UnQuantum Woolf: The Many Intellectual Contexts of To the Lighthouse's Metaphorical Wave-Particle Binary

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Abstract

This thesis is a sceptical investigation into the notion that the metaphorical wave-particle binary of Virginia Woolf's *To the Lighthouse* is related to quantum physics. Indeed, the field of literature and science has employed conceptual similarities as the main means of connecting quantum concepts to novels, however, this has led to a host of scholarly difficulties, prompting the need for a re-examination of analogical linkages. Woolf is the model candidate for such a re-examination, given her historical and philosophical proximity with the developments of quantum mechanics. *To the Lighthouse*, in particular, was written between 1925 and 1927: precisely when quantum physicists were attempting to resolve the wave-particle duality, leading to Niels Bohr's complementarity. This parallel has been noted by researchers as relevant to the novel, as it too displays a general binary that can be read as wave-particle-like, which the author also attempts to resolve along similar philosophical lines. Nevertheless, other than proximity and similarity, there are no reasons to affirm that the science is related to the novel; hence, it is an ideal case study to examine in order to ascertain the value of conceptual similarities in literature and science. To do so, *To the Lighthouse*'s binary and its resolution are interpreted in a thesis-long close reading, in order to compare aspects of it firstly to Woolf's personal thought, and secondly to various non-quantum intellectual contexts that preceded and surrounded her. In doing so, it becomes clear not only that invoking quantum physics serves no clear purpose in better understanding the novel, but also that the notion of resolving wave-particle-like binaries was a widespread philosophical procedure at the turn of the century, decades before Bohr's concept. This negative conclusion interrogates what the scholarly value of interpreting similarities is, though a hypothetical solution can be found in conceptual metaphor theory.

Table of Contents

Chapter 1 - Introduction

Discovering quantum physics can undeniably be exciting. Natural science tends to be viewed naïvely as a drab affair, as it unpoetically formulates a series of sterile objective facts about the material nature of a fixed and indifferent causal universe, without any consideration for human interiority. Such an impression is easy to arrive at, due to the historical and philosophical impact of Newtonian physics, amongst other cultural, educational and political factors.[1] This explains why quantum theory can be so stimulating to explore:[2] its inherent randomness seems to contradict the strict determinism of the "clockwork universe"; it seems to state that the fundamental nature of reality is fuzzy, mysterious, and contrary to common-sense; it seems to take into account the human act of perception in its theorisation; it seems to set foundational limits on knowledge; it seems to allow for impossible behaviours, such as being in two places at once, traversing walls, or faster-than-light connection; and the lack of an institutionally agreed-upon interpretation seems to allow for surprising worldviews, such as the multiverse or the collapsing of realities.[3] Quantum theory, then, can be excitingly perceived as undermining the foundations of traditional science, as well as proposing radical conceptions that imply innovative philosophical consequences, which would previously have been considered anti-scientific or even anti-Enlightenment.

Given this, it is no surprise that many literary scholars have adopted quantum theory as a vehicle for analysis: not only does it contradict a scientific culture and philosophy which has undermined the prominence of literary knowledge and the humanities in history, but its many innovations and implications can also be employed as interdisciplinary interpretative tools, in order to discover rousing new connections between literature and science. Hence, a sizable

[1] See: Ernst Cassirer, (1951), *The Philosophy of the Enlightenment*, translated by Fritz C. A. Koelln and James P. Pettegrove, Princeton, Princeton University Press, 2009. 'the kind of veneration which Newton enjoys in the thinking of the Enlightenment. Thanks to Newton, it believed it stood finally on firm ground which could never again be shaken [...] we must not project our own ideas and subjective imaginings into nature; we must rather follow nature's own course and determine it by observation and experiment, by measurement and calculation. [...] They originate in those universal functions of comparing and counting, of combining and differentiating, which constitute the nature of the intellect'. 44.

[2] The repetition of "seems" in the list is deliberate: these implications only *seem* to emerge out of the science; *they do not portray the field accurately*.

[3] See: Maximilian Schlosshauer, Johannes Kofler, and Anton Zeilinger, "A snapshot of foundational attitudes toward quantum mechanics", in *Studies in History and Philosophy of Modern Physics*, no. 44, 2013. Thirty-three participants at a conference on the foundations of quantum mechanics were polled regarding their preferred interpretations, and no consensus on any picture of reality was reached.

portion of the books, chapters and articles that connect quantum theory and literature scarcely veil the magnitude of their ambition: the uncovered links are not merely cases of science influencing authors, but the sign of a profound shift in humanity's fundamental understanding of the nature of reality, leading to wide-ranging implications for culture, art or philosophy.[4] Literary scholars have only been slowly investigating these connections for the last three to four decades, therefore the field is ripe for new findings, which adds to the underlying enthusiasm obvious in the many studies to be discussed.

However, this drive towards fresh conceptualisations conceals an inconvenient truth: there are not yet any agreed-upon procedures or theories to connect quantum physics and literature together in a manner that would be academically productive; historically valid; scientifically accurate; interpretatively precise; and leading to demonstrable conclusions. Indeed, there is not even an agreed-upon vision of what the nature of the connections between literature and quantum physics actually *are* – if there are any to begin with, beyond the interpretation of analogical similarities. This leads to a situation where the many quantum analyses of literature do not yet cohere into a harmonious field, resulting instead in a variety of conceptions of a variety of connections within a variety of methodological frameworks. Due to this, the laudable desire to tie the novelty of quantum theory to literature in order to reach unprecedented interdisciplinary ideas is threatened; the original excitement in the field turns to overwhelming conceptual confusion.

The best example of this is the increasingly notorious case of Virginia Woolf and quantum theory. It seemed like an active and innovative, yet fringe and underdeveloped, topic of research when the idea for this thesis was first conceived. But now, a half-decade later, the field feels more akin to a problematic *cliché* with unclear validity. It is very much a microcosm of the general situation of literature and quantum mechanics, which justifies – amongst other reasons that will progressively emerge – the focus on Woolf that this study will adopt. The year 2018 alone saw the publication of Morag Shiach's "Woolf's Atom"; Rachel Crossland's *Modernist Physics*; Jennifer Burwell's *Quantum Language*; and Catriona Livingstone's

[4] See, for instance: Samuel Chase Coale, *Quirks of the Quantum: Postmodernism and Contemporary American Fiction*, Charlottesville, University of Virginia Press, 2012. 'Quantum theory, however, reveals more than ambiguity and contradiction. It creates a world so uncertain and entangled that its very ontological basis appears elusive, strange, weird, and eerie. [...] we need to broaden our range and conceptions in order to pursue a process of possibilities and entanglement as opposed to a product of well-balanced ambiguities and contradictions. The transition requires a major rethinking in how we approach literary text'. 201.

"Experiential Identities"[5] – an article presenting a notion from Livingstone's PhD thesis on Woolf and quantum science submitted the same year.[6] Luckily, these publications not only discuss possible ties between the author and the science, they are also critical re-examinations of the topic itself. Indeed, the general problem sketched above is in the process of being wholly recognised and investigated in literature and science. This, in addition to the fact that the present thesis too was conceived as a needed critical evaluation of cross-disciplinary analogies, demonstrates that research into the relationship between quantum mechanics and literature – quantum theory and Woolf in particular – has reached an inflection point: many of the underlying issues can no longer be hand-waved away, they must be tackled head-on if the research is to continue with credibility.

The present thesis fits squarely within this academic reconsideration. It will embrace a sceptical perspective regarding literature and science: instead of substantiating connections and the methodological frameworks that give them meaning, these will instead be interrogated in order to lay bare the misapprehensions they can lead to. The goal is not to delegitimise the study of Woolf and quantum physics, but to unearth, within the numerous problems to be discussed, the most valid, productive, and diligent conceptualisations that bring the author and the science together in fruitful and persuasive ways.

However, the study of literature and quantum physics is predominately associated with the postmodern era, rather than Woolf's high modernist period. This introduction will hence first establish some general observations regarding how literature and quantum physics tend to be studied together within literary studies, in order to then display why Woolf has become so relevant to the field. This will unveil some overarching issues that will run through the whole study, and hence determine the direction to be taken.

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[5] Morag Shiach, "Woolf's Atom, Eliot's Catalyst and Richardson's Waves of Light: Science and Modernism in 1919", in *Being Modern: The Cultural Impact of Science in the Early Twentieth Century*, ed. Robert Bud, et al., London, UCL Press, 2018. Rachel Crossland, *Modernist Physics: Waves, Particles, and Relativities in the Writings of Virginia Woolf and D.H. Lawrence*, Oxford, Oxford University Press, 2018. Jennifer Burwell, *Quantum Language and the Migration of Scientific Concepts*, Cambridge, Massachusetts, The MIT Press, 2018. Catriona Livingstone, "Experimental Identities: Quantum Physics in Popular Science Writing and Virginia Woolf's The Waves", in *Journal of Literature and Science,* 11, no. 1, 2018.

[6] Livingstone's 2018 thesis from King's College London was inaccessible throughout the writing of this study. It was published in 2022 as a book, however, this occurred in the final weeks before this thesis' submission. Therefore, neither of Livingstone's publications will be included, though they are certainly very relevant. Catriona Livingstone, *Virginia Woolf, Science, Radio, and Identity*, Cambridge, Cambridge University Press, 2022.

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A/ Before Modernism: Postmodernism

The postmodern has many definitions. It can be thought of as an academic culture tied to poststructuralist methodologies, or as a trend in art history, or as the characterisation of a cultural moment. However, in the current context – for reasons that will become obvious – the differences between definitions are irrelevant. What is relevant is that the general qualities postmodernism displays, in any form it takes, seem to align with the general qualities of quantum mechanics. This analogical alignment allows for productive connections between both fields. For instance, Burwell's critical evaluation of "quantum analyses" in literary studies explains how academic postmodernism embraced quantum theory as a consequence of this conceptual alignment:

> In the 1980s, quantum theory emerged as an analytic tool [...] to add credence to a literary criticism influenced by the philosophical priorities of poststructuralism: the rejection of Western logos, the rejection of the subject/object duality, the decentering of author and authority, and the disruption of the relationship between signifier and signified[7]

Burwell presents the areas of conceptual overlap between the two fields as a list of philosophical consequences common to the two. In doing so, she is following the lead of many studies of postmodernism and the quantum, such as Susan Strehle's 1992 *Fiction in the Quantum Universe*, whose introduction aims to establish that:

> fiction and contemporary physics join, I propose, in seeing the external world and the human relation to it as:
>
> discontinuous
> statistical
> energetic
> relative
> subjective
> uncertain[8]

This is the clearest case of a scholar making such a list, but Strehle is not alone in enumerating similar-looking concepts. Samuel Chase Coale's *Quirks of the Quantum*, while published

[7] Burwell, *Quantum Language*. 125.

[8] Susan Strehle, *Fiction in the Quantum Universe*, North Carolina, University of North Carolina Press, 2000. 8. Strehle's study does not directly deal with postmodern literature, she instead calls it 'actualistic fiction' on the same page. This difference will be discussed soon.

twenty years after Strehle's book, also aims to study postmodern novels with quantum physics as an analytical tool, and also begins by establishing philosophical overlaps:

> The unknowability of an elusive fluid world, the unknowability or perilous existence of a self within that world, the self's being mysteriously embedded and entangled in a realm of ultimate randomness and accident, the uncertainty of all representations of that world, the murkiness of consciousness itself, and the creation of discontinuous, fragmented, and disrupted fictional structures and plots that reflect that vision underscore the basic patterns and narrative trajectories of much postmodernist fiction[9]

A clearer list of connections can be found in Serpil Opperman's overview of quantum physics and literature's intersections, when he affirms that 'Quantum concepts of complementarity, uncertainty, non-locality, entanglement, to name a few, are among the interlinked conceptions of humanistic and scientific knowledge practices, constituting a space of "intermediation" between the two'.[10] In Robert Grease and Alfred Goldhaber's survey of quantum theory's effects on culture, *The Quantum Moment*, each chapter explores a quantum concept that also defines aspects of contemporary life and art. Examples include 'Quantum Leaps', 'Randomness', 'Matter of Identity', 'Uncertainty' or 'Reality Fractured'.[11] Opperman's earlier use of 'intermediation' was borrowed from N. Katherine Hayles.[12] She is amongst the foremost critics to analyse postmodern concerns from the perspectives of modern physics, mathematics or technology, and a final example of list-making to connect the quantum and postmodern worlds in *The Cosmic Web*: 'its fluid, dynamic nature, the inclusion of the observer, the absence of detachable parts and the mutuality of component interactions. The concept is very different from the older paradigm implicit in Newtonian dynamics'.[13]

Hayles's last sentence is the justification why the many lists are relevant beyond curiosity: they signal an extremely similar philosophical move away from the naïve realism of Newtonian atomistic materialism, occurring within the same broad time and place, in literature, culture, and science – a similarity *so* compelling that the lists *must* be the sign of genuine

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[9] Coale, *Quirks of the Quantum*. 39.

[10] Sepil Opperman, "Quantum Physics and Literature: How They Meet the Universe Halfway", in *Anglia: Journal of English Philosophy,* 133, no. 1, 2015. 89.

[11] Robert P. Crease and Alfred S. Goldhaber, *The Quantum Moment: How Planck, Bohr, Einstein, and Schrödinger Taught Us To Love Uncertainty*, New York, W.W. Norton & Company, 2014. Chapters 3; 4; 5; 7; and 8 respectively.

[12] From: N. Katherine Hayles, *My Mother Was A Computer*, Chicago, The University of Chicago Press, 2005.

[13] N. Katherine Hayles, *The Cosmic Web*, New York, Cornell University Press, 1984. Hayles is here referring to her "field concept", to be defined soon. However, for the present discussion's purposes, there are no relevant differences between it and the current broad understanding of postmodernism.

connection, hence the possibility of coincidence is never discussed. Strehle is more explicit: 'Each of these terms [*from her list*] reflects a major transformation of the assumptions basic to the Newtonian/realistic paradigm'.[14] Coale even cites Hayles early in his book to justify a similar causal connection:

> Katherine Hayles would agree: "Quantum theory … has helped create postmodern consciousness … postmodern texts by such writers as Pynchon … … and DeLillo finally do alter our culture's relationship to reality". Hayles's comment on the creation of a postmodern consciousness, linked to quantum theories, underscores the overall thesis of this book[15]

The connection is therefore assumed to be an overarching paradigm shift: science is embedded in culture, so when the former goes through a foundational change, the latter will also be affected, and this will be identifiable within literature.[16] Consequently, when the physics of the early-20th century was revolutionised by the advent of quantum mechanics, breaking away from the Newtonian paradigm, the surrounding culture and literature equally shifted away from the paradigm attached to Isaac Newton's legacy – traditional realism – leading to literary postmodernism. This is the reason why the differences between postmodernism in literature, academia, or culture are not here relevant: they are all part of the same shift prompted by physics, hence they all contain extremely similar philosophical conceptualisations, which are strong enough to eclipse the differences between various flavours of postmodernism.

Henceforth, the many concepts that appear in all the above lists, which are conceived of by these scholars as evidence of an overarching paradigm shift in culture, art and physics, will be referred to as "quantum-concepts". It should be noted that they are to be called this because they are quantum-*sounding*, and tend to align with the *perceived* philosophical consequences of the science, not because they truly are relevant to quantum physicists and their work. Indeed, the field of quantum physics and literature has the specificity of being entirely uninterested in the day-to-day experimental and mathematical activities of physicists, the actual substance of the science, or the overall state of the discipline: what is taken from quantum theory as a source of connection is almost exclusively its philosophical consequences writ large

[14] Strehle, *Fiction in the Quantum Universe*. 8.

[15] Coale, *Quirks of the Quantum*. 7. Coale's citation will be discussed in depth soon, for though he attributes it to Hayles, it is actually from: David Porush, "Fictions as Dissipative Structures: Priogogine's Theory and Postmodernism's Roadshow", in *Chaos and Order: Complex Dynamics in Literature and Science*, ed. N. Katherine Hayles, Chicago, The University of Chicago Press, 1991. 79.

[16] This is an oversimplification: there are equally many scholars who argue for the reverse movement – a shift in culture creates a shift in science – or that both fields are coequal participants without one directly influencing the other, amongst other viewpoints. These nuances will emerge as the conversation progresses.

(and the history that led to them), usually understood via popularisations of the science. Due to this exclusive focus on conceptual similarity, it is possible to discuss quantum-concepts in literature written *before* quantum physics' emergence, as will become pertinent with Woolf. Another slight consequence of this exclusive focus is that quantum-concepts are to be considered analogies (parallels between two different domains that enable comparisons) rather than metaphors (clarifications of one domain by means of its similarities to another), though this amounts to a distinction without a difference in most literature and science. To synthesise the studies discussed above, quantum physics and the postmodern both conceive of reality, and the human relation to it, as defined by the following anti-Newtonian quantum-concepts: *beyond human knowledge*; *observer-dependent*; *uncertain*; *discontinuous*; *dynamically holistic*; and *complementarily contradictory*.

There are objections to be levelled against this quantum-postmodern narrative, notably: 'the most persistent points of contention in the discussion of science and literature is the question of influence' – an uncontroversial sentence from Dirk Vanderbeke's summary of physics and literature studies.[17] This topic, and the academic frameworks it leads to, will be addressed during the next chapter's literature review. Here, however, another important issue, specific to the postmodern side of the conversation, deserves attention: literature *versus* science. Again, Burwell summarises the situation: in 'the 1990s and then the 21st century, applying quantum physics to literary analysis [...] offered a potential solution to the increasing marginalisation of the humanities and the growing economic clout of the sciences'.[18] This, in addition to the “Two Cultures” debate that had animated academia in the previous decades,[19] generated a contentious division between both fields that is best illustrated with George Levine's *One Culture* collection of essays from 1987, a pioneering publication in the field of literature and science. Levine's introduction formulates a laudable ambition: 'it is possible and fruitful to understand how literature and science are mutually shaped by their participation in the culture at large – in the intellectual, moral, aesthetic, social economic, and political

[17] Dirk Vanderbeke, "Physics", in *The Routledge Companion to Literature and Science*, ed. Bruce Clarke and Manuella Rossini, London, Routledge, 2011. 196.

[18] Burwell, *Quantum Language*. 125.

[19] C.P. Snow, (1959), *The Two Cultures*, Cambridge, Cambridge University Press, 1993. 'The non-scientists have a rooted impression that the scientists are shallowly optimistic, unaware of man's condition. On the other hand, the scientists believe that the literary intellectuals are [...] in a deep sense anti-intellectual'. 5. This published lecture by C.P. Snow, as well as the 1956 article in *The New Stateman* that prompted it, were widely debated within and without academia, by scientists and humanities scholars alike.

communities which both generate and take their shape from them'.[20] This is fully consistent with the program set out by G.S. Rousseau's 1978 foundational essay that birthed modern literature and science studies, and many of its underlying assumptions.[21] However, to fulfil his ambition of overriding the "two cultures" divide, Levine sets down troubling assumptions:

> This volume [...] recognizes that developments in science are closely related to developments in the culture at large. Thus it builds on the assumption that science does not make "universal" statements, that its discourse is as historical as that of literature [...] It proceeds then by accepting the demystification of science that has been so much the object of antipositivist philosophy [...] Science is socially constituted; knowledge is culturally constituted[22]

To conceptualise science as an equal participant to literature in culture then, Levine finds it necessary to reduce scientific activity to a discourse, which is equally as constructed, historical, and culturally-dependent as literature – and hence possessing no privileged claim to truth.[23] Hayles, in her own article in *One Culture*, agrees: 'studies in literature and science have assumed that scientific concepts have "influenced" writers, [...] this methodology [...] assumes that "influence" flows from science to literature, it necessarily implies that science occupies a privileged position within the culture'.[24] In fact, this antipositivistic resistance to science as primary features throughout much of Hayles's work, such as in 2011: 'that influence flows from

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[20] George Levine, "Introduction", in *One Culture: Essays in Science and Literature*, ed. George Levine, Madison, University of Wisconsin Press, 1987. 5-6.

[21] G.S. Rousseau, "Literature and Science: The State of the Field", in *Isis,* 69, no. 4, 1978. 'literature and science affect each other reciprocally. That is, that each influences the other in just about the same degree, [...] Literary scholars are understandably far more concerned about literature than about science, and most applied scientists as well as historians of science have not seriously considered the possibility that literature has shaped or can shape scientific developments. The latter is an unexplored territory, probably the one in greatest need of cultivation right now'. 587. This article was written largely as a reaction against the science-to-literature direct influence studies exemplified by Marjorie Nicholson, and, as a result, opened the door to the indirect poststructuralist literature and science studies of the 1980s and 1990s currently being discussed. These embrace antipositivistic notions (paradigm-relativism; metaphorical modelling; science studies; social constructivism; language games...) as a means of fulfilling Rousseau's 'need of cultivation'.

[22] Levine, "Introduction". 25-6.

[23] While the current discussion focuses specifically on *One Culture* and Hayles, it should be noted that such antipositivism was widespread in literature and science throughout the 1980s and 1990s, particularly in the United States. For instance, see Paisley Livingstone's 1988 response to what he terms 'framework relativism' in literary theory: 'a notion that reappears frequently in literary debates, namely, the idea that the "knowledges" produced by science have no truth other than that bestowed upon them by their own autonomous frameworks [...] Freed from the illusion of a normative model of knowledge, literary critics can go on playing the game of interpretation, confident in the knowledge that their activity is one bundle of relativistic "language games" among others. Is this merely a caricature of contemporary literary theory? I think not, for it can be shown that any number of prominent literary thinkers ascribe to this sort of position'. Paisley Livingstone, *Literary Knowledge: Humanistic Inquiry and the Philosophy of Science*, Ithaca, Cornell University Press, 1988. 23-4.

[24] N. Katherine Hayles, "Information or Noise? Economy of Explanation in Barthe's S/Z and Shannon's Information Theory", in *One Culture: Essays in Science and Literature*, ed. George Levine, Madison, University of Wisconsin Press, 1987. 119.

science to literature implicitly valorises science as the source of truth to which literature responds. Such an approach ignores the ways in which scientific theories, no less than literary theories and literature, are social constructions'.[25] Even *The Cosmic Web*'s methodology is explicitly constructed so as to prevent a perceived valorisation of physics over art, by stressing that influence is not a factor, and that both fields are to be conceived as equal:[26]

> A more accurate and appropriate model for such parallel developments would be a field notion of culture, a societal matrix which consists (in Whitehead's phrase) of a "climate of opinion" [...] Such a field theory of culture has yet to be definitely articulated [...] It would, for example, [...] demonstrate that it is this climate, rather than direct borrowing or transmission, that is the underlying force guiding intellectual inquiry. This climate would be, of course, as capable of influencing scientific inquiry [...] we not to be misled by a causal perspective into thinking of correspondences between disciplines as one-way exchanges, for example, by asserting that the change in scientific paradigms caused a shift in literary form. In a field model, the interactions are always mutual: the cultural matrix guides individual inquiry at the same time that the inquiry helps to form, or transform, the matrix
>
> well-known developments in the modern novel are part of a larger paradigm shift within the culture to the field concept. Rather than attempt this history, I have assumed it by locating a group of representative novels

This 'field concept' is, to Hayles, the main philosophical notion that defines the culture towards which the overarching paradigm shift led, which equally affected, and was affected by, science as well as literature, allowing for the all-important balance of influence. It 'draws from many different models those features that are isomorphic, and hence that are characteristic of 20th-century thought in general'.[27] Of course, these 'isomorphic features' are the quantum-concepts discussed earlier, which is the reason why Hayles's book was included in the same group of quantum-postmodern studies earlier, though her conception of influence is drastically different. By discussing the 'field concept' instead of the relation of physics to literature outright, Hayles is justified in considering science as a mere participant within the culture, instead of a direct actor upon it due to its “superior” objectivity. However, this causes difficulties. One is visible above, when 'Rather than attempt this history, I have assumed it'. Methodologically, this is a stark acknowledgment of vagueness, as her book is founded upon an unproven, and 'yet to be definitely articulated' *assumption* that there exists a widespread and openly-defined cultural concept affecting 'twentieth-century thought in general'. The reason for this vagueness is the

[25] N. Katherine Hayles, "Chaos as Orderly Disorder: Shifting Ground in Contemporary Literature and Science", in *New Literary History,* 20, no. 3, 2011. 317.

[26] Hayles, *Cosmic Web*. 22-3 & 24.

[27] Ibid. 9.

concept's nature: 'The only way to approach a satisfactory understanding of the field concept is to examine and compare a wide range of phenomena that embody it',[28] which implies studying the near-entirety of the affected culture; an unachievable project for even the most ambitious of academics – provided that the unexamined hypothesis behind the field concept is correct to begin with. This situation makes clear that Hayles's hazy concept leads to an equally hazy methodology, entirely due to her dogmatic refusal to consider science as anything more than a coequal cultural discourse, which prohibits discussions of influence. Additionally, this refusal was partially motivated, not by research or evidence, but by the cultural context of poststructuralist antipositivism, caused in part by local economic and political forces affecting academia, which further reduces the applicability of her procedures beyond such restricted concerns.[29]

This type of scholarly creed and procedure is part of what Alain Sokal and Jean Bricmont criticise in their 1997 *Fashionable Nonsense* tome.[30] It expands on their takeaways from the infamous "science wars" debacle, that followed the publication of Sokal's hoax paper in *Social Text* the previous year. This is relevant here because the parody presents itself, on the surface, as validating a one-culture-like *rapprochement* between postmodern philosophies and contemporary physics ('postmodern sciences'), in a manner that is indistinguishable from Strehle, Coale, Hayles, Opperman, or Grease and Goldhaber's earlier listings of quantum-concepts:

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[28] Ibid.

[29] Moreover, her writings on scientific theories sometimes betray an imprecise understanding of them, which leads to an equally imprecise conception of the relations of science and literature. This is visible in her work on chaos theory, as evidenced by Carl Matheson and Evan Kirchhoff's evaluation of the theory's use in literary studies: 'it appears that most, if not all, applications of chaos theory to literature are flawed for a number of reasons. First, chaos theory does not constitute a scientific revolution of sufficient magnitude to effect wholesale changes in our conceptual scheme. Second, the similarities between chaos theory and modern critical theory are few and vague. Third, the applications of chaos theory to specific works of literature have been forced and unilluminating'. Carl Matheson and Evan Kirchhoff, "Chaos and Literature", in *Philosophy and Literature,* 21, no. 1, 1997. 43. For their discussion of Hayles specifically, see 32-8. Another later overview of chaos theory and literature by Merja Polvinen reaches the same conclusion: 'theorists and critics working with chaos theory and literature have declared, with very little actual evidence, that chaos theory is the next universal explanatory model'. Merja Polvinen, "The ends of metaphor: Literary analysis and chaos theory", in *European Journal of English Studies,* 11, no. 3, 2007. 281-2.

[30] Their conclusion on the misunderstandings of chaos theory from humanities scholars, due to their fuzzy definition of the concept, can be applied to Hayles's work on the subject, consistently with Matheson and Kirchoff's own criticisms: 'another abuse arises from confusing (intentionally or not) the numerous distinct meanings of the highly evocative word "chaos": its technical meaning in the mathematical theory of nonlinear dynamics – where it is roughly (though not exactly) synonymous with "sensitive dependence on initial conditions" – and its wider senses in sociology, politics, history and theology, where it is frequently taken as a synonym for disorder'. Alan Sokal and Jean Bricmont, *Fashionable Nonsense: Postmodern Intellectual's Abuse of Science*, New York, Picador, 1998. 146.

> One characteristic of the emerging postmodern science is its stress on nonlinearity and discontinuity [...]
> Secondly, the postmodern sciences deconstruct and transcend the Cartesian metaphysical distinctions between humankind and Nature, observer and observed, Subject and Object. Already quantum mechanics, earlier in this century, shattered the ingenuous Newtonian faith [...]
> Thirdly, the postmodern sciences overthrow the static ontological categories and hierarchies characteristic of modernist science. In place of atomism and reductionism, the new sciences stress the dynamic web of relationships between the whole and the part; [...] the postmodern sciences appear to be converging on a new epistemological paradigm [...]
> A fourth aspect of postmodern science is its self-conscious stress on symbolism and representation. As Robert Markley points out, the postmodern sciences are increasingly transgressing disciplinary boundaries, taking on characteristics that had heretofore been the province of the humanities[31]

This citation contains all the quantum-concepts already synthetised thus far, with the same arguments behind them – to the point that, in the current context, it is unclear how to discern the above passage's parodic nature. It lists the same concepts as evidence of connection; it accepts the anti-Newtonian paradigm shift as the source of philosophical innovations; it advances the hypothesis of a widespread 'new epistemological paradigm' to connect different fields; and it ends on a coequal valuing of the humanities and science within the narrative. The fact that these ideas appear in a parody paper from a physicist is not reason enough to consider them invalid, as Sokal and Bricmont themselves admit in their commentary:

> This section combines gross confusions about science with exceedingly sloppy thinking about philosophy and politics. Nevertheless, it also contains some ideas [...] with which we partly agree, at least when these ideas are formulated more carefully. *We do not want the parody to provoke unqualified derision toward these ideas*[32]

Nevertheless, the affair demonstrates that comparing similar concepts in order to validate a merely "assumed" field-like conceptualisation of science and culture cannot be accepted at face-value. This is a fact already discussed by Alice Jenkins in her critical work on Victorianism and physics:

> literature and science studies sometimes fails to think of analogizing as a process at all, instead viewing it as an outcome in itself. The problem here is that when we see an analogy as providing evidence of a meaningful relationship between two texts, we have comparatively limited means of accounting for that relationship [...] an analogy might prompt us to look for a source of the similarity between two texts in a direct or indirect influence of

[31] Alan Sokal, "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity", in *Social Text,* 46/47, 1996. 227-8.

[32] Sokal and Bricmont, *Fashionable Nonsense*. 265. Emphasis added.

> the one on the other, or a third text or group of texts which is a source of influence on them both. [...]
> However, mapping direct or indirect influence of one text on another is not always possible, [...] Referring the connection to the zeitgeist won't do [...] we also need to go back a step in the process and develop better understandings of analogies and similarities in our primary texts and the cultural field surrounding them[33]

The '*zeitgeist*' notion that 'won't do', while usually defined as "spirit of the times", is in this context synonymous with Hayles and Whitehead's 'climate of opinion', an essential factor of the 'field concept'. Nicola Luckhurst also commented in 2000 that such "field" or "matrix" models are not substantially different from vague *zeitgeist* conceptualisations: 'the account is structured by considering connections through a field, rather than by way of direct causality. At this point, however, "field" begins to sound suspiciously like "Zeitgeist" creeping back in scientific guise'.[34] A year later, Michael Whitworth's discussion of the topic noted that mere *zeitgeist* approaches are incomplete without accounting for how contents are materially propagated within them, for indeed 'we cannot assume that an entire society would have been saturated uniformly in the new knowledge',[35] therefore 'a generalized *zeitgeist* [...] never informed the work of any individual'.[36] Yet, this is precisely Hayles's approach.

Hence, a manifest conclusion: *the prescription that science should never be perceived as having been put in a privileged position over literature can safely be ignored*. Firstly, because in Hayles it has shown itself to be more problematic than useful, as it causes a need to "assume" a large-scale, international, and trans-disciplinary socio-historical phenomenon without any evidence, other than a loose handful of implicit analogies. Secondly, because it has not achieved its own stated goal: Sokal's criticisms arguably devalued the humanities' reputation more than quantum science itself ever could.[37] Finally, and more controversially, because it is incorrect. One does not need to engage in elaborate philosophy of science conversations to accept that the field of physics – even if imperfectly, tentatively, and through

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[33] Alice Jenkins, "Beyond Two Cultures: Science, Literature, and Disciplinary Boundaries", in *The Oxford Handbook of Victorian Literary Culture*, ed. Juliet John, Oxford, Oxford University Press, 2016. 413.

[34] Nicola Luckhurst, *Science and Structure in Proust's À la recherche du temps perdu*, Oxford, Clarendon Press, 2000. 69.

[35] Michael Whitworth, *Einstein's Wake: Relativity, Metaphor, and Modernist Literature*, Oxford, Oxford University Press, 2001. 18.

[36] Ibid. 19.

[37] See: Sarah Dillon, "On the Influence of Literature on Science", in *Configurations,* 26, no. 3, 2018. 'the influence model [...] is implicated in positioning science as the dominant discourse. Models of commonality, in contrast, are thought to level the playing field. [...] In reality, however, it did not. In terms of opening up dialogue between the two cultures, it had the opposite effect: it put scientists not just on their guard but on the attack'. 313.

the relative and distorting prisms of human language, constructs, choices, frameworks, and economic or ideological priorities – does contain *some* claim to truth, in a way that is patently absurd to equally assign to literature, as art possesses no comparable means for empirical testing or falsification.[38] One can take on board the nuanced lessons from poststructural investigations into scientific methodology, practice and ideology, which have done much to temper the field's naïvely-perceived objectivity, without adhering to the overly-extreme conclusion that science's results are equally as constructed as artistic knowledge.[39] Vanderbeke's discussion of Hayles agrees:

> With due respect to a scholar of renown, it needs to be pointed out that while scientists strive for independence from external influences, authors actively seek input from all possible sources, and both would fail miserably if there was a balance of influences. Literature responds to developments in art, music, philosophy, the movies, esotericism, and even pornography, yet none of these is automatically elevated to a "source of truth". Literature is not an empty vessel into which external truth can be poured but rather a predator, searching for suitable matter which it can transform for its own purposes, frequently beyond recognition. This is particularly true for literature's relation to the complex and non-intuitive findings of modern physics[40]

These are rudimentary observations, but are nevertheless relevant in this context: to equalise literature and physics as mere cultural discourses with an equivalent claim to truth is to wilfully

[38] The best illustration of this is Bruno Latour, one of the most important influences on the antipositivism of literature and science in the United States and beyond, due to his sociological work on laboratory practice that heavily pointed towards the constructivism of scientific objectivity. Following the "science wars", and the existential threat of climate change revealed by science, Latour has increasingly attempted to re-evaluate and re-define the tension between objectivity and constructivism in scientific practice, in order to avoid the political risks of antipositivism: 'we spent years trying to detect the real prejudices hidden behind the appearance of objective statements, do we now have to reveal the real objective and incontrovertible facts hidden behind the illusion of prejudices? And yet [...] [*post-graduate-level*] kids are learning the hard way that facts are made up, that there is no such thing as natural, unmediated, unbiased access to truth, that we are always prisoners of language, that we always speak from a particular standpoint, and so on, while dangerous extremists are using the very same argument of social construction to destroy hard-won evidence that could save our lives. [...] what were we really after when we were so intent on showing the social construction of scientific facts? Nothing guarantees, after all, that we should be right all the time'. Bruno Latour, "Why has Critique Run Out of Steam? From Matters of Fact to Matters of Concern", in *Critical Inquiry,* 30, 2004. 227. See also: Jay A. Labinger, "Where are the Scientists in Literature and Science?", in *Journal of Literature and Science,* 10, no. 1, 2017. 'it must be acknowledged that some of those scientists who *have* paid attention to science-humanities relationships have taken a very negative stance'. 66.

[39] Such drastic devaluations of scientific knowledge are straightforwardly stated in deconstructive accounts of science. For example: 'the sociology of knowledge joins with the lovely and nasty tools of semiology and deconstruction to insist on the rhetorical nature of truth, including scientific truth. [...] science is a contestable text and a power field; the content is the form. Period. [...] We unmasked the doctrines of objectivity because they threatened our budding sense of collective historical subjectivity and agency and our "embodied" accounts of the truth, and we ended up with one more excuse for not learning any post-Newtonian physics [...]. They're just texts anyway, so let the boys have them'. Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective", in *Feminist Studies,* 14, no. 3, 1988. 577-8.

[40] Vanderbeke, "Physics". 197.

misunderstand the basic functions, procedures, and goals of each discipline.[41] It is patently obvious that literature is welcoming of, and dependent on, a wide array of humanly-constructed influences, while the methodologies of science are designed with the *precisely* opposite goal of minimising these influences as much as is possible.[42] Furthermore, as literature can potentially respond to anything within its own context of production and beyond, then obviously science can be one of its influences – including in a one-way manner. Pretending that these facts are not the case, even for the laudable motivation of valorising the field of literary studies, is to put ideology over reality – and it is hence unsurprising that the reality which *The Cosmic Web* investigates is *assumed* instead of *demonstrated*.

While Strehle and Coale's books view physics as an influencer *on* culture and literature, unlike Hayles, preventing similar anti-scientific issues, their methodologies and analyses nevertheless come up short. Firstly, Coale's earlier citation already casts doubt on his academic rigour. '"Quantum theory … has helped create postmodern consciousness … postmodern texts by such writers as Pynchon … … and DeLillo finally do alter our culture's relationship to reality"' is how Coale presents 'Hayles' comment on the creation of a postmodern consciousness, linked to quantum theories', found in 1991's *Chaos and Order*. However, this volume is a collection of essays edited by Hayles, which Coale missed, as he is here citing David Porush's article, not Hayles herself.[43] Furthermore, Coale's citation links together two unrelated sentences from Porush, with an entire paragraph separating them. Additionally, the citation comes at the end of the essay, as a concluding curiosity and not a thesis statement,

[41] It is revealing that when individuals who have performed scientific work are faced with such theorisations, the result is typically a confounding incredulity, such as in the case in Livingstone: 'I was at one point an avid student of chemistry, I decided quite some time ago that my interests lay [...] [*in*] the world of humanity. Thus it is not as the result of some scientist's *parti pris* that I am dismayed by the absurd statements about science I have heard, on a regular basis, in the literary seminar room. These statements range from subtle but perverse argumentations to the rather blunt and pathetic "science is just rhetoric too," but the thrust is always the same [...]. I contend that literary critics should recognize that the basic scientific project is not reducible to scientism, or to a group of arbitrary worldviews – as the sterile opposition between positivists and relativists would have it'. Livingstone, *Literary Knowledge*. 4.

[42] Indeed, one of the consequences of the Sokal affair was an increased attempt in literature and science studies to theorise the differences between the two fields, instead of dogmatically insisting on their discursive commonalities, or the "one culture". The best example of this is none other than Levine himself in his 2008 collection of essays, particularly Part II Chapter 6: George Levine, "Why science isn't literature: the importance of differences", in *Realism, Ethics and Secularism: Essays on Victorian Literature and Science*, ed. George Levine, Cambridge, Cambridge University Press, 2008. 165-81. See also: George Levine, "Science and Victorian Literature: A Personal Retrospective", in *Journal of Victorian Culture,* 12, no. 1, 2007. 'As much as the equipment that helps us read *Middlemarch* can help us read Darwin, and as much as Darwin's way of imagining the world might be confluent with George Eliot's, in the end they are different activities, with different objectives'. 95. For a more general overview of this shift towards differentiation, see: Martin Willis, *Literature and Science: A Reader's Guide to Essential Criticism*, London, Palgrave Macmillan, 2015. 'Contemporary Positions', 8-10.

[43] Porush, "Fictions as Dissipative Structures". 79.

which, moreover, Porush seems to disagree with on the same page: 'In fact, it [*postmodern literature*] has continued to receive succor, (I believe mistakenly) from quantum theory itself'. This sentence ends with a footnote explaining why Porush does not believe that the breakdown of the observer-observed dichotomy in quantum theory is significant to literature – even though Coale is defending the exact opposite point.[44] Finally, had Coale understood Hayles's writing on literature and science, he would know that she would never advance the idea that science influenced literature, as a significant amount of her work negates that very claim. Yet, he introduces his piecemeal and fallacious citation of Porush with 'Hayles would agree'. The amount of errors Coale commits here would already make his work disqualifying, however, this is a minor offense compared to his pronounced misunderstandings of quantum physics. Burwell's critical overview makes this clear:[45]

> Coale offers a similarly confusing application of quantum entanglement that collapses entanglement with the Uncertainty Principle in a manner that fails to do justice to either. [...] Coale both misrepresents quantum entanglement, and detaches it from the quantum phenomenon so that it means little more than inseparability. Coale's justification for using quantum entanglement in the first place is somewhat weak [...]: O'Donnell mentions the words "entangled" in relation to *Underworld*, and Coale, [...] uses this passing reference to entangled relationships to justify his introduction of quantum entanglement. [...] Coale's frequent mention of quantum flux may refer to quantum fluctuation; however, quantum fluctuation has nothing to do with quantum entanglement
>
> Coale's collection of incorrectly described and arbitrarily applied quantum concepts exacerbates what is already a largely impressionistic argument. In Coale's analysis, quantum concepts are not just irrelevant to the argument, they actively impede it. The result is further misrepresentation of these concepts and a set of observations that obscure rather than elucidate DeLillo's novels

Burwell is here criticising a 2011 article by Coale and not 2012's *Quirks of the Quantum*; however, both publications advance the same argument concerning the same novels in the same way and were published around the same time: the issues above also apply to Coale's book.[46] Burwell's assessment of Strehle is barely kinder:

> Strehle's analysis of Donald Barthelme offers a prime example among many of how "uncertainty" or "indeterminacy" gets detached from the Uncertainty Principle. [...] Barthelme's association of the Uncertainty Principle with

[44] Ibid. 83.

[45] Burwell, *Quantum Language*. 156 & 157.

[46] Samuel Chase Coale, "Quantum Flux and Narrative Flow", in *Papers on Language & Literature,* 47, no. 3, 2011.

> "knowing that our methods are themselves questionable" already misses the mark, but it is Strehle who empties it of meaning when she observes that Barthelme's *Paradise* fictionalized the Uncertainty Principle in its "looseness, openness, and uncertainty." [...]
> when she attempts to integrate the principle into her textual exegesis, all of its specificity is lost, and the word "uncertainty" is reduced to nothing more than its conventional dictionary definition. This general use of the term is what inspired Sean Kinch's observation that Strehle's "quantum adjectives" are too vague, and that they could be applied to countless literary texts that appeared long before the quantum revolution[47]

This judgement only concerns one chapter from Strehle; however, it is indicative of the general pattern of the tome: in each chapter she selects a quantum-concept from her list, and then analyses a novel through the concept's prism. Unfortunately, in doing so, she tends to detach it from the physics she is supposedly discussing, often to the point where it no longer bears any relevance to the science, which belittles the book's central thesis.[48] As a matter of fact, the chapters barely discuss the science directly, preferring instead to focus on her cultural concept of 'actualism', because it expresses the dual-paradigm shift of quantum physics and literature at once.[49] But – similarly to Hayles – Strehle merely *assumes* 'actualism' to be valid and useful, though it is too open and vague to be compelling, in a way that distracts her from engaging with the physics directly.[50]

Following this overview of Strehle and Coale then, it is clear that Burwell's following conclusion is regrettably accurate:

> The critic may simultaneously promulgate misleading and inaccurate representations of quantum science, and offer confused interpretations of the text. This undermines attempts to bring the sciences and the humanities

[47] Burwell, *Quantum Language*. 143-4. Burwell is paraphrasing: Sean Kinch, "Quantum Mechanics as Critical Model: Reading Nicholas Mosley's Hopeful Monsters", in *Critique: Studies in Contemporary Fiction,* 47, no. 3, 2006. '[*Strehle's*] six quantum adjectives are too vague; [...] they could be applied to countless literary texts that appeared long before the quantum'. 292. These six 'quantum adjectives' are her six quantum-concepts listed in her earlier citation.

[48] While discussing the 'energetic form' of William Gaddis's *J.R.* (its disorganisation and refusal of traditional temporality), Strehle concludes that '*J.R.* is not, like Newton's universe, causally constructed [...] Rather, as in the Heisenbergian universe [...] statistical accumulations of events can precipitate others'. However, she does not explain how anti-material energetics is tied to acausality, temporality, or how the novel employs 'statistical accumulations' that are specific to the mathematics of quantum mechanics, as opposed to any other fields that also employ statistics. Strehle, *Fiction in the Quantum Universe*. 116-8.

[49] Ibid. 'I derive the term "actualism" from a distinction Werner Heisenberg makes between the actual and the real. At the subatomic level, he says, reality is not real, but it is active, dynamic, "actual". Actualistic fiction expresses, then, a literary version of the reality constituted by fundamentally new physical theories'. 7.

[50] It seems as if "field concept" and "actualism" have never appeared in later studies of physics and literature. Other academics have not found them useful. Indeed, even in the present discussion, both concepts are considered to be broadly synonymous with a general postmodernism, because Hayles and Strehle do not make clear how their concepts are substantively or usefully different from it.

> together and to advance the field of science studies – and fails to take up the responsibility of sharing information that is rigorous, thoughtful, and genuinely productive[51]

Nevertheless, it should be noted that Burwell is occasionally overly-severe in her judgements. For instance, the majority of her criticisms are displays of how various studies misunderstand quantum science to some extent, which affects the quality of their analyses. However, this ignores that there is no guarantee that writers, or the culture at large, will not also misunderstand the science in their productions, and hence the literary critic must engage with the misunderstandings as they stand, to discern their relationship with literature. Burwell admits that the author being discussed by Strehle, Donald Barthelme, misinterpreted quantum uncertainty in his work, therefore criticising her for meeting the author at his own level of understanding can seem harsh.[52] Another more obvious case is how Burwell criticises Steven Carter's analysis of Robert Duncan's poetry: 'Here, Carter is more confusing. Because he keeps returning to Schrödinger's thought experiment, which was in fact designed to illustrate the incoherence of superposition on the macroscopic scale'.[53] This is historically correct; however, it ignores that "Schrödinger's Cat" has culturally mutated into more than one man's specific thought-experiment: it has become a widespread trope, expressing the collapsing of potentialities into one actuality with the act of observation, which is what Carter is discussing. This cultural version bears little direct relation to the micro-macro issue that Erwin Schrödinger was concerned with, so restricting one's understanding of the trope to his specific meaning, for the sake of exactitude, can equally limit one's understanding of the culture's engagement with quantum ideas.

Nonetheless, even taking this nuance into account, it is clear that the studies of postmodernism and quantum theory here discussed lack a rigorous foundation.[54] The general narrative employed above by scholars – that there was an overarching paradigm shift that affected the whole of culture near-simultaneously and near-identically, which gives meaning to the apparent analogies between two vastly disparate human activities – *cannot be assumed uncritically*. The present case made clear that the methodology associated with the narrative

[51] Burwell, *Quantum Language*. 165.

[52] Were it not a pervasive issue in her book.

[53] Burwell, *Quantum Language*. 152.

[54] It might be objected that the lack of foundations in the field is merely a reflection of postmodernism's general undermining of all intellectual foundations. However, this explanation would not address, correct, or justify any of the academic issues and inexactitudes encountered in this section, so it is not a relevant objection in the current context.

can lead to an ideological embrace of anti-science attitudes; a need to construct overly-general and merely-assumed frameworks; a lack of academic rigour that can make it indistinguishable from parody; and, additionally, it does not guarantee the production of interpretations that are useful, rigorous, or scientifically accurate. This, no doubt, explains the academic energy being dedicated recently to critical re-evaluations of quantum physics and literature – even though many revolve around Woolf.

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B/ Why Woolf?

Once again, Burwell proposes a condensed narrative of the situation:

> Wave/particle duality is by far the most popular metaphor that is derived from quantum physics and applied to literary criticism, and is most often applied to modernist literature. A thorough survey of articles and books that use quantum concepts in their analysis turns up an interesting artifact: the works of Virginia Woolf are far and away the most popular objects of analysis with respect to wave/particle duality. This preference may in part result from the way Woolf undermines the boundaries between subjectivity and external reality[55]

Burwell certainly is not wrong in presenting wave-particle duality as the main metaphor linking together Woolf and the science, which in turn justifies the specific role for the novelist in literature and science studies, as this thesis will make extensively clear. However, Burwell is being restrictive: Woolf is an ideal candidate for several other historical and material reasons, which equally help explain the author's role in this academic context, even though she is associated with modernism rather than the postmodern. These connections are worth listing here, as they appear in most of the studies to be discussed in the upcoming literature review:

1. Historical Synchronicity. Having lived from 1882 to 1941, Woolf spent the first two dozen years of her life in a scientific context near-completely unaffected by the quantum (pre-1905)[56],

[55] Burwell, *Quantum Language*. 129-30.

[56] The year of Albert Einstein's paper on light-quanta. This is a better year to select as the beginning of quantum physics than the traditionally used 1900, meaning Max Planck's discovery of the quantum. Before Einstein, Planck's quantum was not taken seriously by physicists; they viewed it as a useful yet meaningless mathematical tool. Einstein was first to employ it as an actual physical concept, with light-quanta. It is this paper that allowed

but she also experienced a dozen years before her death during which Niels Bohr's framework of quantum mechanics had imposed itself as a majority-held version of the physics throughout academia (post-1927)[57]. Therefore, she would have experienced the hypothetical overarching paradigm shift within her own life, while consistently writing all the way through it. This leads to:

2. A Large and Varied Output. The sheer amount of Woolf's writing at the disposal of academics allows for extensive investigations into whether science may have permeated her thought or affected her art. Beyond her many famously complex, philosophical, and inexhaustibly analysable novels and short stories, her countless essays also clarify her intellectual standpoints and concerns regarding a variety of topics, several of which are relevant to the philosophical challenges of quantum theory, such as the two examples mentioned by Burwell. Woolf's diaries reveal how her metaphysical ruminations intertwined with her private life and intimate thoughts, which could show how deeply she was affected by quantum-sounding issues and how they made their way into her craft. Finally, her letters provide a picture of the social networks she was a part of, and what she discussed within them. These letters introduce a third connection:

3. The Intellectual Environment. Woolf spent a decent amount of her life active in a very specific community: the Bloomsbury group, which also featured several members from the Cambridge Apostles. As a part of this context, the novelist was surrounded by a large group of intellectuals from various fields with whom she regularly met and, at times, discussed developments in academia and intellectual life.[58] Furthermore, this group was amongst the most intellectually impactful and closely-knit in England throughout the 20th century, and possibly beyond that particular time and place. This is made clear in Randall Collins's *The Sociology of Philosophies*, which traces the history of intellectual innovations, oppositions, and

much of the creativity and innovations of early quantum theory in the 1910s, particularly Bohr's atom. It could even be argued that 1905 is too early a year, as it also took some time for Einstein's paper to be read and accepted.

[57] This should not be confused with the near-unquestioned acceptance of the "Copenhagen Interpretation" in post-1950s departments of physics, particularly given that this "interpretation" was only created in 1955. Following Bohr's publication of complementarity in 1928, the objections against his views were many and famous. But, for the most part, it was implicitly accepted by a majority of working experimental physicists as they applied the new quantum mechanics to chemistry or field theories. See: Helge Kragh, "Paul Dirac and The Principles of Quantum Mechanics", in *Research and Pedagogy: A History of Quantum Physics through Its Textbooks*, ed. Massimiliano Badino and Jaume Navarro, Berlin, Max Planck Institute for the History of Science, 2013. 260.

[58] Virginia Woolf, (1922), "Old Bloomsbury", in *Moments of Being*, ed. Jeanne Schulkind, London, Pimlco, 2002. 'part of the charm of those Thursday evenings was that they were astonishingly abstract. It was not only that Moore's book had set us all discussing philosophy, art, religion; it was that the atmosphere [...] was abstract in the extreme'. 51.

unions in philosophy throughout world history by focusing specifically on the social networks formed amongst thinkers, because, in his view: 'The history of philosophy is to a considerable extent the history of groups. Nothing abstract is meant here – nothing but groups of friends, discussion partners, close-knit circles'.[59] When it comes to the group surrounding Woolf, though, Collins accords it a greater importance than most others:[60]

> we come to the student society known as the "Apostles" at Cambridge, in a burst of glory (1890-1915) with McTaggart, Whitehead, Russell, Moore, Keynes, Lytton Strachey, Leonard Woolf, and Wittgenstein; many of them overlapped with the Bloomsbury literary circle around Virginia Woolf and her husband's publishing house
>
> Most of the creative developments in British philosophy, in all its branches, were concentrated in this period within a single network, centered at Trinity and King's colleges, Cambridge [...] we have a wealth of information which enables us to study how such a group was formed and the dynamics of emotional energy that drove it.
> Leading intellectuals are more elaborately connected by family linkages in the generations from 1840 to 1920 than at virtually any other time in history; there is an intermarrying network that links Russell, Moore, Keynes, Virginia Woolf, and the Bloomsbury circle to the Thackerays, Macaulays, Darwins, Maitlands, Trevelyans, Balfours, and many others. They are genuine cousins, in-laws, and nephews, not merely the metaphorical kinfolk produced by mater-pupil lineages

Hence, Woolf was not merely surrounded by a few scholars with whom she could discuss ideas: she was an active participant in one of the most cutting-edge groups of conceptual innovators in art and academic history. There is therefore no doubt that *if* quantum physics' emergence did indeed affect the philosophical underpinnings of much 20th-century thought, she would have at least somewhat participated in it – as the fourth connection makes clear:

4. Woolf and Publishing. Beyond mere conversations and parties, Woolf was directly involved in the printing of several books by Apostles-Bloomsbury figures, and was more largely associated with the world of intellectual publishing at the time with her and Leonard Woolf's Hogarth Press. With this involvement, she was surrounded by books, essays and articles that discussed the new physics. It is known, for instance, that her home library contained many publications that presented modern science in an accessible manner.[61] Though,

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[59] Randall Collins, *The Sociology of Philosophies: A Global Theory of Intellectual Change*, Cambridge, Massachusetts, Harvard University Press, 1998. 2.

[60] Ibid. 530 & 732.

[61] See: Judith Killen, *Virginia Woolf in the Light of Modern Physics*, PhD Thesis, University of Louisville, 1984. 40, for a list of such books.

of course, this need not mean she read them. Beyond that consideration however, Peter J. Bowler's *Science for All* demonstrates unambiguously that early-20th century Britain was flooded with publications, broadcasts and events that discussed developments in physics in an approachable way. Even were it not for the decent likelihood that Woolf fortuitously came into contact with some of these materials, there are lines of direct connection between several publications and herself. In particular, Bowler's section on highbrow magazines – the kind read by the intelligentsia such as Bloomsbury – mentions that:

> The most active periodical in the area of science was *The Athenaeum*, its influence surviving incorporation into *The Nation* in 1921. Bertrand Russell was a frequent writer on the new physics. But the continuity of science content was largely due to J.W.N. Sullivan, one of the few lay intellectuals able to comment on the implications of modern physics[62]

This is relevant as Woolf worked with *The Athenaeum*, even before its transformation.[63] But more relevant is that after the magazine became *The Nation and Athenaeum* (thanks largely to Woolf's close acquaintance, John Maynard Keynes), Woolf's husband became its literary editor, tying the novelist's life with the publication's activity.[64] Furthermore, Woolf was well acquainted with Russell due to the Apostles connection, and had met J.W.N. Sullivan at least once.[65] This one case already displays how Woolf's immediate intellectual environment was to some extent aware of the philosophical challenges of the new physics.

5. Conceptual Echoes. This final major reason for connecting Woolf to quantum physics is the one discussed by Burwell: her writing displays many philosophical concepts and metaphors that are interpretatively *so* similar to those of the emerging quantum theory – such as the conceptual breakdown of subjective-external boundaries, or the metaphor of wave-particle duality – that it feels as though there *must* be a connection. This claim is reinforced with any

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[62] Peter J. Bowler, *Science for All: The Popularizations of Science in Early Twentieth-Century Britain*, Chicago, The University of Chicago Press, 2009. 189.

[63] Shiach, "Woolf's Atom", 2018. 'Woolf began contributing to *The Ahtenaeum* in 1919 [...] Further references to *The Athenaeum* in her diary suggest that Woolf was a close reader of it throughout 1919'. 62-3.

[64] Whitworth, *Einstein's Wake*. 'During the period in which Leonard Woolf was the literary editor of *the Nation*, it was virtually the house magazine of the Bloomsbury group. Vanessa Bell, felling somewhat excluded, reported that it seemed "like a drug": "Everyone reads it and discusses it in an out and theres [*sic*] always a lot of gossip about each article or review"'. 21. Citation is from: Vanessa Bell, (1923), "Letter to Roger Fry dated 29 Dec.", in *Virginia Woolf*, ed. Hermione Lee, London, Chatto and Windus, 1996. 447.

[65] David Bradshaw, "The Best of Companions: J. W. N. Sullivan, Aldous Huxley, and the New Physics", in *The Review of English Studies,* 47, no. 186, 1996. 'On 18 December 1921 Virginia Woolf noted in her diary that the scientific journalist J.W.N. Sullivan was "too much of the indian-rubber faced, mobile lipped, unshaven, uncombed, suspicious, powerful man of genius in Hampstead type for my taste" and the following month she reiterated her aversion to the "too black and hairy and singular" Sullivan in a letter to E.M. Forster'. 188.

or all of the four above factors, as well as, in some cases, the added facts that the novelist was aware of Einstein's relativity – the other component of the "new physics" alongside the quantum[66] – and that late-career Woolf can be read as proto-postmodern, which ties her to the narrative presented in the previous section: by embracing quantum ideas, Woolf's writing might have paradigm-shifted from modernism to the postmodern.[67]

With these five main reasons, which synthesise and incorporate many more historical facts and viewpoints, one might expect a large amount of evidence on display to validate the connection between Woolf and quantum science. However, this is not the case, because of the lack of a "smoking gun". That is to say, nowhere in Woolf – from her novels to her diaries or even anecdotes regarding her – are there any *direct* and *unambiguous* references to anything that is *definitely* related to quantum mechanics. There is some evidence that she discussed the new physics with people around her, but it is unclear if this was a common occurrence, or if she was receptive to the ideas in any way.[68] Quite the contrary, in fact: in 1938 she was interviewed by Elizabeth Nielson, a literature student who wanted to write the first dissertation on the author. Woolf, however, seemed sceptical of the woman's interest in the influence of Einsteinian physics on literature, calling her 'entirely distracted by Einstein, and his extra mundane influence upon fiction. [...] I gave up on the outskirts'.[69] This certainly does not depict Woolf as having a strong interest in the new physics that she would have knowingly included in her work. Nevertheless, as mentioned, there are some direct ties to astronomy, relativity and

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[66] See: Holly Henry, *Virginia Woolf and the Discourse of Science: The Aesthetics of Astronomy*, Cambridge, Cambridge University Press, 2003. 'Chapter 1: Stars and Nebulae in Popular Culture', 12-50.

[67] Mark Hussey, "To the Lighthouse and Physics: The Cosmology of David Bohm and Virginia Woolf", in *New Essays on Virginia Woof*, ed. Helen Wussow, Dallas, Contemporary Research Press, 1995. 'Recently critics such as Pamela Caughie have read Woolf in the context of postmodernism and it seems that in this framing lie the richest possibilities for interrogating the relations among physics and literature as systems of representation. Postmodernism's attention to the marginal, to gaps, fissures, aporia, makes Woolf an attractive text for its readings. If modernism is typically associated with relativity, [...] postmodernism has found quantum theory a rich source of metaphor and analogy'. 82. Hussey is referring to: Pamela L. Caughie, *Virginia Woolf & Postmodernism: Literature in Quest & Question of Itself*, Urbana, University of Illinois Press, 1991.

[68] Sephen Spender, (1951), *World Within World: The Autobiography of Stephen Spender*, Los Angeles, University of California Press, 1966. 'After tea, I listened [...] while Yeats sat on the sofa with Virginia Woolf and explained to her that her novel, *The Waves*, expressed in fiction idea of pulsations of energy throughout the universe which was common to the modern theories of physicists'. 164. However, this conversation seems to imply that Woolf was not aware that her own novel was tied to the new physics. Nonetheless, this could be explained away by presuming it was a moment of so-called "mansplaining" on Yeats's part. But even then, the notion of 'pulsations of energy throughout the universe' could just as easily be tied to relativity as quantum science, particularly given the absence of quantum field theory at the time. Another example is: Virginia Woolf, (1932), "Sunday 8 May", in *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, London, The Hogarth Press, 1982. 96.

[69] Virginia Woolf, (1938), "Saturday 28 May", ibid. Anne Olivier Bell and Andrew McNeillie, 1984. 146.

Einstein to be found, but this does not, however, imply anything about quantum ideas. The only populariser of quantum theory that Woolf had *for sure* read, as revealed in her letters and diaries from the 1930s, is James Jeans.[70] However, if his publications impacted the author, it was the discussion of the universe as viewed via relativity – in line with her burgeoning interest in astronomy[71] –, as even after 1931 she is never seen *directly* referring to any of the quantum notions presented by Jeans, only his relativistic analysis of space and time. Woolf also cites Russell's 1931 *The Scientific Outlook* in her essay *Three Guineas*, which could indicate that she read it, however, her only citation is a criticism of science's sexism and lack of political neutrality, which cannot be considered an argument for Woolf being inspired by the field.[72] Gillian Beer influentially attached Woolf's writing to the popularisations of physicist and science communicator Arthur Eddington, particularly his 1928 best-seller *The Nature of the Physical World*, which did engage with quantum mechanics.[73] And, indeed, Woolf names him as an essential scientific figure in *Between the Acts*: 'Or not a life at all, but science – Eddington, Darwin, or Jeans'.[74] However, at no point does Beer provide incontrovertible evidence that Woolf ever read his writing. Her analysis never affirms anything more than the five above points in detail, and their importance in tying the author to the science. Though, this fact seems to have been lost on later critics, as Burwell points out:

> the claim that Woolf read or encountered [...] Eddington, which seems to have originated with Gillian Beer's speculation in *Virginia Woolf: The Common*

[70] Virginia Woolf, (1930), "Saturday 27 December", ibid. 1980. 'I moon torpidly through book after book: Defoe's *Tour* Rowan's autobiography; Benson's Memoirs; Jeans: in the familiar way'. 340; Woolf, "Thursday 18 December". 'Talk about the riddle of the universe (Jeans's book) whether it will be known; not by us; found out suddenly; about rhythm in prose' 337; Woolf, "Saturday 30 January". 'You know what Jeans says? Civilisation is the thickness of a postage stamp on the top of Cleopatra's needle; & time to come is the thickness of postage stamps as high as Mont Blanc'. 65; Virginia Woolf, (1937), "Wednesday 11 August", in *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, London, The Hogarth Press, 1984. 'I bought a 6d. Jeans on *the Mysterious Universe*' 107. Woolf also mentions in a letter her ambition to read more science books. However, she does not say which, but given the timeframe, it is likely that this is what led her to Jeans: Virginia Woolf, (1931), "Woolf to Ethel Smyth, 6 Dec. 1931", in *The Letters of Virginia Woolf*, ed. Joanne Trautmann and Nigel Nicolson, London, Mariner Books, 1980. 'I am going to read science'. 401. Killen affirms that Woolf read Whitehead's *Science and the Modern World*, which discusses pre-complementarity quantum theory: Killen, *Woolf in the Light of Modern Physics*. 39. However, Killen does not provide any source or explanation, and no other Woolfian scholar (nor Woolf herself) verify the claim.

[71] Gillian Beer, *Virginia Woolf: The Common Ground*, Edinburgh, Edinburgh University Press, 1996. 'She worked at imagining the bending back of space as she read Jeans's description, and wrote about it in a letter to her friend the composer Ethel Smyth'. 114. This is the above letter.

[72] Virginia Woolf, (1938), *Three Guineas*, London, Houghton Mifflin Harcourt, 2006. '"Anyone," writes Bertrand Russell, "who desires amusement may be advised to look up the tergiversations of eminent craniologists in their attempts to prove from brain measurements that women are stupider than men." Science, it would seem, is not sexless; she is a man, a father, and infected too'. 139.

