belief systems, about early dramatic form, one may also pick up a version, without concern for its translation history or its provenance and read the strange tale that unfolds within it for itself. This naïve outlook may still yield important conclusions, and should not be belittled by scholarly discourse; this approach is still part of a work's potentiality, and it has arguably influenced thought experimental structures isolated from their originating tale, structures as influential as Freud's Oedipus complex. In certain cases, such as for Freud's most widely known theoretical reading, some naïve approaches change the fabric of possibility to such a radical length that the fold operated may forever leave a crease; this world now contains individuals who are familiar with Freud's theory but know nothing of Sophocles's play.

The language of the fold, which seems to have appeared out of the investigation, is in fact already enfolded within presuppositions central to the study. Indeed, the Latin for "fold" is *plicare*, which is still heard in the English word "ply," and it is the root for both the words "explicate" and "implicate." In turn, these words can describe two simultaneous movements in the research. For instance, the notion of the "dimension" was explicated through, or folded

out of *Flatland* and *The Sirens of Titan*. It came out organically, through an investigation into the fabric of the novels that was aiming at understanding the plurality of reading and not the notion of the dimension. As further knowledge was explicated out of the history of the dimension concept, other folds came to light through the strange similarities between the reading experience and the discovery of new dimensions. The remoteness of the past reader-function, as well as the unknowability of the reader as radical variable, working outside of causality, became so similar to the distance between Constant's and Rumfoord's respective visions of time that the notion of the dimension became implicit to the work at hand. It was implicated, or enfolded, within a new line of thought that led to a comprehensive understanding of compossibility and thinkable worlds. This process, which attempts to both implicate and explicate forms as integral shapes of a whole, is perhaps best described in a work that, like this one, spans the gradualistic metaphilosophy spectrum: Bohm's *Wholeness and the Implicate Order*. Bohm, from a physician's point of view, attempts to understand how the analytic tendency to divide knowledge into parts destroys the truly interrelated wholeness that he calls the world. But in a way similar to the one undertaken in this research, he addresses the inevitability of separation as a process of understanding.

The order in every immediately perceptible aspect of the world is to be regarded as coming out of a more comprehensive implicate order, in which all aspects ultimately merge in the undefinable and immeasurable [movements of the whole]. How, then, are we to understand the fact that descriptions involving the analysis of the world into autonomous components do actually work, at least in certain contexts [...]? (Bohm, 2007, 197)

This statement, about the reality of the quantum world when compared with the one described by classical physics, is an encapsulation of what has been investigated. The ceaselessly productive world of literary criticism is constantly enriched by new thoughts, new theories and new readings. For most parts, these studies work within their localised context. The need to address the undivided wholeness of all possibilities is not the most popular subject in literary theory, and neither is the quest to understand how some scientific forms resonate strongly with literary modes of understanding. The cause for this reluctance is simple; there can be no investigation into possibility without localised actualisation. Bohm comes to a similar

conclusion, which also touches on the epistemic worth of a dimensional theory of literary compossibility:

It seems clear [...] that the implicate order is particularly suitable for the understanding of such unbroken wholeness in flowing movement, for in the implicate order the totality of existence is enfolded within each region of space (and time). So, whatever part, element, or aspect we may abstract in thought, this still enfolds the whole and is therefore intrinsically related to the totality from which it has been abstracted. Thus, wholeness permeates all that is being discussed, from the very outset. (Bohm, 2007: 218)

Like implicate order, thinkable worlds are open-ended worlds that fully acknowledge the limitations of their present form. Yet they also remind the critic, the reader, the comparatist, or whoever considers them, that more meaning will come, more meaning has already existed, and that literature is never completely actualised, yet always complete.

Going back to Swirski's initial intuition, of expanding the gradualistic metaphilosophy of Sorensen into a line that includes philosophy, science and literature, it now becomes clear that the foremost problem found in this method is not the inclusion of one sphere or another. Rather, it is the figurative line that is an inadequate form. Or rather, this line can also hold its own folds and be shaped into a solid. There is no directly linear path between these three waypoints; rather they shift, sometimes coming closer or further from one another. The world of science, since its disciplinary separation from philosophy—a separation that can never be completed—, found its own forms and shapes that, interestingly enough, resonate with literary structures and philosophical ideas. Some scientific theories are fought on philosophical grounds through literary means, as demonstrated by arguments between Bohr and Einstein. Science, philosophy and literature are not limits, ideals or points, they are—and I know this conceptual derivation will anger proponents of scientific pristineness, but it is truly the most apt simile—like the electrons of a classically understood object. “The word ‘electron’ should be regarded as no more than a name by which we call attention to a certain aspect of the [movement of the whole], an aspect that can be discussed only by taking into account the entire experimental situation and that cannot be specified in terms of localized objects moving autonomously” (Bohm, 2007: 196). Thus, like subatomic particles, the idea of distinct disciplinary wholes are only strange effects that function in ways difficult to understand, they

can be comprehended statistically, they can yield information about their location or their force, but any truly honest investigation into the limits of these different disciplines will have to agree that thought is composed of all three, at all times, and that in order for a thought to be understood as a whole, the thinker must leave behind the desire to raise strict barriers between all of these components, lest the make up of the studied object, like a hydrogen atom being separated into an electron and a proton, loses all its original characteristics.

I would be disingenuous if I claimed that all these discoveries were planned. At times, I was amazed at the similitudes in vocabulary, the criss-crossed pattern of mutual citations, and the resemblances of forms in the various sources that became this research. It was as though I had stumbled upon a much grander scheme than I had first planned, a community outside of space and time that had been grouped through like-minded explorations and were now hidden into the folds of the libraries and databases. I started out with signs and tales of the unknown that lay beyond the confines of my own comfort and went off into the wilds, following signposts and forest paths, sometimes hurriedly stumbling to return to familiar territory, sometimes haply losing myself in the minutiae of dead-ends. I attempted to draw out a map of these travels, a 1:1 map that could only be lived and could never be fully understood, other than from another dimension. Such a map can only be held if folded, and I am merely suggesting the specific origami necessary to fold it down to a containable size and an engaging shape. Experience with roadmaps tells me that once spread-out, it is very unlikely that a map will be refolded along its original creases. But that is exactly how it should be; I hope that future readers will see new patterns emerge out of this research, take hold of its directions and fold them along new lines of thought; it is the only way to do justice to the considerations within, the truly dimensional manner in which one can read this travelogue, this encyclopaedia of possible possibilities.

This research is not about what literature is, it is about what literature can be. For literature is about what it can be.

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