

**Sharing the Moment's Discourse:  
Virginia Woolf, D. H. Lawrence and Albert Einstein  
in the Early Twentieth Century**

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**D.Phil. Thesis  
Trinity Term 2010  
100,000 words (approx.)**

## ABSTRACT

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DEGREE: D.Phil.

COLLEGE: St. John's

SUBMITTED: Trinity 2010

Using Gillian Beer's suggestion that literature and science 'share the moment's discourse' (*Open Fields*, 1996), this thesis explores the ideas associated with Albert Einstein's three revolutionary 1905 papers, examining the ways in which similar concepts appeared across disciplines during the early part of the twentieth century, and focusing in particular on their manifestation within the literary works of Virginia Woolf and D. H. Lawrence. The study seeks to distinguish between instances of direct influence and a shared contemporary discourse, arguing that the analysis of both is essential to studies within the field of literature and science.

Part I focuses on concepts of duality and complementarity, considering Max Planck's introduction of the quantum, Einstein's development of light quanta, Louis de Broglie's wave-particle duality and Niels Bohr's principle of complementarity. It analyses other contemporary discussions of duality and complementarity, and explores Virginia Woolf's attempts to simultaneously express both sides of dualistic models, suggesting that Woolf is a complementary writer.

Part II focuses on Einstein's theories of relativity, exploring D. H. Lawrence's adoption thereof in *Fantasia of the Unconscious* (1922), in particular his claim that 'we are in sad need of a theory of human relativity'. It argues that this proposed theory is directly

relevant to Lawrence's fictional works, both those that precede *Fantasia* and those that follow it. It also analyses the impact on Lawrence of contemporary ideas of relativism, especially those of William James as expressed in *Pragmatism* (1907).

Part III explores the ways in which both Woolf and Lawrence write about individuals within crowds. It considers the possible links between such scenes and Einstein's paper on Brownian motion as well as contemporary studies of crowd psychology. It suggests that individual characters within modernist works can be considered as similar to the individual particles suspended in a mass which exhibit Brownian motion.

## Acknowledgements

I would like to thank my supervisor, Michael Whitworth, for guiding me calmly and steadily through the last three years of research, as well as for the advice offered prior to my embarking on this project.

I am grateful to Barri Gold for her comments on the ideas explored in Part III, and to the other members of the British Society for Literature and Science with whom I have discussed my research.

I would also like to thank the staff of the various libraries that I have used, in particular those working in the Bodleian and Radcliffe Science Libraries.

I am especially grateful to St. John's College for granting me a Lamb and Flag Studentship, without which I would not have been able to continue my studies.

Thank you to my family, in particular my parents and parents-in-law, for their patience and understanding and for always taking an interest.

Last, but by no means least, my deepest gratitude must be reserved for my husband, Matt. I could not possibly list here the many things for which he deserves my thanks, so I will limit myself to one: for introducing me to the wonders of physics and, in particular, for teaching me about relativity on moonlit walks by the Solent all those years ago –  
thank you.

### **Note to the Reader**

The reader should note that all emphases in quotations are original unless otherwise stated. Conversely, all ellipses in quotations have been added unless otherwise stated. The first reference in each chapter to each novel by Virginia Woolf or D. H. Lawrence appears as a footnote, with later references appearing in parentheses within the text. This model is also employed for references to Lawrence's *Psychoanalysis and the Unconscious* and *Fantasia of the Unconscious* in chapters four, five and six.

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## Introduction

### Steering between 'the Scylla of simplistic causality

### and the Charybdis of random happenstance':

### The Study of Literature and Science as a Balancing Act.<sup>1</sup>

The study of the relationship between literature and science in the early twentieth century has long focused on the relationship between modernist literature and the new physics, with studies centring in particular on the figure of Albert Einstein. Einstein's role within his contemporary culture has been seen as twofold: 'muse' for 'the contemporary revolutions occurring in art, music, theatre, and literature' with which his work had 'strong resonances', and 'mythic figure, representing both the light and dark aspects of science in society'.<sup>2</sup> The vast majority of studies of the modernist period now mention Einstein at least in passing, while the Oxford World's Classics editions of modernist works include the publication dates of his two theories of relativity in the 'Historical and Cultural Background' section of their author chronologies. Many of these references to Einstein imply that he had a direct influence on the literature in question, although this is usually not explained or analysed in any detail in these texts, with the relevant historical dates remaining particularly unclear. For example, Dennis Bohnenkamp, in an unashamedly generalised statement, claims that 'All of Modernist literature reflects some association with the relativist mythology', conceding, as something of an afterthought, 'though some genres do so more overtly than others'.<sup>3</sup> Meanwhile, other studies, such as Thomas Vargish and Delo Mook's *Inside Modernism*, have attempted to construct a new theory of

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1 Stephen J. Weininger, 'Introduction: The Evolution of Literature and Science as a Discipline', in Frederick Amrine, ed., *Literature and Science as Modes of Expression* (Dordrecht, 1989), xix.

2 Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge, 1985), 20.

3 Dennis Bohnenkamp, 'Post-Einsteinian Physics and Literature: Toward a New Poetics', *Mosaic*, 22/3 (1989), 26.

modernism by focusing on some of the key features of Einstein's theories of relativity and situating them within a model based around the *zeitgeist*.<sup>4</sup>

More recently, a series of detailed critical studies have sought to provide in-depth and specific analyses of Einstein's impact on contemporary culture. Such studies tend to focus on the boom in popular science texts which appeared following the announcement of the proof of Einstein's general theory of relativity at the Joint Eclipse Meeting of the Royal Society and the Royal Astronomical Society in November 1919, an announcement which was widely covered in the press. Thus in studies like Michael Whitworth's *Einstein's Wake*, 1919 becomes the pivotal year in which Einstein's fame and reputation, along with those of his scientific theories, became both widespread and assured.<sup>5</sup>

The significance of this chronology cannot easily be denied: there *was* a boom in the publication of popular science books and articles after 1919, and Einstein *did* become a worldwide celebrity following the November meeting.<sup>6</sup> As Stanley Goldberg has stated, 'Before 1919 almost no one outside of physics knew of Albert Einstein. After 1919 almost no one did not know of him'.<sup>7</sup> However, the repeated and almost exclusive focus on November 1919 has granted this date an exaggerated prominence which has in many ways removed it from its contemporary context. For example, Alan Friedman and Carol Donley see the announcement of the results of the eclipse expeditions as changing the public awareness of Einstein 'dramatically', while the 'Revolution in Science' headline which appeared in *The Times* the day after the Joint Eclipse Meeting has frequently been quoted as if it marked a sudden and complete break, a change of paradigm which had an immediate impact nation- and worldwide.<sup>8</sup> However, Alistair Sponsel has shown that 'the

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4 Thomas Vargish and Delo E. Mook, *Inside Modernism: Relativity Theory, Cubism, Narrative* (New Haven, 1999).

5 Michael H. Whitworth, *Einstein's Wake: Relativity, Metaphor, and Modernist Literature* (Oxford, 2001).

6 On the popular science boom, see Michael Whitworth, 'The Clothbound Universe: Popular Physics Books, 1919-39', *Publishing History*, 40 (1996), 53-82.

7 Stanley Goldberg, *Understanding Relativity: Origin and Impact of a Scientific Revolution* (Oxford, 1984), 309.

8 Friedman and Donley, *Myth and Muse*, 10; 'Revolution in Science', *The Times* (7 November 1919), 12.

eclipse experiments were a familiar topic by November 1919', with the 'Revolution in Science' article in fact serving as 'the culmination of a series of ever more in-depth pieces in *The Times* about the eclipse expeditions and the forthcoming results' which had 'appeared over the course of ten months prior to the joint meeting announcement'.<sup>9</sup> As early as April 1919 a detailed, if concise, explanation of the aim of the eclipse expeditions was offered in *The Times*, including a substantial quotation from a recent article by A. C. D. Crommelin in *Nature*.<sup>10</sup> Less than a month later, the popular science writer J. W. N. Sullivan began publishing a series of five articles on relativity in consecutive issues of *The Athenaeum*.<sup>11</sup> Thus the 'Revolution in Science' article was not the first of its kind, as studies of this period have often implied.

Meanwhile, while there was indeed a boom in popular science after 1919, Peter Bowler has recently shown that there was also a 'surge of publication that took place in the years before the Great War'.<sup>12</sup> This early twentieth-century interest in popular science, like that which would follow it after the interval enforced by the First World War, was evident in both books and generalist periodicals: in a 1914 issue of *The Observatory*, the anonymous reviewer of two new popular astronomy books reflected that 'Nowadays there are so many popular astronomical works that it is a real testimony to the interest of the public in the present position and progress of astronomy that publishers should find it profitable to produce still further books on the subject'.<sup>13</sup> Earlier, in November 1907, Desmond MacCarthy had launched *The New Quarterly* with the subtitle 'A Review of

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9 Alistair Sponsel, 'Constructing a "Revolution in Science": The Campaign to Promote a Favourable Reception for the 1919 Solar Eclipse Experiments', *British Journal for the History of Science*, 35/4 (2002), 444.

10 [John Griffiths Hartley], 'Solar Eclipse Next Month', *The Times* (22 April 1919), 16; A. C. D. Crommelin, 'The Eclipse of the Sun on May 29', *Nature*, 102/2571 (6 February 1919), 445.

11 J. W. N. Sullivan, 'A Crucial Phenomenon', *The Athenaeum*, 4645 (9 May 1919), 303; 'On Relative Motion', *The Athenaeum*, 4646 (16 May 1919), 337; 'The Notion of Simultaneity', *The Athenaeum*, 4647 (23 May 1919), 369; 'The Union of Space and Time', *The Athenaeum*, 4648 (30 May 1919), 402; and 'The Equivalence Principle', *The Athenaeum*, 4649 (6 June 1919), 433.

12 Peter J. Bowler, *Science for All: The Popularisation of Science in Early Twentieth-Century Britain* (Chicago, 2009), 87.

13 'Two Popular Works on Astronomy', *The Observatory*, 37/480 (November 1914), 414.

Science and Literature', and the order of the terms here is both interesting and significant. *The Cornhill Magazine* is also notable for the five-year period from 1903 to 1908 during which time the schoolteacher W. A. Shenstone was responsible for the vast majority of its scientific articles; a collection of these articles was published in book form in 1906 under the title *The New Physics and Chemistry*.<sup>14</sup> The Victorian popular science writer John Tyndall also remained significant in the early twentieth century, as we shall see in Part I.

When we turn to the literature of the period, we will also find that the focus on the years after 1919 has had something of a distorting effect. While it is true that Einstein's name and theories only really became part of the cultural currency after 1919, an exploration of earlier literary works reveals some surprising similarities and parallels with some of the concepts for which Einstein is still famous today. The questions as to why and how this came to be the case, and the extent to which Einsteinian science can be said to have had a direct influence on early twentieth-century literary works, provide the focus of this thesis.

In order to avoid some of the dangers inherent in an exaggerated emphasis on the year 1919, this study instead takes as its point of departure the initial emergence of some of Einstein's key ideas in 1905, a year which has long been regarded as a pivotal one in the development of physics, and as Einstein's personal *annus mirabilis*. It was in this year that Einstein, then an unknown patent clerk in Bern, published three extraordinary papers in the seventeenth volume of the *Annalen der Physik*: 'On a Heuristic Point of View Concerning the Production and Transformation of Light' which used Max Planck's 1900 theory of quanta in order to solve an experimentally observed difficulty with the wave theory of light; 'On the Electrodynamics of Moving Bodies', better known as the special theory of relativity; and 'On the Movement of Small Particles Suspended in Stationary Liquids

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<sup>14</sup> W. A. Shenstone, *The New Physics and Chemistry: A Series of Popular Essays on Physical and Chemical Subjects* (London, 1906).

Required by the Molecular-Kinetic Theory of Heat' which proposed a theory and a formula with which to explain Brownian motion. The decision to focus on 1905 may sound like the simple exchange of the over-privileging of one year for that of another fourteen years earlier. However, I am not using 1905 in order to mark a dramatic break or a paradigm shift as has been suggested by critics who focus on 1919, but rather to provide some focus for an exploration which will consider both earlier and later ideas. Unlike other studies of modernist literature in relation to Einstein, then, this study seeks to combine an approach which is not limited to a focus on 1919 and the years following it with one which will enable a detailed analysis of the similarities between ideas which were appearing in literature and science, as well as other areas of culture, in the early twentieth century.

Situating the year 1905 in context, it should be noted that the end of the nineteenth century marked, as Abraham Pais has explained, 'the beginning of an era in which the very foundations of physical theory were found to be in need of revision': Pais focuses on the decade 1895 to 1905 which witnessed the discovery of X-rays in 1895, of radioactivity in 1896, and of the electron in 1897, while in 1900 Planck proposed the existence of the quantum of energy.<sup>15</sup> The impact of these developments was keenly felt by contemporary scientists, including the mathematician Alfred North Whitehead who returns to this moment at various points within the dialogues recorded by Lucien Price: in the early 1880s, he states, when he went up to Cambridge, 'nearly everything was supposed to be known about physics that could be known' and 'physics was supposed to be nearly a closed subject'; however, 'By 1900 the Newtonian physics were demolished, done for!'<sup>16</sup> While there is certainly a sense of exaggeration here, Whitehead explains that these changes 'had a profound effect on me', forming 'one of the supreme facts of my experience'.<sup>17</sup>

Bohnenkamp has underlined the significance of these radical developments in science:

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<sup>15</sup> Abraham Pais, *'Subtle is the Lord...'* *The Science and the Life of Albert Einstein* (Oxford, 1982), 26.

<sup>16</sup> *Dialogues of Alfred North Whitehead*, ed. Lucien Price (London, 1954), 341. See also 4-5, 298.

<sup>17</sup> *Ibid.* 341, 212.

'When the ancient verities collapsed for nineteenth-century doubters, they at least had science to fall back on, but when science was seeming to collapse early in the twentieth century, nothing remained'.<sup>18</sup>

Einstein was thus developing his scientific ideas and theories within a very turbulent period and, unsurprisingly, he was not the only scientist working to solve the various problems to which he turned his thoughts in 1905. Planck's suggestion of the existence of quanta in 1900 constituted a radical new way of thinking about energy, while the 1902 experiments of Philipp Lenard on the photoelectric effect seriously undermined the wave theory of light which had previously seemed so certain. Both Henri Poincaré and Hendrik Lorentz, among others, were working at the turn of the century on the principle of relativity, which Einstein would use in 1905 as one of the postulates for his special theory of relativity, and Brownian motion had repeatedly attracted the attention of scientists even before Robert Brown's explorations thereof in the late 1820s.<sup>19</sup> Thus, as Leopold Infeld has suggested regarding relativity, these ideas were 'not born solely because of Einstein's genius, but it was he who accomplished the revolution for which science had become ripe'.<sup>20</sup>

Because of Einstein's extraordinary accomplishment, the year 1905, like 1919, has gained a mythical status in accounts of the development of twentieth-century physics and, as we have seen, the phrase *annus mirabilis* is frequently employed when referring to this year. However, it is worth remembering that, as we will see later in this study, the reaction of the scientific community to Einstein's 1905 papers was neither instant nor initially overwhelming: his paper on light quanta only received widespread recognition in the 1920s, although it was discussed during the 1910s, even if only to be rejected due to its controversial nature; Einstein's elaboration of special relativity was not fully understood,

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<sup>18</sup> Bohnenkamp, 'Post-Einsteinian Physics', 21.

<sup>19</sup> The background to each of Einstein's 1905 papers is explored in chapters two, five and seven respectively.

<sup>20</sup> Leopold Infeld, *Albert Einstein: His Work and Its Influence on Our World* (New York, 1950), 6-7.

nor its originality appreciated, until 1911; and Einstein's explanation of Brownian motion was not accepted until it received experimental proof at the hands of Jean Perrin in 1908.<sup>21</sup> An exaggerated focus on 1905 would, then, be as likely to falsify the historical evidence as one on 1919. However, by using Einstein's three 1905 papers as the framework for this thesis, we will be able to consider the development and spread of the ideas with which they are related, ideas which form a significant part of the foundations of the new physics which was emerging during the early part of the twentieth century.

Aside from the shift from 1919 to 1905, my focus on Einstein's papers and ideas serves to differentiate my study from those of other critics in another important respect. Previous studies of Einstein's place within early twentieth-century culture have tended to focus on the iconic figure of Einstein himself: for example, as the title of their book suggests, Friedman and Donley focus on Einstein as the 'hero' of the relativity revolution and as 'a personification of the new physics' for the contemporary population.<sup>22</sup> However, while Einstein's position as an iconic figure should not be overlooked, removing him from his contemporary context and detaching him from his scientific ideas in fact serves to trivialise these ideas: Einstein's role was much more complicated than simply that of icon or muse, even though it encompassed these too. In this study, I propose to focus instead on the ideas which Einstein was tackling in his 1905 papers, using these papers as the framework around which this study is constructed in order to develop a greater sense of the context out of which both science and literature were emerging during this period. This does not mean that I will ignore the iconic status of Einstein following 1919, but it will only be considered where it is relevant to my wider argument.

While my focus is on the development and dissemination of ideas, however, it is

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<sup>21</sup> On 1911 as the key year for the acceptance of the special theory of relativity see Arthur I. Miller, *Albert Einstein's Special Theory of Relativity: Emergence (1905) and Early Interpretation (1905-1911)* (Reading, Massachusetts, 1981).

<sup>22</sup> Friedman and Donley, *Myth and Muse*, ix, 5.

important not to ignore the human agents who developed and disseminated them. Such a rejection of human actors is visible in George Levine's *Darwin and the Novelists*, where Victorian gradualism is described as 'an idea that popped up in geology (on a Newtonian model), fought its way into biology, and was the groundwork of nineteenth-century "realism"'.<sup>23</sup> This personification enables Levine to discuss the relationship between literature and science during the period in question without relying on a model of direct influence nor on an insubstantial *zeitgeist*. However, while this approach enables us to recognise 'how deeply ostensibly "disciplinary" ideas are embedded in the whole culture', the absence of human agents still leaves us with an insubstantial model which does not truly reflect the way in which ideas exist and circulate within a culture.<sup>24</sup> Thus my focus is not just on ideas here, but on the ways in which they were used and developed within their context by both scientists and literary writers.

The idea that 'science and literature are not above or apart from their culture but embedded within it' is now well established.<sup>25</sup> The relevance of this model to the early twentieth-century development of radical new ways of thinking across the culture has been pointed out by various critics, with N. Katherine Hayles describing it as 'a revolution in world view' having compared it to the Copernican revolution.<sup>26</sup> Vargish and Mook have described modernism as 'inherently subdisciplinary or transdisciplinary in its operation', and such an assessment is reinforced by Walter Isaacson's analysis of the same period as one in which 'an alignment of forces causes a shift in human outlook'.<sup>27</sup> D. H. Lawrence also seems to have been aware of some wider contemporary cultural change, as we will see

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23 George Levine, *Darwin and the Novelists: Patterns of Science in Victorian Fiction* (Cambridge, Massachusetts, 1988), 5.

24 Ibid.

25 N. Katherine Hayles, 'Introduction: Complex Dynamics in Literature and Science', in N. Katherine Hayles, ed., *Chaos and Order: Complex Dynamics in Literature and Science* (Chicago, 1991), 30.

26 N. Katherine Hayles, *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century* (Ithaca, 1984), 15.

27 Vargish and Mook, *Inside Modernism*, 4; Walter Isaacson, *Einstein: His Life and Universe* (London, 2007), 279.

in Part II: in *Fantasia of the Unconscious* (1922) he writes, 'The latest craze is Mr Einstein's Relativity theory. Curious that everybody catches fire at the word Relativity. There must be something in the mere suggestion, which we have been waiting for. But what?'<sup>28</sup>

The acceptance of the cultural embeddedness of both literature and science means that the discipline of literature and science no longer needs to be justified: that two parts of a broader cultural setting, rather than C. P. Snow's fiercely differentiated 'two cultures', should affect and influence each other is now to be expected.<sup>29</sup> Indeed, the field of literature and science is now so well established that we are in a position to return to an acknowledgement of them as different, although linked, disciplines, an acknowledgement which Levine is particularly eager to stress: he asks us to recognise 'that science is somehow different from literature after all, and that only very strange people would work themselves into a position from which any distinction becomes impossible'.<sup>30</sup>

However, that the sub-discipline of literature and physics *is* still in need of a certain amount of justification is suggested by a simple consideration of the number of critical texts dealing with, for example, evolution and literature in contrast to the number dealing with relativity and literature.<sup>31</sup> The mathematical nature of physics, and the fact that its results are frequently expressed in mathematical formulae, certainly suggest that, superficially at least, physics lies at a further remove from literature than some of the other sciences. However, in some ways the obscure and distanced nature of physics makes it a more fertile site for literary writers in search of new images and ideas. In addition, Joseph Slade has suggested that 'Because physics has been dominant since the seventeenth

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28 D. H. Lawrence, *Psychoanalysis and the Unconscious and Fantasia of the Unconscious*, ed. Bruce Steele (Cambridge, 2004), 190.

29 C. P. Snow, *The Two Cultures: and A Second Look* (Cambridge, 1964).

30 George Levine, *Realism, Ethics and Secularism: Essays on Victorian Literature and Science* (Cambridge, 2008), 172.

31 See the number of respective entries for evolution and relativity, and for Charles Darwin and Einstein, in Walter Schatzberg, Ronald A. Waite and Jonathan K. Johnson, eds., *The Relations of Literature and Science: An Annotated Bibliography of Scholarship, 1880-1980* (New York, 1987).

century, it has been the chief source of scientific metaphor in our culture', adding that 'the parallels between physics and literature are simply too evident to ignore'.<sup>32</sup> While Slade's claims should not be accepted unquestioningly – especially when we consider the key role played by the biological sciences during the nineteenth century – his ideas are useful, not least in encouraging us to address our current relationship to the physical sciences. Indeed, in 1990 Slade suggested that a change was in progress: 'the scientific supremacy formerly accorded physics is beginning to pass to biology'.<sup>33</sup> Any need which we may currently feel to justify the discussion of a relationship between literature and physics is perhaps, then, a symptom of our own age, reflecting the ever-increasing specialisation and distancing of both physics and mathematics from the wider culture.

There is also an ongoing question concerning how we should go about doing literature and science, and in answering this there have traditionally been two approaches. The first is that of focusing on direct influence, an approach which tends to foreground science as the primary discipline with literature seeming, in John Limon's words, 'merely to be following gratefully along in its wake'.<sup>34</sup> Whereas early studies in the field of literature and science, like Marjorie Hope Nicolson's 1946 text *Newton Demands the Muse*, tended to follow such a model, the recognition that science, like literature, is 'always already cultural and cannot be otherwise' has revealed that such automatic precedence is no longer adequate to describe the relationship between these two disciplines.<sup>35</sup> Meanwhile, while the influence of literature on science has been discussed in detail by Gillian Beer in her seminal work *Darwin's Plots*, other examples tend to be of a more simplistic and anecdotal

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32 Joseph W. Slade, 'Beyond the Two Cultures: Science, Technology, and Literature', in Joseph W. Slade and Judith Yaross Lee, eds., *Beyond the Two Cultures: Essays on Science, Technology, and Literature* (Ames, 1990), 15.

33 Ibid.

34 John Limon, *The Place of Fiction in the Time of Science: A Disciplinary History of American Writing* (Cambridge, 1990), 11.

35 Marjorie Hope Nicolson, *Newton Demands the Muse: Newton's Opticks and the Eighteenth-Century Poets* (Princeton, 1946); N. Katherine Hayles, 'Turbulence in Literature and Science: Questions of Influence', in Robert J. Scholnick, ed., *American Literature and Science* (Lexington, 1992), 245.

nature: for example, Sarah Cain mentions Murray Gell-Mann's use of the word 'quark' from James Joyce's *Finnegan's Wake* (1939) as evidence that the interaction between literature and science 'is not simply a one-way, linear, causal process', an example which Hayles criticises as 'so trivial as to border on the frivolous'.<sup>36</sup> In a formulation with which Hayles is perhaps more likely to empathise, Whitworth explains how Eddington's reading of Joseph Conrad's *The Secret Agent* (1907) during the year in which he delivered the Gifford Lectures – on which *The Nature of the Physical World* (1928) is based – 'indicates the possibility of literary texts influencing the presentation and content of scientific ideas'.<sup>37</sup> However, this example is not explored in any further detail and appears relegated in a footnote. Likewise, Richard Sheppard's suggestion that the developments in early twentieth-century physics 'almost certainly owed something to the more global cultural upheavals which were taking place' remains unexplored and, indeed, appears in parentheses, thus suggesting the difficulties inherent in discussions of this kind.<sup>38</sup> In addition, there is an ongoing tendency within studies in literature and science to talk of the 'influence' of science on literature, while literature is said to have 'anticipated' later developments in science: thus Whitworth states that 'Woolf had developed many aspects of her own wave/particle model of the self in anticipation of the physicists'.<sup>39</sup> There is an inequality here, a hierarchy which still grants science a special place within culture taken as a whole.

While the idea of influence is clearly a difficult one to approach in an unbiased manner, the reaction against influence studies within the field of literature and science has

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36 Gillian Beer, *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction* (3<sup>rd</sup> edn, Cambridge, 2009); Sarah Cain, 'The Metaphorical Field: Post-Newtonian Physics and Modernist Literature', *The Cambridge Quarterly*, 28/1 (1999), 56; Hayles, 'Turbulence in Literature and Science', 229. See Murray Gell-Mann, *The Quark and the Jaguar: Adventures in the Simple and the Complex* (London, 1994), 180-81.

37 Whitworth, *Einstein's Wake*, 81 n. 94.

38 Richard Sheppard, 'The Problematics of European Modernism', in Steve Giles, ed., *Theorising Modernism: Essays in Critical Theory* (London, 1993), 14.

39 Whitworth, *Einstein's Wake*, 162.

perhaps gone too far: for example, Vargish and Mook describe causal linkages as 'less interesting and more superficial than the common values that find contemporaneous expression in disparate fields', a formulation which is more limiting than it might initially appear.<sup>40</sup> There *are* cases in which influence can be shown to be the most appropriate term, and if we decide to ignore or discount it when this proves to be the case, we are in danger of falsifying the ideas which we are considering as much as if we overemphasise it.

Considering the sources of a particular set of ideas and the ways in which they have proved influential outside of their immediate context can prove fruitful, as can a consideration of what a literary author has done with those ideas. It can also facilitate the locating of both a text and a set of scientific concepts within a particular cultural and historical moment which may well have been providing its own set of influences on both these fields. In this study, then, ideas of influence will indeed play a part, but only where such ideas are of definite relevance: thus in Part II we will see how Einstein's theories of relativity *at least* influenced the way in which, or rather the language with which, Lawrence wrote about human relationships in *Fantasia of the Unconscious*. The point is, of course, that when we do find ourselves discussing direct influence we must not instantly ascribe everything that can be conceived to fit within it to this cause.

The opposite approach to that of a focus on direct influence is the *zeitgeist* model which considers the wider cultural atmosphere of a particular period, exploring the ways in which ideas coincide across disciplines. While such a model can be helpful in terms of thinking of the ideas that were 'in the air' at a certain time, it remains an abstract and undefinable term and one which frequently involves a series of risky over-generalisations. In addition, Whitworth has stressed that the generalised *zeitgeist* 'never informed the work of any individual', while Randall Stevenson has highlighted the circular nature of such a

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<sup>40</sup> Vargish and Mook, *Inside Modernism*, 5.

model which renders it 'close to tautology'.<sup>41</sup>

Using the more recent concept of the culturally embedded nature of science, literature, and all other disciplines, various critics have attempted to refine the *zeitgeist* model in order to make it more practical and material. Thus Hayles has discussed the idea of a cultural matrix which 'guides individual enquiry at the same time that the enquiry helps to form, or transform, the matrix', and this idea of mutuality is clearly a valuable one when trying to overcome both the traditional hierarchical model of influence and the abstract notion of the *zeitgeist*.<sup>42</sup> Sanford Schwartz has also employed a matrix model in order to investigate the relationship between modernist literature and philosophy, explaining that this approach allows him to 'situate an important literary movement in its intellectual context'.<sup>43</sup> It is also worth noting that, when it comes to studies within the discipline of literature and science, the model of a matrix has the advantage of being, or at least sounding, scientific.

Hayles has analysed in detail the idea that 'Different disciplines are drawn to similar problems because the concerns underlying them are highly charged within a prevailing cultural context'.<sup>44</sup> The logic behind and usefulness of this model are clear, situating both the questions asked and the answers provided by various different disciplines within a wider cultural context which all disciplines share. However, it is also clear that we need to be cautious if selecting this as our model of choice for an interdisciplinary study of this kind: if our concept of the broader cultural matrix becomes too broad, we may find ourselves heading back towards a more generalised, less practical *zeitgeist* model. We need to consider how we can set about formulating a useful and practical cultural matrix for a

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41 Whitworth, *Einstein's Wake*, 19; Randall Stevenson, *Modernist Fiction: An Introduction* (rev. edn, London, 1998), 12.

42 Hayles, *Cosmic Web*, 23.

43 Sanford Schwartz, *The Matrix of Modernism: Pound, Eliot, and Early Twentieth-Century Thought* (Princeton, 1985), 4.

44 N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca, 1990), xi.

particular historical moment: if such a matrix, to be complete, needs to include every part of the contemporary culture, how can we ensure that the cultural matrix produced by such a wide-ranging – and, in fact, impossible – survey remains relevant and specific enough in order to aid us in our analysis of a particular literary text, work of art, or scientific discovery?

In an attempt to make the concept of the cultural matrix more practical and less unwieldy, Hayles, followed by Whitworth, has developed the image of the 'field of force'.<sup>45</sup> Hayles suggests that such a model renders notions of causality 'obsolete', but Whitworth, by focusing on the 'heterogeneous, discontinuous medium' through which such a field would be propagated, seems to provide a greater sense of balance between the cultural and influence models which we have been discussing.<sup>46</sup> The addition of a discontinuous medium here adds an extra element of specificity and practicality to the field model, making it of more obvious relevance to studies of this kind by avoiding the haziness that inevitably attaches to *zeitgeist* models. At the same time, the idea of tracing 'the material paths through which the ideas could have been transmitted' through this medium enables the concept of influence to make a reappearance, depending on the kind of path that is being traced for any specific incident.<sup>47</sup> However, the introduction of such a medium in order to make an existing, but not perfect, model function may remind us of the nineteenth-century obsessive search for the ether in which light was believed to travel, a quest to which Einstein himself put an end in his 1905 special relativity paper when he stated that the introduction of such a medium was 'superfluous'.<sup>48</sup> As such, we may want to think carefully before adopting any model of a medium, no matter how 'heterogeneous' or 'discontinuous', within studies of this kind.

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<sup>45</sup> Whitworth, *Einstein's Wake*, 18.

<sup>46</sup> Hayles, *Cosmic Web*, 22; Whitworth, *Einstein's Wake*, 18.

<sup>47</sup> Whitworth, *Einstein's Wake*, 18.

<sup>48</sup> *The Collected Papers of Albert Einstein. English Translation*, ed. John Stachel et al., trans. Anna Beck et al., to be completed in circa 30 vols (Princeton, 1987–), ii, 141.

The problem that we seem to be returning to repeatedly here, then, is one of balance: we have two opposing models, each consisting of clear advantages and disadvantages, and we must attempt to steer a course between what Stephen Weininger has called 'the Scylla of simplistic causality and the Charybdis of random happenstance'; that is, between the restrictive idea of influence on the one hand, and the somewhat hazy concept of the *zeitgeist* – or rather, the more practical model of the cultural matrix – on the other.<sup>49</sup> It could be argued that the discipline of literature and science is excessively divided between these two models, having moved over the years from an exclusive focus on the former to an equally exclusive focus on the latter; what is in fact needed is a combination of, or rather a balance between, the two. As we have seen, the cultural model which has replaced the old *zeitgeist* model provides us with a specific and precise way of addressing the contexts out of which both literature and science emerge. Yet, as we have also seen, the idea of direct influence between disciplines is not, and should not be, completely redundant. Friedman and Donley attempt to establish a balance between these two models, acknowledging that 'both causal relationships and parallels (not causally related) exist between the new literature and the new science'.<sup>50</sup> However, it is clear that their ultimate focus is on the ways in which 'philosophers and artists were encouraged to assimilate similar revolutionary views into their own disciplines' *following* the developments in science for which Einstein became the symbol, a focus which is perhaps not surprising given the title of their book.<sup>51</sup>

The aim of this study, then, is to provide a model which balances both direct lines of influence and a cultural matrix or field of force, and such a balanced model is suggested by Gillian Beer when she states that 'ways of viewing the world are not constructed

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49 Weininger, 'Evolution of Literature and Science', xix.

50 Friedman and Donley, *Myth and Muse*, 84.

51 *Ibid.* 1.

separately by scientists and poets; they share the moment's discourse'.<sup>52</sup> In making this statement, Beer is commenting on the similarities between passages from Woolf's *The Waves* (1931) and Eddington's *The Nature of the Physical World*, but in *Darwin's Plots* Beer emphasises the significant extent to which language was itself shared by scientists and non-scientists in the nineteenth century:

In the mid-nineteenth century, scientists still shared a common language with other educated readers and writers of their time. There is nothing hermetic or exclusive in the writing of Lyell or Darwin. Together with other scientific writers ... they shared a literary, non-mathematical discourse which was readily available to readers without a scientific training. Their texts could be read very much as literary texts.<sup>53</sup>

This 'common language' facilitated the movement of ideas between disciplines to the extent that such disciplinary boundaries seem unjustified here. Ted Benton, however, takes issue with this assessment, suggesting that the nineteenth-century reader would not have been 'impervious to genre' or 'insensitive to the difference between the communication of a scientific discovery and a work of fiction'.<sup>54</sup> Benton has also criticised Beer's close focus on shared language and metaphor, suggesting that scientists may have drawn on other texts 'for purposes and according to discursive constraints which derived from specific disciplinary requirements', and asking whether the roles of metaphor in science and literature can really be said to be identical.<sup>55</sup> Meanwhile, Whitworth points out that 'the question becomes more difficult when we deal with mathematical physics, both in the nineteenth and twentieth centuries'.<sup>56</sup>

Benton's and Whitworth's are valid points, but when we turn to that quotation from *Open Fields* we can see that Beer in fact goes further here than just discussing a common language: 'ways of viewing the world are not constructed separately by scientists and

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<sup>52</sup> Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 171.

<sup>53</sup> Beer, *Darwin's Plots*, 4.

<sup>54</sup> Ted Benton, 'Science, Ideology and Culture: Malthus and *The Origin of Species*', in David Amigoni and Jeff Wallace, eds., *Charles Darwin's The Origin of Species: New Interdisciplinary Essays* (Manchester, 1995), 72.

<sup>55</sup> Ibid.

<sup>56</sup> Whitworth, *Einstein's Wake*, 17.

poets; they share the moment's discourse'. Here the discourse that is shared does not consist solely of linguistic terms, but of ways of seeing the world; of ways of viewing the world rather than just ways of expressing it. Eddington and Woolf are comparable not just because they both talk about thresholds, doorways and an absence of solidity in similar terms, but because they are both *thinking* in this way, engaging with similar problems because, in Hayles's terms, 'the concerns underlying them are highly charged within a prevailing cultural context'. Likewise, in *Darwin's Plots* there is a suggestion that the shared language is in fact a facilitator, a manifestation and a way of analysing a sharing that goes deeper than this to the very ideas that are in question: Beer explains that 'Because of the shared discourse not only *ideas* but metaphors, myths, and narrative patterns could move rapidly and freely to and fro between scientists and non-scientists', thus suggesting that the ideas themselves would still be shared whether or not the discourse was, and that the sharing of a common language adds an extra dimension to a sharing which is already taking place.<sup>57</sup>

The concept of 'shared discourse' may appear to take us back towards an older *zeitgeist* model, the limitations of which we have already considered. Yet Beer's terminology seems to provide a way in which to achieve that balance between influence and cultural matrix to which we keep returning. 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'.<sup>58</sup> The idea that literature and science share something is not exclusive to Beer: critics within literature and science have stressed that 'Legend, myth, history, philosophy, and science share common boundaries', and in addition that the borders are 'relatively permeable'.<sup>59</sup> However, Beer's concept of shared discourse is broader than these

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<sup>57</sup> Beer, *Darwin's Plots*, 5.

<sup>58</sup> Gillian Beer, 'Discourses of the Island', in Amrine, ed., *Literature and Science*, 18.

<sup>59</sup> Josué V. Harari and David F. Bell, 'Introduction: *Journal à plusieurs voies*', in Michel Serres, *Hermès*:

ideas of boundaries permit: it is closer to the fields of force and cultural matrices which we have already considered, and allows us to think of *both* direct influence between literature and science *and* a broader cultural setting for both disciplines as each individual case requires. It also allows us to consider both the ideas themselves and the human agents who carry out the 'sharing'.

This study, then, uses the concept of shared discourse in order to explore some of the ideas, anxieties and language that literature, physics and the wider culture shared in the early twentieth century. Using Einstein's 1905 papers to frame and structure the discussion, I analyse both apparently direct lines of influence and some of the assumptions that were widely shared within the culture of the period. This focus on what Whitworth calls 'a third element' means that, as this introduction has suggested is necessary, reference will be made to other disciplines and other key intellectual figures of the period where relevant.<sup>60</sup> Thus in Part III various theories of crowd psychology in the late nineteenth and early twentieth centuries appear in relation to discussions of molecular movement, while William James, who, according to Friedman and Donley, '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.<sup>61</sup> This broadening of our focus to include the wider cultural setting will help us to avoid the creation of a new 'privileged pair' of literature and science against which Beer has cautioned, enabling us to 're-immense [science and literature] in the multiplicity of forces that generate the specific text, the particular discovery and which fire the individual imagination'.<sup>62</sup>

While the literary focus of this study revolves around modernist writing, I have

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*Literature, Science, Philosophy*, ed. Josué V. Harari and David F. Bell (Baltimore, 1982), xxix; Craig A. Gordon, *Literary Modernism, Bioscience, and Community in Early 20<sup>th</sup> Century Britain* (Basingstoke, 2007), 12.

60 Michael Hilton Whitworth, 'Physics and the Literary Community, 1905-1939', DPhil thesis, University of Oxford, 1994, 27.

61 Friedman and Donley, *Myth and Muse*, 96.

62 Gillian Beer, 'Science and Literature', in R. C. Olby et al., eds., *Companion to the History of Modern Science* (London, 1990), 792.

decided to approach this broad and varied canon via a close focus on two authors in particular: Virginia Woolf and D. H. Lawrence. These writers, although by no means alone in their use of and parallels with contemporary scientific ideas, provide particularly interesting, because complex, examples of the modernist attitude towards science. Both Woolf and Lawrence, as we will see in later chapters, have been traditionally perceived to possess a negative view of science, a critical response which continues to influence readers' approaches to these writers despite the fact that, over the years, each of their relationships with the science of their day has come to be seen as more complicated. Recent studies have recognised the different, more positive, role that the so-called 'new physics' played for each writer, but more work is needed here in order fully to integrate their responses to contemporary science with their responses to other contemporary disciplines. Woolf and Lawrence both read about the developments associated with the new physics, as we will see, and both seem to have assimilated certain ideas from their reading into their literary works, finding that the direction in which science was moving during this period reflected in some way the direction of their own thoughts. Thus in selecting these two writers we are able to explore two figures who were, to a certain extent at least, open to the new scientific ideas and willing to engage with them, but whose relationships with science as a whole were more complex, more problematic and more difficult to define.

It is, however, worth noting that in general critics have been quicker to pick up on Woolf's positive appraisals of certain aspects of the new physics than they have been with Lawrence. It is difficult to justify this critical distinction, but it can perhaps be explained in part by the many negative appraisals of mechanistic science offered by Lawrence throughout his writing: as Whitworth has stated, and as it seems to have taken some time for critics to recognise, Lawrence in fact 'resembles Conrad in combining a negative valuation of science with an enthusiasm for the new physics and its philosophical

consequences'.<sup>63</sup> In addition, while Lawrence's references to the new physics are obvious and specific in texts like *Fantasia of the Unconscious*, Woolf's use of and references to the latest scientific ideas tend to be more generalised and harder to isolate from her other interests, a fact which perhaps makes them easier for literary critics to discuss.

This study, then, contributes to the ongoing critical debates concerning both the extent and the nature of the relationships which these two writers had with the science of their day, a question whose significance lies, in part at least, in the wider ongoing critical efforts to situate these writers within and in relation to their contemporary context and culture. Direct influence – such as that of Lawrence's reading of 'a simple book on Einstein's Relativity' on *Fantasia of the Unconscious*, or that of Woolf's reading of Jeans on *The Waves* – is explored where relevant, while the concept of shared discourse is employed in order to investigate apparent parallel developments.<sup>64</sup> The focus on Woolf and Lawrence is not designed to exclude other writers automatically, but rather to provide a clear focus for the explorations offered here. While this close focus on two authors clearly limits the range of this study, the depth of the analyses that I am able to provide is, in consequence, significantly increased. By selecting just two writers, I have been able to engage with the considerable range of their works in an in-depth manner, employing detailed close reading techniques focused on small verbal and punctuation choices in order to build up a sense of the way in which specific ideas recur and are changed by these writers over the course of their writing careers.<sup>65</sup> In addition, by combining a close focus on three specific ideas seen through the framework of Einstein's three 1905 papers with a close focus on two specific authors, I have been able to combine a sense of the way in which ideas change over time with a sense of the specific agents involved in such changes,

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<sup>63</sup> Whitworth, *Einstein's Wake*, 124.

<sup>64</sup> D. H. Lawrence, letter to S. S. Koteliansky dated 4 June 1921, *The Letters of D. H. Lawrence*, ed. James T. Boulton et al., 8 vols (Cambridge, 1979-2000), iv, 23.

<sup>65</sup> Note that while my focus has been primarily on the fictional works of these writers, reference is also made to their non-fictional and personal writings where these are relevant.

as discussed earlier. The authors considered here are not, then, simply the passive receivers of various changes in discourse and context, but rather the active users and transformers of particular contemporary concepts.

Critics have repeatedly commented on the idea that Woolf was using and engaging with the concepts of wave-particle duality and complementarity which emerged during the 1920s in her 1931 novel *The Waves*. Friedman and Donley provide a detailed analysis of this novel in relation to wave-particle duality, both in terms of its structure and in terms of the characters within it, suggesting that 'each figure is both an individual and a part of the continuum, both a particle and a wave'.<sup>66</sup> Such considerations provide readers with a useful way in which to approach this dense and frequently confusing novel, and the relevance of these ideas is clearly emphasised through its title. However, as we have seen Whitworth has pointed out that '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'.<sup>67</sup> Part I of this study attempts such a retrospect, but not only of Woolf's earlier novels; in order to approach this somewhat problematic idea of 'anticipation', I also provide a retrospect of the scientific concepts of wave-particle duality and complementarity, a retrospect which leads directly to Einstein's 1905 paper on light.

The significance to Woolf of dualistic formulations has been demonstrated by various critics, with Mitchell Leaska highlighting the importance of Woolf's 'dual vision, which remained with her throughout her life'.<sup>68</sup> What is more significant, however, is Woolf's ability to link, without detrimentally combining, such dualities, and in this regard we might mention the frequent appearance of the conjunction 'and' in her fictional titles: *Night and Day* (1919), 'Blue & Green' (1921), 'Together and Apart' (1944), with 'Monday

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<sup>66</sup> Friedman and Donley, *Myth and Muse*, 143.

<sup>67</sup> Whitworth, *Einstein's Wake*, 162.

<sup>68</sup> Mitchell A. Leaska, Introduction to Virginia Woolf, *A Passionate Apprentice: The Early Journals 1897-1909*, ed. Mitchell A. Leaska (London, 2004), xxvii.

or Tuesday' (1921) remaining something of an exception. My analysis of Woolf's writings involves a particular focus on her use of 'and' in such formulations as 'Orlando the man and Orlando the woman', a focus which leads me to describe Woolf as a complementary, rather than a dualistic, writer.<sup>69</sup> The distinction is a significant one, although not one that previous literary critics have explored, and a full explanation is provided in chapter two: for now, it is sufficient to state that, while wave-particle duality involves the recognition that light, for example, can behave as *either* a wave *or* a particle, complementarity asks us to accept that light is *both* a wave *and* a particle *at the same time*, even though we can only be directly aware of one of these incarnations at any one moment. The difficulties of writing such a complementary 'and' are clear for both Woolf and the scientists who were her contemporaries, and we will see how the discourse shared by literature and science suddenly became inadequate during this period as the old language struggled to convey such radically new ideas. The question of the nature of 'and' and the newly complementary aspect of dualities is relevant to larger issues in Woolf studies such as Woolf's concept of androgyny, as I will show. Woolf's understanding of the nature of light, as well as of the contemporary ideas and ideals of art, is also significant here and is explored in detail in Part I.

For critics and students of Lawrence one of the key areas of interest has always been, and remains, his writing and understanding of human relationships. It is this subject to which Lawrence most frequently returns in his fictional writings, while his essays and letters confirm an almost obsessive focus on issues linked to the ways in which, and indeed the extent to which, people are truly able to relate to one another. One particularly interesting means of approach to this subject is offered by Lawrence in *Fantasia of the Unconscious*, the second chapter of which opens with repeated direct references to Einstein and his theories of relativity, leading Lawrence to suggest that 'we are in sad need of a

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<sup>69</sup> Virginia Woolf, *Orlando: A Biography*, ed. Brenda Lyons (London, 1993), 131.

theory of human relativity'.<sup>70</sup> While this phrase has frequently been mentioned and commented on by critics, it has never been analysed fully: for example, although Mary Freeman included a chapter entitled "Human Relativity" in her 1955 study, she did not engage with or explore the phrase itself.<sup>71</sup> Part II uses Lawrence's idea of the urgent need for 'a theory of human relativity' as a new point of access to discussions of Lawrence's writing of relationships. Taking Lawrence's claim at face value, I investigate the nature of such a theory, both in and of itself and in relation to the science which is its namesake, arguing that it can be seen as directly relevant to Lawrence's other extensive writings about relationships, both those that pre-date *Fantasia* and those that follow it. Such an analysis involves close textual readings of Lawrence's works, with his choice of pronouns coming under particular scrutiny.

The critical analysis and understanding of Lawrence's relationship to the science of his day is, as we will see in Part II, conflicting to say the least. Following Whitworth's assertion, mentioned above, that Lawrence combines 'a negative valuation of science with an enthusiasm for the new physics and its philosophical consequences', this study aims to provide a more comprehensive analysis of what the new physics, in particular Einstein's theories of relativity, meant to and for Lawrence. Lawrence's understanding of the concepts involved is explored in some detail, with his background as both a student and teacher of science, among other subjects, being given particular prominence.

It is not only the approach to Lawrence that is original here, however: while other critics have focused on the influence of relativity on the modernist vision of space and, in particular, time, my approach instead considers the human aspect which Lawrence associated with it. The analyses provided in Part II, then, are significantly distanced from the usual discussions of simultaneity and relative points of view, focusing instead on

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<sup>70</sup> Lawrence, *Psychoanalysis*, 72.

<sup>71</sup> Mary Freeman, *D. H. Lawrence: A Basic Study of His Ideas* (New York, 1955), 144-57.

Lawrence's 1921 reading of that 'simple book on Einstein's Relativity' as the source of a particular series of linguistic and theoretical tools with which Lawrence could approach one of his favourite subjects, rather than as the source of the ideas themselves. The relationship and contrasts between relativity and relativism are also of key importance here, and are discussed in some detail in chapter five.

While Woolf and Lawrence are considered for the most part separately in Parts I and II respectively, Part III sees them being compared more directly, a movement which allows this study to open out into a wider consideration of a key modernist issue: the relation between the individual and the mass. The nature of the modernist writer's relationship to the masses has frequently been seen as a controversial one, not least in John Carey's polemical study *The Intellectuals and the Masses*.<sup>72</sup> Meanwhile, the growth of such masses, in particular those of the newly organised working classes, was certainly a pressing issue at the start of the twentieth century. The late nineteenth century saw the publication of the first works on crowd psychology, a field which, I will suggest, demonstrates close ties with contemporary scientific research on the movements of large numbers of molecules. The phenomenon of Brownian motion, as explained by Einstein in 1905, is employed here as a new model with which to consider the interactions between an individual and a crowd. Such a model enables the investigation of the various media in which both Woolf and Lawrence frequently place their characters, as well as a larger exploration of the significance of cities and crowds to the fictional works of both writers. The critical discourse related to the figure of the *flâneur* is also of key importance here, and I offer new interpretations of the role of this figure in the works of both Woolf and Lawrence.

The idea of comparing the writings of Woolf and Lawrence has not always been an

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<sup>72</sup> John Carey, *The Intellectuals and the Masses: Pride and Prejudice among the Literary Intelligentsia, 1880-1939* (London, 1992).

obvious one, and for a long time they were positioned almost as mutually exclusive writers, primarily, although not exclusively, for reasons of gender politics. However, this has been changing gradually over the years, and the parallels between these two revolutionary writers have been highlighted in a number of recent studies, including Helen Wussow's *The Nightmare of History: The Fictions of Virginia Woolf and D. H. Lawrence*, Youngjoo Son's *Here and Now: The Politics of Social Space in D. H. Lawrence and Virginia Woolf* and Craig Gordon's *Literary Modernism, Bioscience, and Community in Early 20<sup>th</sup> Century Britain*.<sup>73</sup> The structure of the present study allows for both contrast and comparison between Woolf and Lawrence and, in its final part, encourages a consideration of the place of each of these writers within the broader context of literary modernism. In thinking of the way in which these two writers relate to each other we may find a letter which Woolf wrote to Ethel Smyth in April 1931, a year after Lawrence's death, to be of use: 'the fact about contemporaries (I write hand to mouth) is that they're doing the same thing on another railway line: one resents their distracting one, flashing past, the wrong way'.<sup>74</sup> Interestingly, one of Woolf's few sightings of Lawrence occurred from a train in a station, as she explained in a letter to Dorothy Brett in May 1930: 'our train stopped outside Rome in the early morning and there was Lawrence talking to Norman Douglas on the other platform'.<sup>75</sup> It is worth noting that in the event as reported here, neither Woolf nor Lawrence were moving, either in the same or opposite directions, but in 1927 Woolf also described the aftermath of this moment:

Looking out of the carriage window at Civita Vecchia, whom should we see, sitting side by side on a bench, but D. H. Lawrence and Norman Douglas – unmistakable ... They were swept off by train one way and we went on to Rome.<sup>76</sup>

<sup>73</sup> Helen Wussow, *The Nightmare of History: The Fictions of Virginia Woolf and D. H. Lawrence* (London, 1998); Youngjoo Son, *Here and Now: The Politics of Social Space in D. H. Lawrence and Virginia Woolf* (New York, 2006); Gordon, *Literary Modernism*.

<sup>74</sup> Virginia Woolf, letter to Ethel Smyth dated 20 April 1931, *The Letters of Virginia Woolf*, ed. Nigel Nicolson and Joanne Trautmann, 6 vols (London, 1975-80), iv, 315.

<sup>75</sup> Woolf, letter to Dorothy Brett dated 10 May 1930, *Letters*, iv, 166.

<sup>76</sup> Woolf, letter to Vanessa Bell dated 9 April 1927, *Letters*, iii, 361. Woolf later compared Lawrence himself

This formulation may suggest a possible source for the image in the letter to Smyth, while the later idea that Woolf and Lawrence were 'doing the same thing' in opposite directions emphasises the opportunities open to us to both compare and contrast these prolific writers.

Having considered the three figures and the three ideas at the centre of this study, it is worth briefly considering a point to which we will need to return at its close: the question as to how we should evaluate the analyses that are offered in what follows. In a review of the condition of the discipline of literature and science in 1987, Lance Schachterle suggested three criteria by which one could 'measure the success of a critical effort to relate literature and science': 'Does the critic present a lucid, well-informed account of the scientific concepts?', 'Does the critic make a convincing case that the literature examined is affected in some significant way by scientific concepts?', and 'Can the critic show that the author's consciousness as a writer is affected by contact with ideas from science?'<sup>77</sup> Schachterle's focus here is very clearly on studies which consider the direct influence of science upon literature: under the second question above, a further one appears; 'Are sources of influence other than the scientific examined and safely dismissed?'<sup>78</sup> Such a question precludes the option whereby a critic may suggest that an alternative discipline, or even a wider cultural context, may have influenced *both* the literature *and* the science in question.

In order to tackle these problems Hayles has devised her own series of evaluative questions, which is worth quoting at length:

In the past, studies in literature and science have tended to follow a characteristic pattern. First some scientific theory or result is explained; then parallels are drawn (or constructed) between it and literary texts; then the author says in effect Q.E.D., and the paper is finished. In my view, every time this formula is used it should be challenged: What do

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to 'an express train running through a tunnel', letter to Stephen Spender dated 25 June 1935, *Letters*, v, 408.

77 Lance Schachterle, 'A Review Essay: Contemporary Literature and Science', *Modern Language Studies*, 17/2 (1987), 78-9.

78 Ibid. 79.

the parallels signify? How do you explain their existence? What mechanisms do you postulate to account for them? What keeps the selection of some theoretical features and some literary texts from being capricious? What are the presuppositions of the explanations you construct, and how do they connect with what what [*sic*] you are trying to explain? None of these questions is easy to answer. Nevertheless, if we are to arrive at a deeper understanding of the connections between literature and science (and hence implicitly of the underlying cultural dynamics), it is essential not to gloss over the hard issues.<sup>79</sup>

Again the focus here is on influence studies, but the close of the passage suggests that asking ourselves these questions when we are thinking about influence will enable us to fully assess the strength and the significance of any possible lines of direct influence that we do come across during our analyses. However, Whitworth has suggested that Hayles's questions 'might be taken as purely rhetorical' and that, although representing 'an important challenge', her list 'is by no means complete'.<sup>80</sup> Whitworth asks us to add two questions in particular: 'in what ways is your study "historical"?' and 'Why is your paper or book structured as it is, and what factors influenced its structure?'<sup>81</sup> As I said, most of these questions cannot be approached in any satisfactory manner until the conclusion of this, or indeed any similar, study, although they should clearly be borne in mind throughout. The question of structure is, however, one to which we must now turn our attention.

As I have already explained, this study is focused upon the ideas behind Einstein's three 1905 papers which, despite their apparent differences, have been shown by various historians of science to contain 'overlapping themes'; all three, according to Gerald Holton, 'arose in fact from the same general problem, namely, the fluctuations in the pressure of radiation'.<sup>82</sup> Using these three papers as its framework, this study is divided into three parts, each of which focuses on ideas related to one of the papers in particular. Both of the first two parts consist of three chapters, presenting the scientific ideas to the reader as the filling

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<sup>79</sup> Hayles, 'Complex Dynamics', 19-20.

<sup>80</sup> Whitworth, 'Physics and the Literary Community', 4-5.

<sup>81</sup> *Ibid.* 16, 5.

<sup>82</sup> Miller, *Albert Einstein's Special Theory of Relativity*, 137; Gerald Holton, *Thematic Origins of Scientific Thought: Kepler to Einstein* (rev. edn, Cambridge, Massachusetts, 1988), 192.

of this three-part sandwich. The sandwich model provides a means by which to avoid the 'characteristic pattern' to which we saw Hayles refer above, the problem with this pattern being that it prioritises the scientific aspect of the study above the literary, suggesting the presentation of a cause and its effect even if the critic intends to provide a more interdisciplinary model. Such a difficulty can be seen in *Inside Modernism*, the structure of which suggests a model of influence even though, as we have seen, Vargish and Mook repeatedly claim that such a model does not interest them. Each chapter of *Inside Modernism* deals with one of Vargish and Mook's defined values of modernism, considering its presence within relativity theory, Cubism and modernist literature, always in that order, with links being made repeatedly back from the latter discourses to the former. This suggests a model of influence of the kind that Vargish and Mook are so desperate to avoid, and that they themselves may have had doubts about their methodology is suggested by the following passage:

In this study, Relativity Theory gets the same treatment as Cubism and modernist narrative; if it earns a degree of privilege then that privilege derives from its immense resonance throughout the period and not from any claim to have discovered truth about the cosmos. Another way of saying this is to acknowledge that we treat the Special and General Theories of Relativity as important modernist works of art, the most important for our purposes because they contain and express with the highest intensity the values that for us define Modernism.<sup>83</sup>

There is something curiously circular about the argument proposed by Vargish and Mook here and, as I have said, the structure which they employ suggests and emphasises a model of influence, even though this is not intended by the authors.

Whitworth comments on this problem of priority in relation to structure at some length in the introduction to his thesis, and ultimately opts to follow the characteristic model despite the fact that, by his own admission, 'Such a structure distorts the historical pattern of events', justifying this choice because 'It is important that such works attract

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<sup>83</sup> Vargish and Mook, *Inside Modernism*, 7.

readers to whom the scientific material is unfamiliar, as well as the scientifically literate'.<sup>84</sup> In that studies within the discipline of literature and science are primarily intended for those who either work within this discipline itself – mostly critics from literary backgrounds – or for those working within literary studies as a larger field, these preliminary explanations of the scientific ideas that inform the study are clearly of great importance, and this is a question to which I will return.

The sandwich model which I follow in the first two parts of my thesis, then, is designed to facilitate both the discussion of and the distinction between direct scientific influence and what we have been calling the discourse of the moment: by focusing on the literary texts that appeared *before* the first popular accounts of the scientific ideas in question, then addressing those scientific ideas and their dissemination, and then returning to the literary texts that appeared *after* the scientific ideas could feasibly have been known by the author, the intention is to highlight those aspects of the earlier literary texts which would be ascribed to influence if they appeared in later texts, but which are, we see now, more likely to be due to some broader cultural context, no matter how hard this may be to define. Thus Parts I and II track the ways in which the ideas I am considering change through the works of Woolf and Lawrence, and both revolve around specific turning points: Part I centres on 1925, the year of the publication of Louis de Broglie's doctoral thesis on wave-particle duality; and Part II on 1921, the year in which Lawrence read that 'simple book on Einstein's Relativity' while writing *Fantasia*. However, while this chronological split facilitates the exploration of the difference between direct influence and cultural context, it also implies a more dramatic chronological divide than was really the case. My aim is certainly not to replace the traditional divide of 1919 which we discussed at the start of this introduction with new divisions in 1925 and 1921, but rather to use these dates to emphasise that the critical reliance on 1919 has been exaggerated.

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<sup>84</sup> Whitworth, 'Physics and the Literary Community', 5.

The sandwich model has other disadvantages too, some of which are not that different from those inherent in the bipartite structure: like Whitworth's, my structure also 'distorts the historical pattern of events', overwriting the simultaneity of scientific and literary development with a double chronology which gives apparent precedence to the latter. This is particularly questionable in that the literary texts that I consider were, for the most part, written *after* Einstein's original papers; but in that these were not even widely known by the scientific community in Germany in the early years after their publication, this is not as problematic as it first appears. The other difficulty is that an old-fashioned influence model is still suggested by the structure of the second two chapters of each of these first two parts: by breaking up the literary chronology of my writers in order to insert the scientific ideas into my argument, the implication is that those later texts were directly influenced by the scientific ideas to a more significant degree than my argument will itself suggest. The question of the respective advantages and disadvantages of the bipartite and sandwich structures becomes particularly urgent in the third and final part of this study, where I exchange the latter for the former. The justification for this lies in the close links between discussions of Brownian motion, molecular movement and the study of crowd psychology: in this context, it is more valid to place the scientific and psychological ideas before the literary ones because they were available in popular form before the literary texts were written, unlike those ideas considered in the first two parts.

The question as to where to place the scientific chapters within a study of this kind leads to one further, more fundamental, question: why should we have such chapters at all? By treating the scientific ideas separately from the literary ones, a greater division between these two disciplines appears in the structure of studies of this kind than is suggested by their content. And yet the aim of this study is not to state that literature and science are the same thing, but rather, with Levine, to acknowledge that 'science is somehow different

from literature after all', even though both emerge from the same cultural setting.<sup>85</sup> Closely linked to these issues is that of the extent to which the scientific ideas in question should be analysed and their history recounted. As we have already seen, Whitworth makes it clear that studies of this kind should 'attract readers to whom the scientific material is unfamiliar, as well as the scientifically literate', and this means that a certain amount of scientific background must be provided – but how much and with what level of detail?

Unlike most critics working on the links between physics and literature, I have chosen to read Einstein's papers themselves, rather than just the contemporary popularisations thereof. This may seem over-zealous: I am certainly not proposing that either Woolf or Lawrence read these papers, nor even that they were widely available in England during the early years of the twentieth century. However, as critics whose research spans two disciplines, we surely have a responsibility to grapple with both of those disciplines to a similar extent, at least as far as we possibly can. By reading the primary scientific papers and engaging with them to the full extent of our abilities we are able to approach the scientific ideas that interest us more directly and more thoroughly than if we were only to read the popularisations, thus increasing the extent to which we can engage with the other ideas that lie behind and around the scientific ones. However, in reading these papers and engaging with them as far as we can as literary critics, we must not fall into the trap of thinking of scientific papers as *just* texts; that they are texts cannot be denied, but Levine has urged caution when using this argument: 'once the "science is literature" argument is well established in its full sense, it becomes too easy to say that everything is a fiction'.<sup>86</sup> While we are justified in analysing scientific texts as texts, then, we must remember that science does not exist exclusively in a textual form; that there is more to science than the texts which describe it. If the over-privileging of science is

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<sup>85</sup> Levine, *Realism, Ethics and Secularism*, 172.

<sup>86</sup> *Ibid.*

indeed, as we have seen, an outmoded approach, the over-privileging of literature cannot be justifiable either.

What sort of analysis and exploration of the scientific papers, popularisations and ideas should the critic of literature and science provide, then? As we have already seen, Schachterle asks that we 'present a lucid, well-informed account of the scientific concepts', but such a statement is not as straightforward as it may initially seem and takes no account of the different ways in which an account can be lucid and well-informed for different readers. Meanwhile, we might ask whether such an account of the scientific concepts alone is enough: must we not also seek to present a lucid, well-informed account – whatever that proves to mean – of the social context which surrounds these scientific concepts? And how are we to do so?

A useful way to negotiate these questions lies in a focus on contemporary popular science texts, a focus which provides both an explanation of the scientific ideas and, at the same time, the chance to analyse the manner in which they were popularised. Elizabeth Leane posits popular physics as 'a "cultural interface," a point of exchange between science and literature', and Whitworth draws particular attention to the role played by generalist periodicals in 'disrupt[ing] the agreements that govern the interpretation of articles on history, literature, science, and the arts'.<sup>87</sup> The other advantage in studying generalist periodicals, Whitworth explains, is that it 'allows us to reconstruct actual and virtual social networks', networks which in turn can enable us to imagine the nature of the conversations that might have been being pursued during a particular period.<sup>88</sup> Rom Harré has suggested that the conversation is 'the fundamental human reality' and 'the most potent influence in forming our minds', adding that 'To reach the heart of the historical process we must try to reconstruct the conversation that was babbling on during the production of the works in

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<sup>87</sup> Elizabeth Mary Leane, 'Contemporary Popular Physics: An Interchange Between Literature and Science', DPhil thesis, University of Oxford, 1999, 31; Whitworth, *Einstein's Wake*, 24.

<sup>88</sup> Whitworth, *Einstein's Wake*, 19.

which we have taken an interest'.<sup>89</sup> Whitworth's use of generalist periodicals provides us with a way in which to approach the reconstruction of these unrecoverable conversations, while a broader focus on contemporary popularisations of science, especially those that we know a literary author read, will enhance our ability to discuss direct influence where relevant. The focus within the scientific sections of this study is, then, on contemporary popular science as it appeared in both books and generalist periodicals, but reference will be made to both the scientific papers themselves and the analyses of later historians of science where these seem helpful and relevant.

Bringing together all the various ideas that we have considered in this introduction, then, this thesis can be considered as a study of three scientific papers, of three intellectual figures and, most importantly, of three sets of related ideas. Focusing primarily on the period between the publication of Einstein's papers in 1905 through to the death of Virginia Woolf and the subsequent posthumous publication of her final novel, *Between the Acts*, in 1941, I consider the radical and revolutionary developments that were occurring across the culture, in particular in the fields of literature and science. This is not, however, to say that all of the ideas considered here were new in this period: rather, as Vargish and Mook explain, 'a characteristic of Modernism is not a characteristic because it has never appeared before (and thus had to be invented by modernists) but because it becomes a dominant theme or quality of the period in ways that distinguish it from earlier appearances'.<sup>90</sup> As I will show, ideas of duality and complementarity, of relatedness and relativism, and of the interactions and movements of masses, became increasingly significant during the early twentieth century, being addressed by both science and literature, and indeed the wider culture, in ways which set them apart from both earlier and later considerations of similar

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<sup>89</sup> Rom Harré, 'What is the "Zeitgeist"? Prospects and Problems for the Investigation of the Interaction of Arts and Sciences', in Martin Pollock, ed., *Common Denominators in Art and Science* (Aberdeen, 1983), 5.

<sup>90</sup> Vargish and Mook, *Inside Modernism*, 30 n. 36.

thoughts. My aim is to provide both a balance and a distinction between questions of influence and shared discourse. Such a course will be, as we have seen, by no means easy to steer, but it will provide us with a clearer understanding and measure of the impact which Einstein's ideas made outside of science in the early twentieth century, as well as highlighting the extent to which both these ideas and the reactions thereto were influenced by the other discourses which were experiencing, while also creating, the radical changes which marked the start of the twentieth century, regardless of disciplinary boundaries.

## **Part I**

### **Waves, Particles and Heuristic Points of View**

## Chapter 1

### The Obligation to Choose:

#### Representations of Duality in Virginia Woolf's Works up to 1925

The concept of wave-particle duality was developed by the French physicist Louis de Broglie in the early 1920s and states that, in certain conditions, waves, such as those of light, can behave as particles, while the basic constituents of solid matter can also behave as waves. While this discovery only affected the very small world of quantum mechanics, its philosophical impact was far-reaching, especially following Niels Bohr's proposal of the principle of complementarity in 1927. This principle states that 'Light, and indeed radiation of all kinds, is both particles and waves at the same time', while 'electrons and protons, the fundamental units of which all matter is composed ... , can also appear now as particles, and now as waves': both waves and particles are present at all times but we can only be directly aware of one of the possibilities at a particular moment, and the one that we see will depend on the one for which we look.<sup>1</sup>

The idea that Virginia Woolf's works suggest some form of relation with contemporary theories of wave-particle duality is not a new one: Judith Killen has argued that both Bernard in *The Waves* (1931) and Eleanor in *The Years* (1937) inhabit 'the quantum realm', 'revel[ing] in complementarity and uncertainty, existing as both particle and wave', while Sue Sun Yom has suggested that *Orlando* (1928) 'incorporates the beginnings of Woolf's struggle to find the deBroglie [*sic*] balance between wavelike wholeness and particlelike individuality'.<sup>2</sup> Studies of these links have tended, perhaps

1 James Jeans, *The Mysterious Universe* (Cambridge, 1930), 38, 39. These ideas will be explored in more detail in the following chapter.

2 Judith Killen, 'Virginia Woolf in the Light of Modern Physics', PhD dissertation, University of Louisville, 1984, 117, 142; Sue Sun Yom, 'Bio-graphy and the Quantum Leap: Waves, Particles, and Light as a Theory of Writing the Human Life', in Beth Rigel Daugherty and Eileen Barrett, eds., *Virginia Woolf: Texts and Contexts. Selected Papers from the Fifth Annual Conference on Virginia Woolf* (New York, 1996), 147.

unsurprisingly, to focus on *The Waves*, the very title of which seems to engage with contemporary debates as to the nature of matter. We will explore *The Waves* in greater detail in chapter three, but in order to frame our discussion of Woolf's works in relation to wave-particle duality it is worth briefly addressing a few aspects of this text here. Along with the title, the form of the novel suggests a wave-like continuum of crests and troughs, yet within this certain moments stand out clearly in a crystallised particle form: these are the moments of extreme emotion, the reunions at the restaurant and Hampton Court, and Percival's death. While working on *The Waves*, Woolf told Ethel Smyth that she was 'writing to a rhythm and not to a plot', and in the form of the novel we can see the rhythm as the patterning and continuity of the text in its wave-like aspect, while the elements of plot, which could not be entirely erased, appear as the separate moments of significance, particle-like in their distinct nature.<sup>3</sup> Both are present and both are necessary to Woolf's intention within this text. Similarly, a wave-particle model is present within the characters of *The Waves*, each of which, according to Alan Friedman and Carol Donley, 'is both an individual and a part of the continuum, both a particle and a wave', a conundrum which Bernard tries to resolve in the final section of the novel: 'Am I all of them? Am I one and distinct? I do not know'.<sup>4</sup>

The argument for the relevance of de Broglie's wave-particle model to *The Waves* is, on the surface at least, a convincing one, but Michael Whitworth has urged caution before accepting this idea too readily:

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.<sup>5</sup>

In this chapter I propose to carry out such a retrospect, locating and analysing examples of

3 Virginia Woolf, letter to Ethel Smyth dated 28 August 1930, *The Letters of Virginia Woolf*, ed. Nigel Nicolson and Joanne Trautmann, 6 vols (London, 1975-80), iv, 204.