[73] Arthur Eddington, (1928), *The Nature of the Physical World*, New York, The Macmillan Company, 1929.

[74] Virginia Woolf, *Between the Acts*, St Ives, Wordsworth Editions, 2012. 400.

> *Ground*, has increasingly become a "fact" through an iterative process wherein later critics either cite Beer's claim or cite someone citing Beer, leaving out the speculative nature of the original claim[75]

The closest Woolf's novels ever come to making a direct reference to the innovations of quantum science is again in *Between the Acts*, when, during an intermission scene, many faceless characters have overlapping conversations, including someone stating 'It's odd that science, so they tell me, is making things (so to speak) more spiritual... The very latest notion, so I'm told, is nothing's solid'.[76] This could indeed be a reference to quantum-related insubstantiations of matter. However, the phrase also includes the unscientific notion of spirituality to reckon with, and even were it a reference to quantum science, it cannot be considered direct or unambivalent – the sentence could be motivated by something else such as radioactivity or atomic structure, or even be sarcastic in nature.[77] The atom is a physical concept that was capital to the development of quantum physics, and one that Woolf often invokes in her descriptions. However, atoms obviously predate modern physics by millennia, therefore Woolf's use of them cannot be a guaranteed reference to quantum science, especially when, according to Shiach's analysis, 'The semantic associations of the atom in Woolf's writing do vary', which further reduces the probability of atoms being a knowing reference to modern physics.[78] Similarly, some scholars demonstrate that Woolf had access to scientific knowledge of physics in her younger years via her father's library, particularly regarding waves and light.[79] But this, again, reveals nothing about her understanding of quantum physics. Unless new evidence comes to light, then, it is currently impossible to state categorically that Woolf knew of, or directly referenced, quantum theory, no matter how strong the indirect evidence is.

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[75] Burwell, *Quantum Language*. 127. Burwell seems to have missed that Beer already discussed Woolf and Eddington a year earlier: Gillian Beer, "Eddington and the Idiom of Modernism: Physics, Politics and Literature in the 1930's", in *Science, Reason, and Rhetoric*, ed. Henry Krips, Pittsburgh, University of Pittsburgh Press, 1995.

[76] Beer, "Eddington and the Idiom of Modernism". See also: Beer, *Common Ground*. Chapter 6: 'Physics, Sound, and Substance: Later Woolf'. 112-24.

[77] Whitworth's discussion of this sentence, and the novel's other references to science, proposes the possibility that it is a satire of a political moment when scientific communicators, such as Eddington and Jeans, were naïvely bringing together religion, science and spirituality, just as fascism and war were looming: 'In a novel that is sceptical about the claims of authority, Woolf indicates her scepticism about the scope of scientific authority' Whitworth, *Einstein's Wake*. 169.

[78] Shiach, "Woolf's Atom". 65.

[79] See the discussion of John Tyndall's possible influence on Woolf in: Catherine W. Hollis, "Clarissa's Glacial Skepticism: John Tyndall and « Deep Time » in Mrs. Dalloway", in *Interdisciplinary/Multidisciplinary Woolf: Selected Papers from the Twenty-Second Annual International Conference on Virginia Woolf*, ed. Ann Martin and Kathryn Holland, Clemson, Clemson University Digital Press, 2013.

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C / The Overarching Problem

Obviously, how to connect literature to quantum theory will be different in modernist and postmodernist writing: the latter defines itself as incredulous towards the former; the science was not nearly developed to the same extent in modernism; the literary and philosophical approaches differ greatly; the cultural status of quantum theory in each period is beyond compare; and, more generally, the very nature of science, society and culture from one era to the next is close to incomparable. And yet, the specific case of Woolf threatens to return scholars to the same issues encountered with the postmodern analyses of Hayles, Strehle and Coale.

This is because the study of Woolf and the quantum contains at its heart a striking paradox to contend with: *There are many valid indirect reasons to tie Woolf to quantum science, both materially and philosophically. Yet, at the same time, there is no direct evidence to unquestionably validate the connection.* This, inevitably, pressures scholars who wish to bring together both topics to construct a framework that can account for the lack of direct connection. In doing so, there is a risk of embracing the academic path of least resistance: *assuming* the connection to be valid from the outset, and then legitimising it by interpreting the conceptual overlaps between both fields, whose similarities are considered to be *so* compelling that they *must* be the result of some interaction between Woolf and quantum physics, such as their common affiliation to a *zeitgeist* in the midst of an overarching paradigm-shift influencing the whole culture, including physicists and novelists. However, this narrative and associated methodology have already been shown in this introduction to be lacking in critical ways. As a matter of fact, *the very idea that analysing conceptual similarities can substantiate connections is in itself suspect*.

Indeed, such an approach is shared by con artists of the "quantum woo" variety: influencers and merchants who misinterpret quantum science in order to present unscientific notions as if they were scientifically validated.[80] This is made evident in Burwell's chapter on

[80] For a specific case of "quantum woo" masquerading as legitimate literary criticism in order to fallaciously validate an unscientific view of the universe, see: Xavier Cousin, *La fiction quantique: Un dépassement de l'ontologie postmoderne par l'actualisme*, Master's Thesis, Université de Lille, 2014. 30-40. Science-fiction author and poet Vanna Bonta published the novel *Flight: A Quantum Fiction Novel* in 1995, which blurred

'New and Post-New Age Appropriations' of quantum language, wherein the transition of quantum knowledge into everyday terms is shown to generate discursive strategies that can be abused rhetorically by unscientific new age texts and frauds:[81]

> The nomadic potential of quantum metaphors and concepts ensures that, no matter what the individual or social complaint/desire, there exists a quantum strategy to ameliorate or realize it. This remarkable adaptability marks late twentieth and twenty-first century use of quantum discourse as unique[82]

Given this adaptability – which, as demonstrated by Sokal, Hayles, or quantum woo, can lead to anti-scientific attitudes – it is pertinent to question the validity of studying quantum-concepts to begin with, for they are nothing more than open analogies, and hence likely display the same 'unique' and 'remarkable adaptability' as those strategies discussed by Burwell. This scepticism is strengthened by Bouveresse's post-*Fashionable Nonsense* book, *Prodiges et vertiges de l'analogie,* which aims to show that much of the "science wars" was due to academic misuses of analogies. Indeed, to the physicist, academics do not yet possess a true theory of analogy, nor an approximate understanding of what could constitute a disciplined philosophical usage of analogy[83] – a notion also previously advanced by Jenkins. But, rejecting quantum-concepts would possibly be to reject *any* study of Woolf and the quantum, given that conceptual similarities are currently the only avenue for generating new connections between the two. *It is hence essential to determine the nature and academic applicability of quantum-concepts*, for they are at the heart of the issue of how to construct a valid, productive, and diligent conceptualisation of literature and quantum theory.

This investigation into the validity of quantum-concepts will begin with a literature review of Woolf and quantum physics analyses, with a particular focus on the issue of influence: how do the academics conceive of the connection, given the paradox inherent to the field? In doing so, an array of scholarly difficulties will emerge; however, it will

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fictional boundaries in order to substantiate Bonta's misinterpretation of quantum science as validating a human-centered animism. This unscientific notion was disseminated on the early internet by hiding it behind the inane concept of "quantum fiction": a supposedly new moment in literary history caused by quantum science (according to Bonta). "Quantum fiction" was given legitimacy with a deliberate and organised manipulation of Wikipedia, forums, social media, and other sources of free information, which not-coincidentally also tended to elevate Bonta into a cult figure.

[81] Burwell, *Quantum Language*. Chapter 4, 169-209.

[82] Ibid. 209.

[83] Jacques Bouveresse, *Prodiges et vertiges de l'analogie [Prodigious Highs and Dizzying Lows of Analogy]*, Paris, Raisons d'agir, 1999. 'Nous ne disposons toujours pas, sinon d'une véritable théorie de l'analogie [...] du moins d'une conception approximative de ce qui pourrait constituer un usage philosophique réglé et relativement discipliné de l'analogie'. 39.

simultaneously make it possible to ascertain which critics have recognised and dealt with the issues thoughtfully. Examining these academics' methodologies will lead to conclusions on what a valid study of Woolf and the quantum can look like, with a specific focus on complementarity, and these conclusions will be demonstrated with an in-depth analysis of *To the Lighthouse* in the context of Woolf's thought and intellectual environment. Indeed, the novel was written contemporaneously with the discovery of wave-particle duality and the development of quantum mechanics,[84] and contains within it a variety of dualistic constructions that often take the form of wave-particle oppositions, which it then attempts to resolve in an *apparent* parallel with complementarity. It is hence the ideal novel to interrogate the validity of conceptual similarities. But, in line with the thesis' sceptical approach, it will instead be demonstrated that other pre-existing fields of thought can fully account for the resolved dualities in the novel, without any productive need to invoke quantum physics. Due to this, the applicability of connections via conceptual analogies will be examined and reconsidered, which will prompt a striking proposition: quantum-concepts *can* demonstrate a valid connection between novelists and physicists. However, the connection is not influence nor culture. It is the human brain.

[84] While "quantum physics", "quantum science", "quantum theory", and "the quantum" tend to be mostly employed synonymously in this thesis, "quantum *mechanics*" has a specific meaning: the formalisms which integrated the rapid-fire discoveries and complications of quantum physics into a consistent and manipulable mathematical system consistent with experiments. Hence, quantum mechanics did not exist before Werner Heisenberg, Pascual Jordan and Max Born's 1925 matrix mechanics.

Chapter 2 - Woolf, Physics, Culture, and the Frameworks Uniting Them

In the previous chapter, five reasons to believe that Virginia Woolf might have interacted with quantum theory were listed. The first four were historical and material factors, while the fifth dealt with conceptual similarities, or, quantum-concepts. As evaluating their soundness is a main goal of this thesis, the following literature review will focus specifically on the meaning that scholars attach to quantum-concepts, and how these different meanings are entwinned with academic frameworks containing alternative conceptualisations of the connection between Woolf and physics. Unfortunately, many of these frameworks rely on a naïve view of influence, which generates a panoply of difficulties, and hence do not propose an academically sound interpretation of Woolf's relationship with the science. Therefore, after the literature review, the four most valid frameworks contained within it will be isolated and dissected, in order to reach conclusions regarding what a valid study of Woolf, quantum, and culture can look like.

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A/ Literature Review

The starting point of many quantum analyses of Woolf is the notion that her paradigm-shifting views on, and usage of, literature – as expressed in her essays, diaries or novels – in some way mirror the paradigm-shifting views and procedures of the new physics, consistently with the narrative presented earlier in studies of quantum physics and postmodern literature.

Judith Killen, in her 1984 doctoral thesis, the first comprehensive analysis of this topic, states that 'Woolf's anti-materialistic complaint against the Edwardian novelists echoes modern physics' complaint against the classical views of reality'.[1] This assessment of Woolf's modernist conceptions regarding fiction, found in her essays, is shared by Alan Friedman and Carol Donley: 'Woolf [...] recognized the necessity to create literary form which could carry the

[1] Killen, *Woolf in the Light of Modern Physics*. 25.

concepts of relativity, uncertainty, and complementarity'.[2] Drawing a more general parallel between Woolf's philosophy and physics, Gillian Beer points out how similar Eddington's popularised description of the shift away from classical mechanics is to Woolf's famous assertion that human nature changed in 1910,[3] or how both writers employ the philosophical trope of the two tables as a means of developing their respective views of reality having been rendered insubstantial.[4] Sue Sun Yom and Rachel Crossland have also both demonstrated that even Woolf's diary entries show her grappling with issues in her personal life that have strong scientific parallels: for Sun Yom, it is the author's obsession with waves and rhythms, which can evidently be connected to wave mechanics;[5] and for Crossland, it is how Woolf often describes her life in terms of binaries, for instance when she asks 'Now is life very solid, or very shifting?'.[6] Crossland describes this intimate sentiment as 'a definite attempt here to express both "contradictions" at the same time, the "solid" and the "shifting", or what contemporary science might have called the particle and the wave'.[7]

As for the novels, a majority of critics invoke *The Waves* in order to analyse Woolf's many similarities to quantum science, whether it is her centering of the human mind within fiction (Killen)[8]; her use of paired opposites as a structuring principle (Friedman and Donley)[9]; her echoes of quantum physics' popularisers (Beer)[10]; notions of entanglement (Derek Ryan)[11]; subject-object and identity (Morag Shiach,[12] Catriona Livingstone)[13]; or complementarity

[2] Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse*, Cambridge, Cambridge University Press, 1985. 146.

[3] Beer, "Eddington and the Idiom of Modernism". 303.

[4] Gillian Beer, "'Wireless': Popular Physics, Radio and Modernism", in *Cultural Babbage: Technology, Time and Invention*, ed. F. Spufford and J. Uglow, Faber and Faber, 1996. 118-21.

[5] Sue Sun Yom, "Bio-graphy and the Quantum Leap: Waves, Particles, and Light as a Theory of Writing the Human Life", in *Virginia Woolf: Texts and Contexts. Selected Papers from the Fifth Annual Conference on Virginia Woolf*, ed. Beth Rigel Daugherty and Eileen Barrett, New York, Pace University Press, 1996. 147-8.

[6] Woolf, "Friday 4 January". 218

[7] Crossland, *Modernist Physics*. 45.

[8] Killen, *Woolf in the Light of Modern Physics*. 96.

[9] Friedman and Donley, *Myth and Muse*. 143-6.

[10] Beer, "Eddington and the Idiom of Modernism". 304-5. And: Beer, "'Wireless': Popular Physics, Radio and Modernism". 161.

[11] Derek Ryan, *Virginia Woolf and the Materiality of Theory*, Edinburgh, Edinburgh University Press, 2013. 175-7.

[12] Shiach, "Woolf's Atom". 65.

[13] Livingstone, "Experimental Identities". 74.

(Crossland)[14]. Several of Woolf's other novels have been studied in a similar vein: the opposition between Mr. and Mrs. Ramsay in *To the Lighthouse* has been linked to the wave-particle duality by Miriam Marty Clark,[15] Mark Hussey,[16] and Paul Tolliver Brown;[17] Sun Yom similarly interprets a 'struggle to find the deBroglie [*sic*] balance between wavelike wholeness and particlelike individuality' in *Orlando*'s gender-indeterminacy;[18] the radio-waves broadcast by the gramophone in *Between the Acts* are read by Michele Pridmore-Brown as implying a reality of immaterial waves, similar to the new physics;[19] and Crossland shows that many quantum-concepts from later novels can also be found in Woolf's earlier – more traditional – works, such as the imageries of water in *The Voyage Out* which can be tied to the connection-distinction theme common in many analyses introduced thus far.[20]

Beyond any one novel, Woolf's literary style and substance are themselves likened to quantum themes. Beer contends that, stylistically, from the 1930s onwards, the author 'works to a rhythm, not a plot ("the rhythm of the universe" and "rhythm in prose"'). [...] In this turn of her thinking, both physics and poetry help',[21] a perspective shared by Sun Yom: 'Woolf's exploration of waves clearly comes to dominate her thinking by 1930'.[22] Louise Westling points out that Woolf's modernist innovations can be tied to scientific innovations: 'experiments with point of view and narrative structure absorb the epistemological lessons of relativity, wave theory, and the interdependency of observer and phenomena observed from quantum physics into a new fictional ontology'.[23] Finally, there are the conceptual metaphors employed by the author throughout her work, which are comparable to those employed in the discussions of physics, for instance metaphors of identity and the self: 'there are certainly some suggestive similarities [...] Woolf had developed many aspects of her own wave/particle model of the self

[14] Crossland, *Modernist Physics*. 56-8.

[15] Miriam Marty Clark, "Consciousness, Stream and Quanta, in « To The Lighthouse »", in *Studies in the Novel,* 21, no. 4, 1989. 415-9.

[16] Hussey, "To the Lighthouse and Physics". 85-6.

[17] Paul Tolliver Brown, "Relativity, Quantum Physics, and Consciousness in Virginia Woolf's "To the Lighthouse"", in *Journal of Modern Literature,* 32, no. 3, 2009. 49-51.

[18] Yom, "Bio-graphy and the Quantum Leap". 147.

[19] Michele Pridmore-Brown, "1938-40: Of Virginia Woolf, Gramophones, and Fascism", in *PMLA,* 113, no. 3, 1998. 410-1.

[20] Crossland, *Modernist Physics*. 21-2.

[21] Beer, *Common Ground*. 116.

[22] Yom, "Bio-graphy and the Quantum Leap". 147.

[23] Louise Westling, "Virginia Woolf and the Flesh of the World", in *New Literary History,* 30, no. 4, 1999. 856.

in anticipation of the physicists', states Michael Whitworth, while investigating how metaphors of matter from science were taken up by literary communities. Livingstone later studied this phenomenon in further detail, by revealing how Woolf's and scientific popularisers' conceptions of identity are inextricably entwined due to a sharing of metaphors: 'the multiplicity and fluidity of identity found in modernist writing in general, and Woolf's writing in particular, resonate with the preoccupations of the physicists'.[24]

All these analyses display various ways in which Woolf's literature can conceptually be tied to the science, even before taking into account the issues of influence, understanding, or material transmission. However, as explained in the introduction, taking into account the issues of influence, understanding, or material transmission immediately triggers the main problem of Woolf and quantum physics: the lack of a "smoking gun". Nevertheless, considering all of the above, in addition to the four material and historical reasons, it feels unreasonable to be of the opinion that Woolf's many apparent ties to quantum ideas are merely interpretative coincidence based on loose analogies. It certainly feels like there must be "something there". But, faced with a lack of direct evidence, academics must conceptualise what is "there" – what the connection is – in their frameworks for analysis. Which, inevitably, requires an engagement with the contentious topic of influence.

The initial, and most straightforward, means of justifying the link between both domains is aptly summarised on page 1 of Friedman and Donley's 1985 *Einstein as Myth and Muse*:

> Students of literature remember the year 1922 for the publication of James Joyce's *Ulysses* and T.S. Eliot's *The Waste Land*. [...] Also in 1922, Albert Einstein won the Novel Prize in physics. That these major events in the intellectual history of our era happened concurrently is no coincidence. [...] Twentieth-century physics postulated and experimentally validated two new world views, relativity and quantum theory, which differed from the conventional so fundamentally that philosophers and artists were encouraged to assimilate similar revolutionary views into their own disciplines. [...] all fields welcomed this opportunity, studied the new ideas, and experimented with art forms[25]

Modernist authors then, such as Woolf, were directly influenced by physics – as Samuel Chase Coale and Susan Strehle also theorised: they were aware of the contemporary developments, took on board their many consequences, and adapted them to their own work, leading to near-

[24] Livingstone, "Experimental Identities". 76.

[25] Friedman and Donley, *Myth and Muse*. 1.

simultaneous evolutions in literature and science that are structurally and intellectually resonant. This framework was implicitly accepted until the mid-1990s, and its reasoning is still present to some extent in several recent analyses. However, for the framework to operate, the critics must first demonstrate that Woolf was indeed influenced by quantum theory before they can unearth echoes of the science in the novelist's work, such as when Killen affirms that: 'Virginia Woolf's intellectual environment – her acquaintances and her readings – does indicate [...] that she was aware of 20th-century scientific revolutions'.[26] As intimated in the previous chapter, this is frequently achieved by focusing on her possible reading and knowledge of scientific communicators like Jeans, Eddington and others. Indeed, Beer notes that Woolf 'was reading Jeans's *The Universe about Us* (1929)'[27] while writing *The Waves*, and outlines paths of influence that would have also allowed her to be aware of Eddington's work.[28] Beer's article informs much of her own later studies of Woolf and science, and is also cited by Pridmore-Brown, Westling, and Ryan to justify how quantum-concepts made their way into the author's novels. Recently, before analysing the various meanings which the figure of the atom took throughout Woolf's novels and philosophy, Shiach first introduces several ways in which she could have come into contact with physicist Ernest Rutherford, through her work with, and knowledge of, *The Athenaeum* as well as other personal connections, in order to state that 'she was likely to have been familiar with key aspects of Rutherford's work'.[29]

This framework of direct influence is almost always strengthened with a concurrent model of indirect influence, which states that not only did Woolf probably read and discuss the new physics, she was also active in a culture where quantum-concepts were part of her local *zeitgeist*, and it can therefore be assumed that she would also have taken on board aspects of the science through unconscious cultural osmosis alone.[30] Beer illustrates this idea most vividly (without fully adhering to it) when describing the role of the wireless in modernism: not only did it allow scientific communicators to present the revolutions in science to a general audience,

[26] Killen, *Woolf in the Light of Modern Physics*. 35. See 38-40 for a list of Woolf's acquaintances and readings.

[27] Beer, "Eddington and the Idiom of Modernism". 303. Though it is unclear how Beer knows for sure this was Jeans's book she was reading, it could also have been *The Mysterious Universe* from 1930.

[28] Namely, that 'his work was frequently discussed in *The Nation*, of which her husband was literary editor, and she read his work' ibid. Though, again, Beer does not share how she knows that 'she read his work'.

[29] Shiach, "Woolf's Atom". 62-3.

[30] Introductions in literature and science tend to present the “direct” and “indirect” viewpoints as if they were two separate approaches, as is done here, with academics choosing either one or the other. This is due to the legacy of G.S. Rousseau's proposal to transition literature and science from direct to indirect conceptions. However, in the context of Woolf studies, both are usually used simultaneously to advance the same argument.

which included modernist writers, it was also 'the technical realization of the new scientific imaginings',[31] for the radio's ability to interconnect objects using waves of invisible, medium-less forces illustrated the strangeness of the quantum science being discussed on it, allowing the public to become better acquainted and accepting of the philosophical consequences of the new physics. This permits Beer to dig up echoes of this general "mood" in works of literature, such as how *Orlando*'s titular character 'thinks how technology has remade the world as magic', which demonstrates that Woolf was sensitive to the general evolutions of science, technology and culture.[32]

Such an indirect *zeitgeist* model is often invoked for a more specific reason though, which is once again encapsulated by Friedman and Donley: 'In our discussions of the parallels between quantum theory and literature, we have found a close similarity in choices of metaphors and themes, but usually without clear cut links that would establish a satisfying cause and effect between this physics and this literature'.[33] In other words, while it is possible to discover possible material links between Woolf and science, they are nevertheless insufficient to account for the full breadth of echoes between the two fields that the critics discuss. Indirect influence then becomes a means of explaining these gaps, or to justify connections without having to outline a full cause-and-effect path of influence from quantum physics to Woolf. For instance, Westling not only studies Woolf in the light of quantum theory, but also that of Merleau Ponty's ecological humanism, and instead of sketching how these three domains interacted historically, she states that:

> to emphasize the likeness between Woolf's fiction and Merleau Ponty's philosophy as the mark of a cultural ecosystem in flux. The wholeness of their cultural moment is enacted by serious participants within a variety of discourses dialogically responding to each other in a web of interrelations. […] central elements of his ontology are explicit discursive extensions of quantum physics[34]

This therefore accepts that the mere possibility that all of these discourses were interacting within the same *zeitgeist* is reason enough to study their connections: the metaphor of the 'web of interrelations' implies that every element of the culture is always already connected and interacting with everything else within the web, so there is no need to demonstrate that

[31] Beer, "'Wireless': Popular Physics, Radio and Modernism". 153.

[32] Ibid. 154.

[33] Friedman and Donley, *Myth and Muse*. 152.

[34] Westling, "Woolf and the Flesh of the World". 857.

interactions genuinely took place: it is already assumed by the metaphor. Likewise, Marilyn Slutzky Zucker does not map out how linguistics, modern science, and Woolf came into contact in her analysis of the novelist's 'uncertainty principle of language', because she instead relies on the fact that 'among the tradition-shattering theories that were "in the air" while Woolf was writing, there is Saussure's lectures on linguistics [...] And of course, there is the transition from Newton's mechanical universe, to the Uncertain world of Heisenberg and quantum mechanics'.[35] The mere fact that different ideas were all 'in the air' around the same time is justification enough to study them as if they had genuinely interacted.

Sun Yom goes further, concluding her article by stating that the question of influence is *not* relevant, given that the conceptual connections between different fields of study are justification enough from the standpoint of a feminist interpretation:

> as a response to the usual question of whether quantum mechanics is a determining historical influence on Woolf's work, i.e. did she really know physics, or if there is simply a surprising coincidence of the term "wave," I answer that the question is already elsewhere. The question is really about the shape of feminist analysis, about making feminism into a nomadology that refuses borders[36]

This denial of influence's pertinence, whether direct or indirect, to the study of parallels between literature and science helps lay bare a rather obvious issue in many analyses cited thus far: the critics write their papers and books because they have noticed interesting interpretative ties between Woolf and quantum physics and wish to analyse them; *not* because they mean to discuss how these ties came to be. This explains why the question of influence, especially when invoking a vague *zeitgeist* model, is usually treated at surface level: it is only present as a means of legitimising the comparative interpretation – the main point of interest. This causes indifference towards constructing a rigorous framework of analysis, which, inevitably, leads to several issues inherent to influence studies.[37]

The most obvious problem that exposes the unexamined frameworks' weaknesses is, undeniably, anachronism. For instance, Killen's thesis begins by confidently stating that 'many of the images and allusions she [*Woolf*] uses to delineate the Georgian novel from the

[35] Marilyn Slutzky Zucker, "Virginia Woolf's Uncertainty Principle of Language", in *Virginia Woolf: Three Centenary Celebrations*, ed. Maria Cândida Zamith and Luísa Flora, Faculdade de Letras da Universidade do Porto, 2007. 145.

[36] Yom, "Bio-graphy and the Quantum Leap". 150.

[37] The exceptions being Beer, Whitworth, Crossland, and Livingstone, as will be discussed in the next section.

Edwardian indicate that she understood the shifts in reality posited by new physics', and a factor Killen employs to defend this idea is that 'Woolf enters the observing mind into her visions of reality as Bohr and Heisenberg enter the observing mind into their equations; all three realize that to record is, in some part, to create'. However, the notion of including the observer in quantum theory was not developed before 1926, and, more importantly, was not made public to non-experts until 1928, when Niels Bohr published his complementarity framework in *Nature*. This is relevant, given that the three essays that Killen quotes to present Woolf's views on fiction ("Modern Fiction", "The Narrow Bridge of Art", and "Life and the Novelist") were all written before then, rendering her initial statement nonsensical. Similarly, Ryan's article has a close focus on 'the mutual entanglement of agency created by (and creating) intra-actions'[38] in *The Waves*, even though the novel was published in 1931, while entanglement and its meaning in physics were not explicitly made clear until 1935. More egregiously, Hussey's article suggests 'that Virginia Woolf's exploration of how to represent what she frequently termed "reality" and David Bohm's discussion of what he terms the "implicate order" share many characteristics',[39] without accounting for the approximate half-century that separates the two writers ('I intend it as a speculation rather than a thesis').[40] While it is possible to validly study shared characteristics without having to account for the temporal and cultural distance – as Sun Yom implies at the end of her article – it is not clear in the present cases what is being demonstrated if influence is not being taken into account.[41] This is additionally confusing due to the fact that Hussey nevertheless dedicates close to a page and a half justifying 'Woolf's awareness of writing on scientific subjects'[42] before his analysis, indicating that influence is indeed part of his argument – as Sun Yom also does at the start of her own article, in an apparent contradiction with its end.

Another problem is that some critics' analyses portray the novels as containing a granular amount of references to numerous details of the science, and hence employ a dubious one-to-one approach to connecting Woolf to quantum physics. The most representative

[38] Ryan, *Materiality of Theory*. 175.

[39] Hussey, "To the Lighthouse and Physics". 81.

[40] Ibid. 94.

[41] Furthermore, according to Mark Morrisson's study of modernist science and technology: 'The problem with anachronistic interpretations isn't simply that they are anachronistic — not all scholarship need be as historicist as the new modernist studies has tended to be. Rather, it is that they can obscure the wealth of understanding available through more careful attention to the scientific contexts of the period'. Mark S. Morrisson, *Modernism, Science, and Technology*, London, Bloomsbury Publishing, 2016. 73.

[42] Hussey, "To the Lighthouse and Physics". 80.

example is Killen's analysis of *The Waves*, which contends that the novel depicts, to summarise:[43] a view of reality as containing waves and particles at once; the centrality of the human observer; the ability of human agents to collapse potentialities into actuality; transitions in the form of leaps; complementary dualities; and a depiction of the quantum realm as opposed to Newtonianism. This is a large quantity of analogues, which – were they due to Woolf's knowledge of the science as Killen affirms – would demonstrate a comprehensive understanding of quantum mechanics by the author. While this is by no means impossible, it does seem unlikely given that nowhere in her personal or professional writings does she discuss, or even mention, quantum ideas. Such a strong understanding that directly influenced her work also seems to contradict her scepticism towards Nielson's topic of dissertation, and more generally her 1931 affirmation that science is 'the least like to my own ideas'.[44] Neither fact makes it implausible for science to have influenced Woolf; however, they do make it unlikely that she had a profound knowledge that heavily informed the composition of *The Waves* at multiple levels.

A third monumental issue is the fact that there exist many other intellectual fields which could have similarly impacted Woolf. Indeed, Westling and Slutzky Zucker both include another intellectual topic along with quantum theory in their analyses – Merleau Ponty's ecological humanism, and Ferdinand de Saussure's linguistics, respectively – which demonstrates that several of Woolf's quantum-concepts can also be tied to subjects that are not scientific in nature. Killen discusses how the quantum opposition to the Newtonian worldview can also be found in the late-19th century psychology of William James, David Hartley, or more particularly, Henri Bergson: 'Bergson intuits the directions modern science, or new physics, would take in working out the mathematical and physical implications of Max Planck's radiation theory'.[45] Friedman and Donley, quoting Alfred North Whitehead, extend this pre-quantum anti-Newtonianism to romantic poetry: 'Wordsworth and other Romantics had not only realized the limits of materialism but had proposed an organic philosophy which anticipated aspects of modern science'.[46] Given that, as Killen, Friedman and Donley point out, Woolf would have been aware of these pre-quantum, non-scientific factors while writing her

[43] Killen, *Woolf in the Light of Modern Physics*. 88-117.

[44] Woolf, "Woolf to Ethel Smyth, 6 Dec. 1931". 409. It should nevertheless be noted that it is after this claim that she affirms her desire to read science, namely Jeans.

[45] Killen, *Woolf in the Light of Modern Physics*. 4.

[46] Friedman and Donley, *Myth and Muse*. 34.

novels, it is pertinent to question whether what seems like echoes of quantum theory in her work are instead echoes of other pre-quantum sources that “intuited” or 'anticipated' aspects of the new physics. Indeed, Ann Banfield's *Phantom Table*, a book quoted by many of the above academics, proposes an analysis of the novelist's *œuvre* that accounts for many quantum-concepts of her work by invoking Woolf's knowledge and connections to Bertrand Russell, and the associated philosophy of Cambridge realism, while only mentioning physics twice in passing.[47] After reviewing quantum analyses of Woolf, Tolliver Brown seems to conclude that the philosophy which surrounded Woolf's life is a better means of analysing the conceptual content of her work, rather than a vague hypothetical assertion of quantum influence:

> Although these critics have suggested that Woolf's [...] philosophy reflects an essential tenet of quantum physics – specifically the wave-particle duality of light and matter – they have yet to establish the specific ways in which the ideas she shared with the preeminent subatomic scientists of her time work into the characters and themes of some of her most important novels.
> It may be impossible to determine the degree of influence discoveries in contemporary science may have had on Woolf's fiction or in what measure her own ideas preceded them. However, it is certain that, because of her father, she had considerable exposure to the philosophical questions underlying the debates among physicists in the early twentieth century regarding objective reality[48]

Nevertheless, apparently disregarding his own conclusion, Tolliver Brown goes on to give a quantum reading of Mrs. Ramsay in *To the Lighthouse*, which, like Killen's analysis of *The Waves*, is composed of one-to-one analogues, such as subject-object interdependence, non-locality, holism, and observer-observed interactivity. This is even though, when Woolf was writing the novel, Bohr's framework that pushed these factors to the forefront of quantum theory did not yet exist.

The above anachronism regarding *To the Lighthouse* was identified twenty years prior by Marty Clark, which reveals the final main issue, that quantum-concepts can be found in earlier writings by the novelist: 'Woolf began writing novels more than a decade before the major discoveries of the quantum physicists were published; in fact, the publication of *To the Lighthouse* in 1927 coincided with the publication of Heisenberg's Uncertainty Principle'.[49] This leads Marty Clark to reject influence models for her quantum analysis of the novel,

[47] Ann Banfield, *The Phantom Table: Woolf, Fry, Russell and the Epistemology of Modernism*, Cambridge, Cambridge University Press, 2000. 6 & 123.

[48] Brown, "Relativity, Quantum Physics, and Consciousness". 40.

[49] Clark, "Consciousness, Stream and Quanta". 413.

because scientific influence indeed does not make sense if Woolf came first. This is a point already made by Whitworth while discussing *The Waves*, which:

> has been associated with the wave/particle duality of the "new" quantum theories of the mid 1920s. While there are certainly some suggestive similarities, a retrospect of Woolf's earlier novels reveals that Woolf had developed many aspects of her own wave/particle model of the self in anticipation of the physicists[50]

This adds to the scepticisms introduced thus far, for if Woolf's earliest writing also contained wave-particle-like binaries along with other quantum-concepts – as Shiach and Crossland's analyses both suggest – then it would imply that the elements of her work which echoed the new physics are not due to an influence of the science, but may instead be the result of another type of cultural phenomena, or may even merely be an interpretation from academics, hinting at a connection that may not have taken place in the real world.

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B/ Four Valid Frameworks

So, while it seemed like there was "something there", the theory to explain what is "there" in most analyses thus far – influence, direct and indirect – contains weaknesses that render it unconvincing by itself. This is in large part because the nuances and complexities of discussing influence are not the focus of the publications; the notion is merely advanced as justification for interpretation. There are, however, critics who have addressed these issues and their intricacies thoughtfully, and have therefore established refined frameworks to account for the apparent ties between Woolf and quantum physics.

Beer was very much an instigator of these discussions, not only for Woolf and physics, but literature and science more generally. Her work on the echoes between Eddington and Woolf's writings does not employ a naïve direct influence model; nor does her article on the cross-cultural impact of the wireless in the inter-war years adopt a vague *zeitgeist* framework. Instead, they both follow the methodology Beer set out in her pioneering 1983 study on Charles

[50] Whitworth, *Einstein's Wake*. 162.

Darwin and Victorian literature, *Darwin's Plots*, which states that the central means of connecting literature and science is through language writ large, or, discourse:

> [*Darwin*] did not *invent* laws. He *described* them. [...] His work is, therefore, conditional upon the means of description: that is upon language. And his description is necessarily conditioned by the assumptions and beliefs condensed in the various kinds of discourse active at the time he was writing. Though the events of the natural world are language-free, language controls our apprehension of knowledge, and is itself determined by current historical conditions and by the order implicit in syntax, grammar, and other rhetorical properties such as metaphor[51]

This explains why Beer focuses on Darwin's stylistic choices and narrative influences: it is within that use of discourse that literature and science meet. Indeed, Darwin explained his theory in a manner that would be understandable to a non-specialist audience. This forced him to employ narratives ('plots'), ideas, metaphors, and terms that were readily available in widespread culture and literature, and hence tinged with meanings from theology, myths, social conditions or other pervasive constructs from the time: 'Darwin drew upon the imaginative orderings and the narrative formulations of his contemporaries'.[52] These pre-built meanings inevitably had an impact on his theory's reception:

> For scientists working in the same area, words like "man", like "race", like "contrivance", would be severely and effectually contained by the context of published debate using the same terms. But for readers approaching such terminology without an active experimental involvement in day-to-day scientific procedure, the terms could expand their parameters to draw on other shared assumptions[53]

Additionally, because 'Darwin's theories profoundly unsettled the organizing principles of much Victorian thinking',[54] the meaning and use of the linguistic materials the scientist employed were themselves changed when they made their way back into literature following the publication of Darwin's opus, as Beer explores in Part III. In her studies of Woolf and quantum physics, Beer treats Eddington like Darwin: analysing his language, style and metaphors; the influences from his youth that shaped his thought; the culture for which he was writing; and how these factors enabled him to effectively explain the paradigm-shifting nature of the new physics to non-scientists. All this in turn affected how the discourse he employed

[51] Gillian Beer, (1983), *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction*, Cambridge, Cambridge University Press, 2004. 46.

[52] Ibid. 41.

[53] Ibid. 47.

[54] Ibid. 42.

was received and used by authors who read him. One telling example is the philosophical trope of the two tables. In the beginning of Bertrand Russell's 1912 academic popularisation, *The Problems of Philosophy*, he uses the table before him as a means of questioning how human beings gain knowledge of the outside world, and sets up a separation between the table experienced empirically, and a mysterious 'real' table: 'Thus it becomes evident that the real table, if there is one, is not the same as what we immediately experience by sight or touch or hearing. [...] Hence, two very difficult questions at once arise; namely, (1) Is there a real table at all? (2) If so, what sort of object can it be?'.[55] This is a traditional thought-experiment from philosophy, presumably understood by a not-insignificant portion of the public: Russell's book was a best-seller.[56] In *The Nature of the Physical World*, Eddington therefore repurposes the trope to explain physics to a general audience:

> One of them has been familiar to me from earliest years. [...] It has extension; it is comparatively permanent; it is coloured; above all it is substantial. By substantial [...] I mean that it is constituted of "substance". [...]
> Table No.2 is my scientific table. It is a more recent acquaintance and I do not feel so familiar with it. [...] My scientific table is mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed; but their combined bulk amounts to less than a billionth of the bulk of the table itself[57]

Here, the 'real' table is the one revealed by atomic theory, in place of the one revealed by Russell's analytic philosophy, but both illustrate a mysterious reality beyond everyday experience, which is radically unlike that which humans commonly know. This is an example of a scientific writer employing the discourse of their time to help explain new concepts, and as with Darwin, this in turn affects how the discourse is subsequently employed in literature. For instance, Beer points out that:

> Woolf found in the new physics dizzying confirmation of her sense that the real and the substantial are not the same. [...] When Woolf comments wryly of *The Waves* that there is "no quite solid table on which to put it", and when within the novel her thinkers doubt "the fixity of tables", "are you hard?", she is taking part in a stressful debate at large in the world of her time[58]

[55] Bertrand Russell, *The Problems of Philosophy*, London, Williams & Norgate, 1912. 16-7.

[56] See: Werner Martin, *Bertrand Russell: A Biography of his Writings 1895-1976*, München, K.G. Saur, 1981. 32-6, for the book's publication history.

[57] Eddington, *The Nature of the Physical World*. ix-x.

[58] Beer, "Eddington and the Idiom of Modernism". 304.

Woolf employs the same metaphor of a mysterious, insubstantial, table from another “reality”, which ties to her own philosophical concerns regarding the solidity of human experience. To comment on this similarity between philosophy, physics and literature does not necessarily imply a cause-and-effect chain of influence from Russell to Eddington to Woolf. The only claim is that they were all scrutinising a similar concern for independent reasons, and therefore all tapped into the same discourse of the moment, within which the two tables was a fitting trope that they evolved for their own goals. While the chronology of these writers, and the fact that they all may have read each other, could imply that there was influence, Beer refines how this came to be:

> we are likely to go astray if we look only for orderly reading exchanges between scientists and literary writers. It becomes clear that fugitive acquaintance, a sense of the possibilities opened by another's work, sometimes a single sentence on the first page ("The atom is as porous as the solar system"), may suffice to produce a change that changes writing[59]

The point here is that the materials from scientific language that literary authors seem to employ need not demonstrate an understanding of the science or its philosophy; they can merely have come across them accidentally. Woolf's reference to the table in *The Waves* may only be due to a transient contact with Eddington's work that echoed her own concerns, but without her gaining any recognisable knowledge of the physics he discussed. Similarly, Beer's article on the wireless does not declare that it enabled literary writers to become knowledgeable of the new physics, but instead explores how the once separate discourses of literature and science came into contact materially and imaginatively due to the radio's powers of popularisation and its creation of a 'general audience': 'from 1929, literary and scientific talks mingle and often overlap [...] On the radio Harold Nicolson was the foremost interpreter of literary modernism for a general audience at this time, just as Gerald Heard was for scientific modernism'.[60] With her approach, Beer side-steps both the strong claim of scientific knowledge of direct influence studies, as well as the vagueness of the *zeitgest* model.

Following Beer, Whitworth's 2001 *Einstein's Wake* put forward a further refined model for the study of the new physics and modernist literature's interrelations. While similar to Beer's use of discourse, Whitworth focuses on metaphors as the central meeting point between the

[59] Ibid. 296.

[60] Beer, "'Wireless': Popular Physics, Radio and Modernism". 161.

two fields, defined as 'the definition of the unfamiliar in terms of the familiar'.[61] This also allows for a two-way analysis of the connections between literature and science: 'Not only can scientists understand new phenomena in terms of familiar material objects and social institutions, but non-scientists can defamiliarize the familiar, reconceiving it in metaphors provided by new scientific theories',[62] for indeed, what is deemed 'familiar' or not is constrained by any given culture at any given time. Furthermore, in Whitworth's language theory, metaphors are also constitutive of how rational discourse is built; that is, metaphors are not merely "borrowed" from culture to be added to what is being discussed, they construct language itself: 'rational discourse occurs *because of* metaphors, and not in spite of them'.[63] This is germane as it redefines the issue of knowledge and influence: literary writers may employ metaphors which have been in some way affected by science, not because they heard of, or understood, the science itself, but because the metaphors are part the discourse they exist within. This seems as if it might open the door to a *zeitgeist* model of study, as it implies a transformation of language in culture which makes its way from science to literature without direct influence. And indeed, Whitworth does pursue a *zeitgeist* methodology, but – once again – with increased sophistication to avoid academic pitfalls. As already made clear, the key problem with the indirect influence model is its vagueness, invoking a flimsy "spirit", "matrix", "atmosphere", or "climate". Whitworth, therefore, renders it concrete: by studying the periodicals of the time, he can materially determine and track not only how metaphors evolved in discourse due to their scientific associations, but also which local communities had access to certain metaphors and information, depending on which periodicals were read within their circles. This 'allows us to reconstruct the local *zeitgeist* of a particular social network, rather than a generalized *zeitgeist* which never informed the work of any individual. It allows us to pursue intertextual relations within that network without losing sight of the materiality of *parole*'.[64] Additionally, it prevents the issue of anachronisms, for the discussion of science is bound by the periodicals' contemporary understanding of it. This explains Whitworth's tentative scepticism regarding the notion that Woolf's binaries of matter in *The Waves* are due to the influence of quantum mechanics: in studying how notions and metaphors of matter,

[61] Whitworth, *Einstein's Wake*. 10. This is the reason why this thesis focuses on "conceptual similarities" instead of "metaphors" specifically: quantum-concepts are not explanations of one domain by means of another, they are only the denomination of an interesting philosophical parallel between both domains.

[62] Ibid. 12.

[63] Ibid. 14.

[64] Ibid. 19.

porosity, atoms, or substantiality were communicated in the late-19th and early-20th centuries, he concludes that 'It seems likely that the similarities between Woolf's conception of character and the new ideas about matter is due to a more wide-spread set of homologies, particular instances of which may be found in science, philosophy, linguistics, and other disciplines'.[65] This does not prevent a study of these metaphors in her work and how they can be tied to the scientific discourses that surrounded her,[66] but it does not require the notion that she was directly influenced by quantum theory and reacting to it, nor does it require the notion of a vague "spirit of the times", as many other critics employ in their articles: 'any attempt to make too close an identification of Woolf's discourse with Schrödinger's is disrupted by the counter-claims of other scientific discourse'.[67]

A more recent book-length investigation into the ties between the new physics and modernist literature, Crossland's *Modernist Physics*, also compares and contrasts different methodologies – discussing Beer and Whitworth's work at length – to conclude that the notion of a "shared discourse" is the ideal candidate for the study. This notion is taken from Beer, but opened up to encompass not only language, but all aspects of thought and sentiment: 'Sharing can be active or passive, intentional or accidental; it can involve words, structures, or ideas, or even just those underlying "concerns" of which Hayles speaks and which Beer elsewhere calls "the common anxieties of the time"'.[68] Crossland's goal with this concept is not only 'to provide a model which balances direct lines of influence with a cultural matrix',[69] because both frameworks, while limited, do possess some definite historical validity, but also to undermine what she sees in literature and science studies as 'an inequality here, a hierarchy which still grants science a special place within culture'. The scholar therefore shares the anxiety previously discussed with George Levine and N. Katherine Hayles, of not granting a perceived privileged position to science within culture, as they fear this would devalue literature. It should here be noted that Beer also shares this feeling, such as when she states that she is 'not seeking to emphasise only likeness or to suggest one-way debts between Woolf's work and the [...] writing of Eddington and Jeans'.[70] It is hence unsurprising that Crossland invokes both Hayles

[65] Ibid. 156.

[66] As occurs at 153-69.

[67] Whitworth, *Einstein's Wake*. 164.

[68] Crossland, *Modernist Physics*. 9.

[69] Ibid. 8.

[70] Beer, *Common Ground*. 117-8.

and Beer in this context. Luckily, the issues previously discussed with Hayles do not apply here, due to Beer and Crossland's specific focus on discourse as a *shared* cultural construct – that is, instead of considering science *as* a discourse, they consider how it interplays *with* the larger discourse; a neutral point of view regarding scientific objectivity. This also prevents them from theorising an overly open, and merely assumed, concept of "cultural field" as Hayles did. Nevertheless, it means that in Crossland's analysis, Woolf and D.H. Lawrence 'will be considered not simply as passive receivers of various changes in discourse and context, but rather as active users and transformers of, as well as contributors to, particular contemporary ideas'.[71]

The concern of theorising literature as an equal to science in the cultural sphere is shared by Livingstone. In fact, the model she proposes to study quantum experiments in *The Waves* is founded on the proposition that 'Literature and science can be thought of as mutually confirming disciplines, with particular ideas being passed from one to the other in a loop of influence'.[72] This 'loop of influence', or 'feedback loop', is Livingstone's own reconceptualised model of transmission that deviates from either direct or *zeitgeist* frameworks. It possesses the advantage of materially explaining the echoes between Woolf and quantum science, without depicting the author as a second-place, passive receiver of scientific information which influences her work, or by assuming cultural osmosis without evidence. Indeed, Livingstone's framework affirms that concepts in literature – like identity – influence how scientists think of and describe their experiments – like subatomic physics. Then, literary writers re-integrate these now scientifically-tinged conceptions back into their work, which in turn influences scientists again, occasioning the aforementioned 'loop of influence', until 'The result of this process of feedback is that the two questions – quantum physics and human identity – become more and more associated in the cultural imagination'.[73] With this model, the possibility of finding wave-particle constructions in Woolf's early work, before quantum mechanics was born, is no longer an issue; instead, 'it merely illustrates the extent to which literature can inflect scientific discourse'.[74] The question of influence has now come full circle then, with Woolf herself having possibly impacted quantum physics.

[71] Crossland, *Modernist Physics*. 11.

[72] Livingstone, "Experimental Identities". 75.

[73] Ibid. 67.

[74] Ibid. 77.

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C/ Methodological Solutions

Conclusions can be drawn from the four refined frameworks regarding the potential issues of Woolf and quantum physics studies. However, before doing so, there remains one drawback identified in the previous chapter that still affects these scholars, and which should hence be discussed first.

This difficulty is the attempt to shape one's framework in order to impose a dubious balance of influence. Indeed, while none of the four conceptualisations are explicitly antipositivistic like those in the *One Culture* collection, and hence they avoid many of the issues discussed then, there still remains the misplaced anxiety of not being perceived as valorising science over literature. Crossland and Livingstone both make clear that their methodologies were designed with this concern in mind, while Beer warns that one should not conclude that she is implying a one-way transmission that puts literature in an inferior position. The problem here is that, with the hypothetical exception of Livingstone,[75] none of the critics provide much evidence or interpretations that actually do demonstrate that there existed – *in reality* – a balance of influence. Beer states that she is not attempting 'to suggest one-way debts between Woolf's work and the [...] writing of Eddington and Jeans'. However, it is clear that Woolf is almost always positioned as a receiver of scientific knowledge in Beer's studies: 'you will find Woolf reading Jeans and trying to imagine space bending backwards';[76] 'she wanted to explore the work of scientists writing popular works [...] Difference should not lead us to suppose that she was unaffected';[77] 'Woolf read him [*Jeans*] in midst of all else she feels and knows. He is not set apart as "science" but enters the *melée* of response in which her imagination best works';[78] 'one use Woolf made of current scientific writing in her own work

[75] Livingstone's thesis or book may contains convincing arguments for the literature-to-science influence, which is merely hinted at in her article without evidence.

[76] Beer, "'Wireless': Popular Physics, Radio and Modernism". 161.

[77] Gillian Beer, *Wave, Atom, Dinosaur: Woolf's Science*, Virginia Woolf Society of Great Britain, 2000. 1.

[78] Ibid. 6.

was to energise';[79] 'Woolf found in the new physics dizzying confirmation of her sense that the real and the substantial are not the same';[80] 'She knew of the writing of the Victorian physical chemist John Tyndall and may have read passages such as this already in her imagination';[81] 'In this turn of her thinking, both physics and poetry help'.[82] Granted, these sentences occur within a framework that brings a great deal of nuance and methodological contextualisation to the notion of transmission. Nevertheless, it remains clear that, even while advocating against one-way understandings in literature and science, Beer still relies on it almost exclusively, at least concerning Woolf. Furthermore, while the scholar does much to show how new scientific knowledge embraced and modified the moment's discourse, as is made clear via Woolf, Beer is rarely ever seen doing the reverse analysis of investigating how the novelists' writing impacted the discourse, in a way that could potentially be relevant to the new physics or its cultural reception.[83] This is even more visible in Crossland, for while she introduces her study by noting that her subjects of study 'will be considered not simply as passive receivers of various changes in discourse and context, but rather as active [...] transformers of, as well as contributors to, particular contemporary ideas', she does not do much work to demonstrate how Woolf "contributed" to the ideas she discusses, other than by interpreting how the author used and transformed them in her own writing. However, this is not directly relevant to Woolf's influence on the discourse at large, and even less to how physicists employed it. Furthermore, Crossland's differentiating between a conception of authors as being either 'passive receivers' or 'active users and transformers' of the discourse feels meaningless: as was discussed with Dirk Vanderbeke and Hayles, all literature uses and transforms factors external to it, even if unconsciously, as it is very much a defining trait of the artform. It is unclear what is meant, practically, by an author being a 'passive receiver' of scientific discourse, other than to set up a strawman conceptualisation against which Crossland can position herself, in order not to be

[79] Ibid. 8.

[80] Beer, "Eddington and the Idiom of Modernism". 304.

[81] Beer, *Common Ground*. 89.

[82] Ibid. 116.

[83] Indeed, this is a rather awkward outcome of Rousseau's 1978 advocacy for 'the possibility that literature has shaped or can shape scientific developments' (Rousseau, "State of the Field". 587): after forty years of literature and science scholarship, there are still strikingly few studies that convincingly demonstrate the influence of literature on science. Even George Levine himself admits in his 2009 preface to the third edition of *Darwin's Plots* that it is one of the only true examples of such a demonstration, which sets it apart from the rest of the field: 'What distinguished the book, and what continues to distinguish it in literary study, is [...] a bold and convincing demonstration that Darwin should be read [...] as someone whose ideas were also importantly shaped by culture. *Darwin's Plots*, that is to say, indicates that the cultural traffic ran both ways'. George Levine, "Foreword by George Levine", in *Darwin's Plots*, ed. 3, Cambridge, Cambridge University Press, 2009. xii.

seen as somehow devaluing literature.[84] Even though, in practice, the actual body of her study rarely if ever pushes back against the science-to-literature view. Finally, Whitworth does not examine the reversibility or balance of influence with his metaphor model, but as this was not foundational to his methodology, it is not here worthy of comment. However, it does underline the overall point that, in effect, there has rarely been any genuine effort in the field to *demonstrate* the balance of influence – even though many critics advocate for it.[85] Hence, the same conclusion can here be reached regarding the topic as earlier, though for different reasons: the methodological ordinance that literature should never be perceived as being in an inferior position to science tends to be misguided, fruitless, responsible for difficulties, and has not yet convincingly been shown to be coherent with the historical reality being studied. With this factor stated, it is now possible to identify the qualities of the four refined frameworks and extract methodological solutions from them.

First, unlike Hayles, Marty Clark, or Sun Yom, none of the four critics reject influence as a concept. Beer presents a large amount of research displaying how Woolf could have transiently been made aware of quantum science; Whitworth's analysis of periodicals requires that authors or their communities came into contact with articles discussing the new science; Crossland's framework explicitly aims to balance direct and indirect models; and Livingstone's feedback loop also requires 'specific conceptual transmission' in order to operate.[86] For all the discussions regarding the validity, or lack thereof, of influence models in literature and science studies, it is clear that the notion itself cannot be discarded, as it is near-inevitable when attempting to tie together such disparate activities. The problem, then, is not influence itself. It is instead, as previously shown, that many academics invoke it naïvely as a means of justifying their actual goal of interpreting similarities as an end in and of itself. This unsophistication, not the models themselves, leads to many issues, such as those that Jennifer Burwell points out in her own evaluation of the field, which very much echo those of the above literature review.[87] Given this, it seems easier and more productive to accept from the outset the obvious

[84] For, were an author capable of passively absorbing quantum knowledge and uncritically including it in their writing unconsciously, this would nevertheless imply some use and transformation of scientific knowledge, based on the fact that it is visible in the writing, and is hence necessarily interconnected with the rest of the literary materials. It is also unclear why studying such a hypothetical case of passive transmission would not be academically valid and productive in itself, other than the fear that it somehow "devalues" literature.

[85] Again, with the hypothetical exceptions of Livingstone's thesis and book.

[86] Livingstone, "Experimental Identities". 69. It is worth noting that Livingstone's book, published in the final weeks of this thesis' composition, employs BBC radio broadcasts on science to investigate the transmissions between artists and physicists. Livingstone, *Virginia Woolf, Science, Radio, and Identity*.

[87] Burwell, *Quantum Language*. 127-34.

inevitability of the science-to-literature influence conceptualisation (whether direct or indirect, or alternative versions), and *from there* to construct a more refined and methodologically sound framework that takes into account and addresses the many potential flaws of the concept. This could then potentially lead to subtle conclusions regarding the notion of cultural fields, or even the multidirectional nature of influence, that are genuinely supported by the analysis, instead of being assumed theoretically for ideological reasons, and then rarely ever touched upon in practice.

A second observation concerns the notion of a "middle-ground" between literature and science. That is, all four refined frameworks theorise the transmission between both fields as being mediated by something else, as opposed to many other publications in the literature review that tend to straightforwardly connect Woolf with physics, even when invoking the *zeitgeist* to do so. To Beer, the middle-ground it is the moment's discourse; Whitworth focuses on metaphors within periodicals; Crossland opens up Beer's concept to also include 'words, structures, or ideas, or even those underlying "concerns"'; while Livingstone specifically emphasises the physicists' and the author's 'own pre-existing concerns' as their meeting point.[88] All these achieve the same dual-role of preventing the strong claim of scientific understanding from direct models, as personal knowledge is no longer required to justify connections, as well as preventing the immaterial vagueness of indirect models, for the medium of transmission is now defined and analysable. There is not much here to comment upon, other than to highlight the usefulness and importance in such studies of defining the medium of transmission as a middle-ground existing between, and within, literature and science, which can then be unearthed and analysed in either activity to discuss connections in a more academically valid manner. What is more interesting though, is the middle-ground's relevance to another issue in Woolf and quantum physics studies: anticipation.

Whitworth's statement that 'Woolf had developed many aspects of her own wave/particle model of the self in anticipation of the physicists' summarises a major issue that must not be avoided in this field of research. Ignoring it, as several critics do in the literature review, inevitably leads to anachronisms, as the chronology of Woolf's literary conceptualisations and the physicists' theorisations do not perfectly line up. Indeed, to use Whitworth's example, the full implications of quantum wave-particle duality were not made clear before 1925 with Louis de Broglie's thesis, therefore, it is meaningless to affirm that the

[88] Livingstone, "Experimental Identities". 67.

wave-particle dualities found in Woolf's pre-1925 novels were indirectly influenced by quantum physics. Livingstone addresses this considerable difficulty by theorising how the feedback loop model could allow for the novelist's conceptions to have made their way towards physics, as was explained earlier, but also, with her mention that the 'concerns' that form her theoretical middle-ground are 'pre-existing'. This is subtle but important. To some extent, it is necessary that the discourse, metaphors, ideas, concerns, or any other medium that are shared by literature and science also *pre-exist* the specific literature and science being discussed. In Beer's example, the two tables trope that Eddington and Woolf both employed for their own creative reasons was already a part of the discourse before they did so, as Russell exemplified. Much of the richness of Whitworth's study is that the metaphors he deals with are not merely those that emerge from science, and that hence have a restricted meaning in a restricted context, instead, 'The abstract concepts under discussion here are not the complex abstractions of modern science, but far simpler abstractions which preceded and have largely been incorporated into it', therefore his middle-ground also pre-exists literature and science.[89] Anticipation is a major factor in Crossland's theorisation, and informs the structure of her two chapters on Woolf and quantum physics. After quoting Whitworth's statement regarding the 'retrospect of Woolf's earlier novels', Crossland announces:

> I propose to carry out such a retrospect, locating and analysing examples of wave/particle models in Woolf's works up to the end of 1925, and questioning this idea of "anticipation" [...] by also providing a retrospect of some of the various contemporary discourses, both scientific and otherwise, which may have informed such models[90]

Hence, her chapters' analysis openly aim to resolve the quandary of Woolf's quantum-concepts arising before they also became recognised in physics. To do so, she selects a specific middle-ground: 'contemporary discourses, both scientific and otherwise, which may have informed such [*wave-particle*] models'. Crossland's analysis allows her to conclude that it is not the case that Woolf "anticipated" the physicists, but rather that the author and the scientists were both responding to a variety of shared antecedent discourses that similarly affected their own conceptualisations within their own fields. Hence, the middle-ground can account for the anachronistic similarities, even though – critically – this explanation can only operate if the discourses existed *before* Woolf's modernist work and quantum physics. This confirms that the middle-ground one selects for these studies should also pre-exist the literature and the science

[89] Whitworth, *Einstein's Wake*. 9.

[90] Crossland, *Modernist Physics*. 20.

being discussed. A final argument for this conclusion is that if one aims to study how literature and science impacted the various middle-grounds, as Beer explicitly does, it is essential to first isolate what the middle-ground's state was before it was affected by Woolf or physics, to then be able to identify the modifications. This, again, validates Crossland's structure: after her chapter studying how wave-particle models pre-existed Woolf and physics, affecting them both, her next chapter investigates how they then modified and evolved the models, for their own reasons, after 1925 – by correspondingly transitioning from an 'either/or' dualism, to a 'both/and' complementarity. This allow Crossland to propose a much more convincing, subtle, and discerning narrative of Woolf's relationship with physics than what any other academic has published thus far.

While pre-existing middle-grounds are hence ideal to construct an academically valid influence framework, they also risk returning scholars to another large difficulty of the field, one Burwell considers to be 'pervasive':

> other critical paradigms or thinkers – for example, Freud or Bergson in the modernist period, [...] – may be equally or more appropriate and productive than quantum physics as tools of analysis. This last concern proves to be a pervasive problem in "quantum" interpretations of modern and postmodern literature[91]

This is due to another related aspect of the "anticipation" problem: quantum-concepts can be unearthed in several discourses that pre-date the new physics. Indeed, while this fact solves the apparent anticipation of quantum physics in Woolf, following Crossland's study, it also raises the question: what relevance does quantum science *actually* have for Woolf, if one can account for the echoes of it in her work using other factors? This is a particularly urgent concern given the lack of a "smoking gun" already discussed, added to the fact that Freud or Bergson (amongst others) were undeniably larger figures in Woolf's intellectual environment and life, particularly when compared to an overwhelmingly convoluted, ever-mutating, and cryptic science that emerged when she was already well into her adult years, and that she never discussed directly in her writing or letters. While many critics have noticed this issue, few have truly engaged with it. For instance, it was mentioned in the literature review that Marty Clark rejects influence as a model to study quantum themes *To the Lighthouse*, as it was published before Werner Heisenberg's uncertainty principle. Instead, she theorises a possible pre-existing middle-ground to study as a means of connection: it 'might be that Woolf's work and that of

[91] Burwell, *Quantum Language*. 129.

the post-Newtonian physicists of her time emerge from the same rupture and so are connected in ways which cannot be described as either influence or parallel'.[92] This is by now a standard idea – that Woolf and the quantum are tied due to their similar rejection of Newtonian ideals – however, Marty Clark does not investigate or employ it in her study, it is merely presented as an hypothesis that could *potentially* resolve the issue, though no evidence is put forward. Relatedly, Tolliver Brown alludes to the philosophy that Woolf's father wrote in the 19th century, because this could also be considered a pre-existing middle-ground that granted her 'considerable exposure to the philosophical questions underlying the debates among physicists in the early 20th century regarding objective reality'.[93] While this is a worthwhile viewpoint to investigate, in Tolliver Brown it is only present as a justification for his quantum reading of Woolf, and it does not make him question whether the novelist's exposure to philosophy might be justification enough for the intellectual content of her work, without having to invoke anachronistic physics. Finally, Friedman and Donley also mention how:

> Uncertainty and discontinuity have always had a place in literature [...] In much 20th-century literature, however, indeterminacy and related themes become central to tone and structure [...] Even within science itself, there are other possible origins for the ascendancy of these topics[94]

As with Tolliver Brown, the critics present a valid idea – literature and science are paralleled in how they relate to and have evolved formalised themes and structures – which could form the basis of a methodologically sound framework. But, it is instead only mentioned in passing to justify a one-to-one anachronistic reading of the author's novels as being directly influenced by the science, the validity of which is actually lessened by their admission that various quantum-concepts 'have always had a place in literature', while in science they have 'other possible origins'. Beer, Whitworth, and Livingstone's article are all aware of this problem and avoid the error it leads to – indeed, it is the source of Whitworth's scepticism that *The Waves* can undeniably be considered quantum –, but Crossland is alone in fully and actively engaging with, and attempting to resolve, the problem with her two-part analysis. The pre-1925 chapter establishes how Woolf formulated aspects of her wave-particle model, and the many non-quantum discourses that could have influenced her in doing so, before de Broglie's synthesis of light and matter. This then allows for a comparative study with Woolf's post-1925 wave-

[92] Clark, "Consciousness, Stream and Quanta". 414.

[93] Brown, "Relativity, Quantum Physics, and Consciousness". 40.

[94] Friedman and Donley, *Myth and Muse*. 128.

particle model, to ascertain what parts of it were *specifically* modified due to an influence of quantum mechanics' innovations, which cannot be explained with other pre-existing fields. This comparative methodology is therefore the most appropriate and productive manner of investigating this 'pervasive' problem that has been proposed thus far. This, in addition to its resolution of other common issues, as well as the preciseness of its conclusion, makes clear that Crossland's methodology is, as of the writing of this chapter, the best available manner of investigating Woolf and quantum physics.

