Shapes of Time in British Twenty-First Century Quantum Fiction

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By

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Cambridge Scholars Publishing

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This book first published 2015

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Reviewed by Prof. Elana Gomel, University of Tel Aviv, Israel

Parts of Introduction have been previously published as "Temporality in British Quantum Fiction: An Overview," in *'Hours like bright sweets in a jar' – Time and Temporality in Literature and Culture,* ed. Alicja Bemben and Sonia Front (Newcastle upon Tyne: Cambridge Scholars Publishing, 2014), 23-44.

ISBN (10): 1-4438-8029-9
ISBN (13): 978-1-4438-8029-9

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PREFACE

"The study of time
is the study of everything."
/Julian Barbour/

After about a hundred years since the revelations of the new physics, we can say that the quantum has pervaded our culture and language. Amazon, for instance, offers 33,053 titles with the word 'quantum'. Apart from books explaining the rules of quantum mechanics, these include books on such concepts as quantum change, quantum secret of living, quantum leap thinking, quantum success, quantum creativity, quantum faith, quantum affirmations, quantum healing, wellness, soul clearing, supplements, quantum runes, tarot, coaching, leadership, business…. While not everyone is knowledgeable in the principles of quantum mechanics, and many people misuse them, which is sometimes somewhat understandable, given the mind-stretching features of the theory, such hybrids as quantum healing or quantum business certainly constitute an abuse of science, attempting to exploit its cultural prestige to validate dubious arguments. Fiction writers, poets, filmmakers and other artists, however, are not constrained by scientific accuracy and therefore allowed to play imaginatively with scientific concepts. And so, there are quantum sculpture,[1] quantum poetry, quantum theatre, quantum fiction and science fiction books and films, integrating the new physics into their plots. While many of the writers have a consistent scientific rationale behind their plots, some deliberately violate scientific principles or incorporate speculative theories for their own purposes.

This book concentrates on the notion of time and temporality and its various conceptualizations in the theories of the new physics, utilized as a thematic and/or formal framework in the British novel of the twenty-first century. The successive chapters of the book will address one concept of the new physics connected with temporality, and its appropriation in a selected novel: parallel universes in Andrew Crumey's *Sputnik Caledonia* (2008), Poincaré's recurrence theorem in David Mitchell's *Cloud Atlas*

[1] See e.g. Julian Voss-Andreae, "Quantum Sculpture: Art Inspired by the Deeper Nature of Reality," *Leonardo*, vol. 44, no. 1 (2011), 14-20.

(2004), chaos theory in Samantha Harvey's *The Wilderness* (2009) and the end of time in Scarlett Thomas's *The End of Mr. Y* (2006). Each of the theories corresponds to a different conceptual shape of time – tree, concertina, spiral and snapshot, respectively – which is enacted on the formal level.

The notions of space and time are perhaps the most important notions in our geography of reality. They are the first prisms of knowledge whose function is to order objects and events in our environment. Our definitions of space and time determine our conception of the universe, the notions of identity and individuality as well as an understanding of our place in the world. The definitions are always mediated through language. As George Lakoff and Mark Johnson argue, language is of a metaphorical nature in its essence, but so too are human thought processes themselves which constitute the basis of our thinking and agency, reasoning and conceptualization.[2] Since the human conceptual systems are inherently metaphorical, such notions as time, mind and causation are also comprehended by means of metaphor. The employment of metaphors from experiential realms to conceptualize more abstract ones is a standard course of action, and because time is a particularly abstract intangible idea, it is necessary to use metaphor to think and speak about it.

To depict and comprehend temporal experience, people in all cultures most often resort to the conceptual structure of space since human language is structured metaphorically in terms of bodily experience of space.[3] The spatial configurations, however, may differ from culture to culture. In English, talking about time is governed by the sagittal axis, that is, a vertical plane which divides the body into right and left, back and front halves. The future is pictured in front of us and the past behind us, or in a left to right order, determined by the direction of writing. Time is most often visualized as a path or line or fork, and a person as moving along the path towards death. As there is no agreement on what time actually is, various philosophers, scientists, poets and writers have proposed many different theories and shapes in which to imagine time. These spatial figurations constitute a sense-making strategy. Given the ungraspable and enigmatic nature of time, its representations in a narrative, which enacts various scientific, philosophical and cultural notions of time, facilitates comprehending it as a lived dimension. Therefore I have decided to organize my book around the shapes of time that various novels construct.

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[2] George Lakoff, Mark Johnson, *Metaphors We Live By* (Chicago and London: The University of Chicago Press, 2003), 3-6.

[3] See Mark Turner, *Reading Minds: The Study of English in the Age of Cognitive Science* (Princeton, New York: Princeton University Press, 1991), 68-98.

Paul Smethurst has asserted that "where modernist spatialization might have tried to capture time and represent the passing of time in various spatial forms (and so signal the onward rush of the present), postmodernist spatialization is without that rush, without any pretence of being able to visualize time, or see into the entrails of time to prophesy."[4] Nonetheless, as my book testifies, the desire of the novel to spatialize and visualize time so as to see into its guts did not subside with modernism. Twentieth and twenty-first century novels have also fed on various conceptualizations of time, provided by philosophy, science and culture to imagine them in timeshapes. The disparity with modernist fiction is that it effects spatialization of time locally while quantum fiction spatializes a novel as a whole. If, as Ursula Heise observes, "the human experience of time depends on cultural contexts that are themselves subject to change,"[5] my aim is to explore human temporality as mediated by the timeshapes imagined within the context of the new physics.