4 Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge, 1985), 143; Virginia Woolf, *The Waves*, ed. Kate Flint (London, 1992), 222.

5 Michael H. Whitworth, *Einstein's Wake: Relativity, Metaphor, and Modernist Literature* (Oxford, 2001), 162.

wave/particle models in Woolf's works up to the end of 1925, and questioning this idea of 'anticipation' – which, as we saw in the introduction, can prove problematic – by examining some of the various contemporary discourses, both scientific and otherwise, which may have informed such models. My retrospect will consider Woolf's writing of the self and of objects as well as her understanding of the nature of light, and will focus increasingly on the significance of her use of the apparently simple conjunctions 'and' and 'or', conjunctions which, I will argue, were being put under increasing pressure by contemporary developments in the sciences and other disciplines. I have chosen to draw my line across Woolf's chronology in 1925 as it was in this year that de Broglie published his doctoral thesis in the *Annales de Physique* and, as John Gribbin states, 'It was in that form that the basis of his work became clear and sparked one of the major advances in physics during the 1920s'.<sup>6</sup> While the drawing of any line of this kind will always seem arbitrary and remain open to being contested, drawing it here will enable us to consider the ways in which Woolf's writing of dualistic models changed after the emergence of de Broglie's, and then Bohr's, ideas – if, indeed, it changed at all.

Following Whitworth, then, let us consider some examples of wave/particle models of the self in Woolf's writing on the earlier side of our imposed chronological line. These models appear in two main forms: in the first, individual characters are themselves shown by Woolf to consist of multiple selves, different fluctuating parts which must occasionally be brought together, as in *Mrs Dalloway* (1925) when we see Clarissa 'collecting the whole of her at one point'.<sup>7</sup> The difference between the multiple and the centred self is brought out particularly clearly by Peter Walsh as he reflects on Clarissa's 'transcendental theory' later in the novel:

since our apparitions, the part of us which appears, are so momentary compared with the other, the unseen part of us, which spreads wide, the

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<sup>6</sup> John Gribbin, *In Search of Schrödinger's Cat: Quantum Physics and Reality* (London, 1991), 87.

<sup>7</sup> Virginia Woolf, *Mrs Dalloway*, ed. Stella McNichol (London, 1992), 40.

unseen might survive, be recovered somehow attached to this person or that, or even haunting certain places, after death. (167)

These two parts seem to coexist here, and suggest a distinct momentary element on the one hand and a wave-like continuity on the other.

The second, and more interesting, wave/particle model of the self in Woolf's works deals with the constantly changing relationships between people. Thus in *The Voyage Out* (1915) we read of dreams going 'from one brain to another', an experience which Woolf describes as 'natural, considering how thin the partitions were between them'.<sup>8</sup> While these partitions are clearly in one sense simply the walls between the cabins on-board the *Euphrosyne*, Woolf's focus on brains suggests that those 'thin partitions' might also refer to the almost insignificant distinctions that exist between human individuals. Such a reading is certainly encouraged by some of Woolf's later writings: in the draft of *Jacob's Room* (1922), Woolf writes of 'the thin shell dividing' Jacob and Sandra, substituting 'dividing' for the earlier 'between'.<sup>9</sup> By *Mrs Dalloway*, Woolf is expressing this idea more subtly: as Rezia drinks the sedative offered by Dr Holmes following her husband's suicide, 'It seemed to her ... that she was opening long windows, stepping out into some garden. But where?' (164). As readers we know exactly where: the garden at Bourton into which Mrs Dalloway remembered herself 'plung[ing]' on the very first page of the novel (3). That these two characters have never met, let alone inhabited adjacent cabins on a small boat, and yet have come to share certain mental images suggests something of the nature of the 'thin partitions' which exist between people, allowing dreams, thoughts and memories to move between brains, as well as suggesting the possibility of the breaking of the divisive 'thin shell' which is longed for in the draft of *Jacob's Room*. And yet there is a difference between Rezia's image of Mrs Dalloway's memory and the memory itself that goes beyond Rezia's inability to locate that image. Where Clarissa 'plunged', Rezia is 'stepping', and

<sup>8</sup> Virginia Woolf, *The Voyage Out*, ed. Jane Wheare (London, 1992), 44.

<sup>9</sup> Virginia Woolf's *'Jacob's Room': The Holograph Draft*, ed. Edward L. Bishop (New York, 1998), 267.

where Clarissa 'burst open the French windows' (3), Rezia is 'opening long windows'. In Rezia's image the passion and immediacy are lost, despite the use of the continuous verb form, and as such although we recognise the parallel, we also remain aware that these are distinct characters, that the image does not have the same immediate significance for Rezia that it does for Clarissa.

Although there is no conscious 'attempt to communicate' in the scene from *Mrs Dalloway* (202), it may remind us of the difficulties that Woolf so frequently explores in terms of conveying one's thoughts and emotions to another person. Thus in *The Voyage Out*, Rachel's attempt to communicate with Mr Dalloway is described as 'a failure' (57), while later Mr Dalloway exclaims 'What solitary icebergs we are, Miss Vinrace! How little we can communicate!' (66). This desire to communicate, to both understand and be understood by another person by erasing the thin partitions or shells between people, exists in Woolf in conflict with the equal desire to remain separate as oneself and, indeed, one self. It is due to this latter desire that Helen's revelation to Rachel that she 'can go ahead and be a person of [her] own account' is met with such excitement on the part of the latter:

The vision of her own personality, of herself as a real everlasting thing, different from anything else, unmergeable, like the sea or the wind, flashed into Rachel's mind, and she became profoundly excited at the thought of living.

'I can be m-m-myself,' she stammered. (75)

This excitement at the prospect of being 'unmergeable' contrasts with Rachel's later reflections on her relationship with Hewet: 'Although they sat so close together, they had ceased to be little separate bodies; they had ceased to struggle and desire one another. There seemed to be peace between them' (298). Here the thin shell from the draft of *Jacob's Room* has been broken – Rachel and Hewet are no longer 'little separate bodies'. However, the fact that peace exists 'between' them still suggests some form of barrier, some inability to communicate, and there is something strangely unsettling, or at least

unexpected, in Woolf's use of 'Although'. Returning to the earlier passage, there is also something strange in the image of the fluid and changeable sea as 'unmergeable'.

The importance of water, in particular the sea, to all of Woolf's writing, especially the ideas of waves and particles that we are discussing here, cannot be denied. In *The Voyage Out* both the unmergeable and the mergeable aspects of the self are expressed through the imagery of bubbles, which meet and remain distinct or combine together. Thus as Rachel stirs her tea early in the novel, 'the bubbles which swam and clustered in the cup seemed to her like the union of their minds' (48). Later, reflecting on this moment, Rachel sees 'her small world becoming wonderfully enlarged' as if the bubbles are joining together here (73), and this idea reappears in Hewet's attempts to 'get out' of Hirst's impermeable circles of type (97): Hewet imagines what would happen if 'my bubble could run into some one else's bubble', the result he ponders being that 'it would be an enormous world' (98). The self here is thus envisioned as a discrete yet changing entity, a particle surrounded by a permeable membrane which allows for the expansion and contraction of the self as encouraged at any particular moment, permitting it to both merge with other selves *and* remain separate within a cluster. It is for this reason that Hewet is able to conclude that 'The truth of it is that one is never alone, and one never is in company' (98), and this inclusive 'and' which allows the simultaneous coexistence of two opposites will become increasingly important to our analyses of Woolf's writings as they unfold.

The merging or separation of selves in Woolf's works is sometimes facilitated by an external force, in particular music which leads to dance. We will consider dance scenes from *The Waves* and *The Years* in chapter three, but here we will focus on the dancing that appears close to the midpoint of *The Voyage Out*. For all three texts, however, an early essay entitled 'Street Music' (1905) forms an interesting starting point. Towards the end of this essay, Woolf discusses 'The strange sight of a room full of civilised people moving in

rhythmic motion at the command of a band of musicians', and the idea that the musicians are in command is repeated in *The Voyage Out* where the trio of father, daughter and son-in-law induce the hotel residents to appear 'Like the rats who followed the piper' (138), an image which also suggests that they may not be acting consciously.<sup>10</sup> This idea had already been developed by Woolf in an early diary entry describing a scene which, as Mitchell Leaska points out, would later be reworked in the 1907 section of *The Years*.<sup>11</sup> In the diary entry Woolf explores 'the quality which dance music has':

it stirs some barbaric instinct – lulled asleep in our sober lives – you forget centuries of civilisation in a second, & yield to that strange passion which sends you madly whirling round the room – oblivious of everything save that you must keep swaying with the music – in & out, round & round – in the eddies & swirls of the violins. It is as though some swift current of water swept you along with it. It is magic music.<sup>12</sup>

Meanwhile, in 'Street Music' Woolf discusses 'the vast possibilities that lie within the power of rhythm' and which have the potential to revolutionise 'the whole of our life'.<sup>13</sup> While Woolf's tone in the essay is humorous, her idea of the unifying nature of rhythm suggests the relevance of this essay to her later writings of scenes involving music, and dance in particular.

In *The Voyage Out*, as in the diary entry, when the music begins 'It was as though the room were instantly flooded with water' and we see the couples dancing in 'mid-stream' and in 'eddies' (139). Then,

The eddies seemed to circle faster and faster, until the music wrought itself into a crash, ceased, and the circles were smashed into little separate bits. The couples struck off in different directions ... There was a pause, and then the music started again, the eddies whirled, the couples circled round in them, until there was a crash, and the circles were broken up into separate pieces. (139)

<sup>10</sup> *The Essays of Virginia Woolf*, ed. Andrew McNeillie and Stuart N. Clarke, to be completed in 6 vols (London, 1986–), i, 30-31.

<sup>11</sup> Virginia Woolf, diary entry for 1903, 'A Dance in Queens Gate', *A Passionate Apprentice: The Early Journals 1897-1909*, ed. Mitchell A. Leaska (London, 2004), 164 n. 3.

<sup>12</sup> *Ibid.* 165. The idea of 'yielding' to music and dance reappears nearly thirty years later in *The Waves* (76), while the image of water and eddies remains key to Woolf's fictional descriptions of dance scenes, as we will see in chapter three.

<sup>13</sup> Woolf, *Essays*, i, 31.

The circles in this passage are apparently solid and particulate, thus creating a contrast with the fluid 'eddies' and the continuous flow of the narrative. Both waves and particles are thus in some sense present in this scene, and we are only able to see one of these views at a time: the circles disappear within the eddies and are then 'smashed into little separate bits'. However, the fact that the eddies themselves 'circle' reminds us of the other side of the duality even while we are focused on its incarnation as a wave.

The 'mergeable' nature of the dancers themselves is emphasised by Helen and Hewet: 'She seemed to fade into Hewet, and they both dissolved in the crowd' (139). Later we see Helen 'Bursting out of the crowd' alone (145), the violence of 'bursting' reminding us of words like 'smashed' and 'struck off' in the earlier passage. However, dance does not always ensure harmony and unity between two people, as evidenced by Rachel and Hirst: 'instead of fitting into each other their bones seemed to jut out in angles making smooth turning an impossibility, and cutting, moreover, into the circular progress of the other dancers' (139-40). In an earlier draft of this passage, Rachel and Hirst are shown to be even less compatible: 'their anatomies were unsuited; instead of fitting in to each other, the bones seemed to collide'.<sup>14</sup> Thus despite its powerful effects, music and dance are not always enough to overcome the distinctions between individuals.

Neither are they the only situations that can provoke such contrasting imagery: crowds frequently elicit similar models in Woolf's works. In *Night and Day* (1919) Katharine perceives the passing crowd in terms of a 'great torrent' and 'two currents': 'They tended the enormous rush of the current – the great flow, the deep stream, the unquenchable tide'.<sup>15</sup> The people of the crowd are indistinct to Katharine until 'Suddenly she was clutched, unwilling, from the outside, by the recollection of her purpose in coming there. She had come to find Ralph Denham' (374). This recollection of one individual

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<sup>14</sup> Virginia Woolf, *Melymbrosia*, ed. Louise DeSalvo (San Francisco, 1982), 175.

<sup>15</sup> Virginia Woolf, *Night and Day*, ed. Julia Briggs (London, 1992), 374.

instantly changes Katharine's perception of the world around her: she 'look[s] at people who had miraculously regained their solidity', and thinking of Ralph finds that 'more and more did he seem to her unlike any one else' (375). We have moved from a flowing wave-like construction of the self, whereby individuals – apart from Katharine herself – are subsumed into one 'deep stream', to a definite particulate conception, a movement which reaches its climax at the end of the chapter when Ralph appears, 'So little, so single, so separate from all else' (385). Earlier, in a slightly more complicated version of this image, Ralph had perceived the 'people in the street' as 'only a dissolving and combining pattern of black particles'; out of this wave-like swarm of undifferentiated 'particles', Katharine emerges, like Ralph, 'much detached from her surroundings' (193). Similarly conflicting images of individuals in crowds appear in *Jacob's Room*, most notably when Jacob sees Florinda 'turning up Greek Street upon another man's arm': 'Other figures, single and together, poured out, wavered across, and obliterated Florinda and the man'.<sup>16</sup> The contrast here between the wave-like movements of pouring and wavering with the very solid 'obliterated' leaves us wondering just what sort of individuals this crowd contains.<sup>17</sup>

Despite the tone of Whitworth's assertion in *Einstein's Wake*, it is not only the self that portrays the two sides of the apparent wave-particle duality in Woolf's works: solid physical objects are just as capable of becoming fluid and amorphous in Woolf's writings as anything else. Thus in *Night and Day* Ralph sees the furniture in Katharine's house as 'solid', 'and yet ... unreal' (120). However, these different perceptions can again be related back to the self, as Ralph 'scarcely knew whether [his eyes] beheld dreams or realities' (120), a question which underlies the novel as a whole as emphasised by its draft title, 'Dreams and Realities'.<sup>18</sup> Likewise, in *Mrs Dalloway* the motor car remains solid and distinct but has a curious effect on everything around it: at first it causes a 'gradual drawing

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<sup>16</sup> Virginia Woolf, *Jacob's Room*, ed. Sue Roe (London, 1992), 81.

<sup>17</sup> We will consider Woolf's writing of crowds in more detail in chapter eight.

<sup>18</sup> See Julia Briggs, *Virginia Woolf: An Inner Life* (London, 2006), ix and 34.

together of everything to one centre', acting as a kind of atomic nucleus, but then 'The world wavered and quivered and threatened to burst into flames' (16), an image which may remind us of Ralph's drawing of the 'little dot with the flames round it' towards the end of *Night and Day* (419).<sup>19</sup> The combination here of 'wavered *and* quivered' (my emphasis) is particularly forceful, suggesting that the whole world has lost its solidity and security. This moment is seen primarily through the eyes of the shell-shocked Septimus Warren Smith, and thus the duality can be ascribed, at least in part, to his conception of himself within the world and to his madness. But Septimus and his wife move on before the car, and so the 'slight ripple' which it leaves behind it, and which 'flowed through glove shops and hat shops and tailors' shops on both sides of Bond Street' (19), cannot simply be the consequence of Septimus's 'not having a sense of proportion' (106) – the effect is tangible for everyone in London, causing 'all heads' to be 'inclined the same way', even if only for 'thirty seconds' (19).

The presence of these examples of dualistic models of both the self and physical objects in Woolf's early works certainly suggests the possibility that, as Whitworth states, Woolf was working 'in anticipation of the physicists'. However, as we saw in the introduction, this idea can be problematic and needs to be treated with caution. In the first instance, we must ensure that we are fully familiar with the scientific background to any apparently anticipated scientific ideas, and in this regard it is important to acknowledge that in proposing the wave-particle duality of all matter in the 1920s, de Broglie was departing from the basis of two very important scientific papers from the start of the twentieth century: Max Planck's suggestion of quanta as discrete bundles of energy in 1900, and Albert Einstein's 1905 paper on the photoelectric effect entitled 'On a Heuristic

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<sup>19</sup> A similar image is also present in *The Voyage Out*, where Hewet re-imagines his bubble analogy so that 'all we see of each other is a speck, like the wick in the middle of that flame. The flame goes about with us everywhere; its not ourselves exactly, but what we feel' (98). Another similar image appears in Eleanor's repeated drawings of 'a dot with strokes raying out round it', Virginia Woolf, *The Years*, ed. Jeri Johnson (London, 1998), 66.

Point of View Concerning the Production and Transformation of Light'. As we will see in the following chapter, the second of these papers proposed the 'very revolutionary' (in Einstein's own words) theory that light, despite having been shown to be a wave by Thomas Young and James Clerk Maxwell in the nineteenth century, could also behave as if it were made up of individual particles, or quanta.<sup>20</sup>

If we turn, then, to representations of light in Woolf's early works, it is interesting to note that dualistic models such as we have been seeing in relation to the self and objects are also employed by Woolf in her images of light. In *The Voyage Out* Rachel and Hewet discuss notions of solidity and the self one morning after their engagement:

'Does it ever seem to you, Terence, that the world is composed entirely of vast blocks of matter, and that we're nothing but patches of light –' she looked at the soft spots of sun wavering over the carpet and up the wall – 'like that?'

'No,' said Terence, 'I feel solid; immensely solid; the legs of my chair might be rooted in the bowels of the earth.' (276)

The contrast here between solid 'vast blocks of matter' and 'soft spots of sun wavering' is clear, forming an apparently straightforward distinction between matter and light.

However, on closer inspection the notion of 'patches' and 'spots' of light suggests a more distinctly particulate and material image of light than that to which we are accustomed, an image which complicates the earlier matter/light contrast. In addition, the sibilance of 'soft spots of sun', as well as that emphasis on their softness, reminds us of the fluid, wave-like image of light that nineteenth-century science had led us to expect, drawing us from a simple contrast between light and matter to a more complicated distinction between different ways of thinking about light itself.

In *Night and Day* these contrasting conceptions of light are even more clearly expressed. When Ralph is introduced to Mary's brother Christopher, the latter is seen

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<sup>20</sup> Albert Einstein, letter to Conrad Habicht dated 18 or 25 May 1905, *The Collected Papers of Albert Einstein. English Translation*, ed. John Stachel et al., trans. Anna Beck et al., to be completed in circa 30 vols (Princeton, 1987–), v, 20.

'rising from a fluttering circle of soft feathery bodies, upon whom the light fell in wavering discs' (156). As in the previous passage, a solid particulate structure, here 'discs', is shown to be fluid and 'wavering'. However, the clearest example comes at the end of this novel, and is particularly significant in that it forms the image with which the novel closes:

Katharine pushed the door half open and stood upon the threshold. The light lay in soft golden grains upon the deep obscurity of the hushed and sleeping household. (432-3)

The 'grains' here are definite and discrete, and yet, once again, a contrast is created with the adjective 'soft', the two words together providing an unexpected pairing. We should also note that Katharine is 'stood upon the threshold' with the door 'half open', and that there is a contrast between the light outside and the 'deep obscurity' of the house which reflects the title of the novel: there are two obvious and distinct sides here, and Katharine lies somewhere between them. The novel ends with Katharine and Ralph 'loos[ing] their hands' and saying goodnight to each other (433), actions which we know will be followed by Katharine entering 'the deep obscurity of the hushed and sleeping household' while Ralph remains outside in the light. However, the final image remains balanced between inside and outside, darkness and light – and thus also night and day and dreams and realities – with Katharine's position on 'the threshold' providing an intermediary position between two opposites.

Of course, light was a key element for Woolf, especially in relation to its opposite, darkness. The very title of *Night and Day* draws attention to this antithesis, and the fact that we are almost halfway through the novel before Ralph 'realised suddenly that he had never seen [Katharine] in the daylight before' emphasises the contrast between the two (197). Light is also significant for Woolf because of its transformative effects, an idea which appears in the same section of *Night and Day*: the sentence immediately preceding the one above ends 'everything about her seemed rapid, fragmentary, and full of a kind of

racing speed' (197). Stephen Kern has reflected on the changes of perception wrought by the introduction of electric lighting, and his assessments seem to have some relevance to *Night and Day* as a whole: 'One of the many consequences of this versatile, cheap, and reliable form of illumination was a blurring of the division of day and night'.<sup>21</sup> While electric lighting had already been in existence for nearly forty years by the time *Night and Day* was published – and, indeed, was used for the first time in New York in 1882, the year of Woolf's birth – the recent blackouts imposed by the First World War had perhaps made this into a pressing issue once more. Such an assumption is reinforced by a 1915 note in *The Observatory*: 'The recurrence to darkness in the streets also reminds us how rapid have been the changes which gas and electric light have brought'.<sup>22</sup> The fact that Ralph first gets to know Katharine in artificial light, and only later in daylight, certainly seems significant and suggests a 'blurring' of the kind Kern highlights between the opposites of both the final and draft titles of Woolf's novel, *Night and Day* and 'Dreams and Realities'.

In Woolf's works light is capable of changing both people and objects, making them more distinct, clearer, more solid or, interestingly, more amorphous. These effects are particularly evident in the italic interludes of *The Waves*, but are present in Woolf's earlier works too. In a 1905 essay entitled 'A Walk By Night' Woolf explores the impact of both the presence and the absence of light, stating that 'a dozen lights can do much to solidify the world'.<sup>23</sup> The essay ends with a focus on 'the unfathomed waters of darkness', in which 'only the phantoms and spirits of substantial things' can be seen, there are no 'harsh outline[s] of reality', and 'the earth with its infinity of detail was dissolved into ambiguous space'.<sup>24</sup> A similar image appears in *The Voyage Out*: 'The sun was beginning to go down, and a change had come over the mountains, as if they were robbed of their earthy

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21 Stephen Kern, *The Culture of Time and Space 1880-1918* (Cambridge, Massachusetts, 1983), 29.

22 'From an Oxford Note-Book', *The Observatory*, 38/492 (October 1915), 414.

23 Woolf, *Essays*, i, 81.

24 *Ibid.* i, 82.

substance, and composed merely of intense blue mist' (192).

However, light in Woolf does not always solidify scenes and objects – it is also capable, as I have said, of making them more amorphous. Thus in the 'Green' section of the short story 'Blue & Green' (1921) we begin by seeing the light itself as fluid, as it 'slides down the glass, and drops a pool of green', but then find that it is also able to liquefy the glass itself: 'the hard glass drips on to the marble'.<sup>25</sup> What is particularly notable here is that the glass remains 'hard' even as it 'drips', almost as if it is still in the furnace in which it was originally created. Light also becomes something like a protagonist, or at least a subject, in 'Kew Gardens' (1919):

The light fell either upon the smooth grey back of a pebble, or the shell of a snail with its brown circular veins, or, falling into a raindrop, it expanded with such intensity of red, blue and yellow the thin walls of water that one expected them to burst and disappear.<sup>26</sup>

In her notes to this story, Susan Dick quotes a letter from Katherine Mansfield to Woolf from 1917: 'Yes, your Flower Bed is *very* good. Theres [*sic*] a still, quivering, changing light over it all and a sense of those couples dissolving in the bright air which fascinates me'.<sup>27</sup> This 'changing light', light as a force which is capable of altering and re-forming everything with which it comes into contact, appears frequently in Woolf's work throughout her career. Significantly for our purposes, the two main effects that light can have on objects in Woolf's works, either solidifying them or making them more fluid, are suggestive of the two properties that Einstein ascribed to light in his 1905 paper: for Einstein, as we will see in the following chapter, light was a 'fusion' of particle and wave; for Woolf, light could make things both particulate and distinct *and* wave-like and fluid.<sup>28</sup>

It is not surprising that Woolf's style of writing, and in particular her way of writing about light and its effects, has been compared to the visual art of the early twentieth

<sup>25</sup> *The Complete Shorter Fiction of Virginia Woolf*, ed. Susan Dick (2<sup>nd</sup> edn, San Diego, 1989), 142.

<sup>26</sup> *Ibid.* 90.

<sup>27</sup> Katherine Mansfield, letter to Virginia Woolf dated c. 23 August 1917, *The Collected Letters of Katherine Mansfield*, ed. Vincent O'Sullivan and Margaret Scott, 5 vols (Oxford, 1984-2008), i, 327.

<sup>28</sup> Einstein, *English Translation*, ii, 379.

century, especially Impressionism and Post-Impressionism: in 1912 the French artist Robert Delaunay declared that 'Impressionism is the birth of *Light* in painting', and Donald Benson has emphasised that Impressionist painters were seeking 'to render the colour effects of light in a manner faithful to visual experience', as well as 'to render light itself as a substance'.<sup>29</sup> Diane Gillespie links Woolf's descriptions of light, especially in the interludes of *The Waves*, to Impressionist series-paintings in which, as Gillian Beer puts it, 'light itself becomes the topic'.<sup>30</sup> Indeed, Julia Briggs sees 'The question of whether light defined or created form' as the central area of debate between Impressionism and its successor, an idea which is reinforced by Desmond MacCarthy's introduction to the catalogue for the 1910 Post-Impressionist exhibition:

what is new in these [Impressionist] pictures is simply the method of representing the vibration of light by painting objects in dots and squares. The Post-Impressionists on the other hand were not concerned with recording impressions of colour or light. They were interested in the discoveries of the Impressionists only so far as these discoveries helped them to express emotions which the objects themselves evoked.<sup>31</sup>

Such ideas lead to Clive Bell's focus on 'significant form' and 'plastic' rather than 'descriptive' art in which 'Forms and the relation of forms have been for [the Post-Impressionists], not means of suggesting emotion but objects of emotion'.<sup>32</sup> Woolf, I would argue, is concerned with both sides of this debate, but in her early works it is, as the quotations we have explored above suggest, the Impressionist issue of the effect of light upon objects that most frequently wins through.

Like MacCarthy, Kathryn Benzel highlights the Impressionist attempt at 'breaking up colours into particles' in order to create an 'indeterminate perspective' in which 'the

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29 Robert Delaunay, 'Light', in Vassiliki Kolocotroni, Jane Goldman and Olga Taxidou, eds., *Modernism: An Anthology of Sources and Documents* (Edinburgh, 1998), 195; Donald R. Benson, "'Catching Light": Physics and Art in Walter Pater's Cultural Context', in George Levine, ed., *One Culture: Essays in Science and Literature* (Madison, 1987), 153.

30 Diane Filby Gillespie, *The Sisters' Arts: The Writing and Painting of Virginia Woolf and Vanessa Bell* (New York, 1988), 303; Gillian Beer, *Virginia Woolf: The Common Ground* (Edinburgh, 1996), 89.

31 Briggs, *Inner Life*, 182; Desmond MacCarthy, 'The Post-Impressionists', in Kolocotroni, Goldman and Taxidou, eds., *Modernism*, 175.

32 Clive Bell, 'The English Group', in Kolocotroni, Goldman and Taxidou, eds., *Modernism*, 193.

focus is on the space separating the colours rather than a large mass of colour'.<sup>33</sup> Such a desire is perhaps reflected in Hewet's aim in *The Voyage Out* 'to write a novel about Silence ... the things people don't say' (204), and it is interesting to note that in an earlier incarnation Hewet's literary attempt seems more closely linked to contemporary artistic ideas:

Behind every sensation there is a shape. Have you ever seen great flowers made of fireworks? They are made of dots of light. Sensations are dots; combine them and you have a flower or a cow or a tea pot. To combine them, to find out their shape, that is my trade. I've never done it so far, because the sensations themselves are so overwhelming.<sup>34</sup>

Here we seem to have a combination of the two forms of Impressionism: dots of light and sensations as dots with gaps in-between them, as in Impressionism, but also a desire, although unfulfilled here, to combine the dots, to find the underlying shape, as in Post-Impressionism. Allen McLaurin notes a similar effect in *Night and Day*, describing the beginnings here of 'an attempt to move from impressionism to post-impressionism by the use of the recurring image of the web'.<sup>35</sup> Similar images can be found in the 1914 section of *The Years* when Martin looks at a woman who appears 'as if she were caught in a net of light; as if she were composed of lozenges of floating colours'; the 'net of light' is like McLaurin's Post-Impressionist web, while the 'lozenges of floating colours' seem to take us back to the earlier artistic movement, as do the 'separate points of light' which appear later in the same paragraph (177). The relevance of contemporary artistic models to Woolf, then, seems clear, as do the parallels between contemporary art and science, especially in their focus on light, and this cross-disciplinary focus confirms the relevance of Beer's idea that literature and science 'share the moment's discourse'.<sup>36</sup>

33 Kathryn N. Benzel, 'Verbal Painting in "Blue & Green" and "Monday or Tuesday"', in Kathryn N. Benzel and Ruth Hoberman, eds., *Trespassing Boundaries: Virginia Woolf's Short Fiction* (Basingstoke, 2004), 162.

34 Woolf, *Melymbrosia*, 226.

35 Allen McLaurin, *Virginia Woolf: The Echoes Enslaved* (Cambridge, 1973), 37.

36 Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 171. It is worth noting in passing, although perhaps no more than that, that Daniel Albright has described Einstein himself as 'a kind of Impressionist or Post-Impressionist', *Quantum Poetics: Yeats, Pound, Eliot, and the Science of*

In talking of Woolf in relation to both art and science we are naturally led to the figure of Roger Fry who, having abandoned a career in the sciences, became an artist and, in 1910, introduced the ideas and paintings of the Post-Impressionists to a shocked British audience. Fry's scientific background is particularly interesting to explore, and we will examine it in detail in the following chapter, but for now let us focus on some of his artistic ideas. Most significantly for our purposes, Fry, like Woolf had a 'fondness for dualist formations', and in Fry's case this appears most clearly in 'An Essay in Aesthetics' (1909).<sup>37</sup> Here Fry reflects on the idea that humans, unlike animals, have 'the possibility of a double life; one the actual life, the other the imaginative life', adding that between the two there is a 'great distinction'.<sup>38</sup> This may remind us of Woolf's phrase 'dreams and realities', and Fry goes on to explain that art is 'the chief organ of the imaginative life'.<sup>39</sup> While there certainly seems to be some kind of overlap here in terms of Woolf's and Fry's dualistic ways of approaching the world, we should not imagine from this that their artistic ideas were always in agreement: in a 1920 diary entry, comparing Fry's recently-published *Vision and Design* with Samuel Taylor Coleridge, Woolf exclaims, 'Fancy reforming poetry by discovering something scientific about the composition of light!'<sup>40</sup>

Woolf and Fry's interest in duality was not unusual at the start of the twentieth century, and can in fact be traced back to the Victorian period. As George Levine writes, 'Dualism was at the centre of virtually every Victorian argument', with 'the natural world, open to understanding by way of empirical study and rational analysis' on the one hand, and 'the world behind it, a world of mystery, a world of spirit, an enchanted world' on the other: that is to say, the world of science and the world of religion, or at least the

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*Modernism* (Cambridge, 1997), 11. See also A. S. Eddington on Impressionist painting as a model for thinking about nineteenth-century science, *The Nature of the Physical World* (Cambridge, 1928), 103.

37 McLaurin, *Echoes Enslaved*, 23.

38 Roger Fry, *Vision and Design* (London, 1920), 12.

39 *Ibid.* 16.

40 Virginia Woolf, diary entry for 19 December 1920, *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, 5 vols (1977-1984), ii, 81.

mystical.<sup>41</sup> Such an interest in and focus on duality can be traced back much further than the Victorian period, of course: Robert Nadeau discusses the Greeks in this regard, explaining that 'a belief in the duality of Being' became 'one of the most basic features of the symbolic universe of Western man', 'the most characteristic feature of Western philosophical and theological thought'.<sup>42</sup> The Victorian period, however, seems to have been particularly focused on the question of dualities, as Levine's appraisal suggests; in turn, Woolf's interest in and engagement with dualistic ideas seems to have been particularly urgent and fundamental, and it is worth considering here some of the possible reasons behind this.

Hermione Lee has explored the 'dramatic splits' and 'Lines of division' which Woolf perceived in her own childhood family life and which she recorded in her autobiographical writing in her later years.<sup>43</sup> In 'Sketch of the Past', written in a series of diary-like entries through 1939 and 1940, Woolf explains that 'Two different ages confronted each other in the drawing room at Hyde Park Gate. The Victorian age and the Edwardian age', adding 'We were living say in 1910; they were living in 1860'.<sup>44</sup> The difference between these two ages is described by Woolf as a 'gulf', and another set of 'deep divisions' is symbolised by the different floors of the house: 'Downstairs there was pure convention; upstairs pure intellect'.<sup>45</sup> Lee describes this division as 'the extreme, absurd contrast between the social life the two girls were being forced into by their older half-brother George, and the reclusive life of the mind going on in their father's study', and Woolf repeatedly emphasises that 'there was no connection between them'.<sup>46</sup> Meanwhile, Lee suggests that 'From the

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41 George Levine, *Realism, Ethics and Secularism: Essays on Victorian Literature and Science* (Cambridge, 2008), 65.

42 Robert Nadeau, *Readings from the New Book on Nature: Physics and Metaphysics in the Modern Novel* (Amherst, 1981), 10, 25.

43 Hermione Lee, *Virginia Woolf* (London, 1997), 55

44 Virginia Woolf, *Moments of Being: Autobiographical Writings*, ed. Jeanne Schulkind (rev. edn, London, 2002), 149, 150.

45 Ibid. 149, 159, 158.

46 Lee, *Virginia Woolf*, 55; Woolf, *Moments of Being*, 158.

start, one of the most dramatic splits was the contrast between [Woolf's] father and her mother', and this split again appears clearly in 'Sketch of the Past'; here Woolf discusses her 'pride and pleasure' in the feminine beauty of her mother and her half-sister Stella, but explains that this feeling was accompanied by one of 'shame', a fact which she puts down to her having 'inherited some opposite instinct' which is associated by Woolf with her 'spartan, ascetic, puritanical' father.<sup>47</sup>

The sense of divisive opposites was present even within Woolf's own room at 22 Hyde Park Gate which was split between 'the living half' and 'the sleeping half', but while the gap between the two was significant, creating 'those two lives that the two halves symbolised', it was not as unbridgeable as the others that we have considered so far: 'Which should I describe first?' asks Woolf, explaining that 'They must be described separately; yet they were always running together'.<sup>48</sup> Unlike the other differences listed above, there is clearly a connection between these two halves of the one room: they are separate, distinct and particulate, yet they are also linked by a more fluid division than exists elsewhere within the Stephen family household as Woolf describes it.

The effect which such divisions and opposites had on Woolf as a child and a young woman cannot be overestimated, and neither can their ongoing impact on her ideas and her writing, as her close focus on such examples of division throughout 'Sketch of the Past' emphasises. Indeed, the entry with which this text closes, at least in the manuscript version, concludes with a focus on the impact upon Woolf of this dualistic lifestyle. The closing paragraph is quoted here in full:

There they were, on the verge of the drawing room, these great men: while, round the tea table, George and Gerald and Jack talked of the Post Office, the publishing office, and the Law Courts. And I, sitting by the table, was quite unable to make any connection. There were so many different worlds: but they were distant from me. I could not make them

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<sup>47</sup> Lee, *Virginia Woolf*, 55; Woolf, *Moments of Being*, 82. These opposite instincts are, of course, captured most vividly by Woolf in her portrayal of the Ramsay marriage in *To the Lighthouse* (1927).

<sup>48</sup> Woolf, *Moments of Being*, 128, 130, 129.

cohere; nor feel myself in touch with them. And I spent many hours of my youth restlessly comparing them. No doubt the distraction and the differences were of use; as a means of education; as a way of showing one the contraries. For no sooner had I settled down to my Greek than I would be called off to hear George's case; then from that I would be told to come up to the study to read German; and then the gay world of Kitty Maxse would impinge.<sup>49</sup>

Woolf suggests here that her awareness from childhood onwards of 'differences' and 'contraries' was 'of use', an idea which also appears in *A Room of One's Own* (1929) where Woolf asks 'Ought not education to bring out and fortify the differences rather than the similarities? For we have too much likeness as it is'.<sup>50</sup> However, it is also clear that such an awareness was troubling in some way, leading to that urge to 'make any connection' which seems to have remained with Woolf throughout her life. These autobiographical details, then, help to explain Woolf's constant return to attempts both to explore both sides of a particular issue or thing, as well as to try to reconsider the two within some form of complementary model. Leaska calls this Woolf's 'dual vision', adding that it 'remained with her throughout her life'.<sup>51</sup>

This 'dual vision' is key to Woolf's writing, as many critics, including the first student to write a PhD thesis on Woolf, have argued: in 1932 Ruth Gruber defended her thesis in which she had explained that 'A law of polarity, of conflicts as irreconcilable, as endless as night and day, reverberates through all Virginia Woolf's writing'.<sup>52</sup> Woolf was also aware of this element of her writing: Lee quotes a letter from Woolf to Beatrice Howe in 1926 in which Woolf explains the problem of 'two instincts [poetry and realism] each running away, and seeming to refuse to combine', adding 'I am sure that writers thus complicated with two points of view develop more slowly and blunderingly than the simpler sort'.<sup>53</sup> While this letter was written in Woolf's capacity as one of the editors of the

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49 Ibid. 159-60.

50 Virginia Woolf, *A Room of One's Own/Three Guineas*, ed. Michèle Barrett (London, 1993), 79.

51 Mitchell A. Leaska, Introduction to Woolf, *Passionate Apprentice*, xxvii.

52 Ruth Gruber, *Virginia Woolf: The Will to Create as a Woman* (New York, 2005), 124.

53 Woolf, letter to Beatrice Howe dated 31 May 1926, quoted in Lee, *Virginia Woolf*, 373.

Hogarth Press, and thus can be seen to contain an element of flattery and encouragement, such letters, as Lee states, are 'as revealing about [Woolf's] own work' as of that which is ostensibly being discussed within them.<sup>54</sup>

A simple glance at some of the titles employed by Woolf highlights the importance of dualistic images to her work as a whole: *Night and Day*, 'Monday or Tuesday' (1921), 'Blue & Green', 'Together *and* Apart' (published posthumously 1944), to name but a few, and the fact that the conjunction is usually 'and' rather than 'or' is also significant.<sup>55</sup> As we have seen, Woolf considered calling *Night and Day* 'Dreams and Realities', a phrase which, as Briggs points out, 'had been used by Terence Hewet in *The Voyage Out*: 'Dreams and realities, dreams and realities, dreams and realities' (172).<sup>56</sup> As I have already said, the question as to how to balance these two opposites underlies the whole of *Night and Day*, a point which is emphasised by the fact that when the phrase is repeated in this novel, the conjunction is 'or' rather than 'and': '[Ralph] scarcely knew whether [his eyes] beheld dreams or realities' (120). Not long before this passage in the novel, we are told that Ralph 'thought he could pride himself upon a life rigidly divided into the hours of work and those of dreams; the two lived side by side without harming each other' (104), but Woolf shows us in the course of the novel that such a division is unsustainable, that sooner or later it will break down, leaving us unable to distinguish between dreams *and* realities. It is this that causes the 'lapses' in Ralph and Katharine's relationship, meaning that 'The fragmentary nature of their relationship was but too apparent' (403), and that they are able to 'come together' only 'for a moment' at a time (402). Learning to live with both sides of this duality in some kind of complementary form, one involving an 'and' rather than an 'or', is the only

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54 Lee, *Virginia Woolf*, 373.

55 Having said this, when referring to her short story collection *Monday or Tuesday* in 1930 Woolf writes '*Monday* or (or is it "and"? – see, how seldom I look at my own works) *Tuesday*' and, later in the same letter, 'Monday or (and) Tuesday', letter to Ethel Smyth dated 16 October 1930, *Letters*, iv, 230, 231.

56 Briggs, *Inner Life*, 409 n. 15. In addition, Brenda Lyons suggests that 'Woolf's title (also one of her own essays) "Dreams and Realities" is probably an intentional allusion to Leslie Stephen's essay of the same title published as the third chapter in his book, *An Agnostic's Apology* (1893)', 'Textual Voyages: Platonic Allusions in Virginia Woolf's Fiction', DPhil thesis, University of Oxford, 1995, 163 n. 6.

solution. However, the 'and' needs to be more fluid than the one that appears in the rigidly divisive phrase 'the hours of work and those of dreams': rather than just living 'side by side without harming each other', there needs to be some kind of balance and integration between these two kinds of hours, these two different ways of approaching the world; like the two halves of Woolf's childhood room, they should be separate but also run together.

While, as we have seen, 'Dualism was at the centre of virtually every Victorian argument', and while this focus on dichotomies appears to have continued into the early twentieth century, it is also apparent that the latter period marked a shift away from certain Victorian values, with many intellectuals in Woolf's circle defining themselves in contrast to those of the previous generation, just as Woolf does in 'Sketch of the Past'. As Elaine Showalter explains, 'Not only the conventions for representing character had changed for Woolf's generation, but also the very concept of character and personality', moving from the idea of the personality as 'one given fixed monolithic entity' to that of 'a shifting conglomerate of impressions and emotions', a movement that we have already seen Woolf expressing in her own works.<sup>57</sup> Psychology was the main discipline tackling these changing views and shifting personalities at the time, as well as making a fundamental division between the conscious and the unconscious parts of the mind. Woolf was certainly aware of the latter division, writing in 'Modern Novels' (1919) of the new focus on the 'dark region of psychology', a phrase which is better known in its 1925 form, 'the dark places of psychology', in the revised version of the essay under the title 'Modern Fiction'.<sup>58</sup> Meanwhile, in 'How Should One Read a Book?' (1926) Woolf describes the soul itself as dualistic, consisting of 'the light side and the dark side': 'Both are equally real, equally important. But a novelist will always tend to expose one rather than the other'.<sup>59</sup> Again we see here in Woolf's writing the distinction between light and dark, day and night, realities

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<sup>57</sup> Elaine Showalter, Introduction to Woolf, *Mrs Dalloway*, xviii.

<sup>58</sup> Woolf, *Essays*, iii, 35; iv, 162. The shift from the singular 'region' to the plural 'places' is also significant.

<sup>59</sup> *Ibid.* iv, 392.

and dreams, as well as a hint that such distinctions, when treated as mutually exclusive, are limiting in some way.

To sum up, then, it is clear that dualistic images had some special meaning for both Virginia Woolf and the wider society of which she was a part: science, art and literature were all facing the problem of how to resolve, or at least to understand and express, dichotomies. For Woolf, dualities are capable of providing fertile metaphors and sites of departure, yet they frequently seem to become limiting too, especially if the conjunction they imply is 'or', although, as we have seen, the conjunction 'and' is not always as inclusive as it might first appear. The limitations of either/or are particularly well expressed by Woolf in *Jacob's Room*: 'Either we are men, or we are women. Either we are cold, or we are sentimental. Either we are young, or growing old' (60). The use of a comma to split each of these sentences into their two distinct parts emphasises the impossibility of overcoming these distinctions: as Woolf explains a few pages earlier 'we must choose', adding 'Never was there a harsher necessity! or one which entails greater pain, more certain disaster; for wherever I seat myself, I die in exile' (57).

Winifred Holtby, writing in the early 1930s, felt that 'The contrasts, perhaps, in *Jacob's Room* are too violent', and Woolf's later writing certainly suggests an attempt to reduce the starkness of such contrasts, to overcome that dreaded 'or'.<sup>60</sup> Thus in *Mrs Dalloway* there is a repeated questioning of the utility of a 'this or that' formula, primarily, although not exclusively, from Clarissa's perspective:

She would not say of any one in the world now that they were this or were that. She felt very young; at the same time unspeakably aged. She sliced like a knife through everything; at the same time was outside, looking on. (8-9)

There is definite progress here from the very black and white formulation of *Jacob's Room*: although the 'or' remains in the first sentence, the comma has been lost, thus limiting the

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<sup>60</sup> Winifred Holtby, *Virginia Woolf* (London, 1932), 136.

distinction between 'this or that'. Meanwhile, in the later sentences we see the use of 'at the same time', an expression which helps to overcome the ambiguity that we have discussed in the word 'and'. However, in these sentences punctuation returns as a divisive factor, the semi-colon providing a more significant stopping place than the comma. By the end of the paragraph, the 'or' has been lost completely, and the less drastic comma has returned: 'she would not say of Peter, she would not say of herself, I am this, I am that' (9).

Woolf had already used the 'this or that' formula in her essay 'Modern Novels', and again in the revised version 'Modern Fiction'. Here, in a much quoted passage, Woolf writes that the modern novelist 'has to have the courage to say that what interests him is no longer this, but that; out of "that" alone must he construct his work'.<sup>61</sup> The 'this' and 'that' are mutually exclusive here, and the novelist must now reject the former in favour of the latter. However, towards the end of the paragraph Woolf explores 'how complete' and 'how profound' Anton Chekhov's 1890 short story 'Gusev' is, and 'how truly in obedience to his vision Tchekhov [*sic*] has chosen this, that, and the other, and placed them together to compose something new'.<sup>62</sup> We should note that while Chekhov has 'placed together' 'this, that, and the other' he has not combined them in any detrimental sense, as emphasised by the separating commas. The move from 'this or that' to 'this and that', or even 'this, that, and the other' is one which we will consider in more detail when we look at Woolf's later works in chapter three, but it is worth noting that the example from *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.

What Woolf really wants to write, then, is 'and', in spite of her awareness of the dualities inherent in everyday life – precisely, in fact, because of them. However, this 'and' cannot be the divisive 'and' of 'the hours of work and those of dreams' that we have seen in

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<sup>61</sup> Woolf, *Essays*, iii, 35 and iv, 162. Note that in the revised version the earlier 'this' and 'that' also appear within inverted commas.

<sup>62</sup> *Ibid.* iii, 35 and iv, 163.

*Night and Day*. Woolf's aim is instead to find a way to write an inclusive 'and', an 'and' that will allow the simultaneous existence of the two sides of any duality, whether we think of that in terms of waves and particles, dreams and realities, night and day, or any other formulation. There are brief attempts at this in Woolf's earliest novels: we have already seen Hewet's repetition of 'Dreams and realities, dreams and realities, dreams and realities' in *The Voyage Out*, although we must acknowledge here that Hewet himself repeats this 'scarcely knowing what he said' (172). Meanwhile, in *Night and Day* Ralph develops 'an odd image' of

a lighthouse besieged by the flying bodies of lost birds, who were dashed senseless, by the gale, against the glass. He had a strange sensation that he was both lighthouse and bird; he was steadfast and brilliant; and at the same time he was whirled, with all other things, senseless against the glass. (334)

Woolf's focus on the oddness and strangeness of this image helps us to appreciate how difficult it is to write both/and in comparison to the more familiar and straightforward either/or; indeed, this latter formulation has been described by Nadeau as 'the most pervasive organising principle within [our] symbolic universe'.<sup>63</sup> Thus while Ralph is 'both lighthouse and bird' in the first clause of that second sentence, without any interruption, by the second clause the familiar semi-colon has reappeared to enforce the division which Woolf is trying to limit with her 'and at the same time'. In Woolf's early works, then, the writing of both/and can be attempted but cannot be sustained for long, and this is a problem to which Woolf will return again and again, most notably in trying to re-imagine the divisions of gender in *Orlando*, as we will see in chapter three.

Woolf was not alone in this attempt to write an inclusive 'and', however. As we will see in the following chapter, the scientific problem of wave-particle duality, as introduced by Einstein, elaborated by de Broglie and refined by Bohr, required the development of an inclusive 'and' which would express a new complementarity between ideas which had

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<sup>63</sup> Nadeau, *Readings from the New Book*, 11.

previously been understood to be antagonistic. Woolf's writings of wave/particle models, of dualistic images, and of an attempt at both/and situate her, then, not in advance of the physicists, but in parallel with them, at the very forefront of some of the key scientific and philosophical questions of her day. The obligation to choose a side in *Jacob's Room* is stifling, as is the scientific obligation to choose between waves and particles; thus in his principle of complementarity Bohr seeks 'to provide a frame wide enough to embrace the account of fundamental regularities of nature which cannot be comprehended within a single picture'.<sup>64</sup> This wider frame provides a sense of liberation for twentieth-century science and thought, a freedom from opposites in the development of an inclusive 'and' which is able to overwrite, *while still expressing*, difference.

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<sup>64</sup> Niels Bohr, *Essays 1958-1962 on Atomic Physics and Human Knowledge* (New York, 1963), 12.

## Chapter 2

### Waves and Particles, Tigers and Sharks:

#### The Development of Wave-Particle Duality and Complementarity

Having reached the mid-1920s in our survey of Virginia Woolf's works, we will pause at this point to focus on the scientific developments associated with the dualistic ideas that we have been discussing. Starting with a consideration of the work of Louis de Broglie and Niels Bohr, we will then explore the scientific background to their research in the investigations of Max Planck and Albert Einstein. We will consider popular expositions of these discoveries as well as the significance of other disciplines, both scientific and non-scientific, to the development of these scientific ideas, exploring the discourse of duality and complementarity which came to be shared across disciplines during the early twentieth century.

In 1925 scientific images of duality came to prominence when Louis de Broglie published his doctoral thesis outlining his theories on the wave-particle duality of both light and matter which he had started developing in 1923. As Bruce Wheaton explains, the revolutionary aspect of this theory was that 'it did not distinguish between an atom of matter and an atom of light': the particulate nature of matter and the wave-like structure of light as provided by classical physics were both shown to be only part of the story.<sup>1</sup> In his 1930 best-seller *The Mysterious Universe*, James Jeans explained this development as follows:

We may sum up by saying that the ingredients of matter (electrons and protons) and radiation both exhibit a dual nature. So long as science deals only with large scale phenomena, an adequate picture can generally be obtained by supposing both to be of the nature of particles. But when science comes to closer grips with nature, and passes to the study of

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<sup>1</sup> Bruce R. Wheaton, *The Tiger and the Shark: Empirical Roots of Wave-Particle Dualism* (Cambridge, 1983), 293.

small scale phenomena, matter and radiation are found equally to resolve themselves into waves.<sup>2</sup>

Jeans adds that 'If we want to understand the fundamental nature of things, it is to these small scale phenomena that we must turn our attention', and thus suggests that 'we are beginning to suspect that we live in a universe of waves, and nothing but waves'.<sup>3</sup>

In the same year that de Broglie put forward his radical proposals as to the nature of matter, J. J. Thomson discussed the difficulties inherent in the duality that had already been shown to exist for light, explaining it as follows:

The position is thus that all the optical effects point to the undulatory theory, all the electrical ones to something like the corpuscular theory; 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.<sup>4</sup>

That scientists struggled to grasp and accept such a duality is unsurprising, but nevertheless, as Wheaton explains, 'by 1927 most influential European physicists had learned to accept the duality of waves and particles'.<sup>5</sup> In addition, in 1929 de Broglie was awarded the Nobel Prize in Physics 'for his discovery of the wave nature of the electron'.<sup>6</sup>

In terms of its philosophical impact, for scientists and non-scientists alike, wave-particle duality acquired a more intriguing and more problematic significance in 1927 when, at the International Congress of Physics in Italy, Bohr proposed his principle of complementarity. Having explored the necessity and yet the apparent incompatibility of the wave and quantum theories of light, Bohr explained that 'The two views of the nature of light are rather to be considered as different attempts at an interpretation of experimental evidence in which the limitation of the classical concepts is expressed in complementary ways'.<sup>7</sup> In the following paragraph he extends this interpretation of the dual nature of light

<sup>2</sup> James Jeans, *The Mysterious Universe* (Cambridge, 1930), 43.

<sup>3</sup> Ibid. 44.

<sup>4</sup> J. J. Thomson, *The Structure of Light* (Cambridge, 1925), 15.

<sup>5</sup> Wheaton, *The Tiger and the Shark*, 306.

<sup>6</sup> Quoted in Abraham Pais, *'Subtle is the Lord...' The Science and the Life of Albert Einstein* (Oxford, 1982), 515.

<sup>7</sup> N. Bohr, 'The Quantum Postulate and the Recent Development of Atomic Theory', *Nature*, 121/3050 (14

to that of matter: 'here again we are not dealing with contradictory but with complementary pictures of the phenomena'.<sup>8</sup> However, the pictures are not just complementary; they are 'complementary but exclusive' in that, as Gerald Holton explains, 'an atomic entity cannot exhibit both its particle and its wave properties simultaneously'.<sup>9</sup> As such, whether we see a wave or a particle depends on whether we look for a wave or a particle: if we construct a double slit experiment of the kind used by Thomas Young in the nineteenth century in order to prove that light was a wave, but send a stream of electrons through the slits rather than a beam of light, the electrons will produce interference patterns like a series of light waves. However, if we think of electrons orbiting a nucleus, as in the contemporary atomic models designed by Ernest Rutherford and Bohr, they will behave as particles, jumping between states and retaining definite locations in time and space. Both waves and particles are thus as real, or as fictitious, as each other, but we can only ever be aware of one manifestation at a time, and our choice of experiment determines which we will see.

If we return to Thomson's formulation of duality as 'like a contest between a tiger and a shark' we will 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: if we go to the jungle we will see a tiger, whereas if we look in the sea we will see a shark – whichever animal we look for we will see, but finding a tiger in the jungle does not mean that there is not a shark in the sea *at the same time*. Both exist simultaneously in the natural world, but we will only be able to see one at any given moment; and the one that we see is determined by the choice we make in terms of which to seek.<sup>10</sup>

It is interesting to note that Woolf's 1928 novel *Orlando* includes an image which is

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April 1928), 581.

<sup>8</sup> Ibid.

<sup>9</sup> Ibid. 580; Gerald Holton, *Thematic Origins of Scientific Thought: Kepler to Einstein* (rev. edn, Cambridge, Massachusetts, 1988), 140 n. 4.

<sup>10</sup> The fact that there is such an animal as the tiger shark should not be allowed to confuse matters here, although it is worth considering the extent to which Thomson may have had it in mind when choosing to contrast two animals which are apparently so far removed from each other.

strangely like Thomson's of the tiger and the shark, although without the focus on the 'contest' between these two opposites which is integral to Thomson's description: 'A poet is Atlantic and lion in one. While one drowns us the other gnaws us. If we survive the teeth, we succumb to the waves. A man who can destroy illusions is both beast and flood'.<sup>11</sup> Here the apparently opposite forces of Atlantic and lion are united in the figure of the poet; both exist in the same 'element' without needing to compete with one another. While I am not suggesting that Woolf necessarily knew Thomson's text directly, the similarity is an interesting one and may suggest that this kind of image had a particular resonance during the 1920s.

In a popular exposition of the new concept of complementarity in 1928, Thomson clarified his earlier explanation of the nature of light, although without reference to either tigers or sharks on this occasion: 'both the undulatory and the corpuscular theory expressed a part but not the whole of the truth ... both corpuscles and waves are present and must be taken into account'.<sup>12</sup> When we compare this passage with the earlier one from *The Structure of Light* it is clear that Thomson's later formulation demonstrates an acceptance of duality of the type proposed by Bohr: the idea of a contest between two such incompatible combatants as a tiger and a shark has disappeared, to be replaced by an acceptance that both theories are necessary and that both are insufficient on their own. Together, the two theories provide 'the whole of the truth', or, as Bohr put it, 'only the totality of the phenomena exhausts the possible information about the objects'.<sup>13</sup> However, while we must always take both into account, we must remember that only one will be directly applicable to, or visible in, any individual situation that we choose to investigate.

11 Virginia Woolf, *Orlando: A Biography*, ed. Brenda Lyons (London, 1993), 142.

12 J. J. Thomson, *Beyond the Electron* (Cambridge, 1928), 25.

13 Niels Bohr, 'Discussion with Einstein on Epistemological Problems in Atomic Physics', in Paul Arthur Schilpp, ed., *Albert Einstein: Philosopher-Scientist* (3<sup>rd</sup> edn, New York, 1969), 210. Elsewhere Bohr words this slightly, but significantly, differently: 'evidence obtained under well-defined experimental conditions – and expressed by adequate use of elementary physical concepts – exhausts in its entirety all information about the atomic objects which can be communicated in common language', Niels Bohr, *Essays 1958-1962 on Atomic Physics and Human Knowledge* (New York, 1963), 12, my emphasis.

Much as we saw for Woolf at the end of the previous chapter, then, the difficulty becomes how to describe and express a dualistic model in which opposite entities are '*mutually exclusive* without actually contradicting one another'.<sup>14</sup> As Holton explains, 'To call light either a wave phenomenon or a particle phenomenon is impossible; in either case, too much is left out. To call light *both* a wave phenomenon and a particle phenomenon is to oversimplify matters'.<sup>15</sup> It is clear, then, that neither the either/or nor the both/and formulations which we discussed in the previous chapter are adequate for the complementary situation which we now wish to describe, at least not in the manner in which we are used to thinking of them. However, it is also clear that according to Bohr's principle it is the both/and model that is closer to providing 'the whole of the truth' than the limiting and divisive either/or.

While de Broglie's application of a dualistic model to all matter, and Bohr's subsequent development of this duality into a complementary model, were radical developments in contemporary science, it is important to remember that both theories grew out of earlier scientific work, most notably Planck's proposal of quanta in 1900 and Einstein's 1905 paper 'On a Heuristic Point of View Concerning the Production and Transformation of Light'. In this paper Einstein sought to explain some problematic qualities of light, the most important of which had been demonstrated by Philipp Lenard's work on the photoelectric effect in 1902. In order fully to appreciate Lenard's findings, Einstein's explanation thereof and the scientific reaction thereto, however, it is vital that we remember that the wave theory of light was a firmly entrenched scientific paradigm in the late nineteenth and early twentieth centuries: as Wheaton states, 'By 1890 most physicists thought that the wave theory of light was as close to certainty as physics could make it'.<sup>16</sup>

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<sup>14</sup> Jonathan Powers, *Philosophy and the New Physics* (rev. repr., London, 1991), 133.

<sup>15</sup> Holton, *Thematic Origins*, 104. We will consider later the 'compromise' suggested by A. S. Eddington in *The Nature of the Physical World* (Cambridge, 1928), 201.

<sup>16</sup> Wheaton, *The Tiger and the Shark*, 11.

The photoelectric effect is observed when light is shone onto a metal, causing the free electrons within the metal to escape from it. If light were a wave, the maximum kinetic energy of the electron emitted from the metal (the photoelectron) should depend on the amplitude of the incident light wave, that is to say the brightness of the light, as this is related to the energy of the light wave. However, Lenard's experiments showed that this was not the case: while the number of photoelectrons emitted does indeed increase as the amplitude of the light wave increases, the maximum energy of the photoelectron depends instead on the frequency of the incident light wave, that is, its colour, a factor that should not make any difference according to the wave theory of light. Einstein tackled this illogicality in his 1905 paper, utilising Planck's concept of bundles of energy, or quanta, and suggesting that in specific cases such as the photoelectric effect light 'consists of a finite number of energy quanta that are localised in points in space, move without dividing, and can be absorbed or generated only as a whole'.<sup>17</sup> Thus, although Einstein does not use this word here, light in these cases behaves like a particle, not a wave.

Einstein was very careful to emphasise that this was a hypothesis, even in the title of his paper which presents it as 'a heuristic point of view'. He also acknowledged the importance of the wave model of light which 'has proved itself splendidly in describing purely optical phenomena and will probably never be replaced by another theory'; however, he continues:

it is conceivable that despite the complete confirmation of the theories of diffraction, reflection, refraction, dispersion, etc., by experiment, the theory of light, which operates with continuous spatial functions, may lead to contradictions with experience when it is applied to the phenomena of production and transformation of light.<sup>18</sup>

While Einstein does not use the phrase 'wave-particle duality' in his 1905 paper, it is clear from the passage above that he is looking for a theory which will in some way unite the

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<sup>17</sup> *The Collected Papers of Albert Einstein. English Translation*, ed. John Stachel et al., trans. Anna Beck et al., to be completed in circa 30 vols (Princeton, 1987–), ii, 87.

<sup>18</sup> *Ibid.* ii, 86.

well-established wave theory of light with his newly formulated quantum model in order to enable the explanation of all experimental observations of light.

In 1909 Einstein made this implicit duality explicit in a lecture given to the eighty-first Meeting of German Scientists and Physicians in Salzburg which, according to Wolfgang Pauli, 'can be considered as one of the landmarks in the development of theoretical physics'.<sup>19</sup> As in his 1905 paper, Einstein opened his lecture with a reflection on the significance of the wave theory of light, but he quickly moved on to a consideration of those effects which do not fit into this theory, before explaining that

It is therefore my opinion that the next stage in the development of theoretical physics will bring us a theory of light that can be understood as a kind of fusion of the wave and emission theories of light.<sup>20</sup>

This 'fusion' of wave and particle theories requires us to acknowledge that these two structures 'should not be considered as mutually incompatible': both theories have proved themselves useful and valid in their applicability to the explanation of light – the task now is to find a way to combine the two.<sup>21</sup>

Einstein further clarified the nature of his proposed 'fusion' in the discussion which followed his Salzburg lecture: 'I picture a quantum as a singularity surrounded by a large vector field', an image which may remind us of Ralph's 'little dot with the flames round it' in *Night and Day*, as well as the other similar images from Woolf's works which we considered in the previous chapter.<sup>22</sup> This model allows us to retain the prevailing wave theory, while using the quantum theory to explain the interactions of light and matter, but it also allows both of these aspects to be present simultaneously, with the quantum particles travelling within the waves. This marks Einstein's point of departure from Planck's theory of quanta, as Planck saw quanta as necessary only when describing the exchange of energy

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<sup>19</sup> Wolfgang Pauli, 'Einstein's Contributions to Quantum Theory', in Schilpp, ed., *Philosopher-Scientist*, 154.

<sup>20</sup> Einstein, *English Translation*, ii, 379.

<sup>21</sup> Ibid. ii, 394.

<sup>22</sup> Ibid. ii, 398; Virginia Woolf, *Night and Day*, ed. Julia Briggs (London, 1992), 419.

between radiation and matter. The simultaneity of Einstein's theory also provides a clue as to his unwillingness to accept Bohr's principle of complementarity in later years: Einstein was constantly looking for ways to resolve dualities, to limit inconsistencies, and Bohr's demand that we accept such dichotomies as inherent within and fundamental to nature, without attempting to 'fuse' them in any way, required the abandonment of such a quest.<sup>23</sup>

For Einstein, the question as to the nature of light was the key scientific issue of the era: writing to Jakob Laub in 1909, he stated 'This quantum question is so extraordinarily important and difficult that everybody should take the trouble to work on it'.<sup>24</sup> Its influence on the wider scientific community can be seen in its appearance as the focus of the first Solvay Congress in 1911: as Stanley Goldberg explains, the Solvay Congresses were designed to explore 'the most pressing fields of science', and it is certainly significant that in 1911 the topic of quantum radiation was deemed more 'pressing' than relativity.<sup>25</sup>

However, this fact should by no means be taken to suggest that Einstein's views on the nature of light were widely accepted at this time. Indeed, as Abraham Pais states, 'the physics community at large had received the light-quantum hypothesis with disbelief and with scepticism bordering on derision'.<sup>26</sup> In part, this negative reaction was due to the fact that Einstein was one of the first physicists to use Planck's similarly radical theory of the existence of quanta, a theory which, even in 1914 – fourteen years after its first appearance – Jeans could state was still 'far from being regarded as inevitable', at least in Britain.<sup>27</sup> In early twentieth-century accounts of contemporary scientific developments, Planck's theory was described as 'a complete departure from the old Newtonian system of mechanics', as 'very strange', 'in entire contradiction to the classical dynamical theory on which the whole

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<sup>23</sup> See Pais, *'Subtle is the Lord...'*, 404.

<sup>24</sup> Einstein, letter to Jakob Laub dated 17 May 1909, *English Translation*, v, 119.

<sup>25</sup> Stanley Goldberg, *Understanding Relativity: Origin and Impact of a Scientific Revolution* (Oxford, 1984), 182.

<sup>26</sup> Pais, *'Subtle is the Lord...'*, 357.

<sup>27</sup> J. H. Jeans, *Report on Radiation and the Quantum-Theory* (London, 1914), 23.

science of physics had been built', and even 'so revolutionary'.<sup>28</sup>

If physicists struggled to adjust to the strangeness and the radical nature of Planck's ideas on quanta, then it is hardly surprising that their reaction to Einstein's 1905 paper was even less welcoming: Jeans wrote that 'No single feature of the quantum-theory causes more difficulty in its acceptance than the postulate that radiant energy must, so to speak, be in some way tied up in bundles of amount  $h\nu$ '.<sup>29</sup> The revolutionary nature of Einstein's 1905 paper on light quanta cannot easily be denied: Einstein himself called it 'very revolutionary', the only time that he used the word 'revolutionary' in relation to his own work, and it is worthy of note that in the same 1905 letter to his friend Conrad Habicht, Einstein referred to his special theory of relativity as merely employing 'a modification of the theory of space and time'.<sup>30</sup>

For his contemporaries, Einstein's theory of light quanta was certainly radical and shocking, to the extent that even Planck found it unpalatable at first: writing to propose Einstein for membership of the Prussian Academy of Sciences in 1913, Planck, along with Walther Nernst, Heinrich Rubens and Emil Warburg, asked that the fact that Einstein 'might sometimes have overshot the target in his speculations, as for example in his light quantum hypothesis, should not be counted against him too much'.<sup>31</sup> The acceptance of Einstein's ideas came slowly and begrudgingly: in 1915 Robert Millikan confirmed the validity of Einstein's photoelectric equation despite, as he later wrote, 'its

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28 Ibid. 1; J. W. N. Sullivan, *Atoms and Electrons* (London, 1923), 117; J. H. Jeans, 'Discussion on Radiation', in *Report of the Eighty-Third Meeting of the British Association for the Advancement of Science. Birmingham: 1913* (London, 1914), 378.

29 Jeans, *Report on Radiation*, 58. ' $h\nu$ ' represents Planck's constant ( $h$ ) multiplied by the frequency ( $\nu$ ) of the incident light wave. It is worth pausing to consider the strangeness of this formula which sees particulate light quanta – known as photons from 1926 onwards – being defined in terms of the frequency of the light wave, a fact which, as Bohr states, highlights the 'acuteness of the dilemma' which Einstein's proposal fostered between the wave and quantum theories, 'Discussion with Einstein', 203. See Henry J. Folse, *The Philosophy of Niels Bohr: The Framework of Complementarity* (Amsterdam, 1985), 71.

30 Einstein, letter to Conrad Habicht dated 18 or 25 May 1905, *English Translation*, v, 20. See I. Bernard Cohen, *Revolution in Science* (Cambridge, Massachusetts, 1985), 435-6: 'The letter to Habicht is, so far as I know, the only occasion on which Einstein used the term "revolutionary" to characterise any aspect of his own work or, for that matter, any part of the physics of his own century'.

31 Planck, Nernst, Rubens and Warburg, letter to the Prussian Academy of Sciences dated 12 June 1913, in Einstein, *English Translation*, v, 337-8.

unreasonableness'.<sup>32</sup> While acceptance of Einstein's photoelectric equation – which stated that energy was transferred from the incident light to the waiting electrons in discrete quanta – certainly facilitated the eventual understanding and acceptance of Einstein's light quanta, the two did not go together automatically. Indeed, it was not until the discovery of the Compton effect in 1923, and de Broglie's work on the wave-particle duality of matter starting around the same time, that Einstein's work was, in Michael Redhead's words, 'finally turned from a fanciful conception to a generally accepted hypothesis'.<sup>33</sup> It should be acknowledged, however, that Einstein's receipt of the Nobel Prize in Physics in 1922 'for his services to theoretical physics and especially for his discovery of the law of the photoelectric effect', had given 'implicit sanction' to the idea of light quanta.<sup>34</sup> Even then the battle was not over, however: in his *ABC of Atoms* (1923) Bertrand Russell makes direct reference to the ongoing debates as to the nature of light, stating 'The evidence that light consists of waves remains quite unshaken; it is derived from the phenomena of interference and diffraction'.<sup>35</sup> This fierce refutation suggests not only that Russell knew about the emergent quantum models of light, but also that he felt very strongly about them, hence increasing the likelihood of discussions on this topic with friends and acquaintances, among whom Virginia and Leonard Woolf were included.<sup>36</sup> The tone of Russell's assertion is rather revealing, however – the mere fact of having to state that a theory 'remains quite unshaken' suggests that it is facing a serious threat; and by 1923, as we have seen, the classical wave theory of light most certainly was.

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32 Robert A. Millikan, 'Albert Einstein on His Seventieth Birthday', *Reviews of Modern Physics*, 21/3 (1949), 344.