Chapter 3 - Complementarity

Before *Modernist Physics* was published in March of 2018, the plan for this thesis – formulated independently from Rachel Crossland – was a very similar two-part analysis. First, studying Virginia Woolf's writing that pre-dates quantum mechanics, in order to elucidate which of her quantum-concepts were assuredly not influenced by the physics. Then, comparing those to the quantum-concepts of later Woolf, to ascertain the extent to which the science did affect her thought, or not. However, it was deemed too similar to *Modernist Physics*, hence the shift to the current sceptical approach, justified and fortified by Jennifer Burwell's criticisms of the field published the same year. This change was also motivated in part by a shortcoming in Crossland's chapters regarding what is arguably one of the most important concepts in this particular field: complementarity.

To display its relevancy, it will first be contrasted with other quantum-concepts to display complementarity's academic value to Woolf and quantum mechanics. However, given the complexity of the concept's history and philosophical motivations, a deliberate definition will be proposed which will highlight various elementary facets of complementarity that are rarely, if ever, appreciated in literary studies. An unfortunate example of this will be *Modernist Physics*, as it confuses wave-particle duality with Bohrian complementarity. However, this error will illuminate a specific position that *To the Lighthouse* occupies within these considerations, allowing for a productive analysis to follow.

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A/ Complementarity's Relevance to Literature

Wave-particle complementarity is the central idea around which Crossland's study of Woolf revolves, as it is considered to be the marker of the novelist's engagement with quantum physics. Even beyond this one scholar's specific interpretation though, it is a *cliché* that Woolf employs binary constructions in her art and thought, and as complementarity proposed a

philosophical reconceptualisation of physical dualities contemporaneously with the author, it is obviously a key concept to explore.

Complementarity is a core philosophical notion in quantum mechanics, which signals – more than any other associated quantum-concept – the intellectual innovation and disconcerting nature of the science, and has hence been academically debated ever since its inception. Including, most strikingly, a series of influential debates between Niels Bohr and Albert Einstein on the completeness of quantum mechanics from 1928 to 1935, a result of which was the explicit conceptualisation of entanglement.[1] Bohr began developing the theory in response to several anti-classical advances of 1925 and 1926 that birthed quantum mechanics, but only shared it publicly in late-1927 at two physics conferences, and published it in *Nature* in April of 1928.[2] Steen Brock summarises the radical nature of the theory:

> the serious concern, in 1925, was that physics did not just need a new theory to account for a new surprising set of experimental findings; it rather needed a new *kind* of theory, where the links between observations, experiments, measurements, concepts and judgments was seen in a different way than it had previously been.
> Accordingly, this was the perspective from which Bohr tried to assess both Heisenberg's and Schrödinger's "quantum mechanics"[3]

This explains why complementarity matters here: it is a *specific* philosophical theory that organises much of the strange innovative and problematic aspects of the discipline into a genuinely innovative scientific framework. The theory is not merely a "philosophical consequence" such as uncertainty or any other quantum-concept, which only *seem* to arise out of a simplified understanding of the science. This generates many reasons why complementarity is a better notion for unearthing links between literature and the science, instead of the mixed bag of unrelated quantum-concepts – at least in the context of Woolf.

Indeed, Bohr's theory contains within it many of the other paradigm-shifting aspects of quantum physics, and defines them in context.[4] Additionally, the genuine intellectual

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[1] See: Manjit Kumar, *Quantum: Einstein, Bohr and the Great Debate About the Nature of Reality*, London, Icon Books, 2008. 'Part III: Titans Clash Over Reality', 250-328.

[2] Niels Bohr, "The Quantum Postulate and the Recent Development of Atomic Theory", *Nature*, 1928, 580-90.

[3] Steen Brock, "Old Wine Enriched in New Bottles: Kantian Flavors in Bohr's Viewpoint of Complementarity", in *Consitututing Objectivity: Transcendental Perspectives on Modern Physics* ed. Michel Bitbol, Pierre Kerszberg, and Jean Petitot, Springer, 2009. 302.

[4] Complementarity contains the *beyond human knowledge* quantum-concept, as it precisely aims to delineate what knowledge is possible in quantum theory, including when information is non-existent. It is also *observer-dependent*, due to the centrality of measurement choices. Heisenberg's uncertainty principle is at the heart of Bohr's theorisation, so complementarity also contains *uncertainty*. The starting point of Bohr's theory is the

innovation of complementarity ('a new *kind* of theory') means that it is less likely for scholars to locate similar-looking notions in the history of thought that could be rival justifications for the appearance of quantum-sounding materials in literature, unlike concepts such as “holism” or “uncertainty”. The scholarly structure of the theory also renders it ideal for grounded discussions, whereas the various quantum-concepts are so open that they can be applied to a wide array of textual or discourse materials that have no relevance to quantum theory, as Burwell extensively demonstrates. Furthermore, the theory possesses the advantage of having been employed in physics continually from 1928 to today (even if implicitly), while consistently generating scholarly discussions, so it remains relevant, productive, and could hypothetically apply to any and all literature published after that year. Even beyond literature, the theory is as much tied to the philosophy of the science as to the science itself, and hence compels critics of literature and science to also discuss philosophy, which can be an ideal pre-existing basis upon which to construct a middle-ground to connect the two fields. This also leads to the fact that Bohr, and most other quantum pioneers, were educated in pre-existing philosophy, and may have been influenced by parts of it when working in physics:[5] there is, for instance, much academic discussion on the shadow cast by Immanuel Kant on Bohr's complementarity,[6] and also to a lesser extent the influence of Harald Høffding; William James; Bohr's own biologist father; indeed, his intellectual context more generally.[7] As a matter of

quantum of action's lack of continuity, therefore complementarity includes *discontinuity*. And, as the pre-measurement mathematical model is a dynamic wave-equation that contains within it all the information of a system, including the measuring device, complementarity also leads to *dynamic holism*. Finally and most obviously, complementarity suggests *contradiction*.

[5] Helge Kragh, *Quantum Generations: A History of Physics in the Twentieth Century*, Princeton, Princeton University Press, 2002. 'For Planck, Bohr, Schrödinger, Weyl, Heisenberg, Einstein, Eddington, and many more of their colleagues, philosophy was an important aspect of physics. Few of the leaders of postwar physics cared about philosophy or had more than a superficial knowledge of the field. In the 1960s, with the deaths of Bohr and Schrödinger, the once proud and vital tradition of physicist-philosophers came to an end'. 441. See also: Abner Shimony, "Reflections on the Philosophy of Bohr, Heisenberg, and Schrödinger", in *A Portrait of Twenty-five Years: Boston Colloquium for the Philosophy of Science 1960–1985*, ed. Robert S. Cohen and Marx W. Wartofsky, Dordrecht, Springer, 1985.

[6] Makoto Katsumori, *Niels Bohr's Complementarity: Its Structure, History, and Intersections with Hermeneutics and Deconstruction*, Dordrecht, Springer, 2011. 'admitting the lack of evidence for a direct influence, commentators rather focus on the question as to whether Bohr's complementarity bears conceptual resemblance to Kantian philosophy, and/or whether it historically emerged from an intellectual background formed by the latter [...]. Generally speaking, however, commentators are divided'. 55. It is worth noting the parallel here between the commentators of Bohr and literature and science scholars: examining conceptual similarities, but without a clear account of their material causes, leading to *zeitgeist* theorisations and academic disputes.

[7] Kumar, *Quantum*. 'whenever their father played host to his fellow Academicians, Niels and Harald were allowed to eavesdrop on the animated debates that took place. It was a rare opportunity to listen to the intellectual concerns of a group of such men as the mood of *fin-de-siècle* gripped Europe. They left on the boys, as Niels said later, "some of our earliest and deepest impressions"'. 55; See also: Jørgen Kalckar, "General Introduction to Volumes 6 and 7: A Glimpse of the Young Niels Bohr and his World of Thought", in *Niels Bohr: Collect Works*, ed. Jørgen Kalckar, Amsterdam, Elsevier, 1985.

fact, the possibility that the intellectual context within which these physicists were working influenced the radical nature of their publications is itself a controversial hypothesis in the history and philosophy of physics, known as the "Forman thesis", which can also stimulate productive discussions.[8] A final reason to focus on complementarity is that Bohr himself applied it to conceptual issues that went beyond physics, and believed it was relevant in any contemporary field of study, even human life itself:

> Everywhere, new forms of outlook are brought up and new fields and connections (*Zusammenhang*) dawn upon us [...] Nothing is fixed. Every thought, even every word, is only suited to underline a connection, which can never be fully described, but always reflected deeper. Such is, undeniably, the conditions for human thought... we can only complete our picture of the conditions of life by recognizing the play of oppositions[9]

This illustrates that, even while complementarity is specifically tied to physics, it is still open enough to allow for interdisciplinary associations. These many reasons, in addition to the conclusion of Crossland's study and the nature of Woolf's thought, make it clear that complementarity is an – if not *the* – ideal philosophical construct to focus on in Woolf and quantum physics studies.

This, however, leads to an issue: discussing complementarity is challenging. Indeed, Bohr's writing style was famously obtuse; several of the important terms he employed were idiosyncratic or have changed meaning;[10] he revised his thoughts on the matter drastically, but ambiguously, in the years that followed the original publication; and while his theory engages with philosophical considerations, Bohr was very much not a philosopher, which leads to

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[8] From: Paul Forman, "Weimar Culture, Causality, and Quantum Theory, 1918-1927: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment", in *Historical Studies in the Physical Sciences,* 3, 1971. This hypothesis may seem directly relevant to the present thesis, as it deals with culture influencing quantum physics. However, beyond being controversial, Forman's notion has not been satisfactorily verified in the fifty years since its publication, and many academics from history and philosophy of science studies do not adhere to it, such as Helge Kragh who lists seven reasons which, to him, disprove Paul Forman: Kragh, *Quantum Generations*. 153. This does not render the idea irrelevant to literature and science scholars, but it is too uncertain to be engaged with in the current sceptical context.

[9] This is Brock's own translation of: Niels Bohr, *Naturbeskrivelse og menneskelig erkendelse*, Rhodos, K¢benhavn, 1985. From: Brock, "Old Wine Enriched in New Bottles: Kantian Flavors in Bohr's Viewpoint of Complementarity". 310.

[10] For example, in the 1928 *Nature* article, he employs the term 'causality' to refer to what would today be considered "determinism". The difference in meaning is slight, but can nevertheless affect a modern reader's comprehension. It is therefore highly recommended to consult Jan Duck and E.C.G. Sudarshan, *100 Years of Planck's Quantum*, Singapore, World Scientific Publishing, 2000. 374-410, as it shares a simplified, modernised, and commentated version of Bohr's paper.

conceptual and vocabulary inconsistencies in his writing that can be a source of misunderstandings, as Dennis Diek's overview of the physicist's formalism makes clear:

> Bohr's terminology certainly is apt to confuse [...] he comes to the subject as a physicist, adapting his intuitions on the basis of new empirical facts, and wrestles to make these new intuitions clear by couching them in familiar terms. This is completely different from the attitude of a philosopher starting from a desire to hygienically regiment language[11]

Additionally, later physicists, philosophers, and historians of the quantum have done much to streamline and remould Bohr's thought, in order to fit it within a popularised understandings of the science,[12] as well as the much-discussed "Copenhagen Interpretation" of quantum mechanics – which scholars of the modernist period should be wary of employing, as this interpretation was retroactively fabricated in 1955 without any input from Bohr.[13] It is hence difficult to establish an adequate definition of complementarity based on Bohr's writing, or that of other primary authors, that would be both scientifically valid and meaningful to a literary scholar studying the period. The less ambiguous definition Bohr himself ever proposed, according to Kragh, Dugald Murdoch and Carsten Held in their own discussions of the concept's meaning, was in 1934 with: 'a new mode of description designated as complementary in the sense that any given application of classical concepts precludes the simultaneous use of other classical concepts which in a different connection are equally necessary for the elucidation of phenomena'.[14] Which, obviously, requires clarification and a redefinition.

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[11] Dennis Dieks, "Niels Bohr and the Formalism of Quantum Mechanics", in *Niels Bohr and the Philosophy of Physics: Twenty-First-Century Perspectives*, ed. Jan Faye and Henry Folse, London, Bloomsbury Academic, 2019. 318.

[12] For instance, by centering complementarity on the "collapse of the wave-function". However, in none of his published writing does Bohr refer to "collapses", and there is academic debate as to whether he would accept the notion or not. See: ibid. Footnote 11, 323.

[13] Don Howard, "Who Invented the Copenhagen Interpretation? A Study in Mythology", in *Philosophy of Science,* 71, no. 5, 2004. 'Until Heisenberg coined the term in 1955, there was no unitary Copenhagen interpretation of quantum mechanics. There was a group of thinkers united by the determination to defend quantum mechanics as a complete and correct theory [...] But they did not all believe that quantum mechanics entailed observer-induced wave packet collapse, a privileged role for the observer, subjectivism, or positivism. Heisenberg and Bohr, in particular, disagreed for decades about just these issues'. 681-2.

[14] Niels Bohr, *Atomic Theory and the Description of Nature*, Cambridge, Cambridge University Press, 1934. 10.

B/ Defining Complementarity

However, clarifying and redefining complementarity presents another challenge: the closer the theory's meaning is attached to Bohr's own philosophy, the less employable it becomes beyond quantum mechanics. There is a balance to be reached between a definition that is too open to be relevant to Bohr's thought, such as Crossland's (as will become clear), and a definition that is too closed to be useful beyond physics, as Burwell's restriction of Erwin Schrödinger's thought experiment illustrated in the introduction. As a solution, here, the concept will be broken down into elementary parts before reaching a redefinition, to historically display how and why complementarity was developed – and then, evolved – while discussing Bohr's own philosophical opinions as little as possible, in order to focus on the concept itself. This will make complementarity more approachable and correct some mistaken or incomplete understandings of it in literary studies. Additionally, it will display different potential ways the concept can come into contact with various discourses, depending on which part of it is focused upon, independently of Bohr's thoughts on the matter. Hence, literary considerations of complementarity should take into account the following factors.[15]

1. The Connection to Classical Physics. The notion that quantum mechanics fully overthrew Newtonian physics is negated by the crucial connection between complementarity and the classical realm. “The correspondence principle” was formulated by Bohr in the early-1920s as a methodological tool for atomic physics: a quantum system should adhere to classical laws when the quantum numbers within it are high enough, rendering the quantum scale irrelevant. For instance, Bruce Wheaton explains that in 1922, 'Bohr had concluded that the conservation laws governing energy transfer between light and matter may not hold on the microscopic level. He argued that the laws of energy and momentum conservation may only be approximations valid for large numbers of atoms'.[16] While deceptively simple, Kragh explains that the principle was remarkably effective in the history of physics: 'In 1935, Kramers recalled how many

[15] Of course, this division and narrative of complementarity is to some extent arbitrary and based on a non-scientist's choices and understandings, *and should hence be viewed critically*. It should additionally be noted that the general understanding of the formalism of quantum mechanics on display here, and throughout this thesis, is in large part (though far from exclusively) indebted to: David Z. Albert, *Quantum Mechanics and Experience*, Cambridge, Massachusetts, Harvard University Press, 1992. Indeed, the book (particularly its first four chapters) is intended as a means for philosophers to accurately understand how the conceptual issues of quantum theory emerge from its mathematical treatment, without having to rely on imprecise popularisations that rarely wrestle with the formalism itself.

[16] Bruce R. Wheaton, (1983), *The Tiger and the Shark: Empirical Roots of Wave-Particle Dualism*, Cambridge, Cambridge University Press, 1992. 822-3.

physicists perceived Bohr's semi-intuitive use of the principle: "In the beginning the correspondence principle appeared to the physicists as a somewhat mystical magic wand [...]". Bohr's magic was particularly strong'.[17] There is hence continuity between the new and old paradigms in the formulation of complementarity, which is often missed. This is important because there is a simple, open, yet precise conceptual motivation that justifies the use of the correspondence principle in complementarity, as Dieks repeatedly explains:

> The formalism can only tell us about properties of micro systems once it has made contact with physical reality, and this contact can only be established via identifications between symbols and physical quantities on the macro level, described in classical language. The starting point for attributing physical meaning is thus the classical description of laboratory practice – and here experiments certainly have only one result at a time. So the uniqueness of experimental outcomes is not something to be explained, but is something accepted from the outset[18]

This is a foundational factor in Bohr's complementarity, agreed upon by all of his commentators:[19] the classical realm is inescapable, as human beings can only communicate and understand by means of classical language and concepts; additionally, the observations of quantum systems are restricted to macroscopic devices which can only display one classical result at a time.[20] The exact relation of the macro and micro worlds within complementarity is a controversial matter of interpretation, but what is here clear is that literary scholars cannot associate complementarity with a blanket rejection of classical notions due its associated quantum mechanics, as that was precisely the opposite goal of the theory: *to delineate and formalise the validity of classical descriptions when applied to the quantum realm*.

2. The Uncertainty Principle. Due to the tendency to present quantum physics as a catalogue of anti-Newtonian concepts, the inherent overlap of uncertainty and complementarity is oftentimes overlooked by literary scholars. Murdoch relates how 'Heisenberg recalls that after several weeks of discussion he and Bohr concluded that *the uncertainty relations are a special*

[17] Kragh, *Quantum Generations*. 157.

[18] Dieks, "Niels Bohr and the Formalism of Quantum Mechanics". 329.

[19] See the 'Language And The Conditions For Description' section in: David Favrholdt, "General Introduction: Complementarity Beyond Physics", in *Complementarity Beyond Physics (1928-1961)*, ed. David Favrholdt, Amsterdam, Elsevier, 1999. xxxiii-xxxviii.

[20] Dieks, "Niels Bohr and the Formalism of Quantum Mechanics". 'For example, in discussions with Heisenberg in 1927 Bohr already stated: "in spite of your uncertainty principle you have got to use words like "position" and "velocity" just because you haven't got anything else"'. 2.

case of the more general complementarity principle',[21] and following Bohr's less ambiguous definition of complementarity from 1934, Held mentions how Bohr then 'also stresses again that the indeterminacy described by Heisenberg's relations "exhibits" complementarity'.[22] The fact that a measurement of position leads to an equivalent loss of precision in the measurement of momentum, or vice-versa (the same relation also applies to time versus energy) is usually understood in literary analyses. What is not understood, though, is that time and position are kinematic factors, while momentum and energy are dynamic; and this differentiation is why they are in an uncertainty relation. This is true both in theory, as kinematics and dynamics are treated with different mathematical tools, and in practice, as both aspects cannot be measured by the same laboratory device at once. The causal continuity of classical mechanics means that this kinematic-dynamic dichotomy is never an issue, as mathematical relations and successive measurements can lead to a complete simultaneous determination of an object's precise energy, momentum, and position at all points in time. But the discontinuity of the quantum of action fully prevents this: Bohr dedicates two sections of his *Nature* article to demonstrating 'the inevitability of the quantum postulate in the estimation of the possibilities of measurement' (why the uncertainty relations are inevitable when the quantum of action applies) first mathematically, then experimentally,[23] and reaches the conclusion that, 'This circumstance may be regarded as a simple symbolical expression for the complementary nature of the space-time description and the claims of causality'.[24] Again here, Bohr's wording requires clarification, as, Held explains: 'Interpreters have put considerable effort into clarifying Bohr's intention about this mysterious pair of relata, [...] Bohr often characterizes this pair in an ambiguous manner'.[25] Though, in this particular context, 'space-time description' can be understood as kinematic factors (position in space and time), while he 'equates "causality" with "conservation laws" and the latter with a measurement of energy and momentum' – therefore, dynamic factors. Hence, the kinematic-dynamic pairs of classical physical quantities that are in an uncertainty relation are also in a complementary relation. Indeed, to Bohr they are in an uncertainty relation *because* they are complementary. This is a crucial aspect of the concept

[21] Dugald R. Murdoch, *Niels Bohr's Philosophy of Physics*, Cambridge, Cambridge University Press, 1987. 51. Emphasis added.

[22] Carsten Held, "The Meaning of Complementarity", in *Studies in History and Philosophy of Science,* 25, 1994. 873.

[23] Bohr, "The Quantum Postulate". Theoretical discussion of uncertainty: '2. Quantum of Action and Kinematics', 581-2. Experimental discussion of uncertainty: '3. Measurements in the Quantum Theory', 582-4.

[24] Ibid. 582.

[25] Held, "The Meaning of Complementarity". 882.

that rarely appears in the many cited literary discussions of quantum theory: complementarity is not limited to wave-particle duality, it also applies to the kinematic-dynamic descriptions (later generalised to “incompatible observables”) that obey the uncertainty principle.

3. Wave-Particle Dualism. Even with the above, the importance of the wave-particle issue should not be underestimated. After all, 'In the early articles the problem of wave-particle dualism stands out as the decisive problem of understanding quantum mechanics, and accordingly serves as the motivation for introducing complementarity'.[26] Indeed, in Bohr's first recorded use of the term “complementarity” (a letter to Wolfgang Pauli in August of 1927) he defines: 'the quantum theory, according to which the apparently contradictory requirements of superposition and individuality do not subsume contrary but complementary sides of nature'.[27] Here, 'superposition' refers to the ability of waves to be added together, while 'individuality' refers to the discreteness of particles[28] – therefore, Bohr indeed originally saw wave-particle duality as central to the elucidation of quantum mechanics, which he debatably achieved with complementarity. Even beyond Bohr's own conceptions, the historical development of physics was a near-constant tension between wave-like and particle-like conceptions, with each worldview leading to new discoveries and theories. In fact, Wheaton's celebrated book *The Tiger and the Shark: Empirical Roots of Wave-Particle Dualism* demonstrates that physicists in Europe in the 19th and early-20th centuries were generally separated between a wave-approach (exemplified by Germany's focus on radiation) and a particle-approach (exemplified by Britain's focus on atoms), which determined the nature of their work, and their reception of quantum innovations. Wheaton's historical narrative inevitably leads to 1926 in Copenhagen, where Schrödinger's wave-mechanics and Heisenberg's matrix-mechanics:

> were two independently formulated versions of the new quantum mechanics [*which*] was in large part an effect of the virtual separation of the two parent fields - atomic theory and radiation theory - for the preceding decade. And this, in a larger sense, constituted the fullest corroboration of Louis de Broglie's remarkably fruitful but decidedly unorthodox proposal that matter and light are fundamentally one and the same thing[29]

[26] Ibid. 880.

[27] Murdoch, *Bohr’s Philosophy of Physics*. 56.

[28] Again, 'individuality' is a term that can be ambiguous in Bohr's writing, requiring commentary. However, here, in the context of a private letter, it is straightforward.

[29] Wheaton, *Tiger and the Shark*. 301.

However, there is one major additional factor to take into account: 'over the years Bohr tacitly abandons the idea of wave-particle complementarity. [...] from 1935 on, [...], complementarity is instead introduced by means of mutually exclusive experiments'.[30] The nature of Bohr's change of mind will be discussed below, but what is here important is that, even though it is undeniably relevant, wave-particle duality cannot be *inherently* tied to complementarity, as even Bohr did not do so for most of the concept's history: the wave-particle opposition is an artifact of the general history of physical science, not a consequence of Bohr's theorising.

4. Two Types of Complementarity. Murdoch's *Niels Bohr's Philosophy of Physics* makes very clear that:

> The quantum postulate, Bohr holds, gives rise to two distinct species of complementarity. First, wave-particle complementarity [...] Second, the [...] "kinematic-dynamic" complementarity [...] Bohr seems originally to have regarded kinematic-dynamic duality as a consequence, or at least a reflexion, of wave-particle duality. He came to hold that these are simply different species or modes of complementarity, i.e. of the indispensability, yet limited applicability, of the classical concepts in the quantum theory[31]

Hence, Chapter 4 of Murdoch's book is an in-depth discussion of the two types of complementarity, and investigates their relation. Indeed, there are several moments in Bohr's writing when he seems to be tying together wave-particle and kinematic-dynamic complementarities, but Murdoch's analysis fully contradicts this perspective, particularly as Bohr's thought evolves over the years towards a rejection of wave-particle duality:[32]

> It is sometimes stated that wave-particle complementarity is equivalent to kinematic-dynamic complementarity in that the particle model is correlated with spatio-temporal measurements or descriptions and the wave model with momentum-energy measurements. There is, however, *no evidence indicating that this was Bohr's view of the correlations between the two sorts of complementarity*
>
> I do not believe, then, that there is an invariable, systematic association of one or other of the two models with either position or momentum measurement operations: *wave-particle complementarity and kinematic-dynamic complementarity are logically independent*

[30] Held, "The Meaning of Complementarity". 880.

[31] Murdoch, *Bohr's Philosophy of Physics*. 58-9.

[32] Murdoch, *Bohr's Philosophy of Physics*. 66 & 67. Emphases added.

Therefore, discussions of pre-1935 complementarity are complicated by the fact that it should be clarified *which* complementarity is at play. Luckily, there is an essential difference between both types which helps to clarify how each version can apply to non-scientific topics:[33]

> on the one hand, the concepts of particle and wave in a sense fall apart in classical physics, yet in a sense come together in quantum mechanics; and, on the other hand, the concepts of position and momentum go together in classical mechanics, yet in a sense fall apart in quantum mechanics

Held explains the same notion from a different perspective: 'Neither space-time and causal descriptions nor the values of non-commuting observables are contradictory properties, for they harmonize perfectly in classical theories. Only the wave picture and the particle picture of classical physics are logically incompatible by definition'.[34] The choice of which complementarity to discuss is therefore tied to the nature of the binary contradiction within classical frameworks:[35] whether the opposition is classically inherent or not. It is worth remembering, however, that after 1935 Bohr fully embraced the kinematic-dynamic version, which he reformulated into the conception of incompatible observables.

5. The Concept's Evolution. Held's article aims precisely to explain how and why Bohr evolved his concept away from wave-particle duality:

> complementarity, as it is introduced originally, is indeed paradoxical in the sense that it is an inconsistent concept. It is, however, a mistaken view that this meets Bohr's intentions; [...] there is another, mature notion of complementarity which exhibits a different meaning: complementarity no longer refers to actual descriptions of atomic objects but to incompatible observables. In order to make visible this re-interpretation, it has to be shown that Bohr abandons wave-particle complementarity and re-interprets the complementarity of space-time and causal descriptions. The mature conception of the "complementarity of phenomena" refers only to incompatible observables[36]

The inconsistency in the 1927 version of complementarity is described above: waves and particles are mutually exclusive, whereas kinematic and dynamic quantities are not, therefore the former pair cannot give a complete simultaneous description, whereas the latter pair can. This is why Bohr transitions away from discussing “descriptions” after 1935: a “description”

[33] Ibid. 61.

[34] Held, "The Meaning of Complementarity". 879.

[35] Which, beyond physics, is usually viewed as the traditional, common-sense, everyday experience of empirical reality.

[36] Held, "The Meaning of Complementarity". 872.

implies a certain level of cohesion between reality as it exists and the human picture of it that emerges from measurements, theories and models. Even in the case of subatomic physics, which cannot be represented at a human scale, descriptions nevertheless aim for accuracy in their portrayal of nature: 'The [*1927 version of the*] concept is to depict an unvisualizable or even unknowable unity behind the observed phenomena, something which in principle remains hidden from us'.[37] However, given that waves and particles are intrinsically and logically two mutually exclusive properties in reality, there is an unacceptable contradiction in the description, which is compounded by its incoherence with the kinematic-dynamic dualism. Held explains the different strategies Bohr employed to address this urgent inconsistency, all of which were unsatisfying until 1935, when he finally:

> endorses the indefinability thesis in its strongest form: an operationally ill-defined property cannot meaningfully be said to pertain to the object; and this meaninglessness implies that the object really does not have this property [...] specifying an experiment by choosing one arrangement is conditional for the description of any phenomenon to which the term "physical reality" can properly be attached.
> [...] It is, in effect, the conviction that only the variables we actually decide to specify by choosing an experiment have determinate values. What is real is only what we actually observe in a specified arrangement. This is a non-realist position which differs radically from the earlier conception. Bohr well realizes that his new interpretation constitutes "a radical revision of our attitude towards the problem of physical reality" [...]
> *The concept is no longer intended to unite "apparent contradictions"; its role now is to depict a certain completeness of quantum mechanics*[38]

The 'indefinability thesis' states that any property that a quantum system is not displaying at the moment of measurement is ill-defined. The 'strongest form' of the thesis states that if a property is ill-defined, it cannot meaningfully be said to exist at all. Therefore, there is no longer any *inherent* wave-particle duality: it has been dissolved, because it is no longer meaningful to say that a system has wave and/or particle properties beyond the precise moment at which the one or the other property is observed. The logical mutual exclusion of wave and particle does affect experiments however, as only the one or the other can emerge *classically*, but as this is limited to the specific moment of measurement, the mutual exclusion is no longer essential: it is merely a reflection of the limitations of the classical realm and the subject's choice of experiments within it, not the objective nature of reality. However, this solution comes at a cost: quantum physics no longer depicts reality as it exists in of itself, only how it

[37] Ibid. 891.

[38] Ibid. 891-2. Emphasis added, as the final sentence corrects one of the most persistent misunderstandings of complementarity found in literary studies.

interacts with measuring devices. It is this that leads to the notion of "observables", which define the properties of quantum systems uniquely in relation to the values that appear within specified experimental set-ups, and the humanmade mathematical formalism that gives them meaning. This view is hence agnostic towards the existence of the properties when they are not interacting with the classical realm – contrarily to "descriptions".[39] This does not mean that complementarity is anti-realist; it does not deny the reality of observed objects. It is instead anti-metaphysical: the formalism has nothing substantive to say about quantum objects when they are not interacting, and it is therefore purposeless to discuss the nature of the unobserved "reality". The observables (momentum, position, spin, etc...), are called "incompatible" when their pairing displays an uncertainty relation, and therefore displays the kinematic-dynamic complementarity, which is now the only relevant type. With these elements explained, the following definition of a generalised and unified "complementarity of incompatible observables" can be formulated.

6. Redefinition. In quantum mechanics, the inherent discontinuity of the quantum of action means that there are pairs of observable properties which cannot both be applied to a quantum system simultaneously, as the more precisely the one is measured, the less defined the other becomes. These incompatible pairs are said to be *complementary* because they both *mutually exclude* each other at the quantum level and *jointly complete* each other at the classical level. Therefore, when diachronically taken together, incompatible observables can still provide a *complete* account of a quantum system that is meaningful to, and coherent with, the classical realm. But, as a consequence, the theory is fully agnostic regarding the nature of the quantum system when an observable is not being measured. Indeed, when unmeasured, it is only possible to discuss the statistical probability of observables appearing, *nothing more*, including whether they can be said to exist or not.

Held puts it more simply:

> This theory is complete in the sense that all conceivable "questions to nature" are given unambiguous "answers" in the theory; therefore, it is complete in the sense that it accounts perfectly for all atomic phenomena. This does not mean, however, that all questions can be asked of a certain object at once. We

[39] Within the context of the EPR debates, Einstein believed Bohr's quantum mechanics to be incomplete: by accepting complementarity, Einstein thought that Bohr was tolerating an unjustified loss of information regarding reality as it exists in of itself. Bohr denies the validity of this argument by affirming that the information *cannot meaningfully be said to exist* when it is not observed.

> are free to ask any question, but asking certain questions excludes asking certain others[40]

So – in one synthetised non-scientific sentence – complementarity states that *when a pair of descriptions mutually exclude each other, it remains possible to unite them meaningfully by reconceptualising their relationship to human experience*: only when the object comes into contact with the subject can either side of the pair be said to "exist", which eliminates the contradiction, and by coming into contact with each side at a time, a complete description can nevertheless be reached, though it must inevitably include the subject and its choices, preventing subject-less descriptions.

To understand how the theory can be employed beyond quantum physics, one need not look further than Bohr himself. In fact, the tenth volume of Bohr's collected works, published in 1999 and edited by David Favrholdt, contains all of the physicists' writings from 1928 to his death wherein he applied complementarity beyond physics, particularly biology, psychology, philosophy, and culture. Favrholdt's general introduction to the volume provides an overview of Bohr's approach, with examples:

> In observing our own conscious life, we draw a line of separation between the observing subject and the content of the consciousness observed. However, the line of separation is movable and shifts take place invariably.
> Some mental states exclude others [...] thoughts seem to exclude feelings or emotions. Very deep concentration of thought excludes all emotional aspects, whereas great emotional excitement excludes calculated thought. As Bohr often pointed out, the use of words such as thought and feeling [...] refer to [...] experiences which exclude each other [...]
> We may find a similar complementarity in perception. To take one of Bohr's examples, the emotional experience of a piece of music excludes conscious analysis of it, whereas analysis of the music excludes emotional experience. Yet both approaches are necessary for our understanding of what music is.
> In general, we may, within certain limits, choose between a variety of approaches, thereby deliberately causing shifts in the line of separation between subject and object. This is often the case when we work with a theoretical problem[41]

What the above makes abundantly clear is the importance of the subject's choices when complementarity is applied beyond physics: when there is a mutually exclusive binary, such as emotional experience versus thoughtful analysis, both sides can be experienced separately due to the subject's ability to decide where the arbitrary subject-object separation lies, and in doing so, a complete understanding can be reached, which is consistent with the possibilities of

[40] Held, "The Meaning of Complementarity". 892.

[41] Favrholdt, "General Introduction: Complementarity Beyond Physics". xiv-xivi.

human experience and their expression in language – though it cannot be considered fully universal and perspective-less, owing to the subject's particular choice of interactions.

In conclusion then, the frontier between joint completion and mutual exclusion in complementarity is centered on the subject. This is possibly the most important aspect of Bohr's general and mature view of complementarity that is missed in quantum literary analyses: *the theory "solves" binaries not by accepting both sides at once, but by tying their fundamental understanding to the human ability to choose to experience either separately.*

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C/ Complementarity and Duality in *Modernist Physics*

With the nature of complementarity now established, a critical evaluation of Crossland's use of the concept can be reached. Unfortunately, the conclusion is that *Modernist Physics* is not really discussing Bohr's complementarity. The focus is actually on the ontology of wave-particle duality, and the transition towards Louis de Broglie's innovation of recognising that both properties can apply to the same object even though they are inherently contradictory.

This substitution is made immediately obvious with *Modernist Physics'* choice of date to articulate its two chapters on Woolf: 1925 is selected as the turning point towards wave-particle complementarity, 'because it was in this year that de Broglie published his doctoral thesis'. True, de Broglie's dissertation was a landmark publication in the history of physics: it was the first indication that matter, in addition to light, could possess both wave and particle properties, implying that wave-particle duality was to be considered a fact of nature, not a puzzling behaviour of light in specific conditions. It is one of the publications from 1925 that prompted Bohr to formulate complementarity. But it is, crucially, *not* a publication about complementarity. If Crossland were discussing Bohr's concept, 1927 or 1928 would be more appropriate years to select as the cutting-off point, given that it is only then that de Broglie's thesis was widely recognised as important;[42] that the rapid-fire discoveries and advances of

[42] De Broglie's hypothesis was verified experimentally in 1927 by Clinton Davisson, who 'was astonished to learn that some physicists believed that the data from his experiment supported the idea of a French prince. He had not heard of de Broglie or his suggestion that wave-particle duality be extended to encompass all matter. Davisson was not alone. Few people [...] knew of the existence of the doctoral dissertation', Kumar, *Quantum*. 151. This

quantum mechanics from the early-1920s ceased and were formalised; that Bohr published his organising theory; and that the Einstein-Bohr debates began, which thrust complementarity to the centre-stage of theoretical discussions in physics. Though chronology need not be a discriminating factor in literature and science studies, this does not apply here, as *Modernist Physics'* methodology explicitly aims to balance direct and indirect notions of influence.

The choice of date is explained by Crossland's overall understanding of complementarity: in her analysis, the theory is relevant when there is an attempt to solve a wave-particle-like binary construction by accepting both poles of it at once, or by balancing the two sides simultaneously, instead of choosing the one over the other. Hence, before 1925 Woolf follows 'The Obligation to Choose' – the title of the pre-1925 chapter – as opposed to the post-1925 'Complementary Woolf' chapter wherein the novelists is shown to engage with 'the problem of complementarity, of how to balance the duality', which is why it is only after 1925 that are visible 'some of Woolf's most interesting writing of the balancing of opposites, [...] an attempt at the understanding and writing of complementarity'.[43] This choosing-balancing dichotomy is at the heart of Crossland's argument and is therefore often repeated:[44] 'Orlando was not "most" man or woman at all, but an inextricable, complementary coexistence of the two'; 'dualities in a complementary manner: both sides must be presented and they should be welded "into one seamless whole"'; 'One of the key difficulties [...] lay not in the existence of dualities in and of itself, but in the necessity to accept two opposite ideas on an equal footing as two complementary parts of one whole'; or 'Complementarity involves the acceptance of duality as inherent, the acknowledgement that the physicist [...] "must learn to think simultaneously in both systems"'. This interpretation also explains why Crossland consistently associates complementarity with wave-particle duality, as if they are inherently connected, even though this is historically inexact.[45] When Crossland does discuss Bohr's 1928 presentation, it is not in order to define his notion, instead only to cite moments when Bohr

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fact straightforwardly contradicts Crossland's notion that 'it was not until 1925 that such ideas [*duality and complementarity*] came to prominence via Louis de Broglie's doctoral thesis' or that 'its philosophical impact was far-reaching'. Crossland, *Modernist Physics*. 46 & 19.

[43] Crossland, *Modernist Physics*. 49.

[44] Ibid. In order of citation: 52; 54; 67; 67.

[45] 'combined in the wave-particle duality and complementarity'; 'discussions of duality and complementarity'; 'dualities in some kind of complementary form'; 'wave-particle duality and complementarity'; 'the wave-particle duality and complementarity of the physicists'; 'suggests both duality and the need for complementarity'; 'discussions of duality and complementarity'; 'did Woolf really understand the nature of duality and complementarity'; 'similar awareness of duality and complementarity'; 'duality, and in particular complementarity'. Ibid. In order of citation: 27; 38; 40; 44; 51; 53; 55; 66; 67; 68.

mentions that the wave-particle opposition is not a duality but a complementarity, which is Crossland's justification as to why the two terms are opposed, in line with her choosing-balancing reading. As a consequence of this and the discussion of the term 'exclusive' that follows ('the pictures are not just complementary; they are "complementary but exclusive"'[46]), it seems as if Crossland is adopting a common-language definition of complementarity as "two different things working well together", for only then does it make sense to view the concept as opposed to duality, or choosing, or exclusivity. Regrettably, then, the chapters' understanding of complementarity is reminiscent of Burwell's comment regarding Strehle's use of 'uncertainty': 'when she attempts to integrate the principle into her textual exegesis, all of its specificity is lost, and the word "uncertainty" is reduced to nothing more than its conventional dictionary definition'.[47]

Bohr's complementarity is defined by its subject-based tension between joint completion and mutual exclusion; Crossland seems to believe that it is mostly the former that applies.[48] This is confirmed in the following paragraph:

> If we return to Thomson's formulation of duality as like a contest between a tiger and a shark, we can see that complementarity asks us to accept that both tigers and sharks exist in the world but that they will never be in a position to compete with one another. [...] Both tigers and sharks exist simultaneously in the natural world, but we will only be able to see one at any given moment[49]

This presents complementarity as being different from duality because complementarity accepts both poles at once, whereas duality separates them. This is incorrect, and can be further undermined by returning to 'Thomson's formulation of duality' from 1925. Crossland cites the following:[50] 'the contest is something like one between a tiger and a shark, each is supreme in its own element but helpless in that of the other', however, the immediate next sentence begins

[46] Ibid. 47.

[47] Burwell, *Quantum Language*. 144.

[48] There are several moments when Crossland identifies the tension between the two, such as 'we must accept that both waves and particles are there at all times, but we must also acknowledge that only one can be seen, shown, or expressed at any one moment – the two are "complementary *and* mutually exclusive"' Crossland, *Modernist Physics*. 51. However, the fact that this is not applied consistently only further illustrates Crossland's confused use of the theory. Indeed, her sentence here contradicts the very notion that it is possible to obtain waves and particles *simultaneously*, though she elsewhere employs simultaneity as evidence for the notion: 'Like the quantum physicist, Woolf learnt "to think simultaneously in both systems", particle *and* wave, male *and* female, dream *and* reality'. 68.

[49] Ibid.

[50] Sir J.J. Thomson, *The Structure of Light; The Fison Memorial Lecture*, Cambridge, Cambridge University Press, 1925. 15.

with 'Before attempting to reconcile these views...', which shows that efforts to resolve the duality did not begin with complementarity or Bohr. Indeed, de Broglie's motivation with his dissertation was precisely a union of wave and particle, at a time when Bohr himself rejected the duality.[51] The metaphor itself makes this clear: tigers and sharks have always existed simultaneously, the issue is their domains of applicability. There is no implication in Thomson's lecture that obtaining a shark precludes obtaining a tiger, so it is not the case that physics required complementarity to show that they 'both exist simultaneously' – that was already a given, especially following de Broglie, who showed that tigers and sharks are, as it were, the same animal. Similarly, the exclusivity between wave and particle pictures is also a given, as it has been throughout the history of physics.

In other words, it is quantum wave-particle duality that made physics accept both poles of binaries at once, while complementarity was the attempt to understand how to do so, and why. Hence, little in Crossland's study is directly relevant to Bohr's concept (particularly not the mature version), because it is actually de Broglie who is historically responsible for 'a model of simultaneous but distinct coexistence'.[52] It might be possible to argue that the academic is merely discussing the 1927 version of complementarity (based on wave-particle duality) before its evolution in 1935 (based on incompatible observables), however, even then it is not clear that Crossland appreciates how Bohr treated the issue, such as the connection to classical descriptions, the focus on experimental set-ups, or the impossibility of simultaneous acceptance; she is still only discussing the ontological consequences of the duality, not complementarity's epistemology. All this being said, though, if one were to replace Crossland's references to Bohrian complementarity with de Brogliean duality instead, her analysis would become immediately more valid, as her conceptual confusion in the two chapters does not affect this significant part of her conclusion: there does seem to be a transition at the turn of the century from viewing poles of dualities as being inherently separated to being simultaneously accepted, in physics, modernist thought, and Woolf. It just is not directly relevant to quantum mechanical complementarity.

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[51] Wheaton, *Tiger and the Shark*. 'De Broglie's conviction that matter and light should be treated equivalently lay in the symmetry inherent in his goal: to form a synthesis between particle and wave'. 288; Murdoch, *Bohr's Philosophy of Physics*. 'Having resisted wave-particle duality with heroic tenacity for so long, he [*Bohr*] embraced duality with, as it were, rebound intensity when his resistance to it ultimately snapped. Complementarity was the device which Bohr employed to assuage his intellectual conscience when at last he gave in to the idea of duality'. 79.

[52] Crossland, *Modernist Physics*. 59.

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D/ The Curious Case of *To the Lighthouse*

One novel is specifically affected by the confusion, even if one were to perform the substitution suggested above: *To the Lighthouse*. Indeed, selecting 1925 instead of 1928 as the cutting-off point means that the novel, published in June of 1927 and written over the two previous years,[53] is considered to be "complementary" in *Modernist Physics*: it displays Woolf's engagement with quantum ideas. Even though, while Woolf was writing it, de Broglie's thesis had barely been read and had not been verified; quantum mechanics was only just starting to be formulated by a handful of isolated physicists; complementarity did not exist, as conceptual issues that prompted the need for it has not yet been appreciated;[54] and popularised discussions of quantum theory were still limited to the mysteries of the atom, and hence the "old" version of the science, which – while relevant – did not contain any of the quantum-concepts from mature quantum mechanics that scholars typically identify in Woolf.[55] In fairness, Crossland does occasionally regard *To the Lighthouse* as being part of Woolf's transition towards complementarity, not the achievement of it.[56] Nevertheless, the novel is still analysed as consistent with Bohrian quantum mechanics:[57]

> Lily seeks to "achieve that razor edge of balance between two opposite forces; [...]" – a phrase which suggests the "balance" of complementarity rather than a restricting combination. Thus the line that Lily draws in the centre of her picture in order to finish her painting and complete her "vision", as well as

[53] Anne E. Fernald, "To the Lighthouse in the Context of Virginia Woolf's Diaries and Life", in *The Cambridge Companion to To The Lighthouse*, ed. Allison Pease, Cambridge, Cambridge University Press, 2015. 'Her diary for June and July 1925 repeatedly records her intention to retreat to Rodmell and write; she began writing the novel that August, and, in spite of illness, had a draft fourteen months later'. 11.

[54] Burwell, *Quantum Language*. 'The months between early 1925 and the middle of 1927 proved to be determinate for quantum physics, with the field's foundations – Schrödinger's wave mechanics, Max Born and Pascual Jordan's matrix mechanics, Heisenberg's Uncertainty Principle, Max Born's theory of probability, and Bohr's Principle of Complementarity – all emerging during that time'. 5.

[55] Bowler, *Science for All*. 'Atomic Physics', 34-8.

[56] Crossland, *Modernist Physics*. '*Mrs Dalloway*, which moves away from "or" but does not yet reach as far as "and", seems to provide some sort of transitional stage, at least for Woolf's fictional works, an idea which is emphasised by consideration of some of her later novels: like Clarissa, Lily questions the ways in which we sum people up in *To the Lighthouse* [...] There is a definite recognition here of the need to accept different facets of a person as elements of one whole, but for Lily the answer to the question of how to do so remains unclear'. 42.

[57] Ibid. 55-6 & 66.

> close the novel, can just as easily be seen as divisive rather than convergent [...] an acknowledgement of ultimate division, in the form of a separating line which enables complementarity, rather than in the form of swamping unification which, to some extent at least, diminishes the significance of each part. [...] A similar idea is suggested by Gillian Beer in terms of the very form of *To the Lighthouse*: "'Time passes', like Lily's line, both joins and parts."
>
> James's "No" is not entirely dismissive here: it does not mean that the concrete lighthouse that he sees in front of him is not the real lighthouse, any more than that the "misty-looking tower" of his mind's eye is not – they are *both* true, or both parts of the truth, as emphasized by "also" and "too". For Woolf herself, as for James, nothing was ever simply one thing.
> For contemporary science, nothing was simply one thing any longer either

Crossland, though, is not alone in considering the novel as quantum, as was mentioned in the literature review, and as is pointed out by Burwell:

> interpretations of Woolf that apply the notion of wave/particle duality can be reduced to the identification of a generic duality in the text that is then mapped onto the "quantum" opposition between waves and particles. In the case of Woolf, the primary lens through which duality is viewed is gender [...]: on the one hand, Woolf's women are more "wavey," in the sense that their identities are more fluid and expansive, and they connect more to others. Her men, on the other hand, are more "particle-like" because they are more individualistic and self-contained, logical rather than intuitive.
> This gender duality is frequently associated with *To the Lighthouse* – in particular, the opposition between Mr. and Mrs. Ramsay[58]

It should be noted that Crossland does not invoke the Ramsay couple at all in her study. However, Miriam Marty Clark, Mark Hussey and Paul Tolliver Brown all do; respectively:[59]

> That such neediness [*by Mr. Ramsay*] is associated with a male principle, just as Mrs Ramsay's animating force represents a female principle, and that difference should be expressed in the language of particles and waves is interesting because it suggests a relation between this study of the new physics in the novel and the many critical studies of gender in Woolf's work

> the "self" of Mrs. Ramsay might be called, in Bohm's term, a "relatively autonomous sub-totality" of a larger flowing movement. The boundaries of ego and perceptual act are eroded [...]. This is a typical experience of characters in Woolf's fiction and indeed as Jean Wyatt has written, of the protagonists of many twentieth-century novels by women[60]

> Much like the disparate epistemologies that developed in the real world of science, Woolf's fictional characters possess starkly conflicting views along similar philosophical lines in regard to time, space, objectivity and locality.

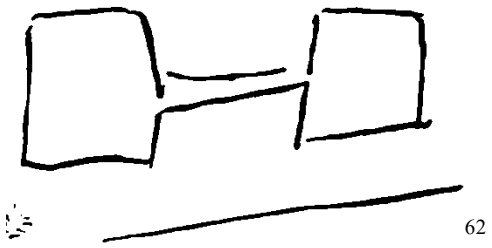
[58] Burwell, *Quantum Language*. 131.

[59] Clark, "Consciousness, Stream and Quanta". 419.

[60] Hussey, "To the Lighthouse and Physics". 85-6. Though Hussey only discusses Mrs. Ramsay without comparing her to the husband, so it could be argued that the academic is not embracing a binary view.

> The discord between Mr. and Mrs. Ramsay is not simply personal [...]. It centers on different conceptions of reality and knowledge. Mrs. Ramsay's holistic vision is opposed to Mr. Ramsay's compartmental one[61]

Indeed, as this thesis will examine in extensive detail, associating the novel's patriarch with particularity and its matriarch with waviness is remarkably easy, as the novel comes just short of explicitly doing so itself. Even beyond the two characters' portrayal, and the binary gender roles they represent, the novel is unambiguously built on dualities: Parts I and III take place ten years apart, with a transitory Part II aiming to experimentally connect them; a major dramatic arc of the novel involves travelling over waves in order to connect two isolated landmasses; said arc ends with the revelation that two spatiotemporally disparate realities can simultaneously be real; the novel itself ends on a line being drawn vertically in the centre of a painting which aims 'to connect this mass on the right hand with that on the left'; and, most revealing, Woolf drew this sketch of 'Two blocks joined by a corridor' in her notes while planning the novel:



62

Even before taking physics into account, then, *To the Lighthouse* is an ideal novel for any literary discussion of binaries, and as such it is not surprising that it has been analysed from a wave-particle perspective, particularly considering the scientific context of 1925 to 1927.

It is also clear from the few elements listed above that the book does not merely display dualities; it actively aims to connect each side of them together, as if 'joined by a corridor'. Due to this, Crossland does not discuss the Ramsay couple, but instead focuses on Lily Briscoe and her art: the character represents the possibility of overcoming the binary of Mr. and Mrs. Ramsay. Indeed, Lily is often read as an androgynous character,[63] who embodies Woolf's ideals

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[61] Brown, "Relativity, Quantum Physics, and Consciousness". 51.

[62] Susan Dick, (ed.), *To the Lighthouse: The Original Holograph Draft*, Toronto, Toronto University Press, 1982. 47.

[63] Margaret E. Melia, "Portrait of an Artist as a Mature Woman: A Study of Virginia Woolf's Androgynous Aesthetics in To the Lighthouse", in *The Emporia State Research Studies,* XXXVII, no. 1, 1988. '[*Lily*] has rejected Mrs. Ramsay's form of femininity and has been excluded by birth from masculinity. As a result, she must forge a new life for herself – an androgynous vision of reality'. 13.

for modernist art, and hence is not limited by the gender binary that the Ramsay couple represents, according to both Marty Clark and Tolliver Brown respectively: 'Lily Briscoe is commonly called an androgynous character, an argument supported by the fact that she sees the world in its wave-likeness as well as in its particularity';[64] or 'Lily is both repelled by and attracted to Mr. and Mrs. Ramsay, pondering the character of each and incorporating their worldviews into her artistic vision'.[65] While Crossland only discusses Lily's supposedly complementary painting and not her gender, *Modernist Physics'* exploration of *Orlando* shows that Crossland nevertheless agrees with the notion of androgyny as a possible attempt to resolve the wave-particle-like gender binary:

> In her explorations of androgyny [...] Woolf seems to be looking for a complementary balance [...] As Justyna Kostkowska has observed, such formulations demonstrate that "Woolf conceptualizes androgyny as at the same time a binary and a unity", a model which confirms the complementary nature of her ideas[66]

This importance of Lily as a resolving force within these wave-particle analyses seems to be mostly missed by Burwell, as her evaluation only concerns the gender opposition of the Ramsay couple:

> opposing wave-like behavior and particle-like behavior, and associating them with opposing gender characteristics loses the sense that the same phenomenon (or man, or woman) can express both wave-like and particle-like qualities, and thus only contributes to reifying essentialist male/female oppositions that obstruct a more nuanced analysis of the characters in *To the Lighthouse*. [...] A correct use of wave/particle duality might have captured the paradoxical fact that [...] the opposition between men and women is not ontological, but rather constructed[67]

Indeed, Lily's androgynous role in both Marty Clark and Tolliver Brown's analyses make clear that they are not essentialising gender differences as Burwell fears, but merely following the novel's consistent structure of displaying a duality (the Ramsay couple), and resolving it (Lily), which can easily be read as a form of modernist deconstruction of prior gender roles, not a reification of them. Furthermore, Burwell is again guilty of overly attaching concepts to science in a manner that impedes cultural discussions: 'While there is no relationship between the concept as it appears in quantum physics and the "waviness" of Woolf's novels, each of these

[64] Clark, "Consciousness, Stream and Quanta". 419.

[65] Brown, "Relativity, Quantum Physics, and Consciousness". 47.

[66] Crossland, *Modernist Physics*. 52.

[67] Burwell, *Quantum Language*. 132-3.

writers makes specific reference to quantum wave/particle duality'.[68] This is a slightly obtuse comment, given that, naturally, the 'waviness' of Woolf and quantum mechanics are not related, other than via possible influence or conceptual echo: one is from literature, the other from physics. Of course their connection is going to be metaphoric and tentative in nature – that is what the articles aim to explore, including when they do so with questionable methodologies or understandings. Beyond the fact that *To the Lighthouse* almost explicitly invites a wave-particle reading, the waves of quantum physics are normalised complex-valued probability amplitudes in infinite-dimensional Hilbert position space, forming linear combinations that add up to wave packets evolving in accordance with the Schrödinger equation, so finding a "wave" in literature that displays 'a relationship between the concept as it appears in quantum physics' in order to analyse wave-particle dualities would be rather challenging. Therefore, Burwell's negative overview of the novel's quantum readings is not useful here.

One can now clearly see how, on the surface, *To the Lighthouse* indeed looks like a post-complementary novel from *Modernist Physics*' perspective: it displays inherently binary structures, often with wave-particle qualities, which it attempts to resolve or balance artistically and intellectually, much as Bohr also attempted with complementarity. However, as has been made clear, "balancing binaries" does not capture the reality of quantum complementarity, and the timeframe does not permit the possibility of Bohr's, nor even really de Broglie's, concepts having influenced Woolf's novel, directly or indirectly. Here is then, in effect, a condensed version of the general issue of Woolf and quantum physics studies: *There are many valid reasons to tie* To the Lighthouse *to quantum wave-particle duality, both historically and conceptually. Yet, at the same time, the framework of influence cannot directly account for the connection, and scientific confusions may temper its validity.* This makes the novel's relevance to the current thesis clear: what is the meaning of its wave-particle opposition, given the period in which it was written? What does it reveal about Woolf's engagement with quantum physics? Does the anachronism prevent it from revealing *anything*, other than interpretative coincidence? Is interpretative coincidence by itself reason enough to comment on the similarities, as it might nevertheless allow for innovative readings of the novel? Or is it the binary a sign of a larger cultural shift which includes *both* Woolf and Bohr? Or maybe even Woolf's indirect influence *on* Bohr? Or is it something else entirely that seems the be "there"?

[68] Ibid. 131.

To investigate such questions, each following chapter will be divided into three parts. First, a close reading of one aspect of *To the Lighthouse*'s binary, presented independently of any Woolfian scholarship. Second, the isolated binary features will be compared to Woolf's general thought, as visible in her essays, short stories, letters, or diaries, to ascertain to what extent the novel reflects her own views on various conceptual dualities. Third, an overarching intellectual context relevant to the discussed binary will be presented and explored. These 'Intellectual Context' sections will not only provide a possible alternative to quantum theory as a source of Woolf's conceptualisations, but will additionally illuminate a weakness of quantum readings of the novel: they ignore the extent to which pre-complementarity fields of thought were already rife with binary-resolutions in the author's philosophical environment. These intellectual contexts will be early psychology (Chapter 4); pre-quantum debates in physics (Chapter 5); the post-Kantian opposition between idealism and realism throughout the 19th century (Chapter 6); and Bertrand Russell's new realism (Chapter 7).

The structural choice to begin each chapter with a self-contained close reading, and only to discuss personal and intellectual contexts afterwards, is certainly unconventional. However, it is justified for a number of methodological reasons, which follow from this thesis' sceptical approach. Indeed, separating the different spheres of human activity reduces the temptation to interpretatively connect very disparate elements merely due to their felt proximity during the discussion, which will enable a more diligent exploration of what is similar as well as what is not; furthermore, beginning each chapter with the novel's reading, rather than the contexts, will result in *To the Lighthouse*'s conceptions guiding the rest of the analysis, instead of the contexts informing the investigation of the literature. These two factors will prevent the risk of "interpretative false-positives": isolating in the discussed context a conceptual connection between science and literature, and then "discovering" it in the novel it by use of a biased interpretation, only because one is academically encouraged to unearth connections rather than interrogate them.[69] The use of an exhaustive close reading of the entire novel is also a response to the risk of contentious interpretations: often, in quantum analyses of literature, mere sentences or brief scenes from literary works are isolated and presented by themselves as relevant to physics, while ignoring the sentences' or scenes' function within the whole of the work, which might otherwise undermine the interpreted connection. Additionally, the author

[69] Jenkins, "Beyond Two Cultures: Science, Literature, and Disciplinary Boundaries". 'if an observed similarity between two texts breaks down altogether on examination, the research is not usually continued to publication. [...] it would be very useful to learn more about the times when similarities fail'. 412-3. This thesis can be viewed as the examination of a failed analogy in literary research, potentially answering Jenkins's request.

of this thesis was educated in the French tradition of *explication de texte* studies of literature, which places the text first and foremost as the object of study, achieved in large part by deploying formalised and self-contained analyses that explicate the inner workings of any given writing, which can then be related to the wider contexts of literary history.

The admittedly subjective embrace of this scholastic practice also explains why the readings will ignore all critical perspectives from scholars, however, there are other more important justifications. Indeed, the upcoming analysis of *To the Lighthouse* aims to examine the philosophical problem of binary descriptions of objective non-human reality, but, in Woolfian scholarship, the theme of binaries or dualities is overwhelmingly tied to the topic of gender, which is an inevitably human, social, political, sexual and cultural factor, unlike the subject at hand. That is not to say that gender is irrelevant, for it would be an untenable argument to affirm that gender did not impact Woolf's conceptions on reality and the human relation to it. However, taking this massive factor into account would not only deeply complicate the reading by making relevant a long legacy of feminist research into Woolf, it would also force the analysis to engage with notions of politics, society, power, and sexuality that are all – for the most part – irrelevant to the metaphysical-scientific topic of analysis. Therefore, *while obviously relevant implicitly*, gender will not be discussed in the upcoming chapters. Another reason for the independence from Woolfian research is merely that many of the interpretations, ideas and contexts to be presented in the upcoming chapters are by no means controversial or unfamiliar: they are for the most part well-established in the field, and have been for decades.[70] That is because the goal is not to present a new reading of Woolf, but instead to display how easy and straightforward it is to conceptually tie the metaphorical wave-particle binary of *To the Lighthouse* to a variety of non-quantum intellectual contexts, which do not present any of the academic problems listed following the literature review.

Consequently, *To the Lighthouse* will guide the remainder of the thesis' investigation. Following the sceptical approach, the analysis will not attempt to verify the connection to quantum physics, but instead to falsify it, by displaying that other intellectual fields – or, to be accurate, pre-existing philosophical middle-grounds – can fully account for the quantum-

[70] For instance, a substantive portion of the following chapter on psychology will compare Woolf to the two most famous texts of the two most famous psychologists of her time, which is obviously well-trodden territory in Woofian research. Indeed, many, if not most, of the contexts to be discussed are also regularly treated in the studies of Woolf and quantum physics themselves. The point is that this thesis will investigate these topics from a different, sceptical angle: instead of validating the connection between the two fields as usually happens in criticism (by means of "anticipation" or "cultural fields"), they will refute it.

concepts contained within Woolf's wave-particle-based metaphors. Not only that, it will also display the stunningly wide-ranging applicability of the binary, and other related ones, in large swathes of late-19th and early-20th European intellectual culture, which did not wait for Bohr or quantum mechanics to begin resolving dualities. These conclusions will inevitably lead to a reconsideration of the academic applicability of quantum-concepts, particularly with regards to complementarity and conceptual metaphor theory.

Chapter 4 - Surface and Depths in Early Psychology

It may seem surprising to investigate the field of psychology in the context of Virginia Woolf and quantum theory. However, as will become clear, psychology arose initially as a philosophical pursuit, and was entangled with other academic discourses relevant to physics. Indeed, both early psychology and physics tackle, though from different angles, the philosophical "problem of knowledge": whether, and to what extent, a subject can know an object as it truly is beyond their own subjectivity.[1] Furthermore, following the controversies surrounding Niels Bohr's complementarity, psychology began to be discussed by physicists, as quantum mechanics seems to imply that the observing subject impacts reality, or that the reality being measured is a relation of human constructs, instead of real objects. This was pointed out as early as 1935 in *Science in the Making*, by Gerald Heard, who, according to *Science for All*, was 'The most prolific broadcaster on science at the time':[2]

> It is clear then, from one end of science, from physics where experts are already involved in the riddle "What is there when no one is there to see" to the other end of science, psychology, the whole science front has come against the profound problem, the great crisis, How shall we manage to see the world yet more clearly? [...] science is now testing over its apprehensions and impressions which it used to call its data, which it thought were given complete, intact, but which it now sees it took and shaped to what it could take in[3]

The overlap of the two fields is illustrated by Bohr's interest in William James, arguably the main figure of turn of century psychology, which has prompted investigations into the impact that the philosopher may have had on complementarity's formulation.[4] In particular, the

[1] Ann Banfield outlines specifically how this constant philosophical problem was conceived of in Woolf's time: 'the seeming incommensurability of two versions of a knowledge of the external world, one direct apprehension of it through the senses and the other scientific knowledge [...] All we ever know immediately is not matter, but our own sensations. The object of science is beyond immediate knowledge. But sensation remains the evidence for it. The empirical basis for objective knowledge can thus rest on subjective foundations. Yet science means to formulate a knowledge ideally independent of the subject. Hence a solution to the problem of knowledge within the framework of empiricism must be an answer to Idealism'. Banfield, *Phantom Table*. 6. By the end of this thesis, all the themes present in this quotation will have been discussed.

[2] Bowler, *Science for All*. 211.

[3] Gerald Heard, *Science in the Making*, London, Faber and Faber, 1935. 179.

[4] See: Katsumori, *Bohr's Complementarity*. Section 3.4, 'Complementarity in the history of Modern Philosophy', 54-60.

physicist admitted in an interview with Thomas Kuhn that he read the most consequential chapter of James's work, Chapter IX of *The Principles of Psychology*: 'I read actually the work of William James. William James is really wonderful in the way that he makes it clear – I think I read the book, or a paragraph, called – No, what is that called? – It is called "The Stream of Thought"'.[5] Bohr went on to apply his framework to psychological considerations, as related by Helge Kragh: 'at the International Congress of Anthropological and Ethnological Sciences in 1938, Bohr explained that emotions and perceptions of them stand in a complementary relationship analogous to situations of measurements in atomic physics'.[6] Alongside James, Henri Bergson was another key philosopher of the field, who not only formulated equally foundational notions in psychology, but whose thought was even further tied to developments in physics. At first, explains Linda Henderson, Bergson's worldview was 'grounded in ether physics. Bergson cited Michael Faraday and Lord Kelvin in his 1896 book *Matière et mémoire*, and there – as well as in his 1907 *L'évolution Créatrice* – he argued that the essence of reality was flux'.[7] He would then go on, in the 1922 book *Durée et simultanéité*, to dispute the philosophical underpinnings of relativity and its incoherence with his own psychological conception of time, which led to a debate with Einstein himself in April of the same year.[8] Hence, the disciplinary boundaries between psychology, philosophy, and physics were not as robust as they would later become, allowing for fruitful interactions.