The temporality of human experience is for Paul Ricoeur necessarily connected with the narrative and "time becomes human to the extent that it is articulated through the narrative mode, and narrative attains its full meaning when it becomes a condition of temporal existence."[6] The relationship between narrative and temporality is circular "in the sense that narrative reconfigures the experience of time in the act of representing it, and in so doing, it inflects the temporality that it represents with the shape that narrative gives to it. Thus the relationship between time and narrative is reciprocal for Ricoeur, to the extent that any understanding of time is marked already by the shape that narrative has given to it."[7] Different shapes of time effected in various novels, then, will shed a different light on the questions of time and human temporality. Indeed, the various scientific metaphors employed in the discussed novels imply different philosophical questions and illuminate understanding of the human condition in different ways. By offering metaphors as spatial representations of time, the narratives become a record of the spatial configurations of temporality. Through this, they explore the representability of time for a subject whose sense of identity is linked with abstract forms of temporality, and demonstrate how subjects attempt to localize themselves in a world

[4] Paul Smethurst, *The Postmodern Chronotype. Reading Space and Time in Contemporary Fiction* (Amsterdam: Rodopi, 2000), 40.
[5] Ursula K. Heise, *Chronoschisms. Time, Narrative and Postmodernism* (Cambridge: Cambridge University Press, 1997), 47.
[6] Paul Ricoeur, *Time and Narrative*, vol. I, trans. Kathleen McLaughlin and David Pellauer (London, Chicago: University of Chicago Press, 2012), 52.
[7] Mark Currie, "The Expansion of Tense," *Narrative*, vol. 17, no. 3 (2009), 355.

without any existential stability; how they endeavour to interpret and make sense of themselves in shifting time frames.

The different shapes of time dismiss chronometric linearity to figure time as lived time, and paint the picture of time in which an individual is located. The Aristotelian definition of a narrative as a linear sequence of events that took its impetus from the unities of action, location and character and the contention that time and space are continuous, coherent and universal are no longer valid. The narrative, previously subjected to the paradigm of linear time, however arbitrary in itself, in modernity has liberated itself from it, proffering a coexistence of plural temporalities. The Newtonian idea that time constitutes a linear continuum in which the events stay in a cause-effect relationship is belied in the modern novel as well as in science, history and philosophy. Modernist and postmodernist fiction became typically antilinear, heterogeneous, contingent, with multi-directional causality. There is an agreement that time must be reasoned about as a "dynamic force" in the conceptions of reality and subjectivity.[8] In so doing, the narrative has come to fulfill the role designated by Ricoeur: it has become the medium to express the temporality of the subject, and comprehending human temporality is necessary in order to understand the world. Elizabeth Grosz has observed that the manners in which subjectivity and space and time are conceptualized are interrelated – when one changes, the other does too.[9] This is visible in the novels I discuss as well: different theories of time are sutured with different notions of identity.

Science is a potent source from which to draw in search of new metaphors to conceptualize time and human temporality. The role of the novel in bringing immediacy to scientific concepts is not to be underappreciated. Without disparaging the significance of non-fiction, Alan Lightman, the American physicist and writer, sometimes prefers to present knowledge in the form of the novel rather than dry scientific discourse, since the novel is for him an "emotional experiment," by means of which he can "probe the limits of rational thought"[10] and produce an emotional impact: "we are taken to the scene, we smell the scent of linseed

[8] Elizabeth Grosz, "Becoming… An Introduction," in *Becomings: Explorations in Time, Memory and Futures*, ed. Elizabeth Grosz (New York: Cornell University, 1999), 3.

[9] Elizabeth Grosz, *Space, Time and Perversion: Essays on the Politics of Bodies* (New York: Routledge, 1995), 97, 99.

[10] Alan Lightman, Rebecca Newberger Goldstein, "Bridging the Two Cultures: A Conversation between Alan Lightman and Rebecca Newberger Goldstein," *World Literature Today*, January 2011, 30.

oil, we hear the cracking voice of a grandfather, we see the smoke rising from a burning house in the distance. We feel the joy and suffering of good characters. Either consciously or unconsciously, we enter the world created by the novelist and experience things at a visceral level. Words and actions and scenes make an emotional impression on us, and that impression is deep."[11] The novel explores the consequences for human temporality and identity of situating an individual in the realm of physical time. In this way it becomes a laboratory for investigating the philosophical questions, such as what happens to human identity in a multiverse, how memory conditions identity, what is the connection between consciousness and time, and is it possible to rewrite the future? In this manner, literature is engaged in the debate on the nature of time and testifies that new concepts and theories open up new ways of seeing, contradictory to the received views. Narrative becomes thus a mediator between the time of physics and cultural time, and a complex reflection on the consequences of scientific theories.

The purpose of this book is to examine human temporality as negotiated by the time concepts of the new physics. I intend to view the selected novels as exemplifications of the literary genre of quantum fiction. I will endeavor to identify quantum poetics in selected novels and establish their authors' purpose in using the lexis of quantum physics. Attempting to single out the ways in which the scientific aesthetic informs insights about time and temporality, I will seek to uncover passages between scientific and humanistic standpoints. To do that, I will draw on physics to elucidate the situation of the protagonist in a given novel; however, I will have recourse to philosophy and literary theories to uncover the philosophical underpinnings and imports of the physical theories as, obviously, physicists do not address these questions.

In the introduction I contextualize the new physics' notions of time against the background of modernist and postmodernist concepts. I also offer a brief history of the relationship between science and literature, and a necessary introduction to the basic concepts in quantum theory.

Chapter One explores the notion of parallel universes on the basis of Andrew Crumey's novel *Sputnik Caledonia*. In fiction parallel universes might be interpreted as bifurcating narratives, or hypertext, or polyhistory or a Multiple Drafts novel,[12] or the enactment of Everett's multiverse theory in physics. Although Crumey's novel seems to be written in a

[11] Lightman, Goldstein, "Bridging the Two Cultures," 34.

[12] See Stephen J. Burn "Reading the Multiple Drafts Novel," *Modern Fiction Studies*, vol. 58, no. 3 (2012), 436-458 where he interprets a few novels through the lens of Daniel Dennett's Multiple Drafts model of consciousness.

traditional chronological way, the vision of reality it presents is far from classical. When one gets the holistic view of the three parts of the book, they do not coalesce into a linear narrative but a bifurcating one, and the protagonist can be perceived as living in parallel realities simultaneously. My aim here is to examine the question of personal identity in parallel time-streams. Can a person in the forking universes be deemed to be the same individual or not? I will address the issue through the lens of various theories dealing with possible worlds, as well as a holistic theory of Johann Wolfgang von Goethe.