33 Michael Redhead, 'Quantum Theory', in R. C. Olby et al., eds., *Companion to the History of Modern Science* (London, 1990), 465.

34 Quoted in Pais, '*Subtle is the Lord...*', 510; Wheaton, *The Tiger and the Shark*, 281. Although Einstein was awarded his Nobel Prize in 1922, this was actually the prize for 1921, while Bohr received the 1922 prize.

35 Bertrand Russell, *The ABC of Atoms* (London, 1923), 147.

36 Woolf was present at a dinner in 1921 at which Russell declared his intention to 'write no more mathematics. Perhaps I shall write philosophy', Virginia Woolf, diary entry for 3 December 1921, *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, 5 vols (1977-1984), ii, 147-8. Given the significant philosophical nature of contemporary science, it is perhaps no surprise to find Russell writing popular science books within a few years of this comment.

In terms of the British reaction to early quantum theory, the most important figure is Jeans who, in 1913, led a 'Discussion on Radiation' at the annual meeting of the British Association for the Advancement of Science, in which he stated 'For myself I feel logically compelled to accept the quantum-hypothesis in its entirety'.<sup>37</sup> Although this acceptance was intended for Planck's theory in the first instance, it certainly facilitated a more tolerant attitude to Einstein's work when Jeans came to consider it in his other investigations. While Einstein does not feature in Jeans's discussion (apart from in a brief note added afterwards), in his *Report on Radiation and the Quantum-Theory* for the Physical Society of London one year later, Jeans is clear that 'The view that radiant energy exists in the form of indivisible "light-quanta" has been put forward and defended by Einstein'.<sup>38</sup> Jeans fully explains the difficulties inherent in Einstein's theory here, but his description is certainly more balanced and less critical than the views of other contemporary scientists like Planck and Millikan:

The experimental evidence – for instance, of the photo-electric effect and of interference – seems almost to indicate that both theories are true simultaneously: that radiant energy both remains concentrated and indivisible, and at the same time spreads and is divisible.<sup>39</sup>

Jeans's tone here is tentative and reluctant, especially in the word 'almost', but we must remember that Einstein himself presented his ideas in a similarly hesitant manner. We may also notice the difficulties inherent in the need to write a both/and formulation here, much as we saw in Woolf's own writings in the previous chapter: the use of 'and at the same time' emphasises the simultaneity of the two theories, while the comma retains some kind of distinction between them.<sup>40</sup> Jeans continues by considering how scientists can hope to move forward from this 'very unsatisfactory' situation, calling for 'some kind of

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<sup>37</sup> Jeans, 'Discussion on Radiation', 378.

<sup>38</sup> Ibid. 383; Jeans, *Report on Radiation*, 58.

<sup>39</sup> Jeans, *Report on Radiation*, 89.

<sup>40</sup> It is interesting to note that quantum theory seems to have been calling increasingly for a model of simultaneous coexistence, as emphasised by that repeated formula 'at the same time', at a time when Einstein's special theory of relativity had provoked a complete rethinking of the very nature of simultaneity.

reconciliation', 'some sort of a compromise', much as Einstein was looking in 1909 for 'a kind of fusion' between waves and quanta.<sup>41</sup> The problem at present, continues Jeans, is that 'any practical attempt at a compromise appears to require the abandonment of something which is essential to one or other of the two theories', and it was this problem that Bohr would attempt to resolve with his principle of complementarity more than ten years later.<sup>42</sup>

Jeans was not alone as a British physicist supporting the theories of both Planck and Einstein before the 1920s, however. Norman Campbell was looking for clear experimental evidence for the existence of light quanta very early on, although without success: in 1910, in his second paper on 'Discontinuities in Light Emission' for the Cambridge Philosophical Society, Campbell revealed that 'contrary to the hopes of the author, no evidence has been produced *against* the "spherical wave" theory', adding that in fact the results he was reporting 'might be held to be favourable to that theory as opposed to the "bundle of energy" theory'.<sup>43</sup> W. H. Bragg was also an early British supporter of the new quantum ideas, starting 'to call for a truly dualistic interpretation of radiation' in 1911.<sup>44</sup> However, there were plenty of British physicists who were not yet prepared to make the apparent leaps of faith necessary to embrace the quantum theory: acting as President of the British Association for the Advancement of Science in 1913, Oliver Lodge made his position very clear by offering an address on 'Continuity' at the same meeting at which Jeans was to lead his discussion of the opposite model. Thus Lodge stated, 'I myself am an upholder of *ultimate* Continuity', using his address to 'urge moderation in the uprooting and removal of landmarks', the chief of which for him was 'Continuity', again in this capitalised form.<sup>45</sup> In the second edition of his *Report on Radiation and the Quantum-Theory*, published in 1924,

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41 Jeans, *Report on Radiation*, 89.

42 Ibid.

43 Norman Campbell, 'Discontinuities in Light Emission. II', *Proceedings of the Cambridge Philosophical Society*, 15 (6 June 1910), 521.

44 Wheaton, *The Tiger and the Shark*, 136. We will return to Bragg shortly.

45 Oliver Lodge, 'Continuity', in *Report of the Eighty-Third Meeting*, 15, 19.

Jeans was able to reflect that at the time of the publication of the first edition 'the Quantum-Theory was but little understood in this country, and in so far as it was understood, was an object of suspicion to most physicists', meaning that the first edition 'had to be an *apologia* as well as an exposition'.<sup>46</sup> By 1924, quantum theory was no longer 'on the defensive', and the difference is clear in the changes that Jeans made to his text: for example, while in 1914 it was 'clear beyond all possibility of dispute that the quantum-theory has disclosed in nature a certain atomicity of a kind unsuspected by the older mechanics', in 1924 the theory was only 'believed to have disclosed' such an atomicity.<sup>47</sup> Already by 1924 de Broglie was looking at this atomicity of radiation and asking, 'If that which we have commonly regarded as a wave partakes also of the nature of a particle, may not that which we have commonly regarded as a particle partake also of the nature of a wave?'<sup>48</sup> We have already seen the answers that de Broglie and then Bohr provided to this question.

The dualistic nature of light proposed by Einstein in 1905 was, then, being discussed before the 1920s, even though it was not widely accepted until the early years of that decade. However, the historical development of our understanding of the nature of light prior to Einstein also involves a series of shifts between wave and particulate models, some of which we will now consider. The earliest theories of light, as formulated by the ancient Greeks, suggested a corpuscular model in which light consisted of 'grains in rapid movement', and a corpuscular, or emission, theory was also favoured by Isaac Newton in the seventeenth century.<sup>49</sup> However, as experimental evidence began to emerge as to the effects of interference, Newton began to adapt his theory, meaning that Einstein's 1909 'fusion' theory was in fact 'remarkably like the theory devised by Newton as a modification

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46 J. H. Jeans, *Report on Radiation and the Quantum-Theory* (2<sup>nd</sup> edn, London, 1924), Preface.

47 Ibid. Preface, 78; Jeans, *Report on Radiation* (1<sup>st</sup> edn), 79.

48 Eddington, *Nature of the Physical World*, 202.

49 Louis de Broglie, *New Perspectives in Physics*, trans. A. J. Pomerans (Edinburgh, 1962), 127.

of his original corpuscular (i.e. particle) theory of light'.<sup>50</sup> As J. J. Thomson explains, Newton 'regarded a corpuscle as surrounded by ether waves excited by its own vibrations' so that 'light in his view was not entirely corpuscular nor entirely undulatory but an inseparable mixture of both'.<sup>51</sup> Apart from its reliance on the ether, this theory is clearly very close to Einstein's image of a 'singularity surrounded by a large vector field' which we have already considered. The nineteenth century, however, with the investigations of Young, Augustin Fresnel, Heinrich Hertz and James Clerk Maxwell, saw the emergence of the wave theory of light as 'virtual certainty', as we have seen.<sup>52</sup>

Accounts of the different stages in the understanding of light abounded in the popular science books of the late 1920s and 30s because they enabled the writer to set up the two distinct views which were now combined in the wave-particle duality and complementarity of both radiation and matter. Thus in *The Mysterious Universe*, Jeans introduces both Newton's corpuscular theory and the wave theory, before explaining that the recent quantum discoveries show that

the seventeenth century, which regarded light as mere particles, and the nineteenth century, which regarded it as mere waves, were both wrong – or, if we prefer, both right. Light, and indeed radiation of all kinds, is both particles and waves at the same time.<sup>53</sup>

From here, Jeans moves to 'the second, and far more exciting, half of our story': 'electrons and protons, the fundamental units of which all matter is composed ... , can also appear now as particles, and now as waves'.<sup>54</sup> By introducing the historical aspect of this story, Jeans enables the reader, scientist or not, to engage with the new ideas of the quantum theory, making them less strange than they would otherwise appear.

Jeans's *Mysterious Universe* is a particularly important text in terms of Woolf's engagement with contemporary science, as not only do we know that the Woolfs owned a

<sup>50</sup> G. P. Thomson, *The Atom* (London, 1930), 177.

<sup>51</sup> J. J. Thomson, *Structure of Light*, 3.

<sup>52</sup> Wheaton, *The Tiger and the Shark*, 11.

<sup>53</sup> Jeans, *Mysterious Universe*, 38.

<sup>54</sup> *Ibid.* 38, 39.

copy of the book, but we also know that Woolf was reading Jeans while writing *The Waves* (1931); as Michael Whitworth states, 'most of the contextual evidence' suggests that the text in question was *The Mysterious Universe* rather than *The Universe Around Us* (1929), although he admits that it is 'just possible' that it was the latter.<sup>55</sup> The Woolfs also owned a copy of G. P. Thomson's *The Atom* (1930) in which Thomson emphasises the new-found complementarity of waves and particles in a similar way to Jeans:

The efforts of the nineteenth century to reduce everything to the properties of a continuous medium, and those of the twentieth to explain it by particles alone, seem equally to have failed. However distasteful the idea, we are apparently forced to admit the two on an equal footing. Somehow they are both there in the world and neither will yield.<sup>56</sup>

Thomson continues with Bohr's 'hope that it will be possible to see them as two complementary halves of a single truth', a hope which our study of Woolf's early works suggests Woolf would also share.<sup>57</sup>

Even before the start of the quantum revolution, however, science writers would include the various developments in the history of our understanding of light in their popular science books, science writers like John Tyndall who, in his *Six Lectures on Light* (1873), first presents Newton's theory that light consists of 'elastic particles of inconceivable minuteness', before exploring Young's success 'in placing on an immovable basis the Undulatory Theory of Light'.<sup>58</sup> Tyndall also explores the 'central difficulty' of distinguishing 'between the motion of the wave itself and the motion of the particles which at any moment constitute the wave', these being the particles of ether which Einstein would, in 1905, show to be a 'superfluous' medium: Tyndall explains that 'while the waves pass onward horizontally, the individual particles are simply lifted up and down

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<sup>55</sup> *Catalogue of Books from the Library of Leonard and Virginia Woolf* (Brighton, 1975); Woolf, diary entries for 11 August 1937 and 27 December 1930, *Diary*, v, 107 and iii, 340; Michael Hilton Whitworth, 'Physics and the Literary Community, 1905-1939', DPhil thesis, University of Oxford, 1994, 155.

<sup>56</sup> G. P. Thomson, *The Atom*, 230.

<sup>57</sup> *Ibid.*

<sup>58</sup> John Tyndall, *Six Lectures on Light* (London, 1873) 45, 49.

vertically'.<sup>59</sup> Gillian Beer has suggested that such an image may have been in Woolf's mind while she was writing *The Waves*, explaining elsewhere that in this novel Woolf 'was responding both to Einstein and to Tyndall simultaneously'.<sup>60</sup> Woolf was certainly aware of Tyndall, mentioning him directly in *Mrs Dalloway* (1925) where he is described as Clarissa's 'favourite reading as a girl'.<sup>61</sup> Beer assumes from this that Woolf herself must have read Tyndall, and she did indeed inherit a couple of his books from her father, Leslie Stephen: while these books focus on the Alps rather than Tyndall's science, it is possible that Woolf also read some of his popular science works at some stage.<sup>62</sup>

Tyndall was not alone in providing popular accounts of the development of our theories of light, however. In his contribution to the entry on 'Light' in the eleventh edition of *The Encyclopaedia Britannica* (1910-11), Hendrik Lorentz included a description of 'Newton's Corpuscular Theory', explaining that 'it remains of considerable historical interest', even though 'it has been entirely superseded by its rival'.<sup>63</sup> Meanwhile, writing on 'Modern Theories of Light' in *The Cornhill Magazine* in 1904, W. A. Shenstone suggests that 'if the existence of electrons and the modern experiments on the pressure of light had been known to Newton and his successors it is possible we might not yet have heard of the undulatory theory'.<sup>64</sup> As later twentieth-century popularisers would do, Shenstone also points out the modifications that Newton made to his theory, which 'acquired in his hands considerable resemblance to the rival hypothesis' by combining corpuscles with waves.<sup>65</sup>

Shenstone's article on light is particularly interesting and is worth analysing in detail, especially when we consider that Woolf's long-running personal – and, from 1908,

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59 Ibid. 51, 52; Einstein, *English Translation*, ii, 141.

60 Gillian Beer, *Virginia Woolf: The Common Ground* (Edinburgh, 1996), 89; Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 314.

61 Virginia Woolf, *Mrs Dalloway*, ed. Stella McNichol (London, 1992), 85.

62 Beer, *Common Ground*, 105; *Catalogue of Books*. Beer also points out that the Tyndalls and the Stephens were friends, *Common Ground*, 108.

63 Hendrik Antoon Lorentz, 'Nature of Light', in *The Encyclopaedia Britannica: A Dictionary of Arts, Sciences, Literature and General Information*, 29 vols (11<sup>th</sup> edn, Cambridge, 1910-11), xvi, 617.

64 W. A. Shenstone, 'Modern Theories of Light', *The Cornhill Magazine*, new ser., 16/95 (May 1904), 628.

65 Ibid.

professional – relationship with *The Cornhill* may well have led her to read it.<sup>66</sup>

Considering contemporary scientific explorations of radioactivity and, in particular, electrons, Shenstone here investigates the nature of light, offering a series of questions relating to electrons which seems particularly resonant when we consider the theory that Einstein was to put forward for the first time just one year later:

Is it not possible that these may be the corpuscles of Newton? That there is, as it were, light of two kinds – corpuscular light, and light due to wave motion? This question, I think, may very well have arisen in the minds of those who are interested in these matters, but who have been unable to follow them closely. On the whole, the answer must be 'No.'<sup>67</sup>

Shenstone's final and concise 'No' is clear and unambiguous, although his 'On the whole' leaves some room for speculation. Most importantly, however, this expression of the idea of there being 'light of two kinds' in a publication like *The Cornhill* suggests the possibility of an early awareness among a general readership of such scientific dualities and, as I have said, Woolf could easily have been included within this readership.

As is beginning to become apparent, then, it was not only historical surveys of light that included discussions of the relative merits of wave and corpuscular theories: Wheaton's work has revealed the extent to which contemporary investigations as to the nature of radioactivity and, in particular, X-rays played a 'significant role in preparing physicists to accept dualistic theory'.<sup>68</sup> Key to this growing acceptance was the development of the impulse hypothesis: as Wheaton explains, 'A pulse is a spherical wave, but it collides with an atom as if it were a particle', thereby creating a theory which combines particles and waves.<sup>69</sup> While the impulse hypothesis gained widespread acceptance for X-rays in the early twentieth century, few physicists were at this point aware of the implications that this would have for the nature of light, as it was not yet

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<sup>66</sup> Further details of Woolf's links to *The Cornhill Magazine* are given in chapter seven.

<sup>67</sup> Shenstone, 'Modern Theories', 634-5.

<sup>68</sup> Wheaton, *The Tiger and the Shark*, xvi.

<sup>69</sup> Ibid. 16.

recognised that X-rays formed part of the electromagnetic spectrum in which visible light is also located. Exceptions to this rule include Bragg, who was working to produce a genuinely dualistic model for X-rays,  $\gamma$ -rays *and* ordinary light.

In a 1912 survey of 'Radiations Old and New', Bragg explored in some detail the apparently antagonistic wave and corpuscular approaches to radiation, including light. Having stated that Planck's work on quanta and Einstein's work on light quanta constitute 'one of the most remarkable developments of modern physics', Bragg explains that if we choose to think of radiation in this way

We ought not to think that in doing so we abandon the wave theory or its electro-magnetic development. Rather we might say that the radiation problem is too great to be seen all at once from any point to which we have hitherto attained, and that it is to our advantage to look at it from every side.<sup>70</sup>

Bragg puts forward the radical and enlightened suggestion that any perceived inconsistencies between these two approaches are 'difficulties of our own making' and that 'we must work in the hope of finding a new hypothesis of greater compass'.<sup>71</sup> The route which would later lead Bohr to complementarity is already starting to emerge here and, indeed, Bragg suggests that 'It is not at all impossible that modern research will once more draw the two theories together'.<sup>72</sup>

That the discovery of radioactivity and X-rays provoked a return to the old questions surrounding waves and particles is, then, clear: even the naming of newly-discovered effects was complicated by these debates, with G. P. Thomson explaining in 1930 that  $\alpha$ -rays and  $\beta$ -rays 'were named before their nature was certain' and were in fact 'charged particles', while electrons were originally known as 'cathode rays'.<sup>73</sup> Of course, the key question for us is whether or not Woolf was aware of any of these scientific debates

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<sup>70</sup> W. H. Bragg, 'Radiations Old and New', *Nature*, 90/2255 (16 January 1913), 558.

<sup>71</sup> *Ibid.*

<sup>72</sup> *Ibid.*

<sup>73</sup> G. P. Thomson, *The Atom*, 98 n. 1, 59-63.

and discussions. She was certainly aware of the development of X-ray photography: early in 1897, just two years after Wilhelm Röntgen's discovery of X-rays (originally called Röntgen rays), Virginia, Vanessa and Adrian Stephen 'by some mistake' attended 'a lecture on the Rontgen [*sic*] Rays' at the Regent Street Polytechnic.<sup>74</sup> Two days later, Virginia, Thoby and Adrian made a visit to 'the mechanical part' of the South Kensington Museum, what we now call the Science Museum; it is possible that this visit was inspired, in part at least, by what they had seen and heard in the lecture, although no direct indication of this is given by Woolf in her diary and the Science Museum did not in fact obtain its first piece of X-ray related equipment until 1898.<sup>75</sup>

X-ray photography appears directly in *To the Lighthouse* (1927), as Lily Briscoe reflects on Charles Tansley's character:

Sitting opposite him could she not see, as in an X-ray photograph, the ribs and thigh bones of the young man's desire to impress himself lying dark in the mist of his flesh – that thin mist which convention had laid over his burning desire to break into the conversation?<sup>76</sup>

A few pages later the characters united around the dinner table are also united in the prayer 'that the inside of my mind may not be exposed' (102), a fear which is realised a little later when Mrs Ramsay's eyes are described as 'so clear that they seemed to go round the table unveiling each of these people, and their thoughts and their feelings, without effort' (116). These images take X-ray photography to a new, more profound, level as indicated by the focus on the bones of *desire* in the first passage above.

The development of X-ray photography raised some interesting questions about the nature and reality of matter, questions which Woolf also addresses frequently in her writing throughout her career, and which appear in the first draft of her first novel: here Mr

Dalloway recalls 'arguing for six hours with the present secretary of state for India upon

<sup>74</sup> Virginia Woolf, diary entry for 9 January 1897, Virginia Woolf, *A Passionate Apprentice: The Early Journals 1897-1909*, ed. Mitchell A. Leaska (London, 2004), 9-10.

<sup>75</sup> Woolf, diary entry for 11 January 1897, *ibid.* 11; Shani Davis, Science Museum Library Administration Assistant, 'RE: 1897 Exhibitions', Email to Rachel Crossland, 25 May 2010.

<sup>76</sup> Virginia Woolf, *To the Lighthouse*, ed. Stella McNichol (London, 1992), 99.

the reality of matter', adding, 'What's the view now? Is it real or not?', to which Helen replies 'That depends –'.<sup>77</sup> In Woolf's final novel, *Between the Acts* (published posthumously 1941), the snippets of the audience's conversation captured during the interval reflect similar ideas as to the nature of matter:

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 ... There, you can get a glimpse of the church through the trees ...<sup>78</sup>

The frequent qualifications within this sentence suggest the new uncertainty and lack of solidity within science itself, and the fact that the church is glimpsed through the apparently non-solid trees at the end of this extract links science to a more mystical, spiritual and religious discourse.<sup>79</sup> If we consider George Levine's claim that 'The struggle to preserve “mystery” – the place of enchantment – against science was, among the Victorians, intense', we can see here the ways in which early twentieth-century science disturbed this duality, encouraging the breaking down, or at least the blurring of, the distinctions between the 'empirical study and rational analysis' of science and 'a world of mystery, a world of spirit, an enchanted world' which we mentioned in the previous chapter.<sup>80</sup>

Such considerations of the nature of matter lead to contemporary scientific explorations of the atom, a unit with which Woolf engages most directly in the 1908 section of *The Years* (1937), as Eleanor reflects on both the nature of her knowledge and the nature of matter:

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<sup>77</sup> Virginia Woolf, *Melymbrosia*, ed. Louise DeSalvo (San Francisco, 1982), 86.

<sup>78</sup> Virginia Woolf, *Between the Acts*, ed. Stella McNichol (London, 1992), 118, ellipses in original.

<sup>79</sup> For further analysis of this passage see Michael H. Whitworth, *Einstein's Wake: Relativity, Metaphor, and Modernist Literature* (Oxford, 2001), 168-9. It should also be noted that Eddington and Jeans are mentioned directly in *Between the Acts*, alongside Charles Darwin, as representative of the options on offer to Isa should she choose to read 'science' (14).

<sup>80</sup> George Levine, *Realism, Ethics and Secularism: Essays on Victorian Literature and Science* (Cambridge, 2008), 65. In addition, Daniel Albright has suggested that 'The opposition between the particle model and the wave model also has certain consequences in our feeling toward our world': while 'The particle model tends to promote a “scientific” view ... The wave model, by contrast, tends to promote a “poetic” view, in which the cosmos is a plenum, a twanging web', *Quantum Poetics: Yeats, Pound, Eliot, and the Science of Modernism* (Cambridge, 1997), 17.

But what vast gaps there were, what blank spaces, she thought leaning back in her chair, in her knowledge! How little she knew about anything. Take this cup for instance; she held it out in front of her. What was it made of? Atoms? And what were atoms, and how did they stick together? The smooth hard surface of the china with its red flowers seemed to her for a second a marvellous mystery.<sup>81</sup>

That Woolf selected the scientific question of the nature of matter, and, indeed, of atoms themselves, as representative of the elements that are missing from Eleanor's knowledge and education suggests the significance of scientific discourse both to Woolf and on a wider contemporary scale. More interesting, however, is the fact that, as Whitworth has pointed out, 'the real answer to [Eleanor's] question comes in the very characterisation of her knowledge. Its being composed of "vast gaps" and "blank spaces" leads towards Rutherford's conception of the atom as mostly empty space'.<sup>82</sup> The 'gaps' and 'spaces' that Eleanor perceives in her own knowledge, then, in fact suggest some kind of openness to and understanding of contemporary scientific ideas. The emptiness of matter was explored in various popular science texts with which Woolf may well have been familiar: thus G. P. Thomson explains in *The Atom* that 'the view expressed by the adherents of the orbit theory that matter is mostly empty space is at least not far from the truth', adding that the new ideas about electrons only having probabilities rather than definite positions leaves us 'with a world mostly holes, occupied by things which are nowhere in particular!'<sup>83</sup> Meanwhile, A. S. Eddington writes that his 'scientific table is mostly emptiness', and Jeans explains that 'a few wasps – six for the atom of carbon – flying around in Waterloo Station will represent the extent to which the atom is crowded with electrons – all the rest is emptiness'.<sup>84</sup>

Moving now into a more general consideration of Woolf's relation to contemporary science, one of the key figures that we need to consider, as I mentioned in the previous chapter, is Roger Fry. In her biography of her friend, published in 1940, Woolf describes

81 Virginia Woolf, *The Years*, ed. Jeri Johnson (London, 1998), 113.

82 Whitworth, *Einstein's Wake*, 166.

83 G. P. Thomson, *The Atom*, 233-4.

84 Eddington, *Nature of the Physical World*, xii; James Jeans, *The Universe Around Us* (Cambridge, 1929), 106.

how in childhood 'his main interest lay in science; and his main pleasure was in the Laboratory', and how, reading natural sciences at Cambridge between 1885 and 1888, 'he was showing brilliant promise as a scientist' – indeed, he gained a first in this subject.<sup>85</sup> Fry's father hoped that Fry would pursue a scientific career, but Fry himself had decided by this point that he wanted to dedicate himself to art. However, a 'compromise', in Woolf's words, was negotiated by J. H. Middleton, the Slade Professor, enabling Fry to combine his artistic and scientific studies while staying on at Cambridge to try, unsuccessfully, for a fellowship.<sup>86</sup> This move towards a combination of his interests was one which Fry would develop throughout his career, and Holly Henry has described Fry as 'continually fascinated by the similarities between the disciplines of art and science'.<sup>87</sup>

While we cannot be certain of the extent to which, nor the frequency with which, science entered into the conversations which Woolf and Fry shared, we know that it did indeed enter at times: in May 1932, while Leonard and Virginia Woolf were on holiday with Roger and Margery Fry, there was discussion of 'the break up of the atom', although it is worth noting that it was in fact Leonard who was 'informing Roger' on this topic.<sup>88</sup> We also know that Fry had a profound impact on Woolf: after his death in 1934 she wrote that 'no one excited and stirred me as he did', and that 'nobody – none of my friends – made such a difference to my life as he did'.<sup>89</sup> We should also factor in what Quentin Bell calls Fry's 'scientific open-mindedness which verged upon sheer credulity', a factor which may well have influenced Fry's approach to, awareness of and interest in contemporary scientific ideas.<sup>90</sup>

85 Virginia Woolf, *Roger Fry: A Biography* (London, 2003), 37, 48.

86 Woolf, *Roger Fry*, 60. See also Frances Spalding, *Roger Fry: Art and Life* (rev. edn, Norwich, 1999), 28.

87 Holly Henry, 'Nebulous Networks: Woolf's Rethinking of Jeans's Analogy of the Scientist as Artist', in Diane F. Gillespie and Leslie K. Hankins, eds., *Virginia Woolf and the Arts. Selected Papers from the Sixth Annual Conference on Virginia Woolf* (New York, 1997), 271. See Roger Fry, 'Art and Science', *The Athenaeum*, 4649 (6 June 1919), 434-5.

88 Woolf, diary entry for 8 May 1932, *Diary*, iv, 96.

89 Virginia Woolf, letters to Pamela Diamand and Mrs R. C. Trevelyan dated end September 1934 and 4 September 1940 respectively, *The Letters of Virginia Woolf*, ed. Nigel Nicolson and Joanne Trautmann, 6 vols (London, 1975-80), v, 335 and vi, 426.

90 Quentin Bell, *Virginia Woolf: A Biography*, 2 vols (rev. edn, London 1996), ii, 181.

Woolf's most obvious and direct engagements with contemporary science came relatively late: in December 1931 Woolf wrote to Ethel Smyth, 'I'm going to read science – as the least like to my own ideas', adding a hope that Smyth would find her 'a nicer, quieter, less remote and arrogant and moody character, when scientific'.<sup>91</sup> However, when asked about the links between literature and science by a doctoral student, Elizabeth Nielsen, in 1938, Woolf complained in her diary of Nielsen as 'entirely distracted by Einstein, & his extra mundane influence upon fiction'.<sup>92</sup> Writing to Nielsen five months later, Woolf stated 'I have not read Einstein; I should not understand it', and her perceived lack of understanding also appears in a much earlier diary entry, from 1926, where the conversation at a dinner party is described as 'passing my limits – how if Einstein is true, we shall be able to foretell our own lives'.<sup>93</sup> This does not prevent Woolf from attempting to engage with and understand the science with which she comes into contact, however: in December 1930, while reading Jeans, she wrote to Smyth 'I read about the Stars, and try to imagine what is meant by space bending back', and this direct, if imaginative, engagement with contemporary science is significant.<sup>94</sup>

The ways in which Woolf's fiction interacted with her engagements with science are perhaps most clearly enlightened by a diary entry and a letter, also from 1930, which deal with Woolf's reading of Jeans and her writing of *The Waves*; in December Woolf recorded in her diary the events of the previous evening: 'Talk about the riddle of the universe (Jeans' book) whether it will be known; not by us; found out suddenly: about rhythm in prose'.<sup>95</sup> The suggestion here is of a sudden revelation, the discovery of a new idea. And yet

91 Woolf, letter to Ethel Smyth dated 6 December 1931, *Letters*, iv, 409, 410.

92 Woolf, diary entry for 28 May 1938, *Diary*, v, 146. I have not been able to establish the precise nature of Nielsen's research on Woolf and Einstein, although it appears to have centred on *The Waves*. However, in a letter to Woolf dated 16 October 1938 (to which the letter discussed above and detailed below was Woolf's reply) Nielsen stated 'You are both, in my opinion, so close to one another in ultimate results', in Anna Snaith, 'Wide Circles: The *Three Guineas* Letters', *Woolf Studies Annual*, 6 (2000), 94.

93 Woolf, letter to Elizabeth E. Nielsen dated 28 October 1938, 'Some New Woolf Letters', ed. Joanne Trautmann Banks, *Modern Fiction Studies*, 30/2 (1984), 198; Woolf, diary entry for 20 March 1926, *Diary*, iii, 68.

94 Woolf, letter to Ethel Smyth dated 27 December 1930, *Letters*, iv, 266.

95 Woolf, diary entry for 18 December 1930, *Diary*, iii, 337.

just four months earlier we find a very similar concept expressed in a letter to Smyth: in August 1930 Woolf told Smyth that she was writing *The Waves* 'to a rhythm and not to a plot', adding 'the rhythmical is more natural to me than the narrative', and she repeated the idea in her diary a few days later.<sup>96</sup> While Woolf acknowledges in her letter to Smyth that the problem is not entirely solved, that she is 'casting about all the time for some rope to throw to the reader', we can see that the sudden discovery associated with the later discussion of Jeans is in fact a *rediscovery* of a technique that Woolf was already employing; the apparent revelation provoked by the discussion of Jeans and his works in fact confirms, consciously or otherwise, an idea that Woolf was already developing in her latest novel.<sup>97</sup> As Beer has suggested, then, 'The physicists did not simply introduce ideas to [Woolf]; rather, their insights and their language coalesced with hers', and this idea of coalescence is, I would argue, of more relevance to our discussions of waves and particles in relation to Woolf than Whitworth's idea of anticipation, as it allows us to envisage a model of shared discourse in which more disciplines than just the literary and the scientific are able to play a part.<sup>98</sup>

As I have shown in this chapter, then, discussions of dualistic models within both science and popular science in the early twentieth century are far more prevalent than previous investigations of wave-particle duality in relation to Woolf have implied.<sup>99</sup> The widely accepted wave theory of light was discussed alongside the apparently vanquished corpuscular theory of Newton as a way to furnish a detailed history of science, as well as to explain various contemporary developments in the field; although there is no suggestion in

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<sup>96</sup> Woolf, letter to Ethel Smyth dated 28 August 1930, *Letters*, iv, 204; Woolf, diary entry for 2 September 1930, *Diary*, iii, 316.

<sup>97</sup> Woolf, *Letters*, iv, 204.

<sup>98</sup> Beer, *Common Ground*, 113; Whitworth, *Einstein's Wake*, 162.

<sup>99</sup> See, for example, Judith Killen, 'Virginia Woolf in the Light of Modern Physics', PhD dissertation, University of Louisville, 1984; Sue Sun Yom, 'Bio-graphy and the Quantum Leap: Waves, Particles, and Light as a Theory of Writing the Human Life', in Beth Rigel Daugherty and Eileen Barrett, eds., *Virginia Woolf: Texts and Contexts. Selected Papers from the Fifth Annual Conference on Virginia Woolf* (New York, 1996), 145-50; Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge, 1985).

these explanations of either the 'fusion' model of Einstein or the complementary model of Bohr that would come to dominate similar discussions at a later date, there is often nothing that necessarily precludes the imagining of such models. However, it must be acknowledged that it is unlikely that Woolf knew of Einstein's, or even Planck's, work directly before the 1920s: although Jeans stated in 1914 that Einstein's quantum theory of light 'has been the centre of much discussion', this was in a scientific text produced for the Physical Society of London, and so presumably referred only to discussions within scientific circles.<sup>100</sup> Such a view is confirmed by de Broglie's statement in the 1950s that this is an aspect of Einstein's work 'with which the public at large is rather unfamiliar'.<sup>101</sup>

There is, however, one question which we have not yet asked ourselves: if science and literature do indeed 'share the moment's discourse', if scientists are 'also being driven by the concerns and thought resources of the historical period they share with contemporaries', which other disciplines were discussing and considering dualities in the early twentieth century?<sup>102</sup> What was going on within the wider discourse of the moment which may have influenced the dualistic direction in which science, art and literature were all moving at this time? In attempting to answer such questions, it makes sense to begin by asking some of the scientists themselves, and this is exactly what the American Physical Society and the American Philosophical Society, working together under the leadership of Thomas Kuhn, set out to do in the 1960s. On 17 November 1962, the research team conducted their fifth interview with Bohr, during which they asked whether the study of philosophy had had any influence on his scientific work. The transcript of Bohr's answer is worth quoting at length:

I read some, but that was an interest by [and here Bohr suddenly stopped and exclaimed] – oh, the whole thing is coming [back to me]! I was a close friend of Rubin [a fellow student, later psychologist], and,

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<sup>100</sup> Jeans, *Report on Radiation* (1<sup>st</sup> edn), 58.

<sup>101</sup> De Broglie, *New Perspectives*, 126.

<sup>102</sup> Beer, *Open Fields*, 171; Beer, *Common Ground*, 113.

therefore, I read actually the work of William James. William James is really wonderful in the way 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 Thoughts,' where he in a most clear manner shows that it is quite impossible to analyse things in terms of – I don't know what to call it, not atoms, I mean simply, if you have some things ... they are so connected that if you try to separate them from each other, it just has nothing to do with the actual situation.<sup>103</sup>

Bohr stated that he had read this work 'many years before' his move to Manchester and formulation of the quantum model of the atom in 1912, but unfortunately he died suddenly the day after this interview was conducted and so was unable to elaborate on his story.<sup>104</sup> Holton states that 'There are enough leads to permit plausible speculations on this subject', but he also explains that 'doubts have been raised about the timing', with Léon Rosenfeld claiming that Bohr did not know of James's work until the early 1930s.<sup>105</sup> Bohr must certainly have read the passage from *The Principles of Psychology* (1890) at some point, but whether his excitement on recalling it originated in its inspirational nature or in its confirmatory one remains uncertain.

On reading James's chapter on 'The Stream of Thought', it is easy to see how it could have either inspired or confirmed Bohr in his scientific work. James addresses the two contemporary views of thought as either 'composed of separate independent parts' or as a 'river' or 'stream': at first he sides with the latter theory, stating that consciousness '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'.<sup>106</sup> Having suggested the title 'the stream of thought', however, James goes on to acknowledge that there is 'a kind of jointing and separateness among the parts, of which this statement seems to take no account', asking 'If the words “chain” and “train” had no natural fitness in them,

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103 Transcript quoted in Holton, *Thematic Origins*, 121, parentheses and ellipses in original.

104 Ibid. 122.

105 Ibid. For a number of such 'plausible speculations' and the suggestion that 'while Rosenfeld may be right about when Bohr read James, *i.e.* not until 1932, Bohr could well have been reasonably acquainted with James' ideas from approximately 1904 on', see Folse, *Philosophy of Niels Bohr*, 50.

106 William James, *The Principles of Psychology*, 2 vols (London, 1890), i, 237, 239.

how came such words to be used at all?'<sup>107</sup> This leads to James's exploration of the existence of these two models within one whole, as praised by Bohr above: 'Every definite image in the mind is steeped and dyed in the free water that flows round it'.<sup>108</sup> James's model positions individual units within a continuum, forcing us to address the nature of the relationship between the two, much as Einstein's model of light would fifteen years later. In addition, the question of how to express this relationship in our usual language emerges as a vital one within James's writing.

James's work can in turn be situated within its contemporary context as a response to the discourse of psychophysics, which was founded in the mid-1800s by E. H. Weber and Gustav Fechner. Psychophysics focused on the individual units or bits of consciousness mentioned by James above, and as such became significant for Victorian fiction and literary theory, which had been utilising Samuel Taylor Coleridge's vision of organic form as consisting of wholes. Thus, as Nicholas Dames has explained, Victorian psychology and physiology and, in turn, literature and literary theory, were trying to combine 'the fundamental importance of individual sensations' with the idea of consciousness 'as a wave-like motion that subsumed and combined these smaller, discrete sensations'.<sup>109</sup> James's formulation of 'the stream of thought' thus provided the complementary model for psychology that Bohr would provide for physics nearly forty years later, a fact which has led Alan Friedman and Carol Donley to suggest that James 'had anticipated many of the new metaphysical positions of modern physics'.<sup>110</sup>

Another field which was participating in these contemporary discussions of duality is that of evolutionary theory, where the question as to whether variation was continuous or discontinuous was being pursued by the followers of Charles Darwin and Gregor Mendel

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107 Ibid. i, 239.

108 Ibid. i, 255.

109 Nicholas Dames, *The Physiology of the Novel: Reading, Neural Science, and the Form of Victorian Fiction* (Oxford, 2007), 178.

110 Friedman and Donley, *Myth and Muse*, 96.

respectively.<sup>111</sup> The link between these developments and those occurring in physics in the early twentieth century is suggested by Lodge's presidential address on 'Continuity' which we have already considered. Lodge states that 'Biology may be said to be becoming atomic', explaining that 'modification by continuous variation, which seemed to be of the essence of Darwinism, gives place to, or at least is accompanied by, mutation, with finite and considerable and in appearance discontinuous change'.<sup>112</sup> Lodge continues by invoking Darwin's *Origin of Species* (1859) directly: 'So far from Nature not making jumps, it becomes doubtful if she does anything else. Her hitherto placid course, more closely examined, is beginning to look like a kind of steeplechase'.<sup>113</sup> However, Lodge's belief in 'ultimate Continuity' remains unshaken as he begins another new paragraph with an all-important 'yet': 'Yet undoubtedly Continuity is the backbone of evolution'.<sup>114</sup>

The 'profound crisis of discontinuities that beset the whole of later-nineteenth-century culture', as well as that of the early twentieth century, was referred to by various other contemporary writers, including T. E. Hulme.<sup>115</sup> Thus in 'A Notebook' (1915-16) Hulme explains that 'One of the main achievements of the nineteenth century was the elaboration and universal application of the principle of *continuity*. The destruction of this conception is, on the contrary, a pressing necessity of the present'.<sup>116</sup> In *Between the Acts* Woolf also demonstrates an awareness of the contemporary shift towards discontinuity: 'The young, who can't make, but only break; shiver into splinters the old vision; smash to atoms what was whole', a reflection which appears after a jazz tune starts to play on the gramophone (109). However, Hulme suggests, like Bragg, that 'For an objective view of

111 For a contemporary account of Mendel's work see W. Bateson, *Mendel's Principles of Heredity* (Cambridge, 1909). It is worth noting that 'the Mendelian theory' is mentioned directly, and alongside Einstein, in *Mrs Dalloway* (30).

112 Lodge, 'Continuity', 13, 14. Eddington makes a similar link between 'the Mendelian theory of heredity' and 'atomic theory' in *The Nature of the Physical World*, 250.

113 Lodge, 'Continuity', 14. See Charles Darwin, *On the Origin of Species*, ed. Gillian Beer (rev. edn, Oxford, 2008), especially chapter six, 129-54.

114 Lodge, 'Continuity', 15, 14.

115 Donald R. Benson, "'Catching Light'": Physics and Art in Walter Pater's Cultural Context', in George Levine, ed., *One Culture: Essays in Science and Literature* (Madison, 1987), 145.

116 *The Collected Writings of T. E. Hulme*, ed. Karen Csengeri (Oxford, 1994), 423.

reality we must make use both of the categories of continuity and discontinuity', and here we again see a movement towards something like the later complementary approach.<sup>117</sup>

While discussions of continuity and discontinuity, of waves and particles, of duality and complementarity, emerged as vitally and fundamentally important to the developing field of quantum mechanics in the 1920s, then, this was by no means the first time that such questions had been raised. Thus when Beer writes that 'wave-particle theory at the end of the 1920s and through the 1930s caught the imagination', we may now find ourselves wondering whether in fact the very scientists who were working in this field had had their own imaginations caught by some of the earlier discourse of similar ideas.<sup>118</sup> As we saw in the previous chapter, 'Dualism was at the centre of virtually every Victorian argument', and this central dualism seems to have been carried forward into the twentieth century, meaning that the discussions taking place within science had a particular cultural resonance.<sup>119</sup>

And yet the key difficulty for physics, psychology, biology, art, literature – for culture as a whole – in the early part of the twentieth century lies 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, a distinction which many previous studies of wave-particle duality and literature do not seem to have grasped fully. In 1923 J. W. N. Sullivan wrote of the two 'quite irreconcilable' theories of light that 'The physicist must keep both and yet they cannot live together': difficult as this was to accept, Bohr's development of this idea to state that we must keep both because they *do* exist together, even though we cannot see them both at any one moment, clearly entails something even more radical.<sup>120</sup> Complementarity involves the acceptance of duality as inherent, the

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117 Ibid.

118 Beer, *Common Ground*, 113.

119 Levine, *Realism, Ethics and Secularism*, 65.

120 Sullivan, *Atoms and Electrons*, 119.

acknowledgement that the physicist, and, I would argue, everyone else, 'must learn to think simultaneously in both systems'.<sup>121</sup>

The whole that is created by simultaneously using both systems does not, however, simply create a new third entity; it is not a 'fusion' in the sense that something new is created by combining theory one with theory two in the way that the chemical combination of two elements creates a compound with a different set of properties. It is not a new entity, and yet nor is it simply the expression of an old-fashioned either/or: it is somehow both a combination of *and* neither of these things. The two sides of the duality remain separate but linked within the new complementary world view, and such a model may remind us of Woolf's description of Anton Chekhov's writing which we considered in the previous chapter, whereby 'this, that, and the other' are 'placed together' without being combined in any detrimental fashion.<sup>122</sup> It is for these reasons that Eddington's coinage 'wavicle' is both inadequate and inappropriate as a description of the new nature of light: as Eddington himself acknowledges, this is 'a compromise', designed to solve the fact that 'We can scarcely describe [light] as a wave or as a particle'.<sup>123</sup> Eddington is correct in recognising that the old either/or formulation is no longer adequate to describe the new, quantum, world; but what he fails to realise is that his combination formula is also inadequate. The only option left to us, then, is both/and, but Bohr's 'and' must be able to both include *and* differentiate, placing opposites together without restricting their differences, much as we saw Woolf attempting at the end of the previous chapter.<sup>124</sup>

We have seen that these ideas were in circulation before the emergence of wave-particle duality and complementarity in the 1920s, but it should also be acknowledged that

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121 Albright, *Quantum Poetics*, 25.

122 *The Essays of Virginia Woolf*, ed. Andrew McNeillie and Stuart N. Clarke, to be completed in 6 vols (London, 1986–), iii, 34 and iv, 163.

123 Eddington, *Nature of the Physical World*, 201.

124 James McFarlane has explored some of these questions in relation to the modernist mind set, suggesting that 'the Modernist formula becomes "both/and and/or either/or"', 'The Mind of Modernism', in Malcolm Bradbury and James McFarlane, eds., *Modernism: A Guide to European Literature, 1890-1930* (London, 1976; repr. 1991), 88.

these scientific formulations seem to have brought the debate to a climax, as well as to the attention of a wider public in the form of popular science. That Woolf would have been aware of these developments through her reading of such books is clear, but the extent of her awareness of the earlier discussions is harder to ascertain. While her early writings suggest some affinity with the later scientific models, the source of her inspiration for such images remains uncertain in that it could stem from science, psychology, art, the dualism that seems to have been inherent in Victorian culture, or even, as we saw in the previous chapter, from the dualities which she perceived to exist in her own life. It is more likely, of course that any inspiration, or, indeed, confirmation, exists as a combination of some or all of these factors: after all, as Beer writes of Woolf's reading of Jeans, 'He is not set apart as "science" but enters the mêlée of response in which her imagination best works'.<sup>125</sup>

One thing we can do, however, is to consider whether or not, and if so how, Woolf's writing of dualities was affected by the scientific climax of such discussions in the work of de Broglie and Bohr. Having explored Woolf's early works as well as the background to this scientific climax, we are now in a position to investigate any difference that may exist in Woolf's use and understanding of such ideas following the public and popular exposition of both wave-particle duality and complementarity in the late 1920s. And where better to begin such an investigation than with Woolf's 1928 novel *Orlando*, in which the question of 'Orlando the man and Orlando the woman' (131), and of 'this mixture in her of man and woman' (133), suggests the development of something radically different, of something dualistic and yet complementary, in the very expression of personality and gender?

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<sup>125</sup> Gillian Beer, *Wave, Atom, Dinosaur: Woolf's Science* (London, 2000), 6.

## Chapter 3

### 'Orlando the man and Orlando the woman':

#### Representations of Complementarity in Virginia Woolf's Later Works

As we saw in chapter one, Virginia Woolf's awareness of, sensitivity to and attempts to re-imagine dualities are present from her earliest works onwards. However, as we will see in this chapter, her efforts to balance opposites, as well as to accept their simultaneous coexistence, become both more frequent and more urgent as time goes by.

Writing in her diary early in 1929 Woolf asks:

Now is life very solid, or very shifting? I am haunted by the two contradictions. This has gone on for ever: will last for ever; 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, & continuous – we human beings; & show the light through. But what is the light?<sup>1</sup>

There is 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. The fact that punctuation is present throughout the extract, keeping the two contradictions apart, does not mean that this attempt has failed, but rather indicates that Woolf recognises the extent of the difficulties inherent in the problem; and indeed the question with which this passage opens certainly does seem to have 'haunted' Woolf throughout her life and writing career. It is also worth noting that the question 'But what is the light?' had a particular contemporary resonance, as we saw in the previous chapter.

Woolf's exploration of the dual nature of life and time in her diary echoes a passage in *Orlando*, which had been published just three months earlier, in October 1928:

Of the two forces which alternately, and what is more confusing still, at

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<sup>1</sup> Virginia Woolf, diary entry for 4 January 1929, *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, 5 vols (London, 1977-84), iii, 218.

the same moment, dominate our unfortunate numbskulls – brevity and diuturnity – Orlando was sometimes under the influence of the elephant-footed deity, then of the gnat-winged fly. Life seemed to him of prodigious length. Yet even so, it went like a flash.<sup>2</sup>

Woolf is exploring the same issue here as she was in her diary, and the repetition of the same questions within such a short space of time emphasises their significance for Woolf. Of particular note here is Woolf's recognition that these two opposing 'forces' appear *both* 'alternately' *and* 'at the same moment', and this latter phrase is one that reappears frequently in similar constructions, both in Woolf's own writing and in that of contemporary popular science writers.

It is to *Orlando* that we must turn for what is perhaps Woolf's first sustained attempt at the writing of a complementary model of the self. Sue Sun Yom has argued that '*Orlando* incorporates the beginnings of Woolf's struggle to find the deBroglie [*sic*] balance between wavelike wholeness and particlelike individuality', exploring the balance between Orlando as 'a compilation of specific personas' and his/her memory which 'seems to weave together all the events of her past life' into a wave-like continuum.<sup>3</sup> However, it is in Orlando's change of gender that we find some of Woolf's most interesting writing of the balancing of opposites which, though not expressed in terms that can be as closely linked to the waves and particles of contemporary scientific discourse, implies a true attempt at the understanding and writing of complementarity; as Dennis Bohnenkamp has written, Woolf 'suggests the complementarity of the sexes by collapsing the male/female dichotomy in the androgyny of *Orlando*'s central character'.<sup>4</sup> While there are a number of problems with Bohnenkamp's formulation here – notably the unquestioning use of the term

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2 Virginia Woolf, *Orlando: A Biography*, ed. Brenda Lyons (London, 1993), 69.

3 Sue Sun Yom, 'Bio-graphy and the Quantum Leap: Waves, Particles, and Light as a Theory of Writing the Human Life', in Beth Rigel Daugherty and Eileen Barrett, eds., *Virginia Woolf: Texts and Contexts. Selected Papers from the Fifth Annual Conference on Virginia Woolf* (New York, 1996), 147. Note, however, that while Yom focuses on dualistic models of light from the 1920s she makes no mention of Albert Einstein, nor of Niels Bohr, focusing instead on Werner Heisenberg's uncertainty principle.

4 Dennis Bohnenkamp, 'Post-Einsteinian Physics and Literature: Toward a New Poetics', *Mosaic*, 22/3 (1989), 26.

'androgyny' and the idea that complementarity collapses duality – his phrase 'the complementarity of the sexes' is a useful one, and an idea to which we shall now turn.

Woolf presents Orlando's change of gender to the reader in radical and unambiguous terms:

He stretched himself. He rose. He stood upright in complete nakedness before us, and while the trumpets pealed Truth! Truth! Truth! we have no choice left but confess – he was a woman. (97)

A similar formulation appears on the following page, when the narrator/biographer 'state[s] the simple fact; Orlando was a man till the age of thirty; when he became a woman and has remained so ever since' (98). No contradiction is suggested in Woolf's grammatically simple phrases 'he was a woman' and 'he became a woman', yet the absence of any dividing punctuation of the kind that we have considered previously coupled with the actual meaning of these phrases is radical in the extreme.

Marjorie Garber has described Orlando's 'transformation' as occurring 'through what is in effect a pronoun transplant', an image which the moments following Orlando's change certainly support.<sup>5</sup>

Orlando had become a woman – there is no denying it. But in every other respect, Orlando remained precisely as he had been. The change of sex, though it altered their future, did nothing whatever to alter their identity. Their faces remained, as their portraits prove, practically the same. His memory – but in future we must, for convention's sake, say 'her' for 'his', and 'she' for 'he' – her memory then, went back through all the events of her past life without encountering any obstacle. (98)

At first sight, the 'pronoun transplant' that takes place here is clear cut: Orlando begins the paragraph as 'he', and by the end of the paragraph (only half of which is given above) Orlando has become 'she'. However, on closer inspection it soon becomes apparent that the change in pronoun, and thus in gender, is not as simple as it first seems: as well as the shift from 'he' to 'she' and from 'his' to 'hers', the reader must also contend with an intermediate movement to 'their', a 'transplant' which enables Orlando to be *both man and woman at the*

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<sup>5</sup> Marjorie Garber, *Vested Interests: Cross-Dressing & Cultural Anxiety* (New York, 1992), 134.

*same time.*

The union of two opposites implied in the pronoun 'their' creates what Garber calls, in relation to cross-dressing, the 'third', although she hastens to add that 'the "third term" is *not a term*. Much less is it a *sex*, certainly not an instantiated "blurred" sex as signified by a term like "androgyne" or "hermaphrodite"; rather it is 'a mode of articulation, a way of describing a space of possibility'.<sup>6</sup> The possibility that Woolf is exploring in those four repeated 'theirs', then, is the simultaneous existence within one whole of two opposites, of man and woman, and the concept of 'a space of possibility' is emphasised by Woolf's description of her idea for *Orlando* as involving 'a change about from one sex to another' – not *the* other, but *an* other.<sup>7</sup>

And yet it soon becomes impossible to sustain the use of the pronoun 'their' in the above passage: it is only used four times, and those uses appear in very quick succession. Most interestingly, however, the pronoun transplants move from 'he' to 'their' and then *back* to 'his' before we make the move forward to 'her', a movement which can only be fully introduced and explained in parenthesis, and which is only made at all 'for convention's sake'. Thus not only has the male version of Orlando been overwritten by the female by the end of the passage above, with even the life and the memory that belong to Orlando's time as a man having been overwritten by 'she' and 'her', but the short moment of joint existence represented by 'their' has also been overwritten, both by 'he' and then by 'she'. Whether Orlando's identity has changed or not, she is now definitely a woman.

As the novel continues, Woolf draws our attention to the gradual change that Orlando has undergone since her transformation into a woman:

Her modesty as to her writing, her vanity as to her person, her fears for her safety all seem to hint that what was said a short time ago about there

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<sup>6</sup> Ibid. 11. See also Lisa Haines-Wright and Traci Lynn Kyle, 'From He and She to You and Me: Grounding Fluidity, Woolf's *Orlando* to Winterson's *Written on the Body*', in Daugherty and Barrett, eds., *Texts and Contexts*, 178-9.

<sup>7</sup> Woolf, diary entry for 5 October 1927, *Diary*, iii, 161.

being no change in Orlando the man and Orlando the woman, was  
 ceasing to be altogether true. (131)

Here there seem to be two Orlandos, 'Orlando the man and Orlando the woman': they are separate, and yet they are the same, the 'and' being of the inclusive kind that we discussed in the first chapter. Two pages later, however, Woolf discusses the 'mixture in her of man and woman, one being uppermost and then the other' (133). While the word 'mixture' implies a combination of the two genders, the second clause seems to provide us with something closer to the complementary image proposed by Bohr: both waves and particles exist within all matter and radiation, just as both man and woman exist within Orlando, but only one incarnation can be seen at any particular moment – one is uppermost and then the other.

Where, then, does this leave the pronoun 'their'? In some ways 'their' is like A. S. Eddington's new term 'wavicle', introduced, by his own admission, as 'a compromise' between the designation of an entity as *either* a wave *or* a particle, as we saw in the previous chapter.<sup>8</sup> In some ways 'their' implies a combination, a 'mixture', like we have seen in some of the early attempts to visualise wave-particle duality. And yet we are always aware that 'they', like 'we', consists of a number of separate, individual entities; this is why the line repeated by Mr Ramsay in *To the Lighthouse* (1927) from William Cowper's poem 'The Castaway' (1799), 'We perished, each alone', has such resonance.<sup>9</sup> 'Their' can thus also be seen as an attempt to capture the new, complementary world picture, in that it allows a sense of something different and new as well as an expression of the separate 'he' and 'she' that exist within Orlando: after all, what is 'their' but a different way of expressing 'he and she', using that inclusive 'and' which we have already discussed. Yet the fact that the writing of 'their' cannot be sustained for long emphasises the problems inherent in

<sup>8</sup> A. S. Eddington, *The Nature of the Physical World* (Cambridge, 1928), 201.

<sup>9</sup> Virginia Woolf, *To the Lighthouse*, ed. Stella McNichol (London, 1992), 180 and 253 n. 2. See Gillian Beer, *Virginia Woolf: The Common Ground* (Edinburgh, 1996), 50.

'think[ing] simultaneously in both systems' – more than that, in *writing* simultaneously in both systems.<sup>10</sup> It either cannot be done at all, or it cannot be sustained. The same applies to the wave-particle duality and complementarity of the physicists: we must be able to 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, that the two are 'complementary *and* mutually exclusive'.<sup>11</sup> Thus the phrase 'Orlando the man and Orlando the woman' is ultimately more representative of the new quantum world than the radical, but unsustainable, 'their'.

Discussions of this kind lead us to androgyny, a concept with which Woolf has long been associated.<sup>12</sup> C. R. Rooney has described *Orlando* as 'not an argument for androgyny but rather an enactment of it', and for the argument itself we must instead turn to *A Room of One's Own* (1929).<sup>13</sup> In this text, the image of 'a girl in patent leather boots' getting into a taxi with 'a young man in a maroon overcoat' comes to symbolise the androgynous mindset which Woolf advocates.<sup>14</sup> Woolf explains that through this observed incident 'the unity of the mind' was 'restored', adding later that the sight enabled 'the mind [to feel] as if, after being divided, it had come together again in a natural fusion'.<sup>15</sup> The conclusion of these observations is thus 'that it is natural for the sexes to co-operate', and while the ideas of 'unity' and 'fusion' suggest a combinatory model of the kind which we have so far rejected, the idea of cooperation implies something closer to complementarity.<sup>16</sup>

As we saw in the previous chapter, one of the key difficulties with the two incompatible theories of light was that 'any practical attempt at a compromise appears to

10 Daniel Albright, *Quantum Poetics: Yeats, Pound, Eliot, and the Science of Modernism* (Cambridge, 1997), 25.

11 Gerald Holton, *Thematic Origins of Scientific Thought: Kepler to Einstein* (rev. edn, Cambridge, Massachusetts, 1988), 140 n. 4.

12 For a basic introduction to a number of different critical approaches to Woolf's idea of androgyny, see Toril Moi, *Sexual/Textual Politics: Feminist Literary Theory* (2<sup>nd</sup> edn, London, 2002), 1-18.

13 C. R. Rooney, 'The Androgyne and the Double in Literature, 1890-1940', DPhil thesis, University of Oxford, 1988, 292-3.

14 Virginia Woolf, *A Room of One's Own/Three Guineas*, ed. Michèle Barrett (London, 1993), 87.

15 *Ibid.* 87, 88.

16 *Ibid.* 88.

require the abandonment of something which is essential to one or other of the two theories', a difficulty which was overcome through Bohr's reinterpretation of the situation in a complementary form.<sup>17</sup> In her understanding of androgyny Woolf is also looking for a complementary balance, explaining in *A Room of One's Own* that 'It is fatal to be a man or woman pure and simple; one must be woman-manly or man-womanly', and that 'Some marriage of opposites has to be consummated' before embarking on any work of art.<sup>18</sup> In *Orlando*, as we have already seen, the enactment of androgyny goes further than the argument for it, as here we have one character who is *both* man *and* woman throughout, even though we usually only see one side of this duality at a time. The point about Orlando, however, is that he/she 'vacillate[s]' between the two genders (113), and Woolf tells us that such 'a vacillation from one sex to the other' is present 'In every human being' (132). Pamela Caughie has highlighted the centrality of 'Oscillating exploration' to *Orlando* and argues that androgyny 'is a refusal to choose'.<sup>19</sup> I would suggest, however, that androgyny is in fact the decision *not* to choose, the decision not to limit oneself with the sort of either/or choice that we saw in *Jacob's Room* (1922) in the first chapter. Thus Woolf writes that 'Whether, then, Orlando was most man or woman, it is difficult to say and cannot now be decided' (133). The absence of judgement here, while partly an ironic comment on the nature of the writing of biographies, also makes a more significant point: Orlando was not 'most' man or woman at all, but an inextricable, complementary, coexistence of the two, a fact which allows for what Rooney calls the 'double perspective' which the novel as a whole provides.<sup>20</sup> Thus, as Elaine Showalter has written of Woolf's concept of androgyny, it is 'a struggle to keep two rival forces in balance without succumbing to either'.<sup>21</sup>

17 J. H. Jeans, *Report on Radiation and the Quantum-Theory* (London, 1914), 89.

18 Woolf, *Room of One's Own*, 94.

19 Pamela L. Caughie, *Virginia Woolf and Postmodernism: Literature in Quest and Question of Itself* (Urbana, 1991), 82.

20 Rooney, 'The Androgyne and the Double', 310.

21 Elaine Showalter, *A Literature of Their Own: From Charlotte Brontë to Doris Lessing* (rev. and exp. edn,

Orlando's gender is not the only binary opposition that requires balancing within the novel, however; the presentation of the book as 'A Biography' on its title page raises questions for the reader about the very nature of fact and fiction, of biographies and novels, questions which, again, Woolf repeatedly asked herself throughout her writing career.<sup>22</sup> A few months before starting work on *Orlando*, Woolf read Harold Nicolson's *Some People* (1927), publishing a review of it in October of that year under the title 'The New Biography'. In this essay Woolf explores the importance to biography of both fact (here called 'truth') and fiction ('personality') in a manner that suggests both duality and the need for complementarity:

On the one hand there is truth; on the other, there is personality. And if we think of truth as something of granite-like solidity and of personality as something of rainbow-like intangibility and reflect that the aim of biography is to weld these two into one seamless whole, we shall admit that the problem is a stiff one and that we need not wonder if biographers have for the most part failed to solve it.<sup>23</sup>

Here, truth is particulate while personality is wave-like, and biography represents the problem of complementarity, of how to balance the duality. In a letter to Nicolson, Woolf praised him for his ability to 'combine the advantages of fact and fiction', a problem with which Woolf had already been struggling for many years: in a 1906 review of another biography Woolf had complained of the author's 'compromise between history and fiction' whereby 'the truth has the vagueness of fiction and the fiction is diluted with fact'.<sup>24</sup> In contrast, Nicolson has found a way to 'combine the advantages' of both, 'a method of writing about people and about himself as though they were at once real and imaginary'.<sup>25</sup> However, Woolf goes on to explain the difficulty of a complementary model in a way that is reminiscent of her earlier review: 'Let it be fact, one feels, or let it be fiction; the

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London, 2009), 218.

22 See Woolf's biography of Elizabeth Barrett Browning's dog, *Flush* (1933).

23 *The Essays of Virginia Woolf*, ed. Andrew McNeillie and Stuart N. Clarke, to be completed in 6 vols (London, 1986–), iv, 473.

24 Virginia Woolf, letter to Harold Nicolson dated 15 June 1927, *The Letters of Virginia Woolf*, ed. Nigel Nicolson and Joanne Trautmann, 6 vols (London, 1975-80), iii, 392; Woolf, *Essays*, i, 118.

25 Woolf, *Essays*, iv, 475.

imagination will not serve under two masters simultaneously'; and yet she acknowledges that while 'Truth of fact and truth of fiction are incompatible', the biographer 'is now more than ever urged to combine them'.<sup>26</sup> The solution to this problem lies in the 'careful' balance between the two, 'that queer amalgamation of dream and reality, that perpetual marriage of granite and rainbow'.<sup>27</sup>

Woolf was very aware of 'the compromise of biography', but the question of balance between what she elsewhere calls 'facts' and 'vision' is not only applicable to Woolf's biographies, factual or fictional as they may be.<sup>28</sup> Woolf often returned to this question when writing her novels, confronting it most directly while writing *The Years* (1937) which she described in her diary as 'Rather an interesting experiment – if I could see the same thing from two different views': at first she found herself 'infinitely delighting in facts for a change, & in possession of quantities beyond counting', feelings which she put down to 'abstaining from the novel of fact all these years – since 1919 – & N[ight]. & D[ay]'.<sup>29</sup> Woolf's aim at this early stage of writing *The Years* was to write an 'Essay-Novel', and her focus on the factual side of this idea was such that she wrote 'I feel now & then the tug to vision, but resist it'.<sup>30</sup> However, nearly half a year later, in April 1933, she wrote 'I want to give the whole of the present society – nothing less: facts, as well as the vision. And to combine them both. I mean, *The Waves* going on simultaneously with *Night & Day*' – and then she pauses to ask, 'Is this possible?'<sup>31</sup>

The recognition of both the necessity and the difficulty of presenting opposites

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26 Ibid. iv, 478

27 Woolf, diary entry for 22 October 1927, *Diary*, iii, 162; Woolf, *Essays*, iv, 478. As Andrew McNeillie points out in his notes to 'The New Biography', the contrast between 'granite and rainbow' can also be found in *Orlando*, the prose style of which is obviously very similar to that of this essay: 'Nature, who has played so many queer tricks upon us, making us so unequally of clay and diamonds, of rainbow and granite' (55), Woolf, *Essays*, iv, 480 n. 15.

28 Woolf, letter to Vanessa Bell dated 24 October 1938, *Letters*, vi, 294; Woolf, diary entry for 2 November 1932, *Diary*, iv, 129.

29 Woolf, diary entries for 24 August 1933 and 2 November 1932, *Diary*, iv, 173, 129. Note, however, that while *Night and Day* is certainly one of Woolf's most 'factual' novels, it is still, as we have seen, at least as concerned with dreams as it is with realities.

30 Ibid. iv, 129.

31 Woolf, diary entry for 25 April 1933, *Diary*, iv, 151-2.

simultaneously is explored by Woolf in relation to a whole range of different dichotomies throughout her writing. As we saw in chapter one, Woolf described the soul itself as dualistic in 'How Should One Read a Book?' (1926), explaining that both 'the light side and the dark side' are 'equally real, equally important. But a novelist will always tend to expose one rather than the other'.<sup>32</sup> That such a privileging of one side of a duality over the other side is a fault in a novelist is emphasised by Woolf in her autobiographical piece 'Sketch of the Past', written during 1939 and 1940. Here Woolf distinguishes between 'moments of being' and 'moments of non-being', suggesting that 'The real novelist can somehow convey both sorts of being'.<sup>33</sup>

Ten years earlier, in 1929, Woolf had published a long essay in three instalments entitled 'Phases of Fiction' in which she explained how the 'dual vision' of 'the thinker and the poet'

makes the great characters in Proust and the whole world from which they spring more like a globe, of which one side is always hidden, than a scene laid flat before us, the whole of which we can take in at one glance.<sup>34</sup>

Marcel Proust is, in Woolf's terms, a 'real novelist', able to present both sides of a duality, but doing so in a way that enables them to remain separate and distinct: together the two sides form 'a globe'; we can only see one side of it at a time, but we are always aware that there is another side, another half that plays an equal part in the whole. The point, as Woolf explains later in the essay in relation to the novel and style, is that 'The two powers fight if they are brought into combination. The most complete novelist must be the novelist who can balance the two powers so that the one enhances the other'.<sup>35</sup> This formulation may remind us of J. J. Thomson's description of the two theories of light as like a 'contest'

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<sup>32</sup> Woolf, *Essays*, iv, 392.

<sup>33</sup> Virginia Woolf, *Moments of Being: Autobiographical Writings*, ed. Jeanne Schulkind (rev. edn, London, 2002), 83, 84.

<sup>34</sup> Woolf, *Essays*, v, 68.

<sup>35</sup> *Ibid.* v, 83.

between a tiger and a shark which we considered in the previous chapter.<sup>36</sup> Likewise, the move towards 'balance' which Woolf sees as necessary for the 'most complete novelist' is similar to that towards complementarity within the sciences: as Thomson wrote in his non-combative reformulation, 'both the undulatory and the corpuscular theory expressed a part but not the whole of the truth'.<sup>37</sup> The trick for the 'real novelist', then, is to recognise and express dualities in a complementary manner: both sides must be presented and they should be welded 'into one seamless whole', like the truth and personality of biography; however, that whole should be a 'globe' with two distinct sides, enabling the 'real novelist', like Proust, to be 'spherical' and 'comprehensive'.<sup>38</sup>

Woolf herself claimed that, unlike the 'real novelist', she had 'never been able' to convey both moments of being and moments of non-being, although she 'tried – in *Night and Day*; and in *The Years*'; yet, whether or not we agree with her assessment, it is clear that she constantly strove to achieve an enhancing balance within her own writing.<sup>39</sup> Part of this struggle manifested itself in the question of how to use different literary forms within that of the novel, or of how to create a new form that includes all others. Woolf's concern with the nature of the 'so-called novels' that she wrote is emphasised by her repeated attempts to 'invent a new name for them'.<sup>40</sup> In 1940 she wrote to Hugh Walpole, 'Oh no – I'm not a novelist. Always wanted to name my books afresh', and this preoccupation first seems to emerge while Woolf is working on *To the Lighthouse*: 'I have an idea that I will invent a new name for my books to supplant "novel". A new – by Virginia Woolf. But what? Elegy?'<sup>41</sup>

If we accept Woolf's term 'elegy' for *To the Lighthouse*, we must acknowledge that

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36 J. J. Thomson, *The Structure of Light* (Cambridge, 1925), 15.