Even had physics never interacted with psychology, however, the development of the latter field would nevertheless remain germane, due to the issue of "anticipation":[9] there are conceptual similarities between the innovations of psychology and of physics which tempt scholars to connect them. Though, one must account for the fact that James's and Bergson's work (amongst others) took place over a decade before physics' major innovations. This issue becomes particularly relevant when literature is also taken into consideration: it may be that

[5] Quoted in: Jan Faye, *Niels Bohr: His Heritage and Legacy: An Anti-Realist View of Quantum Mechanics*, Dordrecht, Springer, 1991. xvi-xvii.

[6] Kragh, *Quantum Generations*. 210.

[7] Linda Dalrymple Henderson, "Modern Art and Science 1900–1940: From the Ether and a Spatial Fourth Dimension (1900–1920) to Einstein and Space-Time (1920s–1940s)", in *The Moderns: Wie sich das 20. Jahrhundert in Kunst und Wissenschaft erfunden hat*, ed. Cathrin Pichler and Susanne Neuburger, Vienna, Springer Vienna, 2012. 182

[8] See: Jimena Canales, *The Physicist and the Philosopher: Einstein, Bergson, and the Debate That Changed Our Understanding of Time.*, Princeton, Princeton University Press, 2015.

[9] Crossland, *Modernist Physics*. 'William James, who, according to Friedman and Donley "had anticipated many of the new metaphysical positions of modern physics", becomes particularly significant in Parts I and II, not least because of my questioning of the "anticipation" of scientific ideas'. 10. Citation is from: Friedman and Donley, *Myth and Muse*. 96.

the modernist literature of Woolf is actually similar to, and hence hypothetically influenced by, the developments of psychology instead of the developments of quantum theory. In order to begin ascertaining the extent to which this may be the case, the presence of philosophical psychology in Woolf must be illuminated. This will be achieved first by independently analysing how the human mind and its activity is depicted in *To the Lighthouse*: as the novel predates complementarity, it will be safe to assume that the psychological imagery revealed within is not causally influenced by quantum mechanics. Then, the depiction unearthed in the novel will be compared to Woolf's personal conceptions and her intellectual environment, to evaluate the extent to which she is in agreement with contemporary developments in psychology.

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A/ *To the Lighthouse*: The Mind as a Pool of Water

To the Lighthouse[10] is obviously famous for its exploration of characters' interiorities, with Woolf's influential use of free indirect discourse to achieve her stream of consciousness effect. But, the novel does not merely reveal inner thoughts: it also sets up a coherent model of the mind's nature and operations. This is achieved by means of a recurring image: the mind as a pool of water.

When Mrs. Ramsay is sat alone, observing the lighthouse's beam, her sudden involuntary consciousness of the 'little phrase or other which had been lying in her mind' is compared to a mist emerging from a lake: 'There rose, [...] there curled up off the floor of the mind, rose from the lake of one's being, a mist' [53-4]. Similarly, when Lily is painting, 'her mind kept throwing up from its depths, scenes, and names, and sayings, and memories and ideas, like a fountain spurting' [132]. In both cases, the sudden unintended appearance of mental content in the conscious mind is presented as an emergence from a pool of water. Conversely, Cam's hearing and understanding of phrases is presented as a plunging down into water: 'The words seemed to be dropped in a well [...] on the floor of the child's mind' [47]. Or, when Lily

[10] Virginia Woolf, (1927), *To the Lighthouse*, Oxford, Oxford University Press, 2008. All pages cited in the body of the thesis refer to this edition.

is contemplating language's inability to express thoughts perfectly, the unexpressed ideas seem to sink down into water: 'one gave it up; then the idea sunk back again' [146]. So, mental content at the surface can also descend down into the waters once it no longer makes a conscious impression. The unconscious mind then is the depths of the pool, where thoughts, memories, phrases, and ideas lay, swirl and intermingle, as when Cam is meditating on the boat: 'her mind made the green swirls and streaks into patterns and, numbed and shrouded, wandered in imagination in that underworld of waters' [150]. The conscious mind, then, is the dry surface above the pool, where from the depths emerge separate words, clear ideas, and judgements, again illustrated with Cam after a sudden conscious realisation: 'the drops falling from this sudden and unthinking fountain of joy fell here and there on the dark, the slumberous shapes of her mind [...] catching here and there, a spark of light' [154], with the 'spark of light' here referring to mental content being "seen" and registered by consciousness. In short, this image of the 'pool of thought' [147], and its related mechanism of materials being exchanged between the depths and the surface, depending on their relation to consciousness, is constant in the novel when mental processes are described: 'Beneath [...] it is unfathomably deep; but now and again we rise to the surface' [53]; 'the minds of men, in those pools of uneasy water' [108]; 'she had come to the surface' [146]; '[*one*] felt something emerge' [157].

The depth-surface binary is more than a mere metaphor to illustrate a psychological mechanism: its omnipresence in the novel also makes clear that each side of the opposition is its own specific realm of mental experience, each possessing antithetical qualities. This is encapsulated by one moment during the dinner scene, when Mrs. Ramsay has achieved her desired harmony, and hence (for reasons to be made clear later) is able to near-telepathically see the unconscious interiority of the diners:

> her eyes [...] seemed to go round the table unveiling each of these people, and their thoughts and their feelings, without effort like a light stealing under water so that its ripples and the reeds in it and the minnows balancing themselves, and the sudden silent trout are all lit up hanging, trembling. [...] what they said was like the movement of a trout when, at the same time, one can see the ripple and the gravel, something to the right, something to the left; and the whole is held together; for whereas in active life she would be netting and separating one thing from another; she would be saying she liked the *Waverley* novels or had not read them; she would be urging herself forward; now she said nothing. For the moment, she hung suspended [86-7]

The ability to see the interior thoughts and feelings of individuals is likened to a light under water, confirming that the paragraph is engaging with the "mind as a pool" image. The underwater realm being explored – the depths – is dynamic, like any active waters ('balancing',

'trembling', 'movement', 'ripples'). It is also holistic, for the underwater contents are 'all lit up' at once, and 'the whole is held together'. This in turn generates a quality of interconnectedness, given that all the 'held together' contents ('reeds', 'minnows', 'trout', 'gravel', 'something to the right, something to the left') are all experienced visually and audibly simultaneously, where, for instance, something heard is intrinsically connected to something seen: 'what they said was like the movement of a trout when, at the same time, one can see the ripple and the gravel'. This water-world is opposed to the realm of 'active life' – the surface. There, instead of observing the activity of fish and their environmental interrelations, one has to 'be netting'; has to be fishing the creatures out from underwater to the surface, where their inevitable death signals the realm's lack of dynamism. Indeed, in addition to netting, one would also be 'separating one thing from the other': the opposite of the depth's holism and interconnectivity, which therefore aligns the surface with atomism and distinction. These opposed qualities make sense given their articulation around the presence or absence of liquid: in the depths, the water is an all-pervading and active medium which sustains and connects all the content within; whereas the surface lacks such a dense holistic medium, so nothing is connecting or acting upon its elements, rendering the realm inert, atomistic, and internally independent. Furthermore, the distinction between the two realms here is centred on the act of talking: Mrs. Ramsay would be 'netting and separating' were she to participate in the conversation about Walter Scott's *Waverley*. The thoughts and sentences she sees and hears within her guests are 'like the movement of a trout': mental content within their interiorities swirling and intermingling together. If the matriarch wished to talk, to express parts of the mental content at the surface of ordinary life, she would have to be 'fishing them up out of her mind by a phrase' [48]; turning her holistic mental experience into dead, solid, separate words. Instead, she remains silent, 'hung suspended' within the dense medium of unconsciousness, in tune with the movements of the depths, ignoring the surface.

The dynamic, holistic and interconnected nature of the unconscious depths is due to the contents within being unexamined: they are not being brought to consciousness' attention, they do not require awareness to be active, and they are independent of the ego, hence they are free to move, interact, and mix up before being made solid and separate by the conscious mind at the surface. The best expression of this is none other than the stream of consciousness itself, precisely because it aims to represent artistically the movements of the unconscious depths. For instance, when Lily is deep in thought while staring at the pear tree, she compares William Bankes to Mr. Ramsay, and in doing so, her mind rushes through a variety of interrelated

thoughts [23-4]: Bankes's qualities and contradictions; how to judge and value people; the meaning of words; the stream-like nature of impressions; the source of her thoughts and their truth; the differences between the two men; the motion of her thoughts; and finally the symbolical nature of the kitchen table. The passage begins with 'Suddenly [...] the load of her accumulated impressions of him tilted up, and down poured in a ponderous avalanche all she felt about him', this watery "pouring down" of simultaneous and interrelated impressions confirms that she is exploring the waters of interiority. Indeed, Lily finds herself incapable of judgements, of making the thoughts solid at the surface, 'How did one judge people, think of them? How did one add up this and that and conclude', or to transform the flowing thoughts into fixed words: 'her thought was like following a voice which speaks too quickly to be taken down'. In other words, she is incapable of bringing any contents up from the waters and fixing them into clear separate thoughts or sentences. The passage ends by comparing these 'poured impressions' to 'a company of gnats, each separate but all marvellously controlled in an invisible elastic net', which expresses the same meaning as the fish held together in the holistic underwater previously: the depths are a system where many mental materials are all active and interrelated for they have yet to be separated, judged and expressed at the surface.[11]

Later in the novel, when Lily is once again in tune with her stream of consciousness and unable to make her vision solid on the canvas, she is said to be 'frozen over superficially but moving underneath with extreme speed' [164]: nothing is happening at the surface, for she is fully immersed in the depths. This moment, as well as Mrs. Ramsay's exploration during the dinner's harmony, both make clear a final aspect of the psychological binary in *To the Lighthouse*: it is possible for characters to become conscious of their unconscious. That is, they can gain some degree of awareness of the dual nature of their own mind, by exploring their depths when in specific alternative psychological states. It is possible to gain knowledge of the strange and unhabitual realm of the depths by means of introspection, though putting that knowledge into words (or other communicable forms) in order to render it experienceable in the realm of the solid habitual surface still seems like an unsurmountable challenge.

[11] For curiosity's sake, it can be pointed out that this sentence regarding the gnats has been analysed as referring directly to quantum physics twice. Clark, "Consciousness, Stream and Quanta", 1989. 'her vision of the gnats, the book's most precise depiction of a quantum world'. 421. And, Zucker, "Woolf's Uncertainty Principle". 'This [...] could be as well a description of the electron cloud of the atom as understood by quantum physics'. 150.

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B/ *Woolf's Thought*: A Consistent Picture of the Mind

The above reading of the mind's operations in *To the Lighthouse* is by no means ground-breaking. As early as 1977, Lisa Ruddick had affirmed that, in Woolf, the 'psyche must be pictured as a small patch of water suspended somewhere in the larger sea', with 'consciousness, or the surface of the sea' opposed to what is 'below the surface plane [...] the "spreading" soul'.[12] However, restating the nature of this binary in a detailed and focussed manner is important as a starting point to articulate the overarching binary system upon which *To the Lighthouse* is constructed. Clearly elucidating the novel's opposition also makes it easier to now consider it within the context of Woolf's personal conceptions.[13]

Ruddick's analysis drew on the posthumous publication of a number of Woolf's private or forgotten writings, including essays, diaries, and letters.[14] These helped clarify Woolf's beliefs concerning mental life, philosophy, and art, and hence make it safe to assume that the depiction of the mind as divided into two opposed realms with a transactional relationship between them is not limited to this particular novel, nor simply her fiction. For instance, as analysed earlier, in *To the Lighthouse* talking and writing involve bringing, voluntarily or not,

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[12] Lisa Ruddick, *The Seen and the Unseen: Virginia Woolf's To The Lighthouse*, Harvard University Press, 1977. 12. 'Soul' can be understood as the unconscious; the opposite side of the conscious mind. Water and the sea are hugely productive metaphorical containers in Woolf's work, beyond mere psychological representations. For a broader view of these metaphors, see: David Bradshaw, "The Purest Ecstasy: Virginia Woolf and the Sea", in *Modernism on Sea*, ed. Lara Feigel and Alexandra Harris, Amsterdam, Peter Lang, 2009. Or, Patrizia A. Muscogiuri, "'This, I Fancy, Must Be the Sea': Thalassic Aesthetics in Virginia Woolf's Writing.", in *Virginia Woolf and the Natural World: Selected Papers from the Twentieth Annual International Conference on Virginia Woolf*, ed. Kristin Czarmecki and Carrie Rohman, Clemson, South Carolina, Clemson University Digital Press, 2011. Or, Patrizia A. Muscogiuri, "Woolfian Seamarks: Commodified Women and the Racial Other on the Shores of Empire", in *Virginia Woolf and the Common(wealth) Reader*, ed. H. Wussow and M. Gillies, Liverpool, Liverpool University Press, 2014.

[13] This section revolves around a dual vision of the mind, however, not a Cartesian dualism: the issue here is not the relationship between the mental and material realms, it is the relationship between two functions of the mind itself. Indeed, Woolf tends to be sceptical of Cartesian dualism, and attempts to undermine it, much like James did. But this is due to a particular conception of the act of thinking, not of the mind itself. See: Patricia Waugh, "'Did I not banish the soul?" Thinking Otherwise, Woolf-wise", in *Contradictory Woolf: Selected Papers from the Twenty-First Annual International Conference on Virginia Woolf*, ed. Derek Ryan and Stella Bolaki, Clemson, South Carolina, Clemson University Digital Press, 2012.

[14] While her diaries were published as early as 1953 by her husband, they were but a selection of heavily edited entries. It is only from 1977 to 1984 that five volumes of her complete and untouched diaries were published, edited by Anne Olivier Bell. Around the same time, Joanne Trautmann edited all of Woolf's letters into six volumes, published from 1975 to 1980. Finally, 1976 also saw the publication of *Moments of Being*, containing several personal and autobiographical writings from the author, most notably "A Sketch of the Past".

materials from the depths up to the surface; this same logic is visible in Woolf's discussions regarding the acts of literary production and creativity. One example is her 1931 speech to The Women's Service League, "Professions for Women", which depicts a young writer 'letting her imagination sweep unchecked round every rock and cranny of the world that lies submerged in the depths of our unconscious being', because her imagination 'had sought the pools, the depths, the dark places where the largest fish slumber', and therefore conveys 'the image of a fisherman lying sunk in dreams on the verge of a deep lake with a rod held out over the water'.[15] Much here is near-identical to the depths metaphor contained in *To the Lighthouse*: a deep, submerged realm of the unconscious that can be explored while in certain states (here, imagination), which allows for 'unchecked' knowledge of the mysterious mental contents that reside within; but in order to concretely materialise these contents, they must be brought to the surface, like a fisherman extracting fish from a body of water – an image Woolf reused from the opening of *A Room Of One's Own*, when 'Thought [...] had let its line down into the stream [...] until [...] the sudden conglomeration of an idea at the end of one's line: and then the cautious hauling of it'.[16] While these remain the depictions of a fictional person's mind, Woolf's diaries show that the same system can be uncovered in discussions of her own creativity, such as the 20/04/25 entry (with the immaterial difference that here the watery depths are an oil well): 'One thing, in considering my state of mind now, seems to me beyond dispute; that I have, at last, bored down into my oil well, and can't scribble fast enough to bring it all to the surface. I have now at least 6 stories welling up in me'.[17] Once again, there is the notion of bringing materials from the depths up to the surface to write them down, a difficult task as pens can scarcely move fast enough to capture the dynamism of the depths. It also makes visible that the transaction can be voluntary ('I have [...] bored down') or not ('stories welling up in me'). The imagery is maintained throughout much of her writing,[18] all the way to "A Sketch of the Past", where the depths are called 'reality', for reasons that will be made clear at a later point: 'my instinctive notion [...] we are sealed vessels afloat upon what is convenient to call reality; at some moment,

[15] Virginia Woolf, (1931), "Professions for Women", in *Selected Essays*, ed. David Bradshaw, Oxford, Oxford University Press, 2009. 143.

[16] Virginia Woolf, (1929), *A Room of One's Own*, London, The Hogarth Press, 1959. 8-9.

[17] Virginia Woolf, (1925), "Monday 20 April 1925", in *The Diary of Virginia Woolf*, ed. Anne Olivier Bell, London, The Hogarth Press, 1980. 12.

[18] For instance, the explicit description of the depth's watery stream of mental contents in *The Waves*, opposed to the routines of ordinary life: 'it is a mistake, this extreme precision, this orderly and military progress; a convenience, a lie. There is always deep below it [...] a rushing stream of broken dreams, nursery rhymes, street cries, half-finished sentences and sights [...] that rise and sink'. Virginia Woolf, (1931), *The Waves*, London, Vintage Books, 2004. 171.

without an effort, the sealing matter cracks; in floods reality; that is a scene'.[19] A literary scene is created when the watery depth 'floods' up to the surface, though most of the time the human experience is to remain 'sealed' at the surface of ordinary life, separate from, and unaware of, the unconscious depths found below. These three examples are cases of the depths emerging at the surface, but the reverse motion can also be found in Woolf's writings: in the "Art of Fiction" essay of 1927, which reviews E.M. Forster's *Aspects of the Novel*, she mentions how he 'has the art of saying things which sink airily enough into the mind to stay there and unfurl like those Japanese flowers which open up in the depths of the water'.[20] The thoughts expressed solidly in language sink down into the unconscious depths where they become part of the medium, and experience dynamic transformations. These examples lead to the conclusion that the view of the mind's operations as an exchange of materials between two realms found in *To the Lighthouse* is broadly tied to Woolf's real-world psychological conceptions.

The antithetical nature of the two realms – the unconscious depths are fluid, dynamic, holistic, and interconnecting while the conscious surface is solid, inert, atomistic, and separating – is also common in Woolf's other writings, a further confirmation of the above conclusion.[21] Indeed, the nature of the contradictory realms and their connection to water imagery has already been noted by scholars, for instance Rachel Crossland: 'the suggestion here is of a self of two parts, distinct and momentary on the one hand, a wave-like continuity on the other. [...] A tension between connection and distinction is evident across Woolf's writings and is often linked to images of water'.[22] Nevertheless, as before, it is important to clearly explain the nature of each side of the binary here, for the rest of Woolf's thought builds upon it. One of the clearest depictions of these opposed worlds of human experience can be found in 1929's "Phases of Fiction" essay, wherein she evaluates the qualities and defaults of

[19] Virginia Woolf, (1939-1940), "A Sketch of the Past", in *Moments of Being: Unpublished Autobiographical Writings*, ed. Jeanne Schulkind, Sussex, The University Press, 1976. 122.

[20] Virginia Woolf, (1927), "The Art of Fiction", in *The Moment, and Other Essays*, ed. London, The Hogarth Press, 1947. 90.

[21] See: Virginia Woolf, (1917), "The Mark on the Wall", in *The Complete Shorter Fiction of Virginia Woolf*, ed. Susan Dick, London, Harcourt Brace Jovanovich Publishers, 1985. In it, Woolf wants to meditate, to explore her thoughts fully, setting up the opposition between depths and surface, one fluid and interconnecting, the other hard and separating: 'I want to think quietly, calmly, spaciously, never to be interrupted, never to have to rise from my chair, to slip easily from one thing to another [...] I want to sink deeper and deeper, away from *the surface, with its hard separate facts'*. 78-9. Emphasis added.

[22] Crossland, *Modernist Physics*. 21. David Bradshaw also shows how characters who experience the sea and the submarine in Woolf are marked by feelings of connections, vagueness, secret passions, and uncertainty; while characters who have no interest in the sea are instead tied to solidity, tangibility, definite objects and the patriarchy. Bradshaw, "Purest Ecstasy". 106-9.

various genres of novels based on their impact on the reader's mind. She refers to authors such as Henry James or Marcel Proust as 'The Psychologists', because in their art 'we see the mind at work; we are amused by its power to make patterns; by its power to bring out relations in things and disparities which are covered over when we are acting by habit or driven on by the ordinary impulses'.[23] In other words, 'The Psychologists' reveal the unconscious depths and its interconnected materials, because they depict a state of mind that is not restricted by 'habit' or 'ordinary' experience (the surface), just as Mrs. Ramsay's lack of participation in the surface's conversation allowed her to be in tune with the depths. From this psychological point of view 'The commonest object, [...], loses its simplicity, its solidity, and becomes a part of life and transparent. The commonest actions, [...], instead of being discharged automatically, rake up in their progress a whole series of thoughts, sensations, ideas, memories'.[24] All the criteria of the depths found in *To the Lighthouse* are also present here: when mental materials descend into the depths, they become interrelated with everything else therein ('part of life', 'thoughts, sensations, ideas, memories'), which makes them seem strange when compared to how they are experienced commonly at the surface, as if they were now permeable ('loses [...] its solidity, and becomes [...] transparent'). The link between this literary psychological realm and the imagery of water is made explicit: 'The common stuff of the book is made of this *deep reservoir* of perception. It is from these depths that characters *rise like waves* forming, then break and *sink again* into the moving *sea of thought*'.[25]

After this explanation of the depths which 'The Psychologists' explore, Woolf discusses a genre entirely at the surface, for after reading James and Proust: 'The mind feels like a sponge saturated full with sympathy and understanding; it needs to dry itself, to contract upon something hard'. This relief at the dry surface full of solid objects is to be found in the works of 'The Satirists', for they depict 'a world where there is nothing more pressing to do than to glide over the face of the waters".[26] Here, all is aligned with the surface, thanks to the ability of satirical caricatures to reduce situations and characters to one solid, distinct, trait: 'Instead of being many-sided, complicated, elusive, people possess one idiosyncrasy apiece, which crystallizes them into sharp separate characters, colliding briskly when they meet. [...] What

[23] Virginia Woolf, (1929), "Phases of Fiction", in *Granite and Rainbow: Essays*, ed. Leonard Woolf, London, The Hogarth Press, 1958. 122.

[24] Ibid. 123.

[25] Ibid. 125. Emphasis added.

[26] Ibid. 132.

lies between is left out'.[27] The mention of how these clearly-defined, acutely distinct characters enter into collisions, while ignoring the medium within which the collisions take place ('What lies between') confirms an adherence to atomism. Just like the surface's conscious mind in *To the Lighthouse*, here only one element of psychology is selected and focused on, which creates a realm of experience where all elements are impermeable, solid, separate and straightforward. The psychological binary is hence a constitutive feature of Woolf's general philosophy.

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C/ *Intellectual Context*: Psychology Emerges out of Philosophy

Another uncontroversial notion in Woolf studies is the extent to which her general philosophy overlaps and resonates with notions from the developing field of psychology, which preceded and surrounded her, particularly what George Johnson has called 'second wave psychology'.[28]

This appellation is useful because it differentiates the movement of interest here from the post-Kantian first wave psychology of Johann Friedrich Herbart, and also because it distances the conversation from Freudian psychoanalysis. This is not to say that Sigmund Freud was an uninfluential figure in the field, but, as Judith Ryan's exhaustive study of the ties between second wave psychology and literary modernism puts it:

> James and Mach are representatives of an earlier kind of psychology whose impact on twentieth-century writing was much greater than is generally realized. It is this earliest of modern psychology – the psychology of the 1870s and 1880s – that this book attempts to rescue from its relative neglect. If Freud plays only a small role here, it is because so much work has been done on the relation of Freudian and post-Freudian psychology to literature; the subsequent prominence of Freud had tended to obscure the importance of pre-Freudian psychology[29]

This sentiment is shared by Michael Whitworth – 'Freud is important, but literary historians have over-emphasised psychoanalysis at the expense of other areas of psychology in the

[27] Ibid. 131.

[28] George M. Johnson, *Second Wave Psychology in Modern British Fiction*, PhD Thesis, McMaster University, 1991. 31-5.

[29] Judith Ryan, *The Vanishing Subject: Early Psychology and Literary Modernism*, Chicago, The University of Chicago Press, 1991. 1-2. Though in her book she calls second wave psychology 'the new psychologies'.

period'[30] – and Johnson – 'Woolf was aware of ideas of earlier proponents of "new" or what I have termed second wave psychology, and it is these neglected influences that I plan to examine'.[31] Even more revealing, Violeta Sotirova's stylistic study from 2013, *Consciousness in Modernist Fiction*, does not mention Freud, though the thought of Bergson is discussed in depth.[32] Finally – as Sandford Schwarz's *Matrix of Modernism* makes clear – second wave psychology is entwined with turn of the century philosophy and physics to an extent that cannot be claimed for psychoanalysis. Hence, Freud will be ignored in the current account, to instead focus on both key figures of second wave psychology, James and Bergson.

This chapter's introduction already alluded to sources of connection between the two philosophers and the new physics, but it is possible to further associate their work – particularly their fundamental insights which revolutionised the study of the mind – with various different strands of intellectual life in Britain and beyond, during the late-19th and early-20th centuries. Indeed, James was the well-connected scholar and cross-disciplinary thinker *par excellence*, as Randall Collins notes while discussing the reorganised post-Kantian University system of the later-19th century: 'the existence of rival disciplinary homes has meant that individuals could migrate back and forth between bases [...], borrowing and combining themes from each', of which 'the career of William James is an elaborate example'.[33] Bergson was arguably even more popular and cross-disciplinary, as his drastic rethinking of the notions of time, intuition and reality were discussed equally in philosophical, literary, and new physics circles, leading him to be widely considered one of the major intellectual figures of modernism, alongside James.[34] It is therefore important here to outline clearly the ways in which Woolf, James, and

[30] Whitworth, *Einstein's Wake*. 84.

[31] George M. Johnson, "« The Spirit of the Age »: Virginia Woolf's Response to Second Wave Psychology", in *Twentieth Century Literature,* 40, no. 2, 1994. 140.

[32] Violeta Sotirova, *Consciousness in Modernist Fiction: A Stylistic Study*, Palgrave Macmillan, 2013.

[33] Collins, *Sociology of Philosophies*. 619.

[34] Mary Ann Gillies's book-length study of Bergson's influence on British literary modernism begins by stating this fact unambiguously: 'Bergson was a leading intellectual force in the early years of this century. His ideas were common currency, in the academic as well as the fashionable societies throughout Europe'. Mary Ann Gillies, *Henri Bergson and British Modernism*, Montreal, McGill-Queen's University Press, 1996. 3. Paul Ardoin, S.E. Gontarski and Laci Mattison's introduction to *Understanding Bergson, Understanding Modernism* similarly aims to establish the overwhelming intellectual presence of Bergson: 'By 1910 [...], Bergson's name was recognizable not only to academics at Cambridge and Oxford but also to a stunning percentage of the educated and aesthetically-minded public at large. After an October 28, 1911 meal with Bergson, the analytic philosopher Bertrand Russell reported, "all England has gone mad about him"'. Paul Ardoin, S.E. Gontarski, and Laci Mattison, "Introduction: "About the year 1910" Bergson and Literary Modernism", in *Understanding Bergson, Understanding Modernism*, ed. Paul Ardoin, S.E. Gontarski, and Laci Mattison, New York, Bloomsbury Academic, 2013. 4. Citation is from: Bertrand Russell, *The Collected Papers of Bertrand Russell*, London, Routledge, 1994. 318.

Bergson's conceptions of the mind are in agreement, particularly regarding their binary constructions, as these correspondences are conceptually relevant to the binaries of modernism and physics.

1. From Atomism to Fluidity. The first wave of psychology that James, and later Bergson, reacted against was pioneered by Herbart, whose interpretation of Kant led him to analyse the laws and materials of psychology as if they were analogous to the mathematical constructs of Newtonian physics. However, in Johnson's words, 'Second wave psychology provoked a paradigm shift in psychology by positing that mind consisted of psychic energy in perpetual movement, unlike the first wave, which had viewed mind as essentially mechanistic, passive, and divisible into elementary contents'.[35] This shift is explicit in the most famous chapter of James's most important work, Chapter IX 'The Stream of Thought' in 1890's *The Principles of Psychology*:

> no two "ideas" are ever exactly the same [...] it makes it already impossible for us to follow obediently in the footprints of either the Lockian or the Herbartian school, schools which have had almost unlimited influence in Germany and among ourselves. No doubt it is often *convenient* to formulate the mental facts in an atomistic sort of way, [...] we must never forget that we are talking symbolically, and that there is nothing in nature to answer to our words[36]

This shift away from atomism, of course, leads directly to the statement that has had an immense influence on the history of literary studies, to name but one affected discipline:

> Consciousness, then, does not appear to itself chopped up in bits. Such words as "chain" or "train" do not describe it fitly as it presents itself in the first instance. It is nothing jointed; it flows. A "river" or a "stream" are the metaphors by which it is most naturally described. In talking of it hereafter, let us call it the stream of thought, of consciousness, or of subjective life[37]

Similar to James's stream of consciousness, Bergson formulates a new philosophical concept by advocating for a shift away from previous theories. Indeed, much of his 1898 doctoral thesis, *Time and Free Will*, is devoted to pointing out the errors of deterministic Kantian and post-Kantian philosophies, psychologies, and even physical theories.[38] His criticisms boil down to

[35] Johnson, "Spirit of the Age". 140.

[36] William James, (1890), *The Principles of Psychology*, Cambridge, Massachusetts, Harvard University Press, 1981. 229-31.

[37] Ibid. 233.

[38] The conclusion of Bergson's thesis begins by pointing out the interlinked schools of thought he has aimed to correct: 'Modern psychology seems to us particularly concerned to prove that we perceive things through the medium of certain forms, borrowed from our own constitution. This tendency has become more marked since

the same general point, that reality is experienced as a mutating multiplicity of fluid mental processes, called 'duration'.[39] As a result, cutting up human experience into inert atomistic bits for analysis can only lead to error:

> we forget that states of consciousness are processes, and not things; that if we denote them each by a single word, it is for the convenience of language; that they are alive and therefore constantly changing; that, in consequence, it is impossible to cut off a moment from them without making them poorer by the loss of some impression, and thus altering their quality[40]

There is much to say about the relevance of James and Bergson's psychological concepts to Woolf, but before doing so, it is worth pointing out that the transition from atomism to fluidity advocated by both philosophers is reminiscent of Woolf's 1919 "Modern Fiction", wherein she criticises a genre of novelists who fail to capture life in their works. These 'materialists' rely on stifling literary traditions; rational designs; a set number of chapters; creative constraints; structured plots; well-defined genres and tropes; as well as a sense of realism coherent with ordinary human experience – the surface. Such methodology is the 'customary way', with a dampening effect on the author's 'own free will', because the tradition's insistence on 'proving the solidity, the likeness to life' is like a 'tyrant', on top of being ineffective at truly enveloping life, like 'ill-fitting vestments'.[41] Indeed, 'Life is not a series of gig lamps symmetrically arranged; life is a luminous halo, a semi-transparent envelope surrounding us from the beginning of consciousness to the end'.[42] Here, Woolf is again constructing a binary, between the materialistic, external, and rationally ordered methods of the authors she criticises, and the real nature of 'life, or spirit, truth or reality', which is dynamic ('moved off'), unsolid ('semi-transparent'), all-pervading ('surrounding us'), tied to human interiority ('the vision in our minds') and hence challenging to capture in words or art ('life escapes'). Woolf advocates instead for a literature in line with the depths-like nature of life, such as that of James Joyce,

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Kant [...] the empirical school, carrying analysis even further, tries to reconstruct [...] space out of duration, and externality out of inner states. Physics, moreover, comes in to complete the work of psychology in this respect'. Henri Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, translated by F.L. Pogson, London, Swan Sonnenschein & Co, 1910. 222.

[39] To be truer to Bergson's philosophy, 'duration' is merely the opposite of space, after his unmixing of the two concepts (as he believes Kant made the mistake of confusing the two as one). However, a conclusion of this separation is that duration is conceived of as existing only in the immediate data of experience, acausaly and heterogeneously. Hence why the concept is here being understood an aspect of mental reality, without focusing on other of its many implications (duration is central to Bergson's thought).

[40] Bergson, *Time and Free Will*. 196.

[41] Virginia Woolf, (1919), "Modern Fiction", in *The Common Reader*, ed. London, The Hogarth Press, 1951. 188.

[42] Ibid. 189.

whom she previously called a 'Psychologist', but here refers to as 'spiritual; he is concerned at all costs to reveal the flickerings of that innermost flame which flashes its messages through the brain'.[43] To do so, he rejects all surface-like literary customs that might impeded his vision, however symbolically "convenient" they may be, to use a word also employed by both James and Bergson to characterise atomistic approaches. Woolf too, then, is advocating for a move from atomism to fluidity within her own field.

2. The 'Shower of Atoms'. Another slight similarity between James, Bergson and "Modern Fiction" is worth pointing out, not because it is overtly relevant to the discussion of binaries, but because it deals with "atoms" and can therefore be a source of confusion when connecting Woolf and physics. 'The mind, exposed to the ordinary course of life, receives upon its surface a myriad impressions [...] an incessant shower of innumerable atoms', affirms the essay.[44] This atomistic image has been read contradictorily in criticism: Melba Cuddy-Keane connects it to 'the new century's atomistic understanding of the way the physical universe is formed',[45] while Morag Shiach proposes that it might be 'suggesting that the atom is being imagined as having something of the substance of water, which does not fit closely with the theories being developed by physicists'.[46] Indeed, while atoms are the epitome of the solid and separate – the surface side of the binary – Woolf sees them as making 'life itself' – the depths side of the binary – which explains the difficulty of placing the 'shower of atoms' within the opposition exposed thus far. Of course, this has to do with Woolf's binary system not being as clearly cut as the present chapter makes it seem, as will become clear in Chapters 6 and 7's reviews of Woolf's thought. However, for the benefit of the present psychological discussion, it is enough to explain Woolf's 'shower of atoms' by comparing it to James's 'primordial chaos of sensations, which gave the mere *matter* to the thought of all of us indifferently' and to Bergson's 'pure sensations' which 'give rise to a dynamic progress':[47] that is, 'atoms' can be understood as the many distinct material elements of the external world which make an impact on the perceptual apparatus of the human body, *before* they are made into anything by the mind's operations. In

[43] Ibid. 190.

[44] Ibid. 189.

[45] Melba Cuddy-Leane, "Virginia Woolf and the Public Sphere", in *The Cambridge Companion to Virginia Woolf*, ed. Susan Sellers, Cambridge, Cambridge University Press, 2010. 244.

[46] Shiach, "Woolf's Atom". 61.

[47] More explicitly: 'our ego comes into contact with the external world at its surface; our successive sensations, although dissolving into one another, retain something of the mutual externality which belongs to their objective causes'. Bergson, *Time and Free Will*. 69.

a sense they are “pre-binary”, for 'atoms' only exist as such at the moment of perception, not the moment of thought that follows, which is what has been relevant thus far. Indeed, Woolf makes clear that it is 'as they fall' that they 'shape themselves in the life'; it is 'in their sum' that they can be called 'life itself'; it is once 'they fall upon the mind' that they create 'the pattern [...] upon consciousness'. So, this particular case of atomism is not as problematic as might seem, for it is not the atoms themselves, but 'The pattern generated by atoms [*which*] becomes the substance of the cognitive process Woolf is trying to describe'.[48]

3. Dual Realms of Experience. Woolf's psychological depth-surface dualism can be mapped effortlessly onto the psychological binary that James's chapter aims to put forward: the stream versus attention. Regarding Bergson, the parallels are even more explicit, such as in the following one-sentence summary of his section on the dualism, found in the 'Contents' pages of his thesis: 'The two aspects of the self, on the surface well-defined conscious states, deeper down states which interpenetrate and form organic whole'.[49] Furthermore, the similarity between James's stream, Bergson's 'deeper down' duration, and Woolf's depths goes beyond the choice of fluid metaphor: they all agree on the nature of this realm of experience.[50] James depicts mental contents as swimming and interacting in active waters: 'Every definite image in the mind is steeped and dyed in the free water that flows around it',[51] and he insists on its 'multiplicity of [...] relations'.[52] His characterisation of the speed and activity of the stream also echoes Lily's moment when 'to follow her thought was like following a voice which speaks too quickly to be taken down': 'The rush of the thought is so headlong that it almost always brings

[48] Shiach, "Woolf's Atom". 61.

[49] *Bergson, Time and Free Will.* xxii.

[50] During the analysis of *To the Lighthouse*, this realm was called the “unconscious” depths, as the term communicates its unexamined, below-consciousness nature, and allows for the opposed word “consciousness” to define the surface. However, it should be noted that neither James, Bergson, nor Woolf call the depths the “unconscious”, in a manner reminiscent of psychoanalysis. To them, the surface and the depths are both equal parts in making the whole of consciousness possible, therefore why James calls it the 'stream of *consciousness*'. Woolf does employ the terms 'unconscious' or 'subconscious' regularly throughout her work, but they mainly refer to unintentional actions, emotions and thoughts. They are closer to synonyms of “unthinking” than to a realm of mental experience. The few times she does employ the terms in this manner, she is directly referring to psychoanalysis, usually with a degree of distancing, such as at page 291 of Virginia Woolf, (1940), *Roger Fry: A Biography*, London, The Hogarth Press, 1969. Or: 'Did she mean, so to speak, something hidden, the unconscious as they call it? But why always drag in sex...'. In: Woolf, *Between the Acts*. 400. The use of the term 'unconscious' in the psychology of James and Bergson is a long-debated topic (see: Joel Weinberger, "William James And The Unconscious: Redressing a Century-Old Misunderstanding", in *Psychological Science,* 11, no. 6, 2000.), but not particularly useful here.

[51] James, *Principles of Psychology*. 246.

[52] Ibid. 219.

us up at the conclusion before we can arrest it'.[53] Following his presentation of this innovative notion, James considers how the mind 'welcomes or rejects' individual elements from the stream: 'Consciousness, from our natal day, is of a teeming multiplicity of objects and relations, and what we call simple sensations are results of discriminative attention'.[54] This act of attention is in tune with Woolf's surface as a realm of experience, where materials are brought up from the waters to be examined consciously. This is most visible in James's elongated comparison of the act of attention from the stream with the act of perception from reality:[55] the real world, as revealed by physics, is an 'infinite chaos of movements', an 'undistinguishable, swarming *continuum*, devoid of distinction or emphasis', similarly to the dynamic, interconnected stream of consciousness. From it, 'each sense-organ picks out those which fall within certain limits of velocity. To these it responds, but ignores the rest'. This leads to the perception of 'a world full of contrasts, of sharp accents, of abrupt changes, of picturesque light and shade' even though such qualities do not exist in of themselves, they are merely 'convenient'. For instance, 'there is no reason whatever to think that the gap in Nature between the highest sound-waves and the lowest heat-waves is an abrupt break like that of our sensations'. Therefore, selective attention, like selective senses, creates the perception of a world of differences, sharpness, discontinuity and solidity to be examined by the ego, following the same logic as Woolf's fishing up of clear ideas, settled judgements, and separate thoughts from the depths to the surface. This idea can be straightforwardly isolated in Bergson:

> to recover this fundamental self, [...] analysis is necessary, which will isolate the fluid inner states from the image [...] solidified in homogeneous space. In other words, our perceptions, sensations, emotions and ideas occur under two aspects: the one clear and precise, but impersonal; the other confused, ever changing, and inexpressible[56]

The surface's 'aspect' is that of 'solidified' images, which are conceived as 'clear and precise'. Though they arise as a quantitative multiplicity, the mind is capable of differentiating between the multiple elements. Conversely, the depths are a 'fluid inner state', which are therefore 'ever changing', rendering them 'inexpressible', and hence this particular experience of qualitative multiplicity is 'confused', for differences cannot be isolated. So, the surface is the realm of atomistic, solid, distinguished and well-defined constituent parts from the outer world, while

[53] Ibid. 237.

[54] Ibid. 219.

[55] Ibid. 273-5.

[56] Bergson, *Time and Free Will*. 129.

the depths are the realm of fluid, dynamic and interrelated inner-world materials which are always experienced together as one – in full agreement with Woolf. It is also worth noting that James and Bergson discuss not only the mind's ability to bring materials up to attention from the fluid depths, but also the reverse motion of ignoring mental content, allowing them to "sink" down, which demonstrates that they also adhere to Woolf's transactional view of the mind. This is visible in James's discussion of how the mind "suppresses" various sensations when they are not useful: 'Attention, on the other hand, out of all the sensations yielded, picks out certain ones as worthy of its notice and suppresses all the rest'.[57] And in Bergson it is revealed in his explanation of why, occasionally, when 'sentiments [...] lodge on the surface of our ego and there get solidified' it is nevertheless possible to feel that 'something may revolt against it. It is the deep-seated self rushing up to the surface', which emerges because 'we had thrust them back into the darkest depths of our soul whenever they came up to the surface',[58] demonstrating that mental content in Bergson, as in Woolf, can both emerge up to the solid surface or be submerged back into the depths, voluntarily or not.

4. The Role of Language. In Woolf, language is associated with the surface, because it separates and fixes thoughts into words. This idea is also explicitly expressed by both philosophers. For instance, to James selective attention is the moment when language operates, as it allows for the discriminated content to be made independent from the rest of the stream's content, and hence named: 'What are things? Nothing [...], but special groups of sensible qualities, which happen practically or æsthetically to interest us, to which we therefore give substantive names, and which we exalt to this exclusive status of independence'.[59] In Bergson, the notion was previously implied when he characterised the confused multiplicity of the depths as 'inexpressible'. This follows from his statement that 'Language gives a fixed form to fleeting sensations'.[60] Indeed, when 'conscious states' are expressed in language, 'this distinctness, and at the same time this solidification, enables us to give them fixed names in spite of their instability, and distinct ones in spite of their interpenetration. It enables us to objectify them, to throw them out into the current of social life'.[61] Again, language is a tool which solidifies, and hence belongs to the surface.

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[57] James, *Principles of Psychology*. 274.

[58] Bergson, *Time and Free Will*. 169-70.

[59] James, *Principles of Psychology*. 274.

[60] Bergson, *Time and Free Will*. 130.

[61] Ibid. 231.

5. Knowledge Through Introspection. While all three writers conceive of the surface, or selective attention, as the realm where the mind constructs its impression of reality during most of human experience – which illuminates why Woolf calls it 'ordinary experience' in the novel or Bergson associates it with 'social life'[62] – they also recognise the possibility of introspection, of being in tune with the stream. This is visible in *To the Lighthouse* with Lily's stream of consciousness, Cam's reverie, or Mrs. Ramsay's moments of oneness. To the psychologists, it is an essential methodological factor: James states that '*Introspective Observation is what we have to rely on first and foremost and always*. The word introspection need hardly be defined – it means, of course, the looking into our own minds and reporting what we there discover';[63] and Bergson makes clear that the 'fundamental self' can be reached by 'deep introspection, which leads us to grasp our inner states as living things, constantly becoming, as states not amenable to measure, which permeate one another'.[64] So, while all three recognise the difficulty of capturing the stream in thoughts and words, they nevertheless acknowledge that it is an accessible realm that can be a source of knowledge; indeed, were it not, their intellectual projects would be bound to fail.

With such strong similarities between the three thinkers, one is tempted to conclude that there must be some degree of influence between them, namely, that Woolf must have read James or Bergson and integrated the above parts of their theories into her own conceptions. While there is evidence to suggest that the author had some degree of knowledge of James,[65] and more so of Bergson,[66] merely studying such lines of direct influence risks eclipsing the much broader, relevant, and interesting truth of the matter, aptly summarised by Schwartz:

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[62] In *To the Lighthouse*, Lily muses that 'One wanted, [...] to be on a level with ordinary experience, to feel simply that's a chair, that's a table, and yet at the same time, It's a miracle, it's an ecstasy' which shows that ordinary experience is part of the surface's realm, as it is opposed to the 'ecstasy' of extraordinary reality found in the depths. Indeed, in the next paragraph, Lily suddenly feels a sensation of extraordinary horror rushing up, caused by grief and absence, but she manages to calm it by rendering it ordinary: 'quietly, as if she refrained, that too became part of ordinary experience, was on a level with the chair, with the table' [192].

[63] James, *Principles of Psychology*. 185.

[64] Bergson, *Time and Free Will*. 231.

[65] For instance in: S.P. Rosenbaum, "Bertrand Russell in Bloomsbury", in *Intellect and Social Consciousness: Essays on Bertrand Russell's Early Work,* 4, no. 1, 1984. 18. This explains how, following the first world war, Russell embraced James's conceptions of consciousness, and presented them in a lecture that Leonard Woolf attended, later adapted into a book (*The Analysis of Mind*), that Roger Fry read. Both men enjoyed Russell's new Jamesian theory, and it seems probable that they would have discussed it with Woolf, given their importance in her intellectual life.

[66] Again, the links between Woolf and Bergson are to be found in her social circle where the philosopher was discussed, more so than direct knowledge. For instance, Woolf's sister-in-law Karin Stephen was a Bergson scholar who wrote a book-length study on him, and dedicated a public lecture to his ideas in 1913, which Woolf attended. Similarly, several members of the Bloomsbury circle were enthusiastic about Bergson, and it is hence

> In seemingly independent developments, the disciplines devoted to the study of the psyche, the sign, and society were reorganizing around the opposition between the world of ordinary awareness and the hidden structures that condition it.
> In philosophy, the same tendency appears as an opposition [...] generally, between the instrumental conventions that shape ordinary life and the original flux of concrete sensations. This opposition is remarkably widespread at the turn of the century: Bergson's "real duration," James's "stream of consciousness," Bradley's "immediate experience" or "feeling," and Nietzsche's "chaos of sensations" all refer to a realm beneath the forms that organize daily existence[67]

The four philosophers cited here are chosen by the academic because of their importance in the history of philosophy, but in his introduction he additionally lists thirteen 'of the most celebrated figures of the period' who also conform to the reorganization he describes.[68] Indeed, Schwartz's 1985 *Matrix of Modernism* has the explicit goal of demonstrating how much of the intellectual community of the late-19th and early-20th centuries in Britain, and much of continental Europe, underwent conceptually homogenous developments and modifications. This central thesis helped rewrite several assumptions of modernist criticism of the later-20th century, but, more importantly here, the general opposition Schwartz considers as fundamental to his matrix is plainly relevant to Woolf's conceptions: 'One element that I will emphasize is the tendency to pose a sharp opposition between conscious "surfaces" and unconscious "depths," between ordinary experience and a hidden realm of mental life of which we are generally unaware'.[69] This implies that Woolf's psychological binary was not merely formed under the influence of one or two psycho-philosophers, but instead that it was a part of a more general conceptual shift that many intellectual spheres were near-simultaneously experiencing.

Schwartz's matrix is constructed on three sites of systematic similarity that bind together all of the thinkers he discusses, though, within the similarities, he unveils a spectrum of opinions, which make it possible to nevertheless differentiate between the various philosophies – an important point, given that noting similarities can tend to obfuscate the variety of thought that can nevertheless exist within agreements. These three sites are the two

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safe to assume that Woolf would've heard her husband, Lytton Strachey, or Maynard Keynes (among others) discussing him. Finally, much of the modernist art that Woolf consumed and thought about was directly influenced by Bergson, such as Proust's novels or T.S. Eliot's poems. Not to mention the overwhelming popularity of the philosopher in Britain, particularly in Woolf's intellectual *milieu*.

[67] Sandford Schwartz, *The Matrix of Modernism: Pound, Eliot, & Early 20th Century Thought*, Princeton, Princeton University Press, 1985. 5.

[68] Ibid. 18.

[69] Ibid. 4.

side of the psychological binary, plus their relationship. Thus, Schwarz's work is extremely useful for intellectually contextualising Woolf's binary, so his matrix will here be briefly presented.[70] The first site is '*Abstraction*. *All of these philosophers agree that concepts are essentially practical instruments for ordering the sensory flux'*, which aligns with the surface in Woolf and Bergson as well as discriminated attention in James, though the thinkers differ in whether they believe the abstractions share a genuine relationship with reality (James), or if they are complete fictions (Friedrich Nietzsche), or some intermediary position on the spectrum of opinion (Bergson, F.H. Bradley, Henri Poincaré, Ernst Mach, Ernst Cassirer...). The second site is '*Sensation*', as in Woolf's depths; James's stream; Bergson's duration; and other related concepts. Here are two lines of differentiation. The '*relative values assigned to the realm*' with Bergson on the one end of the spectrum, for he views duration as the container of genuine reality, and Nietzsche on the other end, who conceives of it as a valueless mass of chaotic sensations. This illuminates why Woolf called the depths 'reality' in "A Sketch of the Past", as she is closer to Bergson than Nietzsche within this particular consideration, illustrating the value of Schwartz's matrix. Then there is '*the degree of emphasis given to the subjective or objective side of experience*', with James and Bergson to one extreme as they insist on the subjective nature of the fluid depths, and Bradley and Nietzsche at the other extreme because their formulation of the stream of experience undermines clear distinctions between subject and object. Between those two extremes are philosophers like Franz Brentano, Alexius von Meinong or Edmund Husserl. The third and final site of similarity is the '*Relation between abstraction and experience*. [...] *At one end are those who emphasize the recovery of immediate experience,*' such as Bergson, who believes that recovering real duration means recovering genuine selfhood and reality, and '*at the other, those who stress the invention of forms that project new order upon experience*', such as Nietzsche, for whom the intentional creation of more 'productive conventions' to organise sensation is the philosophical goal. Between them in the spectrum is James, who 'employs Nietzschean means to achieve Bergsonian ends'. From this, it is already possible to assert one clear conclusion intimated by *The Matrix of Modernism*: even before the public emergence of *any* version of quantum theory, Woolf was already operating in an intellectual realm dominated by discussions of binaries, including her own.

This set of aligned binary philosophies is part of what Whitworth means by 'homologies' when he states that: 'It seems likely that the similarities between Woolf's

[70] Ibid. 45-8. Emphases added.

conception of character and the new ideas about matter is due to a more wide-spread set of homologies, particular instances of which may be found in science, philosophy, linguistics, and other disciplines'. For example, Killen affirms that the shift from atomism to fluidity advocated for in "Modern Fiction" demonstrates 'that she understood the shifts in reality posited by new physics': the arranged lamps are like the 'classical, progressive march from cause A to effect B', while the enveloping halo is 'more akin to the Bohr atom [...] a field of energy rather than a point'; hence 'Woolf's anti-materialistic complaint against the Edwardian novelists echoes modern physics' complain against the classical views of reality'.[71] But, following Whitworth, it seems more likely that if influence did occur – even if indirectly – it was instead from the several philosophies that Schwartz discusses, because they had already existed for decades and were widespread in many disciplinary fields. Killen does acknowledge the potential influence of James, though she fails to explain why he is not enough to account for the binary in Woolf, and fails to provide evidence of the influence of physics other than metaphorical similarities.[72] Whitworth, in Chapter 3 of *Einstein's Wake*, engages with several of the philosophers discussed by Schwartz, though he characterises them as 'descriptionist'. This is the two-sided psychological conception adapted to philosophical conversations about reality and the human perception of it, which is best understood by referring back to James's extended comparison of the act of attention within the stream of consciousness to the act of perception within the external world. That is, Bergson and Nietzsche believe that the reason why the depths of the mind are a “chaos” or “flux” of sensations is because reality itself is chaos, which the human mind orders at the surface with discriminating tools such as *descriptions*, language, or constructs:[73] 'The most common metaphor is of language as a net which catches chaotic reality'.[74] This follows from debates in the philosophy of science of the *fin-de-siècle*, particularly due to discoveries in physics that challenged strict mechanism.[75] While it may

[71] Killen, *Woolf in the Light of Modern Physics*. 25-6.

[72] Furthermore, in Harvena Richter's discussion of "Modern Fiction", she points out that if there was an influence that led Woolf to formulate the term 'semi-transparent envelope', it was Proust, who 'wrote that seeing someone we know is "an intellectual process" in which the actual face is merely a "transparent envelope"'. Harvena Richter, *Virginia Woolf: The Inward Voyage*, Princeton, Princeton University Press, 1970. 36. This metaphor was published in *Swann's Way* in 1913, the same year that Bohr finished theorising the quantum atom, and a year before it was verified experimentally, making it unlikely that the image was influenced by quantum theory as Killen affirms, even if via the French author.

[73] This explains why Bergson attaches the most value to sensation in Schwartz's matrix: duration in the mind mirrors the true nature of reality, therefore it is duration that philosophers should investigate.

[74] Whitworth, *Einstein’s Wake*. 84.

[75] For an overview of the entanglement of descriptionist philosophy of science and the late-1800s advances in physics, see: J.L. Heilbron, "Fin-De-Siècle Physics", in *Science, Technology & Society in the Time of Alfred Nobel*, ed. Carl Gustaf Benhard, Elisabeth Crawford, and Per Sörbom, Pergamon, 1982.

seem like psychology loses its relevance when the conversation turns to philosophy of science, *Einstein's Wake*'s description of the nature of science according to Mach makes clear that notions from second wave psychology are fundamental here too: 'The human mind cannot store all the sense impressions it receives, and so summarizes these impressions into the generalizations of language. *Science is only a more advanced form of this common mental operation'*.[76] 'Descriptionism' hence focuses on the binary between the chaos of reality and the scientifically-ordered description of it, coherently with Schwartz's general opposition. Due to this, while *The Vanishing Subject* aims to be a study of early psychology and modernism, Ryan nevertheless focuses on Machian philosophy of science in her introduction, for 'early psychology was much more closely affiliated with philosophy than it is today [...] the early psychologists' concerns, their discussion of the ontological and epistemological bases on which their work was grounded, appear to us today as essentially philosophical'. Ryan characterises early psychological research as following the empiricist tradition, which explains the new psychologists' binary conception of the human experience of reality:

> Picking up insights first developed by the eighteenth-century empiricists, they started out from the premise that the mind does not see objects as they "really" are. Instead, by putting together a series of related experiences, it makes a total picture out of what we perceive only imperfectly and in part. From this interest in the dual function of distorting vision and correcting mind arose a kind of proto-phenomenology that permeated the thought of most of the early psychologists[77]

Ryan therefore calls this overarching psycho-philosophical movement 'empiricism', but, though her terminology and focus are different, she is very much discussing the same general trend as Whitworth in his investigation of descriptionism, and as Schwartz in his overarching matrix.

When Schwartz, Ryan and Whitworth are taken together then, they offer a compelling picture of a large entangled set of thinkers whose intellectual thought brought together traditional philosophy, philosophy of mind, second-wave psychology, and physics-related philosophy of science. While there are differences and nuances between them, as revealed by Schwartz's matrix, they all agree on an essentially binary conception of the mind and its relation to reality, very much in line with Woolf's own dualistic depiction of psychological functions. This is a first step in unravelling the philosophical middle-ground between literature and

[76] Whitworth, *Einstein's Wake*. 85. Emphasis added.

[77] Ryan, *Vanishing Subject*. 10.

science, Woolf and quantum theory, for it is already apparent how the depiction of the human mind in one of the author's most important novels is conceptually relevant to the philosophy of pre-quantum physics, due to a pool of scholarly thinkers who were all participating in the same interconnected discourse of the moment, preceding and alongside Woolf.

Chapter 5 - Waves and Particles

The previous chapter made clear that within the philosophical middle-ground between Virginia Woolf and physics, the concept of dualism plays an essential role regarding the study of the human mind and its relation to reality. Sandford Schwartz's discussion of late-19th century European philosophy; Michael Whitworth's section on the modern period's philosophy of science; Judith Ryan's book on early empirical psychology; and much of Woolf's work, from *To the Lighthouse* to her private diaries, all rely on a kindred opposition between two fundamentally opposed systems by which the human subject can experience and conceptualise the world – including one's own mental world. Either the external realm is experienced via mental filters or intellectual constructs originating in the subject, which allow for a systematic study of objects, concepts, or thoughts as separate, independent, well-defined, and inanimate entities that materially obey deterministic forces. Or the external realm is experienced directly as it presents itself, untarnished by human processes, as a constant dynamic stream of holistically interconnected materials, which one can intuitively gain knowledge of through introspection. While both of these points of view have their own measure of validity, they cannot operate at once, given that the two roles of the subject, and the two understandings of the nature of reality they presuppose, fundamentally contradict each other.

The relevance of this conclusion to quantum mechanics is obvious: a majority of the problematic aspects of the science, which led to the conceptual innovation of complementarity, emerge from wave-particle duality; two fundamentally opposed conceptions, that nevertheless can be applied onto the same object, depending on the experimental choices of the subject. One might therefore begin to envisage potential connections between the general binary discussed thus far and the specific binary of quantum theory. Indeed, the formalism of quantum mechanics is also divided into two mathematical systems with different connections to the classical human realm; an essential factor of Niels Bohr's complementarity. But to claim the validity of such connections at this stage would be premature: the general binary predates complementarity by several decades; there is a lack of convincing demonstrations that the former influenced the latter; the opposition is conceptually loose and hence easily-adaptable; and the near-contemporaneous appearance of the dualism in so many divergent fields of thought and art suggests a bigger picture than mere influence on, or anticipation of, quantum theory.

Nevertheless, the strength of this overall similarity remains a productive lead to follow in a study of Woolf and quantum physics. So, to ascertain the validity of the connection, in this chapter the general opposition in itself will be clarified. This will be achieved by investigating the state and philosophy of the wave-particle debate concerning the nature of light and matter which preceded and surrounded Woolf – though, in order to prevent anachronisms, only as it existed before Louis de Broglie, Clinton Davisson and Bohr redefined the issue in 1927. The metaphorical qualities of waves, particles, and their system of opposition will also be scrutinised, in order to better understand the role that metaphor plays in the apparent connections between disparate disciplines. First, though, the actual "wave-particle" binary as it appears in *To the Lighthouse* will be opened up and analysed, to keep the discussion grounded in Woolf's literary output.

Before doing so, however, a quick clarification is required on what is meant by "waves" and "particles". These terms are used due to the scientific parallels, however "vibrational-static"; "liquid-dry"; "digital-analogue"; "whole-particular"; "dynamic-inert"; "organic-mechanic"; or any other similar binary expressing the same metaphorical mutual opposition could potentially be applied. That is the point: these are metaphorical containers, they are not expressions of how waves and particles are *actually* treated scientifically and mathematically; though their scientific and mathematical treatments *are* coherent with the metaphors. Therefore, anything which is divisible, separate, inert, or any other associated metaphorical quality, is what is considered to be "particles"; while anything that is holistic, interconnecting, and dynamic or any other associated metaphorical quality is what is considered to be "waves" – as long as there exists an oppositional relation between the two. By expressing themes of mutual exclusion and joint completion, the metaphors of wave-particle duality also express the quantum-concept of *complementary contradiction*, for their metaphorical qualities also imply conceptual similarities. These qualities of each container will emerge during the conversation, and their relation to science will be justified in the final section.

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A/ *To the Lighthouse*: The Ramsay Binary

The binary depths-surface imagery of *To the Lighthouse* is not merely employed to illustrate the mechanisms of human psychology within opposed realms of mental experience: it is an arch-metaphor in the novel, one which operates at many levels of meaning. This is achieved in large part by making the Ramsay couple an unequivocal embodiment of the binary, which can be generalised as a wave-particle opposition.

During a walk in Part I, Lily and Bankes observe the sea together, which prompts a positive feeling of merriment. However, they then turn their gaze to sand dunes, which transforms the feeling into despair:

> They both smiled, standing there. They both felt a common hilarity, excited by the moving waves; and then [...] both of them looked at the dunes far away, and instead of merriment felt come over them some sadness – because the thing was completed partly, and partly because distant views seem to outlast by a million years (Lily thought) the gazer and to be communing already with a sky which beholds an earth entirely at rest [20]

This sets up a clear binary between sea waves and sand particles, with each side creating a distinct and antithetical effect on the characters' moods. However, the switch in emotion does not emerge from the psychological binary: it is present here because the wave-particle opposition also has implications for how the characters – and humankind more generally – relate to nature. The passage makes one side of this relationship explicit: the sand dunes generate sadness because they invoke in Lily a conception of nature that dwarfs human endeavours to the point of meaninglessness, for the non-human objects of Earth predate humanity; were constructed without any human intervention; are everlasting; and make the world seem fully immobile. Mr. Ramsay confirms this conception of nature attached to the particle-like objects of dry land, and helps explain why it is distressing: 'His fame lasts perhaps two thousand years. And what are two thousand years [...] if you look from a mountain top down the long wastes of the ages? The very stone one kicks with one's boot will outlast Shakespeare' [32]. The stone here achieves the same particle-like metaphorical significance as the sand dunes, dwarfing not only the characters' endeavours, but also those of William Shakespeare, even though he possesses one of the grandest legacies of humankind, in order to underscore how insignificant human toil is within this conception of non-human nature. Conversely, waves – while still a part of non-human nature – imply the opposite relationship. Indeed, several times in the novel the sound of waves is perceived by characters as if nature were a sentient being, who communicates directly with humanity via pleasing, beautiful

rhythms, and who also aims to reassure and guard humankind against adversity. This is visible as Lily falls asleep: 'Messages of peace breathed from the sea to the shore [...] as Lily Briscoe laid her head on the pillow in the clean still room and heard the sea. Through the open window the voice of the beauty of the world came murmuring' [116]. Or, when Mrs. Ramsay is listening to waves while considering her children: 'the monotonous fall of the waves on the beach [...] seemed consolingly to repeat over and over again as she sat with the children the words of some old cradle song, murmured by nature, "I am guarding you – I am your support,"' [16-7]. This explains why Lily and Bankes feel merry while watching the waves: they represent a personal and intimate relationship between nature and humanity, with the former being viewed as an omniscient and active force that uplifts and gives meaning to the latter – a conception in full contradiction with that of the dunes. This opposition stems from the same metaphorical implications that Woolf applied to contradictory psychological realms: the side of water implies dynamism, fluid animation, and connection – explaining why the waves seem to be a natural force imbued with life that communicates positively with humanity. While the side of dry land implies solidity, inertness, and separation – explaining why the particles represent nature as a set of dead objects whose eternal fixity negatively reminds humanity of its own meaninglessness. This one case illustrates how the novel can apply the metaphorical wave-particle opposition to a variety of levels of meaning.