The second chapter investigates David Mitchell's *Cloud Atlas*, which engages the framework of eternal recurrence to repeat with a difference characters and patterns of events that are thereby decontextualized and recontextualized in spacetime. In this manner the novel thematizes cyclical time, the transmigration of consciousness, contingency and interconnectedness. Mitchell juxtaposes the circular time of eternal recurrence with other scales of time: individual human time, evolutionary time, physics time and historical time, and demonstrates how people function at their interfaces. Each character belongs to a given place and time but also partakes in a larger pattern which s/he glimpses in moments of epiphany. I intend to address the following questions here: What notion of identity does the narrative framework suggest? How does the story illustrate the risks involved in linear and cyclical approaches to temporality? Does the whole amount to more than the sum of its parts?

Chapter Three discusses Samantha Harvey's *The Wilderness*, in which the tropes of order and chaos, the features of chaos theory, are applied as models of memory process, characteristic of an individual suffering from Alzheimer's disease. The loss of temporal continuity, the bounded randomness of mental processes and the atemporal mode of imagination, memory, dream – and the text itself – constitute a spiral that traces the movement of the protagonist's consciousness. The trajectory of the text, which follows the trajectory of the protagonist's thoughts, assumes a repeating pattern and exemplifies an attractor-structure in the multiple revisitings of past events from different perspectives, thus sabotaging causal links and questioning a fixed truth about the past. In this manner the text thematizes the forward and backward movement of time and the complexity of time's flow to embody a chaotic dynamical system. The question I would like to concentrate on here is how the sense of the self depends on the autobiographical narrative. If memory and personal history are malleable for every person, how would they be influenced by Alzheimer's? Can personal identity be preserved in the case of shattered

memory, or, to put it differently, is the self possible in case of the absence of narrative, the absence of language and memory?

Chapter Four examines Scarlett Thomas's *The End of Mr. Y*, which assumes the role of a microscope through which to study the human mind and its connection to time. I analyze and interpret the novel through the lens of the British physicist, Julian Barbour's, theory presented in *The End of Time. The Next Revolution in Physics* (1999). Both Thomas and Barbour proclaim that time is an illusion generated by human consciousness. In the novel the timelessness of physics (interrogating the concept of the past and traditional causality) is contrasted with tensed psychological time, particularly in the matrix-like realm, the Troposphere, through which Thomas's characters can access other minds. The problems to deal with here concern the nature of reality and consciousness as well as the conjunction between language and consciousness, language and reality, and time and consciousness. What is the relationship between thought and matter? How can vertical causality be replaced with a horizontal one in timeless quantum cosmology? How are time and change connected? Is there an underlying truth beyond language and reality?

In the analyzed novels, then, quantum poetics is employed to assist in our understanding of human temporality and identity. As opposed to the traditional Newtonian notion of temporality as an external dimension which a subject enters, the new physics identifies time with the subject himself/herself. The subject cannot be separated from time because s/he does not exist outside of time. If human temporality, the time of being, is expressed in language, particularly the language of narrative, which is the most sophisticated way to order complex temporal experiences, quantum fiction with its innovative techniques is a significant contribution to the understanding of the complex entanglement between external reality and internal experience.

The intersection between art and science strikes me as momentous because it is writers, directors and other artists who are responsible for assimilating influential scientific theories into the emotional and imaginative dimensions of human life. Underlining the significance of time as an existential problem, the purpose of the discussed novels – and this book – is to feed in an exegesis of the nature of time and its relationship with human consciousness and identity. The subject of my project seems neglected. Apart from various papers published in journals, there have only been a couple of critical book-length studies of quantum fiction (there are, however, a few more that concentrate on chaos theory).

The first scholarly book to deal with the subject was Robert Nadeau's *Readings from the New Book on Nature* (1981). His purpose is to explore

the metaphysical implications of the theories of the new physics mostly on the basis of American writers' works, as well as to investigate the purpose of their employment of physical models in their fictions. I agree with Susan Strehle, however, that in his exegesis Nadeau diverges too much from physics. Although he refers to physics many a time, he does not manage to support the claims with sound arguments. Strehle does not agree with Nadeau's classification of most of the selected novels as quantum fiction (or, in her terms, "actualistic" fiction), and neither do I. He utilizes the concepts from quantum physics in a loose fashion for his analyzes, for example the notion of indeterminacy, which is used in a different manner in the everyday language and in physics. What Nadeau analyzes seems to me postmodernist aesthetics of the texts: constructivism, the relationship between fact and fiction, self-referentiality, non-teleological endings, and the undermining of binary oppositions, rather than quantum poetics. However, he never uses the terms 'modernist' or 'postmodern(ist)', nor does he mention the modernist novels' incorporation of the new physics, thus giving a false impression that this type of novel appeared much later.

Much more successfully, N. Katherine Hayles in *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century* (1984) offers a theory of the marriage between science and literature, using the "field concept" as a critical method. This concept does not correspond to any particular scientific term, but constitutes an amalgamation of various similar concepts appearing in twentieth century culture. Hayles analyzes articulations of the field concept in mathematics and physics as well as in linguistics and literary texts. She underscores such characteristics of the field concept as interconnectedness, symmetry, self-referentiality of language and the multi-directionality of cause and effect.

Susan Strehle in her *Fiction in the Quantum Universe* (1992) explores the formal assimilation of the new physics into the American novels which she calls "actualistic." For her it is the third type of fiction, beyond traditional realism and postmodernist self-reflexive textuality. She gives detailed accounts of the manners in which fiction is informed by quantum aesthetics. It would perhaps be beneficial for the book if the discussion on the form of the novels were more evenly incorporated into the analyses instead of being pushed to the end of the chapters since the critical lens of actualism suggests the integrity of form and content.

The enumerated critical books deal with modernist and 1960s-1980s fiction, therefore a newer analysis of the literary developments in that area seems to be called for. Also, I have not come across a book concentrating on temporality in quantum fiction, nor a book dealing exclusively with

quantum poetics in British fiction. Among the novels I have selected only *Cloud Atlas* has received much critical attention. I have not discovered a single paper on *The Wilderness*, *The End of Mr. Y* or *Sputnik Caledonia*, and that is one reason why I am opening up a critical debate on these novels.