37 J. J. Thomson, *Beyond the Electron* (Cambridge, 1928), 25.

38 Woolf, *Essays*, v, 79.

39 Woolf, *Moments of Being*, 84.

40 Ibid. 83; Woolf, diary entry for 18 February 1928, *Diary*, iii, 176.

41 Woolf, letter to Hugh Walpole dated 19 April 1940, *Letters*, vi, 365 (note that although the date of this letter has been corrected in a footnote, it appears under 20 October 1939); Woolf, diary entry for 27 June 1925, *Diary*, iii, 34.

it is not just an elegy for the character of Mrs Ramsay, nor solely an elegy for Woolf's own lost childhood and parents, but rather that it can also be seen as an elegy for marriage and family life more generally. Michael Levenson has written about *To the Lighthouse* as an expression of the duality that exists between aesthetic experience and philosophy, explaining that 'The aim of the narrative, when it takes up the allegorical thread, is to find a third term capable of surpassing the dualism'.<sup>42</sup> He continues:

Marriage offers itself as just such a third term, but while married life gives moments of blinding glory, it never disables the essential antagonism. It provides complementarity but not unity. ... Art, on the other hand, is a rival third term, composed out of the same dualism but (at least in Lily's understanding) dedicated to overcoming the isolation of its rival parts.<sup>43</sup>

Although Levenson does not make any reference to the contemporary scientific discussion of duality and complementarity, it is clear that his understanding ties in with some of the ideas that we have been considering. However, while Levenson seems to see the ongoing existence of 'the essential antagonism' within the complementary model as a negative point, our previous explorations of the scientific ideas lead us rather to recognise the benefits of such a complementary model. Thus when we read about 'the crepuscular walls of [the Ramsays'] intimacy', and of them 'drawing together, involuntarily, coming side by side, quite close' (133), we may be reminded of the 'thin partitions' of *The Voyage Out* (1915) and the 'thin shell' of the draft of *Jacob's Room* which we considered in chapter one.<sup>44</sup>

Nor is it necessarily obvious that Lily's picture, or art more generally, provides the sort of unity that Levenson says marriage does not: Lily seeks to 'achieve that razor edge of balance between two opposite forces; Mr. Ramsay and the picture; which was necessary' (209), a phrase which suggests the 'balance' of complementarity rather than a restricting

<sup>42</sup> Michael Levenson, *Modernism and the Fate of Individuality: Character and Novelistic Form from Conrad to Woolf* (Cambridge, 1991), 187.

<sup>43</sup> Ibid.

<sup>44</sup> Virginia Woolf, *The Voyage Out*, ed. Jane Wheare (London, 1992), 44; *Virginia Woolf's 'Jacob's Room': The Holograph Draft*, ed. Edward L. Bishop (New York, 1998), 267.

combination. The line that Lily draws in the centre of her picture in order to finish her painting and complete her 'vision' (226), as well as close the novel, 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. Thus, as Marianne Hirsch writes, 'the masses on the right and left can neither be connected nor remain disconnected, but must be both'.<sup>45</sup> A similar idea is suggested by Gillian Beer in terms of the pre- and post-First World War elements which Woolf expresses in *To the Lighthouse*: 'She held them together by separating them. "Time passes", like Lily's line, both joins and parts'.<sup>46</sup>

In order to consider the development towards a complementary model in Woolf's writings of duality, it is worth returning to a relatively minor point that we explored in the first chapter: there we saw a repeated questioning of a 'this or that' formula in *Mrs Dalloway* (1925), with Clarissa stating to herself 'She would not say of any one in the world now that they were this or were that'.<sup>47</sup> Early in *To the Lighthouse*, published just two years later, Lily also questions the ways in which we sum people up:

How then did it work out, all this? 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? And in those words, what meaning attached,  
after all? (29)

There is a definite recognition here of the need to accept different facets of a person as elements of one whole, rather than simply dividing them between *either* this *or* that. For Lily, however, the answer to the question of how to do this remains unclear, unlike Eleanor in *The Years* who, on the evening she first meets Nicholas, moves from 'feeling about him;

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<sup>45</sup> Marianne Hirsch, *The Mother/Daughter Plot: Narrative, Psychoanalysis, Feminism* (Bloomington, 1989), 114.

<sup>46</sup> Beer, *Common Ground*, 32.

<sup>47</sup> Virginia Woolf, *Mrs Dalloway*, ed. Stella McNichol (London, 1992), 8.

this, that, and the other' to a moment in which 'all the feelings came together and made one feeling, one whole – liking'.<sup>48</sup> It is only towards the end of *To the Lighthouse* that we see Lily reflecting on Mrs Ramsay 'resolv[ing] everything into simplicity' – 'she brought together this and that and then this' (175). Like Chekhov in Woolf's essay 'Modern Novels' (1919)/'Modern Fiction' (1925), Mrs Ramsay is here shown to have 'chosen this, that, and the other, and placed them together to compose something new'.<sup>49</sup>

As in the texts that we considered in the first chapter, moments, objects and people are able to portray both particle-like and wave-like attributes at various moments within *To the Lighthouse*, both under the influence, or indeed the absence, of light, and otherwise. Thus in 'The Window' there is a moment when 'it seemed as if solidity had vanished altogether': 'In the failing light they all looked sharp-edged and ethereal and divided by great distances' (80). Woolf pairs a series of incompatible opposites here: how can something lacking solidity also be 'sharp-edged', or something 'sharp-edged' also be 'ethereal'? In addition, while the effects seen here are apparently provoked by the 'failing light', later, when everyone is sat together at dinner, Lily reflects that 'now the same effect was got by the many candles in the sparsely furnished room, and the uncurtained windows, and the bright mask-like look of faces seen by candlelight' (106). It is also interesting to note that in these passages the absence of solidity provokes not a fluid merging of individuals, but rather the recognition of the 'great distances' between them.

There are moments in which things merge in a more liquid manner, however: going to check on her children in the nursery after dinner, Mrs Ramsay

felt, with her hand on the nursery door, 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 Paul and Minta would carry it on when she was dead.  
(123)

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<sup>48</sup> Virginia Woolf, *The Years*, ed. Jeri Johnson (London, 1998), 218.

<sup>49</sup> Woolf, *Essays*, iii, 35 and iv, 163.

Again, we have here an image of thin partitions existing between people but still allowing the transfer of ideas, dreams and memories, as if by a process of osmosis; as in our previous examples, the partitions remain in existence, while everything also flows together into 'one stream', a phrase which may remind us of William James's 'stream of consciousness'. Earlier, Lily had reflected 'how life, from being made up of little separate incidents which one lived one by one, became curled and whole like a wave' (53), an image which resembles Jinny Carslake's box of pebbles in *Jacob's Room*: 'But if you look at them steadily, she says, multiplicity becomes unity, which is somehow the secret of life'.<sup>50</sup> These images certainly suggest the coexistence of something wave-like and something particulate, even if, as in *Orlando*, 'one is uppermost and then the other'.

Images of a loss of solidity, of a sudden fixing of specific moments, and of things streaming together in one fluid continuum lead us naturally to Woolf's 1931 novel *The Waves*. As I mentioned in the first chapter, it is this novel that in many ways suggests the most obvious parallels between Woolf and wave-particle duality, and it is on this novel that critics who have previously explored these links have tended to focus. Thus Alan Friedman and Carol Donley have suggested that the novel consists of a whole series of paired opposites from which 'Wave patterns form' and that 'The entire novel builds from the tensions between isolation and integration, discontinuity and continuity'.<sup>51</sup> Meanwhile, they see each character as 'both an individual and a part of the continuum, both a particle and a wave', and the same could be said for the individual moments or events that make up the plot of the novel; indeed, Christine Froula has suggested that *The Waves* 'displace[s] the Newtonian either/or logic of common sense with the both/and logic of the quantum universe'.<sup>52</sup> Kate Flint has also recognised the complementary viewpoint suggested by the

<sup>50</sup> Virginia Woolf, *Jacob's Room*, ed. Sue Roe (London, 1992), 114.

<sup>51</sup> Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge, 1985), 144. See also their rather simplified, but nevertheless useful, diagrams of the novel as a whole and of the first chapter, 145.

<sup>52</sup> Ibid. 143; Christine Froula, *Virginia Woolf and the Bloomsbury Avant-Garde: War, Civilisation, Modernity* (New York, 2005), 204.

form of the novel, although without designating it as such, in her exploration of 'the particularising details of language through which one establishes one's own private sense of identity' as paired with the repeated and identical narrative syntax that is employed for each character which 'works in the opposite direction': the ultimate effect is to remind us 'that similarity and difference can coexist', just like waves and particles.<sup>53</sup>

It is the characters of *The Waves* which form the most interesting – and, indeed, confusing – images of duality and complementarity in this novel, with each character, in Friedman and Donley's terms, existing as 'both a particle and a wave', appearing now as part of the continuum of the group, and now as one of six (or seven) distinct individuals. Such a model becomes apparent early in the novel: after Susan has listed a variety of factors which make several of the six individuals distinct from her as an individual, Bernard begs to disagree:

'But when we sit together, close,' said Bernard, 'we melt into each other with phrases. We are edged with mist. We make an unsubstantial territory.'

'I see the beetle,' said Susan. 'It is black, I see; it is green, I see; I am tied down with single words. But you wander off; you slip away; you rise up higher, with words and words in phrases.'<sup>54</sup>

Here both sides of the duality are presented to us in quick succession: for Bernard individual personality should 'melt' into one wave-like whole, whereas for Susan each character is a separate particle, just like her 'single words'. The pronouns employed by each character are particularly significant: Bernard's 'we' is separated out by Susan into 'I' and 'you', and this is emphasised by the fact that the two pronouns appear in separate sentences. And yet each character also has an awareness of the other's ideals: for Bernard there is still an 'edge' even if it is of 'mist'; there is still a 'territory' even if it is 'unsubstantial'. Meanwhile, Susan uses Bernard's catchphrase of 'words and words in phrases' which, coupled with the separation of her clauses with semi-colons rather than full-stops, suggests

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<sup>53</sup> Kate Flint, Introduction to Virginia Woolf, *The Waves*, ed. Kate Flint (London, 1992), x.

<sup>54</sup> Woolf, *The Waves*, ed. Flint, 10.

a greater closeness and fluidity than she has first implied, an unconscious linking of two distinct personalities.

Woolf expressed her attempts to create such a duality and complementarity of distinct and combined characters in a number of letters and a diary entry following the publication of *The Waves*. In October 1931, Woolf wrote 'Odd, that they (The Times) shd. praise my characters when I meant to have none', while in September of that year she had told John Lehmann that she had wanted to 'keep the elements of character; and yet that there should be many characters, and only one'.<sup>55</sup> In 1932 Woolf described the two sides in another form to Lady Ottoline Morrell: 'I didn't mean real people, only ghosts – but perhaps real people have ghosts'.<sup>56</sup> These dualities are 'sum[med] up' by Bernard in the final section of the novel (183):

And now I ask, 'Who am I?' I have been talking of Bernard, Neville, Jinny, Susan, Rhoda and Louis. Am I all of them? Am I one and distinct? I do not know. We sat here together. But now Percival is dead, and Rhoda is dead; we are divided; we are not here. Yet I cannot find any obstacle separating us. There is no division between me and them. As I talked I felt 'I am you'. This difference we make so much of, this identity we so feverishly cherish, was overcome. (222)

Again we can track Bernard's thought patterns through the pronouns employed by Woolf: he moves from 'I' to 'them', then 'I' to 'we', 'I' to 'us', 'me and them', and finally, and most importantly, 'I *am* you' (my emphasis) which returns us to 'we'. The indistinct and wave-like continuity of the group of friends is significant here, but Bernard's claim that 'There is no division between me and them' in fact forces the division that Bernard is claiming to have 'overcome', while his constant return to 'I' suggests a greater distinction between Bernard and 'them' than he is willing to admit. Likewise, in *The Years*, in a formulation which may also remind us of *The Voyage Out*, North wishes

To keep the emblems and tokens of North Pargiter – the man Maggie

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<sup>55</sup> Woolf, diary entry for 8 October 1931, *Diary*, iv, 47; Woolf, letter to John Lehmann dated 17 September 1931, *Letters*, iv, 381.

<sup>56</sup> Woolf, letter to Lady Ottoline Morel dated mid-January 1932, *Letters*, v, 6.

laughs at; the Frenchman holding his hat; but at the same time spread out, make a new ripple in human consciousness, be the bubble and the stream, the stream and the bubble – myself and the world together. (300)

As in Bohr's idea of complementarity, the particular form that Woolf's characters take depends on the way in which we approach them at any given moment: Bernard and North provide those ways in all their different incarnations, but because they are also essentially the only way for the reader to access these discussions, we are in the end limited by that 'I'. This concept is itself questioned by Maggie and Sara in *The Years*, however, as they ask 'What's "I"?' (102).

The wave-like oneness of the six individuals in *The Waves* is emphasised in a letter that Woolf wrote to G. L. Dickinson in October 1931: 'But I did mean that in some vague way we are the same person, and not separate people. The six characters were supposed to be one'.<sup>57</sup> Such an idea is emphasised at various points in the novel, with Bernard referring to 'our life, our identity' (213), and Louis reflecting that he and the others are 'like separated parts of one body, and soul' (103). The difference between the particle-like conception of the self and the wave-like is emphasised by Bernard in a parenthetical remark early in the novel: 'we are not single, we are one' (50). That 'single' and 'one' are so closely linked in terms of meaning suggests the similarity between these concepts, and yet Woolf uses them here to express completely opposite ideas. Thus the continuum becomes all-encompassing, and the 'each alone' that constructs the 'we' in *To the Lighthouse* is overwritten and overcome. And yet the six characters do remain distinct too, with their separate names and their individual ways of perceiving and reflecting on the world around them. Each character is, in Friedman and Donley's words 'both a particle and a wave'; each character is both 'one and distinct' *and* 'all of them' according to Bernard's formulation in his summing up. Each character is thus, as Bernard states earlier in the novel, 'this, that and the other' (66), like the elements 'placed together' by Chekhov; but as we know from

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<sup>57</sup> Woolf, letter to G. L. Dickinson dated 27 October 1931, *Letters*, iv, 397.

complementarity, only wave or particle, this or that, can be directly seen at any one moment. However, Woolf is able to keep us aware of the other side of the duality even while she is focusing on one aspect of it, as in Bernard's 'we are not single, we are one'.

Despite the fact that complementarity, like *Orlando*, utilises a model whereby 'one is uppermost and then the other', we have also seen that ideas of simultaneity became essential to thinking about the scientific concept in a more general manner, as in the frequently repeated formulation 'at the same time'. Such simultaneity becomes particularly important in Woolf's *The Years*, but interestingly a shift can be traced in its use over the course of the novel: in the 1880 section Eleanor reflects 'When she was with the others she must stop herself from thinking of two things at the same time', and the fact that she needs to 'wait till she was alone' in order to do this suggests the complexity of such a mode of thinking (23). It is not until the 1910 section of the novel that such dualistic or complementary thinking becomes commonplace: while dining with Maggie and Sara, Rose is made to 'feel that she was two different people at the same time; that she was living at two different times at the same moment' (123), and this is a little later described as 'the odd feeling of being two people at the same time' (124), just as Ralph's image of being 'both lighthouse and bird' was described as 'odd' in *Night and Day*.<sup>58</sup> A few pages later we see Eleanor as 'able to divide herself into two', each 'person' doing something different at the same time (129), and further on Kitty's companion at the opera has 'an odd look on his face as if he were in two worlds at once and had to draw them together' (136). That this new model of simultaneity in this section of the novel may be significant is suggested by Woolf's well-known claim in her 1924 essay 'Character in Fiction' that 'on or about December 1910 human character changed'.<sup>59</sup> While the 1910 section of *The Years* takes place in spring rather than December, this timing allows Woolf to cover the death of

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<sup>58</sup> Virginia Woolf, *Night and Day*, ed. Julia Briggs (London, 1992), 334.

<sup>59</sup> Woolf, *Essays*, iii, 421.

Edward VII on 6 May, one of the key events on which critics have focused when considering Woolf's choice of this date in her essay. 1910 was also the year of the first Post-Impressionist exhibition, entitled 'Manet and the Post-Impressionists', the significance of which we considered in chapter one. The sense of a new model of simultaneity and complementarity in the 1910 section of *The Years* certainly seems significant, then, although further work would be needed in order to think through all the factors which could possibly be contributing to this movement.

As we saw in the first chapter, music and dance are at times used by Woolf in order to enable and enhance the presentation of duality and complementarity, and in the 'Present Day' section of *The Years*, we have a scene in which the focal characters sit watching others dance at Delia's party:

But another dance was beginning. Couples came flocking back into the room. Slowly, intently, with serious faces, as if they were taking part in some mystic rite which gave them immunity from other feelings, the dancers began circling past them, brushing against their knees, almost treading on their toes. And then someone stopped in front of them.

(271)

As in the dance scene from *The Voyage Out* that we considered in the first chapter, the dancing couples are seen 'flocking' and 'circling' like one continuous whole here.

Meanwhile, a contrast is set up by North's appearance at the end of this passage, his 'someone' seeming very definite, and we can perceive his solidity in comparison with the dancers through the fact that he is blocking everyone's view.

However, while in *The Voyage Out* the interludes of dance were relatively brief, with the whole action of one dance being expressed in one long flowing sentence, in *The Years* we have to wait much longer for the end of the music and the consequent cessation of the dancing. Although the narrative is not focused on the dancing as it is in *The Voyage Out*, a gap of more than ten pages appears between the passage above and the following:

The music stopped. The young man who had been putting records

on the gramophone had walked off. The couples broke apart and began to push their way through the door. They were going to eat perhaps; they were going to stream out into the back garden and sit on hard sooty chairs. (284)

These couples 'break apart' at the end of the music, just as the couples in *The Voyage Out* 'were broken up into separate pieces' and 'smashed into little separate bits', although the switch from a passive formulation to a more active one is significant, perhaps reflecting the move from abstract 'circles' to personified 'couples' (139). And yet in *The Years* Woolf maintains an ambiguity between the continuum and the separation in that the couples continue to do things as one; the fluid nature of their dancing has not been lost, as emphasised by the repeated use of 'they' and the verb 'stream'.

The dance scene that appears in *The Waves*, although similar to those in *The Voyage Out* and *The Years*, is different in one significant respect in that here we accompany Jinny within the dance itself:

Now with a little jerk, like a limpet broken from a rock, I am broken off: I fall with him; I am carried off. We yield to this slow flood. We go in and out of this hesitating music. Rocks break the current of the dance; it jars, it shivers. In and out, we are swept now into this large figure; it holds us together; we cannot step outside its sinuous, its hesitating, its abrupt, its perfectly encircling walls. (76-7)

From within, the action of dancing looks very different. The imagery of the sea created by 'flood' and 'current' suggests the wave-like properties that we have seen before in Woolf's dance scenes, while the 'perfectly encircling walls' are much closer to a particulate conception of the self. Jinny and her partner may be 'held together' within this 'body', but they remain more separate than the other dancing couples that we have considered: where Helen in *The Voyage Out* 'seemed to fade into Hewet, and they both dissolved in the crowd' (139), Jinny distinguishes between 'Our bodies, his hard, mine flowing' (77). It is also worth noting that this dance ends when 'Suddenly the music breaks' rather than with the couples themselves breaking apart (77). Once we see the dance from within, then, the

wave-particle duality that it suggests takes on a different and more complex form, now presenting itself within one couple.

It is not only the characters of *The Waves* that portray dualistic and complementary characteristics, however; the objects that appear in the italic interludes are at one moment solid, separate and distinct, and at another fluid, flowing and merged, and these transformations of the very forms of things are motivated by the varying effects of the sunlight coming through the window over the course of the day. In the second interlude,

The light touched something green in the window corner and made it a lump of emerald, a cave of pure green like stoneless fruit. It sharpened the edges of chairs and tables and stitched white table-cloths with fine gold wires. ... Everything became softly amorphous, as if the china of the plate flowed and the steel of the knife were liquid. (20)

Light is here an active force, touching, making, sharpening, stitching and changing the objects that lie in its path, just as we saw in 'Kew Gardens' (1919) in chapter one. We also see that it is capable of having two different effects on these objects: while it makes the indistinct green object into 'a lump of emerald' and 'sharpen[s] the edges of chairs and tables', it *also* makes everything 'softly amorphous', even if this effect is achieved less directly. Thus light here, as in *To the Lighthouse*, is making things both solid *and* liquid, particulate *and* wave-like, and this process for different objects is reversed over the course of the day. In the next interlude 'the rising sun came in at the window':

Now in the growing light its whiteness settled in the plate; the blade condensed its gleam. Chairs and cupboards loomed behind so that though each was separate they seemed inextricably involved. (55)

Here the plate and knife which were 'liquid' in the previous interlude are 'settled' and 'condensed', while the items of furniture whose edges had previously been 'sharpened' are now 'inextricably involved'. In the following interlude the plate is 'like a white lake' and 'shapes took on mass and edge' (82), while the furniture of the penultimate interlude has become 'mellower' and the cutlery is 'lengthened, swollen' (160). In the final interlude (not

including the single sentence with which the novel closes) 'cupboards and chairs melted their brown masses into one huge obscurity' while 'The substance had gone from the solidity of the hills' (181).

Having seen the different effects that light can have in Woolf's later works it is also worth considering, as we did in the first chapter, the various ways in which Woolf expresses her understanding of the nature of light itself. If the effects provoked by light can be seen now as melting, now as solidifying, so too can light appear now wave-like and now particulate. Thus in the fifth interlude of *The Waves*, 'Light descending in floods dissolved the separate foliation into one green mound' (112), and in the seventh 'Through all the flowers the same wave of light passed in a sudden flaunt and flash' (139). However, between these two, in the sixth interlude, 'daggers of light fell upon chairs and tables making cracks across their lacquer and polish', an image which provides a much more distinct and particulate impression of light, even though the paragraph continues with the light 'spil[ing] itself profusely upon the corners and bosses' (125). That Woolf was aware of the contemporary scientific move to describe light in a particulate manner is suggested most forcefully in 'The New Biography', where truth is envisaged as similar to radium, 'able to give off for ever and ever grains of energy, atoms of light'.<sup>60</sup> There is an apparent engagement on Woolf's part here with both Max Planck and Albert Einstein: the 'grains of energy' suggest Planck's quanta, while the 'atoms of light' imply Einstein's light quanta which, from 1926, were known as photons. We should remember too that, as we saw in the first chapter, Woolf had already described light as consisting of 'golden grains' in *Night and Day* (432).

That there is a similarity between some of the ideas being addressed by the scientists of the early twentieth century, including Einstein, and by Woolf herself should by

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<sup>60</sup> Woolf, *Essays*, iv, 473. '[G]rains of heat' also make an appearance in *Between the Acts* (published posthumously 1941), Virginia Woolf, *Between the Acts*, ed. Stella McNichol (London, 1992), 41.

now be clear: but it should also be clear that this is a similarity that does not suggest the exact transfer of science into literature, but rather the manipulation of and further experimentation with ideas that were being explored in both the science and the literature of the period, as well as in various other disciplines. As Beer has suggested, 'The physicists did not simply introduce ideas to [Woolf]; rather, their insights and their language coalesced with hers', and the concept of 'coalescence' is a useful one in that it does not demand a full understanding of the science on Woolf's part, nor imply any sense of precedence in terms of which discipline was approaching the questions and ideas first.<sup>61</sup> As Woolf suggested of her relationship to the psychoanalysts, including their pioneer Sigmund Freud, then, any use of contemporary scientific ideas is, perhaps, 'instinctive'.<sup>62</sup> Such a natural, instinctive coalescence between Woolf and science is suggested in particular by the link between *The Waves* and the popular science of James Jeans, as we saw in regard to the idea of 'rhythm in prose' in the previous chapter.<sup>63</sup>

To what extent, then, did Woolf understand the nature of duality and complementarity, either in a scientific or a more philosophical sense? As we saw in some detail in the first chapter, Woolf's interest in dualistic formulations was present from her earliest writings onwards, perhaps developing from the significant role that dualities played in her personal life. Throughout her life and writing she wanted to 'see the same thing from two different views', without having necessarily to decide which view was the best or the most true to life.<sup>64</sup> Indeed, she understood that such a decision would falsify the true nature of the duality, that the two opposites can never be entirely separated. Such an idea is suggested towards the end of *To the Lighthouse*, as James reflects on the nature of the lighthouse itself:

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<sup>61</sup> Beer, *Common Ground*, 113.

<sup>62</sup> Woolf, letter to Harmon H. Goldstone dated 19 March 1932, *Letters*, v, 36.

<sup>63</sup> Woolf, diary entry for 18 December 1930, *Diary*, iii, 337.

<sup>64</sup> Woolf, diary entry for 24 August 1933, *Diary*, iv, 173.

The Lighthouse was then a silvery, misty-looking tower with a yellow eye that opened suddenly and softly in the evening. Now –

James looked at the Lighthouse. He could see the white-washed rocks; the tower, stark and straight; he could see that it was barred with black and white; he could see windows in it; he could even see washing spread on the rocks to dry. So that was the Lighthouse, was it?

No, the other was also the Lighthouse. For nothing was simply one thing. The other was the Lighthouse too. (202)

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 emphasised by 'also' and 'too', and this is a perfect example of the 'dual vision' of 'observation' and 'imagery', of 'analysis' and 'metaphor' for which, as we have seen, Woolf praised Proust so highly.<sup>65</sup> For Woolf, as for Proust, nothing is ever simply one thing.

For contemporary science, nothing was simply one thing any longer either: as J. J. Thomson wrote in 1928, 'This duality of corpuscles and waves seems to be in evidence in many regions of physics and may be of the nature of things'.<sup>66</sup> Such an idea is by no means easy for scientists to come to terms with or accept, as Gerald Holton has explained, but the difficulty is experienced across disciplines as it is still widely accepted that 'Dualism cannot accommodate "both": its defining poles are essentialised and opposed, and "both" denies opposition'.<sup>67</sup>

However, Woolf seems to have understood that a both/and formulation does *not* necessarily overwrite or destroy difference, that it can allow the existence of opposites as 'two complementary halves of a single truth'.<sup>68</sup> But she also recognises that such an understanding requires a deeper level of thinking, and it is for this reason that Eleanor in *The Years* 'must wait till she was alone' to attempt such thoughts (23). Many critics have recognised the dualistic aspect of Woolf's writing, but few have taken the step beyond

<sup>65</sup> Woolf, *Essays*, v, 68.

<sup>66</sup> J. J. Thomson, *Beyond the Electron*, 12.

<sup>67</sup> Holton, *Thematic Origins*, 138; Haines-Wright and Kyle, 'From He and She', 178-9.

<sup>68</sup> G. P. Thomson, *The Atom* (London, 1930), 230.

duality that Woolf herself took in order to recognise complementarity: thus while Ruth Gruber was correct, in the first doctoral thesis ever written on Woolf, to state that in *The Waves* Woolf recognises 'the necessity of both elements' and that 'There is no synthetic solution to their opposition', when Gruber claims that 'health lies in being a man or a woman, not a compromise between them', she is only half right.<sup>69</sup> Compromise is certainly not the way forward for Woolf, but health in fact lies in being a man *and* a woman, even though one is uppermost and then the other, as in the model of androgyny which Woolf proposes in *A Room of One's Own* and *Orlando*.

Woolf is thus a complementary writer, similar to Orlando when the latter arrives back in England reciting opposite terms to herself linked with 'ands':

'To refuse and to yield,' she murmured, 'how delightful; to pursue and to conquer, how august; to perceive and to reason, how sublime.' Not one of these words so coupled together seemed to her wrong. (116)

Like the quantum physicist, Woolf learnt 'to think simultaneously in both systems', particle *and* wave, male *and* female, dream *and* reality.<sup>70</sup> However, although it might be possible to *think* simultaneously in both systems, *writing* simultaneously becomes more difficult, hence the ultimate inability to sustain the writing of a word like 'their'. That this awareness of and writing of complementarity was influenced in some way by the scientific developments of the day is suggested by the increasing ease with which Woolf presents opposite concepts and ideas together: while in her early works there is a definite attempt to do so, it is only after 1925 that sustained models of coexistence appear at the very centre of Woolf's works, first in the Ramsay marriage, then in the figure of Orlando, and then the individuals and the continuum of *The Waves*. However, we have also seen that there was a much broader cross-disciplinary movement away from the Victorian centrality of dualism and towards a more radical complementary freedom, a movement which was affecting

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<sup>69</sup> Ruth Gruber, *Virginia Woolf: The Will to Create as a Woman* (New York, 2005), 124, 137.

<sup>70</sup> Albright, *Quantum Poetics*, 25.

early twentieth-century discussions in psychology, evolutionary theory, physics, art and literature. The stimulus behind such a movement is difficult to determine, but its culmination in Bohr's scientific concept of complementarity seems clear. While the question of direct influence remains hazy here, then, we can certainly state that duality and, in particular, complementarity had a specific cultural resonance during this period, playing a significant part in 'the common anxieties of the time' which in turn form the basis of the contemporary discourse which is shared across all disciplines.<sup>71</sup>

Woolf was aware of duality from an early age, constantly seeking new ways to present and describe it; but ultimately it was complementarity which drew her further, enabling her to both recognise and celebrate duality, rather than forcing her to combine and compress it. H. M. Daleski has written at length of a similar awareness of duality and complementarity on the part of D. H. Lawrence, and his observations are also applicable to Woolf:

what distinguishes Lawrence's position from most dualist philosophies is his insistence that the contending forces must retain their separate identities. The new whole which is created by establishing a relation between the opposites is not a fusing of the two into one but a complementing of the one by the other.<sup>72</sup>

Such a view is difficult to accept when we are so used to dividing concepts into their opposites and then keeping them separate. The scientific development of complementarity, however, along with the manifestation of similar ideas in other disciplines like literature, empowers us to attempt this acceptance. There is something liberating, if difficult, in using a both/and model, and Woolf seems to have taken full advantage of this liberation, playing with it to its ultimate extreme in her writing of 'Orlando the man and Orlando the woman'. Lawrence also sought this kind of liberation, even though, as we shall see in Part II, he took a slightly different contemporary scientific idea as his starting point when

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<sup>71</sup> Gillian Beer, 'Discourses of the Island', in Frederick Amrine, ed., *Literature and Science as Modes of Expression* (Dordrecht, 1989), 18.

<sup>72</sup> H. M. Daleski, *The Forked Flame: A Study of D. H. Lawrence* (London, 1965), 21.

constructing his own theory of relationships.

Orlando the man and Orlando the woman; dreams and realities; facts and vision: Woolf's works are full of such pairings of opposites, and 'Not one of these words so coupled together seemed to her wrong'. In Woolf's early works there are almost as many 'ors' as 'ands', but in her later writings her inclusive 'and' provides us as readers with a full and unlimited view of the world as she places together 'this, that, and the other'. Woolf's works thus provide a celebration of difference and an understanding that the final answer to any question involves the simultaneous coexistence, but *not* the combination, of dualities and opposites.

## **Part II**

### **Relativity and Relativism**

## Chapter 4

### 'We are in sad need of a theory of human relativity':

#### Interpersonal Relationships in D. H. Lawrence's Early Works

'We are all very pleased with Mr Einstein' writes D. H. Lawrence in his *Fantasia of the Unconscious* (1922) 'for knocking that eternal axis out of the universe. The universe isn't a spinning wheel. It is a cloud of bees flying and veering round. Thank goodness for that, for we were getting drunk on the spinning wheel'.<sup>1</sup> By 1922, following the experimental confirmation of his general theory of relativity during the solar eclipse of 1919, Albert Einstein was a household name, a modern celebrity.<sup>2</sup> His theories of relativity, presented to the general public in the many popularisations that appeared after 1919, had revolutionised both scientific and philosophical conceptions of the universe, as well as such key physical concepts as space, time and gravity. Yet as Lawrence continues in his praise of Einstein's work, it soon becomes apparent that it is not so much the effects of these theories on the universe that interest him, but rather the implications which they may have for us as human individuals:

So that now the universe has escaped from the pin which was pushed through it, like an impaled fly vainly buzzing: now that the multiple universe flies its own complicated course quite free, and hasn't got any hub, we can hope also to escape. (72)

Einstein, in Lawrence's view at least, has set the universe free, has released it from its position as a single 'impaled fly' by realising its 'multiple' manifestation as 'a cloud of bees'. Such a realisation is imperative for human individuals too: 'One is one, but one is not all alone. There are other stars buzzing in the centre of their own isolation. And there is no

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<sup>1</sup> D. H. Lawrence, *Psychoanalysis and the Unconscious and Fantasia of the Unconscious*, ed. Bruce Steele (Cambridge, 2004), 72.

<sup>2</sup> See Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge, 1985); Walter Isaacson, *Einstein: His Life and Universe* (London, 2007), especially chapter twelve, 263-80.

straight path between them' (72). This idea of there being 'no straight path' is a direct reference to Einstein's general theory of relativity, which had shown that light from distant stars is bent by the gravitational field of the sun before arriving on earth. Lawrence clarifies this reference a little later:

I am I, but also you are you, and we are in sad need of a theory of human relativity. We need it much more than the universe does. The stars know how to prowl round one another without much damage done. But you and I, dear reader, in the first conviction that you are me and that I am you, owing to the oneness of mankind, why, we are always falling foul of one another, and chewing each other's fur. (72)

This idea of 'a theory of human relativity' is one which, I will argue, resonates throughout Lawrence's works, including those that pre-date *Fantasia*, as he struggles to express and resolve the difficulties of contemporary human relationships. These difficulties are summed up in the above passage by the use in the first sentence of 'but also' in place of the 'and' which we would normally expect, a change of term which complicates what would seem to be a very straightforward statement and relationship. Lawrence's theory of human relativity forms the focus of these three chapters, and we will approach it in the first instance as an example of Lawrence's 'pollyanalytics' which, according to the foreword to *Fantasia*, 'is deduced from the novels and poems, not the reverse' (65). In this chapter, then, we will consider Lawrence's movement towards a theory of human relativity in the texts which pre-date *Fantasia*, stopping at 1921, the year in which, as we will see, Lawrence read 'a simple book on Einstein's Relativity'.<sup>3</sup> As in Part I, we will then break off from our survey of Lawrence's works in order to consider the emergence and popularisation of Einstein's theories in the early twentieth century, as well as to explore in more detail Lawrence's complicated relationship with the science of his day. We will then return to a close focus on Lawrence's later writings in chapter six in order to attempt to determine the extent to which Lawrence's reading about Einstein directly affected his

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<sup>3</sup> D. H. Lawrence, letter to S. S. Koteliansky dated 4 June 1921, *The Letters of D. H. Lawrence*, ed. James T. Boulton et al., 8 vols (Cambridge, 1979-2000), iv, 23.

writing of relationships.

Let us begin, however, with a brief consideration of Lawrence's understanding of Einstein's theories of relativity, in particular as expressed within *Fantasia*. Here, especially in the opening of the chapter on 'The Holy Family', Lawrence uses the ideas of the general theory of relativity to emphasise the difficulties of human communications, an emphasis which, we can assume, is being offered as a defence against the 'generality of readers' and 'of critics likewise' mentioned by Lawrence in the foreword (61-2): 'There is no straight path between you and me, dear reader, so don't blame me if my words fly like dust into your eyes and grit between your teeth, instead of like music into your ears' (72). This path is not straight whether it is extending from the writer to the reader or the other way around: 'You can twang your old hopeful lyre. It may be music to you, so I don't blame you. It is a terrible wowing in my ears' (73). Relativity is also seen as an answer to misunderstandings: 'just apply a little theory of relativity, and realise that what I say is not what you hear' (72). While the tone is clearly mocking, the same jesting tone which addresses the 'dear reader' throughout *Fantasia*, underneath the joking misuse of the general theory of relativity we are able to glimpse Lawrence's understanding of the physical results thereof. The last sentence quoted above continues 'but something uttered in the midst of my isolation, and arriving strangely changed and travel-worn down the long curve of your own individual circumambient atmosphere' (72). When talking about the reader's own music from his 'old hopeful lyre', meanwhile, Lawrence suggests that the 'terrible wowing' which he hears 'may be something in my individual atmosphere; some strange deflection as your music crosses the space between us' (73). These passages clearly reflect the experimental proof of Einstein's general theory of relativity which showed that light rays from distant stars were deflected by the gravitational field of the sun, thus travelling in curved lines, rather than straight lines as had previously been supposed. Space-time, too, was shown to be curved,

making 'the long curve of your own individual circumambient atmosphere' a particularly resonant image.

Early in June 1921, at about the same time that Lawrence was starting work on *Fantasia*, he wrote to his friend Samuel Koteliansky asking him to 'Lend me, or send me, a simple book on Einstein's Relativity', a request which was fulfilled on 15 June.<sup>4</sup> The following day Lawrence wrote 'I will send you Einstein when I leave Germany', and it seems that he is referring to a different book here as he adds in a postscript 'Don't know what *Einstein* cost: but send 7/- and don't cavil with me about it'.<sup>5</sup> Whilst the absence of any pronoun here means that the postscript remains ambiguous, it seems most likely that it was Lawrence who was sending the seven shillings: in his original request to Koteliansky, Lawrence stated 'I'll return it [the simple book], or pay for it', and on 9 June he wrote that he would send Koteliansky a cheque once the book arrived.<sup>6</sup> Thus if, as seems reasonable, it is Lawrence who is paying for '*Einstein*', the '*Einstein*' that he is going to send to Koteliansky must be a different book.

According to Rose Marie Burwell, 'The two books most likely to be involved' are Einstein's own popularisation, *Relativity: The Special and the General Theory* (1920), and Henry Brose's *The Theory of Relativity: An Introductory Sketch Based on Einstein's Original Writings* (1919).<sup>7</sup> These texts were priced at five shillings and one shilling and

4 Lawrence, letters to S. S. Koteliansky dated 4 and 15 June 1921, *Letters*, iv, 23 and 36.

5 Lawrence, letter to S. S. Koteliansky dated 16 June 1921, *Letters*, iv, 37, 38.

6 Lawrence, letters to S. S. Koteliansky dated 4 and 9 June 1921, *Letters*, iv, 23 (my emphasis), and 30.

7 Rose Marie Burwell, 'A Catalogue of D. H. Lawrence's Reading from Early Childhood', *The D. H. Lawrence Review*, 3 (1970), 258; Albert Einstein, *Relativity: The Special and the General Theory. A Popular Exposition*, trans. Robert W. Lawson (London, 1920); Henry L. Brose, *The Theory of Relativity: An Introductory Sketch Based on Einstein's Original Writings* (Oxford, 1919). Note that while the notes to Lawrence's *Letters* give details of the former text, they do not refer to the latter, presumably due to the belief that the '*Einstein*' of 16 June is the same as the one mentioned previously, *Letters*, iv, 30 n. 2. However, inaccuracies in Burwell's reporting of both the title and date of publication of Brose's text suggest the risk of inaccuracies elsewhere in her research, and she does in fact alter her 'and' to an 'or' in a later version of this catalogue, 'A Checklist of Lawrence's Reading', in Keith Sagar, ed., *A D. H. Lawrence Handbook* (Manchester, 1982), 93. It is also worth noting that neither Burwell nor the Cambridge editors provide any evidence regarding their choice of book titles, even though there were plenty of 'simple books on Einstein's Relativity' available at this date, including a number of texts translated from the German by Brose. Indeed, 'A bibliography of all books, pamphlets, papers, articles, and other publications on the subject of relativity', an extract from which was published in *Nature* in 1921, included 'nearly 650 titles, arranged in chronological order from 1886 to the end of last year', 'Bibliography of Relativity',

sixpence respectively, although it is worth noting that while the price of Brose's text is printed prominently on its cover, that of Einstein's would not have been available to Lawrence if he did not have the dust-jacket. In addition, the seven shillings – if, indeed, they were being sent by Lawrence to Koteliansky – were probably also intended to cover the price of a pen which Koteliansky had had mended for Lawrence in London and, perhaps, the price of the postage.<sup>8</sup> Thus, *if* we are correct in thinking that Lawrence's 'Einstein' and '*Einstein*' refer to different books, *if* we are also correct in thinking that it was Lawrence who was sending the seven shillings to Koteliansky, and *if* Burwell's selection of the two 'most likely' titles is also correct, then Lawrence must have received Einstein's own popularisation and have been planning to send Brose's to Koteliansky. However, it is clear that this puzzle still remains to be solved definitively.<sup>9</sup>

We will return to both the Brose and the Einstein texts in the following chapter, but for now it is worth noting that Einstein's own 'popular exposition' of both of his theories of relativity is, according to the preface,

intended, as far as possible, to give an exact insight into the theory of Relativity to those readers who, from a general scientific and philosophical point of view, are interested in the theory, but who are not conversant with the mathematical apparatus of theoretical physics.<sup>10</sup>

Einstein states that he 'has spared himself no pains in his endeavour to present the main ideas in the simplest and most intelligible form', but admits that he has not 'withheld from the reader difficulties, which are inherent to the subject' even though he has 'treated the empirical physical foundations of the theory in a "step-motherly" fashion'.<sup>11</sup> Einstein concludes his preface by hoping that his book may 'bring some one a few happy hours of

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*Nature*, 106/2677 (17 February 1921), 811.

<sup>8</sup> Lawrence, letters to S. S. Koteliansky dated 9 and 15 June 1921, *Letters*, iv, 30 and 36-7.

<sup>9</sup> A consideration of Koteliansky's contemporary correspondence, as held by the British Library, has failed to reveal any further clues as to the identity of this text or texts, 'Koteliansky Papers', British Library, Add. MSS 48966-48975.

<sup>10</sup> Einstein, *Relativity*, v.

<sup>11</sup> *Ibid.* v-vi.

suggestive thought!"<sup>12</sup>

While Lawrence makes reference to Einstein's theories of relativity at various moments within *Fantasia*, it is towards the end of this text that he provides his most sustained and thorough explanation of 'what I understand of the Einstein theory':

As far as I can see, Relativity means, for the common amateur mind, that there is no one absolute force in the physical universe, to which all other forces may be referred. There is no one single absolute central principle governing the world. The great cosmic forces or mechanical principles can only be known in their relation to one another, and can only exist in their relation to one another. But, says Einstein, this relation between the mechanical forces is constant, and may be expressed by a mathematical formula: which mathematical formula may be used to equate all mechanical forces of the universe. (190)

Lawrence demonstrates a surprising understanding of the nature of Einstein's theories here: there *is* no one absolute force in the physical universe, and mechanical principles *can* only be known in their relation to one another or, more accurately, in relation to their particular frame of reference, as Einstein explained in the special theory of relativity. The 'mathematical formula' to which Lawrence refers also comes, in part, from the special theory of relativity, and is known as the Lorentz Transformations. Interestingly, in the following paragraph, this is the one element of Einstein's work about which Lawrence expresses some reservation, although without offering any explanation as to why: 'What I doubt is the equation formula' (190).

However, in some of what follows we may in turn begin to doubt Lawrence's understanding of the science with which he has been dealing: although mentioning that 'the velocity of light through space is the deus ex machina in Einstein's physics', Lawrence does not ever quite seem to get to grips with this idea, and goes on to claim that 'there is nothing absolute left in the universe. Nothing' (190); in fact, Einstein's special theory of relativity revealed that the speed of light 'is the limiting or maximum velocity in nature and has thus

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<sup>12</sup> Ibid. vi.

a universal significance'.<sup>13</sup> Thus when Lawrence states 'I feel inclined to Relativity myself. I think there is no one absolute principle in the universe. I think everything is relative' (191) we see him starting to fall into what A. S. Eddington calls the 'common mistake' of conflating relativity with relativism.<sup>14</sup> However, Lawrence does not stop there, ending his paragraph with a reflection which seems to transport us back to his theory of human relativity:

But I also feel, most strongly, that in itself each individual living creature is absolute: in its own being. And that all things in the universe are just relative to the individual living creature. And that individual living creatures are relative to each other. (191)

It is here that we see Lawrence moving away from the strictly scientific meaning of relativity and beginning to formulate his own theory of human relativity. Thus we can see in Lawrence's relation to Einstein the same phenomenon as John Worthen highlights in Lawrence's reading of Friedrich Nietzsche: 'He was always less concerned with what Nietzsche actually said or meant than with how he could be used'.<sup>15</sup> This is corroborated by Jessie Chambers's view that Lawrence 'seemed to consider all his philosophical reading from the angle of his own personal need'.<sup>16</sup> Lawrence is starting to *use* Einstein here, applying the scientific theories that Einstein had formulated to the human problems, in particular of relationships, which Lawrence saw as so critical, and Worthen has suggested that 'This *possession* of the thoughts of others, this capacity to turn them into what he wanted, was characteristic of Lawrence's intelligence'.<sup>17</sup>

The evidence in *Fantasia of the Unconscious* certainly suggests that Lawrence found in his reading of Einstein the 'suggestive thought' that the latter had hoped for his readers, a thought which resonated in some way with Lawrence's own understanding and

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<sup>13</sup> Brose, *Theory of Relativity*, 18.

<sup>14</sup> A. S. Eddington, *The Nature of the Physical World* (Cambridge, 1928), 23.

<sup>15</sup> John Worthen, *D. H. Lawrence: The Early Years, 1885-1912* (Cambridge, 1991), 210. Worthen also makes the same point about Lawrence's reading of Arthur Schopenhauer, 174.

<sup>16</sup> Jessie Chambers, *D. H. Lawrence: A Personal Record* (Cambridge, 1980), 113.

<sup>17</sup> Worthen, *Early Years*, 122.

vision of the world, and of human relationships in particular. But what do Lawrence's earlier works tell us about why Einstein's theories of relativity should have proved so suggestive to Lawrence? And to what extent is the theory of human relativity in *Fantasia* relevant to these earlier writings?

In seeking to answer such questions one of the key issues which we must address is that of the relationship between Lawrence's own theories and his fiction. Lawrence begins his 'last weary little word' in the foreword to *Fantasia* with the seemingly straightforward claim that his 'pseudo-philosophy' or 'pollyanalytics' 'is deduced from the novels and poems, not the reverse', that 'The novels and poems are pure passionate experience. These "pollyanalytics" are inferences made afterwards, from the experience' (65). While this argument is related to Lawrence's rejection of Freudian interpretations of *Sons and Lovers* (1913), it is just as relevant to our discussion of relativity in Lawrence's fiction, and as we move into that discussion we must bear in mind the question as to whether Lawrence was intending to write some kind of theory of human relativity in his early fictional work, even if it was not then designated as such, or whether the idea for such a theory occurred to him only afterwards on learning of the new physics which Einstein had introduced.

This question is by no means clearly answered in the foreword to *Fantasia*; in the paragraph following the one from which I quoted above, Lawrence confuses the reader by providing him or her with what appears to be exactly the opposite view to that offered previously, in a sentence which initially sounds like it will follow on from the earlier statement: 'And finally, it seems to me that even art is utterly dependent on philosophy: or if you prefer it, on a metaphysic' (65). He continues, 'Men live and see according to some gradually developing and gradually withering vision. This vision exists also as a dynamic idea or metaphysic – exists first as such. Then it is unfolded into life and art' (65); and then, we feel we should continue, it provides the basis for a pollyanalytics. If Lawrence sees a

difference between these two philosophies, it is not one that is immediately obvious to the reader and, indeed, is one that has caused critics some difficulty over the years. Lawrence seems to be suggesting that there is some kind of philosophy that 'governs men at the time' (65), something like a Kuhnian paradigm, which influences everything that they do, including artistic production; a 'pseudo-philosophy' can then be created from a piece of art produced within the prevailing metaphysic, although how exactly these two philosophies would differ, if at all, remains unclear. In 'Study of Thomas Hardy' (written 1914, published posthumously 1936), Lawrence does offer some elaboration on the nature of a metaphysic, describing it as a 'theory of being and knowing' in contrast to an artist's 'living sense of being'; he continues,

Because a novel is a microcosm, and because man in viewing the universe must view it in the light of a theory, therefore every novel must have the background or the structural skeleton of some theory of being, some metaphysic.<sup>18</sup>

Unfortunately, however, there is no comment here on the nature of pollyanalytics, and thus the distinction between the two remains obscure. Likewise, in a letter to Louie Burrows about his latest reading in 1911, Lawrence complains that Stendhal 'misses out the religion, the philosophy, if you like, of life. He is not a bit metaphysical. He doesn't satisfy my sentimentality'.<sup>19</sup> The metaphysic, then, is the foundation of all human activity, the underlying philosophy of a particular time, and perhaps includes a spiritual aspect; the pollyanalytics meanwhile is, perhaps, the individual philosophical view that can be extracted from any specific work of art dealing with a part of the larger philosophical picture.

Keith Cushman, however, suggests that rather than thinking in this linear cause-and-effect manner, a manner of which Lawrence would not have approved, we should instead see both art and metaphysic as 'part of the same ongoing process' with 'something

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<sup>18</sup> D. H. Lawrence, *Study of Thomas Hardy and Other Essays*, ed. Bruce Steele (Cambridge, 1985), 91.

<sup>19</sup> Lawrence, letter to Louie Burrows dated 28 April 1911, *Letters*, i, 262.

like an effect of oscillation' between them.<sup>20</sup> Thus 'Each work, whether expository or purely imaginative, as it succeeds its predecessor is an attempt to explore and annex new territory. Each new territory then provides a starting point for further exploration'; or, as Mark Kinkead-Weekes puts it, 'Fiction leads to thought, which in turn leads to new fiction' in what he calls 'a constantly dialectical process'.<sup>21</sup> This argument is perhaps most relevant to the relation between Lawrence's theory of 'allotropic states', as described in his frequently quoted 1914 letter to Edward Garnett, and the characters of *The Rainbow* (1915): it is valuable to consider, although impossible to answer, the question as to whether Lawrence had formulated the theory before, or even while, writing the novel, or whether he created the theory solely in answer to Garnett's criticism of Lawrence's 'different attitude to [his] characters'.<sup>22</sup>

In terms of Lawrence's theory of human relativity, then, let us now consider briefly what such a theory may entail and how it may be acted out and articulated in Lawrence's early works.<sup>23</sup> Firstly, it is essential that we recognise the fundamental importance to Lawrence of the interactions and relationships between people throughout his life and work: his fictional works portray an almost obsessive focus on interpersonal relationships, whether in the form of romantic and sexual unions between men and women, or the later focus on male models of leadership. Thus in *Women in Love* (1920), as Birkin and Gerald discuss the question as to where modern life centres, Birkin states that 'The old ideals are dead as nails – nothing there', before continuing:

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20 Keith Cushman, *D. H. Lawrence at Work: The Emergence of the 'Prussian Officer' Stories* (Charlottesville, 1978), 22.

21 Ibid. 23; Mark Kinkead-Weekes, 'The Genesis of Lawrence's Psychology Books: An Overview', *The D. H. Lawrence Review*, 27 (1997-8), 154, 155. See also H. M. Daleski, *The Forked Flame: A Study of D. H. Lawrence* (London, 1965), 19, although Daleski seems to view the philosophy as providing a kind of hypothesis for the art which can then 'modify' the 'a priori theories'.

22 Lawrence, letter to Edward Garnett dated 5 June 1914, *Letters*, ii, 182.

23 It is important to remember, however, that Lawrence himself does not provide any thorough description or working through of this theory, either in *Fantasia* or elsewhere. Rather than exploring Lawrence's definitive statement as to the nature of the theory of human relativity, then, I am using his descriptions of relationships, both in *Fantasia* and elsewhere, in order to suggest one way in which such a theory could be formulated.

'It seems to me there remains only this perfect union with a woman – sort of ultimate marriage – and there isn't anything else.'

'And you mean if there isn't the woman, there's nothing?' said Gerald.

'Pretty well that – seeing there's no God.'

'Then we're hard put to it,' said Gerald.<sup>24</sup>

Mellors expresses a similar view in *Lady Chatterley's Lover* (1928): 'For me it's the core to my life: if I have a right relation with a woman'.<sup>25</sup> Gary Day has explored the reasons behind Lawrence's commitment to 'refashioning the relation between men and women', stating that 'One answer is that it has to carry that numinous quality formerly borne by religion, but a second, closely related answer is that the love between men and women combats the fragmentation of modernity'.<sup>26</sup> The loss of the old unfragmented and religious approach to life leads Lawrence to a new focus on human relationships which, in his thinking, form the only remaining centre for human experience: if this fails, as the passage from *Women in Love* indicates, there is nothing else.

The importance of human relationships is also explored frequently in Lawrence's non-fictional works, with Lawrence adapting, in *Psychoanalysis and the Unconscious* (1921), the Biblical phrase 'man doth not live by bread only, but by every word that proceedeth out of the mouth of the Lord' in a way which reinforces Day's view of the replacement of religion by relationship: 'Man doth not live by bread alone. He lives *even more essentially* from the nourishing creative flow between himself and another or others' (41, my emphasis).<sup>27</sup> In *Fantasia*, Lawrence develops this idea in an exploration of the importance of relativism as a means by which we establish our individuality and separate ourselves from the rest of the world: 'I am I, not because I am at one with all the universe, but because I am other than all the universe' (80).

24 D. H. Lawrence, *Women in Love*, ed. David Farmer, Lindeth Vasey and John Worthen (Cambridge, 1987), 58.

25 D. H. Lawrence, *Lady Chatterley's Lover and A Propos of 'Lady Chatterley's Lover'*, ed. Michael Squires (Cambridge, 1993), 204.

26 Gary Day, 'Introduction: Lawrence and Criticism', in Gary Day and Libby Di Niro, eds., *'The Rainbow' and 'Women in Love': D. H. Lawrence* (Basingstoke, 2004), 11.

27 Deut. 8:3. See also Matt. 4:4 and Luke 4:4.

While this focus on relationships in Lawrence's works is not relativistic in an Einsteinian sense, it suggests why Einstein's theories had such an appeal for Lawrence, and here we are thinking in terms of special rather than general relativity, with its different frames of reference in relation to which everything must be defined. As Kinkead-Weekes explains, Einstein provided reinforcement for Lawrence's 'belief that life was always a matter of *relationships* – between opposite impulses within the self, and between selves, none paramount, all “purely relative to one another”, in an essentially creative pluralism'.<sup>28</sup> For Lawrence, then, as he declares in *Fantasia*, 'Everything is a question of relativity. Not only is every force relative to other force or forces, but every existence is relative to other existences' (188).

A theory of human relativity, then, combining elements of both special and general relativity as formulated by Einstein with Lawrence's own views on the relatedness of all things, would consist of no absolutes and would see individuals defining themselves in relation to others, and others in relation to themselves, as if they were separate frames of reference. It would also explain the problems of misunderstanding and difficulties of communication that seem to exist in all human interactions via an image of deflections. But ultimately, given Lawrence's claim that 'we are in *sad need* of a theory of human relativity' (my emphasis), it would do more than just demonstrate and explain these problems – it would provide some kind of solution so that we, like the stars in *Fantasia*, can learn 'how to prowl round one another without much damage done'. Lawrence was looking for this solution as early as 1907, a fact which emphasises the relevance of the theory of human relativity to his earliest works: writing to Reverend Robert Reid he states 'Cosmic harmony there is – a Cosmic God I can therefore believe in. But where is the human harmony, where the balance, the order, the “indestructibility of matter” in humanity?', and it is worth noting that even at this early date Lawrence associates 'human

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<sup>28</sup> Mark Kinkead-Weekes, *D. H. Lawrence: Triumph to Exile, 1912-1922* (Cambridge, 1996), 659.

harmony' with a scientific concept.<sup>29</sup> The new physics provides a glimmer of hope in the form of a scientific formulation and solution, something which Lawrence was already looking for here, but unlike the earlier physics it is not materialistic or absolute, and provides a background in which the forces of personal emotion and perspective, which Lawrence saw as so important, apparently become paramount.

It is at this point that we must leave Einstein's scientific ideas to one side, returning to them in more detail in the following chapter; although they clearly influenced Lawrence's suggestion of a theory of human relativity in *Fantasia*, here I wish to focus on the 'human' part of Lawrence's formulation, rather than the science behind the phrase. This is a distinction that Lawrence himself made in writing about the futurists in his famous 1914 letter to Garnett: 'Instead of looking for the new human phenomenon, they will only look for the phenomena of the science of physics to be found in human being. They are crassly stupid'.<sup>30</sup> In considering whether such a human theory is present in the early novels, then, we must remember that Lawrence's first acknowledgements of Einstein and relativity emerge in the 1920s, after the widely reported and celebrated results of the 1919 eclipse expeditions. In chapter six we will then consider whether Lawrence's writing of human relationships after his suggestion in *Fantasia*, and after Einstein's emergence as a celebrity, differs in any significant way from that which came before and, either way, what the implications of this are for the ideas expressed within the earlier texts. This will enable us to explore whether Lawrence may have known about Einstein's theories at an earlier date than his first direct references thereto, or whether his positive appraisal of Einstein's work in *Fantasia* originated instead in his recognition of some kind of 'coalescence' between his ideas on human interactions and those of Einstein on the workings of the universe.<sup>31</sup>

Turning now to Lawrence's fiction, let us begin with a consideration of Lawrence's

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<sup>29</sup> Lawrence, letter to Reverend Robert Reid dated 3 December 1907, *Letters*, i, 41.

<sup>30</sup> Lawrence, letter to Edward Garnett dated 5 June 1914, *Letters*, ii, 183.

<sup>31</sup> See Gillian Beer, *Virginia Woolf: The Common Ground* (Edinburgh, 1996), 113.

first novel, *The White Peacock* (1911). The first thing that we notice about this novel, in particular if we are familiar with Lawrence's later works, is the use of a first-person narrator, Cyril Beardsall, who is both involved in and detached from the action of the novel, positioning himself in something like a separate frame of reference, in particular when he is recounting the interactions of the almost-lovers, George and Lettie: 'The light seemed to hold them as in a globe, in another world, apart from the night in which I stood'.<sup>32</sup> The parenthetical commas here emphasise the different world to which George and Lettie have been transported, and this is further highlighted by Lawrence's use of pronouns: the contrast of 'them' with 'the night in which I stood' underlines the different spheres in which these characters are currently moving. However, the distinction cannot here be maintained for long, as a few lines later Lettie turns away 'finally breaking the spell' and returning the narrative to 'we' (99).

The problem of translation between different frames of reference becomes particularly important in the ongoing will-they-won't-they relationship of Lettie and George, and is especially well demonstrated by the fluidity of the shifting pronouns in this passage from chapter seven, 'The Fascination of the Forbidden Apple':

'I wish,' she said, 'I wish we were free like that. If we could put everything safely in a little place in the earth – couldn't we have a good time as well as the larks?'  
 'I don't see,' said he, 'why we can't.'  
 'Oh – but *I* can't – you know we can't' – and she looked at him fiercely.  
 'Why can't you?' he asked.  
 'You know we can't – you know as well as I do,' she replied, and her whole soul challenged him. 'We have to consider things,' she added.  
 He dropped his head. (208)

The speed of the shifts here, and the constant return to, and yet the inability to sustain, either 'we' or 'I' suggest just how complicated this relationship is. The passage begins with an apparently straightforward use of the term 'we', but once George adopts the term its

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<sup>32</sup> D. H. Lawrence, *The White Peacock*, ed. Andrew Robertson (Cambridge, 1983), 98.

meaning is changed, from Lettie's sense of human kind in general to George's focus on the problematic relationship between the two of them as individuals. George's use forces Lettie back to her own 'I', emphasised here in italics, but she then quickly adds 'you' to return to the longed for, and yet feared, 'we'. Lettie then unpacks this 'we' with her 'you know as well as I do'. The dialogue ends with 'we', and yet it is this very pronoun use which seems to be one of the issues which the two characters need to consider, deciding which 'we', the specific or the general, they are going to use to articulate their relationship.

Lawrence frequently employs repetitions within a short space of text of the same word with a different meaning, a technique which Fiona Becket describes as 'an oxymoronic movement of meaning'.<sup>33</sup> Becket suggests that this form of 'double deployment' of a word

is oxymoronic, not because two different elements are brought together in unusual proximity (which is how we usually understand oxymoron) but because the same word is repeated in a context where its meaning is reversed, so that deploying the same word more than once creates the oxymoron. By extension, in using the word singly, its oxymoronic quality is implicitly present as a possibility.<sup>34</sup>

Whilst the two senses of the word 'we' in the passage above are not, strictly speaking, opposite, the repeated use of the same word with different meanings in quick succession clearly reflects the problematic nature of the relationship between these characters by emphasising the difficulties inherent in the very language that they are obliged to use. This is emphasised at the beginning of the passage when each character takes up a different sense of the word 'we', positioning themselves within different frames of reference according to our scientific formulation. Single uses of the word 'we' in either sense later in the text may remind readers of this exchange, thus ensuring that the 'oxymoronic quality' of this pronoun is always 'implicitly present as a possibility'; that the other frame of reference is not forgotten even as one is privileged, much as we saw in Virginia Woolf's writing of

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<sup>33</sup> Fiona Becket, *D. H. Lawrence: The Thinker as Poet* (Basingstoke, 1997), 136.

<sup>34</sup> *Ibid.* 137.

wave-like and particulate properties in Part I.

In terms of a theory of human relativity, this inability to agree on the usage of a pronoun with which to approach the world suggests that human interactions are failing here and that we are, indeed, in sad need of such a theory. The very end of the novel underlines this problem as George, Cyril and the others sit down to tea: 'We were all uncomfortably impressed with the sense of our alienation from him. He sat apart and obscure among us, like a condemned man' (325). As in the previous passage, neither the 'we' nor the 'he' here are entirely secure: George is 'apart', and yet he remains 'among us', and although it is George who is 'obscure', it is the 'we' of Cyril and the other characters present that feels 'alienated *from him*' (my emphasis). There is neither full integration nor utter separation and this, we may feel, is where a theory of human relativity – or, at the very least, a new understanding and use of pronouns – is so sadly needed.

In Lawrence's second novel, *The Trespasser* (1912), these problems of human relatedness, in particular between lovers, retain, or perhaps even increase, their significance. Indeed, Siegmund is left 'tortured with the problem' of Helena:

She was a book written in characters unintelligible to him and to everybody. He was tortured with the problem of her till it became acute, and he felt as if his heart would burst inside him. As a boy he had experienced the same sort of feeling after wrestling for an hour with a problem in Euclid; for he was capable of great concentration.<sup>35</sup>

This linking of the difficulties of human interactions with mathematical problems emphasises the relevance of the concept of a theory of human relativity to contemporary relationships, as well as reminding us of Lawrence's letter to Reverend Reid on 'human harmony' which I mentioned above. A link between mathematics and love is also made in *Mr Noon* (written during the 1920s, but not published in full until 1984): Gilbert complains that Johanna's 'love is a blooming understood affair. I'd rather have mathematics', to which Johanna replies 'It *is* something like mathematics – except that it's *life*. Something to know

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<sup>35</sup> D. H. Lawrence, *The Trespasser*, ed. Elizabeth Mansfield (Cambridge, 1981), 155.

in every man – and something to solve'.<sup>36</sup> This distinction seems directly relevant to Lawrence's theory of human relativity, which *is* something like a theory of relativity, except that it is *human*.

Lawrence does not always express the problems of apparently non-understandable differences between lovers in scientific or mathematical terms, but he does refer to such difficulties frequently within his writings: in *The Rainbow* Ursula feels that 'Every movement and word of [Skrebensky's] was alien to her being', while in 'Daughters of the Vicar' (1914) Louisa is confronted by the painful idea that she and Alfred are 'foreigners, moving in different lives'.<sup>37</sup> The abstract foreignness of two lovers is emphasised by the actual foreignness of Lydia in *The Rainbow*: while she and Tom overcome 'their superficial foreignness' when they are 'together in an elemental embrace', Tom finds that Lydia remains 'foreign and unknown to him' in the morning (57). Meanwhile, in *Sons and Lovers* Miriam feels that Paul is 'speaking another language than hers', an idea which Lawrence takes up in *Fantasia* when exploring the difference between men and women: 'We may speak the same verbal language, men and women: as Turk and German might both speak Latin. But *whatever* a man says, his meaning is something quite different and changed when it passes through a woman's ears' (195).<sup>38</sup> Such an image is clearly linked to those of the theory of human relativity in *Fantasia* which we have already explored. It also adds a new significance to Ursula's early reflection on Birkin in *Women in Love*: 'She thought he seemed to acknowledge some kinship between her and him, a natural, tacit understanding, a using of the same language' (20). The question as to how to develop such a mutual language, or of how to translate meaning between different languages and to overcome foreignness, would clearly form a key part of Lawrence's theory of human relativity.

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<sup>36</sup> D. H. Lawrence, *Mr Noon*, ed. Lindeth Vasey (Cambridge, 1984), 164-5.

<sup>37</sup> D. H. Lawrence, *The Rainbow*, ed. Mark Kinkead-Weekes (Cambridge, 1989), 410; D. H. Lawrence, *The Prussian Officer and Other Stories*, ed. John Worthen (Cambridge, 1983), 73.

<sup>38</sup> D. H. Lawrence, *Sons and Lovers*, ed. Helen Baron and Carl Baron (Cambridge, 1992), 201.

However, closely linked to this question of the foreignness of the loved other is that of the necessity to recognise this foreignness without trying to destroy it, to see the loved one as they truly are. This is in many ways the central problem for the lovers in *The Trespasser*, as Lawrence emphasises early in the novel: 'He interpreted her according to his own idea' (77). The clearest example, however, comes with Helena's sudden despair and complete 'agony of disillusion':

Was this the real Siegmund, and her own, only a projection of her soul?  
She took her breath sharply. Was he the real clay, and that other, her  
beloved, only the breathing of her soul upon this. There was an awful  
blank before her. (125)

Like Siegmund, and like Woolf's characters in *Night and Day* (1919), Helena has interpreted her lover according to her own idea, projected her own soul onto the actual man, but she does at least seem to have done so unconsciously. Even so, as far as Lawrence is concerned this is one of the greatest crimes: as he writes in *Fantasia*, 'You are *not* me, dear reader, so make no pretensions to it', and this 'first conviction that you are me and that I am you, owing to the oneness of mankind' is precisely what causes us to fall 'foul of one another', and is the reason why we are in such 'sad need of a theory of human relativity' (72).

The falsification of, or failure to see, the loved other is an idea which appears frequently in Lawrence's works throughout his career, with Ursula recognising towards the end of *The Rainbow* that 'Skrebensky had never become finally real', that 'she had created him for the time being' (457). Two of the most extreme examples of this unawareness of the real, or creation of the false, lover appear in the short novel 'The Captain's Doll' (1923) and the short story 'Odour of Chrysanthemums' (1914). In the former, the doll in the form of the Captain becomes symbolic of this difficulty, as Hepburn clarifies near the end of the tale: 'if a woman loves you, she'll make a doll out of you. She'll never be satisfied till she's made your doll. And when she's got your doll, that's all she wants. – And that's what love

means'.<sup>39</sup> While Hannele made a physical doll of Hepburn, the latter clarifies that his wife had also made a doll of him, 'in her mind': 'Why, I've heard her talk about me to other women. And her doll was a great deal sillier than the one you made'; the reader has already been privy to such a conversation, between Hannele and Mrs Hepburn, and so is able to confirm Hepburn's assessment.<sup>40</sup>

In 'Odour of Chrysanthemums' it is not a heroic doll that has been made of the husband, but rather an almost demonic one, the falsity of which is only seen following his death when Elizabeth finally recognises that she has 'been fighting a husband who did not exist'.<sup>41</sup> Elizabeth realises that 'she had never seen him, he had never seen her', and that 'she had been wrong. She had said he was something he was not', leading her to conclude that 'She was grateful to death, which restored the truth'.<sup>42</sup> While the realisation clearly comes too late for this particular marriage, it does at least come, and thus suggests the possibility for successful human relationships in the future.

Michael Black has explored the problem of the misunderstanding of the loved other in Lawrence's works, in particular *The Trespasser*, describing the 'flawed ecstasy' of these two lovers who at times 'talk past each other to a projection of the other which is not the reality': 'They are halted by a dismaying awareness of not being "with" each other at these moments, and fall into separate despairs which emphasise their division'.<sup>43</sup> This idea of 'talking past each other' could be related to the lack of a 'straight path' between speakers which Lawrence suggests emerges from the general theory of relativity in *Fantasia*, a difficulty which is, in part at least, caused by our own 'individual circumambient atmosphere[s]'. The concept of 'not being "with" each other' is key to Lawrence, and becomes increasingly important in *Sons and Lovers*, as we shall see.

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39 D. H. Lawrence, *The Fox, The Captain's Doll, The Ladybird*, ed. Dieter Mehl (Cambridge, 1992), 151.

40 Ibid.

41 Lawrence, *Prussian Officer*, 198.

42 Ibid.

43 Michael Black, *D. H. Lawrence: The Early Fiction. A Commentary* (Basingstoke, 1986), 82.

Overall, then, as Siegmund's eventual suicide emphasises, *The Trespasser* portrays another failed relationship. And yet there are moments of intimacy and, as Black suggests, of 'ecstasy' in this novel which hint at a way forward. Lying on the beach, 'Siegmund and Helena, two grains of life in the vast movement, were travelling a moment side by side' (78). This unity, although only lasting 'a moment' is beautiful in its simplicity, and yet the tiny 'grains of life' and the subsequent almost relativistic image suggest its insignificance on the grand scale: 'The lazy ships that were idling down the Solent observed the cliffs and the boulders, but Siegmund and Helena were too little. They lay ignored and insignificant' (78).

Siegmund struggles to find an answer to the obviously doomed relationship, and yet the answer he provides is itself clearly doomed:

If I had her more, I should understand her through and through. If we were side by side we should grow together. If we could stay here, I should get stronger, and more upright. (148)

Again there is a significant pronoun shift in this passage, but we note that it both starts and ends with 'I'. The use of the possessive 'had' is also an interesting one, suggesting that Helena would have to give up at least part of her individuality in order to make this relationship work, although the phrase 'side by side', repeated from the earlier passage above, suggests something closer to independence. Overall, though, the only answer here seems to involve a loss of individuality and distinctness, for one of the pair at least, a loss which, as Siegmund's suicide demonstrates, cannot save a relationship of this kind.