While human interiority and relationship to nature are different concerns, their shared metaphorical opposition inevitably invites the reader to connect them. Indeed, as will become obvious as the novel is analysed, an abundance of considerations within it are constructed by broadly elaborating on this duality, suggesting a wealth of meaningful relations between disparate themes. For instance, the two concerns discussed so far can be linked together owing to another metaphorical quality of water: *oneness*. When Lily has her head on Mrs. Ramsay's knee [44], she attempts to 'make her and Mrs. Ramsay one', to break down the separation between herself and the matriarch. This attempt at oneness is compared to 'becoming, like waters poured into one jar, inextricably the same, one with the object'. Therefore, the act of making a subject (Lily's interiority) become one and the same with an object (Mrs. Ramsay) is compared to water: there are no boundaries or separations between different sources of water in the same container, due to the fluid, interconnecting, identity-less, and holistic nature of the substance. Hence, in *To the Lighthouse*, waves and water often signal subject-object breakdown: the human subject feeling as one with the object being considered, be it nature, one's own thought processes, or other people. Indeed, during one of Mrs. Ramsay's moments

of oneness, when she 'became the thing she looked at' [53] (the lighthouse's beam of light), she considers how:

> she had known [...] intense happiness, and it silvered the rough waves a little more brightly, as daylight faded, and the blue went out of the sea and it rolled in waves of pure lemon which curved and swelled and broke upon the beach and the ecstasy burst in her eyes and waves of pure delight raced over the floor of her mind [54-5]

The intense happiness during her moment of oneness with the light is expressed by waves outside being coloured by her interior feelings (her happiness makes the waves brighter), while her interior feelings simultaneously match the waves outside (she feels 'waves of pure delight' following the sea's 'waves of pure lemon'). This creates a circular relationship between inner feelings and outside waves, allowing the metaphorical waters constituting the depths (or here, 'floor') of her mind and the literal water of the sea to become like two 'waters poured into one jar', one and the same. When this moment of watery unity between mind and nature is over, Mrs. Ramsay expresses how she makes her way back to everyday life, back to the surface: 'one helped oneself out of solitude reluctantly by laying hold of some little odd or end, some sound, some sight' [54]. That is to say, to regain the subject-object distinction characteristic of selective attention, one must grab onto a single element of the material words; a negative act, as signalled by the qualifier 'reluctantly', opposed to the joy of belonging in the holistic system. The slight change from the standard expression “odds *and* ends” to 'odds *or* ends' [emphasis added] underlies that one must grab onto something separate (one *or* the other), more akin to the objects of dry land. Indeed, this is contrasted to a moment of soothing peace the character feels following the dinner, when all the odds *and* ends have come together into a whole in her mind: 'How restful! All the odds and ends of the day stuck to this magnet; her mind felt swept, felt clean. And then there it was, suddenly entire' [98]. This is typical in the novel: when characters feel a moment of oneness, or when they are exploring their mind's pool, they are always returned to the surface of ordinary experience due to their attention being roused by one particular, separate element, such as a noise, an object, or a thought. Lily illustrates this in Part III:

> moved as she was by some instinctive need of distance and blue, she looked at the bay beneath her, making hillocks of the blue bars of the waves, and stony fields of the purpler spaces, again she was roused as usual by something incongruous. There was a brown spot in the middle of the bay [149]

She is here observing the world through her artist's eyes, and is therefore associating the waves with the rest of her view into a holistic vision. She does this in an 'instinctive' manner,

confirming that she is in the depths of her mind, which is uniting with the waves in a similar way to Mrs. Ramsay. But she is 'roused' – that is, raised from the unconscious waters of her mind up to the dry land of selective attention – by a single, separate and unpleasing particle she perceives; a spot, which, unsurprisingly, contains Mr. Ramsay. This is a regular experience: 'always something – it might be a face, a voice, a paper boy crying *Standard, News* – thrust through, snubbed her, waked her, required and got in the end an effort of attention' [149]. This illustrates how the binary metaphorical system of the novel operates: because the view of nature as uplifting and the depths side of the mind are both characterised with water-imagery, they become closely associated or even one and the same, while separate, particular elements of daily life are associated with the act of attention that occurs at the surface, hence implicitly connecting that side of the mind with the uncomfortable view of nature as indifferent and inert – as is rendered explicit in the case of Mr. Ramsay.

Indeed, the backbone of *To the Lighthouse*'s metaphorical system is the Ramsay couple, as the husband embodies the particle side, while the wife embodies the wave side. Therefore, whenever the duality is being discussed, it is always possible to relate it back to the couple. This explains why the above explanations of the waves causing an uplifting view of nature, and how that leads to oneness, was so reliant on Mrs. Ramsay. But Mr. Ramsay was invoked to clarify how the view of nature as a set of separate objects or particles leads to feelings of meaninglessness. This wave-particle-like opposition that defines the pair can be extensively showcased.

At the novel's end, James and Cam reconsider their father, affirming that he is 'like some old stone lying on the sand; he looked as if he had become physically what was always at the back of both of their minds – that loneliness which was for both of them the truth about things' [165]. This comparison of Mr. Ramsay to a stone, explicitly connecting him to discrete objects of dry land, is linked to two other related aspects of the patriarch's character: his loneliness and attachment to truth. This is echoed earlier, when he is compared to 'a stake driven into the bed of a channel upon which the gulls perch and the waves beat inspires in merry boat-loads a feeling of gratitude for the duty it is taking upon itself of marking the channel out there in the floods alone' [38-9]: again, he is a lonely, solid object distinct from the water, resisting the waves as they beat against him, instead of becoming one with their rhythmic medium. The 'duty' of 'marking' refers to his work, which will be the following chapter's topic, though here it is enough to say that it consists in finding solid everlasting truths regarding reality, and translating them into fixed words. Hence, whether in his personality, his work, or his goals,

there is an insistence on Mr. Ramsay's separateness. His 'own accuracy of judgement' and being 'incapable of untruth' makes him seem to James 'lean as a knife, narrow as the blade of one' [7], the metaphor of the blade verifies that the patriarch is indeed defined by his separating. Moreover, when 'restored to his privacy' he compares his thoughts to the 'keyboard of a piano, divided into so many notes, or like the alphabet', where each individual note or letter is a cut section of the whole being considered, and 'his splendid mind had no sort of difficulty in running over those letters one by one, firmly and accurately' [30]. His ability here to clearly and orderly follow his separated thoughts in an attempt to reach an accurate judgement can be contrasted to Lily's stream of consciousness, when her 'pouring down' impressions were dynamically interconnecting too intensely for her to separate her thoughts and reach judgements or sentences. This contrast explains why Mr. Ramsay's wife considers that 'a great mind like his must be different in every way from ours', and that he is 'made differently from other people' [58-9], because he pursues 'truth with such astonishing lack of consideration for other people's feelings' [29], which separates him from humankind, as is confirmed by Bankes who sees in Mr. Ramsay 'that solitude which seemed to be his natural air' [20]. Given that the watery depths allow individuals to feel as one with others, due to their subject-object breakdown, it follows that the patriarch, existing uniquely at the surface, is unable to feel such oneness. There is one passage where Mr. Ramsay does *seem* to experience a non-conscious moment expressed with a watery image [125-7]: 'an enormous need urged him, without being conscious what it was, to approach any woman, to force them, he did not care how, his need was so great, to give him what he wanted: sympathy'; 'his demand for sympathy poured and spread itself in pools at her feet, and all she did, [...] was to draw her skirts a little closer round her ankles, lest she should get wet'. However, this watery moment does not contradict his particle-association, given that one of the two main reasons why the character consistently seeks sympathy is precisely to comfort his overbearing ego, by making women validate his life and work: 'his exactingness and egotism' [33]; 'he wanted, to be assured of his genius' [33]; 'Mr. Ramsay was beginning [...] to want somebody to say, Oh, but your work will last, Mr. Ramsay' [87]; 'He was always uneasy about himself [...] what do people think of me?' [95]; 'His immense self-pity' [126]. Of course, the ego and selfhood are psychologically on the surface's side, so even when Mr. Ramsay is seen mindlessly demanding connection with others, his goal is nevertheless to be returned to the particle side of the binary.

Mrs. Ramsay is the exact opposite: she is characterised by her strong connection to the environment or other people, and constant refusal of ego. While Mr. Ramsay needs his worth

affirmed, she 'did not like, even for a second, to feel finer than her husband', and his reliance on her to fulfil him emotionally 'discomposed her; for then people said he depended on her, when they must know that of the two he was infinitely the more important, and what she gave the world, in comparison with what he gave, negligible' [35]. This humility stands in stark contrast to the patriarch's self-absorption. She does display some vanity in one scene, when Mr. Carmichael ignores her charms, though this moment actually informs her opposition to Mr. Ramsay:

> this desire of hers to give, to help, was vanity. For her own self-satisfaction was it that she wished so instinctively to help, to give, that people might [...] need her and send for her and admire her? Was it not secretly this that she wanted, and therefore when Mr Carmichael shrank away from her [...] she did not feel merely snubbed back in her instinct, but made aware of the pettiness of some part of her, and of human relations, how flawed they are, how despicable, how self-seeking [36-7]

Her annoyance at the rebuff is not merely because it reveals that her selflessness is illusory and self-serving, it is moreso because it displays the imperfection of human relationships: how the 'self-seeking' ego can obstruct connections between people, by keeping the mind at the surface, instead of enjoying the watery depths where oneness is achieved. Her discomfort here then does not stem from vanity itself, but her realisation that she *too* possesses an ego that can feel vanity at all, and this discomfort signals her alignment with the depths. The passage also mentions that her desire to give is instinctive, lacking self-conscious thought, a regular occurrence in *To the Lighthouse*: she 'felt an irrational tenderness' [54]; she feels 'an instinct for truth' [35]; 'Mrs. Ramsay felt, very irrationally' [66]; she 'unconsciously and incongruously, used the branches' [91]; 'she had been thinking quite instinctively' [96]. It is therefore clear that the character's thoughts, feelings and actions are prompted from the unconscious depths of her mind, as the novel insists on her lack of conscious thought or deliberation. Unsurprisingly, then, her interiority is often described with water or wave imagery, such as seen previously with her inner feelings in a circular relationship with the sea waves. Or, when answering her husband's need for sympathy, she starts 'to pour erect into the air a rain of energy, a column of spray, looking at the same time animated and alive [...] this fountain and spray of life' [33]; an accumulation of dynamic water images that signal her embrace of Mr. Ramsay's feelings. Furthermore, 'she was nothing but a sponge sopped full of human emotions' [29]: the human emotions contained within her – whether hers or those of surrounding people – are explicitly compared to water, and her ability to absorb them defines her being. A final confirmation is the importance of oneness to her existence. She deplores differences, as they separate: 'It

seemed to her such nonsense – inventing differences, when people, heaven knows, were different enough' [11]. She becomes one with material objects: 'she thought, how if one was alone, one leant to inanimate things [...] felt they became one' [53-4]. She achieves 'great reconciliation scenes' between herself and life itself, when 'A sort of transaction went on between them, in which she was on side, and life was on another' [50], that is, she brings together the subject (herself) and the object (life) into one scene. And when she is answering her husband's need for sympathy, 'there was scarcely a shell of herself left for her to know herself by' [34]: she loses all sense of self – of ego – because she has become a watery force meeting her husband's equally watery need for sympathy, like two 'waters poured into one jar'.

To the Lighthouse therefore rests upon a binary metaphorical system, which expresses itself as an interpretatively open wave-particle opposition. It structures large swaths of the novel's conceptual content, characterises two of the main characters, and generates an abundance of productive correspondences to analyse. This is made possible by the rigorously opposed, yet thematically loose, metaphorical qualities implied by each side of the binary: the particle-worldview indicates solidity, demarcation, separation, inertness, and the everyday. While the wave-worldview hints at fluidity, holism, connection, dynamism and an unconventional experience of reality.

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B/ *Woolf's Thought*: An Overarching Binary System

In "The Narrow Bridge of Art", Woolf's 1927 manifesto on the future of prose fiction, she begins by listing her generation's philosophical challenges, and every listed element takes the form of a contradictory opposition, leading to 'an attitude which is full of contrast and collision; an attitude which seems to demand the conflict'.[1] There is hence no doubt that oppositional dualistic constructions play an essential role in Woolf's thought – a well-established notion in Woolf studies, which *Modernist Physics* deeply corroborates.[2] However, it is worth revisiting

[1] Woolf, "Poetry, Fiction, and the Future". 74. The paragraph listing the contradictions begins with 'That is true only within certain limits', 74-5.

[2] For an overview of the many ways in which Woolf employs oppositional logic to investigate and depict issues, see: Angeliki Spiropoulou, "Woolf's Contradictory Thinking", in *Contradictory Woolf: Selected Papers from the*

a selection of Woolfian binaries to show that many also adhere to the wave-particle logic being articulated in *To the Lighthouse*. For, in effect, Woolf does not just employ binaries, she tends to employ the *same* binaries.

Rachel Crossland's first chapter comments on 'the thin partitions which exist between people, allowing dreams, thoughts, and memories to move between brains',[3] such as in *The Voyage Out* when characters seem to be sharing dreams. What is further interesting is that this moment of oneness is explicitly tied to water:

> thinking of the black sea outside tossing beneath the moon, she shuddered, and thought of her husband and the others as companions on the voyage. The dreams were not confined to her indeed, but went from one brain to another. They all dreamt of each other that night, as was natural, considering how thin the partitions were between them, and how strangely they had been lifted off the earth to sit next each other in mid-ocean[4]

The dream-sharing occurs between two sentences which reiterate that the sleeping characters are within waters, and that the waters are also within their thoughts. The second sentence even entails that they are 'lifted off the Earth', making the opposition between water and dry land explicit. This is coherent with *To the Lighthouse*: it is within the fluid side of mental life that people experience oneness with each other, for their waters become as one, allowing the same dream to flow from one mind to another. Another confirmation that this experience is tied to the arch-metaphor of waves is the mention of 'how strangely' it feels, signalling that this is not a moment from ordinary life. The other example Crossland employs to display these telepathic-seeming moments in early Woolf is from *Mrs. Dalloway*, when Rezia, while drinking a sedative, realises that her husband has died. She experiences a moment of connection with Clarissa via their shared imagination of the garden at Bourton, even though the two characters never met and are not aware of each other. Once again, it is here possible to see wave-imagery suddenly emerge: after perceiving the garden, Rezia has the impression that 'Mrs. Filmer waving her apron [..] seemed part of that garden; or a flag. She had once seen a flag slowly rippling out from a mast'. The moment of connection causes her to become sensitive to the wave-like motion of her neighbour's apron, which is compared to the wave-like ripples of a flag in the wind. Additionally, Mrs. Filmer seems to become one with the imagined

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Twenty-First Annual International Conference on Virginia Woolf, ed. Derek Ryan and Stella Bolaki, Clemson, South Carolina, Clemson University Digital Press, 2012. 101-6; or: Crossland, *Modernist Physics*. 39-40.

[3] Crossland, *Modernist Physics*. 21.

[4] Virginia Woolf, (1915), *The Voyage Out*, Chippenham, Penguin Books, 1992. 44.

environment, a confirmation that Rezia becomes unable to perceive separations, and is instead interconnecting her visual field with her imagination and memories – which may not even be her own. Indeed, in the following paragraph, as she is losing consciousness due to the sedative, memories of her time with Septimus begin to emerge:

> somewhere near the sea, for there were ships, gulls, butterflies; they sat on a cliff. In London, too, there they sat, and, half dreaming, came to her through the bedroom door, rain falling, whisperings, stirrings among dry corn, the caress of the sea, as it seemed to her, hollowing them in its arched shell and murmuring to her laid on shore[5]

As she falls asleep, various memories are muddled together, including her half-recognised present situation ('through the bedroom door'). But this is also the sign that she is entering the depths of her mind, as various random elements from the present and the past are interrelating mindlessly in her perceptual field. It then makes sense that, in this state, the sea would appear twice, including a 'caress of the sea', even though she is in London. Bonnie Kime Scott even ties this moment to the notion of waves as representing a soothing guardian: 'She is taken up in the waves, protected in a hollow that is part wave, part shell, laid on shore'.[6] Once again, the moment of oneness in Woolf cited by Crossland seems to also be coherent with the wave side of *To the Lighthouse*'s metaphorical system, indicating that the author's use of wave-particle constructions is not limited to the one novel, and appears throughout her work.[7]

As listing all moments when such metaphorical binaries appear in Woolf would be an interminably repetitive exercise, only a few of the clearest and most extensive examples of her wave-particle logic will here be considered, to illustrate how deeply it marks her thought. Most revealing is the 1926 essay, "Street Haunting", as it relies entirely on an opposition between two states of existence, and as such is worth exploring in detail. It narrates the strange experience that occurs when walking London streets alone at a specific moment of the year and day, and how different that experience is to one's usual acquaintance with world and self. Even a superficial reading makes clear that the experience of 'haunting' involves a loss of one's ego-

[5] Virginia Woolf, (1925), *Mrs Dalloway*, Oxford, Oxford University Press, 1992. 196.

[6] Bonnie Kime Scott, *In the Hollow of the Wave: Virginia Woolf and Modernist Uses of Nature*, Charlottesville, University of Virginia Press, 2012. 204.

[7] It is worth pointing out that both cases analysed here also involve the characters sleeping, or falling asleep, when the connections appear. Sleep is not an essential element of such moments, but it is not irrelevant, as it implies a loss of consciousness, and therefore a loss of the surface side of the mind. Due to this, sleep is an important topic in Ann Banfield's analysis of Woolf's philosophy: Banfield, *Phantom Table*. 219-23.

boundness, which is replaced by a feeling of community and oneness with other walkers:[8] 'We are no longer quite ourselves'; 'We shed the self our friends know us by and become part of that vast republican army of anonymous tramplers'; 'The shell-like covering which our souls have excreted to house themselves, to make themselves a shape distinct from others, is broken'; and 'one is not tethered to a single mind, [...] one can put on briefly for a few minutes the bodies and minds of others'. It is therefore predictable that, while 'haunting', one 'floats smoothly down the stream'; one perceives 'a certain look of unreality' and that 'everything seems accidentally but miraculously sprinkled with beauty'; finally, one feels 'the greatest of pleasures', or, 'delight and wonder [...] to leave the straight lines of personality'. This is all congruent with *To the Lighthouse*: loss of selfhood leads to oneness, which is expressed through water imagery, and intimates that such a relation to the world is beautiful and pleasurable. Additionally, in losing the sense of self, the walker becomes 'a central oyster of perceptiveness, an enormous eye', and Woolf insists on the pleasures of this kind of self-less perception, when 'the brain sleeps perhaps as it looks'. This is coherent with Ryan's description of how Ernst Mach and other second wave psychologists redefined the nature of selfhood at the turn of the century:

> no longer did I exist because I thought (the *cogito* of the Cartesians), but I was the one who saw, and I was identical with what I saw. This position, followed to its logical extreme, had some astonishing consequences: it meant, in particular, that the familiar distinction between subject and object was no longer tenable [...] self was no longer firmly anchored in the body but in consciousness itself, and this was no longer a discrete unity but included everything that was within the individual field of perception[9]

This paragraph helps explain how the notion of oneness which Woolf attaches to the arch-metaphor of water is also in agreement with the psychological context explored earlier: in philosophical psychology, the atomistic ego-bound self is what generates the impression of separateness. Therefore, when it is removed – for instance, when introspecting the stream of consciousness – there is no longer any perception of subject-object distinctions, leading to an unfamiliar feeling of oneness. Hence, the binary explored in this chapter remains consistent with the psychological notions seen previously.

Of course, Woolf's extended exploration of the communal state of 'haunting' is contrasted with how one ordinarily feels: 'society is so agreeable after the solitude of one's own room. For there we sit surrounded by objects which perpetually express the oddity of our own

[8] Woolf, "Street Haunting: A London Adventure".

[9] Ryan, *Vanishing Subject*. 9.

temperaments and enforce the memories of our own experience'. Instead of communing with others, one is alone, studying objects, which are reminders of one's personality and experiences: selfhood is not only maintained, it is omnipresent. It is this ego-bound self that is signified by 'The shell-like covering which our souls have excreted to house themselves, to make for themselves a shape distinct from others', which shows how it leads to separation and distinct identity. Indeed, following the unreality of the walk, one begins 'to feel the old possessions, the old prejudices, fold us round; and the self, [...] sheltered and enclosed. Here again is the usual door; here the chair turned as we left it': a return to ordinary reality, to the surface, with its usual objects, its 'old' ways of thinking, and its separate and private selfhood. Again, the binary is expressed as a wave-particle opposition. While 'haunting' is positively compared to an 'adventure', Woolf nuances this by reminding the reader that there are also adventurers who explore the globe for colonial purposes – 'exploring deserts and catching fevers, settling in India for a lifetime, penetrating even to China and then returning to lead a parochial life at Edmonton' – which leads to a wave-particle comparison of the two types of 'adventure': 'The waters of travel and adventure seem to break upon little islands of serious effort and lifelong industry stood in jagged column upon the floor'. There is water-like adventure such as street haunting, and there is island-like adventure such as colonialism, explicitly on the side of dry land, whose ambitions are akin to solid, rough, imposing pillars upon one's mind, preventing one from floating 'smoothly down the stream'. This association of the particle side to Empire is not limited to "Street Haunting"; Woolf approvingly cites Michel de Montaigne's anti-colonial outburst in her review of *The Essays of Montaigne*:

> "So many cities levelled with the ground, so many nations exterminated … and the richest and most beautiful part of the world turned upside down for the traffic of pearl and pepper! Mechanic victories!" [...] Here the soul, getting restive, is lashing out at the more palpable forms of Montaigne's great bugbears, convention and ceremony[10]

His characterisation of colonial violence as 'Mechanic victories', though here referring to technological violence, will become relevant as the history of physics is discussed, for mechanism is a defining feature of Newtonian physics, which embodies the particle side's conceptions of reality and the human study of it. Furthermore, Woolf associates his anti-colonialism with his disapproval of 'convention and ceremony', which epitomise surface-level engagement with other people, for they are superficial, solid ('palpable') filters placed upon the

[10] Woolf, "Montaigne". 85.

genuine version of human connection typical of the other side, 'the soul': 'habits and customs are a convenience devised for the support of timid natures who dare not allow their souls free play'. It is worth noting too that Woolf's appreciation of Montaigne is precisely due to his skill at resolving a creative issue she commonly ponders using wave-particle terms:

> the difficulty of expression. We all indulge in the strange, pleasant process called thinking, but when it comes to saying, [...] what we think, then how little we are able to convey! The phantom is through the mind and out of the window before we can lay salt on its tail, or slowly sinking and returning to the profound darkness which it has lit up momentarily with a wandering light. [...]. But the pen is a rigid instrument; it can say very little; it has all kinds of habits and ceremonies of its own. It is dictatorial

Thinking is here akin to allowing one's 'soul free play', or to Mrs. Ramsay's 'light stealing under water': “sinking” into the depths of one's mind, which is as 'strange' as it is 'pleasant', for one becomes like a 'phantom' instead of a solid, ego-bound person. The pen, however, is 'rigid', and writing involves obeying conventions due to the dictatorial power of literary traditions. Therefore, one must use a tool from the particle side to capture the wave side, a contradiction extensively explored by Lily in *To the Lighthouse*, but which here illustrates the ubiquity and coherence of Woolf's metaphorical system.

Another instructive case is 1918's short story "Solid Objects", which demonstrates that the opposed metaphorical qualities of oneness-separation also operate in the relationship between person and object, not merely amongst people. A character named John digs into sand, wherein he unearths a piece of glass. The act of digging, and the nature of the object, are at first mired with obvious markers of the particle side, such as dry land; the loss of connection to interiority; the insistence on 'surface'; the hardness and distinctiveness of matter; and the opposition to the sea:

> As his hand went further [...] the background of thought and experience which gives an inscrutable depth to the eyes of grown people disappeared, leaving only the clear transparent surface [...]. No doubt the act of burrowing in the sand had something to do with it. [...] still working his fingers [...] they curled round something hard – a full drop of solid matter – and gradually dislodged a large irregular lump, and brought it to the surface. [...] it was so hard, so concentrated, so definite an object compared with the vague sea[11]

John then brings the object home and displays it on his mantelpiece, where it becomes part of his everyday life. However, this means that he occasionally has a different perception of the

[11] Virginia Woolf, (1918), "Solid Objects", in *The Complete Shorter Fiction of Virginia Woolf*, ed. Susan Dick, London, Harcourt Brace Jovanovich, 1985. 96-7.

object, because: 'Looked at again and again half consciously by a mind thinking of something else, any object mixes itself so profoundly with the stuff of thought that it loses its actual form and recomposes itself a little differently in an ideal shape which haunts the brain when we least expect it'.[12] The object's relationship with the person changes when the latter considers it in a reduced state of consciousness, hence when he is in tune with the depths: it becomes mixed up with his thoughts, becoming part of his waters of unconsciousness, and hence loses its solidity and becomes an ideal entity, which inextricably ties its nature to the act of John considering it, so the object can no longer be regarded as existing independently from the human. Subject and object demarcations have hence broken down, a confirmation that the logic of the wave side, in opposition to the particle side, also applies to objects in Woolf's thought beyond *To the Lighthouse*.

The terms “particles” and “waves” to characterise Woolf's binary do not originate from the author; they were applied to her work by critics because of the parallels with the scientific concepts. The closest the author ever came to naming her system was in the opposition she set up between 'something of granite-like solidity and [...] something of rainbow-like intangibility' in her 1927 essay, "The New Biography".[13] While her granite-rainbow binary was deployed to discuss stylistic approaches to biography – capturing the fleetingness of personality with the hardness of truth – it has since been opened up and applied to the rest of the author's thought,[14] most meaningfully by Banfield who worked it into the thesis that 'Woolf's fiction is an implicit theory of modern knowledge, divided, [...], into dual realities and dual ways of knowing'.[15] Indeed, even a cursory look at the beginning of Woolf's essay confirms that the granite-rainbow binary is identical to the overarching wave-particle opposition: 'Granite' is the side of 'truth', 'solidity', 'most obdurate', 'research', 'hard facts', 'forever', 'atoms', 'integrity', or 'stiffness'; while 'Rainbow' is the side of 'personality', 'intangibility', 'light', 'inner life of thought and emotion', or 'hidden channels of the soul'. Furthermore, both sides are set in an oppositional duality, where one pole's presence precludes the other: 'For though both truths are genuine, they are antagonistic'; 'Let it be fact, one feels, or let it be fiction; the imagination will not serve under two masters simultaneously'; and 'Truth of fact and truth of fiction are incompatible'.

[12] Ibid. 98.

[13] Woolf, "The New Biography". 95.

[14] It is revealing that the 1958 posthumous collection of Woolf's essays on fiction, introduced by her husband, was named *Granite and Rainbow*.

[15] Banfield, *Phantom Table*. 52. Banfield will be discussed in Chapter 7.

To conclude, the opposition in Woolf which tends most to be viewed through the prism of wave-particle opposition – it is cited in many Woolf and quantum physics studies – is the last paragraph of her 04/01/29 diary entry:

> is life very solid or very shifting? I am haunted by the two contradictions. This has gone on forever; goes down to the bottom of the world – this moment I stand on. Also it is transitory, flying, diaphanous. I shall pass like a cloud on the waves. Perhaps it may be that though we change, one flying after another, so quick, so quick, yet we are somehow successive and continuous we human beings[16]

Indeed, this demonstrates that the metaphorical system of Woolf's fiction and essays is also found in her private writings, which indicate that it is more than just a stylistic choice; it is indicative of how she thought, so much so that she was 'haunted' by the opposition.[17] This passage also adds more qualities to the binary, which go further in connecting it to the general wave-particle opposition. The "particle" experience of life is obviously 'solid' and tied to dry land, the 'bottom of the world [...] I stand on', and it intimates feelings of infinity, of the universe going 'on forever'. This is expected following the prior analysis, but additionally, this pole of the opposition also implies that human beings are 'successive and continuous', which is curious because, metaphorically, these two qualities apply to waves, and yet here it is their opposites – disorder and discontinuity – which seem to be on the side of life as 'shifting', 'transitory, flying, diaphanous', 'like a cloud on the waves', and 'change [...] so quick'. It would seem as if discontinuity *should* be a metaphorical quality of particles, as they are disconnected and independent of each other, yet this is not the case in Woolf. In the restricted context of the above paragraph, this unexpected alignment is due to the theme of change: in the experience of life as shifting, one necessarily goes through modifications, as nothing is stable or fixed, therefore one's life-story can be considered discontinuous – which, subsequently, implies the opposite for the particle side. More generally, though, discontinuity was indeed a problematic notion within Woolf's scientific context, and is directly responsible for quantum physical wave-particle duality. It hence follows that the quantum-concept would be more ambiguous, and difficult to cohesively include within her binary metaphorical system.

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[16] Virginia Woolf, *The Diary of Virginia Woolf*, London, The Hogarth Press, 1980. 218.

[17] Crossland, citing Hermione Lee, validates this by listing moments from Woolf's personal writing that display her struggling with dual oppositions, including her childhood as revealed in "A Sketch of the Past". Crossland, *Modernist Physics*. 38-9. Another example is the biographical essay "Old Bloomsbury", where Woolf describes the duality she was experiencing between the uplifting experiences of Bloomsbury, versus the conventionalism of domestic life: 'the combination of the two worlds […] was far more difficult. I could not reconcile the two'. Woolf, "Old Bloomsbury". 171-2.

This conclusion will now be demonstrated by examining how the wave-particle opposition, including the problematic role of discontinuity, was treated in the history of physics, to ascertain to what extent the Ramsay couple – and hence Woolf's philosophy – can be aligned with the initial innovations of quantum theory.

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C/ *Intellectual Context*: The Non-Revolution of Wave-Particle Opposition

While quantum theory unquestionably brought wave-particle duality to the forefront of philosophy of science discussions, rendering it directly relevant to quantum mechanic's possible impact on literature and culture, it is equally important to keep in mind that the opposition itself predates quantum theory. This was seen with Bruce Wheaton's *Tiger and the Shark*, which extensively demonstrates how fundamental the opposed wave and particle approaches to physics were in organising European physical research throughout the 19th century. However, it is possible to go further: the wave-particle opposition does not only predate quantum physics; it predates physics itself.

Theoretical physicist Charis Anastopoulos's popularisation of the history of matter in physics, *Particle or Wave*, makes the case that whenever the question "what are things made of?" was asked in the worldwide history of thought, there were *always* two opposed answers: 'If we [...] attempt to trace back in time the origin of the modern physical concepts about matter, we see that they arise from two conflicting theories, whose seeds in art and myth are probably lost in the mists of prehistory'.[18] Hence, Anastopoulos's first chapter traces the development of the two theories from Greek antiquity to Newton, with footnotes signalling that similar propositions appeared in other cultures around the world. The directness and simplicity of the book's presentation makes the relevance of this history limpid, particularly in light of the scene of Lily and Bankes transitioning from a view of the sea to a view of the dunes:

> Any theory about the fundamental constituents of things has at its roots one out of two alternatives – two different metaphors that generalize different observations of everyday life.

[18] Charis Anastopoulos, *Particle or Wave: The Evolution of the Concept of Matter in Modern Physics*, Princeton, Princeton University Press, 2008. 3.

> The first such description may arise from the observation of ordinary sand. [...]
> We next transfer the image of the sand to the level of the fundamental character of matter. We arrive at the statement that things consist of small, fundamental bodies, which cannot be cut into smaller pieces. This is the "atomic theory," [...]
> On the other hand, we may [...] consider water, or rather any fluid, as our basic material. We readily observe that many different objects can be created when fluids are mixed in different proportions. By transferring this simple observation to the level of the deeper structure of the world, we arrive at a different conception: material bodies arise from the mixing of different types of fundamental fluids[19]

Hence: particles versus waves.[20] This helps legitimise the metaphorical nature previously granted these concepts: even in science writ-large, it seems, it is the empirical qualities associated with the "wave" and "particles" metaphorical containers that determined their specific uses in physical theories and procedures. The metaphors predate their scientific conceptualisations. However, the relevancy of *Particle or Wave* goes further, when Anastopoulos outlines how both fundamental theories have philosophical implications beyond merely describing reality:

> These two theories not only differ in their details but also represent very different attitudes toward the world. The atomic theory has the ambition to explain all material phenomena through the motion of undivided entities in space. If the human intellect succeeded in understanding the specific rules that guide the atomic motions, it would be able to explain and describe every single process of nature. The atomic theory then lends itself to an image of predictability and control, a demystification of matter. The theory of the elements is the exact opposite. It places quality at the center of its explanations – and qualities, however much abstracted, are by their nature closer to sense perception than to logical calculation. Moreover, the theory of the elements attributes the cause of change to the intrinsic forces and powers of matter. It emphasizes the spontaneous character of matter, its mutability[21]

Here, the association of full knowledge; materialism; determinism; authority; and meaninglessness ('demystification') to the particle side – opposed to the attachment of the human subject; anti-formalism; dynamism; insubstantiality; and freedom to the wave side – reveals that the metaphorical implications that have thus far been attached to the particle

[19] Ibid. 13-4.

[20] It is worth noting that in this account waves and water are taken to be synonymous: waves are merely the visual expression of the watery world that generates them. This is relevant as it could be possible to discuss waves from a purely mathematical point of view, where themes of circularity or periodicity (for example) that are not quite relevant to water might emerge. This is arguably the case in certain passages of *The Waves*.

[21] Anastopoulos, *Particle or Wave*. 4-5. Note that he here uses the expression 'theory of the elements' to discuss the wave side of the binary. This is explained at page 15: the Greek philosopher 'Empedocles identified four fundamental fluids, or rather *elements*, which he conveniently described as Earth, Air, Water, and Fire'.

and wave-worldviews during the reading of Woolf are not just due to the author's personal choices, her specific scientific context, or even her general historical era: *the metaphorical qualities of waves and particles are intrinsic to the physical concepts themselves*. This is a hugely important fact for this study, and as such it will be reopened and fully explored during the conclusion. In the current chapter however, it will be applied to Woolf's specific scientific environment to evaluate how academics have applied quantum dualism to the Ramsay couple.

Alfred North Whitehead's *Science and the Modern World* provides a picture of how the philosophical implications of physics were conceived of in the intellectual community surrounding Woolf while she was writing her novel. Indeed, the essay was published in 1925, after the quantum atom but before complementarity, like *To the Lighthouse*; it deals with the history of physics as well as its ties to philosophy; Whitworth relates that 'its success apparently took CUP by surprise'; and, though it 'exerted a lasting influence on literary writers and critics, its readership extended far beyond this group';[22] additionally, the author was a well-regarded mathematician and philosopher known within the Apostle-Bloomsbury circles, due in large part to his co-authoring of the *Principia Mathematica* with Bertrand Russell in the early-1910s. While most of the tome is dedicated to developing Whitehead's "process philosophy" and its coherence with physics, he does so by opposing it to the Newtonian worldview:[23]

> the fixed scientific cosmology which presupposes the ultimate fact of an irreducible brute matter, or material, spread throughout space in a flux of configurations. In itself such a material is senseless, valueless, purposeless. It just does what it does do, following a fixed routine imposed by external relations which do not spring from the nature of its being. It is this assumption that I call "scientific materialism." Also it is an assumption which I shall challenge as being entirely unsuited to the scientific situation
>
> The answer, therefore, which the seventeenth century gave to the ancient question [...] "What is the world made of?" was that the world is a succession of instantaneous configurations of matter
> [...] The great forces of nature, such as gravitation, were entirely determined by the configurations of masses. Thus the configurations determined their own changes, so that the circle of scientific thought was completely closed. This is the famous mechanistic theory of nature, which has reigned supreme ever since the seventeenth century

[22] Michael Whitworth, "The Clothbound Universe: Popular Physics Books, 1919–1939", in *Publishing History*, no. 40, 1996. 64-5.

[23] Alfred North Whitehead, (1925), *Science and the Modern World: Lowell Lectures, 1925*, Cambridge, Cambridge University Press, 1929. 22 & 63.

These passages make clear how the materialism and mechanism from Newtonian classical physics can be attached to the metaphorical qualities of particles: it is a 'fixed cosmogony' wherein reality is made up of a variety of non-human pieces of eternally meaningless matter that are defined only by their well-defined location, mass and momentum in space and time,[24] only coming into contact with each other by means of forces that are external, deterministic, and mechanical. This leads to a closed, complete and empirically verified system of knowledge, explaining both its success and its overwhelming authority, as 'It is still reigning. Every university in the world organises itself in accordance with it'.[25] This is all in line with Anastopoulos's exposition. Indeed, Whitehead goes on to insist that Newtonianism separated the subject from the object: 'a fundamental concept which is essential to scientific theory; I mean, the concept of an ideally isolated system [...] there are truths respecting this system which require reference only to the remainder of things';[26] or 'scientific abstractions, yielding on the one hand *matter* with its *simple location* in space and time, on the other hand *mind*, perceiving, suffering, reasoning, but not interfering, has foisted onto philosophy the task of accepting them as the most concrete rendering of fact'.[27] Finally, the philosopher ties together classical physics, common sense, and everyday experience:

> The note of the present epoch is that so many complexities have developed regarding material, space, time, and energy, that the simple security of the old orthodox assumptions has vanished. [...]. The new situation in the thought of to-day arises from the fact that scientific theory is outrunning common sense. The settlement as inherited by the eighteenth century was a triumph of organised common sense. [...] We cannot too carefully realise that science started with the organisation of ordinary experience[28]

In this view, the particle-worldview of Newtonianism began breaking down at the turn of the century precisely because new discoveries were going against common-sense. This could be a reason why discontinuity is associated with the wave-side in Woolf's binary system: it goes against common-sense, therefore against a typical human experience of reality, and hence it cannot be associated with particles even though one might think it should. All of Whitehead's conceptions of classical physics, hence, are fully in accordance with the metaphorical qualities of the particle-side of the binary contained in Mr. Ramsay as well as Anastopoulos's history of

[24] Ibid. 'The material is fully itself in any sub-period however short. [...] The material is equally itself at an instant in time'.

[25] Ibid. 69.

[26] Ibid. 58.

[27] Ibid. 70.

[28] Ibid. 142-4.

the concept. This is not a case of influence, as Whitehead himself states, in apparent agreement with *Particle or Wave*:[29] 'the fundamental principles are so set out as to presuppose independently existing substances with simple location [...]. Those principles lead straight to the theory of a materialistic, mechanistic nature, surveyed by cogitating minds'. That is, the philosophical implications here surveyed are *inevitable* when a human mind considers 'independently existing substances with simple location': particles. Again, *the metaphor is primary*, explaining the strong metaphorical echoes when it is employed.

This strong interpretative connection between Mr. Ramsay, classical physics and particles is immensely important to quantum analyses of *To the Lighthouse*. However, only in so far as it then allows for an opposed interpretative connection between Mrs. Ramsay, quantum physics and waves, as Paul Tolliver Brown illustrates:

> Mrs. Ramsay's intuitive sense of connection to the lighthouse beam and to the world at large is virtually parallel to the connections between subatomic "particles" discovered by quantum physicists. The waves and points in Woolf's novels [...] are exacting metaphors for the perplexing and exciting discoveries in science made during the first third of the twentieth century when relativity successfully usurped Newton's conception of absolute time and quantum interconnectedness profoundly problematized the notion of objectivity. [...]
> Mrs. Ramsay's holistic vision is opposed to Mr. Ramsay's compartmental one[30]

Other instances include Derek Ryan: 'Mrs. Ramsay's relationship with objects therefore reveals, I would add, what Barad has described as "the heart of the lesson of quantum physics: we are a part of that nature that we seek to understand"'.[31] As well as Marty Clark:

> It is by now a critical commonplace that the stream-of-consciousness novel represents a parallel or at least simultaneous [...] attempt to formulate and comprehend uncertainty, to tolerate and master macroscopically the fractious realities of the sub-atomic world.
> [...] In *To the Lighthouse*, the flux which is suggestive of one kind of time suggests also one way of understanding matter, a way which is set against the very different model of particularity or atomization. [...]
> a fluid vision of the world and which, in its otherness, asserts again the impossibility of absolute knowledge. Indeed, Mrs. Ramsay's is the most fluid

[29] Whitehead, *Science and the Modern World*. 180.

[30] Brown, "Relativity, Quantum Physics, and Consciousness". 51.

[31] Ryan, *Materiality of Theory*. 174. Citation is from: Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, Durham, North Carolina, Duke University Press, 2007. 26.

> consciousness of the novel; hers is the single sustained wave-impulse [...] against which all that is particular is set[32]

This notion seems sensible: the metaphorical qualities of particles and waves are fundamentally opposed, therefore when one character embodies particles, their opposed counterpart should necessarily embody waves. This was indeed a main conclusion of the above reading of *To the Lighthouse*. The problem comes when this is applied to the history of physics; that because Mr. Ramsay is associated with Newtonian physics, then Mrs. Ramsay should conversely be associated with the new physics. Whitehead is again useful here to explore the validity of such a notion, for instance in his summary of the challenges that early quantum theory imposed against classical physics:

> perplexity arises from the effort to fit the theory into the current scientific picture of what is going on in the molecule or atom.
> It has been the basis of the materialistic theory, that the happenings of nature are to be explained in terms of locomotion of material. In accordance with this principle, the waves of light were explained in terms of the locomotion of a material ether, and the internal happenings of a molecule are now explained in terms of the locomotion of separate material parts. In respect to waves of light, the material ether has retreated to an indeterminate position in the background, and is rarely talked about. But the principle is unquestioned as regards its application to the atom [...].
> The assumption is, that whatever vibration takes place in the atom is to be attributed to the vibratory locomotion of some bit of material, detachable from the remainder. The difficulty with the quantum theory is that, on this hypothesis, we have to picture the atom as providing a limited number of definite grooves, which are the sole tracks along which vibration can take place, whereas the classical scientific picture provides none of these grooves. The quantum theory wants trolley-cars with a limited number of routes, and the scientific picture provides horses galloping over prairies[33]

These paragraphs make clear three important notions concerning the state of quantum theory as it was understood in 1925.[34] First, the problematic aspects of the theory are restricted to atomic studies, and hence does not quite seem to have implications for the whole of reality, as would soon become the case. Second, a contradictory wave-particle opposition is at the heart of the issue, given that the internal locomotion of the atom is vibratory in nature, and hence continuous (wave), but the vibrations apply to a separate object which only accepts a discontinuous amount of energies (particle) – however, the potential solution to the

[32] Clark, "Consciousness, Stream and Quanta". 415-6.

[33] Whitehead, *Science and the Modern World*. 163-4.

[34] Disregarding, of course, the views of quantum pioneers themselves, who were actively developing the theory at the time, and hence whose conceptions were no doubt more advanced than the popularisers.

inconsistency revolves around correctly applying the 'ether'; a concept to be discussed in the next chapter. Third, the problematic aspects all depend on the one true philosophical innovation of quantum theory at the time: *discontinuity*, which is the main reason why pre-complementarity quantum theory was considered to be contradictory with Newtonianism, for 'The strength of the theory of materialistic mechanism has been the demand, that no arbitrary breaks be introduced into nature'.[35] These three conclusions are not limited to Whitehead. The same can be drawn from Russell's 1923 *The ABC of Atoms* or J.N.W. Sullivan's 1924 *Atoms and Electrons*, two other successful popularisations of physics which discuss pre-complementarity quantum theory. Respectively:[36]

> The motion of an electron round its nucleus seems to be like that of a flea, which crawls for a while, and then hops. The crawls proceed accurately according to the laws of dynamics, but the hops are a new phenomenon, concerning which certain totally new laws have been discovered empirically, without any possibility (so far as can be seen) of connecting them to the old laws. There is a possibility that the old laws, which represent motion as a smooth continuous process, may be only statistical averages, and that, when we come down to a sufficiently minute scale, everything really proceeds by jumps, like the cinema, which produces a misleading appearance of continuous motion by means of a succession of separate pictures

> The key to these extraordinary results is to be found in Planck's Quantum Theory. [...] energy is not emitted in a continuous fashion, but only in little finite packets, as it were. An oscillating atom, for instance, is to be conceived as sending out little doses of energy, one after another. It does not emit energy continually. [...] Such an hypothesis is very strange, and is in entire contradiction to the classical dynamical theory on which the whole science of physics had been built

It is therefore clear that in these pre-complementarity expositions one does not find the 'quantum interconnectedness [*which*] profoundly problematised the notion of objectivity' or the 'holistic vision' proposed by Tolliver Brown, nor the wave-notion that 'we are a part of that nature that we seek to understand' that Ryan attaches to Mrs. Ramsay, and even less Marty Clark's 'fluid vision of the world and which, in its otherness, asserts again the impossibility of absolute knowledge'. The major philosophical difficulty of quantum theory that existed when Woolf was writing *To the Lighthouse* was a wave-particle inconsistency within atoms, implying a fundamental role for anti-classical discontinuity in atomic theory, which

[35] Whitehead, *Science and the Modern World*. 91-2.

[36] Bertrand Russell, *The ABC of Atoms*, London, Kegan Paul, 1927. 15-6; J.W.N. Sullivan, *Atoms and Electrons*, New York, George H. Doran Company, 1924. 119-20. Note that Sullivan's explanation relies on the history of Planck's 1900 discovery, and its application to the photoelectric effect by Einstein, not atomic physics. However, Sullivan sets up this explanation to then apply it to the atom, as Whitehead and Russell both do.

problematised the role of the ether (or any alternative continuous concept) in physical depictions of reality. The version of quantum mechanics implying holism, uncertainty, interconnectivity, the observer effect, or fluidity did not yet exist. Indeed, nor did quantum mechanics itself, as quantum spin; the exclusion principle; matrix and wave formalisms and their equivalency; the probability interpretation; the wave-particle nature of matter; and the uncertainty relations had not yet been fully appreciated or even discovered. Therefore, if one is to posit an influence of quantum theory on Mrs. Ramsay, or merely a strong non-anachronistic similarity, one must demonstrate that she embodies the concept of discontinuity, or at least of an internally problematic relation between waves and particles.[37] But this is not the case: the current thesis, as well as a majority of studies cited thus far, all insist on Mrs. Ramsay's sense of connection and wave-likeness, of being on the side of the mind that *continuously* experiences an unending stream of interrelated and fleeting materials. This is historically inconsistent with early-1920s quantum theory, hence one cannot easily associate her with the new physics if influence is to be part of the argument.

Beyond the one character, however, the general idea that the new physics is "wave-like", in a revolutionary paradigm-shift away from the "particle-likeness" of classical physics is itself erroneous. Firstly, because as Anastopoulos's account made clear, there is nothing revolutionary or modern about wave-conceptions; they existed throughout the history of matter. Indeed, the West's entire philosophical tradition seems to have begun with a wave-theory of reality: 'the person traditionally credited as the first of the Western philosophers, the Greek Thales', provided 'the first recorded instance of an explanation of the constituents of the world, supported with logical argumentation and put forward in nonmythical language', which was 'that all things arise out of water'.[38] Even discontinuity, the "revolutionary" concept at the heart of pre-complementarity quantum theory, is not a novelty in the history of thought, as illustrated by Donald Benson who contextualises his discussion of Walter Pater and physics within 'the profound crisis of discontinuities that beset the whole of later-century culture'.[39]

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[37] One could make the case that Mrs. Ramsay still embodies the new physics by associating her with relativity, which is arguably more holistic and interconnecting than quantum theory was at the time (a popular yet incorrect interpretation of relativity in the 1920s implied subject-object breakdown). However, this is not relevant to quantum physics, and also is not quite so manifest. For instance, Whitehead's interpretation of relativity leads to a view of time as discontinuous too: 'Temporalisation is not another continuous process. It is an atomic succession. Thus time is atomic (*i.e.* epochal), though what is temporalised is divisible'. Whitehead, *Science and the Modern World*. 159.

[38] Anastopoulos, *Particle or Wave*. 13.

[39] Donald Benson, "'Catching Light': Physics and Art in Walter Pater's Cultural Context", in *One Culture: Essays in Science and Literature*, ed. George Levine, Madison, University of Wisconsin Press, 1987. 145. See also:

More generally, the "paradigm shift" narrative of modern physics – that the field, and its attached philosophy, was fully accepted as materialistic, mechanical, and deterministic for two centuries until the double-revolution of Max Plank's quantum and Albert Einstein's relativity – is not quite correct. Helge Kragh's *Quantum Generations* makes this clear, by quoting, for instance, Ludwig Boltzmann who said in 1895, whilst *defending* the mechanical-atomic view of physics against an energetics-based alternative proposed by Wilhelm Ostwald: the 'view that no other explanation can exist except that of the motion of material points, the laws of which are determined by central forces, had generally been abandoned long before Mr. Ostwald's remarks'.[40] In Kragh's view, the revolutionary features of the new physics have been overstated – in part due to Thomas Kuhn's 1962 landmark book on scientific revolutions[41] – therefore, this naïve understanding of the history of physics cannot appreciate the traditionalism of the "revolutions", as Chapter 3's redefinition of Bohr's complementarity already made clear: 'There have indeed been revolutions in the theoretical frameworks of physics, but these have not been wholesale rejections of the classical traditions; on the contrary, they have been solidly connected with essential parts of the physics of Newton'.[42] Nor can it account for the many pre-"revolution" theories, disputes and philosophies which all aimed to contradict the worldview of 18th-century classical physics, except as curious "anticipations": 'The most important nonmechanical trend was based on electromagnetic theory, but this was only one of the indications of a widespread willingness to challenge the mechanical worldview and seek new foundations, either opposed to it or radical modifications of it'.[43] Alice Jenkins similarly advocates, using an vast amount of historical evidence, for a revision of the development of physics that recognises the devaluation of materialism throughout the 19th century, contradicting the prevailing view of Victorianism as strictly Newtonian:

> the early nineteenth-century argument about science and materialism. Did physics and chemistry show that the universe could be explained without recourse to immaterial agencies, crucially that of God, or on the contrary were the hard sciences increasingly describing the universe as immaterial and undermining the definition of matter? Arguments on the latter side of the

Michael Whitworth, "Physics: "A strange footprint"", in *A Concise Companion to Modernism*, ed. David Bradshaw, Oxford, Blackwell Publishing, 2003. 'The themes of continuity and discontinuity manifested themselves in several different sciences simultaneously [...]; the equation of "quantum" with romantic ideals of harmony was by no means universal'. 212.

[40] Christa Jungnickel and Russell Mccormmach, *Intellectual Mastery of Nature: Theoretical Physics from Ohm to Einstein*, Chicago, University of Chicago Press, 1986. 222. Cited in: Kragh, *Quantum Generations*. 7.

[41] Thomas Kuhn, *The Structure of Scientific Revolutions*, Chicago, University of Chicago Press, 1962.

[42] Kragh, *Quantum Generations*. xiii.

[43] Ibid. 4.

> question were stronger both in quality and quantity than simplistic accounts of early nineteenth-century science acknowledge. To equate the physical sciences in this period with an unambiguously materialist outlook is gravely to misread the evidence[44]

As early as 1966, Max Jammer was already promoting the view that the 19th century was headed towards anti-materialism, which may have laid the groundwork for the new physics: 'United in rejecting causality though on different grounds, these currents of thought prepared, so to speak, the philosophical background for modern quantum mechanics'.[45] This is even a central idea used to defend the Forman thesis.[46] While scientific developments are not part of Schwartz's discussion, he nevertheless sees in his multi-faceted philosophical matrix an anticipation of the new physics' anti-Newtonianism:

> Well before relativity and quantum mechanics undermined the foundations of classical physics, philosophers and scientists were beginning to doubt that there is a one-to-one correspondence between scientific formulation and the external world. Paradoxically, the extraordinary pace of scientific development in the late nineteenth century actually fuelled these suspicions[47]

The final confirmation of this nuanced view of materialism is Whitehead's book itself. While his presentation tends to be on the side of the "simplistic accounts" of physics' history, he still highlights how developments in energy physics before the 20th century contain anti-materialistic implications: 'This train of thought [*inverting the relations of mass and energy due to 19th century entropy*] leads to the notion of energy being fundamental, thus displacing matter from that position. [...] The same relegation of matter to the background occurs in connection with the electromagnetic field'.[48] All of this renders one conclusion inescapable: the mere presence in literature of themes, characters, stylistic choices, symbols, or cogitations which contain clear anti-Newtonian wave-like quantum-concepts – most notably immaterialism, subject-object breakdown, energy-based dynamism, or acausality – do not necessarily signal an influence, nor even an anticipation, of the new physics; particularly not of quantum theory before 1927, as anti-Newtonianism was already present in scientific thought for more than a century.

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[44] Alice Jenkins, *Space and the 'March of Mind': Literature and the Physical Sciences in Britain, 1815-1850*, Oxford, Oxford University Press, 2007. 6.

[45] Max Jammer, *The Conceptual Development of Quantum Mechanics*, New York, McGraw-Hill, 1966. 166-7.

[46] Forman, "Weimar Culture, Causality, and Quantum". 2-3.

[47] Schwartz, *Matrix of Modernism*. 13.

[48] Whitehead, *Science and the Modern World*. 127-8.

Therefore, instead of reading the wave-particle opposition that the Ramsays embody in the light of quantum mechanics, it is more appropriate to situate it within the context of late-19th and early-20th century thought and science, when there were already debates surrounding the nature of reality centered on the opposition. This was made clear previously with the philosophical movements discussed by Schwartz, Whitworth and Ryan; it has also been verified in this chapter's exploration of early quantum theory; and it will now be further corroborated by examining how the history of philosophy itself – in particular the 19th and early-20th centuries – was consistent with dualistic constructions.

Chapter 6 - The Real, the Ideal, and the Human

Particle-worldview and wave-worldview denote two interpretatively open conceptualisations of reality which can be applied onto a wide variety of contents in *To the Lighthouse*, and beyond. They represent two mutually exclusive worldviews, which are themselves based on the metaphoric openness of the opposed concepts of particles and waves. In this chapter on Virginia Woolf's philosophical environment, it would be tempting to straightforwardly associate realism with the particle-worldview, and idealism with the wave-worldview, as even a basic understanding of these philosophies and the nature of their opposition makes clear how relevant they are to Mr. and Mrs. Ramsay.[1] Therefore, beyond merely applying philosophical concepts to *To the Lighthouse* and Woolf's thought, this chapter will also examine how each side of the opposition generates dualistic existential points of view regarding humanity's relationship with reality, meaning, and spirituality. This focus on existentialism – here broadly defined as "relating to human existence" rather than the more specific philosophical tradition[2] – allows for the consideration of emotional factors, which might otherwise seem irrelevant to a purely philosophical reading. This broader range of study will ultimately clarify how two of Woolf's most important quantum-concepts employed in scientific readings of the novel – *observer-dependence* and *dynamic holism* – can alternatively be accounted for in the idealistic philosophies of the 19th and early-20th centuries, and the existential worldviews that arose from them.

In order to define what is here meant by "realism and idealism", Leslie Stephen's 1886 article "What is Materialism?", can be usefully employed. Not only was the philosopher Woolf's father and the autobiographical inspiration behind Mr. Ramsay, but in addition, the

[1] Mr. Ramsay considers reality from a separate point of view and never tampers with facts which he analyses individually and dispassionately, while Mrs. Ramsay's mind is in a participatory relation with reality conceived as a interconnecting dynamic whole she becomes one with.

[2] Existentialism as a philosophical movement would undeniably be relevant in these discussions, as it is directly tied to several of the thinkers, concepts and traditions to be discussed, and could be applied to the reading of *To the Lighthouse*. Nonetheless, due to pressures of time and scope, this philosophical tradition will not be treated here. The same comment also applies to romanticism: while undeniably relevant to these discussions, it will nevertheless be passed over for the sake of economy.

article is a straightforward presentation of the philosophical issues inherent in material realism, while also making clear that idealism is not a valid alternative in Stephen's agnostic opinion:

> we are left with two entirely disparate entities, matter and spirit, which cannot be brought together without a confusion of thought. If, as philosophers, we [...] try to meet scepticism by *pronouncing time and space to be independent realities*, we get a solid mathematical universe of indestructible matter, with the soul looking on from a pineal gland or elsewhere, unable really to influence it [...]. If we *pronounce time and space to be merely subjective*, we take leave of all relation to fact, and verbally construct the universe out of bare logic, or we create a mystical theory from emotions cast into some show of logical form. But such constructions, [...] have renounced the only basis upon which genuine knowledge can be systematised, and end in presenting a shifting phantasmagoria of vision[3]

There is therefore a very clear ontological and epistemological duality: either reality is a collection of fixed eternal objects, existing independently of the human subject studying them; or it is a whole of ideal forms that transcend materiality, explorable within the rationality of the introspecting subject.[4] Stephen is hence adopting the straightforward definitions of realism and idealism that can be found, for example, in *The Cambridge Dictionary of Philosophy*. Respectively:[5]

> the view that (a) there are real objects (usually the view is concerned with spatiotemporal objects), (b) they exist independently of our experience or our knowledge of them, and (c) they have properties and enter into relations independently of the concepts with which we understand them or of the language with which we describe them

> the philosophical doctrine that reality is somehow mind-correlative or mind-coordinated – that the real objects constituting the "external world" are not independent of cognizing minds, but exist only as in some way correlative to mental operations. The doctrine centers on the conception that reality as we understand it reflects the workings of mind

[3] Leslie Stephen, (1893), "What is Materialism?", in *An Agnostic's Apology*, ed. Cambridge, Cambridge University Press, 2012. 147-8. Emphasis added.

[4] It should be noted that this chapter will not differentiate between epistemology and ontology for the reason illustrated here by Stephen: they are inherently intertwined within these considerations. That is, a realist view of reality almost always implies a realist epistemology; while an idealist view almost always implies an idealist epistemology.

[5] *The Cambridge Dictionary of Philosophy*, (1995), Cambridge, Cambridge University Press, 1999. 'Metaphysical Realism': 562-3; 'Idealism': 412. It should be noted that this is a specific definition of realism amongst others, chosen here because it is present in Woolf's father's writings and is more relevant to the post-Kantian tradition to be discussed. However, around the same time there was also a form of direct, or common-sense, realism, founded by Scottish philosopher Thomas Reid in the 18th century. In this case, it is not a question of the reality of object, but of the reality of direct impressions: the table experienced *is* the real table. Such a view is not relevant in this chapter's narrative, and will hence remain untreated.

There are, however, subtleties to address. One is the nature of 'real objects', for in Stephen they are synonymous with “material objects”, which is the reason why his article is more concerned with materialism than realism. However, realism need not always imply materiality, but, for historical reasons tied to the developments of physics, materialism and realism are often used interchangeably in the 19th century, and tend to produce the same existential consequences.[6] For the purposes of this discussion, then, both will here be regarded as broadly equivalent, unless otherwise specified. Another subtlety to address is that idealism is not necessarily anti-realist, even though the opposition between the two terms might imply as much. This is a fact often repeated in the 2011 history of idealism by Jeremy Dunham *et al*:

> Where idealists are concerned, however, to promote the fundamentality of mindedness, they do not have in mind some reality other than the one common to us all [...] the deep claim about universal mindedness is not destructive, but rather constitutive of reality.
> This means the idealist, rather than being anti-realist, is in fact additionally a realist concerning elements more usually dismissed from reality. Chief among these is the Idea[7]

A final factor is that, in Stephen's above excerpt, the opposition between 'matter and spirit' that prompts the passage seems reminiscent of a Cartesian duality: either the realm of the physical or the realm of the mind is the genuine foundation of reality. However, here the issue is if matter and spirit can be 'bought together', which, when taken alongside the two italicised clauses regarding space and time, indicate that Stephen's underlying assumptions are not Cartesian; they are Kantian.

While Immanuel Kant's philosophy will be discussed below, it is worth emphasising from the start that all philosophical considerations in this chapter will follow from Kant's “Copernican Revolution”, wherein the problem is the possibility, or lack thereof, of making inner and outer experiences cohere, in order to arrive at knowledge; the concern is not which world is more substantial or foundational than the other.[8] This difference has many

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[6] Kurt Bayertz, "Materialism", in *The Oxford Handbook of German Philosophy in the Nineteenth Century*, ed. Michael N. Forster and Kristin Gjesdal, Oxford, Oxford University Press, 2015. 'in characterizing the key notion "matter", the German materialists closely followed what, at the time, was the best developed physical theory, that is, classical mechanics. So matter was to consist in atoms and their interactions'. 611.

[7] Jeremy Dunham, Ian H. Grant, and Sean Watson, (2011), *Idealism: The History of a Philosophy* London, Routledge, 2014. 4.

[8] For an in-depth exploration of the differences between René Descartes and Kant, see: Hubert Schwyzer, "Subjectivity in Descartes and Kant", in *The Philosophical Quaterly,* 47, no. 188, 1997. 'there is for Kant no such inner world of objects initially (or "directly") apprehended by us, as there is for Descartes. There is no such inner world from which an objective outer world is to be inferred or out of which an allegedly objective world is to be

consequences, the most important of which is summarised by Randall Collins: 'Virtually all academic philosophers in the reformed systems since about 1800 have been post-Kantians. They all do "critical" philosophy, taking for granted that *ontological claims must pass through an epistemological filter*'.[9] This is the "revolution": following Kant, it is impossible to discuss reality, objectivity, truth, things-in-themselves, or facts, without also discussing how all of these factors relate to – and are hence affected by – human experience. Indeed, it is precisely this philosophical innovation that led, albeit after a fair amount of transformation, to the opposition between conceptual abstraction and immediate experience that underpins Sandford Schwartz's matrix of modernism:

> the opposition between "abstraction and experience" did not emerge suddenly at the turn of the century [...]. Bergson, James, Bradley, and Nietzsche are heavily indebted to their nineteenth-century forebears, and their innovations are virtually incomprehensible without the groundwork laid by Kant[10]

The importance of human experience in these highly abstract conversations is also an additional justification as to why this chapter will focus on existential reactions to philosophical worldviews: idealism and realism, in considering the subject's relation to the outer world in strikingly different ways, lead to opposed existential views of humanity's place in reality, with dualistic consequences. This will first be illustrated with *To the Lighthouse*, by showing how Mr. and Mrs. Ramsay's philosophies emerge out of the binary of the novel, and lead to two opposed existential anxieties with equally dualistic solutions. Then, after interrogating the stability of Woolf's personal relation to each worldview, a brief sketch will be presented of the historical debate, following Kant, between idealist and realist-leaning thinkers in Germany and then Britain in the 19th century. This overview of post-Kantian philosophical shifts will provide an intellectual context for a discussion of the ether of space in interwar England, for it is a concept that welded together philosophical, cultural, spiritual, scientific, and existential considerations together, just as Woolf was composing *To the Lighthouse*.

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constructed [...] for Kant the first-person point of view does not itself determine a domain of objects of awareness'. 343.

[9] Collins, *Sociology of Philosophies*. 687. Emphasis added.

[10] Schwartz, *Matrix of Modernism*. 7.

A/ *To the Lighthouse*: Realities, Anxieties, and Solutions

The notion that Mr. and Mrs. Ramsay represent two opposed philosophical standpoints is a critical commonplace, in large part as a result of Andrew's oft-quoted answer after Lily 'asked him what his father's books were about. "Subject and object and the nature of reality, [...] Think of a kitchen table then," he told her, "when you're not there"' [22], which is contrasted to Mrs. Ramsay's feeling that if 'one leant to inanimate things; [...] they *became one*; *felt they knew one*' [53-4, emphasis added].[11] However, the characters do not simply agree cerebrally with a particular worldview, they truly embody them at all levels of their lived experience: both are capable of transforming themselves into a philosophical idealisation, as a result of the novel's conception of reality as being experienceable as either *ordinary* or *extraordinary*. This dualistic experience generates two opposed existential anxieties, with two equally opposed solutions, reiterating the novel's overarching binary structure.

