University of Southampton

Faculty of Humanities

English

‘Explorational Blankness’: Twentieth- and Twenty-First-Century Poets Rewrite Astronomy’s Hidden and Expanding Universe

by

Sophie Heuschling

Thesis for the degree of Doctor of Philosophy

December 2020

University of Southampton

Abstract

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The intersections between modern poetry and modern astronomy remain largely unmapped. This thesis seeks, in part, to correct this situation by exploring a range of poetry that engages with astronomy or cosmology. In a first part, this study analyses a number of anthologies of astronomical poems. The result of this analysis suggests not only that poets engaging with the universe and astronomy write in many different forms and genres, but also that references to spaceflight and the universe are used to gain a wider perspective on terrestrial affairs and give rise to often impassioned poems about political and social injustices and metaphysical concerns with the comparative insignificance of human existence in the face of cosmic expansion and expansiveness. The thesis proceeds, in separate chapters, with analyses of the works of five very diverse and partly under-studied poets: American poets Tracy K. Smith, Will Alexander, Amy Catanzano, Scottish poet Edwin Morgan, and Canadian poet-astronomer Rebecca Elson. Through a series of close readings of selected poems by these writers this thesis argues that these astronomical poems create starkly diverging images of the cosmos: the poems demonstrate that the universe often serves as an abstract creative space for various political agendas, social activism, literary and formal innovation, and, indeed, for astronomical research as well.

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Research Thesis: Declaration of Authorship

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I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
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3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
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Heuschling, Sophie. '"Don't Ask the Questions You've Been Taught by Science": Rebecca Elson's Astronomical Poetry'. *JLS*, vol. 12, no. 2, 2019, pp. 43-61.

Signature: SophieHeuschling Date: 6 December 2020

Acknowledgements

First and foremost, I would like to express my gratitude to my truly wonderful thesis supervisors, Professor Peter Middleton, Professor Daniel Brown, and Dr Sarah Hayden, whose kindness, expertise, and intelligence have inspired and guided me throughout my PhD candidature. I am especially grateful to Peter Middleton for believing in me from the start, for his many suggestions of inspiring poets, and for his willingness to supervise my project by distance, spending many hours video-conferencing with me. I would also like to thank Dr Kevin Brazil and Dr Sarah Hayden for their helpful insights during my Confirmation examination and Dr Sarah Hayden for agreeing to join (and enrich) my supervisory team after my Confirmation. I am also indebted to the editorial board of the *Journal of Literature and Science*, and especially to the two anonymous peer reviewers of my article, whose comments helped me improve my argument.

Next, I would like to extend my thanks to the many people who have kindly assisted me in my research: Professor Jocelyn Bell Burnell, for sharing her large collection of 'astropoetry' with me, Dr Poshak Gandhi, for our discussion of Rebecca Elson and astrophysics, Anne Berkeley, for sharing her invaluable information on Rebecca Elson with me, Ruth Corkill, for our conversations about physics and poetry, and Amy Catanzano, Will Alexander, Tracy K Smith, Jean-Pierre Luminet, Aimee A. Norton, and Emily Grosholz, for their helpful replies to my questions on poetry and astronomy.

Finally I would like to thank my family, whose support and encouragement enabled me to embark on this project. I would especially like to thank my Bopa Jean, who gave me all of his books on astronomy and English poetry and who unfortunately died before I finished this thesis. I am also grateful for my sister's and parents' love, support, and belief in me over the last four years. Lastly, a special thank you to my dear husband, Jeffrey Palms, for his love, the many illuminating walks on which we discussed my ideas, and his unwavering support even through my many tantrums.