Lawrence's theory of human relativity, then, must teach us how to be united individuals, able to travel 'side by side' in the same frame of reference, but without losing any of our distinctness; alternatively, it must enable us to develop some means of translating between the two frames, thus allowing the coexistence of similarity and difference.

The difficulties of human interaction, in particular between lovers, are addressed on

a larger scheme in Lawrence's third novel, *Sons and Lovers* where the problem seems primarily to be one of balance: various different characters portray various different attempts at relationships, different models for human interactions, and yet they are all shown to be flawed in one way or another. This imbalance is most manifest in the character of Miriam, who 'could very rarely get into human relations with anyone' (201). Miriam's main flaw in this regard seems to be a tendency towards absorption: listening to Paul reading a poem, 'Miriam sat on the sofa, absorbed in him. She always seemed absorbed in him and by him, when he was present' (212). However, absorption works through Miriam in both directions – she both is absorbed and absorbs, the latter being an accusation which Paul urges against her:

You don't want to love – your eternal and abnormal craving is to be loved. You aren't positive, you're negative. You absorb, absorb, as if you must fill yourself up with love, because you've got a shortage somewhere. (258)

Although the repetition of 'absorb' is clearly a form of emphasis here, it reminds us of the other aspect of Miriam's absorption technique at the same time as presenting this more active side to it, much as we saw with the repetition of 'we' in *The White Peacock*. This immediate repetition thus provides us with another example of Becket's 'oxymoronic dynamic': both senses of 'absorb' are present here, emphasising the imbalance in Miriam's approach to relationships, an imbalance which must be overcome, or at least acknowledged, by Lawrence's theory of human relativity.<sup>44</sup>

Paul's understanding of Miriam's need almost to drain him of himself is expressed more calmly a little earlier by the narrator, although clearly from Paul's perspective:

He felt that she wanted the soul out of his body, and not him. All his strength and energy she drew into herself through some channel which united them. She did not want to meet him, so that there were two of them, man and woman together. She wanted to draw all of him into her. (231-2)

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<sup>44</sup> Becket, *Thinker as Poet*, 137.

The phrase 'man and woman together' may remind us of the repeated 'side by side' of *The Trespasser*, and is clearly the ideal that Paul envisages of a true relationship here. Miriam's love is selective, taking the soul not the body or, to use the language of *The Trespasser*, the 'projection' rather than the 'real clay'. The use of that 'and' in the first sentence above is intriguing, however, as we might expect to find a 'but' in its place: it suggests that this is a further part of Miriam's request – *not* him is precisely what, in Paul's eyes at least, she really wants.

Paul's relationships with both Miriam and Clara also involve, in slightly different ways, an element of what Black calls 'not being "with" each other', an element which may, as we have seen, remind us of Lawrence's explorations of general relativity in *Fantasia*. In the former relationship, the difficulty seems to be experienced by Paul who 'could not get across to' Miriam (216). In part this seems to be Paul's fault in that it is he who is unable to achieve the meeting: 'With her he felt bound up inside himself. He could not go out to her. Something struggled in him, but he could not get to her' (322). However, we must also acknowledge that Miriam contributes to this failure as it is only with her that Paul feels this way: Miriam is not there to receive Paul's signal, either refusing to acknowledge it or failing to see it at all. A similar model of mutual failure is present in Ursula and Skrebensky's relationship in *The Rainbow*: 'He talked, but not to her. She tried to speak to him, but she could not reach him' (410). In Paul's relationship with Clara, however, it is Paul who 'was not there': 'Often, when she had him with her, she looked for him, and could not find him' (339), 'Always, he was somewhere else' (412). This missing of each other, this inability to exist 'side by side', is one of the most significant difficulties in *Sons and Lovers*.

And yet, as in *The Trespasser*, there are moments of simple and beautiful intimacy, moments which in this novel seem to consist of something more profound: 'Miriam turned

to him. He answered. They were together' (203). These three straightforward sentences seem to carry a wealth of emotion within them, their balanced rhythm and appearance on the page providing a sense of balance for the relationship too. As in *The Trespasser*, the moment cannot be sustained for long, but in this novel there does at least seem to be some hope of achieving a successful and practical theory of relationships; indeed, in the short story 'The Thorn in the Flesh' (1914), a similarly simple construction is used to describe a fulfilled and fulfilling relationship: 'They knew each other. They were themselves'.<sup>45</sup> The point in these formulations is that one individual is coming together with another, and although this is not achieved in any lasting way in *Sons and Lovers*, the fact that it has been recognised as a necessity gives us hope that such a realisation may be possible in the future, as we saw in the case of 'Odour of Chrysanthemums'.

The importance of the established individual, even, or rather especially, within relationships, is one of Lawrence's key themes. In 'Study of Thomas Hardy' Lawrence explains that 'The final aim of every living thing, creature, or being is the full achievement of itself', and this idea is repeated in slightly different terms in *Fantasia*, where 'The highest goal for every man is the goal of pure individual being' (77), and in 'Democracy' (1919), where 'The living self has one purpose only: to come into its own fulness [*sic*] of being'.<sup>46</sup> The ending of *Sons and Lovers* shows us this final full achievement of the self as Paul comes to realise himself as 'not nothing' (464). We can see this fully achieved self as providing the absolute for Lawrence's theory of human relativity; as he wrote in *Fantasia*, 'in itself each living creature is absolute: in its own being'. The idea of the absolute self is one which Lawrence explores directly in *The Rainbow*, where Will Brangwen is shown to have 'come into his own existence', to have been 'born at last unto himself':

Now at last he had a separate identity, he existed alone, even if he were not quite alone. Before he had only existed in so far as he had relations

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<sup>45</sup> Lawrence, *Prussian Officer*, 38.

<sup>46</sup> Lawrence, *Study of Thomas Hardy*, 12; Lawrence, *Reflections*, 78-9.

with another being. Now he had an absolute self – as well as a relative self. (176)

This new 'unalterable self' is described as 'free, separate, independent', and it is clear that Will's achievement thereof is meant to be perceived as progressive, especially in Lawrence's use of the phrase 'at last', repeated three times in two paragraphs (176-7). It is this absolute self, this new constant, which Paul finally achieves at the end of *Sons and Lovers*.

However, in *The Rainbow* Will's relative self is not supplanted by his absolute self, but rather exists alongside it, and likewise the return to the city and to human contact which forms the closing image of *Sons and Lovers* is as important as Paul's realisation of his individual self, as Lawrence explains in 'The Captain's Doll':

All our troubles, says somebody wise, come upon us because we cannot be alone. And that is all very well. We must all be *able* to be alone, otherwise we are just victims. But when we *are* able to be alone, then we realise that the only thing to do is to start a new relationship with another – or even the same – human being. That people should all be stuck up apart, like so many telegraph poles, is nonsense.<sup>47</sup>

The achievement of the individual self is thus a requirement for, but also part of the impulse towards, relationship: the two are inextricably linked within Lawrence's theory of human relativity, and it is for this reason that, having fully understood and realised *himself*, Paul is finally ready to return to 'the faintly humming, glowing town' and to meet and fulfil the possibilities of the new relationships, both romantic and otherwise, that he will find there (464). There is a definite sense of hope here, and even of eagerness, as Paul walks 'quickly' (464).

The meeting of two achieved and absolute selves with 'each seek[ing] only the true relatedness to the other' creates the relationship which Lawrence calls, in 'Morality and the Novel' (1925), 'the third thing, which is neither sacrifice nor fight to the death': 'Each must be true to himself, herself, his own manhood, her own womanhood, and let the relationship

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<sup>47</sup> Lawrence, *The Fox*, 115.

work out of itself'.<sup>48</sup> Something like this is achieved by Tom and Lydia in *The Rainbow*, although the subsequent relationships in both this novel and Lawrence's later works suggest that the model achieved here may be too simplistic to be applied to the complexities of modern, fragmented life. Tom and Lydia achieve 'the baptism to another life' (90), and this is clearly something more than the 'baptism of fire in passion' which Paul longs for and achieves with Clara in *Sons and Lovers* (362, 399). The balance achieved by Tom and Lydia is underlined by Lawrence's choice of language – especially the repeated use of 'each other' – and balanced sentence structures in the description of this new stage in their relationship: 'He went his way, as before, she went her way' (91). Tom is also finally capable of being 'with' Lydia (91), as in those formulations which we have already considered in *The Trespasser* and *Sons and Lovers* and which lead us towards the 'freedom together' for which Birkin longs in *Women in Love* (132, 316).

In many ways it is not until *Women in Love* that this model of balanced, equal relationships receives its first full theoretical, practical and sustained working through. As Mark Spilka has suggested 'At the end of *Sons and Lovers* a man is born; at the end of *The Rainbow*, a woman; and in *Women in Love* a man and a woman meet and marry'.<sup>49</sup> While Spilka acknowledges that this formula is 'too simple perhaps', it does provide us with a useful way in which to approach these three novels: both *Sons and Lovers* and *The Rainbow* end with the emergence of one fully achieved individual, while *Women in Love* seems instead to be concerned with the question of how to relate two such individuals, of how they can achieve the balanced relationship which Lawrence sees as necessary to each individual self.<sup>50</sup>

The key image in *Women in Love*, the model of relationship for which Birkin longs throughout, is, of course, that of star-equilibrium:

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<sup>48</sup> Lawrence, *Study of Thomas Hardy*, 174.

<sup>49</sup> Mark Spilka, *The Love Ethic of D. H. Lawrence* (London, 1958), 121.

<sup>50</sup> Ibid.

'What I want is a strange conjunction with you – ' he said quietly:  
 ' –not meeting and mingling; – you are quite right: – but an equilibrium, a  
 pure balance of two single beings: – as the stars balance each other.'  
 (148)

This image of balance is repeated at various points throughout the novel, with the two individuals balancing each other like two stars, as above, or, elsewhere, 'like two poles of one force, like two angels, or two demons' (199). Birkin and Ursula's eventual achievement of this model of equilibrium leads to another series of balanced sentences of the kind that we have already considered: 'She had her desire fulfilled, he had his desire fulfilled. For she was to him what he was to her, the immemorial magnificence of mystic, palpable, real otherness' (320). This same model is celebrated in Lawrence's 1917 poem 'One Woman to All Women':

There's the beauty you cannot see, myself and him  
 Balanced in glorious equilibrium,  
 The swinging beauty of equilibrium.<sup>51</sup>

Of course, the 'freedom together' which Birkin seeks to achieve with Ursula is not the only relationship model explored by Lawrence in *Women in Love*: the destructive, and ultimately fatal, relationship between Gerald and Gudrun provides an extreme contrast with the equilibrium which Birkin and Ursula move towards. Gudrun reflects on the fact that she and Gerald exist in different worlds and that 'They would never be together', either freely or otherwise (346); meanwhile, Gerald is forced to recognise that Gudrun, looking at the snow scene outside the hostel, 'was gone. She was completely gone' (401), and these formulations cannot fail to remind us of those which we have already considered in *The Trespasser* and *Sons and Lovers* in particular.

Gerald Doherty has explored the two relationships at the heart of *Women in Love* in terms of identification ('the A is B of erotic merging and fusion') and dispossession or disidentification ('let[ting] the other be in a recognition of the attraction of mutual

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<sup>51</sup> *The Complete Poems of D. H. Lawrence*, ed. Vivian de Sola Pinto and Warren Roberts, 2 vols (rev. repr., London, 1967), i, 251.

difference').<sup>52</sup> Interestingly in terms of our focus on a theory of human relativity, Doherty associates the latter with the idea of gravitation as explored by Lawrence in *Fantasia*, stating that 'gravitation is *Women in Love's* rhetorical model for an erotics of disidentification'.<sup>53</sup> The 'laws of gravitation' are in fact referred to directly in *Women in Love*, where our knowledge thereof is described as 'knowledge of the past' (86), a statement which either ignores or ironically alludes to the contemporary changes in our understanding of gravitation as led by Einstein. Doherty explains the importance of gravity to Lawrence as providing 'An interplay of force and counter-force, attraction and repulsion' which enables a balanced model whereby it 'draws the two bodies together at the same time as it holds them apart'.<sup>54</sup> Such an image appears early in *Women in Love*, when Ursula reflects that 'something kept her from [Birkin], as well as attracted her to him' (20). However, Doherty's focus on the balanced nature of gravitation as a model for human interactions and relationships fails to acknowledge that Hermione is described as 'gravitat[ing] physically towards' Birkin in a relationship which comes close to ending in a similar manner to that of Gerald and Gudrun (21). In addition, while Doherty recognises that 'For Lawrence, gravitation is at once a scientific principle and a foundational metaphor for interpreting cosmic life and activity', he makes no mention of the contemporary changes in the understanding of gravity provoked by Einstein's work on the general theory of relativity, an omission which is particularly noticeable when Doherty uses Lawrence's references to gravitation in *Fantasia* as support for his argument.<sup>55</sup>

In one of their political discussions late in *The White Peacock*, Lettie tells George that 'Society and its regulations is not a sort of drill that endless Napoleons have forced on us: it is the only way we have yet found of living together' (295). Although the political

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<sup>52</sup> Gerald Doherty, 'A Question of Gravity: The Erotics of Identification in *Women in Love*', *The D. H. Lawrence Review*, 29/2 (2000), 27.

<sup>53</sup> *Ibid.*

<sup>54</sup> *Ibid.*

<sup>55</sup> *Ibid.* 38 n. 5.

implications of this argument cannot be ignored, the insertion of that 'yet' suggests the possibility for something different, for a new way in which we can learn to live together, and Lawrence seems to have been attempting to forge such a new way in both his fictional and his non-fictional writings. Lawrence saw books as playing a vital role in this quest: in 1908 he told May Holbrook 'The true heart of the world is a book; there are sufficient among your acquaintances to make a complete world, but you must learn from books how to know them'.<sup>56</sup> Such a preoccupation stayed with Lawrence throughout his life: in 'Morality and the Novel' Lawrence states that 'The business of art is to reveal the relation between man and his circumambient universe, at the living moment', adding later that 'If a novel reveals true and vivid relationships, it is a moral work, no matter what the relationships may consist in'.<sup>57</sup> Lawrence's novels and short stories reveal just such relationships, acted out in order to show where human relationships are currently failing and the ways in which we just might be able to put them right. His non-fictional works, through their presentation of Lawrence's 'pollyanalytics', in turn provide the theoretical expression of the situations that have already been acted out in fiction, situations which have developed out of the underlying contemporary metaphysic, as I suggested earlier.

There can be no doubt that Lawrence was thinking, reading and writing about Einstein's theories of relativity as he wrote *Fantasia* but, as I have shown, Lawrence's presentations of human relationships in his earlier works suggest that his later theory of human relativity is directly relevant to his earliest novels, whether he was thinking of it as such while writing them or not. These early novels work towards the recognition of the necessity of the fully achieved individual self to successful, balanced human relationships, and this modern approach to modern relationships is summed up in Lawrence's 1917 poem 'Wedlock' which, despite including many of the clichés of traditional romantic love, ends

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<sup>56</sup> Lawrence, letter to May Holbrook dated 2 December 1908, *Letters*, i, 96.

<sup>57</sup> Lawrence, *Study of Thomas Hardy*, 171, 174.

with a focus on a very modern and Lawrencian model of relationships; thus, while in the first part of the poem the lovers are described as 'a bonfire of oneness', the sixth and final part opens with a significant 'yet':

And yet all the while you are you, you are not me.  
And I am I, I am never you.  
How awfully distinct and far off from each other's being we are!

Yet I am glad.<sup>58</sup>

The recognition of both the self and the other in 'Wedlock' leads to the final stanza in which the couple are 'with' each other like Tom and Lydia in *The Rainbow*:

And you will always be with me.  
I shall never cease to be filled with newness,  
Having you near me.<sup>59</sup>

The couple here remain distinct individuals, creating a fulfilling relationship by existing 'with' and 'near' each other without losing each other in that clichéd and, for Lawrence at least, outdated 'bonfire of oneness'.

Such ideas on individuals and relationships receive their full theoretical working through, as we have seen, in *Fantasia*, with Lawrence employing the language and concepts of relativity in order to frame his discussions thereof. Therefore, the role of relativity for Lawrence may be described, in Kim Herzinger's words, as giving 'needed conceptual support to the direction in which he was already moving'.<sup>60</sup> The questions which we must address in the following two chapters, then, are clear: to what extent can Lawrence's relativistic ideas in *Fantasia* be attributed to Einstein's influence? And to what extent does this influence affect Lawrence's later fictional works? Lawrence's statement towards the end of *Fantasia* that 'people have got the word Relativity into their heads' seems to be as true of Lawrence himself as it is of anyone else (190); the path by which it

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<sup>58</sup> Lawrence, *Poems*, i, 245, 248.

<sup>59</sup> *Ibid.*, i, 248.

<sup>60</sup> Kim A. Herzinger, *D. H. Lawrence in His Time: 1908-1915* (London, 1982), 157. Herzinger is writing about imagism.

got there, and the effect which it had once in place, form the subject of the following chapters.

## Chapter 5

### 'Revolution in Science':

#### The Special and the General Theories of Relativity

D. H. Lawrence's 1921 request for 'a simple book on Einstein's Relativity' could have been fulfilled by any one of a vast number of popular science books which set out to explain the ideas behind what *The Times* had announced as a 'Revolution in Science' in November 1919.<sup>1</sup> As we saw in the previous chapter, a 1921 article in *Nature* provided an extract from 'A bibliography of all books, pamphlets, papers, articles, and other publications on the subject of relativity' which included 'nearly 650 titles, arranged in chronological order from 1886 to the end of last year'.<sup>2</sup> This apparent obsession with relativity continued through the 1920s, with Bertrand Russell referring in 1926 to the 'innumerable popular accounts of the theory of relativity', while the reviewer of eight 'Easy Books on Einstein' in a 1922 issue of *The New Statesman* drew attention to 'The flood of books intended to explain the Theory of Relativity in more or less non-mathematical terms', adding 'unless publishers in general – and Messrs. Methuen in particular – are much worse business men than we take them to be, the number of people who wish to read such books must be very large indeed'.<sup>3</sup>

Towards the end of *Fantasia of the Unconscious* (1922) Lawrence also reflected on the contemporary interest in Albert Einstein's theories, stating that 'people have got the word Relativity into their heads', that 'The latest craze is Mr Einstein's Relativity theory',

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1 D. H. Lawrence, letter to S. S. Kotliansky dated 4 June 1921, *The Letters of D. H. Lawrence*, ed. James T. Boulton et al., 8 vols (Cambridge, 1979-2000), iv, 23; 'Revolution in Science', *The Times* (7 November 1919), 12.

2 'Bibliography of Relativity', *Nature*, 106/2677 (17 February 1921), 811. Needless to say, the earliest texts included in this bibliography deal not with the *theory* of relativity but rather with the *principle* of relativity, a distinction to which we will return.

3 Bertrand Russell, *The ABC of Relativity* (London, 1926), 1; 'Easy Books on Einstein', *The New Statesman*, 18/463 (25 February 1922), 596.

and that 'There must be something in the mere suggestion, which we have been waiting for'.<sup>4</sup> The general public also seemed to have got the name Einstein into their heads: as Stanley Goldberg explains, 'Before 1919 almost no one outside of physics knew of Albert Einstein. After 1919 almost no one did not know of him'.<sup>5</sup> In this chapter we will explore the theories of relativity which led to Einstein's emergence as an international celebrity in 1919, focusing on the scientific ideas and contexts of the two theories, while also addressing both the public reaction to this development and the impact which it had on various non-scientific aspects of contemporary culture, in particular literature.

The special theory of relativity was the third paper that Einstein produced for the seventeenth volume of the *Annalen der Physik* in 1905; it appeared under the title 'On the Electrodynamics of Moving Bodies', a title which, as Arthur Miller has pointed out, provokes a certain set of expectations for the reader which is soon subverted by the paper itself:

The kind of title Einstein had given his paper customarily signalled a discussion of the properties of moving bulk matter, either magnetic or dielectric. Einstein analysed neither of these topics. In fact, the paper's first quarter contains a philosophical analysis of the notions of time and length.<sup>6</sup>

This philosophical analysis is one of the factors which makes this paper so unusual and surprising, with Einstein explaining that 'We have to bear in mind that all our propositions involving time are always propositions about *simultaneous events*'.<sup>7</sup> He continues, 'If, for example, I say that "the train arrives here at 7 o'clock," that means, more or less, "the pointing of the small hand of my clock to 7 and the arrival of the train are simultaneous

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4 D. H. Lawrence, *Psychoanalysis and the Unconscious and Fantasia of the Unconscious*, ed. Bruce Steele (Cambridge, 2004), 190.

5 Stanley Goldberg, *Understanding Relativity: Origin and Impact of a Scientific Revolution* (Oxford, 1984), 309.

6 Arthur I. Miller, *Albert Einstein's Special Theory of Relativity: Emergence (1905) and Early Interpretation (1905-1911)* (Reading, Massachusetts, 1981), 2.

7 *The Collected Papers of Albert Einstein. English Translation*, ed. John Stachel et al., trans. Anna Beck et al., to be completed in circa 30 vols, (Princeton, 1987–), ii, 141.

events”<sup>8</sup>. While Einstein's point forces us to readdress a concept which we have come to take for granted, the elementary nature of the explanation and language used here is not in keeping with the paper's appearance in one of the foremost scientific journals of the time; indeed, Goldberg suggests that 'Finding this discussion in the midst of consideration of the most mathematically complex physical issues one can imagine, is tantamount to finding a lesson in reading for six-year-olds'.<sup>9</sup>

From the very opening of the paper, it is clear that Einstein is approaching the issue under consideration from a new perspective. He begins, 'It is well known that Maxwell's electrodynamics – as usually understood at present – when applied to moving bodies, leads to asymmetries that do not seem to attach to the phenomena'.<sup>10</sup> The parenthetical phrase 'as usually understood at present' highlights Einstein's different approach, and is emphasised a few lines later with the contrast that he draws between 'The observable phenomenon' and 'the customary conception'; it is further emphasised when Einstein introduces his two postulates, the principle of relativity and the principle of the constancy of the velocity of light, two postulates which are, he explains, 'only seemingly incompatible'.<sup>11</sup> Using these postulates together, Einstein is able to develop a theory which, as he states towards the end of the paper, ultimately means that 'All problems in the optics of moving bodies can be solved'.<sup>12</sup>

Einstein's special theory of relativity, as I have already said, forces us to readdress and redefine our fundamental notions of space and time by revealing that there is no such thing as absolute space or absolute time. However, as A. S. Eddington explained in 1928,

It is a common mistake to suppose that Einstein's theory of relativity asserts that everything is relative. Actually it says, 'There are absolute things in the world but you must look deeply for them. The things that

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<sup>8</sup> Ibid.

<sup>9</sup> Goldberg, *Understanding Relativity*, 106.

<sup>10</sup> Einstein, *English Translation*, ii, 140.

<sup>11</sup> Ibid.

<sup>12</sup> Ibid. ii, 165.

first present themselves to your notice are for the most part relative.'<sup>13</sup>

It is for this reason that Einstein himself favoured the term *Invariantentheorie*.<sup>14</sup> The principle of relativity and the constancy of the velocity of light are the two absolutes on which the special theory of relativity is based, and in his 1905 paper Einstein explained the former as follows:

The laws governing the changes of the state of any physical system do not depend on which one of two coordinate systems in uniform translational motion relative to each other these changes of the state are referred to.<sup>15</sup>

Physical laws thus remain absolute, as do the physical constants associated with them.

More surprising, however, is Einstein's other postulate, the absolute nature of the velocity of light. Unlike all other velocities, the speed of light does *not* depend on the speed, or lack thereof, at which its particular frame of reference is moving: it always travels at the same speed, a physical constant which we now know as  $c$ .

Although Einstein's approach was radical and new, in particular in terms of his selection of the two 'seemingly incompatible' postulates, it would not be correct to think of him working in a vacuum or without precedent in 1905. The principle of relativity was one of the leading scientific concerns of the day, with many physicists working on it in one form or another, foremost among them Henri Poincaré and Hendrik Lorentz. Indeed, the latter had already, in 1904, introduced 'Mathematically similar transformation equations' to those derived by Einstein in his 1905 paper, equations which are still known as the Lorentz transformations today.<sup>16</sup> However, Einstein repeatedly affirmed that he had not known this paper at the time of writing his own, and John Rigden makes it clear that there is a significant difference between the way in which the two sets of equations were derived,

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13 A. S. Eddington, *The Nature of the Physical World* (Cambridge, 1928), 23.

14 See Gerald Holton, *Einstein, History, and Other Passions: The Rebellion Against Science at the End of the Twentieth Century* (Cambridge, Massachusetts, 2000), 132.

15 Einstein, *English Translation*, ii, 143.

16 John Stachel et al., eds., *The Collected Papers of Albert Einstein*, to be completed in circa 30 vols (Princeton, 1987–), ii, 308 n. 16.

with Lorentz's resulting 'from his ad hoc attempt to explain the "failed" Michelson-Morley experiment' while Einstein's were derived directly from his two starting principles.<sup>17</sup>

The scientific reception of the special theory of relativity was by no means straightforward. Although Einstein's paper was published in 1905 and received some recognition in 1907, it was not until 1911 that, as I. Bernard Cohen states, the theory 'had gained enough adherents to constitute a revolution in science'.<sup>18</sup> 1911 was certainly a significant year for the theory, as Miller reports:

At the 83<sup>rd</sup> *Naturforscherversammlung* at Karlsruhe in September 1911, Sommerfeld ... could say that although he had been asked to speak on the relativity theory, he decided otherwise because it was already in 'the safe possession of the physicist.' In his opinion, the frontier problems concerned the meaning of Planck's energy quantum and Einstein's light quantum.<sup>19</sup>

While this may have been a tactic on Arnold Sommerfeld's part to facilitate the acceptance of the theory by those still in doubt, it is nevertheless revealing as to the direction in which physics was moving at this time, and this fact is further emphasised by the decision to devote the first Solvay Congress, also in 1911, to the topic of quanta rather than relativity, as we saw in chapter two.<sup>20</sup>

The nature of the responses to the theory also varied, and the historical analysis thereof continues to do so. The first published mention of Einstein's paper appeared in late November 1905 in a paper by Walter Kaufmann which he followed in 1906 with the publication of results which apparently disproved Einstein's theory, although for Kaufmann Einstein's theory was not differentiated from that of Lorentz.<sup>21</sup> In 1906, Max Planck openly supported Einstein's theory against the objections posed by Kaufmann, and in 1916

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<sup>17</sup> See *ibid.* ii, 307 n. 3; John S. Rigden, *Einstein 1905: The Standard of Greatness* (Cambridge, Massachusetts, 2005), 92. On the extent of the significance of the Michelson-Morley experiment to Einstein's work on the special theory of relativity see chapter eight of Gerald Holton's *Thematic Origins of Scientific Thought: Kepler to Einstein* (rev. edn, Cambridge, Massachusetts, 1988), 279-370.

<sup>18</sup> I. Bernard Cohen, *Revolution in Science* (Cambridge, Massachusetts, 1985), 412.

<sup>19</sup> Miller, *Special Theory of Relativity*, 253.

<sup>20</sup> See Goldberg, *Understanding Relativity*, 182.

<sup>21</sup> See Miller, *Special Theory of Relativity*, 226.

Kaufmann's data was finally proved to be flawed. Kaufmann was by no means the only physicist to reject Einstein's theory initially, and Rigden has suggested that scientific responses to the special theory of relativity 'occupy extremes'.<sup>22</sup>

Although various references had been made to Einstein's work in Britain before 1914, José M. Sánchez-Ron describes this year as 'remarkable' in terms of the introduction of special relativity into Britain due to the appearance of the first books dedicated to the subject, among them Ebenezer Cunningham's *The Principle of Relativity*.<sup>23</sup> Cunningham, a mathematical physicist at Cambridge, is, according to Andrew Warwick, 'widely remembered as the man who introduced relativity theory into Britain and acted as its chief spokesman prior to World War I'.<sup>24</sup> However, Warwick has argued convincingly that Cunningham's work in relation to relativity in fact 'represented a direct contribution to Cambridge electrodynamics and not to the development of relativity theory'.<sup>25</sup>

While Cunningham attempted to hold on to the concept of the ether which Einstein had rejected – writing in *The Principle of Relativity* that 'the fact of the propagation in time of light and electromagnetic disturbances will always be a sufficient ground for a belief in some reality by means of which the transmission is effected' – Norman Campbell, an experimental physicist also at Cambridge, was looking for a way to abolish the ether which he believed was 'irrelevant to physics'.<sup>26</sup> Campbell explained his view of the ether to the readership of *The New Quarterly* in 1908, stating 'in this matter I am a faddist. The aether, which is poison to me, is still to almost every other student of physics the necessary sustenance of life', before adding, with a certain amount of foresight, 'But I can hardly

<sup>22</sup> Rigden, *Einstein 1905*, 98.

<sup>23</sup> José M. Sánchez-Ron, 'The Reception of Special Relativity in Great Britain', in Thomas F. Glick, ed., *The Comparative Reception of Relativity* (Dordrecht, 1987), 49.

<sup>24</sup> Andrew Warwick, 'Cambridge Mathematics and Cavendish Physics: Cunningham, Campbell and Einstein's Relativity 1905-1911. Part I: The Uses of Theory', *Studies in History and Philosophy of Science*, 23/4 (1992), 626.

<sup>25</sup> Ibid. 627.

<sup>26</sup> E. Cunningham, *The Principle of Relativity* (Cambridge, 1914), 29; Andrew Warwick, 'Cambridge Mathematics and Cavendish Physics: Cunningham, Campbell and Einstein's Relativity 1905-1911. Part II: Comparing Traditions in Cambridge Physics', *Studies in History and Philosophy of Science*, 24/1 (1993), 5.

believe that I shall remain permanently in so small a minority'.<sup>27</sup>

Warwick describes Campbell as 'the only British physicist to adopt a broadly Einsteinian reading of relativity before 1911', but also notes that 'he did not display any real familiarity with Einstein's work on relativity until September of 1909'.<sup>28</sup> As for other British physicists, Warwick concludes the second part of his study with the claim that 'very few physicists in Britain became competent practitioners of special-relativity theory until the 1920s (or even 1930s)', although this is not, of course, the same as saying that they did not know of it at all until then.<sup>29</sup>

When it came to the general theory of relativity, however, British physicists were somewhat quicker on the uptake, in particular the British astrophysicist, Arthur Eddington who, in 1919, led the eclipse expeditions which proved the validity of this theory. The general theory of relativity was completed late in 1915, although it was not until 1916 that Einstein published the full theory in its final form in one long article in the *Annalen der Physik* under the title 'The Foundation of the General Theory of Relativity'. General relativity grew out of Einstein's work on the special theory of relativity, providing a generalisation of the former theory in order to enable it to be applied to accelerated motion and to address Isaac Newton's law of gravitation, and Rigden has described this theory as 'Einstein's most notable and his single most important scientific contribution'.<sup>30</sup> Einstein made his first step towards the general theory in 1907 when he formulated what he came to call 'the equivalence principle' which states that, as J. W. N. Sullivan explained in 1919, 'there is no difference between a gravitational field of force and a field of force introduced

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27 Norman R. Campbell, 'Another View of the Aether', *The New Quarterly*, 1/3 (June 1908), 444. It is worth noting a number of significant points here: firstly, Warwick makes no mention of this article of Campbell's, focusing instead on his contributions to *Nature* and *The Philosophical Magazine* as well as his book *Modern Electrical Theory* (1907, 2<sup>nd</sup> edn 1913). Secondly, we should note the appearance of Campbell's radical views on the ether in a non-specialist popular publication like *The New Quarterly*. And finally, this is the same Campbell who we considered in chapter two for his early work on light quanta.

28 Warwick, 'Cambridge Mathematics. II', 18.

29 Ibid. 24-5.

30 Rigden, *Einstein 1905*, 5.

by a change of co-ordinates; that by no possible experiment can we distinguish between them'.<sup>31</sup> The equivalence principle enabled Einstein to argue that rays of light should be bent when travelling through a gravitational field, and ultimately that space-time itself is bent.

The suggestion of the existence of such effects was clearly radical, but the effects could at least be tested for to see if they really existed, a fact which was recognised in Britain as early as 1913, as demonstrated by a note in *The Observatory*:

It has been shown by Einstein that one necessary consequence of the generalised Principle of Relativity is a bending of rays of light which pass through a field of gravitational force. Thus, if the light of a star passes near the Sun, the star will appear displaced.<sup>32</sup>

The paragraph-long note continues by describing the existence of this displacement as 'a crucial test as to whether gravitation comes within the scope of the Principle of Relativity', and then describes the use of solar eclipses to provide the necessary evidence.<sup>33</sup> However, it would take six years for such a crucial test to be completed, despite a number of earlier attempted expeditions: bad weather and the outbreak of the First World War were significant factors in this delay.<sup>34</sup>

On 6 November 1919, at the Joint Eclipse Meeting of the Royal Society and the Royal Astronomical Society, the Astronomer Royal, Frank Dyson, announced that 'A very definite result has been obtained that light is deflected in accordance with Einstein's law of gravitation' following the experiments undertaken by Eddington and others during the solar eclipse of 29 May.<sup>35</sup> The following day *The Times* reported on the meeting, leading with the frequently quoted headlines: 'Revolution in Science. / New Theory of the Universe. /

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31 J. W. N. Sullivan, 'The Equivalence Principle', *The Athenaeum*, 4649 (6 June 1919), 433.

32 'Gravitation and Light', *The Observatory*, 36/461 (May 1913), 231.

33 Ibid.

34 See John Earman and Clark Glymour, 'Relativity and Eclipses: The British Eclipse Expeditions of 1919 and Their Predecessors', *Historical Studies in the Physical Sciences*, 11/1 (1980), 60.

35 'Joint Eclipse Meeting of the Royal Society and the Royal Astronomical Society', *The Observatory*, 42/545 (November 1919), 391.

Newtonian Ideas Overthrown'.<sup>36</sup> As Alistair Sponsel has pointed out, and as we saw in the introduction, although this article has been the primary focus of studies of the public reaction to the announcement of the definitive proof of Einstein's general theory of relativity, *The Times* had in fact been publishing various articles on the subject from January 1919 onwards; while some of these were just brief notes, others were more detailed: in April a fifty-line article on the subject included a substantial (twenty-one-line) quotation from a recent article in *Nature* by A. C. D. Crommelin, and the 'Stars of the Month' column for May devoted a significant section to a description of the eclipse which was to occur at the end of that month.<sup>37</sup> Thus, as Sponsel suggests, the 'Revolution in Science' article should in fact be considered as 'the culmination' of *The Times's* coverage of the event.<sup>38</sup>

*The Times* was not the only popular publication to engage with Einstein's theories before November 1919, however; starting in May that year Sullivan published a series of five articles on the subject in *The Athenaeum*. In these articles Sullivan explained to his readers that 'the coming eclipse is awaited by the scientific world with more interest than has attended any similar phenomenon', described Einstein as a 'genius', and even discussed the possibility of a forthcoming 'revolution in our way of regarding natural phenomena'.<sup>39</sup>

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36 'Revolution in Science', 12.

37 Alistair Sponsel, 'Constructing a "Revolution in Science": The Campaign to Promote a Favourable Reception for the 1919 Solar Eclipse Experiments', *British Journal for the History of Science*, 35/4 (2002), 439-67; [John Griffiths Hartley], 'Solar Eclipse Next Month', *The Times* (22 April 1919), 16; A. C. D. Crommelin, 'The Eclipse of the Sun on May 29', *Nature*, 102/2571 (6 February 1919), 445; 'Stars of the Month', *The Times* (1 May 1919), 10. See also 'Coming Eclipse of the Sun', *The Times* (13 January 1919), 8; [Henry Park Hollis], 'Eclipse of the Sun Today', *The Times* (29 May 1919), 14; [Frank Dyson], 'The Eclipse', *The Times* (4 June 1919), 12; [Henry Park Hollis], 'The Eclipse of the Sun', *The Times* (5 June 1919), 16; 'The Recent Eclipse of the Sun', *The Times* (14 June 1919), 10; and [Frederick William Long], 'Photographs of the Eclipse', *The Times* (9 September 1919), 12. In addition, Oliver Lodge's comments on the forthcoming eclipse expeditions in a lecture at the Royal Institution are reported in 'Aether and Matter', *The Times* (1 March 1919), 7. The authors of these articles as given here were established by Sponsel using marked copies of *The Times*, and appear in his 'Constructing a "Revolution in Science"', 446.

38 Sponsel, 'Constructing a "Revolution in Science"', 444.

39 J. W. N. Sullivan, 'A Crucial Phenomenon', *The Athenaeum*, 4645 (9 May 1919), 303; 'The Notion of Simultaneity', *The Athenaeum*, 4647 (23 May 1919), 369; 'The Equivalence Principle', 433. See also 'On Relative Motion', *The Athenaeum*, 4646 (16 May 1919), 337 and 'The Union of Space and Time', *The Athenaeum*, 4648 (30 May 1919), 402.

The five articles taken together provide the reader with a good grounding in Einstein's theories of relativity, while also highlighting the contemporaneity of and scientific interest generated by them.

Sponsel has highlighted the importance of the articles in *The Times* in enabling Eddington 'to construct an audience that would be excited by the eclipse expeditions and primed to accept the results that he hoped the expeditions would produce'.<sup>40</sup> However, while such a campaign may have proved effective in terms of the general public, many scientists were initially reluctant to accept Eddington's results and Einstein's theory. At the Joint Eclipse Meeting, Ludwig Silberstein was particularly keen to point out that 'We owe it to that great man [Newton] to proceed very carefully in modifying or retouching his Law of Gravitation'.<sup>41</sup> However, the controversial nature of the theories of relativity is perhaps most clearly demonstrated by the relationship between Einstein and the Nobel Prize in Physics: first nominated as early as 1910, Einstein received nominations every year apart from 1911 and 1915 until, as we saw in chapter two, he finally received the prize for 1921 in 1922, *not* for relativity, but 'for his services to theoretical physics and especially for his discovery of the law of the photoelectric effect'.<sup>42</sup> Abraham Pais suggests that this lack of official recognition for relativity is due to the absence of experimental evidence, although this is clearly less valid after 1919, but also laments 'the Academy's bad fortune not to have anyone among its members who could competently evaluate the content of relativity theory in those early years'.<sup>43</sup>

Although the November 1919 headline in *The Times*, 'Revolution in Science', seems clear-cut, the paper explains that 'there was difference of opinion' at the Joint Eclipse Meeting 'as to whether science had to face merely a new and unexplained fact, or to reckon

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40 Sponsel, 'Constructing a "Revolution in Science"', 443.

41 'Joint Eclipse Meeting', 397.

42 Quoted in Abraham Pais, *Subtle is the Lord... The Science and the Life of Albert Einstein* (Oxford, 1982), 510. Pais provides full details of 'How Einstein Got the Nobel Prize' in an appendix of that name in this authoritative text, 502-12.

43 Ibid. 511.

with a theory that would completely revolutionise the accepted fundamentals of physics'.<sup>44</sup> Eddington himself emphasised that the results reported 'may be taken as proving Einstein's *law* rather than his *theory*', adding 'The law is right, though the fundamental ideas underlying it may yet be questioned'.<sup>45</sup> In a slightly different manner, the question as to whether Einstein's theories constitute a revolution in science or an evolution of its ideas remains contested even today, and it is worth diverting from our main purpose to consider the various arguments on each side of this debate. Of course, this question also feeds into the larger issue of the way in which science changes and develops at any time, a discussion which we will touch on where relevant.

The name most often associated with the concept of revolutions in science is Thomas Kuhn, whose controversial work *The Structure of Scientific Revolutions* has formed the basis for the vast majority of discussions thereof since its publication in 1962. Kuhn's theory revolves around 'paradigms', fundamental frameworks which guide scientific research but which, following a period of 'crisis', are rejected in a revolutionary move, to be replaced by a new set of paradigms after which the scientist, according to Kuhn, 'works in a different world'.<sup>46</sup> In a slightly less extreme formulation, Leopold Infeld defines a revolution in physics as 'a sudden clarification of our concepts, the forming of a new picture, an unexpected resolution of contradictions and difficulties', subsequently using this definition to explain that Einstein's special theory of relativity provides 'a revolution in our habits of thinking and in our use of language'.<sup>47</sup> This idea is explored by Eddington in *The Nature of the Physical World* (1928) in relation to both relativity and quantum theory: 'These are not merely new discoveries as to the content of the world; they involve changes in our mode of thought about the world'.<sup>48</sup> Russell also addresses this

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44 'Revolution in Science', 12.

45 'Joint Eclipse Meeting', 393.

46 Thomas S. Kuhn, *The Structure of Scientific Revolutions* (3<sup>rd</sup> edn, Chicago, 1996), 121.

47 Leopold Infeld, *Albert Einstein: His Work and Its Influence on Our World* (New York, 1950), 22, 31.

48 Eddington, *Nature of the Physical World*, 4.

fundamental change in his *ABC of Relativity*, stating that 'What is demanded is a change in our imaginative picture of the world'.<sup>49</sup>

That Einstein's theories of relativity could be seen to constitute a revolution in science was recognised very early on: indeed, in 1910 Planck compared the ongoing relativity revolution with the Copernican revolution, a tactical device, according to Richard Staley, which ensures that 'the similar triumph of the new theory is invested with an almost historical inevitability'.<sup>50</sup> Meanwhile, soon after the announcement of the proof of Einstein's general theory, and in one of the books which it has been suggested Lawrence read, Henry Brose wrote of relativity as 'a theory which revolutionises the views of classical physics and discloses the intimate connection between science and philosophy'.<sup>51</sup> The general consensus, both then and now, seems to be not only that Einstein's theories of relativity constitute a revolution, but that they constitute one of the most significant scientific revolutions of all time.

However, such a view was not condoned by Einstein himself, a man who, in Martin Klein's words, 'disliked too much talk about scientific revolutions'.<sup>52</sup> Indeed, as we saw in chapter two, Einstein only once used the word 'revolutionary' in relation to any of his own work, describing his 1905 paper on light quanta as 'very revolutionary' in a letter to his friend Conrad Habicht; in the same letter Einstein described his forthcoming special relativity paper as employing merely 'a modification of the theory of space and time'.<sup>53</sup> Holton highlights this use of the word 'modification', 'announcing a work considered to be within the existing tradition, the very opposite of a revolutionary act', and Einstein uses it

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49 Russell, *ABC of Relativity*, 1.

50 Richard Staley, 'On the Histories of Relativity: The Propagation and Elaboration of Relativity Theory in Participant Histories in Germany, 1905-1911', *Isis*, 89/2 (1998), 287.

51 See Rose Marie Burwell, 'A Catalogue of D. H. Lawrence's Reading from Early Childhood', *The D. H. Lawrence Review*, 3 (1970), 258; Henry L. Brose, *The Theory of Relativity: An Introductory Sketch Based on Einstein's Original Writings* (Oxford, 1919), 29.

52 Martin J. Klein, 'Einstein on Scientific Revolutions', *Vistas in Astronomy*, 17 (1975), 113.

53 Einstein, letter to Conrad Habicht dated 18 or 25 May 1905, *English Translation*, v, 20; see Cohen, *Revolution in Science*, 435-6

again in his own popular exposition of the theories of relativity, explaining that 'this modification [of classical mechanics] affects only the laws for rapid motions'.<sup>54</sup> It is worth noting that Lawrence himself portrays some understanding of this fact in his explorations of relativity in *Fantasia of the Unconscious*: 'Mr Einstein's Theory of Relativity does not supersede the Newtonian Law of Gravitation or of Inertia. It only says "Beware! The Law of Inertia is not the simple ideal proposition you would like to make of it"' (167). Such an assessment is corroborated by Einstein in his popular exposition:

Even though classical mechanics does not supply us with a sufficiently broad basis for the theoretical presentation of all physical phenomena, still we must grant it a considerable measure of 'truth,' since it supplies us with the actual motions of the heavenly bodies with a delicacy of detail little short of wonderful.<sup>55</sup>

And yet, as we have seen, the theories of relativity do require some kind of fundamental change in our way of looking at the world; indeed, if we accept William James's description of a revolution as offered in *Pragmatism: A New Name for Some Old Ways of Thinking* (1907) – a book which, according to Jessie Chambers, 'especially appealed' to Lawrence – we can see just how revolutionary this development was:

The most violent revolutions in an individual's beliefs leave most of his old order standing. Time and space, cause and effect, nature and history, and one's own biography remain untouched. New truth is always a go-between, a smoother-over of transitions. It marries old opinion to new fact so as ever to show a minimum of jolt, a maximum of continuity.<sup>56</sup>

As we know, time and space by no means remained untouched by Einstein's theories of relativity while, in the popular conception at least, cause and effect were also imagined to have been put under threat.

How, then, can we explain Einstein's own reluctance to describe his theories of relativity as revolutionary? While Cohen's appeal to Einstein's modesty seems insufficient

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<sup>54</sup> Holton, *Einstein, History, and Other Passions*, 107; Albert Einstein, *Relativity: The Special and the General Theory. A Popular Exposition*, trans. Robert W. Lawson (London, 1920), 44.

<sup>55</sup> Einstein, *Relativity*, 13.

<sup>56</sup> Jessie Chambers, *D. H. Lawrence: A Personal Record* (Cambridge, 1980), 113; William James, *Pragmatism: A New Name for Some Old Ways of Thinking* (London, 1907), 60-61. We will return to James's *Pragmatism* later.

as an explanation, his suggestion that Einstein's use of the term revolutionary in reference to his quantum theory of light emphasised rather a 'quality of not fitting and even not being true, rather than simply being novel' is insightful.<sup>57</sup> Alternatively, Klein suggests that 'When Einstein reacted sceptically to claims that this or that new discovery or new theory had revolutionised physics, he did so in the name of the True Revolution', that is, the 'new unified foundation for physics' for which Einstein spent his whole life searching.<sup>58</sup> In contrast, Barbara Reeves has highlighted the negative connotations implied by the word 'revolutionary' following the First World War, explaining that opponents of relativity 'emphasised precisely its subversive, discontinuous, revolutionary aspects and made it clear that they believed such developments were “degenerative,” “repugnant,” and unnecessary'.<sup>59</sup> In England, Oliver Lodge made his own feelings on the theory of relativity clear by suggesting that the supporters of this theory should 'be regarded as Bolsheviks and pulled up'.<sup>60</sup> These negative connotations may explain the model offered by Eddington in 1922 whereby 'the present revolution of scientific thought follows in natural sequence on the great revolutions at earlier epochs in the history of science', a model which combines the radical nature of a revolutionary break with something closer to an evolutionary approach.<sup>61</sup> In the face of the contemporary antipathy towards concepts described as revolutionary, then, Einstein's reluctance to use the word in relation to his own work is hardly surprising.

Whether or not the theories of relativity really did constitute a scientific revolution – and personally I think it is difficult to maintain the view that they did not – the idea that such a dramatic change could be taking place was a source of much excitement and interest

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<sup>57</sup> Cohen, *Revolution in Science*, 443, 438.

<sup>58</sup> Klein, 'Einstein on Scientific Revolutions', 120.

<sup>59</sup> Barbara J. Reeves, 'Einstein Politicised: The Early Reception of Relativity in Italy', in Glick, ed., *Comparative Reception*, 204-5.

<sup>60</sup> Oliver Lodge, 'Popular Relativity and the Velocity of Light', *Nature*, 106/2662 (4 November 1920), 326.

<sup>61</sup> Arthur Stanley Eddington, *The Theory of Relativity and its Influence on Scientific Thought* (Oxford, 1922), 31.

for the general public. Rigden has suggested that this public interest stemmed, at least in part, from the contemporary context: 'The public, tired of four brutal years of conflict, embraced Einstein as the epitome of humanity's noble side'.<sup>62</sup> Such a view is apparently confirmed by Virginia Woolf's direct mention of Einstein in *Mrs Dalloway* (1925):

Away and away the aeroplane shot, till it was nothing but a bright spark; an aspiration; a concentration; a symbol (so it seemed to Mr Bentley, vigorously rolling his strip of turf at Greenwich) of man's soul; of his determination, thought Mr Bentley, sweeping round the cedar tree, to get outside his body, beyond his house, by means of thought, Einstein, speculation, mathematics, the Mendelian theory – away the aeroplane shot.<sup>63</sup>

This focus on pure thought, of which Einstein is one manifestation here, frees man from his setting, and even his own body. However, there is a sense of irony in the fact that just seven years before this novel was published, and five years before it is set, the aeroplane was being used in the 'four brutal years of conflict' to which we saw Rigden refer above: while Einstein and other examples of pure thought are seen to set us free from the physical setting of these memories, the fact that Mr Bentley's train of thought both starts and ends with the aeroplane suggests that there is more going on in this passage than initially meets the eye.<sup>64</sup>

Despite the extensive resources available in the 1920s to a general public fascinated by the developments provoked by Einstein, Russell wrote in 1926 that 'Everybody knows that Einstein has done something astonishing, but very few people know exactly what it is that he has done'.<sup>65</sup> In this light, and in terms of our focus on Lawrence's 'theory of human relativity' in *Fantasia of the Unconscious* (72), it is worth returning to the question of the

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<sup>62</sup> Rigden, *Einstein 1905*, 6-7.

<sup>63</sup> Virginia Woolf, *Mrs Dalloway*, ed. Stella McNichol (London, 1992), 30.

<sup>64</sup> Gillian Beer, however, states that 'The aeroplane in *Mrs Dalloway* is no war-machine. Its frivolity is part of postwar relief. It poignantly does *not* threaten those below', *Virginia Woolf: The Common Ground* (Edinburgh, 1996), 162. Although this does ultimately prove to be the case, initially 'The sound of an aeroplane bored *ominously* into the ears of the crowd' (21, my emphasis), while the 'mission of the greatest importance' which the aeroplane is said to be carrying out certainly suggests that the people watching it perceive some kind of wartime link even though this is quickly dispelled (23).

<sup>65</sup> Russell, *ABC of Relativity*, 1. Of course, Russell is, in part at least, seeking to justify his own contribution to what he himself calls the 'innumerable popular accounts of the theory of relativity'.

nature and the extent of Lawrence's own understanding of Einstein's achievements. As we saw in the previous chapter, Lawrence's grasp of the theories of relativity as evidenced in *Fantasia* is at times surprisingly astute, even though he ultimately falls into what Eddington calls the 'common mistake' of thinking that they mean that everything is relative. We know that Lawrence read at least one book about Einstein's theories of relativity in 1921, even though we cannot be sure which book this was: we will now follow Rose Marie Burwell's suggestions as to these texts and consider what impact they may have had on Lawrence's understanding of relativity.

Brose's *The Theory of Relativity: An Introductory Sketch Based on Einstein's Original Writings* (1919) is described by Brose as an attempt 'to give a non-mathematical description of some of the leading ideas of the theory of relativity'.<sup>66</sup> Brose's account is both scientific and historical, placing Einstein's theories within the context of their development, and the explanations are clear and concise. It draws particular attention to the three different, but related, theories of relativity now in existence: Galilean or Newtonian relativity, special relativity and general relativity.

The relation between Newton's theories and those of Einstein was one which many people, including scientists, failed to comprehend fully; indeed, we have already seen the November 1919 warning from one scientist that 'We owe it to that great man [Newton] to proceed very carefully in modifying or retouching his Law of Gravitation'. Interestingly, the evidence in *Fantasia* suggests that Lawrence *did* manage to grasp that *The Times's* subtitle, 'Newtonian Ideas Overthrown', was something of a simplification of the true state of affairs:

Mr Einstein's Theory of Relativity does not supersede the Newtonian Law of Gravitation or of Inertia. It only says 'Beware! The Law of Inertia is not the simple ideal proposition you would like to make of it. It is a vast complexity. Gravitation is not one elemental uncouth force. It is a strange, infinitely complex, subtle aggregate of forces.' And yet, however

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<sup>66</sup> Brose, *Theory of Relativity*, 3.

much it may waggle, a stone does fall to earth if you drop it. (167)

Whilst this is not the kind of language that a scientist would use to make the same point, we can see here that Lawrence has grasped the essential idea that 'Newton's Law of Gravitation ... still remains a law, even if not quite so absolute as heretofore' (153).

The image of dropping a stone which Lawrence employs at the end of the passage above is reminiscent of some of the models used by Einstein in order to describe relativity in his popular exposition:

I stand at the window of a railway carriage which is travelling uniformly, and drop a stone on the embankment, without throwing it. Then, disregarding the influence of the air resistance, I see the stone descend in a straight line. A pedestrian who observes the misdeed from the footpath notices that the stone falls to earth in a parabolic curve. I now ask: Do the 'positions' traversed by the stone lie 'in reality' on a straight line or on a parabola?<sup>67</sup>

While Lawrence's formulation in the passage above is an example of the kind of comic anti-climax which he so frequently liked to employ, it suggests an affinity with Einstein's model as well as emphasising Lawrence's understanding of the fact that the force of gravity as we are used to thinking of it does still have a place within Einstein's new model.

Even before Lawrence read whatever book it was that Samuel Kotliansky sent him in 1921, however, certain of his writings already suggested an affinity with the ideas which he would have found therein. Thus 'Study of Thomas Hardy' (written 1914, published posthumously 1936) provides a lengthy discussion of the fact that 'Motion and rest are the same, when seen completely':

How can one say, there is motion and rest? If all things move together in one infinite motion, that is rest. Rest and motion are only two degrees of motion, or two degrees of rest. Infinite motion and infinite rest are the same thing. It is obvious. Since, if motion were infinite, there would be no standing ground from which to regard it as motion. And the same with rest.<sup>68</sup>

Lawrence's descriptions of the nature of motion and rest are similar to Einstein's special

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<sup>67</sup> Einstein, *Relativity*, 9.

<sup>68</sup> D. H. Lawrence, *Study of Thomas Hardy and Other Essays*, ed. Bruce Steele (Cambridge, 1985), 60.

theory of relativity here, and the similarity lies particularly in Einstein's statement at the start of the special relativity paper that 'no "space at absolute rest" endowed with special properties will be introduced', and thus that 'The introduction of a "light ether" will prove superfluous'.<sup>69</sup> Lawrence's recognition of the fact that 'a thing to us at rest is only a thing travelling at our own rate of motion' is thus a highly topical one, closely linked to contemporary debates within the physical sciences, both in terms of the theory of relativity and the earlier principle of relativity on which the theory is based in part.<sup>70</sup>

Another curious parallel between Lawrence's writings and the theories of relativity appears in *Women in Love* (1920), this time in relation to the general theory, or rather, more specifically, to Einstein's equivalence principle. This principle, as we have seen, states that it is impossible to distinguish between an accelerated frame of reference and one that is at rest within a gravitational field. In his popular exposition (first translated into English in 1920 but published in German in 1916) Einstein asks us to 'imagine a spacious chest resembling a room with an observer inside who is equipped with apparatus':

To the middle of the lid of the chest is fixed externally a hook with rope attached, and now a 'being' (what kind of a being is immaterial to us) begins pulling at this with a constant force. The chest together with the observer then begin to move 'upwards' with a uniformly accelerated motion.<sup>71</sup>

Inside this chest, with no knowledge of what is going on outside, the observer 'come[s] to the conclusion that he and the chest are in a gravitational field which is constant with regard to time'.<sup>72</sup> Brose explains this further: 'the interpretation of the observer in the box and the observer outside, who is not being pulled, are equally justifiable and valid': the former puts the effects he is feeling down to the existence of a gravitational force, while the latter focuses on the force of acceleration which is being applied to the box.<sup>73</sup>

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<sup>69</sup> Einstein, *English Translation*, ii, 141.

<sup>70</sup> Lawrence, *Study of Thomas Hardy*, 60.

<sup>71</sup> Einstein, *Relativity*, 66.

<sup>72</sup> *Ibid.* 67.

<sup>73</sup> Brose, *Theory of Relativity*, 23.

This may not sound relevant to Lawrence's *Women in Love*, but there is one moment in this novel where the image of being suspended in a box appears directly, and may lead us to consider the possibility that Lawrence is drawing a parallel with the above scientific discovery. The moment appears as Ursula and Gudrun go to fetch the former's possessions from the old family home in Beldover:

The sense of walls, dry, thin, flimsy-seeming walls, and a flimsy flooring, pale with its artificial black edges, was neutralising to the mind. Everything was null to the senses, there was enclosure without substance, for the walls were dry and papery. Where were they standing, on earth, or suspended in some cardboard box?<sup>74</sup>

It is worth noting here the focus on flimsiness and a lack of substance, an idea which is repeated in the paragraphs which follow: the drawing-room is 'Another piece of shut-in air; without weight or substance, only a sense of intolerable papery imprisonment in nothingness' (372-3). *Women in Love* was, of course, published in 1920, one year before Lawrence's reading of that 'simple book on Einstein's Relativity'; in addition, Lawrence's earlier version of this novel, completed in 1916, includes an almost identical description: 'there was a sense of enclosure within an unreal structure, for the walls gave no sense of weight. Where were they standing, on earth, or suspended in some box of sterile nullity?'<sup>75</sup> There definitely seems to be some kind of parallel with the emergent scientific ideas here, but the possible precursor of such a parallel remains unclear and, until further evidence can be collected, we may have to put this down to coincidence. However, such coincidental parallels may help us to explain Lawrence's 1921 claim, to which we will return in the following chapter, that 'Einstein isn't so metaphysically marvellous'.<sup>76</sup>

Our consideration of Lawrence's understanding of Einstein's theories of relativity, especially as offered in his direct explorations thereof in *Fantasia*, certainly suggest that

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74 D. H. Lawrence, *Women in Love*, ed. David Farmer, Lindeth Vasey and John Worthen (Cambridge, 1987), 372.

75 D. H. Lawrence, *The First 'Women in Love'*, ed. John Worthen and Lindeth Vasey (Cambridge, 1998), 341.

76 Lawrence, letter to S. S. Koteliansky dated 16 June 1921, *Letters*, iv, 37.

Lawrence did in fact have a significant grasp of certain aspects of the new physics, a grasp which either came from, or was aided by, his reading of at least one contemporary text dealing with the Einsteinian revolution. This assessment contradicts Lawrence's assertions in the foreword to *Fantasia* that 'I am not a scientist. I am an amateur of amateurs' and that 'I proceed by intuition' (62), but it is worth considering the various other ways in which Lawrence came into contact with early twentieth-century science.<sup>77</sup>

Most importantly in this respect, we must remember that Lawrence was both a student and a teacher of science at the time that he was honing his creative skills and embarking on his literary career. The King's Scholarship Examination which Lawrence sat in December 1904, and for which he was one of the few to be placed in the first division of the first class, consisted of a compulsory course on 'Elementary Physics and Chemistry' plus one option from Chemistry, Astronomy or Biology.<sup>78</sup> Meanwhile, 'Elementary Science was among the subjects which he studied in 1906-7 during his first year at Nottingham University College', the subject having been made compulsory for all trainee elementary school teachers in 1904.<sup>79</sup> Lawrence taught at the Davidson Road School in Croydon from 1908 to 1911 and, according to the testimonial written for him by the headmaster, Philip Smith, while there he 'to a great extent influenced the science teaching of the whole school', leading to this subject being 'highly recommended' by the Board of Education's inspectors.<sup>80</sup>

While preparing for his King's Scholarship Examination, Lawrence seems to have

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<sup>77</sup> Aldous Huxley repeats this idea of Lawrence proceeding 'by an immediate process of intuition', suggesting in reference to Lawrence's 'allotropic states' that 'he was able, as it were, to *feel* the carbon in diamonds and coal, to *taste* the hydrogen and oxygen in his glass of water', Introduction to *The Letters of D. H. Lawrence*, ed. Aldous Huxley (London, 1932), xxiii. While this is clearly an exaggeration, primarily for dramatic effect, it does suggest something about the mindset with which Lawrence was able to approach or avoid science.

<sup>78</sup> See 'The King's Scholarship Examination. Our Scholarships', *The Teacher*, 2/58 (25 March 1905), 280-84; Frank Belton, 'Elementary Science', *The Teacher*, 2/47 (7 January 1905), 6.

<sup>79</sup> C. P. Ravilious, 'Lawrence's "Chladni Figures"', *Notes and Queries*, new ser., 20/9 (1973), 332. See D. M. Turner, *History of Science Teaching in England* (London, 1927), 149; Board of Education, *Regulations for the Training of Teachers and for the Examination of Students in Training Colleges* (London, 1904).

<sup>80</sup> Quoted in Ada Lawrence and G. Stuart Gelder, *Young Lorenzo: Early Life of D. H. Lawrence* (Florence, 1931), 95-6.

taken advantage of the revision aids offered in the weekly periodical *The Teacher*, founded in February 1904. He received one of *The Teacher's* own 'scholarships' following his success in the examination, and entry into this competition required not only the regular purchase of *The Teacher*, but the production of all of the numbers thereof before the prize could be awarded.<sup>81</sup> In his letter to the periodical on receipt of this prize, Lawrence mentions the Elementary Science course as 'Especially valuable' and 'particularly adapted for those who cannot enjoy the benefits of a laboratory'.<sup>82</sup> This latter point ties in with one made repeatedly by Frank Belton, the author of the 'Elementary Science' articles in *The Teacher*: 'success therefore can be obtained only by thoroughly grasping principles, in such a way as to be able to apply them to familiar every-day facts'.<sup>83</sup> Science is here related to everyday facts and experiences, which is perhaps not surprising, but it is also being *applied to* them: the impression here is that the science must be fully understood first and then applied to the world at large. This idea of applying science to everyday life is, I would suggest, the model that Lawrence was following – and, indeed, extending far beyond anything implied in *The Teacher* – in formulating his theory of human relativity, although whether or not the idea originated in his reading of *The Teacher* is obviously impossible to say.

Lawrence's relation to contemporary science is an issue that has been hotly contested since his death in 1930, and which remains controversial today. The only factor on which critics seem to have come to agree is that 'Lawrence evolved a lifelong and

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81 'Six New Scholarships', *The Teacher*, 1/1 (20 February 1904), 15. In the letter I go on to discuss above, Lawrence claims that, having been shown the first issue of this periodical, 'I at once recognised its merits, and ordered one for myself. Needless to say, I have continued to take it ever since', Lawrence, letter to the Editor, *The Teacher* dated ante 25 March 1905, *Letters*, i, 25. The context of this letter, also described above, clearly requires that Lawrence's comments therein should be taken with something of a pinch of salt. However, while critics have repeatedly referred to Lawrence's letter, *The Teacher* itself remains a neglected source in terms of Lawrence's reading and engagement with contemporary ideas, an imbalance which I seek to redress in chapter seven.

82 Lawrence, *Letters*, i, 25-6. Lawrence also mentions the lessons provided in *The Teacher* on Geography and History, Mathematics and English, but he is not alone among the winning candidates in mentioning the Science course as particularly useful. See 'King's Scholarship', 280-84.

83 Belton, 'Elementary Science', 6.

complicated relationship to the science and technology of his day'.<sup>84</sup> It is worth considering some of the complexities of this relationship here, and in particular the various critical approaches that have been used to tackle it. The traditional view is that Lawrence was 'deeply and volubly antagonistic to the scientific reduction of life to mechanism', fiercely rejecting the materialism and logical positivism which traditionally accompany scientific discourse.<sup>85</sup> John Worthen argues that Lawrence 'had quickly discovered that he had on his hands a battle not only against home and Christianity, but against the very philosophy of scientific materialism which had destroyed his Christianity'.<sup>86</sup> Thus science was, in some ways, the greater foe, as it had destroyed Lawrence's Christianity, and yet had not provided him with what he felt to be a viable alternative model to live by. Worthen explains that this ongoing battle 'accounts for the odd fact that Lawrence possessed both a deep distrust of scientific conclusions, and a thoroughly scientific vocabulary'.<sup>87</sup> Meanwhile, Jeff Wallace repeats Aldous Huxley's claim that 'Lawrence's rejection of the aims and methods of science was precisely dependent upon a very thorough understanding of them'.<sup>88</sup>

The combination of an apparent dislike of the world of science with a detailed scientific knowledge and vocabulary has led to the development of a rather different theoretical approach, which paints Lawrence as ambivalent to the scientific ideas of his day. This is the argument that N. Katherine Hayles asserts, although it is rather drawn into question by her misplaced claim that Lawrence was 'essentially ignorant of the New Physics'.<sup>89</sup> Ambivalence does seem to have some value as a means of describing

Lawrence's relationship with science, however; in the foreword to *Fantasia* Lawrence

84 Michael Wutz, 'The Thermodynamics of Gender: Lawrence, Science and Sexism', *Mosaic*, 28/2 (1995), 83. See also, amongst others, Jeff Wallace, *D. H. Lawrence, Science and the Posthuman* (Basingstoke, 2005), 6.

85 Wallace, *Science and the Posthuman*, 6. Indeed, according to Huxley, Lawrence's 'dislike of science was passionate', leading him to declare that 'All scientists are liars', Introduction, xiv-xv.

86 John Worthen, *D. H. Lawrence: The Early Years, 1885-1912* (Cambridge, 1991), 180.

87 *Ibid.* 180-81.

88 Wallace, *Science and the Posthuman*, 18; see Huxley, Introduction, xv.

89 N. Katherine Hayles, 'The Ambivalent Approach: D. H. Lawrence and the New Physics', *Mosaic*, 15/3 (1982), 107. See also chapter three of Hayles's *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century* (Ithaca, 1984), 85-110.

states 'I have nothing to say against our science. It is perfect as far as it goes. But to regard it as exhausting the whole scope of human possibility in knowledge seems to me just puerile' (62). This is perhaps the clearest description of Lawrence's feelings as far as science is concerned: it is not necessarily a dislike of the subject in itself, but of its monopoly over human thought and knowledge in a materialistic and objective sense.

Some of these ideas are well illustrated by the laboratory scene in *The Rainbow* (1915) in which we are introduced to the 'woman doctor of physics', Dr Frankstone.<sup>90</sup> On the surface at least Dr Frankstone seems to provide a negative image of the scientist, apparently refusing to acknowledge that there can be any 'special mystery to life' which science is unable to explain (408), while, as Wallace explains, 'Lawrence's choice of "Frankstone", figuring in a cast of otherwise purely naturalistic names, seems to suggest that science is worthy only of caricature'.<sup>91</sup> However, Michael Whitworth has drawn attention to the fact that 'Dr Frankstone advances her argument as a series of questions', and that 'The conversation had ended on a note of uncertainty, indefinite, wistful' (408).<sup>92</sup> It should also be acknowledged that it is Ursula's scientific work with her microscope that provokes, or at least facilitates, her 'consummation' at this moment, her realisation that, as we have seen Lawrence claim repeatedly, 'To be oneself was a supreme, gleaming triumph of infinity' (409).

The final critical stance towards Lawrence and science, then, involves the suggestion of a more positive relationship, although this is often clarified by some kind of restrictive term, as when Michael Wutz writes that Lawrence 'was *in his own way* also interested, and positively so, in scientific and technological developments'.<sup>93</sup> However, various critics have pointed out his more straightforwardly positive reactions to the new

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90 D. H. Lawrence, *The Rainbow*, ed. Mark Kinkead-Weekes (Cambridge, 1989), 408.

91 Wallace, *Science and the Posthuman*, 2.

92 Michael H. Whitworth, *Einstein's Wake: Relativity, Metaphor, and Modernist Literature* (Oxford, 2001), 125.

93 Wutz, 'Thermodynamics of Gender', 84, my emphasis.

physics introduced by Einstein and others in the early twentieth century. Whitworth suggests that Lawrence 'resembles Conrad in combining a negative valuation of science with an enthusiasm for the new physics and its philosophical consequences', while Wutz states that 'He knew and approved of Einstein's Theory of Relativity because it confirmed his belief in the total interdependent connectedness of the universe'.<sup>94</sup> As William York Tindall explains, then, Einstein 'appealed to Lawrence because he had used the word "relativity," which Lawrence liked, and because he had done so much to destroy the logical universe of the nineteenth century'.<sup>95</sup>

Lawrence's favourable reaction to relativity is expressed in the short poem 'Relativity' (1929) which begins, 'I like relativity and quantum theories / because I don't understand them'.<sup>96</sup> While our investigations to date lead us to question Lawrence's claim to ignorance here, this poem does suggest one of the reasons behind the appeal of relativity to Lawrence, with its vision of space 'refusing to sit still and be measured': although relativity is science, it is not what he calls in *Fantasia* 'a science of the dead world' (62); it does not 'reduce me to the level of a thing' like the scientific doctor in Lawrence's poem of the same name (published posthumously 1932).<sup>97</sup> It is this reductive, mechanistic science which Lawrence repeatedly denounces, as in 'The Crown' (1925):

All absolutes are prison-walls. These 'laws' which science has invented, like conservation of energy, indestructibility of matter, gravitation, the will-to-live, survival of the fittest: and even these absolute facts, like – the earth goes round the sun – or the doubtful atoms, electrons, or ether – they are all prison-walls, unless we realise that we don't know what they mean.<sup>98</sup>

Lawrence likes relativity because, in his understanding at least, it allows the ongoing

<sup>94</sup> Whitworth, *Einstein's Wake*, 124; Wutz, 'Thermodynamics of Gender', 84.