Mr. Ramsay's attachment to broadly empiricist ideas is not merely visible because he is a professional British philosopher who reads David Hume, and because Andrew near-explicitly says so. It is also interpretatively clear whenever the character cogitates:

> his gift, suddenly to shed all superfluities, to shrink and diminish so that he looked barer and felt sparer, even physically, yet lost none of his intensity of mind, and so to stand on his little ledge facing the dark of human ignorance, [...] shrunk so that not only fame but even his own name was forgotten by him, kept even in that desolation a vigilance which spared no phantom [38]

[11] Already in the 1950s critics such as James Hafley were stating that: '*To the Lighthouse* is really the story of a contest between two kinds of truth – Mr. Ramsay's and Mrs. Ramsay's. For him, truth is factual truth; for her, truth is the movement towards truth [...] Mr. Ramsay spatializes knowledge: [...] a logical, scientific procedure towards truth. Mrs. Ramsay, on the other hand, knows by intuition rather than by analysis, and is therefore able to know reality'. James Hafley, *The Glass Roof: Virginia Woolf as Novelist*, Berkeley and Lost Angeles, University of California Press, 1954. 82. There is hence a long legacy of academic discussions regarding what type of ontological or epistemological philosophy each character represents; to what extent Woolf agrees or disagrees with either; and how coherent they both are with her intellectual context and thematic content. However, there is no need to explore these disagreements in detail, because the overall point relevant to the current chapter is uncontroversial: Mr. Ramsay represents formal academic philosophy in the Western tradition, which (to oversimplify) emerged from the Greeks, particularly Platonism, see: Stevie Davies, *Virginia Woolf: To the Lighthouse*, University of California, Penguin Critical Studies, 1989. '3. The Question of the Table', 66-99. The tradition was eventually standardised into an objective method following Newton and the Enlightenment, particularly via Bacon and Descartes, see: A.O. Frank, *The Philosophy of Virginia Woolf: A Philosophical Reading of the Mature Novels*, Akadémiai Kiadó, 2001. 42-53. And, one of the resulting branches of this lineage was British Victorian empiricism, the tradition to which Mr. Ramsay seems to belong, though somewhat debatably, see: Lorraine Sim, *Virginia Woolf: The Patterns of Ordinary Experience*, Taylor & Francis Group, 2010. 36-40. Mrs. Ramsay, on the other hand, can be interpreted more openly, as she represents the kinds of knowledge that were directly contrary to the above history, both within and without academic philosophy: idealism; intuition; mysticism; romanticism; becoming; organicism; philosophy of life...

He is here losing his ego by forgetting his name and legacy, ridding his mind of frivolity, and shrinking his being. This may seem opposed to his general characterisation: his ego defines him, and yet it seems as if, in this instance, he is experiencing a subject-object breakdown akin to dissolving down into the depths. However, unlike the experience of such moments of oneness, Mr. Ramsay loses 'none of his intensity of mind', and keeps 'in that desolation a vigilance': his mind and its abilities seem to remain intact and sharply defined, while his ego has dissolved; he is still in tune with the particle-worldview, but leaves the experience of ordinary life. This is Mr. Ramsay transforming himself into a pure, abstract, and universal subject: the theoretical observer of an object, the perspective-less neutral standpoint from which objective knowledge is built. Losing his physical self, his superficial concerns, and his individualised identity is akin to losing all aspects of subjectivity that might bias his investigation. Hence, in this state, he can observe an object unlike any other human: he is 'blind, deaf, and dumb, to the *ordinary* things, but to the *extraordinary* things, with an eye like an eagle's' [59, emphasis added].

The 'extraordinary' as opposed to the 'ordinary things' refers to the topic of the kitchen table, in line with the classic philosophical trope. This is most visible when Lily considers what Mr. Ramsay's table must look like:

> if one's days were passed in this seeing of angular essences, this reducing of lovely evenings, with all their flamingo clouds and blue and silver to a white deal four-legged table (and it was a mark of the finest minds to do so), naturally one could not be judged like an ordinary person [22]

> The kitchen table was something visionary, austere; something bare, hard, not ornamental. There was no colour to it; it was all edges and angles; it was uncompromisingly plain. But Mr Ramsay kept always his eyes fixed upon it, never allowed himself to be distracted or deluded [129]

Unlike the “ordinary” table seen by 'an ordinary person', Mr. Ramsay's has no colour or other secondary features and is reduced to its primary qualities: solidity, angles, number of legs, extension in space... These are all facts that can be objectively assessed by a subject without recourse to subjective or qualitative impressions. Indeed, wherever the character looks, secondary qualities vanish: 'his gaze seemed to fall dolefully over the sunny grass and *discolour it*' [126, emphasis added]. Only primary qualities remain pure in his mind, because he 'never tampered with a fact' [8]. The character achieves this by reducing his mind to a blank slate ('the dark of human ignorance'), in order to empirically observe the object in the most disinterested, objective manner possible, that is, by losing his ego. This enables him to discern its elementary

characteristics, or facts, that he then relates orderly and accurately to other discrete primary qualities, an activity which may eventually enable him to 'reach Z' [32]: to possess in his mind the entire alphabet of neutral judgements that would enable him to write down transcendental objective truths. It is therefore evident, even in depictions of how the character thinks, that he is attached to the realist tradition. Yet, his elevation of primary qualities into immaterial and universal forms, following mental analysis, also betrays a possibly rational transcendentalist angle to his philosophy, which seems inconsistent with strict empiricism. This particularity will be elucidated in the intellectual context section.

Reaching truth in *To the Lighthouse* is often depicted as writing perfectly accurate sentences: when 'words became symbols' to Lily, she feels that 'If only she could put them together, [...] write them out in some sentence, then she would have got at the truth of things' [122]. Or, in Part II, transcendental truth is implied to exist behind a window, as revealed by 'divine goodness' when he 'parted the curtain and displayed behind it, single, distinct'. However:

> divine goodness, twitching the cord, draws the curtain [...] covers his treasures in a drench of hail, and so breaks them, so confuses them that it seems impossible [...] that we should ever compose from their fragments a perfect whole or read in the littered pieces the clear words of truth [105]

Assembling separated elements into sentences to 'read [...] the clear words of truth' is clearly Mr. Ramsay's alphabet. However, there is an alternative method: to 'compose from their fragments a perfect whole'. This alternative, based on holism as opposed to atomism, is recognised by Mr. Ramsay: opposed to those like him 'who, plodding and persevering, repeat the whole alphabet in order', there are also 'the gifted, the inspired who, miraculously, lump all the letters together in one flash' [31].

This, of course, refers to the possibilities of Mrs. Ramsay's philosophical worldview. As observed previously, her capacity for wave-worldview-based oneness grants her the possibility of intuitive knowledge of objects and people, such as the lighthouse's beam, or when she is compared to a 'light stealing under water' at the dinner, gaining direct knowledge of her guest's interiorities. This philosophical possibility based on subject-object breakdown is perceived by Lily while pondering how to 'know one thing or another thing about people', as she concludes that one solution would be to 'make her and Mrs Ramsay one'. Lily here wishes to achieve oneness precisely because she believes that Mrs. Ramsay contains perfect knowledge:

> Was it knowledge? [...] she imagined how in the chambers of the mind and heart of the woman who was, physically, touching her, were stood, like the treasures in the tombs of kings, tablets bearing sacred inscriptions, which if one could spell them out, would teach one everything, but they would never be offered openly, never made public. [...] And yet, she knew knowledge and wisdom were stored up in Mrs Ramsay [43-4]

Again, this passage equates transcendental truth with perfect sentences. So, while Mr. Ramsay constructs his alphabet empirically, Mrs. Ramsay already possesses all the letters within her, all of divine goodness' fragments assembled in one whole. However, this 'sacred' knowledge cannot be made public; this is precisely why Lily wishes to become one with the matriarch. Once again, this is opposed to Mr. Ramsay, who shares his findings with the world in books, lectures or conversations, whereas Mrs. Ramsay is always silent: she does not discuss the *Waverley* novels, and when facing her husband is 'not [...] able to tell him the truth' [35]. This secrecy is consistent with the binary system: words are separating tools from the surface and cannot therefore capture knowledge of the depth's holistic and interconnected reality. These characteristics seem to align Mrs. Ramsay with a form of mystical idealism: reality is a perfect interconnected unity which includes its observers, hence knowledge can be gained by breaking down the subject-object divide and intuiting the secrets of the absolute whole. However, this knowledge cannot be spoken, as it can only be experienced in moments of mystical-like oneness, when one becomes like 'a wedge-shaped core of darkness, something invisible to others' [52]. This transformation suggests that, like her husband, Mrs. Ramsay too reduces her physical being out of everyday life to attain knowledge, allowing her to similarly reach an extraordinary view of reality that is not biased by the material and ego-based impressions inherent in ordinary experience.

Therefore, while their conceptual standpoints and methods for attaining knowledge are opposed, both characters nevertheless share a similar approach: they transition from an experience of ordinary, everyday life – how most human beings live most of the time – towards an experience of extraordinary, “objective” reality, owing to the reducing and transforming of their physical being and ego into philosophical idealisations; Mr. Ramsay becomes a disinterested observer of reality, Mrs. Ramsay becomes one with the reality itself. Hence, while Mr. Ramsay studies 'Subject and Object' [22], Prue calls her mother 'the thing itself' [94]. The two therefore seem to complete each other: Mr. Ramsay has the ability to share knowledge of reality, but he does not have access to the whole of it (the letter R he is stuck at); whereas Mrs. Ramsay can access the whole intuitively, but is incapable of communicating the knowledge she gains (she 'could not keep anything clearly fixed in [*her*] mind' [138] according to her

husband). Once again, then, the binary system of the novel directly generates a conceptual duality featuring a strictly oppositional relationship. However, as the novel is more focused on human life and psychology than on sterile philosophical standpoints, it is equally possible to discern each character's existential reaction to their own worldviews, and how they cope with them. This can be understood by examining how each character relates to ordinary reality, or, the experience of everyday life.

The negative feelings prompted in Lily and Bankes by the sand dune have already been employed to illustrate why the particle-worldview is existentially overwhelming: it implies a world of non-human, meaningless, everlasting, separate, and dead objects that reduces humanity to pointlessness. However, Mr. Ramsay's work is precisely to catalogue the truths of these objects, which clarifies his acute awareness of the finitude of existence: his children 'should be aware from childhood that life is difficult; facts uncompromising; and the passage to that fabled land where our brightest hopes are extinguished' [8]; the line 'we perished, each alone' from William Cowper's "The Castaway" is attributed to the character many times; and he compares himself extensively to the leader of a doomed polar expedition [31-2]. This comparison leads him to imagine two scenarios, which, together, articulate the differences between his experience of reality as extraordinary or as ordinary.

In the first, he imagines a glorified military death: 'he would not die lying down'; 'raise his numbed fingers to his brow, and square his shoulders, so that when the search party comes they will find him dead at his post, the fine figure of a soldier'. This represents his philosophical work and his courage in facing its perturbing implications: 'trying to the end to pierce the darkness, he would die standing'; 'the leader of that forlorn party which after all has climbed high enough to see the waste of the years and the perishing of the stars'. The stars perishing here highlight the non-human scales of time and space being considered, which inevitably imply the finitude of human existence. This fixation also explains the physical deterioration that seems to accompany his cogitations: he 'knows that he must lay himself down and die [...] paling the colour of his eyes, giving him, [...] the bleached look of withered old age'. Or, when Lily imagines him staring at the table: 'his eyes fixed upon it, [...], until his face became worn too and ascetic' [129]. It is therefore clear in this first scenario that Mr. Ramsay's ability to experience the particle-worldview's version of extraordinary reality directly generates his existential anxieties regarding legacy, human meaning, and death.

However, Mr. Ramsay also recognises that all the above can be avoided by embracing ordinary experience – the second scenario:

> who shall blame the leader of the doomed expedition, if, having adventured to the uttermost, and used his strength wholly to the last ounce and fallen asleep [...] he now perceives by some pricking in his toes that he lives, and does not on the whole object to live, but requires sympathy, and whisky, and some one to tell the story of his suffering to at once? Who shall blame him? Who will not secretly rejoice when the hero [...] gazes at his wife and son, [...] lovely and unfamiliar from the intensity of his isolation and the waste of ages and the perishing of the stars

Here the honourable military death is rejected in favour of domesticity: lying instead of standing; removing his uniform instead of saluting; surrounded by people instead of alone; comforts instead of hardships; and gazing at his family instead of extraordinary objects. Indeed, this paragraph prompts him to reunite with his wife in the following chapter, in effect abandoning his philosophical work in favour of everyday life. This is made even clearer when he:

> found consolation in trifles so slight compared to the august theme before him that he was disposed to slur that comfort over, to deprecate it, as if to be caught happy in a world of misery was for an honest man the most despicable of crimes. It was true; he was for the most part happy; he had his wife; he had his children [...] But this and his pleasure in it [...], had to be deprecated and concealed [39]

The 'august theme' here designates his work, 'the sight of human ignorance and human fate' [39]. He feels shame regarding his happiness with family life, as it is considered trivial compared to the honour of his extraordinary egoless investigations. Ordinary experience also returns him to his ego, which clarifies the two reasons why Mr. Ramsay requires sympathy when he is not working: to narcissistically reassure himself that he is indeed honourable, given his feeling of shame for experiencing domestic happiness; as well as to connect with others in everyday life – the only remedy against his existential dread. In summary: 'It was sympathy he wanted, to be assured of his genius, first of all, and then to be taken within the circle of life, warmed and soothed, to have his senses restored to him' [33]. The restoration of his senses here confirming that he is no longer the disinterested subject of empirical philosophy, no longer having to endure the troubling eternity of reality. The solution to Mr. Ramsay's existential anxiety is hence to be found in the ordinary experience of everyday life.

As expected, the opposite is true of Mrs. Ramsay: she 'felt alone in the presence of *her old antagonist, life*' [66, emphasis added]. This is explained by the character's relationship to it:

> she was on one side, and life was on another, and she was always trying to get the better of it, as it was of her; [...]; there were, she remembered, great reconciliation scenes; but for the most part, [...] she felt this thing that she called life terrible, hostile, and quick to pounce [50-1]

She can therefore experience an adversarial relationship, 'brandishing her sword at life' [51], fighting against it as one would an enemy, or 'reconciliation scenes' during moments of oneness. This delineates Mrs. Ramsay's dualistic relation to the ordinary and extraordinary, which is, unsurprisingly, expressed with motifs of water: as analysed earlier, the sound of waves can 'beat a measured and soothing tattoo to her', because they express support and harmony in nature – extraordinary conciliation. But there are equally moments when the waves:

> had no such kindly meaning, but like a ghostly roll of drums remorselessly beat the measure of life, made one think of the destruction of the island and its engulfment in the sea, and warned her [...] that it was all ephemeral as a rainbow – this sound [...] made her look up with an impulse of terror [17]

When life is an adversary, waves express instead fleetingness: how everything is destroyed and nothing lasts, as it all gets engulfed in the sea of reality. Indeed, life “pounces” on Mrs. Ramsay when she is reminded of death and the destruction of humanity: 'life terrible, hostile, and quick to pounce on you if you gave it a chance. There were eternal problems: suffering; death; the poor. There was always a woman dying of cancer' [51]. Mrs. Ramsay, then, is faced with death when considering the everyday life of humanity within such a constant flux: 'she had always seized the fact that there is no reason, order, justice: but suffering, death, the poor. [...] No happiness lasted' [54], for there can be no meaningful absolutes, no fixed ideals, no lasting prosperity in a realm of flow and ephemerality. Therefore, waves experienced in ordinary reality, by expressing unending dynamism, can become an existential reminder of the inevitability of change, destruction, and death.

On the other hand, waves can also be felt as soothing guardians when Mrs. Ramsay experiences oneness. Indeed, it is in this scene that she becomes the extraordinary wedge-shaped idealisation, hence 'All the being and the doing, [...] evaporated', and:

> there was peace, there was, most welcome of all, a summoning together, a resting on a platform of stability. Not as oneself did one find rest ever, [...].

> Losing personality, one lost the fret, the hurry, the stir; and there rose to her lips always some exclamation of *triumph over life* when things came together in this peace, this rest, this eternity [53, emphasis added]

It is therefore clear that only when Mrs. Ramsay experiences oneness with extraordinary reality are her anxieties resolved, and life is no longer an enemy. What is particularly noteworthy, though, is that all expressions of flow ('being and doing'; 'the fret, the hurry, the stir'), drop away in favour of stillness ('peace'; 'stability'; 'this rest; this eternity'). Stillness may seem opposed to the dynamic nature of the wave-worldview; however, the motionlessness is here an expression of holism: a 'summoning together', or 'when things came together'. This slight inconsistency can be elucidated by referring to the other major extraordinary experience of harmonious eternal peace felt by Mrs. Ramsay during the dinner scene:

> It partook, she felt [...] of eternity; as she had already felt about something different once before that afternoon; there is a coherence in things, a stability; something, she meant, is immune from change, [...] in the face of the flowing [...] so that again tonight she had the feeling she had had once today, already of peace, of rest [85]

What she 'had already felt' and 'the feeling she had had once today' both refer to her oneness with the lighthouse's beam. The peace and rest felt are justified because harmony with an interconnected whole implies that 'there is a coherence in things'; that the chaos, fleetingness, and death felt in the everyday are also constitutive of the one holistic reality that will last forever, and which therefore includes all of humanity in a web of meaningful interrelations, alive or dead. This justifies the presence of stillness: it is an expression of peace following the realisation of one's active participation in a hidden harmonious totality, which therefore gives meaning to humanity's existence. This is similar to a mystical revelation. Hence, during her experience with the light, a religious thought emerges in Mrs. Ramsay's mind: 'suddenly she added, We are in the hands of the Lord' [53]. This is meaningful given that her holistic view of reality has divine connotations, as earlier implied in the contrast with Mr. Ramsay's empirical alphabet. However, 'she was annoyed with herself for saying that'. Indeed, the religious sentence is a 'lie': feelings of oneness are not related to religious institutions or doctrines; they are spiritual, unmoored from separating customs. Therefore, instead of praising the Lord, 'She praised herself in praising the light, without vanity': she praises the egoless oneness of herself and the world, the stable experience of being one with a meaningful extraordinary reality that conveys reassurance against the chaotic ever-changingness of ordinary life.

Again, then, the Ramsays complete each other. When Mr. Ramsay takes himself out of ordinary experience he is faced with eternity and the meaninglessness of human endeavours, which conveys mortality: therefore, he finds reassurance in ordinary life where human connection allows for sympathy and comfort. On the other hand, Mrs. Ramsay sees in ordinary life how everything changes and no happiness can last, which also conveys human mortality, so she finds reassurance by taking herself out of everyday experience, by feeling as one with the eternal holistic reality that surrounds and soothes her. Therefore, the characters' connections to the metaphorical systems of waves and particles, and their associated philosophies, also account for how they relate to the world around them existentially, a further confirmation of how foundational the binary system of the novel is to the elucidation of its philosophical content.

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B/ *Woolf's Thought*: A Novelist's Hesitation

The main philosophical subject of interest in this thesis is Woolf herself. And, as it is her imagination that produced the above binary and associated consequences, it is pertinent to question the extent to which she herself was in agreement with – or personally experienced – either of the worldviews delineated here.

Before doing so however, a related consideration needs addressing: Woolf was a novelist, not a philosopher. While obvious, this fact can dissipate when literary scholars treat the author's conceptual contents as if they constitute an internally consistent and carefully considered philosophy.[12] When the truth, of course, is that the literary realm requires no such academic orderliness, and the philosophical notions that Woolf does employ are always present firstly in service of the fiction, her various creative goals, or her own life-long ponderings. Furthermore, literature can be a vehicle for exploring complex thoughts as an end in of itself, without the pressure of arriving at coherent conclusions. This is here important, because the readings of *To the Lighthouse*'s binary structure in these chapters may convey an impression

[12] For example, Frank, *Philosophy of Virginia Woolf*. 'not all literature raises its own meaning of philosophy. Woolf in these three novels does and this is one of the points I set out to show'. 16.

of intentionally constructed organisation, though this is likely more a result of the interpretation's structure and selectivity than the novel's actual composition. This a point concerning *To the Lighthouse* that Gillian Beer has warned against:

> It is tempting [...] to see Lily Briscoe as some sort of Hegelian third term, representing the artistic resolution of [...] fracture and contradiction. But *geometric patterning offers false stability* of reading, a judging optimism, which serves to protect the reader against the evanescence studied in the work [13]

Therefore, to undermine the 'false stability' that the thesis's 'geometric patterning' may imply, this section will also aim to show that Woolf herself displays some degree of 'evanescent' hesitation regarding either worldview, as she is a novelist freely exploring ideas that are relevant to her, not a philosopher constructing well-articulated systems of knowledge.

On October 9th, 1926, *The Nation and Athenaeum* published "The Cosmos": Woolf's review of *The Journals of Thomas James Cobden-Sanderson, 1879-1922*. Her diaries indicate that she wrote the review in the second half of September 1926,[14] so it was produced either simultaneously with, or immediately after, her first draft of *To the Lighthouse*.[15] It is hence interesting that "The Cosmos" provides her clearest and most exhaustive formulation of the wave-worldview:

> he had found that life became suddenly "rounded off and whole" [...] He took [*book-binding*] lessons at once, and became, [...] capable of making "something beautiful and as far as human things can be, permanent." [...] which served to put his own mind and body in order and so in harmony with the greater order [...] transcending all human affairs. For there was a unity of the whole in which the virtues and even the vices of mankind were caught up and put to their proper uses. Once attain to that vision, and all things fell into their places. From that vantage ground [...] Englishmen and Germans blowing each other's heads off in the trenches were "brothers not enemies" conspiring to "create the great emotions which in turn create the greater creation." [...]
> The volumes are full of attempts at explanation. He was not quite certain what he meant; [...]. Instead of becoming clearer, therefore, the vision, iterated and reiterated, becomes more and more nebulous, until after two volumes of

[13] Beer, *Common Ground*. 41. Emphasis added.

[14] Woolf, "Monday 13 September". 'Curse my own procrastinations and nerves. I shall do Cobden Sanderson and Mrs Hermans and make something by them however'. 109.

[15] Virginia Woolf, (1926), "Woolf to Gerald Brenan, 3 Oct. 1926", in *The Letters of Virginia Woolf*, ed. Nigel Nicolson and Joanne Trautmann, London, Harvest/HBJ, 1980. 'I finished a novel 10 days ago: and already regard it [...] with complete indifference'. 296. It is also interesting that it is in this period that she seems to have formulated her first idea for *The Waves,* Woolf, "Thursday 30 September". 'the mystical side of this solicitude; how it is not oneself but something in the universe that one's left with [...] One sees a fin passing far out. [...] Life is, soberly and accurately, the oddest affair; has in it the essence of reality. [...] it may be the impulse behind another book'. 113.

> explanation we are left asking, [...]: "But, Mr. Sanderson, how does one 'fly to the great Rhythm'? What is the extraordinary ring of harmony within harmony that encircles us; what reason is there to suppose that a mountain wishes us well [...]?"[16]

Of course, Woolf is here merely paraphrasing the diaries. But it remains noteworthy that this is the *one* topic she discusses. Indeed, as Barbara Lounsberry's short biography of Cobden-Sanderson's intellectual life reveals, there were numerous shared preoccupations between him and Woolf, including their political views on pacifism, education and feminism; common acquaintances (notably her father and Bertrand Russell); thoughts on diary-keeping; art; or publishing...[17] Instead, Woolf presents 'at some length his lifelong – ultimately failed – drive to explain his mystic *Credo*. Like Woolf, Cobden-Sanderson was a searcher, a questioner who wanted to know "what life is". His questing *Journals* likely encouraged her own search in September 1926 (and after)'.[18] More noteworthy, though, is the near one-to-one correspondences between Woolf's presentation of his *Credo* and Mrs. Ramsay's philosophy. The above excerpt alone displays, in order of appearance: the experience of becoming one with the whole; making something permanent out of the flux;[19] the soothing realisation of one's harmonious role within the whole; how this feeling transcends everyday experience; the whole giving meaning to all of its constituent parts; even death and war which no longer invite despair; the communion with humanity that wholeness implies; the near-religious nature of these thoughts ('the greater creation'); the inability to translate such feelings into words; how that leads people to question knowledge contained within a closed-off mind; the dynamic nature of reality ('the great Rhythm'); and how it implies oneness with nature, allowing the non-human to communicate with humanity. Furthermore, 'he seemed to be *passing out of the body* into a trance of thought [...] the effort which he made persistently to "overcome the ordinariness of ordinary life"'[20], which, additionally, conveys that the book-binder's method for communing with the whole is comparable to Mrs. Ramsay's reduction of her being, when she too transcends the ordinary. In these extraordinary moments, '*the ideal* got the upper hand', and, he 'is neither vapid nor insipid nor wrapped around, *as so many idealists tend to become*, in comfortable

[16] Virginia Woolf, (1926), "The Cosmos", in *The Captain's Death Bed and other Essays*, ed. London, The Hogarth Press, 1950. 80-1.

[17] Barbara Lounsberry, *Virginia Woolf's Modernist Path: Her Middle Diaries & The Diaries She Read*, Gainesville, University of Florida Press, 2016. 163-9.

[18] Ibid. 169.

[19] This aspect of Mrs. Ramsay will be addressed more fully in the following chapter.

[20] Woolf, "The Cosmos". 82. Emphasis added.

cotton wool'.[21] This establishes two points: Woolf is explicitly aware that the philosophy which underpins the wave-worldview is idealistic in nature, and she attaches her notion of the 'cotton wool' to these discussions. This, inevitably, makes relevant Woolf's "A Sketch of the Past" autobiographical essay written throughout 1939 and 1940, wherein 'the cotton wool of daily life' is associated with 'this non-being': the experience of ordinary, everyday, routine living, which makes no lasting impact on memory or impressions.[22] However, non-being is contrasted with 'instances of *exceptional* moments [...] they come to the surface unexpectedly'.[23] These are Woolf's famous "moments of being", when a memorable shock suddenly experienced by one's impressions transforms the view of life from *ordinary* to *extraordinary*. There is much to be said about "A Sketch of the Past" with regard to Woolf's philosophical standpoints, as will be done in the next chapter, but presently it demonstrates that the transition from one experience of reality to another, as a means of articulating different existential experiences, is common to the Ramsay couple, Cobden-Sanderson, and Woolf's own thought, which is explicitly tied, to some extent, with idealism.

That being said, it is equally clear that Woolf is not advocating for Cobden-Sanderson's philosophical lifestyle. Quite the opposite, in fact, as the above passage, the general tone of the review, and its conclusion, are all lightly derisory towards the man's philosophical alienation from humanity. Similarly, in *To the Lighthouse*, while the wave-worldview is clearly an essential part of the novel's construction, it is nevertheless presented with some amount of irony, due to the matriarch it is associated with, and the main figure who judges her – Lily. For instance, before she attempts to 'make her and Mrs Ramsay one', Lily provides an unambiguously caustic impression of Mrs. Ramsay:

> All this she would adroitly shape; even maliciously twist; and, [...] insist that she must, Minta must, they all must marry, since in the whole world whatever laurels might be tossed to her (but Mrs Ramsay cared not a fig for her painting), or triumphs won by her [...] there could be no disputing this: an unmarried woman [...] has missed the best of life. [...]
> Then, she remembered, she had [...] laughed almost hysterically at the thought of Mrs Ramsay presiding with immutable calm over destinies which she completely failed to understand [46-7]

[21] Ibid. 81. Emphasis added.

[22] Woolf, "A Sketch of the Past". 70. For clarity: in "The Cosmos", Woolf associates the 'cotton wool' with the idealists who are 'vapid' and 'insipid'; the second-rate philosophers who fixate misguidedly on non-being, unlike Cobden-Sanderson.

[23] Ibid. 71. Emphasis added.

Mrs. Ramsay's wave-worldview-based drive towards unification can therefore also be negative: she forces the patriarchal institution of marriage onto people who reject it (Lily), or onto fruitless couples (Minta and Paul), or indeed onto 'the whole world', even though she clearly lacks a full understanding of other people's existences, such as their non-matrimonial interests like art, philosophy, or literature. This is confirmed at the dinner scene, when Mrs. Ramsay achieves the unification of Minta and Paul: 'Mrs Ramsay, [...] having brought it all about, somehow laughed, *led her victims, Lily felt, to the altar*' [94, emphasis added], which clearly demonstrates that Mrs. Ramsay's insistence on oneness, while valuable to her own existence, can also be oppressive when imposed unreflectively upon the ordinary experiences of others, who interact as separate, unknowable, individuals. This tempers the apparent "powers" that Mrs. Ramsay seems to possess given the worldview she embodies, as the character clearly does not have access to a *complete* understanding of the people surrounding her: her instinctive knowledge is limited to the depths, and hence does not discern the realities of the surface. There is an additional indication that, maybe, the subject-object breakdown implied by Mrs. Ramsay is an impossibility: as Lily tries to 'make her and Mrs Ramsay one', she concludes that 'Nothing happened. Nothing! Nothing!' [47]. Though this may seem like a contradiction, it instead highlights Woolf's hesitations concerning the worldview.

Indeed, from her earliest journals to "A Sketch of the Past", the author records numerous personal experiences of a mystical nature, and she had an awareness of the idealistic philosophical implications of such moments, as "The Cosmos" reveals, yet, when mystical-sounding ideas are articulated in her fictional or essay writing, they are often questioned, ironized, or to some extent undermined.[24] This can be viewed for instance in her 1926 essay "On Being Ill", wherein the experience of illness is shown to generate the wave-worldview: 'the body, this miracle, its pain, will soon make us taper into mysticism, or [...] into the raptures

[24] Like "The Cosmos", Woolf's "Solid Objects" also ends with the main character becoming alienated from humanity, due to his obsession with extraordinary experience. Or, in the oft-quoted diary entry from the 10th of September 1928, wherein Woolf attempts to define her own personal notion of 'reality' (the wave-worldview) and its relevance to her art: 'a consciousness of what I call "reality": [...] something abstract; but residing in the downs or sky'. However, her statements regarding this experience of reality end with 'But who knows', and, 'but again, who knows?', marking her hesitation. Woolf, "Monday 10 September". 196. Even in "A Sketch of the Past", her most exhaustive attempt at defining her philosophy, there is still ambiguity regarding the reality of her extraordinary experiences, as she sometimes finds herself: 'labouring all the morning to analyse what I mean, to discover *whether I mean anything real, whether I make up or tell the truth* when I see myself taking the breath of these voices in my sails'. Woolf, "A Sketch of the Past". 115. Emphasis added.

of transcendentalism'.[25] However, Woolf also affirms that such a holistic impression of reality is not in itself real:

> That *illusion* of a world so shaped [...], of human beings so tied together by common needs and fears that a twitch at one wrist jerks another, where however strange your experience other people have had it too, where however far you travel in your own mind someone has been there before you – *is all an illusion. We do not know our own souls, let alone the souls of others.* Human beings do not go hand in hand the whole stretch of the way. There is a virgin forest in each; a snowfield where even the print of birds' feet is unknown. Here we go alone, and like it better so. Always to have sympathy, always to be accompanied, always to be understood would be intolerable[26]

This seems to align with Lily's failure at becoming one with Mrs. Ramsay, for even though oneness is an intriguing philosophical hypothesis, the closed nature of human beings in ordinary experience renders intimate knowledge of an other's private mind ultimately impossible, and hence, illusory. Focusing fully on one worldview while dismissing the other inevitably leads to error, as Mrs. Ramsay illustrates with her oppressive match-making.

Such hesitancy is also visible in Woolf's relation to the particle-worldview. However, this ambiguity is not appreciated in most quantum analyses of the author, particularly those focused on *To the Lighthouse* and the Ramsay couple. This is likely due to the legacy of gender-based dualistic readings of the novel, which tend to view Mr. Ramsay as, for the most part, a negative figure: he represents the oppressive Victorian patriarchy, with its dying Enlightenment-based ideals and stifling literary traditions, which can never hope to capture life, and hence the whole of reality.[27] Even beyond considerations of gender, history, or politics, the actual philosophical standpoint that Mr. Ramsay occupies is occasionally interpreted as voluntarily inconsistent, as if Woolf is criticising the failure of his mode of thought. Lorraine Sim puts it most clearly:

> Woolf presents his factual version of the truth as a potential source of violence upon others.
> Woolf's critique [...] extends to several distinct philosophical traditions. Mr Ramsay is affiliated with incompatible traditions; for example, the empiricism of Hume, but also metaphysics which was a branch of philosophy

[25] Woolf, "On Being Ill". 102.

[26] Ibid. 104. Emphasis added.

[27] For instance, Frank, *Philosophy of Virginia Woolf*. 'the ordering, separating and purifying performed by Mr Ramsay in philosophy, or more widely by "men" in their social effort, functions as a quasi-religious system with the aim of creating civilisation out of chaos. But this also means engagement in a systematic untruth which is, however, not consciously perceived as such'. 53. Mrs. Ramsay, on the other hand, represents the liberating possibilities of the feminine, implying a philosophical conception of reality and art as participatory and fluid, which allows them to be complete as they also include human life and interiority.

> that Hume and Stephen rejected [...] Angular essences' suggest an interest in abstract entities and speculative thought and, despite his positivist conviction in fact, Mr Ramsay has a tendency to ignore his material surroundings and to resent domestic activities that might distract him from his meditations. What Lily describes as Mr Ramsay's "narrowness, his blindness" suggests that his intellectual conceit and dogmatism precipitates a narrow, limited vision that makes him insensitive to others and unaware of his immediate environment [...]
> Thus, in *To the Lighthouse*, Woolf frequently positions the rational empiricism of Mr Ramsay as opposed to ordinary life. [...] While his meditations centre upon ordinary objects, like a kitchen table, [...] those things become mere abstractions that are drained of life[28]

This notion is shared by critics who analyse *To the Lighthouse* from a quantum perspective, as the particle-worldview is synonymous with the old paradigm of Newtonianism, and hence must be devalued to make way for the new quantum, wave-worldview-based, paradigm. This is most visible in Louise Westling and Mark Hussey, respectively:[29]

> Through the portrait of Mr. Ramsay, Woolf has rejected humanist pretensions of separation and transcendence, returning to a focus upon embodiment and thus reversing her culture's long dismissal of the living world

> Woolf's fiction questions the solidity of that Cartesian ground Western epistemology has complacently stood upon for several hundred years, suggesting it is only a figment of our creative, constructive consciousnesseses. The mechanistic order of independently existing entities [...] is ironically figured in *To the Lighthouse*

Such readings cannot be considered entirely invalid, as it is obvious that Mr. Ramsay is a deeply flawed character who represents an outdated and authoritarian generation, and whose philosophical project is doomed to forever be incomplete. However, this notion tends to overemphasise the negative aspects of the patriarch to validate the scholars' own dualistic positive-negative readings, while ignoring elements that might reveal a more ambiguously sympathetic view of Mr. Ramsay and his thought.[30] For instance, the fact that the last chapters of the novel see Lily, Cam and James all simultaneously working through their dislike of Mr. Ramsay to finally gain genuine empathy for him, and possibly even recognise his greatness, as other characters equally do throughout.[31]

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[28] Sim, *Patterns of Ordinary Experience*. 40-1.

[29] Westling, "Woolf and the Flesh of the World". 863; Hussey, "To the Lighthouse and Physics". 81-2.

[30] It also ignores the point previously made, that Mrs. Ramsay and her worldview are also presented with some degree of ambiguity and ties to patriarchy.

[31] Though there is often a degree of irony to these recognitions, such as when Lily imagines Mr. Ramsay staring at the table, mentioning that '(and it was a mark of the finest minds to do so)', which can certainly be read as ironic, ridiculing the patriarch's 'great mind' though all he does is impotently observe furniture inhumanely. In fact, the

Furthermore, as strongly revealed in Woolf's "Leslie Stephen, the Philosopher at Home: A Daughter's Memories" originally published in *The Times* in 1932, Mr. Ramsay is directly inspired by her father.[32] This certainly lessens the possibility of *To the Lighthouse* being an intellectual rejection of the philosopher patriarch, as Woolf's ambitions with the novel were, first and foremost, to remember, honour, and work through her complicated feelings towards her parents.[33] This point has already effectively been made in Beer's *Common Ground*, such as "The Victorians in Virginia Woolf: 1832-1941", which makes clear that such a "paradigm-shift" view of Woolf's treatment of the past, implying a rejection of previous worldviews, is inadequate: 'Woolf did not simply reject the Victorians and their concerns, or renounce them. Instead she persistently rewrote them. Surviving our parents is a hard lesson to learn (parent-texts as well as parent-people), but essential'.[34] This notion that Woolf is rewriting instead of rejecting the past is found throughout Beer's collection of essays, particularly "Hume, Stephen, and Elegy in *To The Lighthouse*": 'The narrative engages with the difficulties that Hume's work raises. And by this means, as we shall see, Virginia Woolf movingly allows to her father, Leslie Stephen, within her own work, a power of survival, recomposition, rediscovery, even'.[35] Beer's chapter demonstrates that Woolf is indeed not rejecting her father and his philosophy, but merely reworking them, consistently with the elegiac nature of the novel. Indeed, elegy inevitably leads to considerations of permanence versus flux, so Mr. Ramsay's philosophy is not merely an abstract set of notions to be discarded; they inform the novel, and how Woolf relates to the memory of her father: 'In *To the Lighthouse* the fictitiousness of the separation between object and subject, the question of where to draw the line, is passionately explored, not only by the painter, Lily Briscoe, but by the entire narrative process'.[36]

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entire "conversation" between Bankes and Lily regarding Mr. Ramsay ([19-23]) summarises the ambiguous presentation of the character in *To the Lighthouse*; never fully committing to praise, but also never unfairly criticising: 'It was astonishing that a man of his intellect could stoop so low as he did – but that was too harsh a phrase'. This ambiguous appreciation is merely another mark of Woolf's hesitation towards the Ramsay couple and their worldviews, and more generally a feature of the novel's psychological considerations: 'How did one judge people, think of them? How did one add up this and that and conclude that it was liking one felt or disliking?' [23].

[32] Woolf, "Leslie Stephen".

[33] Woolf, "Wednesday 28 November". 'I used to think of him [*Stephen*] and mother daily; but writing the *Lighthouse* laid them in my mind. And now he comes back sometimes, but differently. (I believe this to be true – that I was obsessed by them both, unhealthily; and writing of them was a necessary act.) He comes back now more as a contemporary'. 208.

[34] Beer, *Common Ground*. 94.

[35] Ibid. 34.

[36] Ibid. 30.

Beyond the specific case of *To the Lighthouse*, though, it is still possible to find indications that, while the particle-worldview was by no means Woolf's preferred conceptualisation, particularly not in her prescriptive essays on literature,[37] she nevertheless recognised its value. "The Mark on the Wall", being a meditation on knowledge (by trying to determine the objective source of the mark), is the most instructive in this regard: it displays Woolf vacillating between one worldview and the other, recognising the value and inevitability of either in human existence, even though they are contradictory. For instance, she imagines a world without the particle-worldview-based, manly, academic knowledge:

> A world without professors or specialists [...], a world which one could slice with one's thought as a fish slices the water with his fin, grazing the stems of the water-lilies, hanging suspended over nests of white sea eggs…. How peaceful it is down here, rooted in the centre of the world and gazing up through the grey waters[38]

This obviously recalls Mrs. Ramsay's version of knowledge, with the same metaphor of fish suspended in water while exploring the depths, and implying a similar feeling of harmonious peace. However, during this meditation, there is a sudden need for action, for an empirical examination using bodily senses: 'I must jump up and see for myself what that mark on the wall really is', which leads to a consideration of the particle-worldview's value:

> This train of thought, she [*Nature*] perceives, is threatening mere waste of energy, even some collision with reality, for who will ever be able to lift a finger [...]
> I understand Nature's game – her prompting to take action as a way of ending any thought that threatens to excite or to pain. Hence, I suppose, comes our slight contempt for men of action – men, we assume, who don't think. Still, there's no harm in putting a full stop to one's disagreeable thoughts by looking at a mark on the wall.
> Indeed, now that I have fixed my eyes upon it, I feel that I have grasped a plank in the sea; I feel a satisfying sense of reality [...] Here is something definite, something real. Thus, waking from a midnight dream [...],

[37] Indeed, in her discussions on how literature *should* evolve for the 20th century, Woolf almost always associates unsuccessful past modes with the particle-worldview, and what she believes is required is an engagement with the wave-worldview, which literary writers do not tend to do. This was already discussed with "Modern Fiction" and "The New Biography" essays, but another example would be "The Anatomy of Fiction", a 1919 review of C.M. Hamilton's *Materials and Reviews of Fiction*, published the same year: 'According to him every work of art can be taken to pieces, and those pieces can be named and numbered, divided and subdivided [...]; logical sequence and chronological succession – all parts of the frog and all capable of further dissection. [...] Still, [...] you may dissect your frog, but you cannot make it hop; there is unfortunately, such a thing as life'. Virginia Woolf, "The Anatomy of Fiction", in *Athenaeum*, no. 16 May, 1919. 331. This is another reason why so many critics believe Woolf is resolutely anti-particle and pro-wave: this is the case in her prescriptive essays on literature, which then justifies considering her entire thought and art from that perspective, even though outside of such discussions she displays overwhelmingly more hesitation than certainty.

[38] Woolf, "The Mark on the Wall". 81.

> worshipping solidity, worshipping reality, worshipping the impersonal world which is a proof of some existence other than ours[39]

Remaining in the depths in this case is linked with 'thought', but also with a certain withdrawal from the shared material world, a lack of action, and a 'waste of energy'. This was also visible in Mrs. Ramsay's secretive silence, or Cobden-Sanderson's alienation: their version of knowledge does not contribute anything productive for the rest of humanity or the common good. Additionally, it is necessarily tied to their own personal interiority, which suggests that if one desires "impersonal" knowledge, one must leave thought, face reality empirically, and be active, as the 'professors or specialists' do – that is, the 'men of action [...] who don't think' – such as Mr. Ramsay or her father. While this leads to a resignation from interiority ('ending any thought that threatens to excite or to pain'), there is nevertheless clear value, as it leads to universally-applicable knowledge of the non-human world, shared by all. This knowledge is like a 'plank in the sea'; something solid that can be grasped in order to escape the engulfment of the depths, the inward turn towards self-satisfied navel-gazing (where one's navel is supposedly also the universe's). This is reminiscent of Woolf's "Phases of Fiction" essay, when she describes the transition from 'The Psychologists' (wave-worldview writers) to 'The Satirists' (particle-worldview writers):

> The confused feelings which the psychologists have roused in us, the extraordinary intricacy which they have revealed to us [...] set up a craving for relief [...] The mind feels like a sponge saturated full with sympathy and understanding; it needs to dry itself, *to contract upon something hard*[40]

And, of course, satirists provide relief and hardness because their characters have 'all the sharpness of a caricature': they represent something universal, and hence only display impersonal personality traits.

Therefore, even in literary and psychological considerations, Woolf is still seen hesitating between the one and the other worldview, as each possesses limitations and uncertainties that can only be fulfilled by reaching towards the other side.[41] As such, instead of

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[39] Ibid. 82.

[40] Woolf, "Phases of Fiction". 130. Emphasis added.

[41] Take for instance "Street Haunting", already discussed because of its dual states of experience. Whenever the narrative transitions from discussing one state to the other, there is often a mention of the previous state's weakness, requiring the transition: 'we sport with the moment and preen our feathers in it lightly, as we stand on the balcony [...] But what could be more absurd? [...]; we are walking to the Strand to buy a pencil. How, then, are we also on a balcony, wearing pearls in June? What could be more absurd?'. Woolf, "Street Haunting: A London Adventure". 182.

considering Woolf with a Cartesian lens – studying which version of reality is foundational – as the quantum readings of *To the Lighthouse* tend to do, it is more meaningful to study her from a Kantian perspective: exploring how the two worldviews are related, and their dual necessity in discussions of knowledge, art, or life.

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C/ *Intellectual Context*: From Kant's Philosophy to Lodge's Theology

As Collins affirmed in this chapter's introduction, Kant's 1781 *Critique of Pure Reason* marked a genuinely critical moment in the history of philosophy, which affected most, if not all, thinkers that followed, and is therefore a key work in understanding Woolf's philosophical environment. But, additionally, according to Dunham, *et al*:

> For Kant we must distinguish between two objects, and two realities, with the utmost clarity. These are the domains of the empirical and the transcendental. The former we can know with absolute certainty; the latter we never can, although we can evidently contemplate its possible existence.
> We can know empirical reality with certainty because it is the realm of our existence[42]

Hence, it might be argued that Kant, like Woolf, adopted dual conceptions of reality and knowledge – one side ordinary and the other extraordinary.

While this is an over-simplification of the philosopher's thinking, it is nevertheless a valid entry point into the *Critique*, employed for instance by James O'Shea in his introduction to the opus:

> The rough idea behind two-aspect readings is as follows.
> [...] the *human standpoint*, as it has been called, following Kant [...] gives us genuine cognition of the objects as experienceable phenomena in objective empirical reality in space and time. The other standpoint, however, is the idealizing standpoint of pure theoretical reason, or, [...] the "God's-eye point of view"[43]

[42] Dunham, Grant, and Watson, *Idealism*. 92.

[43] James O' Shea, (2012), *Kant's Critique of Pure Reason: An Introduction and Interpretation*, London, Routledge, 2014. 36-7.

This view of possible human knowledge as divided into two realms, empirical realism and rational idealism, leads to one of the main legacies of Kant's philosophy: knowledge of the ideal object, as it truly exists in pure reason, independently of any human point of view, is, and always will be, *impossible*. This is the unknowable realm of transcendental and un-experienceable things-in-themselves. It cannot be accessed because, Kant demonstrates, understanding *requires* empirical experience. This negative conceptual consequence is strongly emphasised by Roger Scruton in the conclusion of his overview of the *Critiques*:

> There is no description of the world that can free itself from the reference to experience. Although the world that we know is not our creation, nor merely a synopsis of our perspective, it cannot be known except from the point of view that is ours. All attempts to break through the limits imposed by experience end in self-contradiction, and, although we may have intimations of a "transcendental" knowledge, that knowledge can never be ours[44]

Hence, the second realm, empirical reality. This is the world of appearances, limited by the categories of understanding contained within point of view-bound interiorities. These categories (space, time, causality...) apply to all objects experienceable by human processes of perception and thought. Kant dealt with his empirical limitation by proving that there is harmony between the categories of understanding that a subject employs to order their perception of the world, and the *a priori* nature of the world – what reality *must* be like in order to be experienced.[45] This conceptual harmony between the subject's interiority and the *a priori* appearances of transcendental objects can be employed to construct objective, though still empirically restricted, knowledge. This is Kant's transcendental idealism: objects *exist* independently of experience, but they cannot be *known* independently of experience; however, the innate concepts employed by the subject to organise their experience *are* objective, and can hence be used as reference to transcend subjective points of view. There is therefore also a positive conceptual consequence to be taken from Kant's idealism, alongside his negation that knowledge of the thing-in-itself is possible. This dual and opposed set of conceptual consequences in Kant will become evident in the following examination of the historical trajectory of the philosopher's 19th century reception, from Germany to Britain. From this

[44] Roger Scruton *et al.*, *German Philosophers: Kant, Hegel, Schopenhauer, Nietzsche*, New York, Oxford University Press, 1997. 102.

[45] Though this should not be confused with the thing-in-itself. To employ Terry Pinkard's explanation as to why: '[*To Kant*] it was simply a false inference to conclude from "we must experience independent substances as causally related" to "things in themselves, apart from our experience of them, must be substances that are necessarily causally related"'. Terry Pinkard, "Idealism", in *The Oxford Handbook of German Philosophy in the Nineteenth Century*, ed. Michael N. Forster and Kristin Gjesdal, Oxford, Oxford University Press, 2015. 232.

history will clearly emerge the oppositional nature of ideal versus real discussions, allowing the historical gap to be bridged between Kant and Woolf's intellectual contexts. Following this historical sketch, another bridge will be constructed towards science, with an examination of the interwar ether of space's formulations.

There is a sense, shared by neo-Kantians of the later-19th century, that Kant resolves the tension between real and ideal views of reality.[46] The philosopher cannot therefore be straightforwardly associated with an idealist position:

> "Idealism" in Kantian terms did not amount to the older thesis that only the ideal [...] was real, nor did it hold that the world was a simple construct out of [...] a conscious subject. "Transcendental idealism" did insist that the world that science described was indeed the world described under the only conditions under which we could experience it and that the world science explained was in that qualified way mind-dependent and thus "ideal." *However, "transcendental idealism" was, as Kant insisted, also an empirical realism*. The experienced world was not an illusion, hiding the real world behind itself. The experienced world was the real world, the world of things in themselves but only as they were experienced[47]

Terry Pinkard's analysis here suggests why Kant was viewed as a resolving thinker in Germany at the turn of the century. Indeed, Pinkard's article also aims to clarify the cultural context and impact of the *Critiques*: 'great tensions of life in that period – the cult of "the heart" versus the cold machine state, the growing tension between science and religion, [...] – all seemed to find a possible resolution in the Kantian philosophy', which will become relevant soon.[48] But what is particularly interesting here is that the three main philosophers of the early-19th century who elaborated on Kant's project also rejected his resolving aspect: 'both Schelling and Hegel, following Fichte's lead, rejected the hard and fast Kantian dualism of concepts and intuitions, [...] Both of them rejected the Kantian doctrine of things in themselves for many of the same reasons that Fichte did'.[49] J.G. Fichte, F.W.J. Schelling, and G.W.F. Hegel, here mentioned, were, of course, the three figureheads of German idealism, the movement that dominated the intellectual landscape of Germany until the 1840s, in large part because of contemporaneous academic reforms: 'Idealism was the ideology of the university revolution [...] the major

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[46] Frederick C. Beiser, *After Hegel: German Philosophy, 1840-1900*, Princeton, Princeton University Press, 2014. 'critical of Kant, Lange still held that his philosophy provides the right general strategy [...] because of its distinction between the phenomenal realm of science and the noumenal realm of value, [*which*] offers a middle path between a soulless materialism and an irrational leap of faith'. 90.

[47] Pinkard, "Idealism". 234. Emphasis added.

[48] Ibid.

[49] Ibid. 247.

German Idealists were among the prime movers of university reform'.[50] The reason why this movement is fully idealistic is precisely because of its denial of Kant's negative conceptual consequence, for instance, in Hegel: 'there is nothing in principle in the world that cannot show up for conceptual thought. Even things that cannot be directly experienced'.[51] This rejection allowed German idealism to construct supposedly complete and objective systems of metaphysical knowledge, based within the subject's logical construction of the world.

However, Frederick Beiser's monograph on post-Hegelian German philosophy affirms that: 'By the 1840s, [...], this conception of philosophy had become completely discredited [...] all knowledge of existence, has to derive from experience alone'.[52] This is relevant, as the empirical assault on idealism paved the way for a resurgence of realism:

> The common opinion about German philosophy in the second half of the nineteenth century, even among German contemporaries, was that it was a period of decline and stagnation. The great creative "age of idealism" had passed away with Hegel's death, it seemed, only to be succeeded by "an age of realism,"[53]

Beiser does much to counteract this 'common opinion' by demonstrating that after 1840 there was still productive and influential philosophising in the country. However, it is clear in his book – particularly the second chapter on 'The Materialism Controversy'[54] – that science-based realism was nevertheless a constant factor in post-Hegelian philosophy, even if it was merely to position oneself in opposition to it: 'The identity crisis of philosophy arose not only from the collapse of the foundationalist program but also from another source: the dramatic rise of the empirical sciences'.[55] While there were attempts at constructing idealism-based sciences,[56] the advances of physics and biology throughout the century were viewed as successes for an empirically realist worldview, and hence too for materialistic philosophy. This therefore implies a rejection of Kant's positive conceptual consequence, as nowhere in empirical science does the subject's rational construction of the world structurally come into play. The thinkers

[50] Collins, *Sociology of Philosophies*. 646.

[51] Pinkard, "Idealism". 237.

[52] Beiser, *After Hegel*. 16.

[53] Ibid. 2.

[54] Ibid. 53-96.

[55] Ibid. 16.

[56] Collins, *Sociology of Philosophies*. 'The universe is a world Soul, a unity of mutually conflicting forces. In astronomy the cosmos was theorized as the periodic expansion and contraction of the *Urmaterie*, primary matter. Schelling's *Naturphilosophie* attracted many followers among German scientists from the early 1800s through the 1820s, affecting biological studies even among scientists who later returned to the materialist fold'. 633.

who adopted this perspective in Germany were not as organised or historically influential as the idealists, but Beiser aims to recognise their forgotten importance, for example:

> Lange's *Geschichte des Materialismus*, one of the most important and influential works in German philosophy in the nineteenth century. Lange's work was not simply a history of materialism, as its title suggests, but a reckoning with materialism and the statement of an entire worldview. In its historical and philosophical importance Lange's *Geschichte* was the peer of Lotze's *Mikrokosmus* [...]. The book appeared to great critical acclaim, and among its admirers were Hans Vaihinger, Hermann Cohen, Paul Natorp, and Friedrich Nietzsche[57]

Hemann Lotze's *Mikrokosmus*, 'was the chief statement of idealism during the materialism controversy',[58] and its position alongside F.A. Lange's *Geschichte* as one of the century's most successful philosophical publications displays how far removed from Kant's resolution German philosophy now found itself. Indeed, 'there were two phases to the materialism controversy. The first or classical phase, from 1854 to 1863, was mainly philosophical, characterised by the battle between idealists and materialists'.[59] Beyond that specific debate, Kurt Bayertz's article on 19th century German materialism presents the various stands of realism that existed throughout the period, and renders two facts obvious regarding them all: they were always opposed to idealism,[60] and they were always allied with the sciences.[61] What is relevant to the present argument is that the oppositional relationship between metaphysical idealism and scientific materialism informed the philosophising of the whole century, with each side exchanging moments of prominence. For instance, following Lange's neo-Kantian materialism:

> This friendly but critical approach was superseded by the strict rejection of materialism by other neo-Kantians in the 1870s. Together with empiricism, positivism, and naturalism, materialism was now seen as the main adversary, against which Kantian transcendental idealism had to take a stand. In the 1880s then, an "idealist turn" took place[62]

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[57] Beiser, *After Hegel*. 89.

[58] Ibid. 70.

[59] Ibid. 55. The second phase concerned Darwin and biology, and hence is not relevant here, other than to point out that even in historical discussions regarding biology, there was also a controversial opposition between organic vitalism and atomistic materialism, which was philosophically aligned with the other binaries treated in this thesis.

[60] Bayertz, "Materialism". '[*idealist*] Philosophy was not only charged with being an obsolete form of thought, but also with having become detached from the true spiritual needs of the people and, as such, no longer being able to offer guidance in a modern world'. 613.

[61] Ibid. 'While traditional idealist philosophy had allied itself with theology, the "philosophy of the future" was to lean on science. For Feuerbach the sciences were the paradigm of the materialist, empiricist, or realist way of thinking, which should also gain ground in philosophy. A group of scientifically trained authors sought to spell out what had only been generally postulated in Feuerbach'. 610.

[62] Ibid. 618.

This exchange of power between post-Kantian idealism and realism was not limited to Germany however, for it is also a feature in the history of British philosophy. However, it occurred later, because 'England's academic revolution did not occur until 1860-1870. Before that time, philosophy remained within the mold of the Enlightenment lay intellectual'.[63] The influence of the Enlightenment here mentioned meant that British philosophy was generally realist and empirical in nature throughout most of the 19th century. However, by the 1880s, idealists had once more supplanted the empiricists: 'whenever the German university reform was adopted elsewhere, a generation of Idealist philosophers appeared'[64] – as was the case following the de-clericalisation of Oxford and Cambridge that ended in 1872. Because of the timeframe, British idealism was strongly Hegelian, and focused specifically on one of Hegel's most important contributions to the tradition: the notion that 'the true is the whole'.[65] Hegel's conception of holism, and how it relates to his other notions such as the all-important Absolute, is too complex to be done justice to here, though these partial definitions from *The Cambridge Dictionary of Philosophy* can help provide an impression of his relevance: 'Hegel, [...] defined the Absolute as spirit: the logical necessity that embodies itself in the world in order to achieve self-knowledge and freedom during the course of history',[66] and:

> while Hegel still frequently argued that the subject matter of philosophy was "reason," or "the Absolute," the unconditioned presupposition of all human account-giving and evaluation, and thereby an understanding of the "whole" within which the natural world and human deeds were "parts," he also always construed this claim to mean that the subject matter of philosophy was the history of human experience itself. [...] This *identity theory* or *Absolute Knowledge* means that we will then be able to be "at home" in the world and so will have understood what philosophers have always tried to understand, "how things in the broadest possible sense of the term hang together in the broadest possible sense of the term." The way it all hangs together is, finally, "due to us," in some collective and historical and "logical" sense[67]

In Hegel then (following Schelling's own vision of the Absolute), idealism came to conceive of the world as an interconnected logical whole which contains, and is determined by, the community of human subjects. Furthermore, the realisation of one's belonging to the whole is a liberating act, which gives meaning to human struggles within the enormity of history, and

[63] Collins, *Sociology of Philosophies*. 693.

[64] *Ibid*. 646.

[65] Georg Wilhelm Friedrich Hegel, (1807), *Phenomenology of Spirit*, Oxford, Oxford University Press, 1977. 11.

[66] *The Cambridge Dictionary of Philosophy*. *The Cambridge Dictionary of Philosophy*. 3.

[67] Ibid. 367.

ties individuals into a united communion of "Absolute Spirit". Finally, due to Hegel's focus on large-scale historical development, the whole is also dynamic, in a constant dialectic process:

> the "*telos*" Beiser identifies entails movement, becoming or transition. That the Concept has "moments" in the order of its explication is one of Hegel's important philosophical innovations [...] Hegel calls the Idea "a process", emphasizing the "there and back" movement or "immanent dialectic"[68]

Due to these factors, British idealism was specifically an "absolute idealism", whose main concern was the 'problem about the relations of wholes to their parts'.[69] The introduction to W. J. Mander's *British Idealism: A History* conveniently synthetises the main themes of the tradition, and displays the central importance of holism within it:

> They insisted on its essential underlying *unity*, arguing that all ideas were systematically linked together into one whole with no fundamental divisions between the different departments of learning [...]
> Its area of interest was simply reality; but reality considered *as a whole* – "the connected vision of the totality of things." [...]
> Putting together these two points about the subject-matter of philosophy and the unity of knowledge, we are led to a conception of philosophy itself as a unified whole. [...] To the Idealists, philosophical questions, from religion to logic to ethics, are first and foremost metaphysical questions[70]

Chapters 4 and 10 of Mander's history provide an account of the various metaphysical positions of the main British idealists (T.H. Green; F.H. Bradley; and Edward Caird; then, A.S. Pringle-Pattison; J.M.E. McTaggart; and Bernard Bosanquet). Each chapter focusses on one of the two notable moments of the tradition: 'Idealism was creative in Britain for two generations: the first generation of reform into the research university, and the next generation, when Idealism was challenged by anti-Idealist philosophies'.[71]

Indeed, in Britain too, the supremacy of idealist philosophies ultimately gave way to realism. This is especially relevant here, as this intellectual transition occurred within Woolf's near-immediate environment, and was directly due to her acquaintance, Bertrand Russell. Indeed, as Nicholas Griffin relates in his article "Russell and Moore's Revolt Against British

[68] Dunham, Grant, and Watson, *Idealism*. 145.

[69] Dunham. *Idealism*. 159. Though it did transition into a personal idealism in its second generation, but while retaining many absolute notions.

[70] W. J. Mander, *British Idealism: A History*, Oxford, Oxford University Press, 2011. 3-5.

[71] Collins, *Sociology of Philosophies*. 671.

Idealism", it is precisely Russell's 1898 attempt to overcome the mathematical contradictions of neo-Hegelianism that eventually transformed the landscape of British philosophy:

> In what amounts to a Gestalt shift, Russell saw that his previous problems depended upon his neo-Hegelian theory of internal relations, rejected this theory, and thereby ceased to be a neo-Hegelian.
> Michael Dummett (1993) notoriously proposed that analytic philosophy began with Frege's writing [...] I find it hard to take seriously the claim that something like analytic philosophy had a precise moment of conception, but if one had to propose such an event I think Russell's *volte-face* on internal relations late in 1898 has a much better claim[72]

Russell's rejection of internal relations, which are essential to the parts-whole philosophising of absolute idealism, led him to put external relations at the forefront of his thinking. This notion, when allied with G.E. Moore's affirmation in 1899 that the concepts contained within human judgements are not generated by the mind but exist outside of it, led to the formulation of 'a drastic form of direct realism', though, in this case, not material in nature.[73] The result was a formal philosophical system for determining the truth-value of complex propositions concerning reality, by logically analysing their atomised parts and relations:

> "A thing becomes intelligible first when it is analysed into its constituent concepts". This is the only hint Moore gives of a new philosophical method, but it is the method to which the new philosophy – analytic philosophy – owes its name. As practised at this time by Moore and Russell, philosophical analysis is to be understood as analogous to chemical analysis, in which complex substances are broken down into their elementary constituents, though philosophical analysis is, of course, intellectual rather than physical. [...] Since complex concepts are propositions, analysis is the analysis of propositions[74]

Russell went on to evolve and transform his methods (for instance, *direct* realism is abandoned in 1905), but always with the goal of grounding knowledge of the external world in a realist and objective epistemology comparable to that of empirical science, and hence based on direct experience.

As Russell's thought will be discussed in the following chapter, the sketch of Kant's reception from Germany to Britain throughout the 19th century can be ended here,[75] with the

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[72] Nicholas Griffin, "Russell and Moore's Revolt Against British Idealism", in *The Oxford Handbook of the History of Analytic Philosophy*, ed. Michael Beany, Oxford, Oxford University Press, 2016. 391-2.

[73] Ibid. 396.

[74] Ibid. 398. Citation is from: G.E. Moore, (1899), "The Nature of Judgement", in *The Early Essays*, ed. Tom Regan, Philadelphia, Temple University Press, 1986. 67.

[75] Though, one additional factor should be mentioned: another method employed to undermine materialistic scientific inquiry in the decades surrounding the turn of the century was the general movement discussed with

following main conclusion: the quantum-concepts of *observer-dependence* or *dynamic holism*, which are employed by scholars as evidence of Mrs. Ramsay's attachment to the new physics, are *much* more historically consistent with the legacy of absolute idealism. In effect, all the following excerpts from quantum analyses of *To the Lighthouse* display this issue:[76]

> In *To the Lighthouse*, the flux [...] suggests also one way of understanding matter, a way which is set against the very different model of particularity or atomization. In other words, embedded in the novel, with its fluid notions of time and truth, is something like a wave-particle duality. [...] it forces an awareness of the subjectivity of the observer
>
> the thinking of both Woolf and Bohm also connects with a mystical tradition [...] that has often been identified in Western patriarchal discourse with the feminine. [...] the historic association of silence, and of flux and flow, with the feminine has been commented on, often ironically, by the theoretical writings of feminist thinkers
>
> As Herbert explains, "Bell's theorem shows that the holistic grammar of the quantum formalism reflects the inseparable nature of reality itself. Beneath phenomena, the world is a seamless whole". Virginia Woolf suggests [...] that such a wholeness exists, and it is the same kind of Being to which Merleau Ponty refers
>
> For Woolf, a unifying pattern exists behind the arbitrary divisions associated with subjects and objects, which suggests some form of unification in the whole [...]. *To the Lighthouse* presents a complex world defined in part by the principles of relativity and in part by the discoveries of quantum physicists

Miriam Marty Clark, Hussey, Westling, and Paul Tolliver Brown are all respectively introducing the notions of dynamism, anti-particularity, subject-object breakdown, mysticism, holism, Being; and/or unity to the new paradigm of quantum theory, which therefore implies that Mrs. Ramsay's character – who displays these quantum-concepts – can be interpreted as the reflection of a radical new philosophical position, which is opposed to the tradition of

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Sandford Schwartz, Michael Whitworth and Judith Ryan in Chapter 4. To quote *The Matrix of Modernism*: 'Poincare's "conventionalism" was no isolated phenomenon at the turn of the century. Many philosophers and scientists were arguing that rational constructs like Euclidean geometry were neither representations of external reality nor forms through which the mind necessarily organizes experience. Instead, they maintained that intellectual formulations are simply practical instruments for arranging the sensory flux in a convenient manner', and; 'All of them acknowledge the instrumental efficacy of scientific constructs while denying that any one of them represents the essential order of external reality'. Schwartz, *Matrix of Modernism*. 17 & 18. However, the ambiguous nature of their scientific opposition; their ties to developments in psychology; the international distribution of the thinkers; and their ambiguous ties to realism-idealism discussions, renders these philosophers overly-difficult to include in the narrative presented above, though they are all tied to it. For a discussion of some of the interactions between idealism and this tradition, see the 'Experimental Psychology and the Pragmatist Movement' section in: Collins, *Sociology of Philosophies*. 680-3.