Chapter 1 Anthologies of Astronomical Poetry

1.1 Poetry and Astronomy

There are practically no recent poets who write exclusively, or nearly exclusively, about the universe and astronomy.[1] The poets analysed in this thesis have either only one collection that is inspired by the cosmos (which is the case with Tracy K. Smith), or they have several poems spread over various collections that engage with astronomy (Will Alexander, Edwin Morgan, and Amy Catanzano). As a result, it takes a researcher many hours of digging and combing through anthologies and collections to tease out those poems that do engage with the cosmos. This is a situation that this thesis also seeks, in part, to correct. In that context, anthologies of poems with astronomical themes are immensely helpful. There is, in fact, a considerable number of such anthologies that have been published since the 1950s. This emergence of anthologies regrouping astronomical poetry, however, has not been followed by the appearance of a critical discourse on this poetry, which, to some extent, explains the absence of any journals and magazines dedicated to poetry with astronomical themes. The publication of such poems in the medium of anthologies, instead of academic journals and magazines, has perhaps been motivated by the opportunity for publishers to reach a wide readership. As anthologies can be (and often are, as will become evident) marketed as popular astronomy, they can be read as popular astronomy *instead* of poetry, which evidently changes the effect of the poems. Whether they count as popular astronomy, poetry anthologies, or both, these collections have greatly helped me find poets who do engage with astronomy and the universe, even if only sporadically. Notwithstanding the challenges involved in delineating a new field in this way, this endeavour is yet a valuable one. As this study of poetry on astronomy demonstrates, this dispersed body of writing prompts us to assume a wider perspective on our relationship to our surroundings, to redefine our relationship with the Other, the utterly alien, and to understand the importance of an expanded sense of self and home to our lives.

In this introductory chapter, I will discuss three of these anthologies in more detail. A discussion of selected poems, their tones, their poetics, and their imagery helps to introduce the main poets of this thesis by identifying the main trends and techniques of poets who engage with outer space and cosmology. A critical engagement with how poems with space imagery are framed by the editors of these anthologies, who consist of a mix of poets and astronomers, also allows me to discuss the cultural significance of contemporary developments in space exploration, and especially how modern poetry engages with these developments. This chapter will analyse Robert

[1] Exceptional examples of poets who do engage with astronomy and the universe exclusively are Rebecca Elson, whose only (and posthumous) publication *A Responsibility to Awe* engages profoundly with astronomy, yet also contains poems about her family, her cancer, and her travels; and perhaps Amy Catanzano, though her publications treat of cosmology, physics, quantum physics, and astronomy more generally.

Vas Dias's *Inside Outer Space* (1970), *Verse & Universe*, edited by Kurt Brown (1998), and Jocelyn Bell Burnell and Maurice Riordan's *Dark Matter* (2008). I selected these anthologies for closer inspection as, except for a few classics of the English canon in *Dark Matter*, they contain mainly poems written by contemporary poets. This means that the poems in these collections often either directly or indirectly react to developments in astronomy and cosmology, and as such allow a reader to form an impression of the most impactful aspects of astronomy and the cosmos for poets.[2] Furthermore, the themes developed by the poets in these anthologies – the scepticism of space travel, the similarities between cosmological structure and poetic form, and the puniness of humankind compared to the vastness and dangers of the cosmos – are also detectable to a certain extent in the poets discussed later in the thesis.

Several big questions motivated me in this project: Why do poets turn to the cosmos and astronomy to write poetry? How does the universe figure in modern poetry? How, if at all, does poetry configure the relationship between humankind and the cosmos? These questions gradually led to more focused research questions, which this thesis seeks to answer: How is the universe, as revealed by astronomy and cosmology, configured as a space for political reinvention in poems engaging with these two sciences? To what extent are poems with references to the cosmos attempts to understand the puzzling new discoveries of astronomy and cosmology? What new opportunities for experimental and poetic play, involving new metaphors and formal innovation, do modern astronomy and cosmology offer the poets in this thesis?

The answers to the questions above are explored through a methodology that is heavily based in close reading. Close attention to form, lexis, rhythm, and syntax ensures that my readings are anchored in the poems, and a close engagement with the ensemble of poetic techniques and features helps to reveal the complexity of the meaning-making devices employed by a poem. I shall show how these different devices converge in a complex questioning of the new ideas and images of the modern cosmos.