<sup>95</sup> William York Tindall, *D. H. Lawrence & Susan His Cow* (New York, 1939), 31.

<sup>96</sup> *The Complete Poems of D. H. Lawrence*, ed. Vivian de Sola Pinto and Warren Roberts, 2 vols (rev. repr., London, 1967), i, 524.

<sup>97</sup> *Ibid.* i, 524 and ii, 620.

<sup>98</sup> D. H. Lawrence, *Reflections on the Death of a Porcupine and Other Essays*, ed. Michael Herbert (Cambridge, 1988), 287. See also D. H. Lawrence, *Apocalypse and the Writings on Revelation*, ed. Mara Kalnins (Cambridge, 1980), 51-2, and *Lady Chatterley's Lover and A Propos of 'Lady Chatterley's Lover'*, ed. Michael Squires (Cambridge, 1993), 331.

existence of uncertainty while also encouraging the abandonment of restrictive absolutes.

At this point we should pause to consider the extent to which Lawrence really wanted to create a theory of human relativity, a theory which is, at least in part, scientific and which, in its application to individuals and their relationships, could risk reducing us 'to the level of a thing'. The theory of human relativity, as it is introduced in *Fantasia*, is in part a joke, as emphasised by the language which surrounds it:

The stars know how to prowl round one another without much damage done. But you and I, dear reader, in the first conviction that you are me and that I am you, owing to the oneness of mankind, why, we are always falling foul of one another, and chewing each other's fur. (72)

However, Lawrence's opinion on such matters does not remain constant by any means: while in that early letter to Reverend Robert Reid which we considered in the previous chapter Lawrence wanted to know where to find 'the "indestructibility of matter" in humanity', in the passage from 'The Crown' given above this same indestructibility is described as a 'prison-wall'.<sup>99</sup> Meanwhile, in 'The Novel' (1925) Lawrence complains of 'Man handing out absolutes to man, as if we were all books of geometry with axioms, postulates and definitions in front. God with a pair of compasses! Moses with a set-square!'<sup>100</sup> In addition, when explaining 'what I understand of the Einstein theory' in *Fantasia*, Lawrence states 'What I doubt is the equation formula' (190), meaning, as we saw in the previous chapter, the Lorentz Transformations.

And yet Lawrence's theory of human relativity does seem to provide something different from these views of restrictive, mechanical scientific laws; something more dynamic, more mysterious, more alive. And while the tongue-in-cheek nature of Lawrence's assessment of human relationships in *Fantasia* cannot be denied, the fact that we are in 'sad need' of some kind of theory with which to approach and improve these relationships is suggested over and over again by Lawrence's writings as we have seen

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<sup>99</sup> Lawrence, letter to Reverend Robert Reid dated 3 December 1907, *Letters*, i, 41.

<sup>100</sup> Lawrence, *Study of Thomas Hardy*, 184.

(72). There is something creative in relativity for Lawrence: unlike mechanistic science, it is a science of the living, relative, human world.

It is also important to acknowledge that the mysterious nature of relativity in Lawrence's understanding thereof allowed it to fit in with his interest in spiritualism, thus meaning that we can see Lawrence's appropriation of relativity as 'dialogic, open both to spiritualist, Blavatskyan readings, and to scientific ones'.<sup>101</sup> While we do not have the space here to consider this in detail, the general point can be illustrated by one particular instance: in his frequently quoted 1914 letter to Edward Garnett, Lawrence claims that the characters of *The Rainbow* 'fall into the form of some other rhythmic form, like when one draws a fiddle-bow across a fine tray delicately sanded, the sand takes lines unknown'.<sup>102</sup> These lines are known as Chladni figures, and critics have highlighted two possible sources for Lawrence's knowledge thereof: C. P. Ravilious focuses on Lawrence's scientific training and his work as a teacher, while Thomas Gibbons points out that an explanation of these figures, along with various examples thereof, appeared in Annie Besant and C. W. Leadbeater's 1905 occultist work *Thought-Forms*.<sup>103</sup> Taken together these ideas help to emphasise the interest which relativity held for Lawrence: as Michael Black explains, Lawrence saw relativity as capable of helping him in his quest 'to convert the dead fact [of science] into religious feeling by recovering the sense of mystery which ought to attach to over-familiar concepts'.<sup>104</sup>

The idea that relativity could liberate us from the confines of traditional approaches was not exclusive to Lawrence: in 1889 Walter Pater wrote that, in contrast to 'the dominant tendency of life' which turns 'ascertained truth into a dead letter', 'The relative

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<sup>101</sup> Whitworth, *Einstein's Wake*, 152.

<sup>102</sup> Lawrence, letter to Edward Garnett dated 5 June 1914, *Letters*, ii, 184.

<sup>103</sup> Ravilious, 'Lawrence's "Chladni Figures"', 331-2; Thomas Gibbons, "'Allotropic States" and "Fiddle-Bow": D. H. Lawrence's Occult Sources', *Notes and Queries*, new ser., 35/3 (1988), 338-41. See Annie Besant and C. W. Leadbeater, *Thought-Forms* (London, 1905), 27-8.

<sup>104</sup> Michael Black, *D. H. Lawrence: The Early Philosophical Works. A Commentary* (Basingstoke, 1991), 459 n. 12.

spirit ... begets an intellectual *finesse*, of which the ethical result is a delicate and tender justice in the criticism of human life', and such a statement serves to remind us that relativity is not solely an Einsteinian or scientific term.<sup>105</sup> Indeed, as Whitworth writes, 'Einstein's theory of relativity appeared at the end of several decades of philosophical discussion of "relativity", meaning, most frequently, the historical or social relativity of truth'.<sup>106</sup> Christopher Herbert has emphasised the extent to which 'the modern principle of relativity' can be traced back to the nineteenth-century focus on 'the Relativity of Human Knowledge', and highlights 'the intense contagiousness of the relativity hypothesis among late-Victorian intellectuals'.<sup>107</sup> This 'contagiousness' certainly seems to have continued into the twentieth century, and may remind us of Lawrence's statement in *Fantasia* that 'people have got the word Relativity into their heads'.

The existence of such relativistic ideas prior to the emergence of Einstein's own theories of relativity has led Wallace to suggest that Lawrence's theory of human relativity and 'the modes of linguistic and cultural relativism which might inform it, were first impressed upon Lawrence by James's *Pragmatism*' which Lawrence read in 1907.<sup>108</sup> Of course, in these discussions we are moving closer to relativism than to relativity, and this confusion of terms and combining of ideas has been explored by Thomas Glick among others: 'cultural and philosophical relativism antedated relativity but, after 1919, were assumed to have been influenced by it'.<sup>109</sup> Thus, following the announcement of the proof of Einstein's general theory of relativity in November 1919, earlier debates and discussions about relativism were increasingly caught up with and explained by reference to the new scientific concept of relativity. As such, while 'relativity' became what Lawrence called, in

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<sup>105</sup> Walter Pater, *Appreciations with an Essay on Style* (London, 1889), 104-5.

<sup>106</sup> Whitworth, *Einstein's Wake*, 131.

<sup>107</sup> Christopher Herbert, *Victorian Relativity: Radical Thought and Scientific Discovery* (Chicago, 2001), 101, 182.

<sup>108</sup> Wallace, *Science and the Posthuman*, 95; Chambers, *Personal Record*, 113. James's influence on Lawrence will be considered in detail in the following chapter.

<sup>109</sup> Thomas F. Glick, 'Cultural Issues in the Reception of Relativity', in Glick, ed., *Comparative Reception*, 388.

*Fantasia*, a 'catchword' and the 'latest craze', it was in fact, in many cases, being used outside of its scientific context to refer to the earlier concept of relativism, whether cultural, social or historical.

Such confusion between relativity and relativism was widespread; in a paper on 'The Philosophical Side of the Theory of Relativity' delivered to the British Astronomical Association in 1920, J. Gavin Burns concluded that

the metaphysical basis of the Principle of Relativity is that the material world, as we know it, is not an independent entity, as it is regarded in ordinary thought, but is made up of things as they are apprehended by the human mind, so that the mind contributes something to all our perceptions of the material world.<sup>110</sup>

Although Burns recognised that 'This is not the mode of viewing Nature that is adopted in scientific thought .... it is certainly not the method hitherto adopted in physical science', there is nothing here that significantly distinguishes Einstein's theories of relativity from the discussions of the relativity, or relativism, of truth and knowledge which preceded them.<sup>111</sup>

Closely linked to the problems of the misunderstanding and misappropriation of scientific relativity is the difficulty inherent in describing it: as Russell explains, 'Many of the new ideas can be expressed in non-mathematical language, but they are none the less difficult on that account'.<sup>112</sup> Meanwhile, as early as 1919 Eddington had written that 'The main difficulty in giving an account in simple language is that the whole theory is a revolt against "simple language." If the theory is right, simple language involves very confused ideas'; we have already considered this concept in Part I in relation to the conjunctions 'and' and 'or' which, following the development of quantum theory, no longer seemed quite so straightforward.<sup>113</sup> Thus relativity involves changes to both 'our imaginative picture of the

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<sup>110</sup> Reported in 'Meeting of the British Astronomical Association. Wednesday, 1920 May 26', *The Observatory*, 43/554 (July 1920), 253-4.

<sup>111</sup> Ibid. 254, ellipsis in original.

<sup>112</sup> Russell, *ABC of Relativity*, 1.

<sup>113</sup> A. S. Eddington, 'Einstein's Theory of Space and Time', *The Contemporary Review*, 116/648 (December 1919), 640.

world', as we have seen, and our use of language, changes which, while increasing the difficulties inherent in understanding the ideas, may also make them seem more interesting and exciting to the intrigued amateur.

Glick's commentary explores the susceptibility of Einstein's ideas to appropriation by non-scientists, a susceptibility which, he explains,

is related to the paradoxical use of simple, familiar words like time, space, relative and absolute to (ostensibly) describe complex concepts. The everyday meanings of these terms were so broad that, taken together, they constituted an 'open text' which persons of starkly contrasting ideologies could make over to suit their political preconceptions.<sup>114</sup>

Michel Biezunski has discussed the contemporary 'freedom of interpretation of the scientific concepts' as 'perhaps due to the fact that they were not yet accepted within the scientific community', explaining that 'The absence of consensus within the scientific community authorised the use of "semantic slidings"'.<sup>115</sup> While Biezunski's focus is on scientific popularisations, I would argue that the possibility of 'semantic slidings' related to relativity also opened up this area of science to culture as a whole. Literary writers in particular, in that they were working with language itself, took advantage of 'semantic slidings' from relativity into popular culture, pressing, as Gillian Beer writes, 'on the uncontrolled implications of science' and using their understanding, however slight, of relativity theory to authorise new explorations of time, space and relationships in narrative and poetry alike.<sup>116</sup> Even the 'common mistake' of thinking that all is relative, although not condoned in any sense by either Einstein or the theories of relativity themselves, was reinforced by such semantic slidings.

However, Lawrence acknowledges in *Fantasia* that Einstein's relativity, and the popular reaction to it, seems to have provided something different from the cultural relativism previously explored by James and others:

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<sup>114</sup> Glick, 'Cultural Issues', 394.

<sup>115</sup> Michel Biezunski, 'Einstein's Reception in Paris in 1922', in Glick, ed., *Comparative Reception*, 182.

<sup>116</sup> Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 168.

The latest craze is Mr Einstein's Relativity theory. Curious that everybody catches fire at the word Relativity. There must be something in the mere suggestion, which we have been waiting for. But what?  
(190)

Later he adds 'All I know is that people have got the word Relativity into their heads, and catchwords always refer to some latent idea or conception in the popular mind' (190). The suggestion, then, is that although relativity may have existed and been discussed before – may even have been an example of 'a metaphysic that governs men at the time, and is by all men more or less comprehended, and lived' as in the foreword to *Fantasia* (65) – 'Relativity' with a capital 'R' has done something different, is serving some different purpose – 'But what?'

In thinking of Lawrence's relationship with the word 'Relativity' it is helpful to consider Bakhtin's concept of the 'internally persuasive word': this word is 'half-ours and half-someone else's', and 'It is not so much interpreted by us as it is further, that is, freely, developed, applied to new material, new conditions'.<sup>117</sup> In turning Einstein's theories of relativity into a theory of *human* relativity, Lawrence was developing relativity, applying it to human relationships in order to create a humanised and yet still scientific theory, much like James's pragmatism as we will see in the following chapter. Bakhtin explains that

we can take [the internally persuasive word] into new contexts, attach it to new material, put it in a new situation in order to wrest new answers from it, new insights into its meaning, and even wrest from it new words of its *own* (since another's discourse, if productive, gives birth to a new word from us in response).<sup>118</sup>

Lawrence's new word for this context, his response to Einstein's 'Relativity' is, of course, 'human'.

There can be no doubt that Einstein's theories of relativity had a dramatic impact after 1919, in both scientific and wider circles, and Lawrence was, as we have seen, by no

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117 M. M. Bakhtin, *The Dialogic Imagination*, ed. Michael Holquist, trans. Caryl Emerson and Michael Holquist (Austin, 1981), 345.

118 Ibid. 346-7.

means immune to this impact. Indeed, in *Fantasia*, Lawrence combines his understanding of Einstein's theories with his interest in the nature and difficulties of human relationships. He thus, as suggested in the 'Elementary Science' training offered in *The Teacher*, applies scientific relativity to human relationships, creating a new compound term with his theory of human relativity

Einstein's theories of relativity, both taken together and treated separately, demand, as Russell wrote, 'a change in our imaginative picture of the world' and there is, perhaps, no more dramatic change that we can be asked to make. Literature, itself a product of this imaginative picture, could not long remain unaffected by a revolution which, though hailed by *The Times* as a 'Revolution in Science', in fact ultimately entailed what Infeld called 'a revolution in our habits of thinking', a revolution which still forms the basis of our imaginative world picture today.

## Chapter 6

### The Search for 'living relativity':

#### D. H. Lawrence's Writing of Relationships After 1921

As we have seen, D. H. Lawrence's reading of 'a simple book on Einstein's Relativity' in 1921 had a profound impact on the way in which he presented his theories on human relationships in *Fantasia of the Unconscious* (1922), despite the fact that he had already been exploring such relationships in a similar manner in his fictional work since the start of his writing career more than ten years earlier.<sup>1</sup> The word 'relativity' became increasingly important to Lawrence after he read the book sent to him by Samuel Kotliansky, and it appears frequently in his later fictional and non-fictional works as we shall see. But what did relativity really mean for Lawrence? How important was Albert Einstein to his understanding of it? And how did Lawrence use the word and the ideas associated with it in his own writing? In this chapter we will explore these questions in relation to the texts that Lawrence wrote following his first direct acknowledgement of Einstein in 1921. As in chapter four, we will keep in mind throughout Lawrence's claim in *Fantasia* that 'we are in sad need of a theory of human relativity', a theory which, as I argued in the earlier chapter, resonates significantly with Lawrence's writing, including that which was completed before *Fantasia*.<sup>2</sup>

Aside from *Fantasia*, in which, as we have already seen, Lawrence offers a sustained explanation of 'what I understand of the Einstein theory' (190), Lawrence's most prolonged, and perhaps most confusing, explorations of the nature of relatives and absolutes appear in the novel *Kangaroo* (1923), in particular in chapters thirteen

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1 D. H. Lawrence, letter to S. S. Kotliansky dated 4 June 1921, *The Letters of D. H. Lawrence*, ed. James T. Boulton et al., 8 vols (Cambridge, 1979-2000), iv, 23.

2 D. H. Lawrence, *Psychoanalysis and the Unconscious and Fantasia of the Unconscious*, ed. Bruce Steele (Cambridge, 2004), 72.

('“Revenge!” Timotheus Cries') and fourteen ('Bits'). Thus towards the end of the former chapter we read 'Life makes no absolute statement: the true life makes no absolute statement' and, a bit later, 'Life is so wonderful and complex, and *always* relative'.<sup>3</sup> While these claims sound reasonably straightforward (life is relative, not absolute), we soon discover that this formulation will not hold: as Michael Bell has written, 'Lawrence's absolutes are always relative and his relatives are never simply relative'.<sup>4</sup> Thus as Lawrence, or rather Richard Lovatt Somers, moves into his analysis of the Sermon on the Mount with which the chapter ends, we are told that the statement '*Blessed are the pure in heart*' is 'absolute truth, a statement of living relativity' (267). Relativity itself becomes an absolute here, a concept which is emphasised by the phrase 'It depends' which is added to four of the following six further statements from the Sermon on the Mount (268).

However, the chapter ends with something of a comic anti-climax:

After all this terrific upheaval, Richard Lovatt at last gave it up, and went to sleep. A man must even know how to give up his own earnestness, when its hour is over, and not to bother about anything any more, when he's bothered enough. (268)

Somers does continue to bother about these questions in the following chapter, however, which takes place the following day. It is worth quoting this section at length:

'Everything,' said R. to himself, in one of those endless conversations with himself which were his chief delight, 'everything is relative.'  
 And flap he went into the pot of spikenard.  
 'Not quite,' he gasped as he crawled out. 'Let me drag my isolate and absolute individual self out of this mess.'  
 Which is the history of relativity in man. All is relative as we go flop into the ointment: or the treacle or the flame. But as we crawl out, or flutter out with a smell of burning, the *absolute* holds us spellbound. Oh to be isolate and absolute, and breathe clear.  
 So that even relativity is only relative. Relative to the absolute. (280)

This passage starts with the idea of relativity as an absolute, as we saw above, but this idea

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<sup>3</sup> D. H. Lawrence, *Kangaroo*, ed. Bruce Steele (Cambridge, 1994), 267.

<sup>4</sup> Michael Bell, *D. H. Lawrence: Language and Being* (Cambridge, 1992), 149.

is not sustained for long as the human self soon emerges as its own absolute, leaving us at the close of the passage with the opposite idea to that with which we started: 'even relativity is only relative. Relative to the absolute'. As readers, we definitely start to feel that Lawrence is forcing us to go around in circles here, just as he does in 'The Crown' (1925) with its 'two relative absolutes'.<sup>5</sup> Bell has described Lawrence in *Kangaroo* as 'steer[ing] a conscious course between the Scylla and Charybdis of the absolute and the relative', and there is also a definite sense that Lawrence is, so to speak, trying to have his cake and eat it where relatives and absolutes are concerned; after all, making relativity relative in some way also makes it more absolute.<sup>6</sup>

The idea of the self as an absolute to which all else is relative is one which we explored in chapter four in relation to Lawrence's discussions of relativity in *Fantasia*:

I feel inclined to Relativity myself. I think there is no one absolute principle in the universe. I think everything is relative. But I also feel, most strongly, that in itself each individual living creature is absolute: in its own being. And that all things in the universe are just relative to the individual living creature. And that individual living creatures are relative to each other. (191)

This view is summarised in *Kangaroo*: 'No, the self is absolute. It may be relative to everything else in the universe. But to itself it is an absolute' (280). There is, however, a slight difference between these two formulations: while in *Fantasia* 'all things in the universe are just relative to the individual living creature', and those 'individual living creatures' appear to be relative only to each other, in *Kangaroo* it is the self that 'may be relative to everything else in the universe'. This is a significant, if only small, distinction as it makes the absolute of *Kangaroo* seem less absolute than that of *Fantasia*, as emphasised by the 'an' which appears with the second use of 'absolute' in the passage from *Kangaroo*: the absolute nature of the self becomes, in *Kangaroo*, something more internal than in

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<sup>5</sup> D. H. Lawrence, *Reflections on the Death of a Porcupine and Other Essays*, ed. Michael Herbert (Cambridge, 1988), 294.

<sup>6</sup> Bell, *Language and Being*, 149. See Jeff Wallace, *D. H. Lawrence, Science and the Posthuman* (Basingstoke, 2005), 239: 'If all is relative, then relativity is an absolute'.

*Fantasia*, something more liable to alteration by the universe which surrounds it; something more relative.

However, the absolute nature of the individual self, either in the sense provided in *Fantasia* or that in *Kangaroo*, is not, as we saw in chapter four, an automatic given nor a simple achievement. In *Sons and Lovers* (1913) Paul must lose his mother, Clara and Miriam, a process which leaves him 'alone' in a 'void', before he can fundamentally realise himself as 'not nothing'.<sup>7</sup> In Lawrence's later novels, the absolute self of the protagonist is already, or nearly, assured, but the problem remains in the relation between these protagonists and other characters who have not yet achieved this realisation. Thus if we think back to Mark Spilka's comment which we considered in chapter four that 'At the end of *Sons and Lovers* a man is born; at the end of *The Rainbow*, a woman; and in *Women in Love* a man and a woman meet and marry', we can see that the later novels involve a further movement towards a full and meaningful relationship with society as a whole: as Kim Herzinger has explained, 'a self-responsible identity is necessary before true intimacy, the "star-equilibrium," is possible; both of these qualities are necessary before true community is possible'.<sup>8</sup> Thus, having reached 'the full achievement' of the self and, in some cases at least, the full achievement of balanced marriage, characters like Somers in *Kangaroo* and the protagonists of *The Plumed Serpent* (1926) must now seek the full achievement of what we might call community: as Lawrence writes in *Studies in Classic American Literature* (1923), 'The central law of all organic life is that each organism is intrinsically isolate and single in itself. ... But the secondary law of all organic life, is that each organism only lives through contact with other matter'.<sup>9</sup>

This movement towards community involves another stage in Lawrence's proposed

7 D. H. Lawrence, *Sons and Lovers*, ed. Helen Baron and Carl Baron (Cambridge, 1992), 464.

8 Mark Spilka, *The Love Ethic of D. H. Lawrence* (London, 1958), 121; Kim A. Herzinger, *D. H. Lawrence in His Time: 1908-1915* (London, 1982), 90.

9 D. H. Lawrence, *Study of Thomas Hardy and Other Essays*, ed. Bruce Steele (Cambridge, 1985), 12; *Studies in Classic American Literature*, ed. Ezra Greenspan, Lindeth Vasey and John Worthen (Cambridge, 2003), 67.

theory of human relativity, one which highlights a central difficulty in human relationships: while Lawrence's central characters in the later works have achieved, or mostly achieved, the establishment of their own individual and absolute selves, the vast majority of the other characters have not. Thus Somers's realisation in *Kangaroo* that mankind must return to 'the central self, the isolate, absolute self' is tempered by the realisation which immediately follows that 'The bulk of mankind haven't got any central selves: haven't got any. They're all bits' (280). Kate suffers a similar shock of discovery in *The Plumed Serpent*:

She had thought that each individual had a complete self, a complete soul, an accomplished I. And now she realised as plainly as if she had turned into a new being, that this was not so. Men and women had incomplete selves, made up of bits assembled together loosely and somewhat haphazard.<sup>10</sup>

Although Lawrence does not employ the word 'absolute' here, it is clear that this passage represents a similar concept to that in *Kangaroo*, an idea which is emphasised through the references in both to 'bits'. The question in these so-called leadership novels thus becomes that of how to awaken other people to their absolute selves; or, failing that, how to lead them in the appropriate direction.

In *Kangaroo*, Somers is unable to find a way out of either of his realisations described above: for Somers 'the man alone by himself' is 'the beginning and end, the alpha and the omega, the one absolute', and this fact applies 'Whatever your relativity' (281). Even if the problem of the absolute, complete self *is* overcome, Somers identifies another factor which contributes to the problems currently facing mankind, the inability to listen: 'The man by himself – that is the absolute – listening – that is the relativity – for the influx of his fate, or doom. ... But most men can't listen any more' (281-2). The key role given to listening here may remind us of the end of the previous chapter in *Kangaroo*, where life is described as being 'all Call and Answer' (267), an image which Lawrence had already used in a much earlier poem exploring human relationships, 'Bei Hennef' (written 1912,

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<sup>10</sup> D. H. Lawrence, *The Plumed Serpent*, ed. L. D. Clark (Cambridge, 1987), 105.

published posthumously 1932): 'You are the call and I am the answer'.<sup>11</sup> In the ideal model of 'living relativity' as envisaged by Lawrence in *Kangaroo*, then, a man or a woman must be absolute in him or herself and yet always responsive to what is around him or her: the self must be an absolute 'to' (*Kangaroo*, 280), or 'in' (*Fantasia*, 191), itself, but one that is also capable of being relative to both 'everything else in the universe' (*Kangaroo*, 280), and every other 'individual living creature' (*Fantasia*, 191). An absolute that is relative is an obvious contradiction in terms, but that is clearly what Lawrence is asking us to accept in *Kangaroo*.

The mixing and combination of such radically opposed ideas would obviously not have been sanctioned by Einstein. Although his special theory of relativity states that certain measurements, such as time and length, are relative to the frame of reference in which they are measured, the laws of mechanics remain true for all frames. Meanwhile, the speed of light becomes the ultimate absolute in Einstein's formulation, retaining the same value in whichever frame of reference it is measured – unlike Lawrence's, Einstein's absolutes remain absolute throughout.

However, that Lawrence was thinking of Einstein while writing his own theorisation of the nature of relatives and absolutes in *Kangaroo* is suggested by two factors in particular: firstly, we have already seen some of the similarities between Lawrence's explorations in *Kangaroo* and those provided in *Fantasia*, a text in which Einstein is mentioned directly on more than one occasion as we have seen, and which was written in 1921, the year before Lawrence wrote *Kangaroo*. Secondly, Lawrence makes direct reference to Einstein's work on relativity in *Kangaroo*, although on this occasion he does not employ Einstein's name: when Somers first goes to meet and lunch with Kangaroo, the latter 'started a discussion of the much-mooted and at the moment

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<sup>11</sup> *The Complete Poems of D. H. Lawrence*, ed. Vivian de Sola Pinto and Warren Roberts, 2 vols (rev. repr., London, 1967), i, 203.

fashionable Theory of Relativity' (109). Interestingly, we do not actually hear Kangaroo's own contributions to this discussion; instead we read Jack's reflections on the fact that the theory makes us 'all little *Its*, chirping like so many molecules one with another', along with Somers's comment, similar to Lawrence's in *Fantasia*, that 'It needed a Jew to lead us this last step in liberty' (110, see *Fantasia*, 190). Kangaroo's unheard comments gain some significance a little later, however, when Somers reflects on Kangaroo's 'kindly love for real, vulnerable human beings' which 'had given his soul an absolute direction, whatever he said about relativity' (111). Lawrence tells us that the lunch itself 'passed frivolously' and that 'Somers was bored, but he had a shrewd suspicion that the other two men really enjoyed it' (110); however, the choice of relativity as a topic for lunchtime conversation does not seem purely coincidental in the light of the reflections on relatives and absolutes that appear later in the novel.

Despite these direct mentions of Einstein and his theories, critics have questioned the extent to which Einstein takes precedence in Lawrence's thinking of relativity, with some suggesting William James as another possible contemporary source for these ideas, as we saw in the previous chapter.<sup>12</sup> James's influence on Lawrence becomes particularly significant in *Kangaroo* when we consider that William James is the name given to a character in this novel and that, although increasingly referred to as Jaz as the novel continues, as well as very occasionally by his surname, Trehwella, the name William James appears frequently in the text and cannot but remind us of his namesake.

James does indeed write about the interrelatedness of all things in a similar way to Lawrence: 'Loosely speaking, and in general, it may be said that all things cohere and adhere to each other *somehow*'.<sup>13</sup> However, whereas for James *everything* is relative *to us*

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<sup>12</sup> See Jeff Wallace, *D. H. Lawrence, Science and the Posthuman* (Basingstoke, 2005), 95.

<sup>13</sup> William James, *Pragmatism: A New Name for Some Old Ways of Thinking* (London, 1907), 137. As we saw in the previous chapter, Lawrence read this text in 1907 according to Jessie Chambers, *D. H. Lawrence: A Personal Record* (Cambridge, 1980), 113.

in the sense that 'We read the same facts differently', for Lawrence *everything* is relative to the extent that so is *everyone*.<sup>14</sup> The essay 'Aristocracy' (1925) begins 'Everything in the world is relative to everything else. And every living thing is related to every other living thing', and here we have returned to the model from *Fantasia* in which 'individual living creatures are relative to each other', rather than that in *Kangaroo* in which the individual self 'may be relative to everything else in the universe'.<sup>15</sup> Commenting on the lines from 'Aristocracy', Mary Freeman states that 'All Lawrence's writing might justly be regarded as explorations within this premise', and our investigations would suggest that there is some truth in this assessment even though these are not always the terms in which Lawrence's explorations proceed.<sup>16</sup> In addition, while Jeff Wallace claims that Lawrence's theory of human relativity and 'the modes of linguistic and cultural relativism which might inform it, were first impressed upon Lawrence by James's *Pragmatism*', I would argue that Lawrence's formulation of a theory of human relativity owes at least as much to Einstein as it does to James: Einstein's influence can be seen in terms of the content and vocabulary of the theory of human relativity, whereas James's influence may instead be more evident in the actual structure of the idea of a theory of human relativity.<sup>17</sup> James introduces pragmatism to the reader as

a system that will combine both things, the scientific loyalty to facts and willingness to take account of them, the spirit of adaptation and accommodation, in short, but also the old confidence in human values and the resultant spontaneity, whether of the religious or of the romantic type.<sup>18</sup>

Lawrence's *theory* of *human* relativity is trying to provide just this: a scientific and factual formulation of the contemporary situation *as well as* a recognition of the importance of human values – indeed, the theory of human relativity is, to some extent at least, a theory

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<sup>14</sup> James, *Pragmatism*, 246.

<sup>15</sup> Lawrence, *Reflections*, 367.

<sup>16</sup> Mary Freeman, *D. H. Lawrence: A Basic Study of His Ideas* (New York, 1955), 1.

<sup>17</sup> Wallace, *Science and the Posthuman*, 95.

<sup>18</sup> James, *Pragmatism*, 20.

of human values, a theory of humanity.

There is, however, one highly significant way in which Lawrence's explorations of relativity differ from those of both Einstein and James: his use of relativity to explore human relationships, as in that statement in *Fantasia* that 'we are in sad need of a theory of human relativity'; indeed, Lawrence adds that we need such a theory 'much more than the universe does' (72). It goes without saying that Einstein was not concerned with any human implications that his theories may have been perceived to have, but we might anticipate some reflections of this kind from James. And yet James's focus in *Pragmatism* is on the relative nature of *human views of actual reality*: 'What we say about reality thus depends on the perspective into which we throw it. The *that* of it is its own; but the *what* depends on the *which*; and the *which* depends on *us*'.<sup>19</sup> Thus it is reality that is relative, depending for its form on our own views and sensations; the significance of the self lies purely in the effect which it has on our perception of material reality.

Focusing, then, on the human aspect of Lawrence's proposed theory of relativity, and so moving away from both Einstein and James, we can see Lawrence attempting to clarify and work out this theory and the 'sad need' for it in some detail in *Kangaroo*. As such, let us now remind ourselves of the key passage for our purposes from *Fantasia*:

I am I, but also you are you, and we are in sad need of a theory of human relativity. We need it much more than the universe does. The stars know how to prowl round one another without much damage done. But you and I, dear reader, in the first conviction that you are me and that I am you, owing to the oneness of mankind, why, we are always falling foul of one another, and chewing each other's fur. (72)

In *Kangaroo* Lawrence, via Somers, explains that 'love is the greatest thing between human beings', but that 'Man-and-woman love is a disaster nowadays' because of our failure to recognise that 'human love is truly a relative thing, not an absolute. It *cannot* be absolute' (198). And yet Lawrence recognises, starting a new paragraph, that 'the human heart must

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<sup>19</sup> Ibid. 246.

have an absolute', and that this absolute must be 'the God who is the source of all passion' (199). The 'theory of human relativity' is thus necessary in order to abolish absolute love because it is an impossibility, to establish a relative relationship between individual human beings, and to provide us with the absolute which is 'one of the conditions of being human' (199).

The importance of human relationships to Lawrence, in both his personal life and his writings, cannot be overestimated. In August 1927 he wrote to Trigant Burrow, 'I believe as you do – one must use words like believe – that it is our being cut off that is our ailment, and out of this ailment everything bad arises. ... One has no real human relations – that is so devastating'.<sup>20</sup> The final sentence here may remind us of Miriam in *Sons and Lovers* who 'could very rarely get into human relations with anyone' (201), but the problem described here is both better and worse: better in that the focus is on 'real human relations' rather than any human relations, but worse in that in *Sons and Lovers* the failure seemed to be down to Miriam herself, whereas now the difficulty seems to be more widespread and harder to control. The 'devastating' nature of this absence of 'real human relations', the fundamental need to escape this 'cut-offness', is explored in detail within Lawrence's fiction. Thus in *Kangaroo* we are told that 'one cannot live a life of entire loneliness, like a monkey on a stick up and down one's own obstacle. There's got to *be* meeting: even communion' (283), and, later, that man is 'only perfected in his individual being by his groping, pulsing unison with mankind' (302). This may remind us of the image from 'The Captain's Doll' (1923) of people 'stuck up apart, like so many telegraph poles' which we considered in chapter four.<sup>21</sup> Meanwhile, in *Lady Chatterley's Lover* (1928), Mellors states 'For me it's the core to my life: if I have a right relation with a woman', and it is this quest for 'a right relation', either with one woman or with the whole of mankind, which

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<sup>20</sup> Lawrence, letter to Dr Trigant Burrow dated 3 August 1927, *Letters*, vi, 113.

<sup>21</sup> D. H. Lawrence, *The Fox, The Captain's Doll, The Ladybird*, ed. Dieter Mehl (Cambridge, 1992), 115.

dominates Lawrence's explorations of relationships.<sup>22</sup>

Lawrence's focus on relationships as something of vital importance to human individuals has, unsurprisingly, been commented on frequently by critics over the years, with T. S. Eliot writing in 1931 of Lawrence's 'philosophy of human relations and unrelations', and Freeman including a chapter on "Human Relativity"<sup>23</sup> – although without offering any detailed analysis of this phrase – in her 1955 study.<sup>23</sup> Meanwhile Charles Rossman has suggested that 'One idea remained with Lawrence throughout his life: the need for relationship as the means of individual fulfilment'; of course, it is also important to acknowledge the significance of the reverse of this statement: that there is a need for individuality as the means for true fulfilment within a relationship.<sup>24</sup> Thus a balanced relationship is fundamentally important to the emergence of true individuality, while an individual's true individuality enables the development of a balanced relationship.

For this reason, Lawrence repeatedly advocated the need for 'a new sort of relationship, between people', as emphasised by his focus on our 'sad need of a theory of human relativity' in *Fantasia*: Lawrence's novels frequently demonstrate attempts to work out what this new relationship should be like, and his letters confirm that he tackled this problem in his life as well as in his art.<sup>25</sup> However, Lawrence was aware that provoking a change in human relationships would not be an easy task, and in 1926 he wrote to Mabel Dodge Luhan on this subject:

But the habits that are hardest to break down are habits of feeling and consciousness, and above all, habits of relationship. Our habits of emotion go so deep, we almost die before they break: and our habits of relationship have so many cancer-like threads, any one of which will start the whole old thing again – it's a case of *poveri noi!*<sup>26</sup>

<sup>22</sup> D. H. Lawrence, *Lady Chatterley's Lover and A Propos of 'Lady Chatterley's Lover'*, ed. Michael Squires (Cambridge, 1993), 204.

<sup>23</sup> T. S. Eliot, in R. P. Draper, ed., *D. H. Lawrence: The Critical Heritage* (London, 1970), 362; Freeman, *Basic Study*, 144-57.

<sup>24</sup> Charles Rossman, "You are the call and I am the answer": D. H. Lawrence and Women', *The D. H. Lawrence Review*, 8 (1975), 255.

<sup>25</sup> Lawrence, letter to Rolf Gardiner dated 11 October 1926, *Letters*, v, 552.

<sup>26</sup> Lawrence, letter to Mabel Dodge Luhan dated 8 May 1926, *Letters*, v, 471.

These images are, again, particularly relevant to *Lady Chatterley's Lover*, where the song 'the bonds of love are ill to loose' resonates with Connie as she comes to realise just 'how ill to loose they were': 'It was as if thousands and thousands of little roots and threads of consciousness in [Clifford] and her had grown together into a tangled mass, till they could crowd no more, and the plant was dying' (83). Earlier in the novel, Clifford had expressed to Connie his own belief that 'You and I are interwoven in a marriage' alongside a focus on the importance of 'habit' within 'life-long companionship', thus emphasising Connie's growing need to dissolve and break free from this stifling relationship (44).

One of Lawrence's key fictional tools for advocating the need for a new relationship, or a theory of human relativity, is a focus on those elements which he perceives as problematic in relationships as they currently stand; by presenting examples of failing or failed relationships of the old sort, Lawrence encourages us to see both that a new relationship is needed and the way in which it might be possible to achieve it. We have already considered, in chapter four, some of the key problems that Lawrence saw in contemporary relationships, many of which continue to appear in the novels that he published from 1922 onwards. We will continue with an exploration of some of these difficulties in the later fiction, before considering the solutions that Lawrence suggests to us and which, we can imagine, would form part of his longed-for theory of human relativity.

In chapter four, we saw that one of the key problems with the relationships portrayed in the early novels consisted of a sense of the characters, in Michael Black's phrase, 'not being "with" each other', a factor which, I suggested, could be linked to Lawrence's subsequent explorations of general relativity within *Fantasia*.<sup>27</sup> This idea continues to play a significant part in Lawrence's later novels, including *Aaron's Rod*

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<sup>27</sup> Michael Black, *D. H. Lawrence: The Early Fiction. A Commentary* (Basingstoke, 1986), 82.

(1922). Here Aaron's wife and lovers find that he keeps them at a distance: his wife, Lottie, states that 'He kept himself back, always kept himself back, couldn't give himself', and Josephine finds that 'there was a curious cold distance to him, which she could not get across', formulations which may remind us of Clara's reflections on her relationship with Paul in *Sons and Lovers*.<sup>28</sup> On only one occasion does Aaron let his guard down, but when he does so he seems to let it too far down: having found that he and the Marchesa 'understood one another', Aaron walks through the crowded streets 'in a sort of trance or frenzy, whirled away by his evening's experience, and by the woman', only to be robbed by a gang of soldiers (228). Returning to his room following this encounter, Aaron reflects:

I gave myself away: and there was someone ready to snatch what I gave.  
I gave myself away. It is my own fault. I should have been on my guard. I  
should be always on my guard: always, always. With God and the devil  
both, I should be on my guard. Godly or devilish, I should hold fast to  
my reserve and keep on the watch. And if I don't, I deserve what I get.  
(230)

The repetitions here suggest the depth to which this lesson has been learnt, as does the narrator's comment at the end of the chapter that 'Aaron never forgot' (231).

The problems experienced by Aaron in all his relationships with women are representative of the larger questions of relatives and absolutes which we have been considering: when Aaron is absolute in himself he is distant and remote, unable to enter into any kind of balanced relationship with another individual; but when he is relative, when he recognises that sense of mutual understanding with the Marchesa, he gives everything away too quickly. As so often in Lawrence's works, then, the question is one of balance, of the relative relationship between absolutes. This takes us back to the model in *Kangaroo* of 'The man by himself – that is the absolute – listening – that is the relativity'. If the woman can also achieve this absolute self listening relatively then there is hope of achieving the model of call and answer advocated in 'Bei Hennef'. This model is what

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28 D. H. Lawrence, *Aaron's Rod*, ed. Mara Kalnins (Cambridge, 1988), 43, 65.

Lawrence calls, in 'Morality and the Novel' (1925), 'the third thing, which is neither sacrifice nor fight to the death': in this model, as we saw in chapter four, each partner remains 'true to himself, herself, his own manhood, her own womanhood': each is an absolute, yet they achieve 'true relatedness' by recognising their difference.<sup>29</sup> Ramón reflects on this necessary distance between lovers in *The Plumed Serpent*:

Even though I eat the body and drink the blood of Christ, Christ is Christ and I am I, and the gulf is impassable. Though a woman be dearer to a man than his own life, yet he is he and she is she, and the gulf can never close up. (252)

The repeated formulations of the form 'I am I' are reminiscent of *Fantasia's* 'I am I but also you are you', but here that unexpected 'but' has finally been replaced by 'and'. The gap is as important here as the relation, and we are told that 'Any attempt to close it is a violation' (252).

There does, however, seem to be one way in which men and women can meet in this gulf, not bridging it or closing it but meeting in mutual recognition within it: Kate and Cipriano pledge during their Quetzalcoatl marriage ceremony that they will meet 'in the abiding place that is between us for ever' (329). This place is symbolised by the Morning Star which exists between day and night and, as Ramón explains, 'If there be no star, no meeting-ground, no true coming together of man with the woman, into a wholeness, there is no marriage. And if there is no marriage, there is nothing but an agitation' (331).

One of the other relationship problems which we saw in Lawrence's earlier fiction, in particular in *The Trespasser* (1912), was a tendency to fictionalise one's partner, to see them exclusively from one's own frame of reference such that Siegmund 'interpreted [Helena] according to his own idea', while the Siegmund that Helena loves is 'only a projection of her soul'.<sup>30</sup> Seeing one's partner incorrectly is only a short step from failing to see them at all, and in *Aaron's Rod*, Lottie's failure to spot Aaron when he hides in the

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<sup>29</sup> Lawrence, *Study of Thomas Hardy*, 174.

<sup>30</sup> D. H. Lawrence, *The Trespasser*, ed. Elizabeth Mansfield (Cambridge, 1981), 77, 125.

garden at night early in the novel is representative of a greater lack of awareness of, or even interest in, her husband: 'She might have seen him had she looked' (40). The failure to see Aaron here is due to a distinct lack of effort on his wife's part – she has never even tried to see him, and as such the distance between them that we considered above is hardly surprising. Again, there is an earlier precedent for such a failure of sight, in 'Odour of Chrysanthemums' (1914), but whereas there was a sense of hope in the short story that future relationships might be freed from the failed pattern by Elizabeth's realisation, this hope is absent from *Aaron's Rod* where there is no indication that Aaron's wife might start to look for him, either in a physical or a more abstract sense.

Another fatally flawed marriage appears in *Lady Chatterley's Lover*, where one of the key difficulties between Clifford and Connie is their lack of physical intimacy with, and physical awareness of, each other. This becomes particularly clear following Connie's father's discussion with each of them about Connie's 'demi-vierge' status:

[Clifford] wanted to say something, later, to Connie about the demi-vierge business – the half-virgin state of her affairs. But he could not bring himself to it. He was at once too intimate with her, and not intimate enough. He was so very much at one with her, in his mind and hers. But bodily they were non-existent to one another, and neither could bear to drag in the *corpus delicti*. They were so intimate, and utterly out of touch. (18)

In neither case here does this marriage suggest an appropriate balance – Clifford is 'not intimate enough' with Connie in the physical sense, even to the extent that they are physically 'non-existent to each other'; but he is also '*too* intimate' (my emphasis) with her in 'the life of the mind' which Connie rejects during the novel in favour of the 'greater reality' of 'the life of the body' (234). That the two go together is suggested by the final sentence above, where that 'and' in place of the expected 'but' forces us to consider the damage that 'the life of the mind' can do to 'the life of the body'.

A more successful model of a fully functioning marriage is described, although not

actually achieved, in *Kangaroo*. Here Lawrence presents what he calls 'one of the deepest realities in life': 'When a man and woman truly come together, when there is a marriage, then an unconscious, vital connection is established between them, like a throbbing blood-circuit' (163). This connection must be maintained '*inwardly*' and 'Silently', primarily, according to Lawrence, by the man, so that the couple remain in 'unison' (163-4); however, Somers, through what Lawrence calls 'his insistence on "male" activity' betrays this 'inner connection' with his wife, Harriett, thus provoking her to be 'a devil to him' (164).

Clifford Chatterley also describes, although without managing to achieve, a similar marital model: 'Little by little, living together, two people fall into a sort of unison, they vibrate so intricately on one another. That's the real secret of marriage, not sex' (44). The word 'unison' reminds us of the passage from *Kangaroo*, while the vibration of the later passage suggests something like the 'throbbing blood-circuit' of the earlier, as well as some of the formulations in *Fantasia* where a family is described as 'a group of wireless stations, all adjusted to the same, or very much the same vibration' (77).<sup>31</sup> However, in Clifford's model there is no sense of either partner having to work at the maintenance of this relationship: the unison is something into which the partners 'fall' rather than something that is 'established between them'. The irony of Clifford's statement, and the extent to which his marriage with Connie fails to live up to his apparently preferred model, is further highlighted by the exchange of dialogue which follows it, in which Clifford expresses various convictions about Connie's behaviour if she were to conceive a child by another man: 'You just wouldn't let the wrong sort of fellow touch you' he says (44); 'You cared for me. I don't believe you'd ever care for a man who was purely antipathetic to me. Your rhythm wouldn't let you' (45). Connie, meanwhile, reflects on the fact that Michaelis 'was

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<sup>31</sup> Lawrence's idea of people vibrating to each other was an early one: see Lawrence's letter to Blanche Jennings dated 30 July-3 August 1908: 'Various folk vibrate to various frequencies, tones, whatever you like', *Letters*, i, 66. It is also worth noting the scientific, or at least pseudo-scientific, nature of images of this kind.

absolutely Clifford's idea of the wrong sort of fellow' and, we may add, Mellors, by whom Connie does in fact conceive a child later in the novel, is even more so (44). Following Clifford's comment on her 'rhythm', Connie remains silent while the narrator explains, clearly from Connie's point of view, that 'Logic might be unanswerable, because it was so absolutely wrong' (45). That this couple are out of synch, so to speak, is left in absolutely no doubt here.

The true coming together, or 'marriage', of a man and a woman which Lawrence writes of in *Kangaroo* is, of course, only achieved by Connie and Mellors in *Lady Chatterley's Lover*, and the sense that this is meant to be perceived as a marriage by the reader is emphasised by the physical marriage between John Thomas and Lady Jane. The depth of Connie and Mellors's togetherness becomes particularly clear following their argument on the first night that Connie spends in the cottage: in a simple phrase which may remind us of that moment of intimacy between Paul and Miriam in *Sons and Lovers* which we considered in chapter four – 'Miriam turned to him. He answered. They were together' (203) – we read 'And there he held her, and there she remained' (207). This sentence is perfectly balanced, with the same number of syllables in each clause, and suggests a similar balance between the two characters now that their quarrel is over. As the pair comfort each other, Mellors suggests 'Let's be together', provoking Connie to ask 'Do you really want to be together with me?' to which, after a pause, Mellors answers 'Let's be together! Let's be together on oath' (208). Connie's phrase 'together with me' suggests an even greater level of intimacy between the two, a true togetherness of the kind which Lawrence's writings indicate is necessary despite being difficult to achieve.

But for us as readers, the question remains: if this is the ideal model of a true 'marriage', in Lawrence's sense of the word, how are we to achieve it? What is the 'theory of human relativity' that will enable us to be together with each other in such a fulfilling

way? John Middleton Murry wrote of Lawrence in 1922 as 'a man who has experimented deeply and sincerely with human relationship in the determination to find some bedrock on which to build', adding that he has now 'found what he sought' and, in *Aaron's Rod*, expresses it 'plainly and persuasively'.<sup>32</sup> Murry's contention that in *Aaron's Rod* Lawrence 'is tackling a real problem and offering a real solution' is a useful one, and it is to this novel that we will now turn for some answers.<sup>33</sup>

The most important point about relationships that is made repeatedly in *Aaron's Rod* is one which we discussed in chapter four but one which, in those earlier novels, was often implicitly rather than explicitly stated: in *Aaron's Rod*, however, as in *Fantasia* and *Kangaroo*, we are left in no doubt that the most important element of a successful relationship is a successful individuality. This idea is primarily embodied by the Lawrence character within the novel, Rawdon Lilly, who repeats it first to Jim Bricknell and a little later to Aaron himself. Thus Lilly tells Jim, 'You shouldn't want to abandon yourself. You shouldn't want to fling yourself all loose into a woman's lap. You should stand by yourself and learn to *be* by yourself' (81), while Lilly and Aaron concur in 'hat[ing] married people who are two in one – stuck together like two jujube lozenges' (91). Lilly continues:

Everybody ought to stand by themselves, in the first place – men and women as well. They can come together, in the second place, if they like. But nothing is any good unless each one stands alone, intrinsically.  
(91)

This is an absolute model of the self which requires complete independence and individuality before any relationship can be achieved, and the importance of this idea is emphasised by that 'nothing' in the final sentence above, the lack of any further defining term suggesting that it is not only relationships that will suffer through the absence of the absolute self.<sup>34</sup>

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<sup>32</sup> John Middleton Murry, in Draper, ed., *Critical Heritage*, 179.

<sup>33</sup> Ibid.

<sup>34</sup> In a similar formulation in *The Plumed Serpent* Ramón reflects that 'If there is no honourable meeting of man with woman and woman with man, there is no good thing come to pass' (331).

Although Aaron expresses his agreement with Lilly's view of the importance of an individual's individuality even, or rather especially, within a relationship, he still finds himself having to work through these ideas as the novel progresses: 'Let there be clean and pure division first, perfected singleness. That is the only way to final, living unison: through sheer, finished singleness' (128). The concept of a 'perfected' absolute self is, perhaps, clearer here than in any other of Lawrence's fictional writings, as is the idea that one must work to establish this self before one can hope to develop a relationship. What is more, as Aaron discovers for himself when he reflects on his failed marriage later in the novel, once one embarks on a relationship with this new 'finished' self, one must 'Give thyself, but give thyself not away' (165), a lesson which is later reinforced by the incident with the soldiers which we have already considered. The two absolute selves of the couple must remain intact within the relationship that they establish, not melt themselves into that all-consuming 'bonfire of oneness' which is rejected in the poem 'Wedlock' (1917).<sup>35</sup>

The requirement for the meeting of two absolute selves in a true relationship, or what Lawrence would call a 'marriage', creates a sense of dualism, as in the two stars or 'two poles ... two angels ... two demons' of the balanced relationship which Birkin seeks to achieve with Ursula in *Women in Love* (1920).<sup>36</sup> But the key point about Lawrence's balanced opposites is that they in fact exist together within a complementary model involving an inclusive 'and', much like that which we considered in relation to Virginia Woolf in Part I. Thus a man and a woman exist together in a relationship not as a 'bonfire of oneness', but rather as an individual man and an individual woman meeting as two complementary opposites, an image which has been described by H. M. Daleski as we saw at the end of Part I:

what distinguishes Lawrence's position from most dualist philosophies is

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<sup>35</sup> Lawrence, *Poems*, i, 245.

<sup>36</sup> D. H. Lawrence, *Women in Love*, ed. David Farmer, Lindeth Vasey and John Worthen (Cambridge, 1987), 148, 199.

his insistence that the contending forces must retain their separate identities. The new whole which is created by establishing a relation between the opposites is not a fusing of the two into one but a complementing of the one by the other; and the relation itself is the only absolute Lawrence is prepared to acknowledge.<sup>37</sup>

While we have already had cause to question the nature of Lawrence's absolutes, it is certainly true that relationship is of vital importance to him, as we have seen: the meeting of two absolute selves in this complementary manner, then, perhaps provides something like that concept which we have already considered from *Kangaroo*: 'absolute truth, a statement of living relativity'.

True complementarity between two individuals, however, is only achieved via a perfect, perhaps absolute, balance between them; Birkin attempts to create something like this in *Women in Love* (1920) with his model of 'an equilibrium, a pure balance of two single beings:— as the stars balance each other' (148), although, as Rossman has suggested, this model in practice 'assumes that both "stars" orbit in a path that the male selects'.<sup>38</sup> In Lawrence's later novels we are instead looking for what Daleski calls 'a meeting on equal terms of two people who have themselves achieved full individuality and transcend their duality in the balance that is attained between them'.<sup>39</sup>

Such a balance is theorised by Lilly in *Aaron's Rod* in terms which may remind us of Birkin's 'freedom together' in *Women in Love* (132). Indeed, Gerald Doherty has described Lilly's views on marriage as 'a non-figurative recapitulation of Birkin's twin-star polarity'.<sup>40</sup>

I'm learning to possess my soul in patience and in peace, and I know it.  
And it isn't a negative Nirvana either. And if Tanny possesses her own  
soul in patience and peace as well – and if in this we understand each  
other at last – then there we are, together and apart at the same time, and

37 H. M. Daleski, *The Forked Flame: A Study of D. H. Lawrence* (London, 1965), 21-2.

38 Rossman, 'D. H. Lawrence and Women', 281. Likewise, the model of a couple meeting in the Morning Star in *The Plumed Serpent*, which at first seems equally balanced, is later undermined to an extent by the revelation that 'man is the Morning Star. / And woman is the Star of Evening' (340).

39 Daleski, *Forked Flame*, 24.

40 Gerald Doherty, 'A Question of Gravity: The Erotics of Identification in *Women in Love*', *The D. H. Lawrence Review*, 29/2 (2000), 32.

free of each other, and eternally inseparable. I have my Nirvana – and I have it all to myself. But more than that. It coincides with her Nirvana.  
(104)

The pairing of apparently incompatible opposites here is, again, reminiscent of some of the ideas that we explored in relation to Woolf in Part I: the ideal is to be 'together *and* apart *at the same time*', to be 'free of each other, *and* eternally inseparable' (my emphases). Only by fully knowing oneself, and by allowing one's partner to also fully know themselves, can true balance be achieved, allowing the two selves to 'coincide' within a complementary model.

Later in the novel, once Aaron has 'accepted his loneliness or single-ness as a fulfilment, a state of fulfilment' (166), the narrator, from Aaron's point of view, suggests a new, more equal and balanced model that will replace Birkin's 'star-equilibrium':

Two eagles in mid-air, maybe, like Whitman's 'Dalliance of Eagles.' Two eagles in mid-air, grappling, whirling, coming to their intensification of love-oneness there in mid-air. In mid-air the love consummation. But all the time each lifted on its own wings: each bearing itself up on its own wings at every moment of the mid-air love consummation. That is the splendid love-way.  
(166-7)

In this model the eagles are, in Lilly's phrase, 'together and apart at the same time': they meet together to consummate their love in mid-air, but each supports itself in that location 'on its own wings' and is thus unable to forget itself or give itself away. In Lawrence's formulation, the two distinct eagles are present 'all the time', despite that reference to 'love-oneness', and the same is true in Walt Whitman's poem on which this idea is based, 'The Dalliance of the Eagles' (1855): here we are reminded that the 'swirling mass' consists of 'Four beating wings, two beaks' and that the two eagles are 'twain yet one'.<sup>41</sup> However, there is still a slight sense of loss of individuality in Whitman's image, which we only really become aware of at the end of the poem when the two eagles separate:

then parting, talons loosing,  
Upward again on slow-firm pinions slanting, their separate diverse flight,

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<sup>41</sup> Walt Whitman, *Leaves of Grass*, ed. Jerome Loving (Oxford, 1990), 216.

She hers, he his, pursuing.<sup>42</sup>

The final separation here is emphasised by the use of those commas in the final line, and we realise at this point that there is a sense in which the earlier 'swirling mass' of four wings and two beaks resembles one strange creature, rather than the very distinct two eagles of which Lawrence writes.

The mutuality of balanced relationships is also theorised particularly clearly in *Kangaroo*, where Kangaroo states 'I believe the sun's attraction for the earth is a form of love', an idea which Somers immediately counters with the question 'Then why doesn't the earth fly into the sun?' (133-4). Kangaroo explains:

Love is mutual. Each attracts the other. But in natural love each tries at the same time to withhold the other, to keep the other true to its own beloved nature. ... The earth and sun, on their plane, have discovered a perfect equilibrium. But man has not yet begun. (134)

This model is based on gravitation, as in Doherty's analysis which we considered in chapter four, and despite the differences which we know to exist between the earth and the sun there is no hint at an inequality here of the kind that Rossman sees in Birkin's orbiting stars: love is, says Kangaroo, 'mutual', and the ideal that we must try to attain is 'a perfect equilibrium'. Thus the earth and the sun, like the two eagles, are equal: both are absolute, but neither is more absolute than the other, neither should relinquish any of its absolute nature to the other – they are equally absolute, equally balanced and, therefore, equally relative, existing within that 'living relativity' which Lawrence praises in *Kangaroo*. In practice, the mutuality of love becomes clear in *Lady Chatterley's Lover* when Mellors realises that 'There must be a coming together on both sides. And if she wasn't coming to him, he wouldn't track her down. He mustn't. He must go away, till she came' (145-6). The

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<sup>42</sup> Ibid. It is also worth noting that the distinct genders of the two eagles only appear in the last line of Whitman's poem, quoted above, while in *Aaron's Rod* no distinction is made. The reference to Whitman as well as the absence of pronouns suggest that Lawrence may be imagining a same-sex relationship here, an idea which is reinforced by the repeated references to the lily in the section which precedes that on the eagles, reminding us of the character Rawdon Lilly despite the fact that the lily itself is referred to as 'she' throughout (166).

idea of a mutual 'coming together' here is clear; and yet the difficulties inherent in achieving such a balanced relationship are emphasised by that last sentence, in which the burden of approach seems to be placed on Connie. At this point Mellors may mean that Connie needs to come to meet him halfway, as Kate wishes Cipriano to do in *The Plumed Serpent*: 'I want a man who will come half way, just half way, to meet me' (271). However, the following paragraph in *Lady Chatterley's Lover* complicates this further: 'She must come to him: it was no use his trailing after her. No use!' (146). This does not sound mutual or equal, but the fact that the couple do indeed meet halfway between Wragby Hall and Mellors's cottage on the first night that Connie spends in the latter suggests that they do manage to achieve the 'coming together on both sides' for which Mellors initially hopes.<sup>43</sup>

As we move back towards Albert Einstein and his theories of relativity we can see that although they do not often appear directly in Lawrence's writings, the repeated references to both Einstein and relativity in *Fantasia of the Unconscious* suggest that Lawrence was tackling Einstein's science head on in this text in terms of the human implications which he perceived it to have. These human implications are foregrounded in *Kangaroo* with its frequent references to relatives and absolutes in discussions of human relationships. However, it cannot be denied that the scientific ideas within Lawrence's novels are, usually, implicit, unlike the direct and explicit references to the science of relativity which appear in *Fantasia*.

And yet Lawrence's engagement with Einstein's theories is by no means straightforward: Lawrence does not mention relativity just for the sake of it, as so many other writers did in the period following 1919: Lawrence *uses* relativity, taking Einstein's ideas one step further into the realm that interested him most – human relationships.<sup>44</sup> As

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<sup>43</sup> In *The Plumed Serpent* Ramón reflects on these difficulties in his reply to Kate's desire above: 'in these matters, one never knows what is half way, nor where it is' (271).

<sup>44</sup> Contrast Lawrence's references to Einstein and relativity with, for example, Rose Macaulay's in *Potterism: A Tragi-Farcical Tract* (London, 1920), 231-2.

we have seen, Lawrence's scientific training facilitated his surprisingly accurate understanding of Einstein's theories of relativity, while his ability to make other people's thoughts his own enabled him to extend and redefine them in terms of his own personal preoccupations. Thus although Lawrence ultimately falls into the 'common mistake' outlined by A. S. Eddington, stating 'I feel inclined to Relativity myself. I think there is no one absolute principle in the universe. I think everything is relative', Lawrence's engagement with relativity in *Fantasia* portrays a rather different approach to that employed by many of his contemporaries, a fact which perhaps explains his omission from many studies addressing the links between modernist literature and contemporary physics.<sup>45</sup> Indeed, this idea can be emphasised by a consideration of the range of responses to Charles Darwin's *On the Origin of Species* (1859) as explored by Morse Peckham:

those who totally rejected it; those who completely misunderstood it; those who incorporated it into their existing set of attitudes by misinterpreting it; and finally those who understood it and subjected their personal cultures to a complete restructuring.<sup>46</sup>

In order to explain Lawrence's response to Einstein's theories of relativity we need a new category: although his response has elements of categories three and four above, Lawrence also does something different, restructuring Einstein's theories in order to enable him to develop his thoughts further in the direction in which they were already moving. Thus while Alan Friedman and Carol Donley describe Einstein as a provider of laws for scientists, contrasting this with his role as 'a muse for artists and writers' in which he was 'a provider of potent images and ideas, not a giver of laws', we can see that Lawrence was in fact stimulated by Einstein to re-imagine *his own laws*.<sup>47</sup>

Thus for Lawrence, as Lee Calcraft has written of Lawrence Durrell in *The Alexandria Quartet* (1962), Einstein's theories provide 'a source of literary metaphors for

<sup>45</sup> A. S. Eddington, *The Nature of the Physical World* (Cambridge, 1928), 23. Lawrence is not included in Alan Friedman and Carol Donley's *Einstein as Myth and Muse* (Cambridge, 1985), nor in Thomas Vargish and Delo Mook's *Inside Modernism: Relativity Theory, Cubism, Narrative* (New Haven, 1999).

<sup>46</sup> Morse Peckham, 'Darwinism and Darwinisticism', *Victorian Studies*, 3/1 (1959), 33.

<sup>47</sup> Friedman and Donley, *Myth and Muse*, 88.

the treatment of interpersonal relationships and human perception' and, again like Durrell, Lawrence has in turn provided 'a fairly loose translation of aspects of these scientific theories into the human idiom'.<sup>48</sup> Rather than 'debunk[ing]' the theory of relativity 'by appropriating its language' as Fiona Becket has suggested, then, Lawrence uses Einstein's theories, appropriating their language in order to create a new theory of his own.<sup>49</sup>

Reading about Einstein, and writing about him in *Fantasia*, certainly seems to have had an effect on Lawrence; and yet writing to Koteliansky after reading that 'simple book on Einstein's Relativity' in June 1921 Lawrence stated 'Einstein isn't so metaphysically marvellous'.<sup>50</sup> As we saw in chapter four, Lawrence's concept of a 'metaphysic' as opposed to a 'pseudo-philosophy' or 'pollyanalytics' is, like so many Lawrencian terms, by no means unambiguous, but the foreword to *Fantasia* suggests that Lawrence saw a metaphysic as something like a Kuhnian paradigm, something 'that governs men at the time, and is by all men more or less comprehended, and lived' (65). Although the number of references that Lawrence makes to relatives and absolutes increases, especially in the early 1920s, Lawrence's writing of relationships after reading Einstein and after writing *Fantasia* is not drastically different from his writing of them in the early novels that we considered in chapter four.<sup>51</sup> Thus Lawrence was already moving in the direction suggested to him by Einstein's ideas before he had read about them and before they were widely known; 'Einstein isn't so metaphysically marvellous' for Lawrence in his apparent revelation of the

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48 Lee Calcraft, 'Einstein and Relativity Theory in Modern Literature', in Maurice Goldsmith, Alan Mackay and James Woudhuysen, eds., *Einstein: The First Hundred Years* (Oxford, 1980), 176.

49 Fiona Becket, *D. H. Lawrence: The Thinker as Poet* (Basingstoke, 1997), 43.

50 Lawrence, letter to S. S. Koteliansky dated 16 June 1921, *Letters*, iv, 37. Note that Bertrand Russell makes a similar point in *The ABC of Relativity* (London, 1926), 219: 'The philosophical consequences of relativity are neither so great nor so startling as is sometimes thought'.

51 While it certainly would not be true to say that words like 'relative' and, in particular, 'absolute' do not appear in Lawrence's works prior to 1921 – indeed, in chapter four we considered Will's development of an absolute in addition to a relative self in *The Rainbow* (1915) – the increased frequency and centrality with which such terms appear in *Fantasia* and *Kangaroo* in particular, as demonstrated by the numerous examples considered here, suggest a significant change in Lawrence's choice of language for the expression of such ideas. This is emphasised by his employment in *Mr Noon* (written during the early 1920s, published posthumously 1984) of two alternative words for the same meaning: 'the universal ideals and morals were after all only local and temporal', D. H. Lawrence, *Mr Noon*, ed. Lindeth Vasey (Cambridge, 1984), 108.

relatedness of all things because Lawrence was already aware of something similar, and Lawrence's reading of William James seems to have played a part in this awareness. In terms of the way in which we live our lives everyday, in terms of 'the religion, the philosophy, if you like, of life' to which Lawrence referred in his 1911 letter on Stendhal which we considered in chapter four, Einstein has not changed anything for Lawrence; rather, in many ways they both seem to have been departing from the same metaphysical basis.<sup>52</sup> In addition, Lawrence seems to have already had some understanding or awareness of the ideas behind Einstein's theories before reading up on them, as we saw in the previous chapter in relation to motion and rest in 'Study of Thomas Hardy' (written 1914, published posthumously 1936). However, Lawrence did admit in that letter to Koteliansky that he liked Einstein 'for taking out the pin which fixed down our fluttering little physical universe', an idea which is repeated in *Fantasia*, where Einstein is seen to have 'knock[ed] that eternal axis out of the universe', enabling it to escape 'from the pin which was pushed through it, like an impaled fly vainly buzzing', an action which means, states Lawrence, that 'we can hope also to escape' (72).<sup>53</sup>

And yet there *is* a significant difference between Lawrence's writings pre- and post-Einstein that goes deeper than the simple adoption of the latest 'catchword', as Lawrence calls it in *Fantasia* (190). Einstein, in conjunction with James, seems to provide Lawrence not only with a new language with which to express the nature of human relationships, but also with a whole theoretical framework on which to plot them. Lawrence's 'theory of human relativity', although only a passing phrase in *Fantasia*, is worked out in some detail both in that text and in those novels which follow it, in particular those that are its near contemporaries, *Aaron's Rod* and *Kangaroo*. Lawrence was certainly already moving in this direction before he read about Einstein, as I demonstrated in chapter four, but that

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<sup>52</sup> Lawrence, letter to Louie Burrows dated 28 April 1911, *Letters*, i, 262.

<sup>53</sup> *Letters*, iv, 37.

reading seems to have acted as a catalyst, increasing the extent to which Lawrence was willing to theorise the relatedness of human individuals, as well as providing the terminology of absolutes and relatives with which he would do so.

As we have seen, the most important aspect of Lawrence's theory of human relativity is the absolute nature of the self within it, a concept which becomes increasingly important, as well as increasingly well realised, in the post-1922 novels. The absolute self is of primary importance to Lawrence, with any relationship having to remain in second place, even though it is only this relationship which will ultimately fulfil the perfected self. There must be absolute individuality *as well as* the perfected balance of relationship, a fact which leads Connie Chatterley to suggest 'Perhaps only people who are capable of real togetherness have that look of being alone in the universe' (271), a formulation which reminds us of her earlier concept of being together with each other. Lawrence's theory of human relativity is thus ultimately a theory of absolute selves, a theory of invariants, just like Einstein's preferred title for relativity theory, *Invariantentheorie*. Gerald Holton has suggested that when writers include science in their work 'it is futile to judge whether the traces of modern physics are good physics or bad, for these trace elements have been used in the making of a new alloy'.<sup>54</sup> The new alloy which Lawrence created, combining what he had read of Einstein with what he had read by James along with his own ideas on human relationships, is his 'theory of human relativity'.

But before we conclude it is important to recognise that there was not just one relativity for Lawrence: in the poem 'Give Us Gods' (1929) Lawrence writes that 'the father of all things swims in a mist of atoms / electrons and energies, quantum and relativities', while in *Kangaroo* he explains that '*Whatever* your relativity, that's the starting point and the finishing point: a man alone with his own soul: and the dark God beyond him' (281, my

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<sup>54</sup> Gerald Holton, *Einstein, History, and Other Passions: The Rebellion Against Science at the End of the Twentieth Century* (Cambridge, Massachusetts, 2000), 137.

emphasis).<sup>55</sup> Lawrence's theory of human relativity is, then, just one kind of relativity, one way of formulating and thinking about this concept: it is not designed to supplant the scientific theories, but rather to aid us in our understanding of modern human relationships by extending these scientific ideas into a different – and, for Lawrence at least, more important – realm. One of the key forms that relativity can take for Lawrence seems to be the 'living relativity' to which he refers more than once in *Kangaroo*, a relativity which is itself relative as it calls, listens and answers. Lawrence's theory of human relativity would be an example of living relativity, in that it concerns itself with the relations between living beings, with the humankind which has, in *Kangaroo*, 'fallen out of living relativity, on to the teeming absolute of the dust-heap, or the ant-heap' (282).