[76] In order: Clark, "Consciousness, Stream and Quanta". 415; Hussey, "To the Lighthouse and Physics". 82; Westling, "Woolf and the Flesh of the World". 869; Brown, "Relativity, Quantum Physics, and Consciousness". 55.

patriarchal philosophy that is allied with Newtonianism – as represented by Mr. Ramsay. However, every one of these qualities was already present in British absolute idealism, which was itself a continuation of the largest philosophical movement in Germany of the 19th century – a movement that was as traditional and patriarchal as any version of realism.[77] Furthermore, "The Cosmos" makes clear that Woolf was aware that such a worldview was idealistic in nature. Finally, the non-material and atomised logical analysis of Russell's new realism helps make sense of Mr. Ramsay's apparent platonic transcendentalism, which was read by Sim as voluntarily incompatible with his supposedly-positivistic empiricism. Indeed, when one realises that Russell was amongst the closest and most important empirical-realist thinkers discussed in Woolf's direct environment, then the patriarch's philosophy fully makes sense: what he is elevating into his dispassionate mind is not a metaphysical platonic object, but the immaterial logical analysis of an object's atomised constituent qualities. These facts, when taken in addition with Woolf's historic position within the social circle responsible for the evolution of British idealism, as well as her father's writings and library books on the disputes between materialists and idealists, make it much more likely that the dynamic holism generating a subject-object breakdown in *To the Lighthouse* is influenced by pre-existing philosophy.

The above narrative may give the impression of a logical evolution of the history of philosophy, based on well-reasoned intellectual exchanges amongst research universities. However, studying the motivations that prompted the participation of several thinkers to these discussions displays that the real-ideal dispute was not purely conceptual; it also involved existential, religious, and ideological factors, which guided the exchanges more than the formal structure of the debates. Indeed, at its heart, the idealism versus realism debate was a faith versus reason debate:

> Materialism was generally understood to be the doctrine that only matter exists and that everything in nature obeys only mechanical laws. If such a doctrine were true, it seemed there could be no God, no free will, no soul, and hence no immortality. These beliefs, however, seemed vital to morality and religion. So the controversy posed a drastic dilemma: either a scientific materialism or a moral and religious "leap of faith." It was the latest version

[77] If anything, idealism was more often the worldview of conservatism, while realism was adopted by progressives. Bayertz, "Materialism". 'in its specific shape and effect, scientific materialism was a product of the historical situation in Germany after the failed revolution of 1848: a situation in which parts of the bourgeoisie sought an invincible ally in fighting for the modernization and democratization of Germany. They believed that they had found it in science'. 614.

> of the old conflict between reason and faith, where now the role of reason was played by natural science[78]

This is consistent with Collins's notion of 'intellectual ritual chains'; discussions which tend to reoccur throughout history, depending on the cultural capital and emotional energy of any given generation or individual: 'The entire macro-social structure, of non-intellectuals as well, is anchored on ritual interactions. What we call structure is a shorthand way of describing repetitive patterns, encounters that people keep coming back to, a recycling of rituals'.[79] Indeed, as Pinkard affirmed above, Kant was received enthusiastically in Germany partially because he seemed to resolve 'the growing tension between science and religion' of the period, hence: 'Post-Kantian "idealism" was kept alive in part by the widespread belief that something *crucial for life at large* was at stake'.[80] Therefore, the philosophical dispute summarised above was not purely intellectual, it also involved profound existential angsts regarding humanity's possible relationships to reality and immaterial realms, which resulted directly from the worldviews implied by either side of the real-ideal binary. Beiser's chapter on the materialism controversy consistently analyses this fact, which can be illustrated at an individual level with William James's or Joseph Conrad's notorious expressions of despair regarding strictly materialistic views of the universe, respectively: 'I'm swamped in an empirical philosophy, I feel that we are nature through and through, and that we are *wholly* conditioned, and that not a wiggle of our will happens save as the result of physical laws', and; 'the most withering thought is that the infamous thing has made itself; made itself without thought, without conscience, without foresight, without eyes, without heart [...] you can't even interfere with it'.[81] In this section, though, the existential nature of the opposition will be illustrated with the case of the scientific ether of space, as it was closer to Woolf's immediate environment, and involves the new physics.

Schelling's own version of the Absolute was in part based on a scientific observation:

> it seemed that there were great leaps between various domains. From the model of billiard balls colliding in mechanics, there did not seem to be any way to get to magnetism and electricity [...] That suggested that there might

[78] Beiser, *After Hegel*. 53.

[79] Collins, *Sociology of Philosophies*. 28-9.

[80] Pinkard, "Idealism". 236. Emphasis added.

[81] William James, (1869), *The Thought and Character of William James: As Revealed in Unpublished Correspondence and Notes, Together with his Published Writings*, Boston, Little Brown & Company, 1935. 472; Joseph Conrad, (1897), *Joseph Conrad's Letters To R. B. Cunninghame-Graham*, Cambridge, Cambridge University Press, 1969. 56.

> be something like deeper metaphysical forces binding the different regions together that were not susceptible to empirical investigation[82]

Indeed, in physics, material vibrations require a physical medium through which they can be vehiculated, such as waves requiring water, or sound waves requiring an atmosphere. But with the 19th century's reformulation of the wave theory of light, allied with James Clerk Maxwell's treatment of electromagnetism as a field of energy, a non-physical medium had to be formulated to account for the movement of non-material vibrations. This leap from materialism to immaterialism is what inspired Schelling, as well as many other anti-materialistic thinkers and scientists, for example:

> Ostwald explicitly emphasizes that the key concept of "energy" is to be understood in its "physical sense", his formula was indeed physicalistic, but he did not want it to be understood as materialistic, because for him "energy" was a concept defined in opposition to "matter", so that materialism was to be replaced by "energism"[83]

The ether of space became the scientific formulation of this hypothetical incorporeal medium.[84] Helge Kragh's *Quantum Generations* discusses the concept at length, including the various forms it took from the late-1860s to the early-1910s,[85] as it highlights the historian's thesis that the ideals of European physics were not particularly Newtonian when the new physics arrived: 'The new science of energetics was, in many ways, contrary to the mechanical world picture and was thought of as a revolt against what was called "scientific materialism". [...] Another aspect of energetics was its denial of atomism as other than a useful mental representation'.[86] It is therefore clear why the ether was an attractive concept for idealism-inclined thinkers: it was anti-material; dynamic; all-pervading; unifying;[87] anti-atomistic; and beyond empiricism. Due to this last factor, idealist methodologies were employed to study the concept,[88] or, in some cases, the ether itself was conceived as a straightforwardly idealistic notion, whose existence is mind-dependent:

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[82] Pinkard, "Idealism". 242-3.

[83] Bayertz, "Materialism". 617.

[84] It should be noted that the notion of an ether already existed in Antiquity, and it was also influentially employed by Descartes in the 17th century. Here the discussion only concerns the revival of the concept in the 19th and 20th centuries.

[85] Kragh, *Quantum Generations*. 3-8 & 105-19.

[86] Ibid. 7.

[87] Maxwell's theory of radiation unified into one phenomenon the disparate domains of light, electricity, and magnetism.

[88] As exemplified by Schelling's *Naturphilosophie*.

> materialism was discarded and matter declared an epiphenomenon. Joseph Larmor, the eminent British theorist, had no difficulty imagining a world based on a non-material, transcendent ether. He admitted, as he wrote in 1900, that this might seem "as leaving reality behind us," but defended his ether worldview by arguing that it described *an inner reality not directly accessible to the senses*[89]

While the ether is for the most part forgotten in the 21st century due to its lack of success when faced with relativity, its widespread importance at the end of the long 19th century should not be underestimated.[90]

As a matter of fact, the particular period of relevance here is the period when the ether exploded in popularity within British culture in between the two world wars. This occurred for two reasons. The first was the growing desire for, and accessibility to, scientific popularisations, which caused the boom of publications extensively related in Peter J. Bowler's *Science for All*, as exemplified by the following 1927 quote from *Nature*:

> With the spread of popular education and the use of applied science there has come into existence not only a large body of the general public which desires further knowledge, but also, in the shape of cheap printing, broad-casting, instructional films, and the systematisation of popular lectures, the means for gratifying this desire[91]

The second reason was the widespread attention to alternative modes of spirituality, following the decline of church attendance after the first world war, as related again by Bowler, this time in *Reconciling Science and Religion: The Debate in Early Twentieth-Century Britain*:

> [*there was*] evidence of a continuing demand for some kind of spiritual engagement, which manifested itself in various ways within the popular culture. [...] people turned to spiritualism, especially in the traumatic years of the Great War and after, while astrology, Theosophy, and various other nonmaterialistic ways of thought flourished[92]

These factors, when taken together with the monumental cultural moment that was the public confirmation of general relativity by Arthur Eddington in 1919, which was widely reported as

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[89] Kragh, *Quantum Generations*. 10. Emphasis added.

[90] The Michelson-Moreley experiment on ether-winds of 1887 is often credited with disproving the existence of the ether in popularisations. This is incorrect, as the concept was still being investigated and defended in the 20th century, including by Albert Michelson himself: 'the grandest generalizations of modern science [...] that all the phenomena of the physical universe are only different manifestations of the various modes of one all-pervading substance'. Albert A. Michelson, *Light Waves and their Uses*, Chicago, The University of Chicago Press, 1903. 162.

[91] "New and Views", *Nature*, 1927. 722. Cited in: Bowler, *Science for All*. 80.

[92] Peter J. Bowler, *Reconciling Science and Religion: The Debate in Early Twentieth-Century Britain*, Chicago, University of Chicago Press, 2001. 22.

an idealistic-sounding turn in humanity's relationship with the universe,[93] meant that Woolf was writing *To the Lighthouse* in a period when the metaphysical ether; idealism; religion and spirituality; energy physics; pre-complementarity new physics; philosophical anti-materialism; communal existential trauma; broadcast technology; and popular culture were all mutating, overlapping, and intertwined. No other figure from the period embodies the moment better than physicist and writer Oliver Lodge, as he most completely fulfilled the dual desires of popular science and spirituality of the time, and was at the nexus of all the themes listed in the previous sentence. He was one of Britain's best known scientists,[94] as he gave lectures in public and on the radio; appeared on newsreels; wrote several dozen books about science aimed at the general audience; participated in the *Encyclopaedia*; and regularly had his articles published in prominent journals and magazines of the time, including those read by the intelligentsia.[95] Lodge consistently advocated for a renewal of Christian theology based on the spiritual nature of the ether, which: 'with its ability to serve as a unifying principle for the whole universe, is the seat of all activity we call spiritual [...]. Lodge's commitment to the ether was absolute and unchanging'.[96] He even invoked the ether to account for early quantum theory in his 1924 *Atoms and Rays*: 'the apparent discontinuity which the Atomic Theory suggests, the discontinuous nature first of matter and then of electricity, is supplemented or replaced by the absolute continuity of the connecting ether'.[97]

What is most pertinent in the case of Lodge, though, is that his advocacy for the spiritual ether was a direct consequence of his visit to a medium, following the 1915 death of his son in the war, as the concept's holistic all-pervasiveness implies that son and father might be spiritually reunited. The details of this event are related in Lodge's 1916 book, *Raymond: or, Life and Death*, which 'was widely read', and hence 'played a role in the general revival of

[93] Ibid. 'Eddington's writings were widely interpreted as reintroducing a role for mind in our understanding of reality. The new physics showed that the human minds in the form of an observer was necessary to the description of nature'. 103-4. It is worth noting that both Eddington and James Jeans represent the next chapter in this narrative: they are responsible for interpreting quantum physics in a mystical manner to a wide audience, after Lodge's ether had fallen out of fashion. However, these writings, while undeniably relevant to Woolf, are outside of the temporal scope of this thesis.

[94] "Sir Oliver Lodge Renders Science Intelligible", British Movietone Newsreel, England, 1930, Accessible at: http://www.aparchive.com/metadata/youtube/8d64ee77b11f4dc49927fb2d57ff3779 As of: 27/02/22. 'Sir Oliver Lodge needs no introduction to British audiences as one of the greatest scientists of modern times'. 00:30.

[95] A fuller presentation of Lodge can be found at: Bowler, *Reconciling Science and Religion*. 95-101.

[96] Ibid. 97.

[97] Oliver Lodge, *Atoms and Rays: An Introduction to Modern Views on Atomic Structure & Radiation*, London, E. Benn Limited, 1924. 14-5.

interest in the paranormal in this time of collective grief'.[98] Lodge is hence representative of a general societal mood with inherent ties to philosophical-scientific discussions, though Alfred North Whitehead could also be employed as an example. Indeed, the chapter on religion in Victor Lowe's *Alfred North Whitehead, Volume II: The Man and His Work, 1910-1947* makes clear why the philosopher transitioned from atheism to faith:

> what if the religious vision is a persistent illusion? Whitehead gave his answer at once. Apart from this religious vision, he said,
> "human life is a flash of occasional enjoyments lighting up a mass of pain and misery, a bagatelle of transient experience."
> That is how human life looked to him during and after World War I. He could not have said this before that war decisively ended an age of secular progress and hope. Whether his harsh summary of human life is true or false, it appeared true to most of the people in the nations at war.
> When I asked Bertrand Russell about his view of Whitehead's turn to religion, he gave it flatly and crudely: "Eric's death made him want to believe in immortality." It would perhaps be more accurate, because less explicit, to say what Jessie immediately said when I brought up this subject: "Eric's death is behind it." North expressed a similar view[99]

Eric was Whitehead's son, also killed in the war (while Jessie was his daughter). Similarly to Lodge, this event led to a profound philosophical reconsideration, with the aim of solving the existential anxiety and despair felt as a direct result of his trauma. The result was of course his anti-Newtonian process philosophy, already discussed in the previous chapter. These two are therefore cases which, in more ways than one, are representative of the general idealistic turn within the environment that preceded and surrounded the writing of *To the Lighthouse*, wherein conversations regarding scientific innovations, philosophical views of reality, and existential salvation were often one and the same, from research universities to popular radio. Two contemporary observers of the moment provide ample evidence for this conclusion. The first, from an academic perspective, is Antonio Aliotta, as related by Bowler:

> That there was an association between the idealism of the late nineteenth century and the explosion of interest in mysticism was admitted by Antonio Aliotta [...] who wrote perhaps the best survey of the period, translated as *The Idealistic Reaction against Science* in 1914. Aliotta's purpose was to survey the rise of an idealistic reaction not so much against science itself as against the materialist philosophy so often associated with it[100]

[98] Bowler, *Reconciling Science and Religion*. 96 & 44.

[99] Victor Lowe, *Alfred North Whitehead*, Baltimore, Johns Hopkins University Press, 1990. 188.

[100] Bowler, *Reconciling Science and Religion*. 366.

The second, from a cultural perspective, is J.W.N. Sullivan, whose collection of essays, *Aspects of Science*, first published in 1923, provides many different examples of the idealistic excitement that accompanied the new physics' apparent refutation of the Newtonian worldview. "The Interest of Science" presents science as now coherent with irrationality or metaphysics; "James Clerk Maxwell" makes the case that radioactivity theory was created due to Maxwell's mysticism; "The Entente Cordiale" advocates for a new kind of knowledge that unifies the new physics, metaphysics, religion and mysticism; "The Sceptic and the Spirits" displays how a scientifically-minded person can still be open towards spirituality; "The Hope of Science" predicts that new science will lead to a new age of humankind; "The Return of Mystery" discusses (while citing James) how causality, space and time are mind-based; though, the most revealing essay of the whole collection is possibly "The New Scientific Horizon":

> we are asked to revise our most deep-rooted assumptions – so deep-rooted that we are, for the most part, unconscious of them – our assumptions regarding space and time.
> It is this thorough overhauling of primary assumptions which distinguishes the modern progress in physics from all the progress of the Victorian age. Physics has not merely been extended, it has become a radically new thing, [...] The total effect of the new ideas is to make the universe of physics less objective; to an unsuspected extent this indifferent universe, with its iron laws, is a product of our own minds. To some extent this fact was always recognized, particularly by the Continental physicists, but as a general persuasion it is comparatively recent. We cannot escape the structure of our own minds, it is true, but we do not yet know what that structure is; we do not know what barriers are breakable; we do not know what thoughts are thinkable by man. A universe in whose construction so plastic and mysterious an entity as the mind of man collaborates, may very well hold great surprises[101]

Sullivan is here displaying much of the same enthusiasm towards the new physics as that of literary scholars who employ quantum theory: the innovative developments of the science seem to be excitingly reversing several of the bleaker aspects of the previous paradigm, and may hence recentre the human mind within reality. The writer is particularly relevant here due to his ties to the literary intelligentsia, such as the fact that the majority of the essays in *Aspects of Science* were first published in *The Athenaeum*, amongst other connections noted by Bowler and David Bradshaw.[102] Indeed, in the latter's opinion: 'Sullivan's wider role as an exponent of

[101] J.W.N. Sullivan, (1923), *Aspects of Science*, London, The Traveller's Library, 1927. 167-8. "The Interest of Science", 11-26; "James Clerk Maxwell", 48-57; "The Entente Cordiale", 90-5; "The Sceptic and the Spirits", 124-31; "The Hope of Science", 169-74; "The Return of Mystery", 175-84: "The New Scientific Horizon", 162-8.

[102] Bowler, *Science for All*. 188-90. Bradshaw, "Best of Companions". 188.

the new physics of relativity and quantum theory within both the modernist avant-garde and the more traditional recesses of English literary culture, have remained uninvestigated', though the scholar then goes on to present an exhaustive account of the tumultuous relationship between Aldous Huxley, Sullivan, and his new scientific worldview.[103]

The ether, then, and its many associated cultural discussions linking together the new physics, idealism, and mysticism, illustrates how philosophical content emerging from real-ideal debates was evolved, adapted, and decontextualised within the scientific, intellectual and cultural contexts that surrounded Woolf's own personal hesitations between two very similar worldviews, all with the backdrop of a near-universal existential trauma. Indeed, throughout the many conversations touched upon here, the broad mutually-exclusive binary of worldviews remained. The side that conceptualised reality as a collection of bits of matter obeying forces without any relevance to the mind almost inevitably led to a view of humanity as meaningless within a fixed mechanical universe. The side that conceptualised reality as containing ideal forms which interconnect mind and object into a metaphysical whole almost always led to a view of humanity as dynamically participating in a meaningful and possibly animistic universe. Collins's notion of intellectual ritual chains is therefore an ideal means of accounting for the many conceptual echoes that compel literary critics, as it is additionally fully consistent with a comparative study of pre-existing shared philosophical middle-grounds, advocated for in Chapter 2. Indeed, in this section, it accounted for the emergence and articulation of Mr. and Mrs. Ramsay's worldviews, both in their philosophical and existential forms, and suitably connected them to discussions preceding or occurring in many different cultural levels around the novel's composition, accomplished without any need for a dubious invocation of anachronistic quantum mechanics.

[103] Bradshaw, "Best of Companions". 189.

Chapter 7 - Resolutions

When a thesis and its antithesis appear at once, one often feels a dialectical instinct to overcome their separation, by bringing both poles of the duality together; or by making them simultaneously present; or by balancing them equally; or by compromising; or by finding a third term that reaches beyond the original two; or with a synthesis; or by deconstructing the opposition's foundations; or by any other possible strategy. Nothing profoundly abstract or psychological is meant here, merely that every dual construction necessarily involves a space of intermediation between each pole to be explored, because binaries express a conceptual relationship as much as they do a conceptual contradiction: there can be no mutual exclusion between two elements that are entirely unrelated.

In the case of Niels Bohr's complementarity, the strategy to resolve the binaries of quantum mechanics is to reconceptualise their relationship to the subject who studies them: either pole only meaningfully applies in reality when it is in contact with the subject, therefore the contradiction is resolved, because the presence of one pole necessarily implies that the other cannot meaningfully be said to exist at the time of observation. Additionally, the subject possesses the ability to select which pole to experience at any one given time, so that both sides can be observed in succession, allowing for complete and consistent knowledge. This solves what seems to be the otherwise ontologically unsurmountable mutual exclusion of wave and particle, though at the cost of remaining agnostic regarding the status of the binary when it is unobserved. Does this apply to Virginia Woolf?

This will be explored first by isolating the interconnected resolutions that can be interpretatively found in *To the Lighthouse*, and how they all emerge from the binary logic analysed thus far, as well as from other literary themes such as memory or impersonality. Given that this is a longer, more subtle, and meticulous analysis than the previous more straightforward presentations of binaries found in the novel, it will be divided into thematic subsections. However, another reason for the increased intricacy of the resolutions' analysis will then be illuminated with a reading of Woolf's "A Sketch of the Past" biographical essay: while this will display the extent to which the artistic and philosophical themes encountered by Lily are directly relevant to Woolf's life, it will also cast doubt on the very idea of resolution

and its stability as a procedure. That is, maybe Woolf did not actually know how to resolve her binary system, and *To the Lighthouse* was hence an attempt to explore this issue, without necessarily solving it. In any case, it will finally be shown that none of Woolf's resolutions, successful or otherwise, are relevant to quantum complementarity: no literary critic has successfully applied Bohr's concept onto the novel, whereas Ann Banfield's *Phantom Table* alternatively displays the profound extent to which Bertrand Russell's philosophy can be applied onto Woolf's attempts at synthesis – eliminating any need to invoke quantum mechanics in a study of *To the Lighthouse*.

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A/ *To the Lighthouse*: 'I have had my vision'

Two sequences in *To the Lighthouse* are successful resolutions of the general binary of worldviews: Mrs. Ramsay's dinner, and Lily's picture. The following reading will focus more on Lily and her attempt, as the painter achieves a goal the matriarch never could: rendering her resolution universal and eternal.

The theme of everlasting universality is common to both Mr. and Mrs. Ramsay's philosophies, and is therefore an avenue for resolving their differences. The theme's importance is explicitly recognised by Lily, when she compares herself to the wife:

> Mrs Ramsay making of the moment something permanent (*as in another sphere Lily herself tried to make of the moment something permanent*) – this was of the nature of a revelation. In the midst of chaos there was shape; this eternal passing and flowing [...] was struck into stability [133, emphasis added]

They are both attempting to make something fixed out of the flux; to express the wave-worldview with the particle-worldview – a resolution.[1] As discussed in the previous chapter, when Mrs. Ramsay achieves harmony as a result of her dinner table resolution, expressions of flux drop away in favour of solid eternity, which was interpreted as the realisation of one's meaningful participation in the all-pervading whole: 'something, [...] is immune from change,

[1] In the case of Lily: expressing impressions from her depths with tools from the surface. In the case of Mrs. Ramsay: generating a wave-like harmony amongst particle-like individuals.

and shines out [...] in the face of the flowing, the fleeting, the spectral, like a ruby' [85]. However, one can go further: due to her existential anxieties, Mrs. Ramsay is obsessed with the conundrum of how to make fleeting moments last forever, in order to reach 'some exclamation of triumph over life when things came together in *this peace, this rest, this eternity*' [53, emphasis added]. The unchanging 'ruby' that 'shines out' of such moments is reminiscent of divine goodness' treasures from Part II, when the challenge was to 'compose from their fragments a perfect whole or read in the littered pieces the clear words of truth' [105]. This clarifies the nature of universal eternity being aimed at with resolutions, particularly Lily's: *truth*. Indeed, 'a picture like that, it was true [...] it "remained for ever,"' [147]. Therefore, the artist too engages with the philosophical issues explored thus far in the novel.

1. Lily's Visions. The importance of truth to Lily is clear when she begins to paint: 'Here she was [...], out of gossip, out of living, out of community with people into the presence of this formidable ancient enemy of hers – this other thing, this truth, this reality, which suddenly laid hands on her, emerged stark at the back of appearances' [131]. This reveals that Lily, like the Ramsay couple, possesses the ability to reduce away her experience of everyday life in order to arrive at an extraordinary connection to reality.[2]

The transition to this state is visible whenever Lily is about to paint, as she loses consciousness of herself as a person related to the world and people: she 'subdued the impertinences and irrelevances that plucked her attention and made her remember how she was such and such a person, had such and such relations' [130]; 'she lost consciousness of outer things, and her name and her personality and her appearance' [132]; or 'subduing all her impressions as a woman to something much more general' [46]. The extraordinary realm she perceives in this state too is explicit: reality 'at the back of appearances'; that is, behind ordinary experience. The notion of 'appearances' and the role of the visual arts mean that Lily's extraordinary state is inherently aesthetic: she expresses her realm in painterly visions, which demarcates her from the Ramsays. Indeed, 'she could see it all so clearly, so commandingly, when she looked' [19], for instance, 'looking, straining, till the colour of the wall and the jacmanna beyond burnt into her eyes' [18]. The fact that the *colour* of the wall is burnt in her eyes demonstrates that she is not viewing reality as Mr. Ramsay: secondary qualities are not

[2] Also visible are her own existential anxieties: that the reality she is aiming at is an 'enemy', reminiscent of Mrs. Ramsay and life. There is also an influence of Mr. Ramsay, due to her self-doubts arising from her work: 'she seemed like an unborn soul, a soul reft of body, hesitating on some windy pinnacle and exposed without protection' [131]. This dual-anxiety is resolved by the end of the novel too.

abstracted away.[3] This is clear in Lily's comparison to the other painter, Mr. Paunceforte: 'She would not have considered it honest to tamper with the bright violet and the staring white, since she saw them like that' [19]. Colours are part of the reality she is representing, since 'she saw them like that': they are constitutive of her vision, like facts not to be tampered with, which again demonstrates her art's attachment to truth.

The artist's experience of extraordinary reality can be understood when Bankes questions one of her representations:

> What did she wish to indicate by the triangular purple shape, "just there"? he asked.
> It was Mrs Ramsay reading to James, she said. She knew his objection – that no one could tell it for a human shape. But she had made no attempt at likeness, [....] Mother and child then – objects of universal veneration, and in this case the mother was famous for her beauty – might be reduced, he pondered, to a purple shadow without irreverence [45]

Lily's visions are abstract symbols of eternal universality. Indeed, Lily repeatedly experiences sudden shocks that shift her view of the ordinary ('Mrs Ramsay reading to James') into an extraordinary vision ('Mother and child'), which is experienced as a shape that abstracts the universal from the particular. One example is the table that Lily “sees” within the tree trunk, when her consideration of Mr. Ramsay the individual transforms into the symbol of his topic of inquiry, which becomes 'fixed there for eternity' [23]; as confirmed in Part III: 'tables, she added, *remembering the symbol* [...] as to what Mr Ramsay did think about' [128, emphasis added]. Another case is on the tennis lawn:

> suddenly the meaning which [...] descends on people, making them symbolical, making them representative, came upon them, and made them in the dusk standing, looking, the symbols of marriage, husband and wife. Then, after an instant, the symbolical outline which transcended the real figures sank down again, and they became, as they met them, Mr and Mrs Ramsay [60-1]

Here, the vision's nature is explicit, with three mentions of its symbolical quality: in visions, Lily does not see the individuals in front of her, she instead sees what they transcendentally represent. These shapes are the “truths” that Lily is attempting to represent, which transcend the fleeting and particularised moment of perception. However, these fixed eternal truths are nevertheless tied to the depths of her mind, and hence are on the side of the wave-worldview.

[3] However, it should be noted that the colours that Lily sees are not necessarily the surface colours of ordinary life, as illustrated by the purple triangle. The reason why Lily sees colours and Mr. Ramsay does not is because she always remains tied to her interiority and impressions in her philosophy and art, while the patriarch reduces all interiority away, so that he can reach a purely abstract view.

This can be understood with Lily's relation to beauty, which she reduced out of Mrs. Ramsay's depiction for the following reason: 'Beauty [...] stilled life – froze it. One forgot the little agitations; the flush, the pallor, some queer distortion, some light or shadow, which made the face unrecognisable for a moment and yet added a quality one saw for ever after' [146]. This follows from the general binary, as beauty is on the particle side, being a mere appearance that freezes life, which hides the wave-like reality beneath: movements ('agitation', 'distortion') and shifts in colour ('flush', 'pallor', 'light or shadow') reveal that people are forever changing and can become extraordinarily 'unrecognizable' if seen beyond the surface.

While such visions are shifting and subtle due to their wave-like properties, they nevertheless add 'a quality one saw for ever after': a newly-discovered truth, which remains permanent as a visual shape, even once the moment has vanished. There is hence a tension in Lily: in her mind's depths she perceives the fluid ever-changing nature of reality beyond appearances, yet she must solidly bring up these impressions to symbolically represent them at the surface. This difficulty is repeatedly pointed out by the character:

> Beautiful and bright it should be on the surface, feathery and evanescent, one colour melting into another like the colours on a butterfly's wing; but beneath the fabric must be clamped together with bolts of iron. It was to be a thing you could ruffle with your breath; and a thing you could not dislodge with a team of horses [141]

The inherent contradiction of flow and solidity in her work is explicit here, and explains why Lily often refers to her painting as a balancing act of sorts, which must contain 'that razor edge of balance between two opposite forces' [158], because it must 'connect this mass on the right hand with that on the left' [46]. This is a major sense in which Lily is a resolving force: the nature of her aesthetic vision requires an engagement with both sides of the binary, in order to create a picture that successfully combines their qualities, and can hence be shared with humanity. Indeed, Lily's piece is not meant for herself, nor for a particular person or community: it is meant to 'become part of the human gain', an important notion linked to her depictions of eternal truth.

2. Universal Love. The 'human gain' refers to Lily's view of Bankes as he observes Mrs. Ramsay, a moment that clarifies Lily's conception of universality, and its relevance to her art:

> It was love [...]; love that never attempted to clutch its object; but, like the love which mathematicians bear their symbols [...] was meant to be spread over the world and become part of the human gain [...] could Mr Bankes have said why that woman pleased him so; why the sight of her reading a fairy tale

> to her boy had upon him precisely the same effect as the solution of a scientific problem, [...] and felt, as he felt when he had proved something absolute about the digestive system of plants, that barbarity was tamed, the reign of chaos subdued [41]

As discussed in the previous chapter, there is value in the academic particle-worldview, as it generates universally applicable knowledge of the non-human world: mathematical equations, solved scientific problems, or objective understandings of plants can be 'shared by all' over the entire world, due to their eternal universality. And, as with Mrs. Ramsay, such eternality defeats the chaos of ever-changingness. Therefore, Lily's aim is impersonal knowledge, as is made clear by the fact that the view which affects Bankes like a solved problem is the same view that Lily is transforming into the symbolic triangle. Indeed, Bankes's science-mindedness is specifically what allows him to engage with Lily's artistry: 'Thanks to his scientific mind he understood – a proof of disinterested intelligence. One could talk of painting then' [145]. However, Lily's activity is more complicated than science, for she is attempting to express that which is inexpressible, that which Bankes is unable to say: fluid impressions of others, that are near-impossible to express due to the limitations of solid communication. Sharing universal truths is an act of love, a love that does not 'clutch its object': it is non-exclusive, directed towards the whole of 'human gain' – that is, universal.

While this “universal love” is here tied to scientific work, it is not limited to it. Indeed, Lily expresses the feeling regularly, for instance when she wishes 'to fling herself [...] at Mrs Ramsay's knee and say [...] "I'm in love with you?" No, that was not true. "I'm in love with this all,"' [19]. Lily is not sentimental for any one individual, but instead for 'this all', an uncommon formulation that places the wholeness of 'all' as the subject of her affection. The following excerpt is the clearest illustration of the relevance of Lily's love to the novel's binary system:

> Empty it was not, but full to the brim. She seemed to be standing up to the lips in some substance, to move and float and sink in it, yes, for these waters were unfathomably deep. Into them had spilled so many lives. The Ramsays'; the children's; and all sorts of waifs and strays [...]: some common feeling which held the whole together.
> It was some such feeling of completeness perhaps which, ten years ago, [...] made her say that she must be in love with the place. Love had a thousand shapes. There might be lovers whose gift it was to choose out the elements of things and place them together and so, giving them a wholeness not theirs in life, make of some scene, or meeting of people [157]

The first paragraph is a direct revelation of the wave-worldview, specifically that the sum total of human lives, past and present, are part and parcel of the same dynamic whole, instinctively felt in the depths of one's mind. In this context, the revelation allows Lily to overcome grief:

the feeling of nothingness caused by the dead's absence is replaced by fullness, due to the realisation that their interactions with the whole of human experience can still be felt within it. This is then connected to universal love in the second paragraph, by referring back to Lily's love for 'this all', which transcends the ordinary limitations of time and space due to its adherence to the wave-worldview. One can share a 'gift' with this whole, though it must inevitably adhere to the particle-worldview, for it needs to be eternal and universal in order to be valid for all – alive, dead, or unborn – such as a philosophical analysis, a scientific fact, or an artistic truth. Two examples of gifts are given: designing 'some scene', Lily's picture, or designing a 'meeting of people', Mrs. Ramsay's dinner – the two resolutions.

Indeed, a final example of Lily's universal love occurs while viewing the Ramsay couple, whose union becomes the symbolical representation of the resolution of wave and particle:

> what she called "being in love" flooded them. They became part of that unreal but penetrating and exciting universe which is the world seen through the eyes of love [...], what was even more exciting, she felt, too, as she saw Mr Ramsay bearing down and retreating, and Mrs Ramsay sitting with James [...], *how life, from being made up of little separate incidents which one lived one by one, became curled and whole like a wave* [40-1, emphasis added]

Seeing Mr. and Mrs. Ramsay in their separate domains, while recognising that they love each other, leads to the most explicit resolution of wave and particle in the novel in the italicised clause. It is therefore clear that universal love is a capital factor for Lily to succeed in her resolution. However, another factor that she requires is a specific conception of memory, which requires the context of Mrs. Ramsay's dinner to be fully understood.

3. Mrs. Ramsay's Resolution. Mrs. Ramsay's goal throughout the dinner is explicit, and expected: 'Nothing seemed to have merged. They all sat separate. And the whole of the effort of merging and flowing and creating rested on her' [69]. At first, she attempts to unify her guests through surface-level conversation,[4] which fails, therefore, as chaos nears, she orders the lighting of the table's candles:

> flames stood upright and drew with them into visibility the long table entire, and in the middle a yellow and purple dish of fruit. What had she done with it, Mrs Ramsay wondered, for Rose's arrangement [...] made her think of a

[4] 'when there is a strife of tongues at some meeting, the chairman, to obtain unity, suggests that every one shall speak in French. Perhaps it is bad French; French may not contain the words that express the speaker's thought; nevertheless speaking French imposes some order, some uniformity. [...] and Mr Tansley, who had no knowledge of this language [...] at once suspected its insincerity'. [74].

> trophy fetched from the bottom of the sea, of Neptune's banquet, of the bunch that hangs with vine leaves over the shoulder of Bacchus (in some picture), [...] to her pleasure (for it brought them into sympathy momentarily) she saw that Augustus too feasted his eyes on the same plate of fruit, plunged in, broke off a bloom there, a tassel here, and returned, after feasting, to his hive. That was his way of looking, different from hers. But looking together united them.
>
> Now all the candles were lit up, and the faces on both sides of the table were brought nearer by the candle light, and composed, as they had not been in the twilight, into a party round a table, for the night was now shut off by panes of glass, which, far from giving any accurate view of the outside world, rippled it so strangely that here, inside the room, seemed to be order and dry land; there, outside, a reflection in which things waved and vanished, waterily.
>
> Some change at once went through them all, as if this had really happened, and they were all conscious of making a party together in a hollow, on an island; had their common cause against that fluidity [...] Lily Briscoe, trying to analyse the cause of the sudden exhilaration, compared it with that moment on the tennis lawn, when solidity suddenly vanished, and such vast spaces lay between them; and now the same effect was got [79-80]

All three paragraphs begin by mentioning the simultaneous unity felt amongst all the individuals at the table: Mrs. Ramsay has achieved her merging, therefore, all mentions of fluidity are banished to the outside, allowing solid eternity to exist inside. This existential victory against life is felt by all guests at once, and the fact that they are 'all conscious' of this – even though nobody is communicating – highlights the oneness at play, wherein mental contents are shared across their depths. However, such oneness typically implies fluidity and dissolution of ego, which is not occurring in this scene. This is because there is here a major difference, which summarises the nature of the resolution Mrs. Ramsay has reached: '*That was his way of looking, different from hers. But looking together united them*'. The first sentence accepts that differences exist between the individuals, which separates them; while the second sentence accepts that beyond such division, the consciously communal activity they are all partaking in nevertheless allows for oneness: both sides of the binary are accepted at once. Mrs. Ramsay sees this unity through Carmichael: the man who once refused oneness with her, demonstrating the upsetting reality of ego. But here, by accepting instead of deploring their separate ego-centric viewpoints, which nevertheless come together in a communal activity, the two characters can be 'brought [...] into sympathy' at last; revealing that the ego is welcomed simultaneously with harmonious oneness. This can be tied to the logic of the 'separate incidents' that become 'curled and whole': it is possible to add up particle-elements in such a way that a wave-experience is generated.

When it is revealed that all points of view are united by looking together, the novel momentarily drops its free indirect discourse style. The passage's second paragraph describes

the scene from a perspective-less perspective: the 'view of the outside world' or the impression that there 'seemed to be order' are two perceptions that are not attributed to any one character, nor to the collective. Indeed, while in the third paragraph the narration is centered in a group consciousness – which is itself directly relevant as an expression of united perspectives – the second employs a third-person omniscient narrator giving an objective description independently from *any* viewpoint. It is therefore closer in style to the 'eyeless' Part II of the novel, where much of the text describes the house when it is empty or guests are sleeping – when there are no perceiving standpoints.[5] In effect, then, Part II can be read as a description "when you're not there": as if the narrator becomes Mr. Ramsay's analytical subject, describing the facts of objects that are universally true for every particularised perspective, regardless of interiority or space-time location. The return of such perspective-less narration when guests are united by looking implies, therefore, the possibility of adding up individualised points of view of a common object in order to reach a truly objective description of it. Resolution leads to truth.[6]

However, unlike Mr. Ramsay's own table, Mrs. Ramsay's scene at the dinner table does not disregard interiority, given that all guests are self-consciously remaining within their own point of view, which brings them into sympathy and allows for the harmonious victory against fluidity to be felt by all. Indeed, Lily connects this resolution 'with that moment on the tennis lawn': the moment when her particularised view of the Ramsay couple turned into an extraordinary, eternal, and universal view of marriage. Furthermore, the scene being observed objectively is described like an *ekphrasis*, which Mrs. Ramsay explicitly links to the visual arts by comparing it to 'some picture', confirming again that this resolution is relevant to Lily's artistic ambitions: the objective dish, seen through Mrs. Ramsay's resolution, illustrates what the painter is attempting to depict, 'in another sphere'.

4. The Memory Lake. There is, however, a flaw in Mrs. Ramsay's success:

> she had been keeping guard over the dish of fruit (without realising it) jealously, hoping that nobody would touch it. Her eyes had been going in and out among the curves and shadows of the fruit, [...] every time she did it, she

[5] Woolf, "Sunday 18 April". 'I have to give an empty house, no people's characters, the passage of time, all eyeless and featureless'. 76.

[6] It should be noted that not once during the long dinner chapter does the narration centre on Mr. Ramsay's thoughts, nor is he ever heard speaking: it could be said that Mr. Ramsay is "not there" in his philosophical sense, so that the whole event can be read as a success for both himself and his wife, highlighting even further the resolution that is occurring.

> felt more and more serene; until, oh, what a pity that they should do it – a hand reached out, took a pear, and spoilt the whole thing [88]

The reason why the dish makes her 'serene' is obvious, following from the analysis above. It also explains why Mrs. Ramsay is shielding the dish and scorning anyone who modifies its composition: keeping it still, unchanged, and eternal might enable the moment it caused to be equally still, unchanging, and eternal. But, inevitably, guests pick at the fruit and change the moment, consistently with Mrs. Ramsay's earlier observation: 'this cannot last, she thought' [85]. Indeed, even a moment that has created eternal objectivity will become 'already the past' [90] as it ends. However, while the moment will pass, the matriarch conceives how it can endure:

> wound about in their hearts, however long they lived she would be woven; and this, and this [...] All that would be revived again [...], that community of feeling with other people which emotion gives as if the walls of partition had become so thin that practically (the feeling was one of relief and happiness) it was all one stream, and chairs, tables, maps, were hers, were theirs, it did not matter whose, and [...] would carry it on when she was dead [92]

The solution is memory. Given that the harmony allowed for oneness in the depths – explicitly expressed by the thin wall of partition – this means that all the listed elements that were present then have now become 'woven' with the flowing mental materials within her guests. Hence, how the moment can live on: it will always remain present in the submerged minds of the diners, even after her death. This is expressed visually by Lily with 'curves and arabesques flourishing round a centre of complete emptiness' [147]: an interrelated web of materials flowing from an absent centre – the dead woman who orchestrated the moment. This is confirmed in Part III, when Lily remembers Mrs. Ramsay and a ghostly shadow of the matriarch seems to appear.

This follows from the novel's conception of memory, which can be ascertained when Mrs. Ramsay again adopts a ghostly form, after she asks:

> was Carrie still living at Marlow, and was everything still the same? Oh, she could remember it [...], gliding like a ghost among the chairs and tables of that drawing-room [...] it fascinated her, as if, while she had changed, that particular day, now become very still and beautiful, had remained there, all these years. Had Carrie written to him herself? she asked.
> "Yes. She says they're building a new billiard room," he said. No! No! That was out of the question! [72]

The matriarch's fascination with her memories remaining the same, as well as her negativity towards the remembered environment having changed, signal that memories make it possible

to keep moments 'still going on'. So, Mrs. Ramsay again feels a characteristic tension between change and stillness: the moment has disappeared, as everything about it has changed, yet it is still within her and she can revive it, unchanged. Her description of remembrance continues: 'like reading a good book again, for she knew the end of that story, since it had happened twenty years ago, and life, which shot down even from this dining-room table in cascades, heaven knows where, was sealed up there, and lay, like a lake, placidly between its banks' [76]. The comparison to an already-read book makes the nature of memories in *To the Lighthouse* obvious, but the image of the placid lake additionally connects it to the novel's binary: a body of water that contains no waves, no flux, and no relations with other fluids. This contrasts with the 'life, which shot down [...] in cascades' that she is feeling at the table.[7] The image of the lake demonstrates that memories can also be viewed as a resolving force: while they are indeed a part of watery depths, related to the emotions and thoughts of a particular moment that changes, they are also 'sealed up' and remain always the same, enabling them to be re-experienceable, untarnished by any other feeling, like an isolated lake.

The importance of this topic to Lily is obvious, given that it is precisely after exploring another one of Mrs. Ramsay's merged memories in Part III that the painter connects it to her own activity: 'it stayed in the mind affecting one almost like a work of art' [133]. The difference is that the matriarch's resolution is inherently tied to the mind, and hence cannot go beyond the people present and their limited lives, while Lily is attempting to turn her own resolution externally into a picture, which could therefore be experienced by the whole of humanity forever, reaching a level of eternal universality impossible to the silent matriarch.

5. Contradictory Knowledge. Lily desires the presence of both members of the Ramsay couple throughout Part III, as she struggles to finish her picture: 'to want and want [...]! Oh, Mrs Ramsay!' [148]; 'Where was [...] Mr Ramsay? She wanted him' [165]. However, following the father's departure, both are absent; Lily is separated by Mr. Ramsay in space, while she is separated from Mrs. Ramsay in time, therefore: 'Distance had an extraordinary power; they had been swallowed up in it, she felt, they were gone for ever' [154]. As a result, the only means to “have” them is either through memories, which re-actualise moments featuring absent people; or through universal love, which reveals how absent people remain interconnected with the whole of human experience. Hence, in much of Part III, Lily is exploring her memories and

[7] This occurs before the lighting of the candles, so Mrs. Ramsay has not yet gained the victory over life that banished fluidity.

imaginations of symbolic scenes: her only means of gaining extraordinary visions of people beyond appearances. However, as Lily does not possess Mrs. Ramsay's ability to know people's intimate nature, nor Mr. Ramsay's talent for perspective-less analysis, the painter is constantly questioning to what extent her knowledge via scenes can be considered truthful.

This is illustrated by Tansley [132-3]. At first, Lily's remembrance of him is aligned with his portrayal as a disrespectful misogynist: 'Tansley used to say that, she remembered, women can't paint, can't write. Coming up behind her, he had stood close beside her, a thing she hated'. This is a truthful perspective informed by her empirical experience, leading to a negative judgement. However, the portrayal is immediately undercut by 'But after all, she reflected, there was the scene on the beach. One must remember that', generating an opposed view: 'Tansley became as nice as he could possibly be. [...] What they said she could not remember, but only she and Charles throwing stones and getting on [...] When she thought of [...] the whole scene on the beach, it seemed to depend somehow upon Mrs Ramsay'. This is one of Mrs. Ramsay's intentionally designed memories, hence depicting a harmonious merging of individualities into the same activity, as signalled by the scene depending on her. Indeed, it is this that prompted Lily's 'like a work of art' revelation. The moment of playful oneness intimates an opposite conception of Tansley, contradicting Lily's empirical judgements: here he is nice towards both women and engaged equally in the same playful activity. The shift in perspective, caused by Mrs. Ramsay, is explicitly recognised by the painter:

> That woman [...] made these angers, irritations fall of like old rags; [...] and so made out of that miserable silliness and spite (she and Charles squabbling, sparring, had been silly and spiteful) something – this scene on the beach for example, this moment of friendship and liking – which survived, after all these years complete, so that she dipped into it to re-fashion her memory of him

The negative impression caused by a subject-object separation is replaced by a positive impression caused by harmonious oneness under Mrs. Ramsay's influence. This paradoxical view – aligned with the novel's binary – occurs again several chapters later, when Lily once more recalls Tansley negatively, only to be contradicted by the beach memory [160-1]. Additionally, though, the second time allows Lily to appreciate Tansley's own active participation in universal love, as she remembers that 'He was educating his little sister [...] It was immensely to his credit', and that she had 'heard him speaking during the war. [...] He was preaching brotherly love'. Memories can therefore result in two contradictory views of people that are equally true and hence self-defeating, a problem that Lily was already made aware of

in front of the pear tree: 'How did one judge people, think of them? How did one add up this and that and conclude that it was liking one felt or disliking? [...] her own voice saying without prompting *undeniable*, *everlasting*, *contradictory* things' [23, emphasis added].[8]

As a result, following her dualistic view of Tansley, the painter ponders the problem of knowledge, and considers a solution inspired by the dinner:

> Half one's notions of other people [...] served private purposes of one's own. [...] She found herself flagellating his lean flanks when she was out of temper. If she wanted to be serious about him she had to help herself to Mrs Ramsay's sayings, to look at him through her eyes.
> [...]
> One wanted fifty pairs of eyes to see with, she reflected. Fifty pairs of eyes were not enough to get round that one woman with, she thought. Among them, must be one that was stone blind to her beauty. One wanted most some secret sense, fine as air, with which to steal through keyholes and surround her [...] sitting silent in the window alone; [...] what did it mean to her when a wave broke? [161]

The hundred eyes might allow Lily to resolve her contradictory knowledge: to accept multiple perspectives at once while recognising their differences, in order to add them up into an objective vision, as illustrated during the dinner. Nevertheless, this would fail: human beings are orders of magnitude more complex and shifting than a *nature morte* dish of fruits. Indeed, no eye can perceive a person “when you're not there”; in this case, to know how Mrs. Ramsay acts when alone, the intimate nature of her ever-fluctuating being, as expressed by the wave that she (unbeknownst to Lily) became one with. What the painter desires, then, is Mrs. Ramsay's ability to gain instinctual knowledge of others, the 'secret sense'. But this is foreign to Lily, therefore the only option is to 'look [...] through her eyes', as enabled by her intentionally designed memories; which allows the artist to finally appreciate Tansley's involvement in universal love.

The reason why Lily could not see this fact without Mrs. Ramsay's help is bias, as expressed in the first paragraph of the above passage: the subject's internal needs distort the knowledge gained of an object – unless one possesses Mr. Ramsay's ability for near-supernaturally disinterested analysis, which has already been shown to not be Lily's case. Such failure of the subject-object dichotomy is consistently pondered by the painter, as she is tormented by the issue of how objective knowledge of other people can be gained, 'sealed as

[8] In the case of this citation, it is a contradictory view of Bankes: 'generous, pure-hearted, heroic man! But simultaneously, she remembered how he had brought a valet all the way up here; objected to dogs on chairs' [23].

they were', given the threat of bias: 'making up scenes about them, is what we call "knowing" people [...]! Not a word of it was true' [142]. More generally, she is aware that the Ramsay binary leads to contradictory impressions depending on the distance between subject and object, preventing objective knowledge: 'what happened to her, especially staying with the Ramsays [...], was to be made to feel violently two opposite things at the same time; that's what you feel, was one; that's what I feel, was the other, and then they fought together in her mind' [83]. She is stuck between Mr. and Mrs. Ramsay's conceptions of knowledge; hence, again, the need for resolution.

6. Lily's Resolution. Following the 'fifty pairs of eyes' paragraph, Lily imagines the symbolic scene that led to the Ramsay couple becoming united: 'Mrs Ramsay had thought (Lily supposed) the time has come now. Yes, she would say it now. Yes, she would marry him. [...] Probably she said one word only, letting her hand rest still in his. I will marry you' [162].

Lily is 'supposing' what 'probably' happened: she is 'making up scenes about them', and therefore likely injecting her own bias, rendering the scene untrue. And yet:

> She was not inventing; she was only trying to smooth out something she had been given years ago folded up; something she had seen. For in the rough and tumble of daily life, with all those children about, all those visitors, one had constantly a sense of repetition – of one thing falling where another had fallen, and so setting up an echo which chimed in the air and made it full of vibrations

While the scene she is creating in her mind is not factual, it is also not an invention. It is instead similar to her picture's triangle: a symbolical representation of a truth about people that intimates universal love. In this case, it is the truth that occurred during her vision on the tennis lawn: 'life, from being made up of little separate incidents which one lived one by one, became curled and whole like a wave', which expresses the same logic as the 'sense of repetition' that causes a world 'full of vibrations' in the above – a resolution of the binary, symbolically expressed by the loving union of Mr. and Mrs. Ramsay. It is therefore clear that the notion of repetition – a constant addition of similar individual elements which can generate a dynamic whole – is capital to Lily's resolution. This explains why whenever she paints, her brush displays a rhythmical repetition: 'a dancing rhythmical movement, as if the pauses were one part of the rhythm and the strokes another, and all were related' [130]; 'moving her brush hither and thither, [...], as if it had fallen in with some rhythm which was dictated to her by what she saw, so that while her hand quivered with life, this rhythm was strong enough to bear her along with it on its current' [131-2]. This second excerpt attaches Lily's rhythmical artistry to the

wave-worldview, as if it were a watery current that is inextricably linked to her depth-based vision. Indeed, in *To the Lighthouse* rhythms signal characters being soothed, a sign of reality felt as harmonious and guarding; particularly Mrs. Ramsay, who feels existential relief by listening to all rhythmical sound, not merely sea waves: 'she waited for some habitual sound, some regular mechanical sound; and then, hearing something rhythmical, half said, half chanted, beginning in the garden, as her husband beat up and down [...] she was soothed' [17]; 'her husband passed her once more, she was relieved to find that the ruin was veiled; domesticity triumphed; custom crooned its soothing rhythm' [28]; 'Her husband spoke. He was repeating something, and she knew it was poetry from the rhythm and the ring of exultation' [89]. All three examples attach the notion of soothing rhythms to the activities of Mr. Ramsay, whether his movements, his domesticity, or his words. Additionally, Mr. Ramsay's rhythm is called 'mechanical', a quality also attached to the rhythms of Mrs. Ramsay's voice when nursing Cam: 'the words echoing as she spoke them rhythmically in Cam's mind, [...] and Mrs Ramsay went on speaking still more monotonously, and more rhythmically, [...] speaking more and more mechanically" [93]. The connection of rhythms to Mr. Ramsay, mechanicism, and meaningless words make clear that they are from the particle-worldview, though, in their repetition, the human mind can be soothed and hence reach a state of peaceful harmony more akin to the wave-worldview: separate sounds, 'lived one by one, became curled and whole like a wave'. A final confirmation of repetition as a resolving force is waves themselves, as expressed by Lily while painting: 'the waves shape themselves symmetrically from the cliff top, but to the swimmer among them are divided by steep gulfs, and foaming crests. [...] Down the hollow of one wave she saw the next wave towering higher and higher above her' [130-1]. This change in perspective demonstrates that, in actuality, waves are a 'divided' system of differentiated elements, given that when Lily is within them she repetitively experiences one individual wave at a time; but it is specifically from this repetition that the view of waves as a dynamic whole of unified elements emerges.

The repetition Lily is experiencing is not limited to her brush strokes, it also applies to the artistic attempt itself:

> always, something – it might be a face, a voice [...] – thrust through, snubbed her, waked her, required and got in the end an effort of attention, so that *the vision must be perpetually remade*. [...] she looked at the bay beneath her, making hillocks of the blue bars of the waves, [...] she was roused as usual by something incongruous. There was a brown spot in the middle of the bay [...] Mr Ramsay's boat [149, emphasis added]

Indeed, a few pages earlier Lily realised that, 'One might say, [...], *of what it attempted*, that it "remained for ever,"' [147, emphasis added]. This is because, between Part I and III, her picture 'had been knocking about in her mind all these years' [122]. But, whenever she considered the extraordinary vision it expressed (indeed, any of her visions), some particular element of ordinary life interrupted her, requiring it to be repetitively reseen. For instance, in the above excerpt, her artistic concentration – 'making hillocks [...] of the waves': making the fluid solid – is interrupted by a 'spot', which contains the representative of the particle-worldview. Hence, Lily faces the challenge of having to force her wave-based vision into the particle-based reality: 'struggling against terrific odds to maintain her courage; to say: "But this is what I see; this is what I see," and so to clasp some miserable remnant of her vision to her breast, which a thousand forces did their best to pluck from her' [19]; 'It was a miserable machine [...] the human apparatus for painting or for feeling [...] heroically, one must force it on. She stared, frowning' [158]; or, 'One must keep on looking without for a second relaxing the [...] determination not to be put off, not to be bamboozled. One must hold the scene – so – in a vise and let nothing come in and spoil it' [164]. To achieve this, Lily must adopt Mr. Ramsay's extraordinary ability to keep concentrating on his subject of study, without allowing himself to be distracted from, or to interfere with, its objective reality, even though it is painful, lonely, and overwhelmingly difficult. Indeed, in the above examples where Lily is forcing her vision onto the canvas, she takes on aspects of the patriarch: the attempt is considered to be courageous and heroic, recalling Mr. Ramsay's militaristic honour; she is seen grimacing during the attempt ('screwing up her little Chinese eyes' [130]), which recalls the ten mentions of Mr. Ramsay's frowning, scowling or glaring in Part I; and both are attempting to communicate impersonal truth to humanity. This explains why a through-line of Part III is Lily's attempt at providing sympathy for Mr. Ramsay, because she requires an understanding of his nature to complete her attempt; just as she requires Mrs. Ramsay's deliberate memories to 'look [...] through her eyes', enabling the recollection of universal love.

While Lily is perplexed by contradictory impressions of others, the fact is that her visions do not require intimate knowledge of people to be valid, but merely an understanding of their participation in the whole of human experience, for it is only that which can be universalised and remain for ever. Therefore, to return to the example of Tansley, what matters to her artform is the view composed by Mrs. Ramsay, of a spirited man who uses his philosophical talents to educate his community through wartime, given that her empirical knowledge of him as an antagonist serves no purpose to her goals: 'the fact remained, it was

impossible to dislike any one if one looked at them' [70]. Similarly, what matters in her understanding of Mr. Ramsay is not his tyrannical nature, but his dedication to universal and eternal truth:

> He had all the appearance of a leader making ready for an expedition. [...] what a face, she thought, immediately finding the sympathy which she had not been asked to give troubling her for expression. What had made it like that? Thinking, night after night, she supposed – about the reality of kitchen tables [...] He had doubts, she felt, or he would have asked less of people [128-9]

Mr. Ramsay seeming like a leader is due to his children following him, but it also refers to his self-depiction as the leader of a polar expedition, displaying the extent to which Lily has gained an understanding of the philosopher. Indeed, she perceives how his need for sympathy is tied to his anxieties surrounding his work, and why it physically affects him. This understanding emerges from the sympathy she manages to give him throughout Part III, achieved by "seeing through Mrs. Ramsay's eyes" via recollection:

> she could imitate from recollection the glow, the rhapsody, the self-surrender, she had seen on so many women [...] when on some occasion like this they blazed up – she could remember the look on Mrs Ramsay's face – into a rapture of sympathy, of delight [...] the most supreme bliss of which human nature was capable. [...] She would give him what she could [125]

Again, a memory of the matriarch informs how people participate in the whole of human experience. In this case, it shows how giving sympathy causes the women who do so to experience an extraordinary 'rapture', which provides relief against the chaos of everyday life. The term 'rapture' was also employed to characterise the scientific effect that Mrs. Ramsay's view had on Bankes, which confirms again that the sympathy discharged by the painter towards Mr. Ramsay is tied to universal love: 'this "rapture," this silent stare, for which she felt intense gratitude; for nothing so solaced her, eased her of the perplexity of life, and miraculously raised its burdens, as this sublime power, this heavenly gift, [...] That people should love like this, [...] was helpful, was exalting' [41].

Therefore, by the last chapter of the novel, Lily finally manages to adopt Mrs. Ramsay's ability for sympathetic oneness thanks to her memories; which she uses to adopt Mr. Ramsay's ability for concentration; so that she can keep her vision fixed in her mind; allowing her to bring up a depth-based view of reality behind appearances up to the surface; where it can be depicted rhythmically, as rhythms allow for a transition from particle to wave. Indeed, in the final chapter, both Mr. and Mrs. Ramsay have vanished: the father has disappeared as he

reaches the lighthouse which 'had become almost invisible' [169]; and 'She looked at the steps; they were empty' [170], which signifies that the mother's memory-ghost is gone. Lily has adopted the useful parts of their talents – those tied to universal love – and is therefore able to go beyond them by achieving what neither of them could; to gift the whole of human experience with a complete, objective, solid, eternal, and universal truth behind appearances that will remain, for ever, for all.

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B/ *Woolf's Thought*: 'What I might call a philosophy'

"A Sketch of the Past" is Woolf's most extensive, intimate, and unfiltered attempt at characterising her life, art, and philosophy, written towards the end of her life with the benefit of hindsight. As such, it alone will guide this section, in order to display the extent to which the logic of Lily's art is consistent with the author's interconnected thoughts on permanence; visual shapes; impersonality; the Stephen couple; contradictory knowledge; and artistic wholeness. However, this will lead to an alternative interpretation of Lily's completed picture, in order to relativise the “resolution” account.

In the essay's first pages, Woolf summarises childhood scenes, including two tied to waves, that illustrate her notion of 'moments of being'; the shock of suddenly experiencing reality in its extraordinary wholeness. She is capable of exploring these scenes in her memories as if they had never changed, consistently with *To the Lighthouse*: 'my memory supplies what I had forgotten, so that it seems as if it were happening independently [...] things we have felt with great intensity have an existence independent'.[9] Of the three scenes she remembers, two defeated her, while in the third she won a Mrs. Ramsay-like victory because she managed satisfactorily explain it to herself, so that it had meaning and later became useful.[10] This leads to what is arguably the capital excerpt of the piece:

[9] Woolf, "A Sketch of the Past". 67.

[10] Ibid. : '"That is the whole", I said. [...] it seemed suddenly plain that the flower itself was a part of the earth [...] and that was the real flower; part earth; part flower. It was a thought I put away as being likely to be very useful to me later'. 71.

> explanation blunts the sledge-hammer force of the blow. I think this is true, because though I still have the peculiarity that I receive these sudden shocks, [...] I always feel instantly that they are particularly valuable. And so I go on to suppose that the shock-receiving capacity is what makes me a writer. [...] but it is not, as I thought as a child, simply a blow from an enemy hidden behind the cotton wool of daily life; it is or will become a revelation of some order; it is a token of some real thing behind appearances; and I make it real by putting it into words. It is only by putting it into words that I make it whole; this wholeness means that it has lost its power to hurt me; it gives me [...] a great delight to put the severed parts together [...] when in writing I seem to be discovering what belongs to what; making a scene come right; making a character come together. From this I reach what I might call a philosophy; at any rate it is a constant idea of mine; that behind the cotton wool is hidden a pattern; that we – I mean all human beings – are connected with this; that the whole world is a work of art; that we are parts of the work of art. [...] we are the words; we are the music; we are the thing itself[11]

Everything here is directly relevant to Lily: sudden shocks are experienced, which intimate a transcendental reality hidden behind ordinary life and appearances; these shocks can be experienced either as difficult or as soothing, depending on whether they are revelatory or not; however, via memories the shocks can be re-lived as scenes in order to understand them; so that when a shock hence becomes revelatory, it can be shared with humanity via art; for indeed, art can add up disparate elements into a scenic whole; and these artistic wholes express the wholeness of transcendental reality revealed in moments of being. There is hence no doubt that Lily is representative of Woolf's own artistic thought-process, even before discussing any notion of modernism, post-impressionism, or literary history.

While the above is a decently straightforward artistic procedure, much of the essay then goes on to explore the author's doubts and struggles regarding it. For example, the issue of change, which occurs as she attempts to make a 'rough visual description of childhood':

> into that picture must be brought, too, the sense of movement and change. Nothing remained stable long. [...] That is what is indescribable, that is what makes all images too static, for no sooner has one said this was so, than it was past and altered. [...]
> among the innumerable things left out in my sketch I have left out the most important – those instincts, affections, passions, attachments – there is no single word for them, for they changed month by month – which bound me, I suppose, from the first moment of consciousness to other people[12]

This is obviously the issue of how to express fleetingness with solidity, which plagues Woolf as much as Lily: 'The present [...] destroys the fullness of life – any break – like that of house

[11] Ibid. 72.

[12] Ibid. 79-80. The inherently visual nature of the scene should also be noted as relevant to Lily.

moving – causes me extreme distress; it breaks; it shallows; it turns the depths into hard thin splinters'.[13] It recalls the painter struggling with intrusions from ordinary life that interrupt the exploration of her depths, forcing the vision to be remade, just as Woolf does: 'I write this partly in order to recover my sense of the present by getting the past to shadow this broken surface. Let me then, [...] descend again into that stream'.[14] Indeed, the essay somewhat parallels Lily's activity in Part III: exploring memories and imagined scenes in order to reach a level of understanding (of oneself, of others, of art, of life, of reality...) that can usefully be employed to artistically explore a human contradiction. In Woolf's case, the contradictory knowledge she is facing is explicit: 'It would be interesting to make the two people, I now, I then, come out in contrast', however, 'I have no energy at the moment to spend upon the horrid labour that it needs to make an orderly and expressed *work of art; where one thing follows another and all are swept into a whole*';[15] "A Sketch of the Past" is merely an accumulation of thoughts, impressions and memories before they are made into art. Nevertheless, this admission displays the same resolving logic found in *To the Lighthouse*, where the repetition of individual elements can be arranged in such a way so as to generate a whole. Furthermore, the flux that Woolf wishes to include in her sketch is 'instincts, affections, passions, attachments': her feelings towards other people, which bind her to a continuous whole of human experience.