Gioia Woods argues that there is a tradition in American poetry, begun by Walt Whitman, of 'sci-animism', to animate or render relatable the discoveries of science. American poets, according to Woods, 'seek to vivify and embody the mysteries of science' (200). In that sense, Woods regards poetry as rendering a service to the sciences as poems do scientific popularisation work: they turn the abstract and at times mathematical sciences into notions and ideas to which the uninitiated can relate by providing them with a 'context of experience, sensuality, and valuation' (202). Yet, what this research has found is that poetry is rarely merely at the service of the modern sciences. With

[2] Other collections of poems about space or spaceflight include Helen Plotz's *Imagination's Other Place* (1955), which combines poems by Shakespeare and other classics with contemporary poets like Adrienne Rich and extracts from Genesis; *Frontier of Going* (1969), which exhibits a more science fiction turn; *Moonstruck: An Anthology of Lunar Poetry* (1973), which centres on poems, both old and new, about the moon; *Songs From Unsung Worlds: Science in Poetry* (1985); *Starry Night: Astronomers and Poets Read the Sky* (2001), whose editor, David H. Levy, is an amateur astronomer; and *Giant Steps: Fifty Poets on the Fiftieth Anniversary of the Apollo 11 Moon Landing and Beyond* (2019), a collection of commissioned poems for the fiftieth anniversary of the Apollo 11 moon landing.

only very few exceptions (such as Sleigh's poem discussed below), the poems in this thesis cannot be described as just popularising the findings of astronomy and cosmology and elucidating their implications for human existence and subjectivity. Instead, the poems in this thesis can challenge and reflect on, while still celebrating, the implications of these findings, establishing much more complex relationships between poetry and the sciences or universe than those between popular astronomy books and astronomical research. While none of the poems studied here are religious poems, almost all of them find a source of metaphysical wonder in the universe – Auden unambiguously even personifies the moon as a goddess – raising questions about life or spirituality in the cosmos that transcend the limits of the sciences. In other words, poetry is not to be understood as being in the service of the sciences; poets do not see it as their mission to promulgate scientific findings. Instead, they see poetry as complementary to the sciences: it addresses questions about the entities science studies – the universe, the nature of being – that go beyond the frontiers of science.

Thus, this thesis will show that some poems turn to astronomy and cosmology for aesthetic and artistic reasons; the images and vocabulary of physics and cosmology are found to be germane to new poetic explorations of love and romantic bonds, as in Amy Catanzano's poetry. A similar yet different relationship between poetry and astronomy is established in the astronomer Rebecca Elson's poems: they are not merely poetic experiments, but also sometimes anticipate her own astronomical research. Although her colleagues found out about her poetic work when she died in 1999, her poems have not penetrated the scientific community at large. This is why this still little-known poet deserves more critical attention. Attempts in poetry to visualise invisible or abstract phenomena such as dark matter or the big bang through such literary devices as metaphors, similes, and puns ultimately further Elson's scientific research. Other poems in this study are less concerned with the science of astronomy or cosmology, and engage instead with the phenomenological experience of the cosmos. These engagements often revolve around the question as to our (in)significance in the vast cosmos: the incredibly vast time and distance scales of the universe, dwarfing an individual human's life, have led Tracy K. Smith to emphasise the importance of human existence in a poetry that locates the lyric subject at the centre of the cosmos, whereas the vast scale of the universe has led Will Alexander to deemphasise and decentralise the lyric subject, for instance inventing and assuming consciousness in extra-terrestrial geological features. Lastly, the universe is also configured as a metaphorical space, which sometimes serves as escapist fantasy and sometimes as critical commentary on terrestrial politics, as the poems by Edwin Morgan, Anne Sexton, and W. H. Auden demonstrate.

As I show below, developments in astronomy and cosmology over the last one hundred years have vastly advanced our knowledge of the universe. Current research in cosmology and astronomy is motivated by the persisting question marks at the core of our modern scientific paradigm: black holes, dark matter, dark energy, and multiple dimensions are not yet fully understood by the

astronomy community and need further research (and funding).[3] The poets in this thesis exploit these cosmological mysteries, which are used as points of departure for astronomical and non-astronomical reimaginings of the cosmos: like a blank piece of paper, the universe can be illustrated and written by the poets under study. Will Alexander imagines the land of 'New Mars' as 'explorational blankness' and this 'blankness' 'burns, & extends, & accelerates' ('Water on New Mars' 52). For the poets I study the universe, being blank in Alexander's sense, is reimagined and rewritten as a rich and active, almost living, universe.