It is also important to remember that, as we saw in the previous chapter, Lawrence's theories and approaches to the world were by no means always consistent. Thus while *Kangaroo* sees Lawrence stating that 'the human heart must have an absolute', the 1925 essay 'The Novel' offers the opposite assertion, that 'For man there is neither absolute nor absolutism': 'Damn all absolutes. Oh damn, damn, damn all absolutes!'<sup>56</sup> Black comments on Lawrence's two versions of 'The Crown' in this regard: in the 1915 version Lawrence writes 'We know we are never purely relative', while in the 1925 version he changes this to 'We know that in the process of life we are purely relative'; Black states that these differences are 'a natural part of [Lawrence's] relativity', but they are clearly also a reminder that we need to take great care when attempting to determine any consistent metaphysic or pollyanalytics with which to approach Lawrence's works.<sup>57</sup>

As we saw in chapter four, Keith Cushman has suggested that each of Lawrence's works 'whether expository or purely imaginative, as it succeeds its predecessor is an

<sup>55</sup> Lawrence, *Poems*, i, 438.

<sup>56</sup> Lawrence, *Study of Thomas Hardy*, 184.

<sup>57</sup> Michael Black, *D. H. Lawrence: The Early Philosophical Works. A Commentary* (Basingstoke, 1991), 346. See Lawrence, *Reflections*, 263-4 and 469; a note to the former pages states that the typist of the 1925 version of 'The Crown' 'left out the "never" in "never purely relative"', leading [Lawrence] to make at least some of these changes', 418 n.

attempt to explore and annex new territory. Each new territory then provides a starting point for further exploration': each of Lawrence's works, then, develops out of its predecessor, commenting on, questioning and developing it in an attempt to either take the ideas further or to adapt them to suit Lawrence's latest thinking.<sup>58</sup> Lawrence's writing of and interest in human relationships in his earliest works are thus brought into a creative dialogue with his more recent interest in Einstein's theories of relativity in the 1920s, leading to the emergence of the idea of a theory of human relativity in *Fantasia*. This in turn leads to further explorations of the nature of human relationships using Lawrence's new language of relatives and absolutes, in particular in *Kangaroo*; and later, with the theory fully worked out and explored, Lawrence is able to drop this language, as he does in *Lady Chatterley's Lover*, even though the same concepts continue to appear.

As with so many of Lawrence's ideas, we may not, finally, be certain as to what it is exactly that he means by these repeated references to relativity and by his creation of the new compound terms 'a theory of human relativity' and 'living relativity'. However, the urgency of his suggestions, initially in *Fantasia of the Unconscious*, and subsequently in his fiction, in particular *Aaron's Rod* and *Kangaroo*, means that we cannot ignore these ideas even if we do not fully understand them. Learning about Einstein's theories of relativity seems to have suggested to Lawrence the pressing necessity for a theory of human relativity to match them, a theory which would encourage us to develop our own absolute individuality, as well as to learn how to be 'together and apart at the same time', like Lilly and Tanny; together with each other, like Connie and Mellors. The idea of exploring human relationships in such a way may not have been new to Lawrence in the early 1920s, but the idea of developing a complete theoretical framework and terminology with which to do so certainly was. Lawrence leaves us in no doubt in *Fantasia* that 'we are

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<sup>58</sup> Keith Cushman, *D. H. Lawrence at Work: The Emergence of the 'Prussian Officer' Stories* (Charlottesville, 1978), 23.

in sad need of a theory of human relativity', and that 'We need it much more than the universe does'; his subsequent writings leave us in no doubt that Lawrence will do his utmost to provide us with such a theory.

## Part III

### Brownian Motion and Crowds

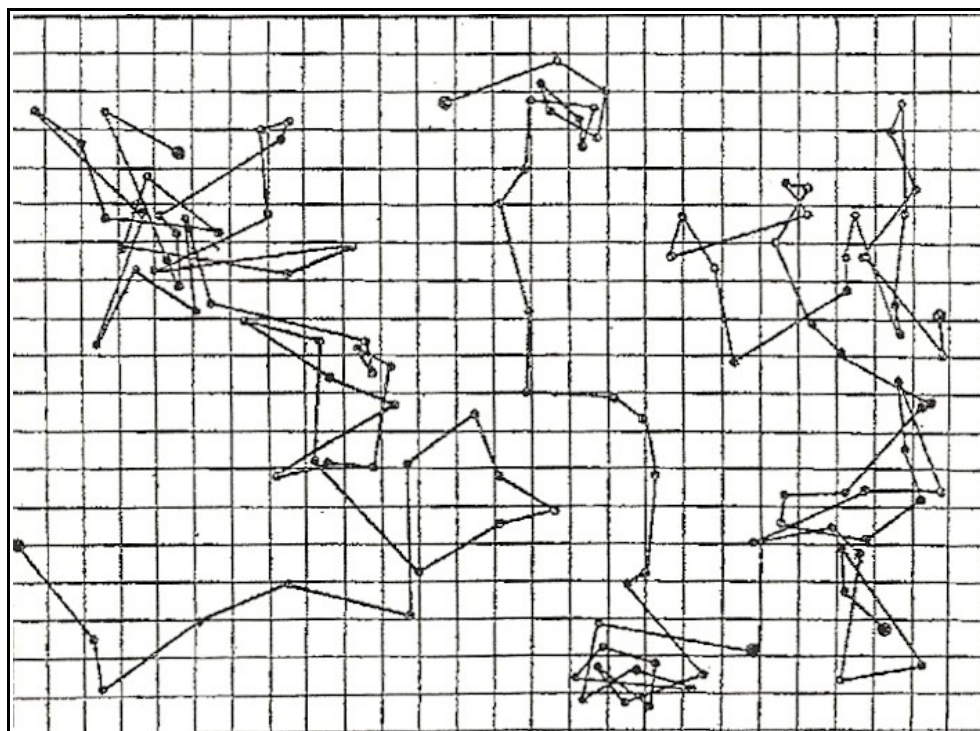


Figure 1. Brownian motion in action: 'three drawings obtained by tracing the segments which join the consecutive positions of the same granules of mastic at intervals of thirty seconds'.

Jean Perrin, *Brownian Movement and Molecular Reality*, trans. F. Soddy (London, 1910), 63-4.

## Chapter 7

### **Brownian Motion and Crowd Psychology:**

#### **Shared Moment, Shared Discourse**

The second paper that Albert Einstein published during his *annus mirabilis*, 'On the Movement of Small Particles Suspended in Stationary Liquids Required by the Molecular-Kinetic Theory of Heat', is perhaps the least well-known of his 1905 papers outside of the scientific community, yet it was no less revolutionary than the other two in its content and style. Along with four other papers published by Einstein over the following three years, it tackled a problem that scientists had been trying to solve for nearly a century: what causes the movements of particles suspended in a fluid which are known as Brownian motion? Approaching this problem from the perspective of the kinetic theory of heat, Einstein focused on fluctuation phenomena and probability theory, and in so doing he paved the way for the definitive proof and the gradual acceptance of the physical existence of atoms.

Meanwhile, the late nineteenth and early twentieth centuries saw an increasing focus on the nature and psychology of the human crowd, starting with the publication of Gustave Le Bon's *Psychologie des foules* in 1895 (translated into English as *The Crowd* in 1897). As we will see in this chapter, striking similarities can be found between the language used by physicists and by psychologists in order to describe the large masses on which they were focusing, resemblances which suggest a broader contemporary focus on such issues than has previously been highlighted. This chapter considers the nature of Brownian motion, exploring the context in which Einstein's paper emerged and the scientific reaction to it, and relating these developments to various contemporary approaches to the nature of the crowd, before investigating some of the possible lines of influence and areas of cross-over between these two disciplines. Chapter eight then reflects

upon the literary manifestations of such ideas in the works of Virginia Woolf and D. H. Lawrence.

Although it was named after him, Robert Brown was not the first to observe Brownian motion at work when he carried out his experiments thereon in the late 1820s. He was, however, the first scientist to prove that the motion was due not to living organisms, but rather 'belonged to the particle itself', and he thus, as Stephen Brush explains, 'removed the subject from the realm of biology into the realm of physics'.<sup>1</sup> Writing his 'Additional Remarks on Active Molecules' in 1829, Brown highlighted that he was still 'unable to account' for the observed motions, before explicitly rejecting a number of current hypotheses.<sup>2</sup> The main difficulty in formulating a theory to account for this phenomenon lay in the fact that, as Jean Perrin explained nearly one hundred years later, 'the most striking feature of the Brownian movement is the absolute independence of the displacements of neighbouring particles, so near together that they pass by one another'.<sup>3</sup>

It is perhaps because of these difficulties that 'After the initial flurry of excitement caused by Brown's publications in 1828-29, interest in Brownian movement dropped off to almost nothing for about thirty years'; indeed, according to Brush, it was only 'with the development of thermodynamics and the revival of the kinetic theory of gases in the 1850's' that scientists became interested in this phenomenon again.<sup>4</sup> The kinetic theory of gases, formulated by James Clerk Maxwell, uses a molecular model, explaining the overall properties of gases through reference to the interactions of individual microscopic molecules. Various scientists in the latter half of the nineteenth century saw the possible

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1 Robert Brown, 'A Brief Account of Microscopical Observations on the Particles contained in the Pollen of Plants; and on the general Existence of Active Molecules in Organic and Inorganic Bodies', *The Edinburgh Journal of Science*, 9/18 (October 1828), 338; Stephen G. Brush, 'A History of Random Processes. I. Brownian Movement from Brown to Perrin', *Archive for History of Exact Sciences*, 5/1 (1968), 3.

2 Robert Brown, 'Additional Remarks on Active Molecules', *The Edinburgh Journal of Science*, new ser., 1/2 (October 1829), 315.

3 Jean Perrin, *Brownian Movement and Molecular Reality*, trans. F. Soddy (London, 1910), 5.

4 Brush, 'Random Processes', 7. Brush's capitalisation of scientists' names has been altered in this and subsequent quotations.

relevance of this theory to the movements visible in Brownian motion and, in 1877, Joseph Delsaulx 'expressed for the first time the now generally-accepted [*sic*] idea that the Brownian movement has its origin in the impacts of the molecules of the liquid on the particles', an idea which was soon taken up by other scientists, including R. P. Carbonelle and J. Thirion.<sup>5</sup> However, the molecular hypothesis was not universally accepted at this time, and the idea that microscopic molecules could have such a dramatic influence on the macroscopic particles observable in Brownian motion was particularly fiercely opposed by the botanist Karl von Nägeli.

In 1879, Nägeli 'assaulted the mechanical theorists on their own terms', completing the necessary calculations to show what he considered to be the ridiculous nature of the molecular model of Brownian motion: as Mary Jo Nye explains, Nägeli's results demonstrated that 'a million water molecules must strike the starch particles (*Stärkekörnchen*) at the same moment and from the same direction in order to explain the single jerk of the Brownian granule', findings which were confirmed three years later by the British chemist William Ramsay.<sup>6</sup> However, in 1888, the tables were turned again, this time by Léon Gouy who, in Perrin's words, established 'not only that the hypothesis of molecular agitation gave an admissible explanation of the Brownian movement, but that no other cause of the movement could be imagined'.<sup>7</sup> Gouy's work was particularly controversial because it suggested that Brownian motion could be seen as an example of perpetual motion, and thus an exception to the second law of thermodynamics.<sup>8</sup>

In 1905, less than two weeks after the submission of his doctoral dissertation on 'A New Determination of Molecular Dimensions' to the University of Zurich, Albert Einstein

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5 R Fürth, Notes to Albert Einstein, *Investigations on the Theory of the Brownian Movement*, ed. R Fürth, trans. A. D. Cowper (London, 1926), 87 n. 1. For a detailed introduction to the history of Brownian motion see Mary Jo Nye, *Molecular Reality: A Perspective on the Scientific Work of Jean Perrin* (London, 1972). This provides some interesting points of contrast with the account offered by Brush in 'Random Processes', as we shall see.

6 Nye, *Molecular Reality*, 25, 26.

7 Perrin, *Brownian Movement*, 4-5.

8 Nye, *Molecular Reality*, 27.

turned his attention to the ongoing problem of Brownian motion, although slightly tentatively at first; having introduced the concept of 'thermal molecular motions' at the start of his paper, 'On the Movement of Small Particles Suspended in Stationary Liquids Required by the Molecular-Kinetic Theory of Heat', Einstein added:

It is possible that the motions to be discussed here are identical with the so-called 'Brownian molecular motion'; however, the data available to me on the latter are so imprecise that I could not form a definite opinion on this matter.<sup>9</sup>

Einstein knew of Gouy's work as Henri Poincaré had included 'a brief discussion' of it in his 1902 book *La Science et l'hypothèse* which Einstein read 'Some time between 1902 and 1905'.<sup>10</sup> Einstein was also already 'firmly committed' to the atomic hypothesis, taking it for granted in his first published papers.<sup>11</sup> This was not, however, a universally accepted hypothesis at this time, the main opponents to this theory being 'energeticists' like Wilhelm Ostwald and Georg Helm, while 'It was not uncommon, even among scientists who made explicit use of atomic assumptions in their work, to regard atomism as a mere working hypothesis', rather than as a physical reality.<sup>12</sup> As such, Einstein set his 1905 paper up as something of a crucial test as far as 'the molecular-kinetic conception of heat' was concerned, concluding, as he does some of his other papers, with a call to arms: 'Let us hope that a researcher will soon succeed in solving the problem posed here, which is of such importance in the theory of heat!'<sup>13</sup>

Researchers were quick to take on this challenge, and there was 'widespread interest among physicists and chemists' in Einstein's paper.<sup>14</sup> However, it was not until 1908 that

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<sup>9</sup> *The Collected Papers of Albert Einstein. English Translation*, ed. John Stachel et al., trans. Anna Beck et al., to be completed in circa 30 vols (Princeton, 1987–), ii, 123.

<sup>10</sup> 'Einstein on Brownian Motion', Editorial Note to *The Collected Papers of Albert Einstein*, ed. John Stachel et al., to be completed in circa 30 vols (Princeton, 1987–), ii, 211.

<sup>11</sup> Sahotra Sarkar, 'Physical Approximations and Stochastic Processes in Einstein's 1905 Paper on Brownian Motion', in Don Howard and John Stachel, eds., *Einstein: The Formative Years, 1879-1909* (Boston, 2000), 207; 'Einstein on Brownian Motion', 208.

<sup>12</sup> 'Einstein on Brownian Motion', 207.

<sup>13</sup> Einstein, *English Translation*, ii, 123, 134.

<sup>14</sup> 'Einstein on Brownian Motion', 215.

Perrin provided the experimental evidence that proved Einstein to be correct, both qualitatively and quantitatively. In addition, there is some debate as to whether Perrin was originally working from Einstein's paper, or whether he only discovered Einstein's work once he had begun collecting his own results: Brush tells us that 'Jean Perrin quickly attempted to establish Einstein's theory by experimental test of the displacement formula and of another formula for the vertical distribution of particles in a fluid', while Nye states that Perrin's papers 'were completed with little attention to the theoretical work undertaken a year or two earlier by Albert Einstein and Maryan Smoluchowski', an interpretation which, she assures us, is 'confirmed by a careful scrutiny of Perrin's published papers, as well as by the opinion of his son'.<sup>15</sup> Either way, Perrin was certainly very impressed when he did discover Einstein's work, describing Einstein's 1905 and 1906 papers as 'very beautiful theoretical investigations'.<sup>16</sup> The feeling was mutual: in 1909 Einstein wrote to Perrin stating, 'I would have thought it impossible to investigate Brownian motion with such precision; it is fortunate for this material that you have taken it up'.<sup>17</sup>

Perrin's results, and his explanations thereof, were very successful within the scientific community: they were translated 'almost immediately', with his 1909 work *Brownian Movement and Molecular Reality* appearing in English as early as 1910 in a translation by the noted physical chemist Frederick Soddy.<sup>18</sup> Meanwhile, his presentation at the 1911 Solvay Congress met with 'no real opposition', although as Nye explains this was perhaps partly influenced by the 'juxtaposition of his incisive, straightforward, and logically reasoned paper against the more confusing and perplexing reports on radiation and quantum theory'.<sup>19</sup> Perrin went on to win the Nobel Prize in Physics in 1926 for his work on the physical reality of atoms, within which his experiments on Brownian motion

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<sup>15</sup> Brush, 'Random Processes', 2; Nye, *Molecular Reality*, 97, 136 n. 1.

<sup>16</sup> Perrin, *Brownian Movement*, 51.

<sup>17</sup> Einstein, letter to Jean Perrin dated 11 November 1909, *English Translation*, v, 139.

<sup>18</sup> Nye, *Molecular Reality*, 148.

<sup>19</sup> *Ibid.* 156.

played a vital part.

The fundamental importance of Perrin's research lies in his proof of the physical existence of atoms, a theory which, as we have seen, was by no means universally accepted at the turn of the century. In 1909 Perrin wrote that 'the molecular theory of the Brownian movement can be regarded as experimentally established, and, at the same time, *it becomes very difficult to deny the objective reality of molecules*'.<sup>20</sup> Indeed, according to Brush, 'There was only one major dissent from the scientific consensus on the reality of atoms after 1908', that dissent being provided by Ernst Mach, who never relented on this issue.<sup>21</sup> Nye is rather more conservative in her estimation of the success of the atomic hypothesis, but even so she acknowledges that 'the essential point was accepted by 1913'.<sup>22</sup> Perrin was recognised at the time for his achievements in having 'virtually made [atoms and molecules] visible and established their reality', and in that Perrin's experiments provided proof for Einstein's theories on Brownian motion and the molecular-kinetic nature of heat, it is thus possible to state, as does Abraham Pais, that Einstein was 'the first to make molecules visible'.<sup>23</sup> Perrin was somewhat more cautious in this regard, however, explaining that

Direct perception of the molecules in agitation is not possible, for the same reason that the motion of the waves is not noticed by an observer at too great a distance from them. But if a ship comes in sight, he will be able to see that it is rocking, which will enable him to infer the existence of a possibly unsuspected motion of the sea's surface.<sup>24</sup>

The imagery employed by Perrin here provides a clear indication of the way in which Brownian motion, and molecular movement more generally, could now be understood to function, as well as the fact that it is still only indirectly observable.

But what, we may ask, is the actual theory behind Brownian motion? How are we

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<sup>20</sup> Perrin, *Brownian Movement*, 46.

<sup>21</sup> Brush, 'Random Processes', 35.

<sup>22</sup> Nye, *Molecular Reality*, x.

<sup>23</sup> 'Atoms and Molecules', *Nature*, 91/2280 (10 July 1913), 473; Abraham Pais, '*Subtle is the Lord...*' *The Science and the Life of Albert Einstein* (Oxford, 1982), 86.

<sup>24</sup> Jean Perrin, *Atoms*, trans. D. LL. Hammick (London, 1920), 83.

to understand those movements of particles suspended in a fluid which have been the subject of scientific observations for two hundred years? Having accepted the concept of molecular movements and the idea that it is collisions that provoke the movements that we see, there are two key, though linked, points to bear in mind here: the randomness of the movements and the importance of fluctuations. Beginning with the latter, we see that Einstein's key insight lay in the acknowledgement that fluctuations in the fluid medium mean that a number of molecules suddenly collide with a particle at the same time and in the same direction, thus causing it to move in that direction.<sup>25</sup> As such, the objections of Nägeli and Ramsay to the molecular explanation of Brownian motion are overcome: while it is true that one individual molecule could not move a comparatively massive particle, a large number of molecules moving in the same direction at the same moment due to a random fluctuation within the medium will clearly be able to do so.

That these fluctuations are, indeed, random is also key, thus explaining 'the absolute independence of the displacements of neighbouring particles' which, as we have seen, Perrin designated as 'the most striking feature of the Brownian movement'. In his 1908 'Elementary Theory of Brownian Motion', Einstein particularly emphasised this randomness: 'The process of random motion, which is what the heat content of a substance must be considered to be, will cause the individual molecules of a liquid to change their position in the most random manner imaginable'.<sup>26</sup> Einstein continues with an interesting image of the 'haphazard meandering of the molecules of the dissolved substance', an anthropomorphism which leads us to the concept of the random walk, vividly described by Walter Isaacson through reference to a drunkard's random stumblings: if we 'imagine a drunk who starts at a lamppost and lurches one step in a random direction every second' then 'statistically, the drunk's distance from the lamp will be proportional to the square root

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<sup>25</sup> See John S. Rigden, *Einstein 1905: The Standard of Greatness* (Cambridge, Massachusetts, 2005), 63-4.

<sup>26</sup> Einstein, *English Translation*, ii, 323.

of the number of seconds that have elapsed'.<sup>27</sup> It is this mathematical relationship that Einstein presented to the scientific community in his 1905 paper and that Perrin proved to be correct in 1908.

The fundamental importance to such a theory of statistical measures and probabilities is obvious, and Einstein highlighted his focus on the latter in the opening to his 1905 paper:

If it is really possible to observe the motion to be discussed here, along with the laws it is expected to obey, then classical thermodynamics can no longer be viewed as strictly valid even for microscopically distinguishable spaces.<sup>28</sup>

Such an idea was not wholly new, as Perrin highlighted in his discussion of Gouy's work of 1888: 'the point of view that Carnot's principle expresses simply a law approximated to has been upheld by Clausius, Maxwell, Helmholtz, Boltzmann, and Gibbs'.<sup>29</sup> Thus Perrin explains that

it must not any longer be said that perpetual motion of the second sort is impossible, but one must say: 'On the scale of size which interests us practically, perpetual motion of the second sort is in general so insignificant that it would be absurd to take it into account'.<sup>30</sup>

The shift here from absolute determinism to assumptions based on probabilities, no matter how likely, is a significant one, as is that clarification as to the different scales on which our observations can function. Thus, as Charlotte Bigg has expressed it, the second law of thermodynamics 'must be seen no longer as absolutely, but as statistically true: at the macroscopic scale of the liquid the law holds, but at the atomic or molecular scale contrary events might occur'.<sup>31</sup>

Such a statistical and probabilistic approach may well have been relatively new to

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<sup>27</sup> Ibid. Walter Isaacson, *Einstein: His Life and Universe* (London, 2007), 105.

<sup>28</sup> Einstein, *English Translation*, ii, 123.

<sup>29</sup> Perrin, *Brownian Movement*, 6.

<sup>30</sup> Ibid.

<sup>31</sup> Charlotte Bigg, 'Brownian Motion', in Jürgen Renn, ed., *Albert Einstein – Chief Engineer of the Universe*, trans. Isabel Cole et al., 3 vols (Weinheim, 2005), ii, 122. The contrast between the macroscopic and the microscopic is one to which we will return.

physics at the turn of the century, but the same certainly cannot be said of studies within what we now call the social sciences. Indeed, it was the nineteenth century which saw the emergence and increasing influence of the field of social statistics, a discipline which 'begins by conceding that individual humans are too complex and diverse to serve as the basis of science, and has recourse instead to numerical frequencies as its elemental data'.<sup>32</sup> This realisation, and the practical applications thereof, had a significant impact on a particularly important nineteenth-century scientist who we have already had cause to mention: Maxwell. As David Bodanis explains, 'it was by explicit acknowledgement to [social statistics] that Maxwell worked out his theory of gases where the scurrying molecules also were described only by overall statistics, and not individual biographies'.<sup>33</sup>

This explicit acknowledgement on Maxwell's part comes in a lecture that he delivered to the British Association in 1873, and which was subsequently published in *Nature*:

As long as we have to deal with only two molecules, and have all the data given us, we can calculate the result of their encounter, but when we have to deal with millions of molecules, each of which has millions of encounters in a second, the complexity of the [*sic*] problem seems to shut out all hope of a legitimate solution.

The modern atomists have therefore adopted a method which is I believe new in the department of mathematical physics, though it has long been in use in the Section of Statistics.<sup>34</sup>

Statistics thus enters into physics, and the relevance of this development thirty years later to Einstein and other theorists of Brownian motion is clear.

As the nineteenth century came to a close and the twentieth century began, the use of statistics as a means of studying human masses was becoming increasingly important. While the overall population increased rapidly – the population of England and Wales more than doubling between 1841 and 1901 – the urban population in particular was

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<sup>32</sup> Gerd Gigerenzer et al., *The Empire of Chance: How Probability Changed Science and Everyday Life* (Cambridge, 1989), 42.

<sup>33</sup> David Bodanis, *Web of Words: The Ideas Behind Politics* (Basingstoke, 1988), 19.

<sup>34</sup> James Clerk Maxwell, 'Molecules', *Nature*, 8/204 (25 September 1873), 440.

growing at an unprecedented rate:

Towns of over 100,000 inhabitants increased from six in 1841 to thirty in 1901 – only London had been so large in 1801. Towns of 50,000 to 100,000 inhabitants, of which there had been five in 1801, increased from twenty-two in 1841 to forty-nine in 1901.<sup>35</sup>

Nor was such growth limited to this country: 'By 1900 there were already eleven metropolises in the world with populations of over a million'.<sup>36</sup> Meanwhile, Alan Bullock emphasises the increased organisation of this increased population, in particular the working class section thereof, which meant that 'Social questions began to figure more and more prominently on the agenda of politics'.<sup>37</sup> Many critics have highlighted the emergence of the masses as a political force in the late nineteenth and early twentieth centuries, and Raymond Williams has related this 'new phenomenon' to three contemporary social tendencies: the 'physical massing' of the growing population in the industrial towns, the 'physical' and 'social massing' of workers in factories, and 'the consequent development of an organised and self-organising working class: a social and political massing'.<sup>38</sup> It was this latter movement in particular, towards an organised and politically active mass, which meant that an understanding of crowd psychology rapidly became an urgent concern for those in government and other positions of responsibility in the early part of the twentieth century. Out of this need various different theories emerged, the most significant and successful of which we will consider below.

Gustave Le Bon is widely regarded as the most important and, indeed, 'most popular', proponent of a theory of the crowd, his ideas retaining their relevance even today, more than one hundred years after the publication of his highly significant 1895 work, *La*

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35 J. A. Banks, 'The Contagion of Numbers', in H. J. Dyos and Michael Wolff, eds., *The Victorian City: Images and Realities*, 2 vols (London, 1973), i, 105.

36 Allan Bullock, 'The Double Image', in Malcolm Bradbury and James McFarlane, eds., *Modernism: A Guide to European Literature, 1890-1930* (London, 1976; repr. 1991), 59.

37 Ibid. 61.

38 Michael Tratner, *Modernism and Mass Politics: Joyce, Woolf, Eliot, Yeats* (Stanford, 1995), 1; Raymond Williams, *Culture and Society, 1780-1950* (Harmondsworth, 1961), 287. See also John Carey, *The Intellectuals and the Masses: Pride and Prejudice among the Literary Intelligentsia, 1880-1939* (London, 1992).

*Psychologie des foules*.<sup>39</sup> One of Le Bon's main propositions within this work is that 'The age we are about to enter will in truth be the ERA OF CROWDS'.<sup>40</sup> However, it is not merely the crowd as a random gathering together of various completely unrelated people in which Le Bon is interested, but rather in what he calls the organised, or psychological, crowd:

Under certain given circumstances, and only under those circumstances, an agglomeration of men presents new characteristics very different from those of the individuals composing it. The sentiments and ideas of all the persons in the gathering take one and the same direction, and their conscious personality vanishes. A collective mind is formed, doubtless transitory, but presenting very clearly defined characteristics. The gathering has thus become what, in the absence of a better expression, I will call an organised crowd, or, if the term is considered preferable, a psychological crowd. It forms a single being, and is subjected to the *law of the mental unity of crowds*.<sup>41</sup>

Le Bon was certainly not alone in suggesting such a different side to the crowd. In 1920 William McDougall explained the difference between a 'mass of human beings' and 'a crowd in the psychological sense of the word' as follows:

There is a dense gathering of several hundred individuals at the Mansion House Crossing at noon of every week-day; but ordinarily each of them is bent upon his own task, pursues his own ends, paying little or no regard to those about him. But let a fire-engine come galloping through the throng of traffic, or the Lord Mayor's state coach arrive, and instantly the concourse assumes in some degree the character of a psychological crowd. All eyes are turned upon the fire-engine or coach; the attention of all is directed to the same object; all experience in some degree the same emotion, and the state of mind of each person is in some degree affected by the mental processes of all those about him. Those are the fundamental conditions of collective mental life.<sup>42</sup>

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39 Robert A. Nye, *The Origins of Crowd Psychology: Gustave Le Bon and the Crisis of Mass Democracy in the Third Republic* (London, 1975), 167. Anecdotally, it is interesting to note that Robert Nye is the husband of Mary Jo Nye, whose book on Perrin has proved so useful to the Brownian motion section of this paper. This perhaps suggests some kind of shared interest between crowd psychology and molecular science.

40 Gustave Le Bon, *The Crowd: A Study of the Popular Mind* (Harmondsworth, 1977), 14. However, it should be noted that Gabriel Tarde, in 'The Public and the Crowd' (1901), instead describes 'our age' as 'the era of the public or of publics', adding 'and that is a very different thing!', *On Communication and Social Influence: Selected Papers*, ed. Terry N. Clark, trans. N. Claire Ellis, Priscilla P. Clark and Terry N. Clark (Chicago, 1969), 281.

41 Le Bon, *The Crowd*, 23-4.

42 William McDougall, *The Group Mind: A Sketch of the Principles of Collective Psychology with Some Attempt to Apply Them to the Interpretation of National Life and Character* (Cambridge, 1920), 22-3.

Le Bon's view of the crowd is rather negative in tone: he states that 'Crowds are only powerful for destruction' and that 'An individual in a crowd is a grain of sand amid other grains of sand, which the wind stirs up at will'.<sup>43</sup> In addition, Le Bon explains that the crowd portrays characteristics 'which are almost always observed in beings belonging to inferior forms of evolution – in women, savages, and children, for instance'.<sup>44</sup>

Unsurprisingly, then, Le Bon's opinion of the non-psychological, or non-organised, crowd is even more disdainful: it is 'an agglomeration of individualities lacking cohesion', 'a mere swarm of isolated individuals', while for McDougall the actions of such a crowd are 'comparable with the actions of an animal rather than with those of a man'.<sup>45</sup> Nevertheless, or perhaps, indeed, because of this, Le Bon's ideas met with widespread success and popularity, as Deborah Parsons explains:

*Psychologie des foules* was translated into English as *The Crowd* in 1897, and into thirteen other languages by 1913. It underwent twenty-six reprintings in French by 1920, and sixteen in English by 1926. That it achieved such enormous popularity is an indication of the widespread interest in the crowd throughout European society.<sup>46</sup>

And, we may add, of the widespread suspicion and dislike thereof.

The next major work to tackle the nature of the crowd, although this time in a somewhat more positive light, was Wilfred Trotter's *Instincts of the Herd in Peace and War*, which was first published in 1916, although the first two of the three essays included within it were originally published as articles in *The Sociological Review* in 1908 and 1909. Like Le Bon, Trotter emphasises the 'homogeneity' of the herd, stating – and here we see him diverting somewhat from the path followed by Le Bon – that 'the great advantage

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43 Le Bon, *The Crowd*, 18, 32-3.

44 Ibid. 36.

45 Ibid. 206, 207; McDougall, *Group Mind*, 45. McDougall's opinion of the non-organised crowd in fact seems to reflect Le Bon's of the organised crowd; McDougall describes the former's behaviour as 'like that of an unruly child or an untutored passionate savage in a strange situation, rather than like that of its average member', adding that 'in the worst cases it is like that of a wild beast, rather than like that of human beings', *Group Mind*, 45. Note, however, that female characteristics are not included in McDougall's censure of the nature of the crowd.

46 Deborah L. Parsons, *Streetwalking the Metropolis: Women, the City, and Modernity* (Oxford, 2000), 44 n. 3.

of the social habit is to enable large numbers to act as one'.<sup>47</sup> The key to this unity of members of the herd, according to Trotter, lies in their 'sensitiveness to the behaviour of their fellows'; thus, 'The individual isolated will be of no meaning, the individual as part of the herd will be capable of transmitting the most potent impulses', an image which is reminiscent of the models of molecular collisions that we considered at the start of this chapter.<sup>48</sup>

Rather than focusing on the inherent criminality of the crowd, as explored by Le Bon, Trotter provides us with three different models of the 'gregariousness' which he sees as key to human interactions:

We have the aggressive gregariousness of the wolf and dog, the protective gregariousness of the sheep and the ox, and, differing from both these, we have the more complex social structure of the bee and the ant, which we may call socialised gregariousness. The last-named is characterised by the complete absorption of the individual in the major unit, and the fact that the function of the social habit seems no longer to be the simple one of mere attack or defence, but rather the establishment of a State which shall be, as a matter of course, strong in defence and attack, but a great deal more than this as well.<sup>49</sup>

The last of these is, apart from its more positive portrayal, the closest to Le Bon's psychological crowd, providing 'a complete substitute for individual existence' and behaving 'like a new creature'.<sup>50</sup> Furthermore, it is 'the goal of man's development' and, perhaps unsurprisingly given the wartime context in which Trotter's work was published, we are told that 'while Germany is the very type of a perfected aggressive herd, England is perhaps the most complete example of a socialised herd'.<sup>51</sup>

The final key figure to consider in this brief survey of early twentieth-century crowd psychology is, of course, Sigmund Freud. Freud repeatedly refers to and quotes

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<sup>47</sup> W. Trotter, *Instincts of the Herd in Peace and War* (London, 1916), 29. Trotter seems to have been particularly popular among contemporary intellectuals and his ideas were familiar to both Woolf and Lawrence, as we shall see.

<sup>48</sup> Ibid.

<sup>49</sup> Ibid. 166.

<sup>50</sup> Ibid.

<sup>51</sup> Ibid. 167, 201.

from Le Bon in his own treatise on *Group Psychology and the Analysis of the Ego* from 1921 (first published in English by the Hogarth Press in 1922), and focuses in particular on the importance of the unconscious actions of the crowd. Developing Le Bon's idea about the new characteristics evident in crowds which are 'in no sort a summing-up of or an average struck between its elements', Freud explains that an individual within a crowd 'is brought under conditions which allow him to throw off the repressions of his unconscious instinctual impulses', so that 'The apparently new characteristics which he then displays are in fact the manifestations of this unconscious, in which all that is evil in the human mind is contained as a predisposition'.<sup>52</sup> The negative implications of this assertion clearly cannot be overlooked, but interestingly Freud goes on to explain that this negative appraisal of crowd psychology and action by various critics is only ever linked to 'groups of a short-lived character', the psychological crowds we explored above; a more positive view can be assembled via 'the consideration of those stable groups or associations in which mankind pass their lives, and which are embodied in the institutions of society'.<sup>53</sup> This view helps to explain Trotter's more positive image of the mass: his ideal of socialised gregariousness is always linked to long-term and stable groups like the beehive, and the herd for him seems to be something of longer duration than the psychological crowd at the Mansion House Crossing to which we saw McDougall refer above. Similarly, McDougall writes of 'the well-organised group' such as the army in more positive terms: 'the whole is raised above the level of its average member; and even, by reason of exaltation of emotion and organised co-operation in deliberation, above that of its highest members'.<sup>54</sup>

Freud is not fully in agreement with Trotter either, however, suggesting that

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<sup>52</sup> Le Bon, *The Crowd*, 27; Sigmund Freud, *Group Psychology and the Analysis of the Ego*, ed. and trans. James Strachey (rev. edn, London, 1959), 6. It is worth noting, however, that McDougall offers the opposite view, stating that 'each member of the crowd acts in full publicity; and his knowledge of, and regard for, public opinion will to some extent incline him to suppress the manifestation of feelings which he might indulge in private but would be ashamed of in public', *Group Mind*, 39-40.

<sup>53</sup> Freud, *Group Psychology*, 15.

<sup>54</sup> McDougall, *Group Mind*, 53.

'Trotter's exposition can be undermined psychologically' in that 'it can be made at all events probable that the herd instinct is not irreducible, that it is not primary in the same sense as the instinct of self-preservation and the sexual instinct'.<sup>55</sup> Freud also focuses on the importance of the leader of a group, an element which we do not have the space to consider here, and one which plays no part in Trotter's ideal of the socialised herd. Thus Freud suggests a 'correction' to Trotter's appraisal, describing man not as a herd animal, but rather as 'a horde animal, an individual creature in a horde led by a chief'.<sup>56</sup>

It is worth pausing at this point to consider the extent to which Virginia Woolf and D. H. Lawrence can be said to have been aware of these contemporary discussions of crowd psychology. While Woolf read 'Freud on Groups' in December 1939 in order 'to enlarge the circumference. to [*sic*] give my brain a wider scope: to make it objective; to get outside. Thus defeat the shrinkage of age', it is Trotter's ideas which seem to have been particularly significant to members of the Bloomsbury group earlier in the century.<sup>57</sup> The Woolfs owned a copy of Trotter's *Instincts of the Herd* and Leonard Woolf reviewed it for *The New Statesman*, describing it as 'exceedingly original'.<sup>58</sup> Indeed, Leonard Woolf's statement that Trotter's 'is not the ordinary beaten track of the writer on herd instinct and crowd psychology' suggests the extent to which such works and ideas were familiar to both Leonard and his readers by 1916.<sup>59</sup>

Virginia Woolf also internalised, to some extent at least, the ideas explored by Trotter: writing in her diary in 1917 she reports Roger Fry's 'gloomy view, not of our life, but of the world's future' adding, 'but I think I detected the influence of Trotter & the herd, & so I distrusted him'.<sup>60</sup> However, she continues with a somewhat different tone:

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<sup>55</sup> Freud, *Group Psychology*, 51.

<sup>56</sup> *Ibid.* 53.

<sup>57</sup> Virginia Woolf, diary entries for 17 December and 2 December 1939, *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, 5 vols (London, 1977-84), v, 252, 248.

<sup>58</sup> See *Catalogue of Books from the Library of Leonard and Virginia Woolf* (Brighton, 1975); L. S. Woolf, 'The Inhuman Herd', *The New Statesman*, 7/170 (8 July 1916), 327.

<sup>59</sup> L. S. Woolf, 'Inhuman Herd', 328.

<sup>60</sup> Woolf, diary entry for 22 November 1917, *Diary*, i, 80.

Still, stepping out into Charlotte Street, where the Bloomsbury murder took place a week or two ago, & seeing a crowd swarming in the road & hearing women abuse each other & at the noise others come running with delight – all this sordidity made me think him rather likely to be right.<sup>61</sup>

Allen McLaurin points out that in general the Bloomsbury group 'interpreted the herd theory in a much more pessimistic sense than Trotter intended', as the quotations above emphasise.<sup>62</sup> However, Trotter's ideas certainly seem to have had a resonance for Woolf and others, changing the way in which they observed and interacted with their urban surroundings.

Lawrence also read Trotter, but 'didn't like him very much', complaining 'Oh, I *cannot* stand this scientific talk of instincts and bee communities and wolf packs and such like, as if everything worked from a mechanical basis. It is a great lie'.<sup>63</sup> For Lawrence, the problem with the psychological or sociological study of humanity is that 'It is just like anatomy: it examines every bit of the dog, but, the dog is all *dead dog*'.<sup>64</sup> Lawrence's reading of Trotter, then, does not seem, on the surface at least, to have had such an impact as Woolf's did on her understanding of the crowd as a physical presence. However, his repeated references to swarms of bees complicates this notion to some extent, as we shall see, while his image in *Aaron's Rod* (1922) of a theatre audience as 'one monstrous, unnatural consciousness' suggests a greater internalisation of contemporary ideas on crowd psychology than Lawrence would perhaps have been willing to admit.<sup>65</sup> In *Kangaroo*, Lawrence comments more directly on the contemporary approach to crowd psychology, stating that 'The study of collective psychology today is absurd in its inadequacy' (294). That contemporary theories of crowd psychology were known by intellectuals and writers

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61 Ibid.

62 Allen McLaurin, 'Consciousness and Group Consciousness in Virginia Woolf', in Eric Warner, ed., *Virginia Woolf: A Centenary Perspective* (London, 1984), 37.

63 D. H. Lawrence, letter to Dollie Radford dated 20 December 1916, *The Letters of D. H. Lawrence*, ed. James T. Boulton et al., 8 vols (Cambridge, 1979-2000), iii, 59.

64 Ibid. Lawrence repeats this idea in his 1923 novel, *Kangaroo*, ed. Bruce Steele (Cambridge, 1994), 294.

65 D. H. Lawrence, *Aaron's Rod*, ed. Mara Kalnins (Cambridge, 1988), 47. It is worth noting that the theatre is itself described as a 'restless hive' a few pages later (49).

in the early twentieth century, then, is clear, and Trotter seems to have been particularly widely read and acknowledged, perhaps due to the war-time context of his work.

The contemporary focus, both in physics and in the social sciences, on the behaviour of large masses and, in particular, on the ways in which individuals behave within them, can no doubt be linked in part, as I have already said, to the rapid growth of urban populations which was being experienced across the world in the nineteenth and twentieth centuries. In addition, John Plotz has explored the sense of the random which became inherent in urban systems meaning that 'chance encounters on London streets produced a new sort of social life, both a pleasant and a threatening urban anonymity', and the idea of random encounters is certainly paralleled in some way in the molecular interactions visible in Brownian motion.<sup>66</sup>

Significantly, the image of the crowd appears frequently in contemporary descriptions of molecular interactions and motions, and is used by Karl Pearson when explaining the discontinuous nature of matter in *The Grammar of Science* (1892):

A crowd of human beings seen from a great height may look like a turbulent fluid in motion at every point. But we know from experience that this motion is only possible because there is some void in the crowd. It may become so densely packed that motion is no longer practicable. Thus it is with that relative motion of the parts of bodies upon which so much of modern physics depends; absolutely close packing, that is continuity, seems to render it impossible.<sup>67</sup>

Such a metaphor provides Pearson with a rhetorical device with which to persuade his reader of the validity of this scientific theory and to help them to understand and visualise it, but it also suggests the possibility that the contemporary focus on and interest in crowds may have influenced contemporary approaches to scientific questions themselves.

Pearson's use of the image of the crowd to describe a scientific concept was not an original one, however; it was used by Maxwell in his 1873 lecture on 'Molecules' in order

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<sup>66</sup> John Plotz, *The Crowd: British Literature and Public Politics* (Berkeley, 2000), 1.

<sup>67</sup> Karl Pearson, *The Grammar of Science* (3<sup>rd</sup> edn, London, 1911), 202.

to describe the difference between diffusion in a gas and in a liquid:

in a liquid the diffusion of motion from one molecule to another takes place much more rapidly than the diffusion of the molecules themselves, for the same reason that it is more expeditious in a dense crowd to pass on a letter from hand to hand than to give it to a special messenger to work his way through the crowd.<sup>68</sup>

This linking of crowds to liquids is an image to which we will return in the following chapter, but it is not the only example of anthropomorphism in Maxwell's lecture, in which molecules of oxygen and hydrogen in water occasionally 'part company, and dance about through the crowd, seeking partners which have become dissociated in the same way', that is, through a molecular collision.<sup>69</sup> Likewise, in his notes to a collection of Einstein's papers on Brownian motion, R. Fürth describes the Brownian particle 'danc[ing] hither and thither in an irregular manner', much as in Einstein's own description which we have already considered, and which appears in one of the papers included in Fürth's volume, of the 'haphazard meandering of the molecules of the dissolved substance'.<sup>70</sup>

Such images of molecules as crowds were also available in early twentieth-century popular science texts to which Virginia Woolf and D. H. Lawrence could easily have had access. Thus in a 1906 article on 'Matter, Motion, and Molecules' in *The Cornhill Magazine*, W. A. Shenstone used an image of the crowd in order to explain the molecular make-up of a liquid in terms that are very similar to Pearson's above: 'close packing would cause molecules to jostle one another, like people in a panic-stricken crowd in the street who have ceased to observe the rules of the road'.<sup>71</sup> By linking the scientific ideas which he is presenting with a familiar everyday image of life in the city – as well as with an image which was, by 1906, familiar in popular science – Shenstone both convinces and enlightens his readers. It is interesting to note, however, that his focus on 'a panic-stricken

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<sup>68</sup> Maxwell, 'Molecules', 439.

<sup>69</sup> Ibid.

<sup>70</sup> Fürth, Notes to Einstein, *Investigations*, 111 n. 17. In this volume A. D. Cowper translates Einstein's phrase as the 'wandering about of the molecules of the solute', 76.

<sup>71</sup> W. A. Shenstone, 'Matter, Motion, and Molecules', *The Cornhill Magazine*, new ser., 20/115 (January 1906), 71-2.

crowd' which has 'ceased to observe the rules of the road' also ties his ideas in with contemporary images of the crowd as a dangerous and unpredictable force.

As this 1906 article indicates, Brownian motion and, more generally, molecular movement, were being discussed in non-scientific and more popular formats in the early years of the twentieth century. Shenstone writes particularly vividly on the subject of molecular movements and collisions: 'We may think of a bubble of gas as consisting of a swarm of extremely minute particles flying about incessantly, in every direction, in straight lines, with immense velocities, except when they come into collision with one another'.<sup>72</sup> In the description which follows Shenstone combines familiar everyday sights like 'dust particles' and 'a lady's thimble' with the extraordinarily large numbers involved in particle physics ('sixty million million million'), thus enabling the reader to follow the scientific ideas which he is exploring by giving them some kind of familiar handle on such unfamiliar concepts.<sup>73</sup> Woolf's links to *The Cornhill Magazine*, through the editorship of her father, Leslie Stephen, from 1871 to 1882 (although he wrote for the magazine from 1866 to 1883), and later through her own contributions to its pages starting in 1908, are well known, and it is thus possible to speculate about her reading the popular science articles therein, provided almost exclusively by Shenstone from 1903 onwards.<sup>74</sup> However, following Shenstone's early death in 1908, popular science seems to have lost its regular spot in *The Cornhill Magazine*, with a four-year absence of any articles thereon after the reprinting of Shenstone's final article in July 1908.<sup>75</sup> As such, Woolf (at that time still Virginia Stephen) and Shenstone never published articles in the same issue of *The Cornhill Magazine*, thus making it more difficult for us to say with any certainty that Woolf would

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<sup>72</sup> Ibid. 72.

<sup>73</sup> Ibid.

<sup>74</sup> For details and analysis of Leslie Stephen's contributions to and involvement with *The Cornhill Magazine* see Oscar Maurer, 'Leslie Stephen and the *Cornhill Magazine*, 1871-82', *Studies in English*, 32 (1953), 67-95.

<sup>75</sup> W. A. Shenstone, 'The Electric Theory of Matter', *The Cornhill Magazine*, new ser., 23/134 (August 1907), 206-16; reprinted with minor changes and a short editorial note announcing Shenstone's death in *The Cornhill Magazine*, new ser., 25/145 (July 1908), 97-107.

have known Shenstone's work.

As a student and then teacher of science, among other subjects, Lawrence's access to such ideas and images would have been more direct and, as we saw in Part II, one of the key, if neglected, sources that we can consider in this regard is Frank Belton's 'Elementary Science' articles in *The Teacher*. Like Shenstone, Belton employs the image of a crowd in order to explain molecular movement, this time in relation to expansion due to heat:

each particle has its movement increased, consequently it takes up more space, and so does the whole mass. Compare with a crowd of people; each individual is moving among the others, or possibly just moving from side to side in his place. Something causes them to move with more energy; each person takes up more room, and the crowd spreads out.<sup>76</sup>

The less naturalistic image of the crowd employed here, with an individual 'possibly just moving from side to side in his place', emphasises the slightly more advanced nature of Belton's articles: in that his audience are training to be teachers, Belton can clearly assume a higher level of scientific understanding on the part of the majority of his readers than can Shenstone. Thus the image of the crowd is employed as a form of reinforcement of an idea, but not, as it was for Shenstone, as the main form of explication: indeed, if anything the members of Belton's crowd behave more like particles than the particles can be said to behave like human individuals. Lawrence's description in *Aaron's Rod* of an Italian crowd 'uneasily moving like boiling pitch' can perhaps be traced back to Belton's description here (183-4).

When exploring the movements of gas molecules, however, Belton employs an image of perhaps greater resonance than that of Shenstone's dust particles:

A swarm of flies in a bottle gives us a good illustration of the condition of a gas contained in a bottle. The individual flies move about into all parts of the interior, colliding with each other and with the sides of the bottle. The same is true of the Molecules of the gas.<sup>77</sup>

Interestingly, this image of a swarm of flies is reminiscent of another image used by

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<sup>76</sup> Frank Belton, 'Elementary Science', *The Teacher*, 1/17 (11 June 1904), 8.

<sup>77</sup> Frank Belton, 'Elementary Science', *The Teacher*, 1/1 (20 February 1904), 10.

Maxwell in his lecture on 'Molecules':

If we wish to form a mental representation of what is going on among the molecules in calm air, we cannot do better than observe a swarm of bees, when every individual bee is flying furiously, first in one direction, and then in another, while the swarm, as a whole, either remains at rest, or sails slowly through the air.<sup>78</sup>

Unlike Shenstone's dust particles, these flies and bees have some kind of volition of their own, while, as we have seen, the image of the swarm later became relevant to the study of crowd psychology, most notably in Trotter's repeated use of images involving bees as the ideal of socialised gregariousness. It is also worth remembering the frequency with which bees appear as an image in Lawrence's works, especially in relation to crowds: for example, in *The White Peacock* (1911) Cyril directly links 'watching the throng of varied bees which poise and hesitate outside the wide flowers, then swing in with a hum which sets everything aquiver' with watching 'the come and go of people weaving and intermingling in the complex mesh of their intentions', even though for him the latter is 'still more fascinating'.<sup>79</sup> However, this image is complicated somewhat by Cyril's earlier description of his own attention 'rov[ing] like a bee which clammers drunkenly among blue flowers' (264).

While the use of images of the crowd, or of other crowd-like groups, is common in early twentieth-century scientific models, there is also an influence in the other direction, from science onto crowd psychology. Such an influence had a particularly important role to play in legitimising the new discipline as scientific, as Parsons explains: 'To emphasise the role of crowd psychology as a "scientific" discipline, theorists employed terminology from other discourses such as medicine and evolutionary science'.<sup>80</sup> Such examples are easy to find, especially in Le Bon's writing: thus in biological terms, just as the individuals in a

<sup>78</sup> Maxwell, 'Molecules', 438.

<sup>79</sup> D. H. Lawrence, *The White Peacock*, ed. Andrew Robertson (Cambridge, 1983), 286. Woolf also refers to the crowd as bee-like in *Orlando* (1928), although this thought on the part of her focal character is 'violently snapped off and she saw, regaining perspective with one flick of her eye, that they were bodies', Virginia Woolf, *Orlando: A Biography*, ed. Brenda Lyons (London, 1993), 207.

<sup>80</sup> Parsons, *Streetwalking*, 44 n. 1.

psychological crowd present new characteristics simply by being joined in a crowd, 'the cells which constitute a living body form by their reunion a new being which displays characteristics very different from those possessed by each of the cells singly'.<sup>81</sup> Likewise, for Trotter, the socialised gregariousness of the hive 'seems like a new creature', and 'The hive and the ant's nest stand to the flock and the pack as the fully organised multicellular animal stands to the primitive zoogloea which is its forerunner'.<sup>82</sup> Alternatively, returning to Le Bon, the same idea can be explained with recourse to chemistry, where 'certain elements, when brought into contact – bases and acids, for example – combine to form a new body possessing properties quite different from those of the bodies that have served to form it'.<sup>83</sup>

Le Bon also compares 'the purely destructive nature' of crowds with 'those microbes which hasten the dissolution of enfeebled or dead bodies', an image which links him to another social commentator and scientist: Louis Pasteur.<sup>84</sup> According to Bodanis, 'The language of Pasteur and conservatives generally against the masses of the people was almost exactly like the language Pasteur had developed to use against bacteria'.<sup>85</sup> Later in his essay, however, Bodanis seems to suggest that the apparent order here of science influencing social analysis is not necessarily the whole picture, explaining that 'There is some evidence that for Pasteur it was fear of the mob' which came first: Bodanis refers to extreme population growth, particularly emphasising the role played within this by increased life expectancy and internal migration, both within Europe and 'from the land to the city', before stating that 'One would not need to have been M. Pasteur to be attuned to swarming masses with that going on'.<sup>86</sup> While this unstructured, uncontrolled and unsupervised mass was clearly of great concern to someone of Pasteur's political views, it

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81 Le Bon, *The Crowd*, 27.

82 Trotter, *Instincts of the Herd*, 166-7.

83 Le Bon, *The Crowd*, 27.

84 Ibid. 18.

85 Bodanis, *Web of Words*, 17.

86 Ibid. 17, 20-21.

is also easy to understand why the later organisation of these groups into political forces of their own would have had even more of an impact and, as Bodanis puts it, when formulating a scientific theory 'what better place to get fresh ideas than to just look around you?'<sup>87</sup>

That Le Bon himself may have followed such a model is suggested by the fact that soon after his work on crowd psychology, in 1896, he began to devote himself to physics: 'For almost a decade he continued to do steady research in molecular and theoretical physics'.<sup>88</sup> It is precisely the area of molecular physics that we have seen to be of such fundamental importance to contemporary discussions of Brownian motion, and that the greatest and most well-known early analyst of crowd behaviour decided to turn his attention to this field suggests some kind of resonance, or relevance, between the two disciplines. However, that Le Bon's achievements in the field of physics may have left something to be desired in comparison with his earlier work on crowds is suggested by a cutting article from *The New Quarterly* in 1909: here the reader is warned of the 'danger that an altogether worthless work may come to be regarded by those who really want to know as an authoritative expression of the results of scientific research', while the author, Norman Campbell, explains that Le Bon's popular physics books have 'been "boomed," no doubt with the best intentions, but with singularly little knowledge'.<sup>89</sup>

Peter Nicholls has drawn attention to an insightful scientific image of the crowd, and an 'increasingly popular metaphor', in a paper by John Ruskin on 'The Study of Architecture in Our Schools' which Ruskin read to the Royal Institute of British Architects in 1865: here the crowd is envisaged as 'a tormented mob' in which 'every creature is only one atom in a drift of human dust, and current of interchanging particles'.<sup>90</sup> Such an image

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<sup>87</sup> Ibid. 18.

<sup>88</sup> Robert Nye, *Origins of Crowd Psychology*, 87.

<sup>89</sup> Norman Robert Campbell, 'The Physics of M. Gustave Le Bon', *The New Quarterly*, 2/6 (April 1909), 227, 240.

<sup>90</sup> Peter Nicholls, *Modernisms: A Literary Guide* (2<sup>nd</sup> edn, Basingstoke, 2009), 16; *The Works of John Ruskin*, ed. E. T. Cook and Alexander Wedderburn, 39 vols (London, 1903-12), xix, 24.

may remind us of Le Bon's 'grain of sand amid other grains of sand, which the wind stirs up at will', but with its vocabulary of atoms in relation to particles and currents, it is clearly possible to suggest a scientific link here, especially when we consider that, according to Perrin, many early observers of Brownian motion 'thought it analogous to the movement of the dust particles, which can be seen dancing in a ray of sunlight, under the influence of feeble currents of air which set up small differences of pressure or temperature'.<sup>91</sup> Intentionally or not, Nicholls emphasises the similarity with Brownian motion by pointing out that 'it was not always just a matter of "drift", for the new pace of life in the city made the streets ... a setting for *violent collisions* and confrontations'.<sup>92</sup> This all led to a form of 'collective experience but without any sense of communal relationship', an idea which was highlighted by Friedrich Engels in the 1840s:

And still they crowd by one another as though they had nothing in common, nothing to do with one another ... The brutal indifference, the unfeeling isolation of each in his private interest becomes the more repellent and offensive, the more these individuals are crowded together, within a limited space.<sup>93</sup>

Such images are curiously reminiscent of those associated with both crowd psychology and Brownian motion in the early twentieth century.

It is worth noting that a particularly direct link between the two disciplines that we have been discussing here was made in 1985 by the historian of crowd psychology Serge Moscovici, a fact which emphasises the ongoing resonance of metaphors of this kind: Moscovici repeatedly refers to individuals as 'isolated atoms' and 'grains of the multitude' and suggests that they 'form a kind of gas'.<sup>94</sup> He also makes an explicit link between the movements of the crowd and Brownian motion: 'The crowd is filled with hundreds of incessant movements like those of particles suspended in a liquid and is perpetually milling

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<sup>91</sup> Perrin, *Brownian Movement*, 3.

<sup>92</sup> Nicholls, *Modernisms*, 16, my emphasis.

<sup>93</sup> Ibid. Friedrich Engels, *The Condition of the Working Class in England*, ed. David McLellan, trans. Florence Kelley-Wischnewetsky (Oxford, 1993), 37.

<sup>94</sup> Serge Moscovici, *The Age of the Crowd: A Historical Treatise on Mass Psychology*, trans. J. C. Whitehouse (Cambridge, 1985), 23.

and agitated'.<sup>95</sup> We must note, however, that Moscovici's model is not fully elaborated, and that in particular he offers no comment on the nature of the liquid medium which surrounds and influences the human particles of the crowd, a question to which we will return in the following chapter.

Questions of influence between two different fields of intellectual endeavour are rarely self-evident or easy to define. As we have seen, it is possible to trace lines of influence between scientific conceptions of Brownian motion and psychological models of crowd behaviour *in both directions*, a set of relationships which is perhaps most readily conveyed by Theodore Porter's image of 'an interdisciplinary matrix'.<sup>96</sup> Porter is discussing the links between statistics and physics in the nineteenth century, and sets up his interdisciplinary matrix as follows: 'The statistical astronomy of Gauss and Laplace, and the theory of judgements promulgated by Condorcet, Laplace, and Poisson were invaluable sources for Quetelet, whose social statistics in turn became a model for Galton, Edgeworth, Maxwell, and Boltzmann'.<sup>97</sup> Maxwell's development of the kinetic theory of gases in turn was, as we have seen, of fundamental importance to the later development of the theory of Brownian motion which is still accepted today, but his images of individual nameless molecules seem also to have had an impact outside of the scientific community. Meanwhile, the growing numbers and pressures within that outside world can certainly be seen to have had some bearing on the scientific discussions of masses at the turn of the century. Furthermore, randomness itself, as Alfred Bork has explained, was 'a cardinal feature' of the twentieth century, 'a feature permeating many different and apparently unrelated aspects of our culture'.<sup>98</sup> Thus Gillian Beer's image of different disciplines 'shar[ing] the moment's discourse' certainly seems relevant here, and the unravelling of

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<sup>95</sup> Ibid. 274.

<sup>96</sup> Theodore M. Porter, 'A Statistical Survey of Gases: Maxwell's Social Physics', *Historical Studies in the Physical Sciences*, 12/1 (1981), 114.

<sup>97</sup> Ibid.

<sup>98</sup> Alfred M. Bork, 'Randomness and the Twentieth Century', *Antioch Review*, 27/1 (1967), 41.

such sharing will remain both challenging and enlightening in equal measure.<sup>99</sup>

To sum up, then, it is clear that our knowledge and understanding of either of the disciplines of physics in the area of Brownian motion and molecular movement, or of psychology in the analysis of crowd behaviour, can aid our appreciation of the other: indeed, a recent article in *Physics World* emphasises the fact that 'a crowd can be treated like a many-particle system', suggesting that 'next time you leave a stadium, or any other large and crowded building, ... you could take a moment to imagine yourself as not a person but a particle'.<sup>100</sup> Both disciplines were of particular topical importance at the start of the twentieth century, and both were pursued in great detail by intellectuals in each separate area. Both fields were confronted by large masses, each individual of which could not possibly be accounted for separately, and both thus had recourse to more general and statistical ways of discussing the interactions experienced by individuals. These new methods allowed the study of random interactions and large masses to become an 'exact science', with order generated 'on a higher level'.<sup>101</sup> Thus, as Bork explains, 'statistical thermodynamics introduced statistical modes of thought to the physicist; but the underlying laws were still considered to be deterministic'.<sup>102</sup> Meanwhile, crowd psychologists were also looking to develop deterministic laws for the behaviour of individuals within masses, as in Le Bon's '*law of the mental unity of crowds*'.<sup>103</sup> The similarities between these two disciplines, then, allow us to suggest that they were both feeding into, and developing out of, a larger contemporary issue or question, 'concern' or 'anxiety', perhaps even an area as significant as the nature of society or being as a whole.<sup>104</sup>

It is certainly apparent that the two fields shared the moment's discourse, and it would be

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99 Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 171.

100 Andreas Schadschneider, 'I'm a Football Fan... Get Me Out of Here', *Physics World*, 23/7 (2010), 22, 25.

101 Porter, 'Statistical Survey', 79.

102 Bork, 'Randomness', 51.

103 Le Bon, *The Crowd*, 24.

104 N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca, 1990), xi; Gillian Beer, 'Discourses of the Island', in Frederick Amrine, ed., *Literature and Science as Modes of Expression* (Dordrecht, 1989), 18.

interesting to consider, although impossible to answer, where that discourse originated.

With the development of both of these discourses, the importance of the individual began to fade: the individual became just one of a mass, its own properties declining in significance in comparison with the overall characteristics of the group of which it formed a member. Conversely, randomness and probability became increasingly important in both fields, concepts which can be seen as both terrifying and liberating.

And yet there is also a significant difference between the portrayal of the individual within a psychological crowd and that of the individual Brownian particle, a difference which is perhaps best summed up by Perrin in his contrasting of dust particles and Brownian particles in motion:

it is easy to see that the neighbouring dust-particles move in general in the same sense, roughly tracing out the form of the common current which bears them along, whereas the most striking feature of the Brownian movement is the absolute independence of the displacements of neighbouring particles, so near together that they pass by one another.<sup>105</sup>

The mass of the psychological crowd behaves like the dust particles, 'stir[red] up at will' by the wind in Le Bon's words, while the Brownian particles can be more closely related to individuals in a non-psychological crowd: 'each of them is bent upon his own task, pursues his own ends, paying little or no regard to those about him'. Thus, in Engels's terms, 'The dissolution of mankind into monads, of which each one has a separate principle and a separate purpose, the world of atoms, is here [in the city] carried out to its utmost extreme'.<sup>106</sup>

That such ideas, images and concepts should find their way into the literature of the day is not, in the light of our considerations here, surprising, and when we apply the ideas we have been exploring to contemporary literature we will need to be open to depictions of crowds and masses both as examples of the organised or psychological crowd and as

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<sup>105</sup> Perrin, *Brownian Movement*, 5.

<sup>106</sup> Engels, *Condition of the Working Class*, 37.

examples of the random agglomeration of individuals, both of which appear in McDougall's image of the Mansion House Crossing. Of course, in literature the individual cannot be completely overcome and replaced by a set of averages – the very nature of literature defies such a notion. But this struggle to maintain the individual, or to write the mass without completely losing the individual, is significant in itself and is, moreover, reflected in some of the different approaches to Brownian motion from the early twentieth century. Leopold Infeld explored three such different approaches in 1940:

Smoluchowski investigated the life history of one Brownian particle in irregular collisions with the suspending fluid's particles (using time averages), while Langevin studied the life history of not just one particle, but of a whole ensemble. Einstein, on the other hand, dealt with a probability distribution from which time averages could be calculated.<sup>107</sup>

Infeld explains that 'In the theories of Smoluchowski and Langevin are the seeds of a general and simple theory of Brownian motion', while Einstein's theory involves 'the analysis of more complicated physical phenomena', and it is thus Einstein's focus on probabilities and statistics that separates his theory from those of other scientists working within the same context and time period as himself.<sup>108</sup> However, it is worth noting that the experimental proof of Einstein's ideas was established through Perrin's close focus on the movements of a small number of individual particles, as in the diagram at the opening of this section. Maxwell explained this distinction in 'Molecules':

Thus molecular science teaches us that our experiments can never give us anything more than statistical information, and that no law deduced from them can pretend to absolute precision. But when we pass from the contemplation of our experiments to that of the molecules themselves, we leave the world of chance and change, and enter a region where everything is certain and immutable.<sup>109</sup>

In the following chapter, then, I will suggest that the individuals portrayed within literary texts of the period suggest some kind of resemblance to the 'small particles

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<sup>107</sup> Nye, *Molecular Reality*, 112. Nye's account is closely based on Leopold Infeld's in *On the Theory of Brownian Motion* (Toronto, 1940), 5.

<sup>108</sup> Infeld, *Theory of Brownian Motion*, 6.

<sup>109</sup> Maxwell, 'Molecules', 440.

suspended in stationary liquids' to which the title of Einstein's 1905 paper refers: the individuals remain larger, or more significant, than the molecules of the mass surrounding them, but random fluctuations within that mass can have a dramatic effect on those individuals, altering their course and changing their position. Recent analysis of the nineteenth-century literary figure of the *flâneur* suggests some kind of resonance with this model, as we shall see.

Individuals and masses, particles and molecules: these were key terms at the start of the twentieth century, and the working out of these terms in the literature of the day forms just one more network of the interdisciplinary matrix within which both molecular physics and crowd psychology were functioning at the turn of the century.

## Chapter 8

### Brownian Motion as a Model for Literary Crowds:

#### Individuals Suspended in a Mass

In the previous chapter, we considered the psychological impact of increasing urbanisation and the political organisation of the masses in the early twentieth century, examining the ways in which these dramatic changes influenced developments in the realms of statistics and physics, while also promoting a new discipline in the form of the sociological and psychological analysis of crowds. In this chapter we will turn to an exploration of the ways in which this range of ideas came to be manifested in the literary works of D. H. Lawrence and Virginia Woolf, focusing in particular on the relevance and resonance of contemporary research on molecular movement, especially Brownian motion, to the experience and description of living in a modern urban setting.

That a scientific phenomenon like Brownian motion should appear in some form within literature is not surprising, especially when we consider the fierce debates that raged over the course of the nineteenth century as to the cause of this motion. Indeed, as Stephen Brush explains, by 1878 'the phenomenon of Brownian movement was becoming widely known, as can be seen from the many references to it in scientific journals and even in fiction'.<sup>1</sup> Brush highlights the direct mention of Robert Brown's pioneering work on the topic in George Eliot's *Middlemarch* (1872): here the doctor, Lydgate, offers the clergyman, Mr Farebrother, 'Robert Brown's new thing – *Microscopic Observations on the Pollen of Plants*' as a 'fair barter' for the latter's 'lovely anencephalous monster'.<sup>2</sup> Lydgate's qualification to the offer, 'if you don't happen to have it already', emphasises the popularity

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1 Stephen G. Brush, 'A History of Random Processes. I. Brownian Movement from Brown to Perrin', *Archive for History of Exact Sciences*, 5/1 (1968), 9-10.

2 Ibid. 10 n. 29; George Eliot, *Middlemarch*, ed. W. J. Harvey (London, 1965), 202-4.

of this work, while his inclusion of it in his 'fair barter' suggests its value as a piece of significant and up-to-date research.<sup>3</sup>

Of course, the presence of science in literature does not have to be, and indeed usually is not, as direct as in this example, and it is on the more subtle links between the two that we will be focusing here. Still, the idea that scientific concepts and phenomena like Brownian motion can and do find their way into literature in this less direct manner is not a new one, as Daniel Albright's work shows: 'In Auden's *The Orators*, as well as in the recent fiction of Donald Barthelme and others, human social behaviour is explicable through probability theory, particle interaction, Brownian movement'.<sup>4</sup> What I wish to suggest here, then, is that, just as images of crowds provided a useful way for scientists to visualise and explain the movements of molecules, both in general and within the phenomenon of Brownian motion, so Brownian motion provided literary writers with interesting insights into, and a new vocabulary and set of images with which to describe, the movements and interactions of modern crowds. That there was an awareness of and interest in ideas like Brownian motion among literary intellectuals in the early twentieth century is suggested by one of F. T. Marinetti's futurist manifestos from 1913: in this manifesto, Marinetti encourages us to abandon 'the obsessive *I* that up to now the poets have described, sung, analysed, and vomited up', calling instead for a focus on 'the infinite smallness that surrounds us, the imperceptible, the invisible, the agitation of atoms, the Brownian movements, all the passionate hypotheses and all the domains explored by the high-powered microscope'.<sup>5</sup>

We have already seen, in the previous chapter, that Woolf and Lawrence both had

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<sup>3</sup> Eliot, *Middlemarch*, 204.

<sup>4</sup> Daniel Albright, *Personality and Impersonality: Lawrence, Woolf, and Mann* (Chicago, 1978), 5.