INTRODUCTION

THE SHIFTING SHAPES OF TIME

"Science and fiction both begin with similar questions:
What if? Why? How does it all work?"
/Margaret Atwood/

Fiction writers readily appropriate ideas from science to articulate them within a narrative and reflect on their consequences and philosophical implications. The two words "literature and science" were first used in this connection by Matthew Arnold in 1882. However, as his and other lectures testify, the "and" of the phrase indicates separation and disagreement, rather than an agreeable union. While the novels which explore the constructivity of science would certainly be disparaged by scientists, their criticism is mainly directed at literary scholars and theorists. What follows is a short history of the relationship between literature and science.

"Poetry … in theoretical physics"[1] – a short history of the two cultures

By the late nineteenth century when religion no longer claimed the right to be the only source of truth about cosmology, a debate between Matthew Arnold and Thomas Henry Huxley took place on whether scientific or literary education should be given priority. Huxley in his "Science and Culture" (1880) was in support of science, claiming that it could provide "a mental twist" in the same way that literary education did. Rejecting literature's pretensions to interpretative authority, he suggested that science, apart from providing knowledge about the world, upheld "a

[1] Scarlett Thomas, *The End of Mr. Y* (Edinburgh, New York, Melbourne: Canongate, 2007), 25.

criticism of life."[2] Arnold, on the other hand, interrogated the idea that the requirements of modern life demanded that the predominance should pass from letters to science. For him the knowledge of literature, of "the best which has been thought and said in the world," was essential "to know ourselves and the world."[3] Although his definition of literature encompassed not only *belles lettres* but all written words, including for instance the work of Galileo or Newton, he underappreciated the explanatory power of science and its ability to contribute to the understanding of human nature. To his mind, science provided merely dry facts, and it was only literature that could satisfy the human need for beauty and provide models of proper conduct. The physicist John Tyndall in his "Belfast Address" (1874) prescribed a division of roles for science and literature: science was to explicate the natural world and the humanities were to sustain moral life and to satisfy spiritual needs.[4] This polarization was concurrent with the institutionalization of the discourses of science and literature and their establishment as distinct university subjects at the end of the nineteenth and the beginning of the twentieth centuries.

Another important stage in the debate on the role and significance of science and literature in society was Charles Percy Snow's infamous lecture "The Two Cultures and the Scientific Revolution" (1959).[5] Snow, a scientist and novelist himself, argued that intellectual life in Britain revolved around two poles: literary intellectuals were placed at one pole and the scientists at the other. Because he, rather superficially, set literary scholars and scientists in a binary opposition of backward versus forward looking, reflective versus active, ignorant of science versus willing to influence social change, respectively, his underlying argument that scientists contributed more to the improvement of social life than litterateurs was overlooked. Snow's superficial generalizations provoked a heated discussion in which F.R. Leavis's response, "Two Cultures? The Significance of C.P. Snow" (1959) was perhaps the most relentless and

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[2] Thomas Henry Huxley, "Science and Culture," in *The Major Prose of Thomas Henry Huxley*, ed. Alan P. Barr (Athens, Georgia: University of Georgia Press, 1997), 235, 229.

[3] Matthew Arnold, "Literature and Science," in *The Norton Anthology of English Literature*, vol. 2, eds. M. H. Abrams and S. J. Greenblatt (New York: Norton, 1993), 1432.

[4] John Tyndall, "Belfast Address," <http://victorianweb.org/science/science_texts/belfast.html>.

[5] See C.P. Snow, *Two Cultures and the Scientific Revolution* (Cambridge, New York: Cambridge University Press, 1959).

aggressive. He was particularly inflamed by Snow's pronouncement of the superiority of science over the humanities and his suggestion that literature did not constitute science any more.[6]

Other voices in the debate included, for example, Aldous Huxley's book *Literature and Science* (1963) where, on the one hand, he assaulted Snow's "bland scientism," but, on the other hand, he accused literary scholars of isolating themselves in an ivory tower, uninterested in Heisenberg's or Einstein's discoveries. He recommended a meeting between technology and aesthetics, a shared awareness of man's "manifold amphibiousness" and nature's "multiple causation."[7] Peter Madawar in his lecture "Science and Literature" (1968) tried to achieve a "conciliatory attitude" by stating that "imagination is the energizing force of science as well as poetry, but in science imagination and a critical evaluation of its products are integrally combined."[8]

The growing interest in the connection between literature and science has been visible since the 1970s in conferences, scholarly papers and books (one of the first works being Carson Duncan's *New Science and English Literature*, 1913), and the establishment of the Society for Literature and Science in 1985. Yet the scholarship usually showed how the influence was one-directional, with literature drawing on science for ideas and images. The impact in the other direction was revealed in the 1990s by social constructivism which led to the so-called "Science Wars."

Social constructivism, a Saussurean legacy, for the first time treated science as one of the discourses, which did not reflect the natural world as it was but the underlying ideology, power relations and social structure that affected the production of scientific knowledge. As such, science was denied its claim to truth and objectivity as well as prerogative epistemological status in describing the natural world. Science was held to be socially constructed and relative and its statements considered impossible to evaluate from the external, social or cultural, perspective.

Some of these ideas found their corroboration in the results of Thomas Kuhn's research presented in *The Structure of Scientific Revolutions* (1962). Having examined the actual historical practice of science, he discovered it was governed periodically by a paradigm, that is, a thought pattern, a theoretical framework, within which all scientific thinking and

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[6] See F.R. Leavis, *The Two Cultures* (Cambridge: Cambridge University Press, 1998).

[7] Aldous Huxley, *Literature and Science* (New York: Harper & Row, 1963), 197.

[8] Peter Medawar, "Science and Literature," in *Pluto's Republic: Incorporating the Art of the Soluble and Induction and Intuition in Scientific Thought* (Oxford: Oxford University Press, 1982), 18.

practices operated. Periods of conceptual continuity in normal science are interrupted by a "paradigm shift" which initiates a period of revolutionary science. However, the reasons for the shift to the new paradigm are not completely neutral or logical, and there is no objective theory-independent way to determine if the new paradigm is closer to truth.[9] Some critics have deemed Kuhn's revelations to be a violation of the integrity of science with the introduction of the irrational element; others have interpreted it as an injection of a realistic humanism into the kernel of science.