While recent literary criticism on contemporary or modern poetry and science is flourishing, there is a gap in scholarship on modern poetry and modern astronomy. Trending research subjects in poetry and science are ecology; climate change; hydrocriticism (or the Blue Humanities, the focus of the fall 2019 issue of *Configurations*); the Anthropocene; the Posthuman (Tom Bristow; Matthew Griffiths; Sam Solnick); physics and nuclear warfare (Peter Middleton 'Poetry, Physics'; Daniel Cordle *States of Suspense: The Nuclear Age, Postmodernism and United States Fiction and Prose*); botany and plant neurobiology; molecular biology; and neuroscience, among a few others. These are the trends revealed by books of essays on literature and science and the issues of the last ten years of academic journals specialising in science and literature, such as the British *Journal of Literature and Science*, the publication of the British Society of Literature and Science, or *Configurations*, published by the American equivalent of the BSLS, the Society for Literature, Science, and the Arts.[4] Scholarly studies of astronomy and poetry that have been undertaken in the last few years are focused on Romantic, Victorian, and Modernist poetry (Wiegand Brothers and Ebury), while there is practically no scholarship on the intersections between modern and contemporary poetry and astronomy and cosmology. The reason for this lack is certainly not any scarcity of modern poetry with astronomical themes. On the contrary, a significant amount of astronomical poetry has in fact been published over the last three to four decades. Likewise, the relatively high number of anthologies of astronomical poetry that have appeared over the last fifty years, as well as events such as the 'The Universe in Verse', organised by *Brainpickings* creator Maria Popova to bring together astronomers, astrophysicists, and poets, and whose 2020 instalment expected over 3,000 spectators (but unfortunately had to be cancelled due to the COVID-19 pandemic), show that there is a certain interest in how and where poetry and astronomy meet and overlap.

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[3] The science of physical cosmology, which studies the origins and structure of the cosmos, is a relatively young science, having been born only at the beginning of the twentieth century with Einstein's theory of relativity and astronomical observations of extremely distant objects, which allowed scientists to map the universe.

[4] Books of essays on literature and science include Robert Crawford's *Contemporary Poetry and Contemporary Science* (2006), John Holmes' *Science in Modern Poetry: New Directions* (2012), Kurt Brown's *The Measured Word* (2001), Bruce Clarke and Manuela Rossini's *The Routledge Companion to Literature and Science* (2011), Philip Coleman's *On Literature and Science: Essays, Reflections, Provocations* (2007), Claire Maniez, Ronan Ludot-Vlasak, and Frédéric Dumas's *Science and American Literature in the 20th and 21st Centuries: From Henry Adams to John Adams* (2012), and Sharon Ruston's *Literature and Science* (2008).

An essential requirement for this project was to learn about the most important developments in astronomy and cosmology. It must be noted that I approached these developments, like the poets I study, from a humanities and literature background, as an enthusiastic layperson with no scientific training or any expertise in the subject. In my reading I was interested in how these astronomical and cosmological advances might appeal to poets as metaphors, fertile concepts, or prompts for new departures in their thinking about and understanding of the world. Although I will not describe or discuss these developments in detail, a brief review will provide a useful context for my subsequent readings of poems with astronomical themes and references. In what follows, I sum up the milestones of astronomical and cosmological research of the twentieth and twenty-first centuries: the theory of relativity, the redshift observed in galaxies, the big bang, black holes, dark matter, dark energy, and the theory of the multiverse.

The last 120 years have seen significant developments in the sciences of astronomy, astrophysics, and cosmology. At the beginning of the century, the Einsteinian revolution in physics had repercussions for cosmology, too: while the force of gravity had been measured and theorised by Isaac Newton in the seventeenth century, its source was only explained by Einstein's theory of general relativity, published in 1915. Gravity is now conceived as a function of the fabric of space-time, which is warped and distorted by celestial objects, whose motion around other objects is in turn influenced by the distortions in space-time.

In the 1920s, the American astronomer Edwin Hubble was responsible for another revolution in astronomy: through the use of Cepheid variables in Andromeda on stars whose period-luminosity function makes them reliable measures of distance, Hubble discovered that the Andromeda nebula lay far outside the limits of the Milky Way, thus establishing it as a galaxy of its own. Hubble is also credited with discovering the expansion rate of the universe by calculating the distance to the galaxies in which he observed a redshift: his discovery was that a galaxy's redshift was proportional to its distance, which means that distant galaxies were receding at a faster pace than nearby galaxies. Hubble's findings had extraordinary implications for our conception of the universe: not only did the cosmos suddenly explode in size – our galaxy was just one among countless others – but this cosmos was also expanding at a great speed.