Indeed, following this passage, Woolf enters a long memory-based meditation regarding her mother, and, like Lily, tries to understand her fluctuating inner being, 'apart from her beauty':

> She was keeping what I call in my shorthand the panoply of life – that which we all lived in common – in being. [...] The later view, the understanding that I now have of her position must have its say; and it shows me that [...] a woman who had to keep all this in being and under control must have been a general presence rather than a particular person[16]

This is a case of sympathy via memory: Woolf comes to understand that her childhood impression of Julia Stephen as an omnipresent and central figure was a result of her endless social and parental responsibilities, which changes the author's view of her. This is consistent with the portrayal of Mrs. Ramsay, particularly the harmony of human experience that she created at the dinner, which makes her seem symbolic and universal, as on Lily's picture.

[13] Ibid. 89.

[14] Ibid. 98.

[15] Ibid. 75. Emphasis added.

[16] Ibid. 82-3.

Indeed: to 'give a sense of my mother's personality one would have to be an artist. It would be as difficult [...] to paint a Cézanne', which explicitly connects Woolf's own artistic challenges with those of Lily and post-impressionism.[17] The reason why a picture would be required in addition to Woolf's memories is also explicitly tied to the logic of *To the Lighthouse*: 'There is the memory; but there is nothing to check that memory by; nothing to bring it to ground with',[18] that is to say, nothing solid upon which to project the memory, hence the need for 'a book, or a picture, or any piece of work' – something objective and impersonal against which memory-based impressions can be 'checked'.

This is also visible in the memories of her father, re-explored as an adult:

> I should have to be able to inhabit again the outworn shell of my own childish mind and body. I am much nearer his age now than my own then. But do I therefore "understand" him better than I did? Or have I only queered the angle [...], so that I shall fail to describe it, either from his point of view or my own?[19]

Without the patriarch's presence, or any impersonal fact against which to check him, Woolf faces the problem of knowledge as Lily did, stuck between different points of view that are contradictory, and whose legitimacy is threatened by the possibility of bias, of 'queering the angle'. Therefore, what is the reality of Leslie Stephen? How to describe him? The answer, surprisingly, is not only the resolution implied in the following passage's first sentence, but also a leap of faith:

> scenes, by the way, are not altogether a literary device – a means of summing up and making a knot out of innumerable little threads. [...] whatever the reason may be, I find that scene making is my natural way of marking the past. A scene always comes to the top; arranged; representative. This confirms me in my instinctive notion – it is irrational; it will not stand argument – that we are sealed vessels afloat upon what it is convenient to call reality; at some moments, without a reason, without an effort, the sealing matter cracks; in floods reality; that is a scene – for they would not survive entire so many ruinous years unless they were made of something permanent; that is a proof of their "reality". [...] These are questions about reality, about scenes and their connection with writing to which I have no answer[20]

As in the previous chapter's exploration of Woolf's thought, her philosophy resists a firm systematisation, because – beyond all discussions of dual realities, contradictory knowledge,

[17] Ibid. 85.

[18] Ibid.

[19] Ibid. 107-8.

[20] Ibid. 142.

or binary philosophies – the fact remains that Woolf has always been an artist following her artistic impulse first and foremost: to depict symbolic scenes that illustrate her moments of being. The excerpt displays a consistent reiteration of ignorance, uncertainty, unfoundedness, and instinct regarding the bedrock of her artistry, though it is also connected to every theme that has been explored thus far in her thought. Even the view of the mind as a 'sealed vessel' atop waters that can suddenly emerge at the surface, which was connected to philosophical psychology in Chapter 4, is here an 'instinctive notion' instead of the knowing result of academic influence. Woolf's philosophical ruminations should hence be considered emergent properties, attempts at self-explanation, of her explicitly non-philosophical literary faculties, rather than viewing her literature as resulting from her philosophy.

From this point of view, a resolution is no longer required to write, nor, indeed, is a binary: the dualities and their resolutions emerge from the art itself, they are not conditions for it. Similarly, the wave-particle nature of much of Woolf's thematic content can be understood as merely resulting from the visceral impact the sound of the sea had on her earliest memories of being. And, as a consideration of fluidity automatically leads to a consideration by *différance* of non-fluidity, Woolf also instinctively attached non-fluidity to non-being.[21] This is not to undermine Woolf's philosophical explorations or abilities, nor to contradict this thesis' reading of *To the Lighthouse*: substantial philosophising need not require rational foundations, and analysis need not require knowing intent. But it remains a necessary conclusion to be highlighted, given how central theoretical notions have been to the author's analysis, and following Beer's sceptical warning from the previous chapter.

Therefore, the search for resolution in *To the Lighthouse* can be understood as just that: a *search*, not only by Lily, but also by Woolf, who spent her life wrestling with the ontological dynamics and implications of her own instincts and writing, as "A Sketch of the Past" unambiguously demonstrates. Therefore, while the above analysis accepted that Lily's victorious resolution and overcoming of the Ramsay couple led to her final brush-stroke, an alternative analysis could focus instead on her last thought before making the mark: 'It would be hung in the attics, she thought; it would be destroyed. But what did that matter? she asked herself, taking up her brush again' [198].[22] For – notwithstanding all philosophical

[21] As is the thesis of: Anastopoulos, *Particle or Wave*.

[22] One should nevertheless keep in mind that this sentence is not independent from the novel's binary system: Lily's acceptance of destruction goes alongside Mr. Ramsay's acceptance of death in the previous chapter, as well as Mrs. Ramsay's absence becoming 'part of ordinary experience'.

considerations – maybe Lily's picture will not be eternal, maybe the resolution it represents will not participate in universal love, maybe 'It was nonsense of course' [170]. But, it will be an artist following her artistic instinct, while doing her best to understand it, as Woolf always did.

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C/ *Intellectual Context*: The Non-Scientific Outlook

Daniel Albright's 1997 *Quantum Poetics* is a study of the modernist poetry of T.S. Eliot, Ezra Pound, and W.B. Yeats through the prism of quantum physics. As such, its approach is entirely unsurprising:[23]

> The particle model tends to promote a "scientific" view, in which isolated huddled bits are more important, more real, than the relations and interactions among them; and in which the spectator is [...] well insulated from the object of study. [...]
> The wave model, by contrast, tends to promote a "poetic" view, in which the cosmos is a plenum, a twanging web; every event modifies the infinitely elastic whole [...] and every object is merely a thickening of the general vibrancy. The relation is more real than the entities
>
> the attempt to hold two contradictory models at the same time is a central characteristic of Modernist poetics, and Modernist physics, too. [...] This [...] forms one of the main theses of this study: the Modernist poets teach themselves how to conceive the poem according to the wave model and the particle model *at the same time*

This is, in outline, the same thesis that *Modernist Physics* applies onto Woolf: an interpretative impact of quantum physics on modernist literature is to be found in its balancing of wave-particle oppositions. However, Albright's tome is not based on an influence framework; as a matter of fact, he is a rare academic who admits the coincidental nature of his connection between literature and science: 'that actual scientists also found themselves in exasperating positions when trying to explain the real world according to a particle model or a wave model is only a nice analogy, not a proof of some profound congruence'[24], which is a reason why the

[23] Daniel Albright, *Quantum Poetics: Yeats, Pound, Eliot, and the Science of Modernism*, Cambridge, Cambridge University Press, 1997. 17 & 25.

[24] Ibid. 2.

book has not been discussed until now. Another reason is simply that Albright's invocation of quantum ideas does not serve any clear purpose in his analyses.[25] Indeed, Sandford Schwartz's *Matrix of Modernism* also analyses the poetry of Eliot and Pound as modernist due to their attempts at resolving tensional binaries, though the academic is entirely unconcerned with physics, and instead employs pre-existing philosophical middle-grounds that are genuinely relevant to the poets' thought and art, even though his analytical approach is the same as Albright's: 'this chapter and the next, [...] begins with the poet's tendency to think in terms of certain oppositions – form/flux, abstraction/experience, identity/difference, unity/multiplicity – and then to find constructs that hold together the antithetical terms'. This case therefore raises the question of quantum physics' pertinence to *To the Lighthouse*'s own 'attempt to hold two contradictory models at the same time'.

While the above close reading attempted to relate them into one consistent interpretation, this chapter has actually illuminated three different resolving strategies employed in *To the Lighthouse*: uniting self-conscious perspectives onto the same object, so that their addition generates an objective vision that transcends any one particular point of view (Mrs. Ramsay's dinner); forcing, through a sheer mental expenditure of will and concentration, one side of the binary up towards the other (Lily achieving her vision); and experiencing a repetition of particular elements, whose rhythmical addition generate an experience of wholeness ('life, from being made up of little separate incidents which one lived one by one, became curled and whole like a wave'). It is not clear that any of these are relevant to complementarity as it is presented in Chapter 3: the binary is not dissolved; the subject does not possess agency on deciding which side to experience; the resolutions are simultaneous instead of diachronic; the subject's interaction does not modify the status of the binary; and the view of objectivity that results from the resolution is entirely impersonal and universal, contradicting the inexorable centrality of the subject's measurement choices in Bohr's theorisations. Nevertheless, several critics mentioned in the literature review have attempted to connect quantum complementarity to the novel, therefore it is worth exploring their conceptions of Woolf's resolved binaries before stating categorically that complementarity is irrelevant.

Sue Sun Yom considers Woolf to be specifically modernist due to her breaking down of the previous generation's dualities, in agreement with Albright's thesis: 'in Woolf's work,

[25] This is a point already made in more detail in: Burwell, *Quantum Language*. 134-6.

memory and location break down in an exceedingly radical commitment to simultaneity, in what Thomas [*sic*] Bohnenkamp has called the Modernist methexis, breaking down oppositions such as individual-history, male-female, and microcosm-macrocosm'.[26] However, in the cited Dennis Bohnenkamp article, it is mainly relativity that is responsible for this 'methexis'; a notion itself borrowed from Wylie Sypher's 1968 *Science and Technology*: 'Relativity thus collapses the subject-object dichotomy of the previous paradigm; they merge in a process that Wylie Sypher calls "methexis". In fact, in the new view, any bi-polar oppositions collapse, as Bohr's theory of complementarity predicts'.[27] In Sypher's book, the term 'methexis' is taken from Aristotle's discussion of mimesis, and merely means that 'There is participation as well as observation',[28] which is indeed meaningful for the blurring of subject-object boundaries, but cannot be considered synonymous with modernist quantum-influenced simultaneity, as Sun Yom seems to believe. According to Miriam Marty Clark, Woolf's attempt at making contradictions cohere in Lily's picture actually results in a failure, a lack of resolution, more postmodern than modernist, as explained after citing Albert Einstein's 1909 hope that the wave and particle theories of light will one day become united:[29]

> As compelling as such a prospect is, and as suggestive as Niels Bohr's "principle of complementarity" [...] might be for Woolf and for her character Lily Briscoe, it is finally not unity of vision which prevails in *To the Lighthouse* but the blurred canvas, [...], a powerful indeterminacy not yet governed by a principle of indeterminacy, scientific or literary[30]

While Paul Tolliver Brown's article admits that 'Lily is both repelled by and attracted to Mr. and Mrs. Ramsay, pondering the character of each and incorporating their worldviews into her artistic vision' – which implies a resolution-based reading – he does not analyse specifically how the painter incorporates both worldviews at the same time, other than:

> By lodging Mr. Ramsay's kitchen table in the fork of a tree, Lily can't help but situate his life and career in direct relation to Mrs. Ramsay, [...] To understand Mr. Ramsay's beliefs, Lily must distinguish the wood of the table

[26] Yom, "Bio-graphy and the Quantum Leap". 147.

[27] Dennis Bohnenkamp, "Post-Einsteinian Physics and Literature: Towards a New Poetics", in *Mosaic: A Journal for the Interdisciplinary Study of Literature,* 22, no. Summer 1989, 1989. 22.

[28] Wylie Sypher, *Literature and Technology: The Alien Vision*, New York, Random House, 1968. 102.

[29] Albert Einstein, (1909), "Über die Entwickelung unserer Anschauungen über das Wesen und die Konstitution der Strahlung", in *The Collected Papers of Albert Einstein*, ed. J. Stachel et al., Princeton, Princeton University Press, 1987-2009. 'It is my opinion, therefore, that the next phase of the development of theoretical physics will bring us a theory of light that can be interpreted as a kind of fusion of the wave and emission theories. The purpose of the following arguments is to give a foundation for this opinion'.

[30] Clark, "Consciousness, Stream and Quanta". 421-2.

> from the wood of the tree and ignore this obvious connection, a connection more in line with Mrs. Ramsay's worldview[31]

This does present both worldviews occurring at once in Lily to some extent, but it does not illuminate how she deals with their contradiction, nor how she applies them to her art or thoughts in Part III. *Modernist Physics*' analysis does not comment much on *To the Lighthouse*, as other Woolfian novels are focused upon. Nevertheless, Crossland's few detections of complementarity in *To the Lighthouse* are equally unstable, as her approach throughout much of the post-1925 chapter on Woolf is to cite academics who have noted some form of binary resolution in her work, which is then adapted to the chapter's own conception of complementarity. In the case of *To the Lighthouse*, Crossland invokes Michael Levenson's reading of the novel's philosophy versus aesthetics binary, wherein 'Lily's painting brings the conventional figures for gender into an unconventional fusion'.[32] However, Crossland resists this notion of 'fusion', because such a version of resolution would eliminate the mutual exclusion aspect of complementarity, therefore:

> the line that Lily draws in the centre of her picture in order to finish her painting [...], can just as easily be seen as divisive rather than convergent. What Levenson calls "the isolation of its rival parts" may well be overcome by an acknowledgement of ultimate division, in the form of a separating line which enables complementarity, rather than in the form of swamping unification which, to some extent at least, diminishes the significance of each part[33]

This modal reading is the near-totality of Crossland's commentary on *To the Lighthouse*;[34] it is not connected to the rest of the character's artistry or any of the novel's binaries (other than via Levenson), and hence does not really illuminate the novel, or even Lily's picture in particular.

The only analysis that comes close to explaining how a resolution occurs in *To the Lighthouse* under the light of physics is from Mark Hussey:[35]

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[31] Brown, "Relativity, Quantum Physics, and Consciousness". 47-8.

[32] Michael Levenson, *Modernism and the Fate of Individuality: Characters and Novelistic Form from Conrad to Woolf*, Cambridge, Cambridge University Press, 1991. 186. Even in this thirty-year-old analysis, the idea of Lily as a resolution of the Ramsays is presented as a *cliché*: 'it is still cast in similarly strict metaphoric anti-theses: husbandly scimitars and wifely fountains, male girders and female auras. *It will be no news to say* that the tendency of *To the Lighthouse* is toward an overcoming of these stark differences'. Emphasis added.

[33] Crossland, *Modernist Physics*. 55-6.

[34] Other than a latter comment on James's 'No' as he accepts both lighthouses as real, a 'no' that also maintains complementarity's mutual exclusion according to Crossland. Ibid. 66.

[35] Hussey, "To the Lighthouse and Physics". 87 & 88.

> In her painting, Lily is attempting to make palpable a whole complex of insight, emotion, memory, perception, and embodied being-in-the-world. [...] The reader of Woolf's novel can experience a similar moment of creative insight, of striking the chaos into stability, [...], in the act of reading, which depends upon the successful performance of memory
>
> Bohm and Woolf acknowledge that the totality cannot be described; both, however, suggest that a non-mechanistic order can become manifest in acts of creative perception [...] it can be apprehended in "moments of being."

Hussey correctly identifies the binary tensions inherent to Lily's painting, and their resolution via memory and extraordinary experiences of reality. Furthermore, he applies Woolf's resolving logic to the act of reading, in agreement with the novelist's own thought, as is most visible in her 1925 essay "How Should One Read a Book" extensively cited by Hussey:

> The book upon which we have spent so much time and thought fades entirely out of sight. But suddenly, [...] the whole book floats to the top of the mind complete. [...] The different details which have accumulated in reading assemble themselves in their proper places. The book takes on a definite shape [...]. Now one can think of the book as a whole, and the book as a whole is different, and gives one a different emotion, from the book received currently in several different parts. [...] though it is possible to receive the greatest pleasure and excitement from the first process, the actual reading, [...] it is not so profound or so lasting as the pleasure we get when the second process – the after reading – is finished, and we hold the book clear, secure, and (to the best of our powers) complete in our minds[36]

This two-step procedure of reading follows the same resolving logic as the 'separate incidents which one lived one by one,' becoming 'curled and whole like a wave' found throughout *To the Lighthouse*: many elements are received separately and chaotically, until their accumulation causes a moment of being that transforms the book into a holistic shape that simultaneously interconnects all of its elements, providing a different artistic view that is in line with the extraordinary whole of emotion that its author is attempting to express. This is consistent with Hussey's analysis, the nature of Lily's resolution outlined in this chapter, and Woolf's philosophical conceptions of art. Unfortunately, though, the connection to physics invoked by Hussey occurs through David Bohm's 1980 theories of implicate and explicate order. This, in itself, is not a problem. However, Bohm's own controversial philosophical interpretations of quantum mechanics and consciousness cannot be considered representative of the science.[37]

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[36] Woolf, "How Should One Read a Book?". 71-2.

[37] According to Max Jammer, Bohm's program was: 'regarding quantum mechanics as a guide towards a conception of *a new order in physics*, according to which the fragmentation of the physical world into relatively autonomous parts, separately existing even in interacting with each other, has to yield to the conception of an undivided wholeness, in which the observer or the observing instrument is no longer separable from what is observed'. Max Jammer, "David Bohm and His Work – On the Occassion of His Seventieth Birthday", in

Indeed, Bohm's personal obsession with the notion of wholeness was in part a reaction *against* Bohr's complementarity, which he attempted to refute with his famous hidden variables theory. So, while Hussey's reading can be tied to Bohm's writing and philosophy, it cannot be extended to quantum physics in general, particularly not complementarity. Is there, then, any value in invoking the quantum when discussing *To the Lighthouse*'s binary resolution?

Ann Banfield's *Phantom Table* leads one to answer in the negative. In its fourth chapter, the section 'The Analytic Mind' explains Woolf's vision of the manly, academic, philosophical mind inspired by her father as well as many Bloomsbury-Apostles figures, and embodied in Mr. Ramsay.[38] Then, the 'Mysticism and Logic, Rainbow and Granite, Vision and fact' section contrasts this formal version of the human mind to one more attuned with mystical experience or knowledge, as represented by Mrs. Ramsay.[39] This leads, inevitably, to the section 'Flight and Return: The Androgynous Mind', which outlines Woolf's strategies for uniting both modes of thought: 'the artist, who presents this dichotomy – between Mr. and Mrs. Ramsay, logician and mystic – does not ultimately choose between the two. Lily Briscoe, first painting Mrs. Ramsay, must finally confront Mr. Ramsay [...] neither way alone suffices to reach knowledge'.[40] This is a rather customary analysis of *To the Lighthouse*, but, additionally, the logic of Woolf's resolution is elucidated with Bertrand Russell's philosophy:

> This intellectual union takes the form of two successive stages [...] The pure recording of data [...] undergoes logic's corrective analysis. The particulars the eye isolates are composed in a network of relations, erected into Russell's "fact," the eye's vision supplemented with an eyeless one[41]

These two stages are of a piece with the Woolfian resolutions already isolated in this chapter, as well as the "How to Read a Book" essay: first particular elements are received repetitively, then they assemble into a whole. Additionally, though, Banfield includes the notion of eyelessness, which makes relevant Mrs. Ramsay's own resolution at the dinner table, when all the individual 'eye's visions' of the guests came together into 'an eyeless one'. Indeed, Russell's thought is the main interpretative key employed by Banfield to revaluate Woolf's modernism; and after 1899 Russell was himself consistently attempting to formulate a philosophical method

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Foundations of Physics, 18, 1988. 696, emphasis added. It is hence plainly obvious why Bohm is a tempting candidate for an interdisciplinary reading of Woolf, or indeed, of any anti-atomistic text.

[38] Banfield, *Phantom Table*. 188-91.

[39] Ibid. 191-6.

[40] Ibid. 200.

[41] Ibid. 198.

that could go beyond the trappings of previous idealisms and realisms: 'Physics must be interpreted in a way which tends towards idealism, and perception must be interpreted in a way which tends towards materialism'.[42] However, the notion of eyelessness is more closely related to Russell's neutral monism, a philosophical method borrowed initially from William James, which enables the philosopher to bypass the matter-mind dualism, as explained in John Hamilton's thesis on Russell's metaphysics:

> Russell's theory, [...] is neither materialism nor idealism but what, following a suggestion by the logician H. M. Sheffer, Russell called "neutral" monism. The "neutral stuff" of this monism consists of "events". "Minds" and pieces of matter are classes of events grouped together in different ways. It is quite possible for an event to belong to both groups, and thus be at once mental and material[43]

What interests Banfield more specifically is that the forms Russell analyses to construct objective knowledge do not require an observer, for they are purely logical descriptions: they 'are not sensible objects, not even unsensed sensible objects, but logical constructions out of them. Russell's "solution" makes rigorous Leslie Stephen's idea of a hypothetical extension of the observer's powers. [...] Russell erects Stephen's non-solution into a solution'[44]. Leslie Stephen's hypothetical idea here referred to appears in his agnostic article on materialism and idealism, discussed in the previous chapter, when he attempts to demonstrate that 'An object without a subject is a meaningless phrase':[45] he posits 'a kind of *hypothetical consciousness*, of which my own is an essential part, but which extends indefinitely beyond it. By this artifice [...] I state a general truth without explicit reference to my own perceptions'[46]: that is, Mr. Ramsay's perspective-less perspective. This Russellian philosophical innovation indebted to Woolf's father is at the heart of Banfield's argument, and explains the title of her book:

> Yet the vanished observer leaves in his wake not nothing but a world of phantom "solid objects." Hence, because knowledge is not equivalent to perception, the disappearance of the observer does not, in Russell, entail a denial of the possibilities of knowledge. [...]

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[42] Bertrand Russell, (1927), *The Analysis of Matter*, Nottingham, Spokesman, 2007. 7.

[43] John Hamilton, *Russell and the Metaphysics of Neutral Monism*, PhD Thesis, Cardiff University, 2013. 14. It should be noted that Russell only briefly embraced neutral monism explicitly in his life, though it went on to affect the next steps of his thought (Hamilton is specifically presenting Russell's mature version of the method). For Banfield's explanation of this aspect of Russell, see sections 'The Logical Construction of Physical Objects and Biographies', 96-102; and 'The Unobserved', 106-7. Banfield, *Phantom Table*.

[44] Banfield, *Phantom Table*. 48.

[45] Stephen, "What is Materialism?". 135.

[46] Ibid. 136. Emphasis added.

> The "kitchen table when you're not there," [...] identifies Mr. Ramsay's philosophical object with the unobserved. The table is interposed between Woolf's woman-artist and the philosopher, placing the problem of knowledge at the center of Woolf's art[47]

With this, Banfield develops an understanding of *To the Lighthouse* – indeed, of Woolf's entire career – which accounts for immense swathes of its conceptual content, including the resolution of philosophical binaries such as realism-idealism; logic-mysticism; form-flux; order-chaos; or public-private, by referring to Russell's (as well as G.E. Moore's and Roger Fry's) contemporaneous treatment of these same conceptual issues.

The question of influence unavoidably arises with such a procedure – which Banfield treats in-depth in the 'The Influence of Something upon Somebody' section of her introduction[48] – however, Russell is arguably one of the least controversial figures in this regard concerning Woolf. S.P. Rosenbaum's article, "Bertrand Russell in Bloomsbury", displays the extent to which Russell's thought was received by the Bloomsbury group, beyond mere interpersonal relationships:

> Russell's impact on Bloomsbury extends far beyond the Cambridge years, when he and Moore made their philosophical revolution, to the Great War, when Bloomsbury strongly supported Russell's crusading pacifism, and on into the Twenties and Thirties, when Russell's social, historical, and popular philosophical writings were more appealing to Bloomsbury than the work in logic and epistemology which the Group had originally found so interesting[49]

In particular, Rosenbaum notes the overwhelming impact that Russell's 1912 popularisation, *The Problems of Philosophy*, had on the group: 'No other work sums up so lucidly and concisely the conception of philosophy that Bloomsbury took from Russell and Moore; none illuminates so well the intimations of epistemology to be found in the Group's criticism, biographies, and fiction'.[50] This is relevant, as the first pages of the book introduce the problem of 'Appearance and Reality' as the foundational issue of philosophy, illustrated with the study of his two tables. Furthermore, in his continued dissection of this issue, Russell posits the notion of 'Universals': logical truths that emerges out of the repeated acquaintance with common qualities during particularised material and psychological experiences. This notion would go on to evolve in

[47] Banfield, *Phantom Table*. 49.

[48] Ibid. 36-47.

[49] Rosenbaum, "Russell in Bloomsbury". 12.

[50] Ibid. 17.

his thought to become closer to the logical forms and events discussed above, but, nevertheless, their relevance to Woolf is obvious:

> The world of universals, therefore, may also be described as the world of being. The world of being is unchangeable, rigid, exact, delightful to the mathematician, the logician, the builder of metaphysical systems, and all who love perfection more than life. The world of existence is fleeting, vague, without sharp boundaries, without any clear plan or arrangement, but it contains all thoughts and feelings, all the data of sense, and all physical objects, everything that can do either good or harm, everything that makes any difference to the value of life and the world. According to our temperaments, we shall prefer the contemplation of the one or of the other. [...] But the truth is that both have the same claim on our impartial attention, both are real, and both are important to the metaphysician. *Indeed no sooner have we distinguished the two worlds than it becomes necessary to consider their relations*[51]

This can easily be applied onto Lily's impersonal shapes: expressions of universality that emerge out of the repeated experience of particularity. Additionally, though, the final sentence makes clear that when a conceptual binary is presented, one is immediately incited to relate them. This fact is made even more explicit in a further Russellian publication that Rosenbaum notes as also having had a particular impact on Bloomsbury: 'Another essay of Russell's on mysticism written before the war has more bearing on Bloomsbury's philosophical education than most of Russell's religious or ethical essays because it attempted to reconcile mysticism with logic'[52]. This is 1914's "Mysticism and Logic", which compares and evaluates the two modes of thought as they relate to four capital issues of philosophy. Consistently with his prior rejection of idealism, Russell embraces the 'logic' side of the binary as veracious, but, nevertheless: 'there is an element of wisdom to be learned from the mystical way of feeling, which does not seem to be attainable in any other manner. If this is the truth, mysticism is to be commended as an attitude towards life'[53]. This shows that mystical modes of thought were not necessarily refuted or undermined when Cambridge Realism became the norm in Woolf's philosophical environment: even the tradition's founder found value in them, as well as avenues to reconcile them with realist conceptions.

The Problems of Philosophy and "Mysticism and Logic" are but two minor examples amongst an overwhelming wealth of conceptual connections to be made between Russell and

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[51] Russell, *The Problems of Philosophy*. 57. Emphasis added.

[52] Rosenbaum, "Russell in Bloomsbury". 20.

[53] Bertrand Russell, (1914), "Mysticism and Logic", in *Mysticism and Logic, and Other Essays*, ed. London, G. Allen & Unwin, 1917. 11.

Woolf, as Banfield's pioneering tome illustrates on every page.[54] Furthermore, Russell was arguably one of the Britain's most dominant intellectual figures in the first half of the 20th century, and was involved to some extent in all the fields of study discussed in this thesis' *Intellectual Context* sections. Indeed, even Randall Collins notes the philosopher's centrality in his intellectual history:

> At Cambridge after the university reform, there occurred a confluence of all the major trends of British intellectual life [...]. Russell epitomizes the resulting transformation, for he was involved in every aspect of these networks. [...] Russell not only inherited the Cambridge tradition but was also an aggressive internationalist[55]

It is therefore clear that if there are influences on Woolf's conceptual binaries and their resolution to be found before 1928, it is enormously more likely that Russell is one of those influences, rather than the distant echoes of Louis De Broglie's French PhD thesis, or Bohr's yet-to-be-published theory of complementarity.

That being said, there remains the possible counter-claim that Russell was also a populariser of the new physics, which impacted the development of his thought;[56] hence, even via him, Woolf may have been influenced by quantum physical innovations. This argument, however, is contradicted by Russell's *The ABC of Atoms* and *The Scientific Outlook*: the former is Russell's straightforward presentation of pre-complementarity quantum physics, while the latter is Russell's only publication on science that Woolf had certainly read. As was touched on in Chapter 5, *The ABC of Atoms* only views discontinuity as the main philosophical innovation of the old quantum theory, given that at the time of its 1925 publication, this was the lone anti-Newtonian factor being widely reckoned with in atomic physics:

> Evolution in biology and relativity in physics seemed to have established the continuity of natural processes more firmly than ever before [...]. But just when the triumph of continuity seemed complete, and when Bergson's philosophy had enshrined it in popular thought, this inconvenient discovery

[54] It should also be noted that Banfield ties all of this to the philosophy of post-impressionism via Fry as well, which is another pre-complementarity topic from Woolf's direct intellectual context that impacted her conceptual and artistic thoughts, which is remaining untreated in this thesis for the sake of economy: 'the canvases Fry put on display in 1910 presented the look of things at the moment the completion of the logicist project turned the philosopher to the physical world. But our argument is also that for Woolf Fry showed the importance of the "eyeless" dimension learned from the Apostles' "doctrines" for a "modern" art'. Banfield, *Phantom Table*. 13.

[55] Collins, *Sociology of Philosophies*. 709.

[56] Banfield, *Phantom Table*. 'it was a philosophy which addressed the seeming incommensurability of two versions of a knowledge of the external world, one direct apprehension of it through the senses and the other scientific knowledge, chiefly modern physics'. 6. See also: Bertrand Russell, (1914), "The Relation of Sense-Data to Physics", in *Mysticism and Logic, and Other Essays*, ed. London, G. Allen & Unwin, 1917.

> about energy came and upset everything. How far it may carry us no one can yet tell. [...] Perhaps it is merely habit and prejudice that makes us suppose space to be continuous[57]

This is an eminently philosophical issue prompted by the new physics, which could undeniably be connected to literature via the reference to Bergson, for example, or even Michael Whitworth's exploration of "descriptionist" trends of thought in philosophy of science. However, it is clearly not directly relevant to the themes found in Woolf, certainly not to the same degree that Russell's discussion of mysticism and logic was, for instance – other than by applying quantum discontinuity to her binary system, which has already been shown to be an inconsistent approach. *The Scientific Outlook* was published in 1931, by which time the new quantum mechanics and complementarity were becoming established, as is visible in his reference to Erwin Schrödinger's wave function when he claims that 'the physicist thinks that it [*matter*] is a wave of probability'.[58] It is hence interesting that Russell's treatment of the subject is limited to, firstly, denying Arthur Eddington's claim that quantum indeterminacy allows for free will,[59] and, secondly, incorrectly denying that quantum indeterminacy leads to acausality: 'modern quantum mechanics has made it evident that a more fundamental reconstruction is necessary. The Principle of Indeterminacy is merely an illustration of this necessity, not of the failure of physical laws to determine the course of nature'.[60] Complementarity is not mentioned once, even implicitly, which certainly reduces the probability that Woolf adopted binary-resolutions as a result of his popularisations: Russell himself seems not to have acknowledged the notion, preferring instead to discuss the quantum themes of discontinuity and indeterminacy, which are not prominent features of Woolf's general binary system or its resolutions.

Therefore, as with Albright, the analysis of *To the Lighthouse*'s resolutions is in no way relevant to quantum physics: it is possible to isolate Woolf's logic by studying her personal philosophy and artistry, which can be productively illuminated by referring to an acquaintance of hers, who happened to be one of the largest intellectual figures of her time and place, long before modern quantum mechanics emerged. Even beyond influence, it is difficult to discern how complementarity could productively be used as an interpretative framework that leads to

[57] Russell, *The ABC of Atoms*. 64.

[58] Bertrand Russell, (1931), *The Scientific Outlook*, New York, Routledge, 2009. 50.

[59] Ibid. 64-6.

[60] Ibid. 74.

novel understandings: all critics who have attempted to do so have failed to provide explanations of how *To the Lighthouse* arrives at a resolution, and the logic of Woolf and Bohr do not seem to cohere. As a matter of fact, the notion of eyelesness in this chapter's analysis, reinforced by Banfield's thesis, seems to *contradict* complementarity: in Woolf and Russell, the unobserved is the bedrock of an objective knowledge of reality; in Bohr's quantum mechanics, the unobserved can only be known as a statistical probability, because it cannot be meaningfully said to exist in reality.

It is true that, before 1928, modernist art and philosophy was marked by conceptual dualities that artists and philosophers attempted to resolve, balance, or synthetise. It is also true that physicists were attempting to solve their own conceptual duality at the same time. However, at the end of this study, there are no good reasons to affirm that these two truths are correlated, other than via the ability of literary critics to relate conceptual metaphors.[61]

[61] This conclusion is consistent with Merja Polvinen's overview of chaos theory's uses in literary studies: *'Even the most intriguing metaphorical connection does not alone establish a link between two fields of research*'. Polvinen, "The ends of metaphor: Literary analysis and chaos theory". 280. Emphasis added.

Chapter 8 - Conclusion

A close reading of *To the Lighthouse* unambiguously displays an overriding contradictory binary system that organises significant portions of the novel's composition, conceptual content, and characters. Furthermore, this general binary employs metaphorical qualities that emerge out of the fundamental opposition of fluidity and solidity: one of the poles is holistic, interconnecting and dynamic, while the other is divisible, separate and inert.

This should not be surprising, given that many of Woolf's textual materials display the deep and life-long extent to which the same fluid-solid opposition marked her childhood; her view of her parents; her generation; her irrational instincts; her understanding of existence; her artistry; her thoughts on modernist literature; her conception of the mind; and her approach to philosophy. *To the Lighthouse* was arguably the most autobiographical novel of her career, therefore one should expect this intimate dualism to be articulated clearly within it.

Also visible are her attempts to resolve it, for, in her own words: '*the goal is always towards some synthesis in which views generally found antagonistic are harmonised*'.[1] In *To the Lighthouse*, this occurs with several strategies by characters to reach a harmony between each pole, in part by exploring the relationship between subject and object. These strategies are less stable and clear-cut than her general binary (which is itself marked by a certain amount of hesitation), but that is because, like her characters and in her own life, she was *attempting* to resolve it, without ever really managing to satisfactorily do so – as "A Sketch of the Past" reveals. Woolf, therefore, did not construct a well-articulated system of artistic-philosophical knowledge based on wave and particle, but she nevertheless accepted the binary as conceptually essential, and hence explored it freely in any shape it took around and within her, which inevitably led to attempts at synthesis.

At the same time as the composition of *To the Lighthouse*, some physicists had just discovered that every fundamental element that constructs reality could be expressed *both* as a wave or as a particle, depending on the chosen experiment, which went against humanity's ontological understanding of the wave-particle binary: either an element is the one *or* the other, as the two concepts are the *ur*-example of mutual exclusion, whether in terms of their physical

[1] Virginia Woolf, (1917), "Stopford Brooke", in *The Essays of Virginia Woolf: Volume Two*, ed. Andrew Mcneillie, New York, Harcourt, 1988. 185. Emphasis added.

description; their domains of applicability; their mathematical treatment; their instinctive understanding; or their antagonistic history. This striking fact forced the physicists into radically innovative experiments and theorisations to make sense of it, transforming the world of physics, and resulting in the theory that is still implicitly (though controversially) employed today in academia to account for quantum wave-particle duality: complementarity. That is, a resolution that does not embrace one side or the other, but instead strategically employs both, by reconceptualising the relationship between subject and object.

The parallels are as obvious as they are unexplainable. The two attempts at resolution occurred at the same time and in private, preventing the possibility of the one influencing the other. This is in addition to the fact that Woolf seems generally ignorant and disinterested in physics, almost never mentioning it, just as there is no evidence that Bohr or most other quantum pioneers were readers of Woolf. Even an exploration of scientific popularisations published around this time shows that binary-resolution was not a discussed issue.[2] A solution might be to follow in the footsteps of G.S. Rousseau's renewal of literature and science, by *assuming* that both Woolf and Bohr were responding to shared antecedent cultural or philosophical forces, in which such mutually exclusive binaries were rampant, so that the two individuals' attempts at resolution are not to be directly linked to each other, but to the supposed shared culture of London's Bloomsbury and Copenhagen's Institute for Theoretical Physics. This entirely speculative procedure, however, presents the risk of unjustifiably reducing scientific developments to mere cultural discourses with no privileged claim to truth, for it implies that subatomic physical theories follow implicit cultural trends rather than the explicit results of verified experiments and peer-reviewed discussions.[3] This is a difficult argument to make at the best of times, requiring a subtle framework such as that of Gillian Beer's 1983 tome

[2] Whitworth, "Physics: “A strange footprint”". 'research into matter in the period 1880 to 1930 [...] [*was*] rapid, but incremental; popularizers were reluctant to write about the latest developments, in case their expositions became obsolete between submission and publication'. 206.

[3] Daniel Cordle, *Postmodern Postures: Literature, Science, and the Two Cultures Debate*, Aldershot, Ashgate, 1999. 'It is not sufficient to justify the cultural analysis of science merely by stating that it is a discourse, and then going on to treat it exactly the same as any other use of language (especially as the use of language discussed is more likely to be a popularisation – and hence a translation – of the science, rather than the technical and mathematical incarnation of the science itself, used by expert practitioners in the field). We need to be aware of exactly *how* it is (and is not) a discourse, how this discourse is shaped by the context of the natural world it describes, and how it relates to the culture in which it finds expression'. 50. See also Helge Kragh's response to the “Forman thesis”, in: Kragh, *Quantum Generations*. 'Zeitgeist and the Physical Worldview', 151-4. Particularly: 'the theory had its origin in Copenhagen, with a cultural climate very different from that of Weimar Germany, and was proposed by a Dane, a Dutchman, and an American [...] none of whom was influenced by the Weimar Zeitgeist. The young German physicists who created quantum mechanics were more interested in their scientific careers than in cultural trends and sought deliberately to isolate themselves from what went on in society'. 154.

on Charles Darwin – still one of the *only* book-length study to successfully validate Rousseau's 40-year-old assumptions regarding culture, literature, and science[4] – but is even more difficult in the case of the history of quantum mechanics: a thirty-year collaborative effort of multiple generations of internationally disseminated and ideologically diverse physicists who were constantly overwhelmed by extremely abstract results expressed in pure mathematics that went against their prejudices, the resulting theories of which have yet to be meaningfully undermined by a century of ever-accelerating scientific, cultural, technological, institutional, and intellectual innovations.[5] So, if direct and indirect influence do not account for the similarities, is the only alternative coincidence?

The notion of quantum-concepts intimates a positive answer. The quantum-concept of *contradictory complementarity*, consisting in having "wave" on one side and "particle" on the other (or any other mutually exclusive pairing), then attempting to "resolve" them, is in no way inherent to quantum mechanics. After explaining how, in the 5th century B.C., solidity and fluidity came to define the two main Greek philosophical views of the nature of matter, Charis Anostopoulos's history continues:

> But as opposites flow to each other, *the two conflicting perspectives were destined to a marriage. A third party was needed to bring them together* [...] Pythagoras, had come up with an idea that may perhaps appear self-evident to a modern person. Reality is structured upon symmetry, and symmetry – the proper proportion – is something that subsists in number and figure, the subject matter of mathematics. The two conflicting theories for matter together with the realization of the mathematical character of reality were the germs of subsequent ideas about the structure of matter, to which we may trace the lineage of even the most complex theory of modern physics[6]

That is not to say that the wave-particle duality that emerged in the 1920s was not revolutionary; it was, but only because the forever opposed features could now diachronically emerge *from the same object*; a bewildering dismantling of the very notion of mutual exclusivity, which few literary scholars seem to appreciate. Indeed, beyond the aspect of De

[4] Dillon, "On the Influence of Literature on Science". 'Beer's work is regularly celebrated for its uniqueness in precisely having addressed the bidirectionality of literature-science influence'. 312.

[5] Indeed, much of the theorisations in literature and science that followed Rousseau's foundational essay were based on the Victorian period, which presents specificities that are far removed from those of modern physics: 'Like Beer's and Levine's, the majority of other work focusing on this direction of influence [*literature-to-science*] also takes as its period of study the nineteenth century, which was, of course, before the formalization of disciplines and *a time when scientists drew unabashedly from literature for inspiration and information*'. Ibid. Emphasis added.

[6] Anastopoulos, *Particle or Wave*. 5. Emphasis added.

Brogliean same-object contradiction*, the idea of conceptually resolving waves and particles is as old as the conceptualisation of waves and particles themselves*.

Maybe the notion of same-object duality could be applied onto Woolf? However, in the author's view of the mind in Chapter 4, the metaphor of the pool of thought implies quite clearly that both realms are separate, with elements being exchanged between the two. Similarly, the author's general binary system in Chapter 5 is embodied in two separate characters, whose gendered differences inform the two opposed worldviews they represent. Indeed, the two character's existential anxieties seem to complete each other in Chapter 6: where the one fails, the other succeeds, and vice versa, underlying the mutual exclusivity of both realms. Finally, when in Chapter 7 the opposition is to be resolved, the options are to force elements from one side to the other, or to accept individuality within a communal activity, or to generate one realm by experiencing a soothing repetition of the other. Only the last of these options could be potentially tied to the quantum wave-particle duality, as it is a transformation of the *same* moment and person from experiencing one realm and then the other, diachronically. But, even then, the goal of this resolution in the novel is 'to connect this mass on the right hand with that on the left' on a picture: a simultaneous acceptance of two different worldviews that apply in two different realms of thought, implying two different views of reality and experience, that helps to unite two different approaches to art. Hence, Woolf's duality rarely emerges from the same object or person in *To the Lighthouse*.

Furthermore, an in-depth comparison of Bohr and Woolf's resolutions reveals profound ontological and epistemological differences: to Bohr, the mutual exclusion applies in one realm but not the other, whereas in Woolf the mutual exclusion is between the two realms; to Bohr, one realm cannot meaningfully be said to exist, whereas in Woolf both are equally real and experienceable; to Bohr, the subject's subjective choices are inherent parts of the theorisation, whereas in Woolf the ideal is to reduce away subjectivity to observe or experience the object as disinterestedly as possible; and, relatedly, to Bohr, the unobserved implies a lack of knowledge, whereas in Woolf it is a foundation for objectivity. In effect, then, *To the Lighthouse* is much closer to Pythagoras than to Bohr in its resolving logic: the universal forms – like Bertrand Russell's logical analyses and Pythagoras's mathematics – are attempts at perspective-less knowledge that unite the binary; whereas quantum mechanics is forever trapped in the subject's choice of experimental perspective, by always having to select one side of the binary or the other. The only real way in which complementarity and the novel can be connected, therefore, is by focusing uniquely on that which is similar – resolving wave and

particle, a procedure that is around 2500 years old – while smoothing over all that is different: everything else.

This analogical coincidence is even less remarkable when compared to the wide breadth of other intellectual fields that Woolf could have been materially influenced by, as many also display binaries and resolutions, that happen to be interpretatively *much* closer to Woolf's strategies, without displaying a hint of anachronism or imprecise *zeitgeist* assumptions. Chapter 4 not only connected Woolf's dual-view of the mind very closely to William James's and Henri Bergson's; it was also linked to Sandford Schwartz's thesis that a majority of modernism's philosophical sources from the late-19th century accepted a conceptual binary between the mind's flux of sensations and its conceptual abstractions, conceived of as separate realms that artists attempted to resolve. Chapter 5 then displayed that several aspects of the new physics that are often considered by literary critics to be revolutionary or "wave-like" – that is, anti-Newtonian – were by no means new in the early-20th century, but were instead continuations of a general disdain for classical physics that could be felt in the second half of the previous century at multiple levels, so that even the opposition to the classical materialistic worldview, and the exclusivity of wave and particle perspectives, are not exclusive features of quantum science. Indeed, Chapter 6 demonstrated that the history of European philosophy throughout the 19th century was marked by mutually exclusive conceptions of reality and the human relation to it, which can themselves be connected to underlying intellectual ritual chains regarding religion, salvation, materialism, mysticism, generational trauma, or existentialism, debates which have always existed in some form. This overarching philosophical opposition, tied to that of Schwartz, was in some regards "resolved" by Bertrand Russell and Cambridge Realism at the turn of the century, as is explained in Chapter 7, in a manner that can be made to cohere with Woolf in all the ways that Bohr cannot, which is particularly relevant given Woolf's interpersonal proximity with the philosopher, and his large impact on her intellectual community. In each of these cases, any or all of quantum-concepts of *observer-dependence*, *dynamic holism*, or *contradictory complementarity* could be directly applied, even though all of these contexts are unquestionably pre-quantum. Invoking quantum science as a conceptual tool to interpret these oppositions produces no new knowledge, only difficulties and unanswerable questions.

Analogical similarities, then, as they are generally employed in literature and science, do not seem to possess any value in of themselves. On the contrary, they are more akin to siren songs that encourage academics to err. Finding in literature an opposition that appears wave-

particle-like, which is then resolved in some manner, demonstrates nothing by itself other than the fact that humanity has always tended to conceive of reality as either fluid or solid, which naturally prompts curious minds to synthetise the two. That is not to say that quantum-concepts cannot participate meaningfully in an attempt to connect literature and quantum science. However, they cannot be the main argument or means of analysis, upon which the critic's other assumptions rest, as tends to be case both in modern or postmodern contexts.

A conceptual connection between two fields, presented by itself, demonstrates nothing more than the academic's capacity for interpretation.

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Almost inevitably, a sceptical investigation will lead to a negative conclusion, as is the case here. Therefore, in order to prevent the impression that the above verdict has undermined all study of Woolf and the quantum, the following is a list of academic factors that have *not* been affected by this thesis' conclusion, and can hence still be employed in productive ways.

1. Post-1928 Studies of Woolf and Physics. This is without a doubt the most important element to keep in mind at the end of this study: *To the Lighthouse* was chosen as the novel to be studied precisely because it was written *while* quantum mechanics was reaching maturity, not afterwards, which made it an interesting case study for issues of influence, anticipation, cultural fields, historical chronology, and conceptual proximity. However, by the 1930s, the scientific landscape had changed: quantum science was no longer in a phase of rapid development and was hence formalised, popularised, and philosophically examined; Albert Einstein and Bohr were debating complementarity publicly; Arthur Eddington and James Jeans were publishing best-sellers that popularised the new quantum mechanics; and their popularisations were controversial, leading several intellectual figures of the period – including Russell and J.W.N. Sullivan – to engage with interpretations of quantum physics in a variety of publications, including those read by Woolf. As such, it is absolutely possible that the quantum-concepts of later Woolf could indeed be influenced by the new physics. This could be shown, for example, by comparing the different role of the observer in Bernard's own binary within 1931's *The Waves* to that of Lily's, which could signal a possible change in Woolf's

strategies for resolution that are more in line with the logic of complementarity than in *To the Lighthouse*.

2. Quantum-Concepts as Tools. This conclusion's refutation of quantum-concepts only specifically applies when they are presented by themselves as worthy of study, or if they are the primary argument in favour of a framework. However, a quantum-concept in itself, like any conceptual analogy, is merely a neutral tool. The above example of comparing Lily and Bernard's resolutions could be a valid application of quantum-concepts, as they are merely productive elements of a larger argument. Indeed, it is difficult to see how studying literature and quantum physics could occur without any reference to perceived metaphors, similarities, or analogies, so quantum-concepts will always be part of the field; it is their value and usage that requires a profound rethinking.

3. Non-Influenced-Based Models. Much of the scepticism of this thesis was directed first towards the tradition of quantum analyses that are influence-based, whether direct or indirect, and second towards the use of quantum physics as an interpretative tool. That being said, these two approaches do not account for the full breadth of possibilities to connect both fields. It is entirely possible that new frameworks will emerge that conceive of the connection in a manner not covered by this study, and hence unaffected by its negative conclusions. For instance, Catriona Livingston's 'loop of influence' model, if it were to be validated, could justify a quantum analysis of *To the Lighthouse*, even while recognising that it was produced in a pre-complementarity period.

4. New Material Evidence. Relatedly, another source of scepticism was due to the lack of any "smoking gun" in Woolf: if quantum physics had really affected her thought and art, it would surely be visible beyond the mere interpretation of widely-applicable quantum-concepts. However, it is far from impossible that new evidence could come to light regarding the author or her environment, which would change this factor. Again, Livingstone could possibly illustrate this, given that her book, *Virginia Woolf, Science, Radio, and Identity*, studies BBC Radio Broadcasts as a means of connecting the author and science, which has not been extensively studied before: new historical connections may still be unearthed.

5. Binary Resolutions. Because quantum readings of *To the Lighthouse* focus on its apparent resolution of wave-particle binaries, this is the interpretation that has been regarded with the most scepticism as a means of connecting the author and science, particularly in the previous chapter. However, the scepticism only applies due to the invocation of quantum mechanics: it

does not deny the validity of the interpretation in of itself, when disconnected from science. Indeed, throughout this thesis, the books of Schwartz, Judith Ryan, Beer, Ann Banfield, Daniel Albright, and Rachel Crossland have all pointed out the deep dualities that mark modernist thought, and the consistent attempts by artists and philosophers to overcome them. This is a valid conclusion, the issue is only the unstable and misleading analogies with quantum science.

6. Coincidence for Coincidence's Sake. While this investigation has failed to find any material or interpretative links between the novel's and the science's resolutions that imply anything more than coincidence, it remains the case that the coincidence can be interesting enough in of itself to be commented on, particularly in light of the above point on resolutions. Indeed, while this thesis has been sceptical of many unsatisfying "cultural field" models of study published thus far, there remains the possibility that a more rigorous version of the framework could account for the cultural – or maybe even cross-cultural – similarity, in a manner that is less restrictive than employing influence, but more specific than using a *zeitgeist*. As a matter of fact, this chapter aims to introduce a possible means by which this could, hypothetically, be achieved with the use of conceptual metaphor theory.

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Throughout this thesis, the terms "analogy", "metaphor", "parallel", "correspondence", or "similarity" have been understood rather openly, in order to examine all possible connections indiscriminately. However, now that these linkages have been to a large extent refuted, a better hypothetical understanding of metaphor can be proposed, one that re-interprets the nature of the connection being implied.

The starting point for this is to be found in Anastopoulos's history of matter, as he again explains the anthropologic universality of wave and particle concepts:

> "matter" is an abstraction common to people of different times and cultures. It arises out of the one single thing that a modern person shares with a Greek of Plato's times, a tribesman of New Guinea, and a courtier of the Forbidden City: our common humanity in the way we sense, feel, act, and live our lives in the world. Matter is therefore a universal concept. [...] Of course "matter" is not the only such word: time and space, emotion and reason, divine and profane, multiplicity and unity, flux and immobility, cause and effect, psyche and matter – all these are ideas that resonate in the thoughts and languages of

> all times, and their significance is explored in the people's philosophies, myths, religion, songs, or dreams. There exist differences of meaning, of course. One concept may be understood differently in different cultures. But no matter how important such differences may be, they do not affect the essence of the fundamental concepts. These concepts are perceived at a deep level of the human psyche, before any association to words, logical definitions, or social practices. At that level, they are the same everywhere because they refer to an experience of reality common to all people[7]

Such an unambiguous statement of cross-cultural universality is liable to be received with immediate incredulity in literary studies. However, in this case it is consistent with scientific research. *Descartes' Baby* is a 2004 book by psychologist Paul Bloom that champions the theory that child development leads to an inherent mind-body dualism in the human brain, and examines its many consequences. 'Part II: The Material Realm' is an extensive study of how infants relate to and understand the physical world, and one of its main conclusions is that: 'essentialist bias appears to be universal. Although cross-cultural research finds differences in the precise way that the essences are understood [...] essentialism shows up in every society that has been studied. It appears to be a basic component of how we think about the world'.[8] While in the humanities, "essentialism" brings to mind the notion of socially constructed categories, which are falsely considered to be essential in order to impose arbitrary power relations (something denounced by Bloom as 'Bad Essentialism'[9]), what is meant here is merely that 'children believe in essences'.[10] That is, the psychological studies that Bloom cites all show that infants, even before they receive *any* education, accord greater importance to the potentially hidden internal nature and categorisation of objects and animals, than they do to their mere appearances or superficial properties. The relevance of this idea is that humans, from their youngest age, can be expected to *naturally essentialise the inherent properties of solid and fluid matter*, creating in their minds two arch-categories to discriminate between everything that is solid, and everything that is liquid – even if the various solids or liquids do not appear, on the surface, to be similar at all: a seeming confirmation of *Particle or Waves*' introductory idea. From this, it follows that the human mind would seize these two blanket categories of experienced matter to universalise them into scientific concepts, by imaginatively abstracting their inherent categories into a whole system of reality, for 'it is essentialism that

[7] Anastopoulos, *Particle or Wave*. 2.

[8] Paul Bloom, *Descartes' Baby: How the Science of Child Development Explains What Makes Us Human*, London, Arrow Books, 2004. 48.

[9] Ibid. 49-51.

[10] Ibid. 47.

drives us to search for the deeper nature of things'[11]. This is undoubtably an overly-general and overly-simplified view of how humanity as a whole operates, particularly within such complex topics as psychological development and comparative anthropology. But, as the elements of interest here are as universal, omnipresent, fundamental and obvious as the inherent differences between solid and fluid matter in a mammal's daily experience, even such a generalised view is useful.[12]

However, Anastopoulos and Bloom are only discussing the pre-linguistic concepts of matter, before they inevitably become metaphorical containers infused with values, biases, narratives, acquaintance, or interpretative interconnections via language, upbringing and culture. Nevertheless, even a certain linguistic understanding of metaphor does not entirely refute the universal nature of wave and particle conceptions. This follows from Michael Whitworth's definition, inspired by George Lakoff and Mark Johnson's conceptual metaphor theory:

> Lakoff and Johnson describe metaphor as the definition of the abstract in terms of the concrete. This is unsuitable as an account of metaphor in science, where the new objects to be described are undeniably material: for example, atoms, or fields of force. They seem "abstract" only in so far as they are not graspable by unaided human senses; they are not abstract in the sense that time or love are abstract. It might be better to define metaphor [...] as the definition of the unfamiliar in terms of the familiar[13]

What follows this passage is a discussion of the nuances and limitations in such a theorisation, due to the risk of ignoring the possible cultural relativism in defining what is 'familiar' or 'abstract' in language and experience. Indeed, not every given community at every given time will agree on what is or is not familiar. However, Whitworth goes on to admit that:

> Lakoff and Johnson also list examples of the more "concrete" natural kinds which provide structures for the more abstract ones: physical orientations, objects, substances, seeing, journeys, war, madness, food, and buildings. Again, while *the set of possible physical orientations has presumably changed little in evolutionary history*, the domains known as "war" and "madness" have changed immensely[14]

[11] Ibid. 48.

[12] The debate between universality and particularity vis-a-vis conceptual metaphors is the object of: Zoltán Kövecses, *Metaphor in Culture: Universality and Variation*, Cambridge, Cambridge University Press, 2005.

[13] Whitworth, *Einstein's Wake*. 10.

[14] Ibid. 11. Emphasis added.

Indeed, like physical orientation, it is difficult to conceive how experiencing solid and fluid matter, and essentialising their basic ontological differences, can be considered relative, when it is such an unescapable fact of any animal's existence in nature. It is not a situation similar to 'war' and 'madness', which are inevitably human and social. Of course, even with this, there will always be *some* variation in the nature of the metaphorical qualities of waves and particles and their implications, as was made clear with Schwartz's *Matrix of Modernism*: even when several philosophers from the same time, place, and culture adopt the same philosophical duality for the same reasons, there can still remain difference of interpretation and emphasis that result in different philosophies. But, the foundational metaphors, their innate physical opposition, and their most basic qualities, can be accepted as applying unproblematically throughout history, even when their understandings, depictions, and interpretations were subjected to the limitless possibilities of human creativity.

Scientific ideas need abstractions, in order to be generalisable: Newton theorised gravity, not one falling apple. But, metaphor is inevitable in order to render abstractions meaningful in ordinary language; moreover, a metaphor is constructed by observing a familiar element from everyday life that is similar enough to the abstract concept, and transferring the innate qualities of whatever has been observed onto that which is to be signified by the metaphor: before Newton, “gravity” mainly referred to heaviness or weight, of one's body being more or less attracted towards the ground. A consequence of this is that, in ordinary language, particularly in the absence of mathematisation and modern science, the possible scientific conceptualisations that can be expressed are limited by the conceptual metaphors available in everyday life to express them. For instance, in the everyday realm of experience, there are fundamentally only two types of matter that human beings come into experience with daily: that which is solid, and that which is fluid. Therefore, human language – and hence to some extent, thought – is limited to the expression of two primordial abstract conceptualisations of the nature of matter, one focused on material qualities, the other on flowing qualities. Furthermore, as the metaphorical qualities are not exclusive to the abstract concept or its associated metaphor, many other relations can be established by means of conceptual proximity, such as relations to philosophical ideas and worldviews, which explains why, even in antiquity, each conceptualisation of matter implies its own specific consequences for humanity, reality, and the ties between the two.

This is, in a drastically simplified and approximate form, the notion of conceptual metaphor theory applied onto the primary metaphors of "reality is fluid" and "reality is solid". This theoretical conception was created and explored by Lakoff and Johnson:[15]

> We acquire a large system of primary metaphors automatically and unconsciously simply by functioning in the most ordinary of ways in the everyday world from our earliest years. We have no choice in this. Because of the way neural connections are formed during the period of conflation, we all naturally think using hundreds of primary metaphors
>
> When the embodied experiences in the world are universal, then the corresponding primary metaphors are universally acquired. This explains the widespread occurrence around the world of a great many primary metaphors

Unfortunately, this academic framework was discovered too late in the composition of this thesis to be substantively included, as it is a large field with many linguistic and cognitive concepts to come to terms with, which justifies its current position as a merely hypothetical solution at the end of the conclusion. Nevertheless, if the understanding of conceptual metaphors presented above is correct, then its relevance to this study is clear: the reason why the quantum-concept of *contradictory complementarity* as it relates to waves and particles can be found throughout history, culture, philosophy, literature, and science, is because waves and particles are primary metaphors, inherent to embodied thinking:

> we understand the world on the basis of certain of our real experiences in it, even if our understanding is metaphorical in nature, as it commonly is. Metaphorical understanding of our experience is a natural consequence of being neural beings with both bodies and brains connected as they are, with the kind of neural learning capacities that we have.
> Abstract concepts don't just float in the air. They have to be given embodied meaning somehow. Embodied metaphor is a major mechanism for characterizing how we understand abstract concepts[16]

From this vantage point, what is being seen in the metaphorical connection between Woolf and Bohr is not direct influence between the two, nor is it indirect influence via pre-existing culture; *it is the common humanity of their brains*.

Both Bohr and Woolf were facing their own profoundly abstract mutually exclusive binary. Therefore, they employed the nearest primary metaphor that applied to their

[15] George Lakoff and Mark Johnson, *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought*, New York, Basic Books, 1999. 47 & 56.

[16] George Lakoff, "Mapping the Brain's Metaphor Circuitry: Metaphorical Thought in Everyday Reason", in *Frontiers in Human Neuroscience,* 8, 2014. 9.

problematic dualisms: the fundamental mutual exclusion of matter, even though their abstractions bore no actual physical relevance to fluid or solid objects.[17] In Bohr, this choice of primary metaphor was because of the institutionalised and pre-existing mathematical treatment of the concepts he was dealing with.[18] In Woolf, this choice of primary metaphor was because of the role that the sea played in her earliest impressions.[19] As a result, the conceptual qualities of the metaphors (holism, interconnection, dynamism versus divisibility, separateness and inertness...) are common to the two individuals – as they also are to *all* the contemporary thinkers who conceptually applied the same matter-mutual-exclusion primary metaphor onto their abstractions. From these shared metaphorical qualities, similar dual worldviews emerge, with conceptual consequences, such as observer-dependence on the one side and observer-separation on the other – which explains why so many thinkers seemed aligned on these themes, even in the absence of any kind of influence between them. Finally, there is the inevitable temptation to find a synthesis of some kind, as there has been throughout the entire history of the wave-particle opposition, even though Bohr and Woolf's strategies to do so differ immensely. This difference in strategic approaches is explained because, beyond the metaphors and their philosophical consequences, the abstractions they were genuinely dealing with, and the way in which they dealt with them, shared absolutely no relationship; which explains the negative conclusion that this thesis arrived at after illuminating many of the abstractions hidden behind the metaphors.

Such an approach, based on cognitive linguistics, if found to be genuine, verified, and productive, could allow a dual-reading of Woolf and quantum mechanics that is not merely based on analogical similarities, assumed connections, or scientific misunderstandings.[20] The

[17] Indeed, in quantum mechanics what are called “waves” and “particles” bear no actual resemblance to what would be classically considered “waves” and “particles”, other than aspects of their technical treatment. The concepts are almost entirely mathematical abstractions, with unclear – or according to some physicists and philosophers, non-existent – physical interpretations. Just as in Woolf the relevancy of waves and particles is largely metaphorical, being applied onto mental or philosophical contents that are not literally fluid nor solid.

[18] Frieda A. Stahl, "Physics as Metaphor and Vice Versa", in Leonardo, 20, no. 1, 1987. 'Late nineteenth- and early twentieth-century discoveries made us aware of the intrinsic limitations of these two words [*particle and wave*], and because we had exhausted both language and logic we could only flagellate ourselves with the notion of "wave-particle duality"'. 59.

[19] Woolf, "A Sketch of the Past". 'my first memory, and in fact it is the most important of all my memories. If life has a base that it stands upon, if it is a bowl that one fills and fills and fills – then my bowl without a doubt stands upon this memory. It is of lying half asleep, half awake, in bed in the nursery at St Ives. It is of hearing the waves breaking, one, two, one, two, and sending a splash of water over the beach; and then breaking, one, two, one, two, behind a yellow blind'. 64.

[20] There has already been one reading of *To the Lighthouse* based on the methodologies of cognitive linguistics and conceptual metaphor theory: Janja Čulig, "Conceptual Metaphors in Virginia Woolf’s To The Lighthouse: A Linguistic Perspective of Literature Studies", in Proceedings of the ESIDRP International Conference: English

metaphorical connection *in itself* would be interpreted as a door into the common human brain of all physicists and all writers, as the conceptual *starting-point* to compare and contrast how each discipline deals with the same embodied response to the world and its concepts, though with radically different toolsets, from which emerge their respective philosophies, procedures, and geniuses. This could be an empirically-verified and truly interdisciplinary foundation upon which to base studies of literature and science, particularly whenever clear lines of influence are not obvious or are inexistent, or when wide-spread cultural similarities cannot be accounted for.

Bohr and Woolf did not develop their respective quantum-concepts of wave-particle-resolution because of each other, nor was there any cultural influence preceding or between them: *the metaphor was primary in their brains.*

Studies at the Interface of Disciplines: Research and Practice, 2017. Her focus is on the conceptual metaphor of "light", which allows her to develop an interpretation of light as replacing Mrs. Ramsay's embodied presence in Part III. However, her conclusion ends with the same hypothetical and tentative note as the present conclusion: 'This kind of theoretical positioning could also lead us to a psycholinguistic understanding of not just a literary author, but any person writing a text. However, this should be left for further research to prove or disprove'. 297.

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