Similarly, in the humanities, Michel Foucault in *The Archaeology of Knowledge* (1966) analyzed the processes that stand behind the production of discourses and postulated that knowledge and science were the effects both of and in discourse. Knowledge in a given period is conditioned by "epistemes" or "discursive formations," that is, a system of conceptual possibilities that determines the boundaries of thought in a given field and period. This collection of received ideas and assumptions is expressed in texts from various domains.

The new view of science as a discourse embedded in culture allowed its analysis by means of the same analytical tools as literature or sociology. Scholars began to investigate the problems of how scientists utilize literary techniques, such as metaphor, analogy, simile, metonymy and other devices, to structure their narratives.[10] Amit Goswami, for instance, has demonstrated how science hinges upon its own fictions, not confirmed experimentally, for example hypothetical particles, such as quarks or gluons, or the fictions of Maxwell's demon or Schrödinger's cat, or the metaphors of a wormhole or electron cloud. Gerald Holton has argued that the "process of building an actual scientific theory requires explicit or implicit decisions, such as the adoption of certain hypotheses and criteria of preselection that are not at all scientifically 'valid' in the sense previously given and usually accepted."[11]

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[9] See Thomas S. Kuhn, *The Structure of Scientific Revolutions: 50th Anniversary Edition* (London, Chicago: University of Chicago Press, 2012).

[10] See for example Gillian Beer, *Open Fields. Science in Cultural Encounter* (New York: Oxford University Press, 1996) and *Darwin's Plots. Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction* (Cambridge: Cambridge University Press, 2009); Amit Goswami with Maggie Goswami, *The Cosmic Dancers: Exploring the Physics of Science Fiction* (New York: Harper, 1983), Sergio Sismondo, *Science without Myth: On Constructions, Reality, and Social Knowledge* (Albany: SUNY Press, 1996).

[11] Gerald James Holton, *Thematic Origins of Scientific Thought: Kepler to Einstein* (Cambridge, Mass.: Harvard University Press, 1988), 33.

Furthermore, in *Cultural Boundaries of Science: Credibility on the Line* (1999), Thomas F. Gieryn investigated the boundaries of science, that is, the attributes that designated science as a discrete and legitimate epistemic project. These boundaries determine which domains of science are regarded as credible and authoritative, and, as a result, which of them influence policy-making. It appears that the boundaries of science depend on the party who draws the boundaries and the purpose to which the map is to be employed; the boundaries are "selectively deployed in a contingent contest for epistemic authority and resources among multiple makers of belief."[12] As science turns out to be contingent on political relations, flexible and malleable to serve certain aims, Gieryn finds that there are no stable criteria to differentiate science from non-science. He finds the same controversy in the centre of the "Science Wars."

As a response to cultural relativism, Norman Levitt and Paul Gross published *Higher Supersition: The Academic Left and Its Quarrels with Science* (1994) in which they criticized postmodernist attitudes and declared them "an irrelevant botch."[13] Infuriated scientists who considered themselves as the discoverers of truth vehemently repudiated social constructivism and its allegations. Wendell V. Harris in a paper with the telling title, "Physics is Physics, Literature is Literature and Criticism is Something Else Again" (2000), questioned the role and methodology of the English departments, accusing them of "disregard for, if not opposition to, lucidity" and lack of logical rigour, and mocking their inability to understand that science must be based on testable predictions, as opposed to a poem or a novel: "That fashionable literary critics unquestioningly go to meetings at which to pronounce that the theories of physics (presumably including aeronautic) are as fictional as the events recounted in *Tom Jones* or *Clarissa* is a situation that cries out for a Molière or Swift."[14] He accused scholars in the humanities and social sciences of following ideological fashions, unrelenting belief in the profundity of argument of the texts they did not comprehend, and the shallowness of interdisciplinary approaches, which, in fact, appeared to be misappropriations of theories from fields in which the scholars were not well-versed.

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[12] Thomas F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Chicago: University of Chicago Press, 1999), 30.

[13] Paul R. Gross, Norman Levitt, *Higher Supersition: The Academic Left and Its Quarrels with Science* (Baltimore: JHU Press, 1997), 89.

[14] Wendell V. Harris, "Physics is Physics, Literature is Literature and Criticism is Something Else Again," *Philosophy and Literature*, vol. 24, no. 1 (2000), 212, 217, 213.

Harris drew these reflections from another infamous paper, Alan Sokal's "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity" (1996) hoax. Sokal proposed to *Social Text*, a respectable journal of postmodern cultural theory, an article, "chock-full of absurdities and blatant non-sequiturs,"[15] yet expressing the trendy constructivist approach. It was published in a special issue devoted to invalidating by several eminent scientists the criticisms raised against postmodernism and social constructivism. His purpose, as he explained in the paper commenting on his hoax, was not "to defend science from the barbarian hordes of lit crit (we'll survive just fine, thank you). Rather my concern is explicitly political: to combat a currently fashionable postmodernist/ postructuralist/ social constructivist discourse – and more generally a penchant for subjectivism."[16] He believed his parody was published because it supported the ideas of thinkers held high on the pedestal: Derrida, Deleuze, Guattari, Lacan, Latour, Irigaray, Serres, Lyotard and Virilio. Their reflections on the philosophical implications of the natural sciences and mathematics, however, were exposed in Sokal's and Bricmont's book *Fashionable Nonsense: Postmodern Intellectuals' Abuse of Science* (1998) and in Bricmont's lecture "Postmodernism and its Problems with Science" (2002) as being based on the misuse and lack of understanding of physical and mathematical concepts. They also exposed instances in which the above mentioned theorists and others lifted scientific concepts and tried to apply them to their own theories without any relevance or intellectual aim, but to impress the readers with rhetorical tricks and "a clever abuse of sophisticated terminology."[17] The use of scientific concepts as metaphors Sokal and Bricmont deemed to be pointless, as neither the thinker nor the readers really understood them, and therefore the only goal was possibly "to pass off as profound a rather banal philosophical or sociological observation, by dressing it up in fancy scientific jargon."[18] Raymond Tallis is another thinker who profusely criticized postmodern excesses in his *Newton's Sleep: The Two Cultures and the Two Kingdoms* (1995), *Enemies of Hope: A Critique of Contemporary Pessimism* (1997), *Not Saussure: A Critique of Post-*

[15] Alan Sokal and Jean Bricmont, *Fashionable Nonsense: Postmodern Intellectuals' Abuse of Science* (New York: Picador, 2014), 1-2.
[16] Alan Sokal, "Transgressing the Boundaries: An Afterword," *Dissent*, vol. 43, no. 4 (1996), <http://www.physics.nyu.edu/sokal/afterword_v1a/afterword_v1a_singlefile.html>.
[17] Sokal and Bricmont, *Fashionable Nonsense*, 8.
[18] Sokal and Bricmont, *Fashionable Nonsense*, 11.