<sup>5</sup> F. T. Marinetti, 'Destruction of Syntax – Imagination without Strings – Words-in-Freedom 1913', in Umbro Apollonio, ed., *Futurist Manifestos*, trans. Robert Brain et al. (London, 2009), 100. Floris Delattre also refers to the discrete, atomic nature of contemporary physics, including Brownian motion, in her study *Le Roman psychologique de Virginia Woolf* (Paris, 1932), 127-8. I am grateful to Anne-Marie Willison for providing me with a translation of the relevant passage from this text.

access to contemporary ideas and images of both molecular movement and crowd psychology, and we have also seen that both the nineteenth and the twentieth centuries were witness to a dramatic growth in population, in particular in terms of that in urban areas, while the increasing organisation of the masses into political forces in their own right encouraged the urgency with which such questions were addressed by those in power. The outbreak of the First World War in 1914 also influenced contemporary approaches to the concept of the mass, and certainly affected Lawrence's view of humanity taken as a whole: in 1916 he wrote to E. M. Forster of the need for 'a flood to drown mankind', linking this need directly to the ongoing war in which 'it rains bombs etc. by their own contrivance'.<sup>6</sup> Meanwhile, in 1917 he complained of the destructive nature of the herd, stating 'I disbelieve *utterly* in the public, in humanity, in the mass'.<sup>7</sup>

While urban population growth was of clear significance throughout the nineteenth and into the twentieth centuries, the later stages of the nineteenth century also introduced a new aspect to this issue in the form of the emergence of the commuter suburbs, a phenomenon which both Woolf and Lawrence address directly in their writings. Stephen Kern has emphasised the difference which such a development made to the size of the urban population, which had previously been limited by 'the distance workers could travel to work on foot or by horse'.<sup>8</sup> John Carey has also highlighted the significance of 'the growth of suburbs and the enormous increase in the numbers of white-collar workers' who lived in them, while Gail Cunningham has explained that commuters form 'a crowd that *moves*, and that moves, moreover, in a purposeful and patterned manner'.<sup>9</sup> This development, taken together with the others given above, highlight the contemporary

6 D. H. Lawrence, letter to E. M. Forster dated 6 November 1916, *The Letters of D. H. Lawrence*, ed. James T. Boulton et al., 8 vols (Cambridge, 1979-2000), iii, 20-21.

7 Lawrence, letter to Waldo Frank dated 27 July 1917, *Letters*, iii, 143.

8 Stephen Kern, *The Culture of Time and Space 1880-1918* (Cambridge, Massachusetts, 1983), 191.

9 John Carey, *The Intellectuals and the Masses: Pride and Prejudice among the Literary Intelligentsia, 1880-1939* (London, 1992), 46; Gail Cunningham, 'London Commuting: Suburb and City, the Quotidian Frontier', in Gail Cunningham and Stephen Barber, eds., *London Eyes: Reflections in Text and Image* (New York, 2007), 12.

relevance of Gustave Le Bon's 1895 work *La Psychologie des foules*.

Meanwhile, Laura Marcus has written of the significance of the city to modernist literature as 'a metaphor for the trajectories of narrative itself', adding that 'Its new forms of transport and the chance encounters it sustains also provided powerful metaphors for human relationships'.<sup>10</sup> In addition, according to Richard Lehan 'the two great subjects of modern literature are the artist and the city', two subjects which combine to mean that 'the one great subject has to be the artist in the city – an aesthetic consciousness in the midst of the mob, a controlling sensibility within the maze'.<sup>11</sup> We will return to the figure of the artist later, but first let us consider the city, and especially the crowds within it, as they appear in the literature of Woolf and Lawrence.

For both Woolf and Lawrence, as for so many writers of the period, one of the key features of the city seems to have been its sense of movement, its liveliness, an aspect which, especially for Woolf, most frequently has positive connotations. Thus in *The Trespasser* (1912), Lawrence writes of Siegmund making his way home across London 'amid all the vast miracle of movement in the city night', a movement with which, due to his 'sense of wonder', Siegmund's own is contrasted as he 'went on slowly, like a slow bullet winging into the heart of life'.<sup>12</sup> Siegmund thus appears like George at the end of *The White Peacock* (1911), 'apart and obscure among us', moving 'amid' the general movement of the city, but 'slowly', dreamily, wonderingly.<sup>13</sup> For Woolf meanwhile, the city encompasses 'the great and eternally moving pattern of human life' in *Night and Day* (1919), and 'the crowded dance of modern life' in 'Life and the Novelist' (1926).<sup>14</sup> Woolf is particularly adept at capturing the dynamic movement of the city, as demonstrated in her essay 'Oxford Street Tide' (1932) which emphasises the 'changing sights, sounds and

<sup>10</sup> Laura Marcus, *Virginia Woolf* (2<sup>nd</sup> edn, Tavistock, 2004), 61.

<sup>11</sup> Richard Lehan, *The City in Literature: An Intellectual and Cultural History* (Berkeley, 1998), 106.

<sup>12</sup> D. H. Lawrence, *The Trespasser*, ed. Elizabeth Mansfield (Cambridge, 1981), 169.

<sup>13</sup> D. H. Lawrence, *The White Peacock*, ed. Andrew Robertson (Cambridge, 1983), 325.

<sup>14</sup> Virginia Woolf, *Night and Day*, ed. Julia Briggs (London, 1992), 65; *The Essays of Virginia Woolf*, ed. Andrew McNeillie and Stuart N. Clarke, to be completed in 6 vols (London, 1986–), iv, 405.

movement' of London which exists 'in perpetual race and disorder'.<sup>15</sup>

Prolonged observation of the city, and of the crowds within it, does not always have a positive effect, however, and this is particularly noticeable in some of Lawrence's city scenes. Thus in *Sons and Lovers* (1913), Paul and Clara stand looking down from Nottingham Castle at the 'tiny people' who go 'scurrying about in almost ludicrous importance'.<sup>16</sup> Paul comments 'You feel as if you could scoop up the folk like tadpoles, and have a handful of them', to which Clara replies, 'Yes – it is not necessary to get far off in order to see us proportionately' (313). This is reminiscent of a scene in *The White Peacock*, which we will explore in more detail later, where Cyril and George sit looking out at the London crowds passing a restaurant: to Cyril's comment 'I like to watch the people', George replies 'Ay – and doesn't it seem an aimless, idiotic business – look at them!' (286). While clearly a more violent exclamation than Clara's, George's words express the same idea of the pointlessness and triviality of human life when viewed from a distance. We should note, however, that George's 'them' becomes, for Clara, a realisation that 'it is not necessary to get far off in order to see *us* proportionately' (my emphasis). Whether we see ourselves as part of the crowd or not is a vital question, and one to which we will return later when we consider the relationship between the crowd and the individual in more detail. It is worth noting at this point, however, that it was a question of which Woolf was also painfully aware: recording a trip to Hampstead Heath on Easter Monday 1919, Woolf refers to the crowd in the third person throughout until the moment at which an aeroplane appears which 'made more noise than the whole crowd of us', a slip which causes her to pause to question 'Why do I say "us"? I never for a moment felt myself one of "them"'.<sup>17</sup>

As we saw in the previous chapter, Brownian motion is caused by the collisions of

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<sup>15</sup> Woolf, *Essays*, v, 284.

<sup>16</sup> D. H. Lawrence, *Sons and Lovers*, ed. Helen Baron and Carl Baron (Cambridge, 1992), 313.

<sup>17</sup> Virginia Woolf, diary entry for 24 April 1919, *The Diary of Virginia Woolf*, ed. Anne Olivier Bell and Andrew McNeillie, 5 vols (London, 1977-84), i, 268.

the molecules of a fluid with the larger particles of a substance suspended within that medium: random fluctuations within the fluid cause a number of molecules to hit the particle at the same time, together providing enough energy to move the particle. City life, according to Walter Benjamin also 'involves the individual in a series of shocks and collisions', and Woolf seems to have shared this way of seeing the city.<sup>18</sup> Writing about walking home along Oxford Street in 1930, Woolf describes how 'People fight & struggle. Knocking each other off the pavement', while more than ten years earlier, in 1918, she had written of the 'jerks & spasms' of London.<sup>19</sup> Such images also appear regularly in Woolf's fiction: in *The Years* (1937) 'People jostled and hustled and [Eleanor] quickened her pace in time with theirs', while later Crosby pauses to rest before she goes on 'to do battle with the crowd of shoppers in the High Street' where she will 'have to shove and push, and be jostled this way and that'.<sup>20</sup> In *Flush* (1933), on their arrival in Italy, 'Flush leapt and jumped this way and that, and so did Wilson' as 'They were forced on and off the pavement twenty times, to avoid a cart, a bullock, a troop of soldiers, a drove of goats'; and in 'Abbeys and Cathedrals' (1932) the problem of sustaining a line of reasoned thought under such circumstances is emphasised as Woolf breaks off to reflect 'how we jostle and skip and circumvent each other in the street, how sharply we cut corners, how nimbly we skip beneath motor cars'.<sup>21</sup> Likewise, in 1922 Lawrence wrote that 'One gets a sore soul' in America because 'the people charge at you like trucks coming down on you – no awareness. But one tries to dodge aside in time. Bump! bump! go the trucks. And that is human contact'.<sup>22</sup> A similar image appears in his poem 'Song of a Man Who is Loved' (written by 1917, published 1928):

All things on the move, going their own little ways, and all

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18 Walter Benjamin, *Charles Baudelaire: A Lyric Poet in the Era of High Capitalism*, trans. Harry Zohn (London, 1973), 132.

19 Woolf, diary entries for 28 March 1930 and 3 January 1918, *Diary*, iii, 298 and i, 95.

20 Virginia Woolf, *The Years*, ed. Jeri Johnson (London, 1998), 82, 222.

21 Virginia Woolf, *Flush: A Biography*, ed. Alison Light (London, 2000), 65; Woolf, *Essays*, v, 302.

22 Lawrence, letter to Amy Lowell dated 19 October 1922, *Letters*, iv, 325.

Jostling, people touching and talking and making small  
 Contacts and bouncing off again, bounce! bounce like a ball!<sup>23</sup>

Meanwhile, in *Aaron's Rod* (1922) Lawrence writes of 'the sense of friction [Lilly] got from the streaming of people who meant nothing to him', an experience which Lilly enjoys in contrast to Aaron's contact with the crowd which robs him later in the novel: 'a gang of soldiers suddenly rushed round him, buffeting him in one direction, whilst another gang, swinging round the corner, threw him back helpless again into the midst of the first gang'.<sup>24</sup>

Marshall Berman, in his reflections on Charles Baudelaire's poetry, has explored the 'moving chaos' of the modern city street in some detail, explaining that it 'lies not in the movers themselves – the individual walkers or drivers, each of whom may be pursuing the most efficient route for himself – but in their interaction, in the totality of their movements in a common space'.<sup>25</sup> This leads to an interesting phenomenon:

In order to cross the moving chaos, he [the 'man in the modern street'] must attune and adapt himself to its moves, must learn to not merely keep up with it but to stay at least a step ahead. He must become adept at *soubresauts* and *mouvements brusques*, at sudden, abrupt, jagged twists and shifts – and not only with his legs and his body, but with his mind and his sensibility as well.<sup>26</sup>

As such, in order to avoid the Brownian-esque collisions that the modern city threatens, Berman's modern man has to pre-empt them; yet such avoidance means that he still exhibits an equivalent spasmodic pattern of movement.

Apart from, although linked to, the movement and collisions which characterise modern city crowds and life, the fleetingness and the randomness of the interactions that are thereby created are also of key importance to modernist conceptions of the self in the city. Janet Wolff emphasises the former, talking of 'the fleeting, ephemeral, impersonal nature of encounters in the urban environment', while Elizabeth Wilson suggests that such

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<sup>23</sup> *The Complete Poems of D. H. Lawrence*, ed. Vivian de Sola Pinto and Warren Roberts, 2 vols (rev. repr., London, 1967), i, 249.

<sup>24</sup> D. H. Lawrence, *Aaron's Rod*, ed. Mara Kalnins (Cambridge, 1988), 111, 228.

<sup>25</sup> Marshall Berman, *All That Is Solid Melts Into Air: The Experience of Modernity* (London, 1983), 159.

<sup>26</sup> *Ibid.*

fragmentary encounters mean that 'we observe bits of the "stories" men and women carry with them, but never learn their conclusions; life ceases to form itself into epic or narrative, becoming instead a short story, dreamlike, insubstantial or ambiguous'.<sup>27</sup> Woolf shows a particularly keen awareness of this concept in 'Street Haunting: A London Adventure' (1927) when she compares flicking through books in a second-hand bookshop to the process whereby 'in the street outside, one catches a word in passing and from a chance phrase fabricates a lifetime'.<sup>28</sup> Similarly, in 'Kew Gardens' (1919) we catch momentary glimpses of individual stories as characters pass by the flower bed, but it is important to note that the narrator of this story is stationary, unlike in 'Street Haunting' – an extra sense of the movement and random interactions of city life is captured in the latter exploration, in which both narrator and subjects are moving, often in opposite directions.

However, despite the obvious importance of crowds and masses to modern literary expressions of the city, it is clear that within the fiction of both Woolf and Lawrence individual characters remain distinct and all-important for the reader – the very title of *Mrs Dalloway* (1925) emphasises this, while Lawrence tells us in *Kangaroo* (1923) that 'the only way to make any study of collective psychology is to study the isolated individual'.<sup>29</sup> Indeed, the nature of fiction, and of the novel in particular, means that individual characters cannot be overwritten by images of the mass. Even in the group consciousness of *The Waves* (1931), the reader is able to hold on to the six individuals as distinct, at least at certain moments within the narrative. What is interesting in terms of crowds in literature, then, are the ways in which an individual character relates to them; the ways in which they remain distinct from them or are affected by them. At this point it is worth returning to the idea of different types of crowds, an idea which was particularly well expressed by William

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27 Janet Wolff, 'The Invisible Flâneuse: Women and the Literature of Modernity', *Theory, Culture & Society*, 2/3 (1985), 38; Elizabeth Wilson, 'The Invisible Flâneur', *New Left Review*, 1/191 (1992), 107.

28 Woolf, *Essays*, iv, 488.

29 D. H. Lawrence, *Kangaroo*, ed. Bruce Steele (Cambridge, 1994), 294.

McDougall as we saw in the previous chapter, and which is worth quoting again here.

McDougall explains the difference between a 'mass of human beings' and a 'crowd in the psychological sense of the word' in the following manner:

There is a dense gathering of several hundred individuals at the Mansion House Crossing at noon of every week-day; but ordinarily each of them is bent upon his own task, pursues his own ends, paying little or no regard to those about him. But let a fire-engine come galloping through the throng of traffic, or the Lord Mayor's state coach arrive, and instantly the concourse assumes in some degree the character of a psychological crowd. All eyes are turned upon the fire-engine or coach; the attention of all is directed to the same object; all experience in some degree the same emotion, and the state of mind of each person is in some degree affected by the mental processes of all those about him. Those are the fundamental conditions of collective mental life.<sup>30</sup>

McDougall's book, *The Group Mind: A Sketch of the Principles of Collective Psychology with Some Attempt to Apply Them to the Interpretation of National Life and Character*, was first published in 1920, and for any reader of Woolf the first thing that strikes one in the passage above is its similarity to certain moments in *Mrs Dalloway*, published just five years later.<sup>31</sup> The early scenes involving the motor car and the aeroplane are particularly reminiscent of McDougall's description of a psychological crowd: in the former, 'Every one looked at the motor car', just as 'the attention of all is directed to the same object' in McDougall.<sup>32</sup> Meanwhile, we see that 'all experience in some degree the same emotion', even if only for 'thirty seconds', as 'in all the hat shops and tailors' shops strangers looked at each other and thought of the dead; of the flag; of Empire' (19). This universally fixed attention on the motor car is preserved until the aeroplane appears, at which point 'Every one looked up' (22): the attention of the crowd is shifted from the question 'Whose face was it?' (15), to another question, 'what word was it writing?' (23). As Gillian Beer emphasises, however, 'Each person reads the plane's message differently', but

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<sup>30</sup> William McDougall, *The Group Mind: A Sketch of the Principles of Collective Psychology with Some Attempt to Apply Them to the Interpretation of National Life and Character* (Cambridge, 1920), 22-3.

<sup>31</sup> See also Lawrence's analysis of different examples of 'the mass-spirit' in *Kangaroo*, 294.

<sup>32</sup> Virginia Woolf, *Mrs Dalloway*, ed. Stella McNichol (London, 1992), 16.

'The message does not matter; the communal act of sky-gazing does'.<sup>33</sup> Both incidents involve the formation of a psychological crowd as defined by McDougall, but interestingly, despite her inclusion in the first psychological crowd, Mrs Dalloway herself remains separate from the second, asking Lucy on her arrival back home not what word the aeroplane has written, but 'What are *they* looking at?' (31, my emphasis).

As many critics have pointed out, these moments in *Mrs Dalloway* seem to have a literary precedent in the 'Wandering Rocks' episode of James Joyce's *Ulysses* (1922): indeed, in 1934 Wyndham Lewis described the car scene in *Mrs Dalloway* as 'a sort of undergraduate imitation' of Joyce's Viceregal Cavalcade.<sup>34</sup> However, closer inspection of each of the relevant passages reveals significant differences between the aims and intentions of Joyce and Woolf, despite the superficial similarities. Thus while the car in *Mrs Dalloway* forms the focus of attention almost, it seems, for everyone in London at one particular moment, Joyce is more concerned to present the random simultaneity of city life, only focusing on the procession in the final coda of the chapter, and in doing so focusing specifically on it in itself rather than on the overall impact which it makes. Those who observe the passing of the Cavalcade are only united in the apparently random fact of having done so, whereas those who observe Woolf's car are united in the collective response thereto of a psychological crowd: the individual stories of Joyce's characters, as told in the earlier sections of his episode, remain more significant than the passing fact that they have each observed this event taking place.<sup>35</sup>

Woolf's focus on the drawing together to a single focus of a mass of disparate individuals across London links her work to the contemporary movement of unanimism, associated in particular with the French novelist Jules Romains. Leonard Woolf had reviewed Romains's *Les Copains* in 1913, highlighting the importance of unanimism to

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33 Gillian Beer, *Virginia Woolf: The Common Ground* (Edinburgh, 1996), 161.

34 Wyndham Lewis, *Men Without Art* (London, 1934), 168.

35 See James Joyce, *Ulysses*, ed. Jeri Johnson (Oxford, 1993), 210-44.

this work, even though 'it does not dominate the book as it did *Mort de Quelqu'un*', first published two years earlier, in 1911, and first translated into English by Desmond MacCarthy and Sydney Waterlow in 1914.<sup>36</sup> In his dedicatory letter to Roger Fry in his translation of *The Death of a Nobody* MacCarthy explains that

Individuality – character, the very pivot on which the art of the novelist has turned hitherto, is here made of no account. Individuals are as of little importance as wisps of straw riding down a river in flood-time, melting and dissolving as they pass, one straw going this way, one that; congregated together with bubbles and sticks they may make a noticeable patch on the sliding surface for a moment; detaching themselves again and still borne onwards, they are gradually dismembered and scattered and finally – lost? Well, in a sense.<sup>37</sup>

The relevance of Romain's work, and of the unanimist movement more generally, to Virginia Woolf's novels has been commented on by a number of critics, in particular Allen McLaurin, who focuses on *The Waves*, and E. M. Forster, who described the closing chapters of *The Voyage Out* (1915) as having 'an atmosphere unknown in English literature – the atmosphere of Jules Romain's *Mort de Quelqu'un*'.<sup>38</sup> However, the image used by MacCarthy to describe Romain's work seems also to have had a particular resonance for Woolf, and appears at various moments within her later works: thus in *The Waves*, Louis reflects 'We are drawn through the booking-office on to the platform as a stream draws twigs and straws round the piers of a bridge', while in *The Years* Charing Cross station is repeatedly described in similar terms, as 'People on foot, people in cabs were being sucked in like straws round the piers of a bridge' (82).<sup>39</sup> Meanwhile, North's reflections in the final

<sup>36</sup> Leonard Woolf, 'Les Copains', mistakenly attributed to Virginia Woolf and thus included in her *Essays*, ii, 17. The mistake is highlighted and corrected by B. J. Kirkpatrick and Stuart N. Clarke in their *Bibliography of Virginia Woolf* (4<sup>th</sup> edn, Oxford, 1997), 304.

<sup>37</sup> Desmond MacCarthy, Dedication to Jules Romain, *The Death of a Nobody*, trans. Desmond MacCarthy and Sydney Waterlow (New York, 1914), vi-vii.

<sup>38</sup> Allen McLaurin, 'Virginia Woolf and Unanimism', *Journal of Modern Literature*, 9/1 (1981-2), 115-22; E. M. Forster, in Robin Majumdar and Allen McLaurin, eds., *Virginia Woolf: The Critical Heritage* (London, 1975, repr. 1997), 54.

<sup>39</sup> Virginia Woolf, *The Waves*, ed. Kate Flint (London, 1992), 21. See also 84 and 172 in *The Years*. The fact that these images are related to train travel suggests another possible link to *The Death of a Nobody* which focuses both on the death of a man who had been a train driver and on his father's journey from rural France to Paris by train. However, see also *A Room of One's Own* (1929) where the 'river, which flowed past, invisibly, round the corner, down the street, and took people and eddied them along' brings together the 'girl in patent leather boots', the 'young man in a maroon overcoat' and the taxi-cab, Virginia Woolf, *A*

section of *The Years* that he wishes to be 'the bubble and the stream, the stream and the bubble – myself and the world together' (300) indicate Virginia Woolf's awareness, also present in Leonard Woolf's review, that Romaine's aim is to give 'a kind of consciousness of the group *in addition to* that of each individual of the group'.<sup>40</sup>

In contrast to the psychological crowd, or unanimist group consciousness, of *Mrs Dalloway*, the crowd of commuters which appears in *Night and Day* provides an example of McDougall's 'dense gathering of several hundred individuals at the Mansion House Crossing at noon of every week-day'. Although Katharine sees these commuters as 'tend[ing] the enormous rush of the current – the great flow, the deep stream, the unquenchable tide' (374), there is no indication that they are pursuing anything other than their own ends; indeed it is Katharine's pursuit of *her* own ends that forces these other individuals to appear, both for her and for the reader, as 'two currents' (374): 'More and more plainly did she see him [Ralph]; and more and more did he seem to her unlike any one else' (375). In a more chaotic version of a similar scene, although one in which reference is still made to 'Streams of people', the protagonist of *Orlando* (1928) is confronted by the confusing multiplicity of the streets of London:

She looked anxiously at people's faces. But that confused her still more. Here would come by a man sunk in despair, muttering to himself as if he knew some terrible sorrow. Past him would nudge a fat, jolly-faced fellow, shouldering his way along as if it were a festival for all the world. Indeed, she came to the conclusion that there was neither rhyme nor reason in any of it. Each man and each woman was bent on his own affairs. And where was she to go?<sup>41</sup>

This scene provides a particularly clear example of McDougall's non-psychological crowd, and the verbal similarity between Woolf's penultimate sentence above and McDougall's phrase 'each of them is bent upon his own task' is worth noting.

In terms of our exploration of links between Brownian motion and crowds, it is

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*Room of One's Own/Three Guineas*, ed. Michèle Barrett (London, 1993), 87.

<sup>40</sup> Leonard Woolf, 'Les Copains', 17, my emphasis.

<sup>41</sup> Virginia Woolf, *Orlando: A Biography*, ed. Brenda Lyons (London, 1993), 191.

clear that the 'mass of human beings' model is of greater relevance and significance to us than that of the psychological crowd. As we saw in the previous chapter, the difference between the two is expressed scientifically in Jean Perrin's explanation of the difference between the movements of dust particles and Brownian particles:

it is easy to see that the neighbouring dust-particles move in general in the same sense, roughly tracing out the form of the common current which bears them along, whereas the most striking feature of the Brownian movement is the absolute independence of the displacements of neighbouring particles, so near together that they pass by one another.<sup>42</sup>

Brownian particles thus resemble McDougall's non-psychological crowd, the individual in which 'is bent upon his own task, pursues his own ends, paying little or no regard to those about him'. This is the model of the crowd that Woolf is presenting in *Night and Day*, but we can perhaps extend this image further: in that the crowd rushing past Katharine appears, to her at least, as 'the great flow, the deep stream, the unquenchable tide', it is possible to picture Katharine as something like the particle suspended in a fluid whose movements, provoked by the surrounding medium, are known as Brownian motion. Katharine certainly remains detached from the crowd which surrounds her, existing as 'an invisible spectator'; there is only one short moment during which she appears to be about to be overwhelmed by and 'absorbed' into it, but in that instant her recollection of the individual figure of Ralph calls her back to herself: 'Suddenly she was clutched, unwilling, from the outside, by the recollection of her purpose in coming there. She had come to find Ralph Denham' (374). Earlier in the novel, looking out of the window of an inn over the streets of Lincoln, Ralph had himself experienced a similar moment of revelation, as Katharine appeared among the crowd below which 'seemed to him only a dissolving and combining pattern of black particles':

he was about to turn and ask the waiter to bring the bill, when his eye was caught by a tall figure walking quickly along the opposite pavement

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<sup>42</sup> Jean Perrin, *Brownian Movement and Molecular Reality*, trans. F. Soddy (London, 1910), 5.

– a tall figure, upright, dark, and commanding, much detached from her surroundings. (193)

In addition to these instances, it is worth noting that Woolf herself uses the word 'suspended' on a number of occasions, most notably for our purposes in *To the Lighthouse* (1927) where she writes of Mrs Ramsay that 'For the moment she hung suspended', glossing this a few pages earlier as follows: 'she hovered like a hawk suspended; like a flag floated in an element of joy'.<sup>43</sup>

Both Woolf and Lawrence make frequent references in their works to some kind of medium as opposed to the distinct individual within it. Thus in *The White Peacock* Cyril feels 'as if I were a mere fleck drifting unconsciously through the dark' on learning of the death of his father (37), while in *The Trespasser*, 'Siegmond and Helena, two grains of life in the vast movement, were travelling a moment side by side' (78). As we have seen, the 'vast miracle of movement' will reappear later in this novel, and the fact that Siegmond experiences the later example on his own emphasises the momentary nature of his and Helena's union here, a fact which the novel as a whole also highlights. For Woolf, the medium is usually less abstract and is most often liquid in form, as in the examples from *Night and Day*, or in the essay 'Oxford Street Tide' which describes 'the bounding, careless, remorseless tide of the street'.<sup>44</sup> Images involving a liquid medium, 'naturally come to mind every time we speak of crowds as well as publics' according to Gabriel Tarde as both are 'like streams with a poorly defined channel', and Lawrence also frequently returns to the 'two divided streams' of modern urban life, as in *Kangaroo* (306).<sup>45</sup> Similarly, Georg Simmel in 'The Metropolis and Mental Life' (1903) describes the 'stimulations, interests, uses of time and consciousness' of life in the metropolis as like a 'stream' in which 'one needs hardly to swim for oneself'.<sup>46</sup> Interestingly in relation to Brownian motion, Simmel

43 Virginia Woolf, *To the Lighthouse*, ed. Stella McNichol (London, 1992), 116, 114.

44 Woolf, *Essays*, v, 287.

45 Gabriel Tarde, *On Communication and Social Influence: Selected Papers*, ed. Terry N. Clark, trans. N. Claire Ellis, Priscilla P. Clark and Terry N. Clark (Chicago, 1969), 278.

46 *The Sociology of Georg Simmel*, ed. and trans. Kurt H. Wolff (Glencoe, Illinois, 1950), 422.

also speaks of the difficulty of maintaining one's individual personality under the 'impact' of so many and such varied stimulations.<sup>47</sup>

Characters like Katharine Hilbery and many of Lawrence's strong characters do manage to maintain their own personalities despite the impacts upon them of the media surrounding them, however; but this does not make for an easy relationship with such a medium, and this is a difficulty with which Lawrence's characters seem to struggle in particular. Miriam in *Sons and Lovers* provides an especially noticeable example, with Lawrence writing that 'She always looked so lost and out of place among people' (458), and the phrasing here again reminds us of George at the end of *The White Peacock*, 'apart and obscure among us'. Similarly, with Lydia in *The Rainbow* (1915) we see that 'It was very difficult for her to adjust herself' to the 'looming presences' which, for her, form the 'people who passed around her'.<sup>48</sup> Her initial meeting with Tom Brangwen provokes a different reaction, however: 'But she had felt Brangwen go by almost as if he had brushed her. She had tingled in body as she had gone on up the road' (54). This imagery suggests a direct link with the molecular-type collisions that modern life seems to promote.

The moment when Tom and Lydia pass each other in the road is a very powerful one, and one which links our discussions with yet another widely explored aspect of modernity and city life: the *flâneur* and the *passante*. Both of these figures are associated with the poetry of Baudelaire, especially as explored by Benjamin and Berman, and the latter appears most vividly in the poem 'A une passante' (1860) in which Baudelaire describes a fleeting, momentary encounter with a widow in the streets of France, an experience which leaves him 'suddenly reborn' due to what Deborah Parsons calls, 'the shock of the mutual encounter'.<sup>49</sup>

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47 Ibid.

48 D. H. Lawrence, *The Rainbow*, ed. Mark Kinkead-Weekes (Cambridge, 1989), 53.

49 Quotations from Baudelaire's 'A une passante' are taken from the translation by C. F. MacIntyre which appears in Benjamin's *Charles Baudelaire*, 45; Deborah L. Parsons, *Streetwalking the Metropolis: Women, the City, and Modernity* (Oxford, 2000), 72.

That Lawrence had this poem in mind when writing the scene in which Tom and Lydia share such a 'mutual encounter' is suggested by the very nature of the scene, as well as the fact that, like the *passante* 'in deep mourning', Lydia is a widow 'dressed in black' (29). For Tom, the incident leaves him feeling 'as if a new creation were fulfilled, in which he had real existence' (32); meanwhile, for Lydia Tom 'was the man who had come nearest to her for her awakening' (54), images which are certainly reminiscent of Baudelaire's rebirth, although perhaps without the 're-'. That Lawrence knew the poem seems likely based on the fact that Jessie Chambers describes Baudelaire and Verlaine as 'the two great poetic lights in [Lawrence's] firmament' around 1909, and goes on to specifically mention *Les Fleurs du Mal*, the collection in which it originally appeared.<sup>50</sup> Lawrence's knowledge of the poem and his use thereof in this fictional scene is further emphasised as it draws to a close when he writes 'She had passed by' (29).

What is intriguing, however, is the contrast in settings between the scene described in *The Rainbow* and that which forms the backdrop for Baudelaire's poem. Many critics, Parsons included, have explained that the interaction described by Baudelaire in 'A une passante' 'is particular to the modern city – a sudden collision with the unknown, a transient moment of communication and then move away back into anonymity'.<sup>51</sup> Meanwhile, Benjamin explains that although 'the crowd is nowhere named in either word or phrase' within the poem, 'the whole happening hinges on it, just as the progress of a sailing-boat depends on the wind', and such an image may remind us of Perrin's focus on the movements of the Brownian particle as the visible manifestation of smaller, molecular movements in his image of a ship rocking on invisible waves.<sup>52</sup> Neither is the crowd named by Lawrence in *The Rainbow*, but this is because his setting is *not* that of the city: Tom is

<sup>50</sup> Jessie Chambers, *D. H. Lawrence: A Personal Record* (Cambridge, 1980), 121, 122.

<sup>51</sup> Parsons, *Streetwalking*, 72.

<sup>52</sup> Benjamin, *Charles Baudelaire*, 124; Jean Perrin, *Atoms*, trans. D. LL. Hammick (London, 1920), 83. In turn, it is worth noting a similar image in Woolf's *The Waves*: 'I am going to push out into the heterogeneous crowd. I am going to be buffeted; to be flung up, and flung down, among men, like a ship on the sea' (134).

'coming one day from Cossethay' (based on the real-life village of Cossall) when he sees Lydia for the first time, not in Nottingham or even Ilkeston (29). The identical experiences that the subject of Baudelaire's poem and Lawrence's Tom undergo thus occur in completely opposite settings, thereby suggesting that the changes in human interactions which city and crowd life have fostered have also been translated to the less busy, less chaotic world of the country and village life. However, one important difference between the experiences of the male subjects remains: while we know that Baudelaire's subject will never meet his *passante* again, and that, as Benjamin states, 'The delight of the city-dweller is not so much love at first sight as love at last sight', Tom will marry Lydia – even the title of the chapter, 'How Tom Brangwen Married a Polish Lady' (9), tells us so.<sup>53</sup> Thus, while the subject of Baudelaire's poem states 'Neither knows where the other goes or lives', Tom is able to ask Tilly 'Who might that be?' (30), and that Tom's interest does indeed lie in love at first sight is emphasised by his involuntary exclamation 'That's her' (29). Another crucial development that Lawrence's text provides is that the point of view of the *passante* herself is given, as we saw above. Even though this perspective is only given briefly in comparison with Tom's own view of the event – Lydia's experience is captured in a single five-line paragraph (54) – and even though it only appears some twenty-five pages after the event itself, it almost, although not fully, meets Wolff's request for 'a poem written by "la femme passante"' about her encounter with Baudelaire'.<sup>54</sup>

The figure of the *flâneur* is, perhaps, more widely known than that of his female counterpart. He is an observer, a wanderer (and also a wonderer) 'without aim', or rather whose 'aimless stroll *is* the aim'.<sup>55</sup> For Baudelaire, the *flâneur* is the same as Edgar Allan Poe's 'man of the crowd', although Benjamin suggests that this cannot be the case as in the

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53 Benjamin, *Charles Baudelaire*, 45.

54 Wolff, 'The Invisible *Flâneuse*', 45.

55 Zygmunt Bauman, 'Desert Spectacular', in Keith Tester, ed., *The Flâneur* (London, 1994), 139.

latter 'composure has given way to manic behaviour'.<sup>56</sup> Either way, Poe's short story 'The Man of the Crowd' (1840) appears to have some relevance for Lawrence's Cyril in *The White Peacock*, although Cyril is comparable with the narrator of Poe's story rather than the eponymous man of the crowd. Poe's short story opens with the narrator 'sat at the large bow window of the D- Coffee-House in London' feeling 'a calm but inquisitive interest in every thing'.<sup>57</sup> He gradually becomes 'absorbed in contemplation of the scene without', explaining that 'At this particular period of the evening I had never before been in a similar situation, and the tumultuous sea of human heads filled me, therefore, with a delicious novelty of emotion'.<sup>58</sup> When we turn to *The White Peacock* we find a scene in which Cyril plays a very similar role to this narrator-observer: sitting in a London restaurant with George, Cyril describes the fascination of watching 'the come and go of people weaving and intermingling in the complex mesh of their intentions, with all the subtle grace and mystery of their moving, shapely bodies', a sight which leads him to describe the view before him as an 'amphitheatre' (286).

Such images of Cyril watching the crowd while remaining detached from it as some sort of audience can be found at various points within this novel; and indeed in many ways the above passage can be seen as Cyril's (or perhaps Lawrence's) justification for the whole narrative approach to this novel, in that Cyril never quite seems to be either fully engaged with or fully detached from the action and the stories played out within it. In an earlier London scene, Cyril explains how he 'began to love the town':

In the mornings I loved to move in the aimless street's procession, watching the faces come near to me, with the sudden glance of dark eyes, watching the mouths of the women blossom with talk as they passed, watching the subtle movements of the shoulders of men beneath their coats, and the naked warmth of their necks that went glowing along the street. (264)

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<sup>56</sup> Benjamin, *Charles Baudelaire*, 128.

<sup>57</sup> Edgar Allan Poe, *Tales and Sketches*, ed. Thomas Ollive Mabbott, 2 vols (Urbana, 2000), i, 507.

<sup>58</sup> Ibid. Note that Poe also envisages the crowd in terms of a liquid image, referring to the 'two dense and continuous tides of population'.

The use of the continuous tense here gives us a sense of the movement and bustle of the city, while the repeated verb 'watching' emphasises Cyril's slight detachment from the scene which he is describing – although he is moving 'in the aimless street's procession' we still do not feel that he is directly engaged with it. Writing about Poe's 'The Man of the Crowd', Benjamin states that 'The first thing that strikes one is the rapt attention with which the narrator follows the spectacle of the crowd', and the same could certainly be applied to Cyril as he appears in these interludes.<sup>59</sup>

If we accept Benjamin's idea that Poe's man of the crowd is too 'manic' to be a true *flâneur*, it seems to me that both Cyril and Poe's narrator are themselves representative of the figure of the *flâneur*: both observe the city life around them, playing a part in the urban scene in which they find themselves, even though often at a slight remove from it. Such a view would tie in with Cunningham's description of the *flâneur* as 'the man who moves randomly through the streets, observing but apart from the crowd, alienated and disconnected, yet deriving stimulus and indeed identity from the city'.<sup>60</sup> While the journey that Poe's narrator takes through the streets of London cannot be seen as without aim, in that he is following the man of the crowd through them, this action in itself is random and, ultimately, pointless. In the same way, Cyril drifts through life, following those around him because he seemingly has nothing better to do.

Cyril is not the only example of a *flâneur*-like figure in Lawrence's works, however; in *The Trespasser* Lawrence unites the figures of the *flâneur* and the *passante* as Siegmund walks home through London in a scene that we have already considered:

He watched the people. Soldiers, belted with scarlet, went jauntily on in front. ... The women went blithely alongside. Occasionally in passing one glanced at him. Then, in spite of himself, he smiled; he knew not why. The women glanced at him with approval, for he was ruddy; besides, he

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<sup>59</sup> Benjamin, *Charles Baudelaire*, 48.

<sup>60</sup> Gail Cunningham, Introduction to 'Part I: Victorian and Edwardian London on the Page', in Cunningham and Barber, eds., *London Eyes*, 3.

had that carelessness and abstraction of despair. The eyes of the women said, 'You are comely, you are lovable,' and Siegmund smiled.

(168-9)

Despite, or perhaps because of, his highly emotional state, Siegmund seems here to be completely free from other responsibilities and able just to observe the people around him. The women, meanwhile, are drawn to him and able to communicate with him in the brief moment in which they pass each other.

The way in which these women communicate with Siegmund, in particular with that repeated 'you', is curiously echoed in *Mrs Dalloway* when Peter Walsh, *flâneur*-like, sets out to follow the 'extraordinarily attractive' young woman he sees in Trafalgar Square:

Straightening himself and stealthily fingering his pocket-knife he started after her to follow this woman, this excitement, which seemed even with its back turned to shed on him a light which connected them, which singled him out, as if the random uproar of the traffic had whispered through hollowed hands his name, not Peter, but his private name which he called himself in his own thoughts. 'You,' she said, only 'you', saying it with her white gloves and her shoulders.

(57-8)

The connection between Peter and the woman seems to be a curious combination of the profound and the ridiculous: the woman may know 'his private name which he called himself in his own thoughts', but 'you' is also clearly a word that could be applied by anybody to anybody else. This whole 'escapade' is a fiction, 'half made up, as he knew very well' (59), but it serves to emphasise both the randomness of city interactions and their anonymous nature. In addition, in the light of our considerations here the fact that Peter's 'fun' is finally 'smashed to atoms' is surely relevant (59).

The figure of the *flâneur* may not at first sight appear to have any relevance to the ideas of Brownian motion that we have been discussing, and yet his nature as both a member of the urban crowd and an individual distinct from it takes us back to the image of the individual as a particle suspended in the medium of the crowd that we have already considered. Rob Shields describes *flânerie* as 'a sociability of "Ones"' in which 'Despite

their proximity [individuals] keep their social distance from each other and preserve a discrete estrangement'.<sup>61</sup> This description certainly seems to have some relevance to models of Brownian motion: the suspended particles remain separate and discrete, existing within the medium that surrounds them, and yet distinct from it. Both the *flâneur* and the suspended particle are influenced by their surrounding medium, but ultimately they stand firm, merely drifting through the currents that transport them. This in turn reminds us of Lehan's claim as to 'the one great subject' of modern literature: 'the artist in the city – an aesthetic consciousness in the midst of the mob, a controlling sensibility within the maze'.<sup>62</sup> Both the *flâneur* and the suspended particle provide us, as either readers or scientists, with the means by which to understand the media which surround them: as Michael Tratner states, they become 'only a phenomenon whose movements, like those of a fish, are there to reveal the action of "the stream," the social medium', much as in Perrin's image of the boat revealing the action of the waves on an apparently calm sea.<sup>63</sup>

Tratner's image is taken from Woolf's 'Sketch of the Past' (written 1939-40) in which Woolf, having discussed 'the invisible presences who after all play so important a part in every life', states 'I see myself as a fish in a stream; deflected; held in place; but cannot describe the stream'.<sup>64</sup> Interestingly, Lawrence used a similar image in his 1925 essay 'The Novel': 'like a fish in the stream the characters in the novel swim and drift and float and turn belly-up when they're dead'.<sup>65</sup> For Woolf, however, the appropriate image is more frequently that of a plant in a river rather than a fish: thus in *Mrs Dalloway*

the shock of Lady Bruton asking Richard to lunch without her made the moment in which [Clarissa] had stood shiver, as a plant on the river-bed feels the shock of a passing oar and shivers: so she rocked: so she shivered. (32)

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61 Rob Shields, 'Fancy Footwork: Walter Benjamin's notes on *flânerie*', in Tester, ed., *The Flâneur*, 63, 77.

62 Lehan, *The City in Literature*, 106.

63 Michael Tratner, *Modernism and Mass Politics: Joyce, Woolf, Eliot, Yeats* (Stanford, 1995), 9.

64 Virginia Woolf, *Moments of Being: Autobiographical Writings*, ed. Jeanne Schulkind (rev. edn, London, 2002), 92.

65 D. H. Lawrence, *Study of Thomas Hardy and Other Essays*, ed. Bruce Steele (Cambridge, 1985), 185.

Similarly, in *The Waves* Jinny describes herself as 'like a plant in the river, flowing this way, flowing that way, but rooted, so that he may come to me' (76), and it is this contrast between being rooted and flowing which makes the image of the plant more interesting in some ways than that of the fish, reminding us also of Mrs Ramsay hanging suspended in *To the Lighthouse*. The image is one which Woolf began using early on: in a 1908 letter to Clive Bell, Woolf thanks him for his 'usual strains of aetherial flattery' in which he has compared her to a waterfall, adding 'But – if you could see me under the influence of Lytton, Saxon and Miss Sheepshanks – “Miss Stephen do you ever think!” you would liken me rather to some swaying reed which swings with the stream'.<sup>66</sup>

The key difference between the fish and the plant within the watery medium lies, of course, in the sense of volition and free will: while a fish may, as in Lawrence's formulation, 'swim and drift and float', a plant is limited to responding to the tide or the current, 'flowing this way, flowing that way'. And yet Jinny does retain a sense of control, remaining rooted so that 'All gold, flowing that way, I say to this one, “Come”. Rippling black, I say to that one, “No”' (76). This leads us to an important point: while the comparison of the focal characters of modernist works with the suspended particle exhibiting Brownian motion is a useful one, I do not mean to imply by it that the characters have no free will of their own within the narrative framework within which they exist: Katharine Hilbery seeks Ralph Denham among the London commuter crowd, and Ralph himself stresses that Katharine looks 'as if the scurrying crowd impeded her, and her direction were different from theirs' (106); Mrs Dalloway buys the flowers for her party; even Lawrence's Aaron recovers his sense of self after being robbed, 'gather[ing] himself together' (229), and taking the decision to 'be always on my guard' (230). These issues are also relevant to the ongoing critical debates surrounding the *flâneur*: Parsons states that

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<sup>66</sup> Virginia Woolf, letter to Clive Bell dated 3 August 1908, *The Letters of Virginia Woolf*, ed. Nigel Nicolson and Joanne Trautmann, 6 vols (London, 1975-80), i, 339-40.

'The *flâneur* is a moving observer, indeed more specifically a *walking* observer, whose movement has autonomy even if not direction', but it is possible to question the extent to which this is truly the case.<sup>67</sup> While the *flâneur* does indeed have autonomy in terms of who he decides to follow, he is then often constrained by where they go, following a path selected by another as does Peter Walsh in *Mrs Dalloway* or Poe's narrator in 'The Man of the Crowd'. In addition, there is often a sense in which the *flâneur* seems to feel compelled to follow these particular individuals: Walsh is drawn by the attractiveness of the young woman, while Poe's narrator is captured by 'a countenance which at once arrested and absorbed my whole attention, on account of the absolute idiosyncrasy of its expression'.<sup>68</sup> If we wish to extend our Brownian motion analogy further, then, the *flâneur*, like the suspended particle, is affected by some kind of unusual and unexpected fluctuation within the medium which surrounds him, but with this difference: the *flâneur* is drawn to follow the fluctuation, rather than pushed away by it; he is attracted rather than repelled. And yet, as in Berman's formulation which we considered earlier, the resultant visible motion remains the same no matter how it is achieved.

We have already considered a number of narrators as *flâneurs*, and it is interesting to explore their relation to this question also. Lawrence tends to employ a more traditional narrator who follows one individual at a time through a particular scene, even when employing the *flâneur*-like Cyril. Thus we are given Tom's perspective on his initial meeting with Lydia in *The Rainbow*, and only later do we see the same scene from Lydia's point of view, and that in the form of a memory. Woolf's narrators are more liable to getting drawn and distracted of their own accord, however, so that in texts like *Mrs Dalloway* and 'Street Haunting' the moving narrator, while ostensibly following one particular character or aim, is in fact jumping between subjects with incredible speed and alacrity. Such a

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<sup>67</sup> Parsons, *Streetwalking*, 224.

<sup>68</sup> Poe, *Tales and Sketches*, i, 511.

movement may remind us of Woolf's frequently quoted reflections on the nature of 'an ordinary mind on an ordinary day' from the essay 'Modern Fiction' (1925): 'The mind receives a myriad impressions – trivial, fantastic, evanescent, or engraved with the sharpness of steel. From all sides they come, an incessant shower of innumerable atoms'.<sup>69</sup> Such an image seems to reflect not only the internal impact of impressions but also the external, physical effects of life in a contemporary metropolis: the narrator, like the *flâneur* or the central characters of modernist novels, is subjected to this 'incessant shower of innumerable atoms', influenced and affected by it but still remaining firm in the face of it.

Our focal characters and, in Woolf at least, narrators do have some impetus or free will of their own, then; they are not exclusively influenced by the media and events which surround them, even though these often play a significant part in their actions. But there is one further point which we have not yet considered: unlike the Brownian particles suspended in a foreign medium, the central characters in modernist novels are not fundamentally different from the medium of the crowd which surrounds them: both they and the crowd are human individuals. This leads us back to Serge Moscovici's claim, which we considered briefly in the previous chapter, that 'The crowd is filled with hundreds of incessant movements like those of particles suspended in a liquid and is perpetually milling and agitated'.<sup>70</sup> The problem with Moscovici's formulation is that he does not provide any indication as to the nature of the surrounding medium, and we are left to wonder whether he is considering this as something more abstract, like Tratner's 'social medium', or whether he simply has not thought through the implications of the scientific model which he is employing here. The advantage of my own model is that it does indeed differentiate between the suspended particles and the surrounding medium, but to what

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<sup>69</sup> Woolf, *Essays*, iv, 160. The same image also appears in the earlier version of this essay, 'Modern Novels' (1919), *Essays*, iii, 33.

<sup>70</sup> Serge Moscovici, *The Age of the Crowd: A Historical Treatise on Mass Psychology*, trans. J. C. Whitehouse (Cambridge, 1985), 274.

extent is this justifiable when they ultimately consist of the same thing?

As we have seen, individuality remains key to modernist literary works, even those that seek to address a larger group consciousness or awareness of the mass. As such, individual characters remain more significant than the mass of human individuals which surround them in their usually urban setting – like the suspended particles in Brownian motion they are, in some way, more massive than the constituents of the surrounding medium. This is particularly noticeable in Woolf's writings: in 'Abbeys and Cathedrals' Woolf explains that 'men and women seem to have shrunk and become multitudinous and minute instead of single and substantial', contrasting the individual figures of William Shakespeare and Ben Jonson with 'a million Mr Smiths and Miss Browns', and reflecting that the latter 'seem too many, too minute, too like each other to have each a name, a character, a separate life of their own', terms which may remind us of the nineteenth-century movement towards statistical representations of the masses.<sup>71</sup> In contrast, the opening of *The Voyage Out* presents us with a couple in comparison with which 'most people looked small', this majority being described as consisting of 'small, agitated figures'.<sup>72</sup> Likewise, in *Night and Day*, as we have seen, Katharine appears in the street below Ralph as 'a tall figure, upright, dark, and commanding, much detached from her surroundings' (193), while Katharine sees Ralph 'More and more plainly ... and more and more did he seem to her unlike any one else' (375). At these moments the individuality of each character is defined in contrast to the generalised, indistinguishable mass: the undifferentiated medium facilitates the recognition of the uniqueness of these two individuals, for themselves, for each other and for the reader. Indeed, the medium is almost exclusively significant in these passages for the way in which it privileges these two individuals. As such, both Katharine and Ralph remain more significant than the crowd

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71 Woolf, *Essays*, v, 301.

72 Virginia Woolf, *The Voyage Out*, ed. Jane Wheare (London, 1992), 3.

which surrounds them within their urban settings, even though they still remain, as we have seen, subject in some way to the influences and effects of this surrounding medium.

The question of the relationship between the individual and the mass was an urgent one in the early twentieth century, and its frequent appearance in the literature of the period further emphasises its importance. The fact that the individual should apparently gain in significance at the same time that the mass was receiving recognition as a powerful force in its own right is not surprising: as Kern has explained, 'As the public became more intrusive, the individual retreated into a more strongly fortified and isolated private world'.<sup>73</sup> Likewise, Simmel emphasised the dual movement between 'the formations of community life' and 'the individual's summoning the utmost in uniqueness and particularisation, in order to preserve his most personal core'.<sup>74</sup> The writings of both Woolf and Lawrence seem to reflect this dual movement, providing an awareness of the increasing importance of the mass, but never losing sight of the significance of certain individuals within it, allowing them to be affected by it and yet also to remain intact within it.

One final image from *Night and Day* may serve to emphasise this point particularly clearly:

[Katharine's] mind, passing from Mary to Denham, from William to Cassandra, and from Denham to herself – if, as she rather doubted, Denham's state of mind was connected with herself – seemed to be tracing out the lines of some symmetrical pattern, some arrangement of life, which invested, if not herself, at least the others, not only with interest, but with a kind of tragic beauty. ... They were the lantern-bearers, whose lights, scattered among the crowd, wove a pattern, dissolving, joining, meeting again in combination. (266)

There is no suggestion in this passage that the crowd plays a direct part in the movements of the novel's protagonists – the crowd, indeed, remains indistinct, and undefined here – and yet we may be reminded of Benjamin's comments on Baudelaire's 'A une passante' that

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<sup>73</sup> Kern, *Culture of Time and Space*, 191.

<sup>74</sup> *Sociology of Georg Simmel*, 422.

although 'the crowd is nowhere named in either word or phrase' within the poem, 'the whole happening hinges on it, just as the progress of a sailing-boat depends on the wind'.<sup>75</sup> Thus by applying some of the ideas that we have considered to this passage we may develop a new way of interpreting the place of these 'lantern-bearers' within the wider medium of the crowd from which they can never escape. Such an interpretation is, perhaps, aided by a consideration of Perrin's diagram which is included at the opening of this section, a pattern which, I would argue, represents something very similar to that which Woolf is describing above. However, while in her review of Lawrence's *The Lost Girl* (1920) – 'Postscript or Prelude?' (1920) – Woolf writes that 'it is the pattern of the whole that interests us rather than the fate of one of the individuals', the image from *Night and Day* suggests that both are important in their own ways and, perhaps more significantly, that the two are in fact linked.<sup>76</sup>

The early twentieth century, then, seems to have demanded some sort of shift back towards the recognition of the importance of the individual at the same time as calling for an increasing awareness of the wider mass. Both Woolf and Lawrence seem to have been alert to these kinds of arguments, with Lawrence writing in *Kangaroo* that 'the only way to make any study of collective psychology is to study the isolated individual' (294), and Woolf suggesting in *Three Guineas* (1938) that we should 'Find out new ways of approaching "the public"; single it into separate people instead of massing it into one monster, gross in body, feeble in mind': what is key in both these passages is the necessity for *both* approaches; the awareness that the group cannot be ignored but that it must be seen to consist of individuals.<sup>77</sup> In many ways it is this question of the relation between the individual and the mass which has formed the subject of the current study as a whole: in Part I we asked with Woolf whether we should consider ourselves to be particles or waves,

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<sup>75</sup> Benjamin, *Charles Baudelaire*, 124.

<sup>76</sup> Woolf, *Essays*, iii, 272.

<sup>77</sup> Woolf, *Room of One's Own*, 223.

individuals or groups and, ultimately, how we should accept the idea that we are in fact both; in Part II we addressed with Lawrence the question of how to achieve full individuality, before considering the fact that this is meaningless if we cannot then achieve some kind of relationship with another fully formed individual; and in Part III we have explored specific scientific and psychological models which might aid us in moving between and relating the individual and the mass.

It is for this reason that the careful reader will have noted the repetition in this chapter of various quotations which have already been analysed in the earlier sections of this study. This has not been due to a lapse of memory on the part of the author, nor to a sense of indecision as to where best each quotation fits, but rather due to an awareness that the issues considered here are closely related. Likewise, and as we saw in the introduction, Einstein's three revolutionary 1905 papers have been shown to be closely linked despite their apparently radically different subject matter: thus Arthur Miller has discussed the 'overlapping themes' of the three papers, while Gerald Holton has explained that 'they arose in fact from the same general problem, namely, the fluctuations in the pressure of radiation'.<sup>78</sup>

That the world was changing radically in the early part of the twentieth century, though something of a cliché, is beyond doubt. In such a situation what question could be more pressing, what issue more urgent, than that of the place of the individual within and in relation to that new world? As we have seen, N. Katherine Hayles has argued convincingly that 'Different disciplines are drawn to similar problems because the concerns underlying them are highly charged within a prevailing cultural context'.<sup>79</sup> The context of the early twentieth century clearly included the issues raised by a rapidly growing and

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<sup>78</sup> Arthur I. Miller, *Albert Einstein's Special Theory of Relativity: Emergence (1905) and Early Interpretation (1905-1911)* (Reading, Massachusetts, 1981), 137; Gerald Holton, *Thematic Origins of Scientific Thought: Kepler to Einstein* (rev. edn, Cambridge, Massachusetts, 1988), 192.

<sup>79</sup> N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca, 1990), xi.

increasingly organised population, as well as mass urbanisation, leading both literary authors and scientists to turn their attention to the movements and interactions of masses: contemporary research on molecular movements may well have been provoked, or at least encouraged, by the cultural setting in which scientists found themselves, but even if not that setting certainly provided a range of useful images with which to explain and describe such interactions. Meanwhile, images of molecular collisions and of individual particles suspended within a medium seem to have resonated with literary writers whose individual characters are frequently placed in scenes of a similar formulation. This is not to say that scientists were exclusively influenced by the crowds around them, nor that writers were exclusively influenced by scientific models of molecular interaction: developments in statistical methods, in the field of psychology, and the emergence of the figure of the *flâneur* all had a role to play here. But if, as in the previous chapter, we think of different disciplines as part of the same 'interdisciplinary matrix', and if we remember our fundamental premise that different disciplines 'share the moment's discourse', the links between early twentieth-century explanations of Brownian motion and molecular movements and modernist explorations of the relationships between self and society become more manifest.<sup>80</sup>

There is, perhaps, no greater or more frequent question in the field of human endeavour than the nature and significance of the individual within, and with respect to, the larger whole. As society changed and grew, and as the individual became apparently less significant within it, this question became increasingly urgent, forcing both science and literature, as well as many other disciplines, to try to find some kind of answer to, or at least a way of understanding, the issue. The scientific explanation of Brownian motion, as explored in greatest depth during this period by Albert Einstein and Jean Perrin, provided

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<sup>80</sup> Theodore M. Porter, 'A Statistical Survey of Gases: Maxwell's Social Physics', *Historical Studies in the Physical Sciences*, 12/1 (1981), 114; Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 171.

one such way; the literary works of Virginia Woolf, D. H. Lawrence and others, with their detailed investigations of human relationships and interactions, provided another. Putting the two together provides us with a more complete understanding of the issue as it was experienced at the time, enabling us to consider in greater detail both the 'prevailing cultural context' and the discourse shared by these two disciplines during this particular period.

## Conclusion

In my introduction I highlighted various criteria that have been put forward by a number of different critics as a means of evaluating studies within the discipline of literature and science, and as we move towards the close of this study it is necessary for us to consider its own place in relation to some of those criteria. Let us begin with Lance Schachterle's three questions, which have proved significant in the field of literature and science, even if only for their somewhat problematic nature: 'Does the critic present a lucid, well-informed account of the scientific concepts?', 'Does the critic make a convincing case that the literature examined is affected in some significant way by scientific concepts?', and 'Can the critic show that the author's consciousness as a writer is affected by contact with ideas from science?'<sup>1</sup> None of these questions are as straightforward as they may initially appear, as we saw in the introduction, and all three of them focus on a model of direct influence which extends exclusively from science onto literature, without any recognition of the wider cultural background which lies behind both disciplines. Such an exclusive focus has not been the aim of this study, although I have sought to highlight examples of significant influence where such a model has seemed appropriate. As such, Schachterle's second and third questions are of most obvious relevance to Part II, where we considered the impact of Albert Einstein's theories of relativity on D. H. Lawrence's writing and theorisation of human relationships, seeking to determine the extent of the impact of Einstein's ideas in contrast to those of contemporaries like William James.

Unlike Schachterle, however, my consideration of 'sources of influence other than the scientific' has not been included in this study merely for the purposes of allowing them

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<sup>1</sup> Lance Schachterle, 'A Review Essay: Contemporary Literature and Science', *Modern Language Studies*, 17/2 (1987), 78-9.

to be 'examined and safely dismissed'.<sup>2</sup> Indeed, the idea of 'safely dismissing' such parallel sources is by no means compatible with the concept of shared discourse around which this study has been focused. As we saw in the introduction, when it comes to parallel ideas of this kind N. Katherine Hayles has provided a different set of questions for the critic of literature and science to ask him or herself:

What do the parallels signify? How do you explain their existence? What mechanisms do you postulate to account for them? What keeps the selection of some theoretical features and some literary texts from being capricious? What are the presuppositions of the explanations you construct, and how do they connect with what what [*sic*] you are trying to explain?<sup>3</sup>

As Hayles makes clear, 'None of these questions is easy to answer', although this may in part be due to what Michael Whitworth has called their 'purely rhetorical' nature.<sup>4</sup> Certainly Hayles's list suggests something closer to an idealised manifesto rather than a set of practical tools which we can apply to studies of this kind. In addition, and again as we saw in the introduction, Whitworth points out that 'Hayles's list is by no means complete', supplementing it with three further questions of his own: 'Why is your paper or book structured as it is, and what factors influenced its structure?', 'in what ways is your study "historical"?', and 'are the parallels representative of authors and readers beyond those studied? Or are they merely local peculiarities?'<sup>5</sup> I have already explored the first of these questions in some detail in my introduction, and I will return to the third shortly, but in terms of the 'historical' nature of this study, my focus has been very much on the context and circulation of a certain number of ideas during the early part of the twentieth century. These ideas were tackled in various and diverse ways by the disciplines of literature, physics, psychology, art, the social sciences and so on, each of which I have approached

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<sup>2</sup> Ibid. 79.

<sup>3</sup> N. Katherine Hayles, 'Introduction: Complex Dynamics in Literature and Science', in N. Katherine Hayles, ed., *Chaos and Order: Complex Dynamics in Literature and Science* (Chicago, 1991), 19.

<sup>4</sup> Ibid. Michael Hilton Whitworth, 'Physics and the Literary Community, 1905-1939', DPhil thesis, University of Oxford, 1994, 4.

<sup>5</sup> Whitworth, 'Physics and the Literary Community', 5, 16, 296.

through close analyses of contemporary texts. The aim of such a focus has been to suggest the prevalence of such ideas within this period at a level that supersedes an exclusive emphasis on direct influence. I have also sought to reassess the somewhat exaggerated focus on the year 1919 which appears in many studies of twentieth-century literature in relation to Einstein. By re-immersing Einstein the icon, along with his revolutionary ideas, into the contemporary cultural context we have gained a greater sense of the pressing issues of the period, an understanding which in turn enables us to appreciate the provenance of the scientific concepts as well as the widespread and dramatic reaction which they provoked when they first became known to the general public.

Of the questions asked by Hayles in the list above, the one which perhaps needs to be answered most urgently is that regarding the choices made in a study of this kind: 'What keeps the selection of some theoretical features and some literary texts from being capricious?' Such a question is particularly important to a study like this, which has focused almost exclusively on three specific scientific ideas and three individual intellectual figures. The fact that the scientific ideas, at least as they appeared in the formulations offered by Einstein in his three 1905 papers, have been shown to be closely related is significant here, but the selection of Virginia Woolf and D. H. Lawrence as the literary focus of this study perhaps requires further justification, not least in relation to Whitworth's third additional question above: 'are the parallels representative of authors and readers beyond those studied? Or are they merely local peculiarities?'

Both Woolf and Lawrence developed complicated relationships with the science of their day, as I have shown, relationships which are perhaps most clearly visualised as layered. Woolf's writing of wave-like and particulate models has frequently been discussed in relation to the contemporary development of wave-particle duality, whereas Lawrence's direct engagements with the theories of relativity have not received as much critical

attention as they deserve. In this study, I have provided a systematic survey and analysis of both of these examples, situating both within their scientific and broader cultural contexts, and seeking to isolate individual instances of direct influence from those of the broader cultural setting.

My close focus on Woolf's use of the conjunctions 'or' and 'and' is significant not only in allowing us to consider Woolf as a complementary rather than a dualistic writer – a distinction which, as I have demonstrated, is an important one – but also in encouraging us to readdress certain key topics in Woolf studies, including her relation to contemporary art and her explorations of androgyny. In addition, Woolf's own repeated return to dualistic images in her late autobiographical writings suggest that such questions were of key importance in her life as well as her writing.

Meanwhile, my focus on Lawrence's suggestion that 'we are in sad need of a theory of human relativity' provides a new way of approaching one of the ongoing issues at the very centre of Lawrence studies: his understanding and writing of human relationships.<sup>6</sup> The model of relatives and absolutes introduced by Lawrence in *Fantasia of the Unconscious* (1922) and elaborated in particular in *Kangaroo* (1923) resonates with his explorations of such relationships, both those that pre-date and those that follow these particular texts.

The close focus here on three figures and three ideas has certainly allowed me to engage with each on a profound level, providing close readings of a large number of primary literary and scientific texts and exploring the ways in which certain ideas and images are adapted and reused over time. However, the extensive range of materials available means that certain texts have not found their way into the final study, and in particular I would highlight the fact that more could be done with the early drafts of certain

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<sup>6</sup> D. H. Lawrence, *Psychoanalysis and the Unconscious and Fantasia of the Unconscious*, ed. Bruce Steele (Cambridge, 2004), 72.

texts. In addition, it cannot be denied that the choice of a deep and detailed analysis on the one hand necessarily involves the sacrifice of a broader approach on the other, meaning that this study must, to a certain extent, be limited in its scope. By considering Woolf and Lawrence together in Part III, I have been able to make some broader statements about modernist writing and the relation between the modern urban individual and the mass, statements which suggest that such a survey could be extended in order to include other early twentieth-century writers. The contemporary focus on molecular models on the one hand and on images of the crowd on the other, as well as the frequent combining of the two, highlight the possible further scope of this analysis, a possibility which is emphasised by Whitworth's description of modernism itself as 'not so much a thing as a set of responses to problems posed by the conditions of modernity': that the question of the mass, and of the relationship of the individual to the mass, were key problems posed by the conditions of urban modernity is evident.<sup>7</sup>

The foundation and framework for this study has been Gillian Beer's idea that 'ways of viewing the world are not constructed separately by scientists and poets; they share the moment's discourse'.<sup>8</sup> Thinking of discourse in its purely linguistic sense, we have seen over the course of this study that the discourse of the particular historical moment which we have been considering was becoming strangely inadequate; that, as A. S. Eddington wrote concerning relativity in 1919, 'If the theory is right, simple language involves very confused ideas'.<sup>9</sup> Such difficulties of expression were making themselves felt across the science and literature of the period, as well as through the wider culture, as we have seen. If, as I suggested in my introduction, Beer's use of discourse here extends beyond the purely linguistic, however, we can see that the ways of viewing the world which are shared

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7 Michael H. Whitworth, Introduction to *Modernism*, ed. Michael H. Whitworth (Oxford, 2007), 3.

8 Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford, 1996), 171.

9 A. S. Eddington, 'Einstein's Theory of Space and Time', *The Contemporary Review*, 116/648 (December 1919), 640.

across a culture were also becoming increasingly complicated and inadequate during this period. Thus when we read Eddington's statement regarding the new theories of relativity and quantum physics that 'These are not merely new discoveries as to the content of the world; they involve changes in our mode of thought about the world', we can see now that this mode of thought was changing more generally across the contemporary culture, both encouraged by and encouraging the changes that were specific to contemporary science.<sup>10</sup>

As I stated in my introduction, the benefits of the model of shared discourse for a study of this kind lie in the various connotations of the verb to share; as something active or passive, intentional or accidental, with either words, images or ideas as its object and with a human actor as its subject. In addition, by focusing on the idea of shared discourse, and by using the word 'discourse' in its broadest sense, we have been able to discuss something like a *zeitgeist* while avoiding some of the significant pitfalls inherent in such a model.

More importantly, the concept of shared discourse provides us with a way in which to balance the models of direct influence and *zeitgeist* or cultural matrix which we explored in the introduction. By combining the active, intentional sense of sharing, which facilitates discussions of direct influence, with the passive, accidental sense, which provides an image of something closer to a cultural matrix, we increase our chances of steering a safe course 'between the Scylla of simplistic causality and the Charybdis of random happenstance' which forms one of the fundamental dilemmas at the centre of studies of literature and science.<sup>11</sup>

However, we are still left with the significant problem of how we can define the components which make up the shared discourse of a particular moment; namely, how we can include everything of significance without being left with a completely unwieldy and

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<sup>10</sup> A. S. Eddington, *The Nature of the Physical World* (Cambridge, 1928), 4.

<sup>11</sup> Stephen J. Weininger, 'Introduction: The Evolution of Literature and Science as a Discipline', in Frederick Amrine, ed., *Literature and Science as Modes of Expression* (Dordrecht, 1989), xix.

impractical quantity of information. Closely linked to this question is that of the provenance of the shared discourse of a particular moment, the origin of the underlying 'concerns' or 'common anxieties' which create it: that the ideas explored in this study were at issue during the period in question, and that they were widely discussed using similar language, is now evident, but why this should have been the case and where those ideas and language first originated has not yet been satisfactorily explained.<sup>12</sup> Further research is clearly needed here, across and between disciplines, but whether such research could ever provide a final and thorough answer to these questions remains both uncertain and unlikely.

The shared discourse model raises one further, related problem for critics working in the field of literature and science: how are we to avoid the danger, against which Beer frequently cautions, of isolating literature and science as 'a privileged pair'?<sup>13</sup> Beer writes that we must 're-immense [science and literature] in the multiplicity of forces that generate the specific text, the particular discovery and which fire the individual imagination'.<sup>14</sup> In this study, I have sought to include a range of disciplines, including philosophy, psychology, art and the social sciences. However, as Whitworth acknowledges, 'One cannot study the whole of science and culture, only small parts of each', and it will be clear to the reader that my focus throughout has centred primarily on the disciplines of literature and physics.<sup>15</sup>

The question of how to reintegrate the separate disciplines of literature and science into a larger cultural background while still maintaining the field of literature and science as a separate entity is one to which the latter discipline now needs to turn its attention. How can we extend the discipline of literature and science to embrace and include other

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12 N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca, 1990), xi; Gillian Beer, 'Discourses of the Island', in Amrine, ed., *Literature and Science*, 18.

13 Gillian Beer, 'Science and Literature', in R. C. Olby et al., eds., *Companion to the History of Modern Science* (London, 1990), 792.

14 Ibid.

15 Whitworth, 'Physics and the Literary Community', 296.

disciplines where relevant without diminishing the status which it now holds as a separate discipline within literary studies? To how many other contemporary disciplines are the ideas discussed in this specific study relevant? And to how many other contemporary writers, readers and texts? Finally, to what extent can Beer's idea of shared discourse as I have used it here help us in attempting these developments? After all, the notion of a discourse that is shared across disciplines during a specific period is certainly beyond the scope of any one study and leaves plenty of room for the insertion of further writers, ideas and disciplines as one particular study is broadened.

With so many questions still before us, it is perhaps fitting to conclude this study with an adaptation of one of Albert Einstein's own calls to arms, in this case that which appears at the close of his 1905 paper on Brownian motion: Let us hope that a researcher, or researchers, will soon succeed in solving the problems posed here, which are of such importance in the further development and extension of the discipline of literature and science!<sup>16</sup>

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<sup>16</sup> *The Collected Papers of Albert Einstein. English Translation*, ed. John Stachel et al., trans. Anna Beck et al., to be completed in circa 30 vols (Princeton, 1987–), ii, 134.

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