Saussurean Literary Theory (*Language, Discourse, Society*) (1998) and *Theorrhoes and After* (1999).

In a response, Mara Beller observed that scientists were not without blame themselves – some quantum physicists wrote in an obscure manner that invited misinterpretation.[19] *The Guardian* accused some physicists of monopolizing "the big questions" by maintaining that they were too difficult for the general public to understand: "if the priests tell us it's easy, they will lose their priestliness."[20] Sokal admitted that for instance Heisenberg and Bohr were as unreliable as New Age popularizers; however, apart from David Alberts's *Quantum Mechanics and Experience* (1992) he did not suggest any other reliable popular science books.[21] It remains unclear, then, how a literary scholar is to evaluate and choose the books that would help her gain some non-expert knowledge on scientific subjects. Sokal and Bricmont have given some titles in *Fashionable Nonsense* in footnotes; still, it would be appreciated if the lists of recommended books could appear in a more accessible form, for example in newspapers.

While Harris went so far as to interrogate the validity of the existence of the English department and to reconsider whether studying English literature still held some value to university students,[22] returning thus to Arnold-Huxley debate, other scientists have underscored their appreciation for the importance of the humanities, philosophy and social sciences. Maarten Boudry and Filip Buekens admitted that some science might be ideologically-driven, yet, certainly, it did not apply to all science.[23] Bricmont also recognized that the applications of science raised various ethical issues but they should not be confused with ontological and epistemological questions, for example whether "atoms … really behave according to the laws of quantum mechanics."[24]

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[19] Mara Beller, "The Sokal Hoax: At Whom Are We Laughing?" *Physics Today*, vol. 51, no. 9 (1998), 29-34.

[20] "Let us into the tower of knowledge," *The Guardian*, 13 March 1999, <http://www.theguardian.com/books /1999/mar/13/books.guardianreview2#>.

[21] Sokal, "Transgressing the Boundaries: An Afterword."

[22] Harris, "Physics is Physics, Literature is Literature and Criticism is Something Else Again," 222.

[23] Maarten Boudry, Filip Buekens, "The Epistemic Predicament of a Pseudoscience: Social Constructivism Confronts Freudian Psychoanalysis," *Theoria*, vol. 77, issue 2 (2011), 159–179.

[24] Jean Bricmont, "Postmodernism and its Problems with Science," 2002, <http://www.dogma.lu/txt/JB-Postmodernism.pdf>, 16.

The biologist Edward O. Wilson proposed a bridge between science and the arts in his vision put forward in *Consilience: The Unity of Knowledge* (1998) where he argued for the fundamental unity of all knowledge. He recognized the need to seek consilience – the proof that a small number of fundamental natural laws that included the principles controlling all branches of knowledge governed the world. He began to explore literature from the perspective of evolutionary biology to establish its evolutionary origin and role. Attempting to achieve the unity of science, Wilson recommended the reduction of all knowledge to natural sciences. However, when we take into account the increasing compartmentalization and multiplication of disciplines, this reduction seems dubious. Although Wilson advanced the linkage of "art, ethics and religion," he did not explain the way in which the unity of scientific enquiry would provide a template for consilience between science and the arts. After all, physics or biology, and art, ethics or religion provide different explanations of the world. The relationship of literature to science has not been agreed upon (rather, as I have demonstrated, it has been the subject of many a dispute), nor has the question whether it is possible to apply the methodology of any science to literature. Wilson did not offer any specifics about how this synthesis could be realized; he merely emphasized the importance of mutual interactions between science and the humanities: "Neither science nor the arts can be complete without combining their separate strengths. Science needs the intuition and metaphorical power of the arts, and the arts need the fresh blood of science."[25] While science fiction or quantum fiction are certainly energized by scientific concepts, there are many other genres which do not refer to science in any way, and cannot be, in Wilson's nomenclature, considered "incomplete."

Contrary to Wilson, Stephen Jay Gould in *The Hedgehog, the Fox and the Magister's Pox* (2003) proffered that the arts and science were two alternative but related paths toward wisdom. A similar supposition was behind *One Culture: Essays in Science and Literature* (1987), a volume edited by George Levine. The book did not offer an easy conjunction between literature and science but attempted to shed light on their complex interrelations. It recognized that although there were significant differences between scientific and literary language, both expressed a culture's values, intellectual frameworks and assumptions, and both were under various political, social and psychological pressures. Furthermore, it

[25] Edward O. Wilson, *Consilience: The Unity of Knowledge* (Thorndike, ME: Thorndike Press, 1998), 230.

was not only that literature drew on science but literature informed science as well. Levine traced other relations between science and literature and analyzed Darwin's scientific language in *Darwin and the Novelists: Patterns of Science in Victorian Fiction* (1988) and *Darwin Loves You: Natural Selection and the Re-enchantment of the World* (2006).

In the 2010 Aronui Lecture *The Two Cultures Fifty Years On*, Onora O'Neill said that the division between science and the humanities was not a bygone problem: "I think we still do live in the world in which assumptions about intellectual and academic cultures and about differences between them remain quite evident and in which many knowledgeable people think … that those on the far sides of certain divides do work that is intellectually suspect or limited or trivial in some way." To exemplify this line of thought, she mentioned reductionist approaches in biology and psychology that presumed that "naturalistic explanations will not just supplement but somehow supersede cultural, moral, not to mention theological, enquiry."[26]

If there has been a "third culture," it is popular science books which enjoyed a boom in the 1990s. John Brockman called the phenomenon "the third culture" to indicate that scientists were directly communicating their new ideas to the general public.[27] Some required the books to be recognized as a separate genre, "distinct from the old literary forms, and conveying pleasures and triumphs quite different from theirs."[28] Such books as Fritjof Capra's *The Tao of Physics* (1975) and Gary Zukav's *The Dancing Wu Li Masters* (1979) became very popular. Together with many press articles, they introduced quantum mechanics to popular consciousness. Fiction and films are another channel through which the knowledge has been absorbed by common imagination, shaping non-expert grasp of science. Obviously, fiction writers' and filmmakers' knowledge of physics hinges on popular science books as they are rarely physicists themselves. Although Sokal and Bricmont grant "poetic licence" to the artists, allowing them even to distort terminology,[29] they rightly oppose the misappropriations of science by scholars and thinkers who create theory or write on sociology, philosophy or psychoanalysis.

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[26] Onora O'Neill, *The Two Cultures Fifty Years On*, Aronui Lecture (2010), <http://vimeo.com/15756075>.

[27] See John Brockman, *The Third Culture: Beyond the Scientific Revolution* (New York: Simon and Schuster, 1995).

[28] John Carey, "Introduction," in *The Faber Book of Science*, ed. John Carey (London: Faber, 1995), xiv.

[29] Bricmont, "Postmodernism and its Problems with Science," 14.

The accurate presentation of scientific concepts in popular science books is very important, then, as errors will be perpetuated.

Elizabeth Leane has given much critical attention to popular science books to explore how rhetorical strategies, such as metaphor, may distort the meaning of quantum physics' theories. She questions the validity of illustrating quantum mechanics with metaphors since quantum theory does not refer to reality but to the results of experiments: the "mathematics employed in quantum theory does not provide a model for a system, but is better thought of as a tool to predict experimental outcomes. Quantum theory thus implies a radical failure of metaphor: the metaphors popularizers employ, like the equations employed by particle physicists, are all vehicle and no tenor."[30] Leane has investigated distortions stemming from the use of anthropomorphic metaphors – how they can generate unexpected interpretations and ambiguity in non-expert readers – and the consequences of employing "metaphorical shorthands."[31] In a similar fashion, it is risky to take advantage of pictorial models to illustrate science. In his "Picturizing Science. The science documentary as multimedia spectacle" (2006), Josè van Dijck argues that science documentaries do not illustrate but facilitate scientific statements.[32]

Similarly, Danah Zohar critiques constructivist approaches and cautions against the popular scientific misconceptions and simplifications of quantum mechanics, according to which the observer creates reality. She explains that the interaction between the quantum wavefunction and the observer gives rise to one of the multiple possibilities "inherent within that wave function. But there is already the potential for some very definite sort of reality there – the wave function of a table can't collapse into a cat or a kangaroo. It can become only a table."[33] Furthermore, as Zohar explains, "once the wave function has collapsed its reality is as objective as anything else science studies. Any two (or more) people

[30] Elizabeth Leane, "Knowing Quanta: The Ambiguous Metaphors of Popular Physics," *The Review of English Studies*, New Series, vol. 52, no. 207 (2001), 419-20.

[31] Leane, "Knowing Quanta," 427-8, 430. See also Elizabeth Leane, *Reading Popular Physics: Disciplinary Skirmishes and Textual Strategies* (Aldershot, Burlington: Ashgate Publishing, 2007).

[32] See Josè van Dijck, "Picturizing Science. The science documentary as multimedia spectacle," *International Journal of Cultural Studies*, vol. 9, no. 1 (2006), 5-24.

[33] Danah Zohar in collaboration with I. N. Marshall, *The Quantum Self. Human Nature and Consciousness Defined by the New Physics* (New York: William Morrow and Company, Inc., 1990), 48.

looking at Schrödinger's cat will agree that he is objectively dead – he won't look dead to one and live to another. His mortality is not a matter of anyone's 'point of view', and certainly not of someone's 'value judgment'."[34] She critiques the postmodernist rejection of 'truth' and its replacement with the notion of a plurality of truths, determined by one's point of view. She warns that such misconceptions of quantum theory are encouraged by popular science books, which she calls "bad physics." She particularly critiques some of Fritjof Capra's statements in his *The Turning Point*, according to which modern physics rejects the classical model of an objective description. He also suggests that the results scientists achieve are value-laden and determined by their "frame of mind."[35] Contrary to what some authors attempt to argue, one cannot change reality by means of thought, nor has the new physics "rediscovered ancient Buddhist wisdom."[36] Sean Carroll stresses that "It is disrespectful to both ancient philosophers and modern physicists to ignore the real differences in their goals and methods in an attempt to create tangible connections out of superficial resemblances."[37]

Leane has exposed Zukav's *The Dancing Wu Li Masters* as driven by blind desire to support the connections between the new physics and eastern mysticism and to that end using unstable metaphorical language and making unjustified analogies between human consciousness and quantum physics, and other superficial connections. And yet Zukav's book was awarded a U.S. National Book Award in the category of Science in 1980. No wonder some literary scholars have used such books for their analyses, relying on the prestige of the award. According to Leane, the whole science versus literature debate hinges on the quality of popular science books; literary scholars need to "show a contextual awareness of how the rhetorical construction of a particular popularization situates it with respect to the body of knowledge developed by the scientific community. Only then will literary critics be able to achieve the degree of finely nuanced argument that will render their analyses meaningful, not only within the community of 'science and literature' scholars, but within a broad, multidisciplinary academic sphere."[38] The selection of popular science books that a literary scholar chooses to read and base her critical analysis on is very important, as it determines her credibility as a scholar

[34] Zohar, *The Quantum Self*, 48.
[35] Zohar, *The Quantum Self*, 48.
[36] Sean Carroll, *From Eternity to Here: The Quest for the Ultimate Theory of Time* (Oxford: Oneworld Publications, 2011), 230.
[37] Carroll, *From Eternity to Here*, 402 n. 195.
[38] Leane, "Knowing Quanta," 431.

and influences the argument itself. It follows, then, as I have already argued, that more attention should be paid to evaluating popular science books and making the reviews widely available.

Before I move on to the study of the connection between literature and science in the form of quantum fiction, I will give a short account of quantum mechanics to those readers who are unfamiliar with the subject, or those who might need a quick revision.

A brief introduction to quantum mechanics

The two pillars of modern physics embrace Albert Einstein's general theory of relativity and quantum mechanics. Einstein's theory of special relativity (1905) created a fundamental link between space and time: the three dimensions of space are combined with the fourth dimension of time to create a four-dimensional single continuum, called Minkowski spacetime (after the mathematician Hermann Minkowski, who showed that special relativity could be understood geometrically in this way). Special relativity postulates that the duration of an event depends on the observer's velocity and reference frame, from which the measurements are taken. The theory is called "special" because it refers only to the special case of inertial reference frames, that is, objects that are moving at constant velocities relative to each other. When the nature of the motion is altered in any way, the general theory of relativity (1916) applies.

While relativity refers to macroscopic scales, quantum mechanics describes what happens at microscopic scales, and can also be applied to grander systems, such as quantum field theory or quantum gravity. The boundary between macroscopic and microscopic scales has not been established. Quantum theory takes its name from quanta, that is, energy packages in which light is emitted, as suggested by Max Planck in 1900. Louis Victor de Broglie showed that light or electrons are manifested both as a particle and a wave. The notion of complementarity (1928) introduced by Niels Bohr states that the particle picture and the wave picture are parts of the account of the same reality, both necessary to give a full description, yet it is impossible to observe the two aspects simultaneously.

A system, that is, an object under study, is in quantum mechanics assembled from sets of experiments. When the system is not subject to any observation, it evolves according to a rule called the Schrödinger equation. However, when a scientist attempts a measurement, s/he influences what is observed. As the Uncertainty Principle, presented by Werner Heisenberg in a 1927 paper, states, it is not possible to determine the velocity of a particle and its position at the same time, nor can the outcome be predicted

before the measurement because the physical system exists in a superposition, quantum fuzziness, which is a spectrum of all its possible states simultaneously, the probabilities of which are described by a wavefunction. When a system is measured or observed (by a measurement apparatus, a camera or human being that becomes entangled with the observed system), it collapses to only one of the possible configurations. This is the standard interpretation of quantum mechanics, named the Copenhagen interpretation, and put forward by Niels Bohr and Werner Heisenberg during their collaboration in the 1920s in Copenhagen.

From the beginning of quantum theory, the concept of measurement proved a source of difficulties ("the measurement problem") which resulted from a conflict between several principles of the theory of measurement. In particular, the linear dynamics of quantum theory is in conflict with the postulate that during the measurement a non-linear collapse of the wave packet (a short 'burst' of localized wave action that travels as a unit) takes place. Because the process of the collapse of wavefunction cannot be observed directly, various interpretations of quantum mechanics strive to resolve the problem. To critique the Copenhagen interpretation and testify that, as Einstein said, "God doesn't play dice with the world," the EPR paradox (Einstein-Podolsky-Rosen paradox) and Schrödinger's cat paradox were designed.

The EPR paradox, also known as quantum entanglement, involves two particles that interact with each other and are afterward separated so that they apparently do not interact any more. Because the measured values of the first and second particle are related, after measuring the position or momentum of one of the particles, the observer can determine the value in the second particle. Then a measurement of the second value is made on the second particle, and on its basis this value can then be known in the first particle. This is so because a system has only one wavefunction and the properties of one subset of the whole are strongly correlated with properties of the other subset, no matter how far from each other they are located in space. The entangled particles communicate with each other faster than the speed of light, surpassing space and time. Quantum entanglement violates the uncertainty principle since both the position and momentum of the particles are known with certainty. The EPR paradox thus revealed a new consequence of quantum mechanics, dismissed by Einstein as unreasonable and therefore famously called "spooky action at a distance."

Schrödinger's cat thought experiment did not serve its purpose, either, as it actually supported what it aimed to disprove. The experiment illustrates the principle of superposition. A cat is locked in a box with a

device containing a phial of poison. If a quantum event, such as the decay of a radioactive atom takes place, a relay mechanism will trip a hammer, which will break the phial and kill the cat; if it doesn't, the cat will live. Because neither of the two possibilities has any reality until it is observed, the cat exists in an indeterminate state, both dead and alive simultaneously until the state reduction takes place.

The most serious alternative to the Copenhagen interpretation, though not unanimously accepted, is Everett's many-worlds interpretation of quantum mechanics, originally named "relative state formulation" by its creator Hugh Everett (1957).[39] The theory was popularized under the name "many-worlds" by Bryce Seligman DeWitt, who was Everett's supervisor. The interpretation assumes that the collapse of the wavefunction does not take place at all but the multiple possibilities continue to coexist. In the case of Schrödinger's cat, the world splits into two worlds and in one of them the cat is dead while in the other it is alive. There are, then, two versions of the observer and the cat. The totality of the infinite number of parallel universes comprising everything that exists is called multiverse. While in Copenhagen interpretation the collapse of the wavefunction is irreversible, in the many-worlds interpretation "[t]here is no intrinsically quantum mechanical arrow of time"; "the entire procedure is reversible – given the final state, we could use the Schrödinger equation to uniquely recover the original state."[40]

Sean Carroll labels the multiverse a "prediction," rather than a theory, and explains that "we predict on the basis of reasonable extrapolation of gravity and quantum field theory that a multiverse really should exist."[41] Unfortunately, this prediction is untestable. In the parallel realities one cannot interact with other quantum branches and is not even aware of them; to put it otherwise, the wavefunction appears to collapse although it doesn't. One explanation, not undisputed, is the phenomenon of decoherence which takes place when "the state of some small piece of the universe – your brain, for example – becomes so entangled with parts in

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[39] See Hugh Everett, *Theory of the Universal Wavefunction*, Ph.D. Thesis (Princeton University, 1956, 1973), 1-140. This theory is classified as 'Level III' (among IV) in the taxonomy of universes as provided by the cosmologist Max Tegmark. See his "Parallel Universes," *Scientific American*, 14 April 2003, 41-51, and his website <http://space.mit.edu/home/tegmark/crazy.html>. For a readable introduction to multiverse and the arguments for and against see Bernard Carr and George Ellis, "Universe or Multiverse," *Astronomy & Geophysics*, vol. 49, issue 2 (2008), 29-37.

[40] Carroll, *From Eternity to Here*, 250.

[41] Carroll, *From Eternity to Here*, 372.