Radio astronomy, developed after the Second World War with equipment left over from the war, complemented optical astronomy and led to more breakthroughs in cosmology. The theory of the big bang, first developed by Georges Lemaître in the 1930s, was confirmed in 1964 through the accidental discovery of the cosmic microwave background radiation, a leftover of the ur-explosion, through radio astronomy. More precise measurements of this cosmic background radiation were taken over the ensuing decades by more and more powerful telescopes, giving us a map of the early universe with temperature fluctuations which conform to the fluctuations of density in the known universe.

The twentieth century also saw a proliferation of theories with poetic names: black holes and dark matter. Black holes are areas in space-time that are so massive and condensed that nothing,

not even light, can escape them. Even if the idea of a black hole was first postulated by John Michell in the eighteenth century, these cosmological singularities only started to be studied in earnest after the Second World War. The term was popularised by John Wheeler in 1967 and, after their existence was only postulated in theory, a black hole was finally spotted in 1971. The first photograph of a supermassive black hole was taken in 2019 by a global network of telescopes. Dark matter is invisible matter that does not interact with other particles other than gravitationally. Galaxies are believed to be embedded in a halo of dark matter that stabilises them. Dark matter is, as yet, still only theoretical as it has not been detected, either in labs or in space. Dark energy is the term physicists use to describe the strange energy at the root of a ground-breaking discovery of the late 1990s. In 1999, scientists found out that the universe is expanding at an accelerating rate, rather than at a decreasing rate, as had been expected. The energy that makes the universe swell at such a staggering speed was named dark energy. The 'dark' in dark matter and dark energy does not point to any colour but to the fact that they remain unknown and mysterious to scientists.

The most recent developments in astrophysics and cosmology are in the domain of theoretical physics. In the last thirty years, string theory, which is an attempt to explain the extremely weak force of gravity (compared to the strong and weak nuclear force and the electromagnetic force) on a subatomic scale through the existence of tiny vibrating strings, has proven a promising candidate for a theory of everything. One version of string theory is the notion of the multiverse and membranes, or branes, advanced by Lisa Randall. Branes are areas of the universe, or the multiverse, with different dimensions and therefore different properties. In this theory of the multiverse, our local universe is stuck on a three-dimensional brane in a higher-dimensional multiverse.[5]

While dark matter, black holes, the big bang, and hidden universes with multiple dimensions have captured writers' and poets' imaginations, there are some equally valuable and publicised discoveries that have not. For instance, quasars, short for 'quasi-stellar objects', which are galactic nuclei consisting of supermassive black holes, gamma ray bursts, and the Hertzsprung-Russell diagram, which allowed astronomers to study stellar evolution, do not feature prominently in the poetry written since the mid-twentieth century. Neither do more recent advances, such as the inflationary theory, according to which the early universe went through phases of extreme expansion; the detection of exoplanets; the Higgs particle, whose discovery finally explained the origin of mass in elementary subatomic particles; or gravitational waves, even if all of these were

[5] The information for this overview of developments in astronomy and cosmology is taken from these popular astronomy and cosmology books and articles: David W. Hughes and Richard de Grijs's 'The Top Ten Astronomical "Breakthroughs" of the 20th Century', Simon Singh's *Big Bang: The Most Important Scientific Discovery of All Time and Why You Need to Know About it*, Martin Rees's *Just Six Numbers: The Deep Forces that Shape the Universe*, Lisa Randall's *Warped Passages: Unraveling the Mysteries of the Universe's Hidden Dimensions*, Jeremiah P. Ostriker and Simon Mitton's *Heart of Darkness: Unraveling the Mysteries of the Invisible Universe*, John David North's *The Norton History of Astronomy and Cosmology*, Iain Nicolson's *Dark Side of the Universe: Dark Matter, Dark Energy, and the Fate of the Cosmos*, Helge Kragh's *Conceptions of Cosmos: From Myths to the Accelerating Universe: A History of Cosmology*, Richard J. Gott's *The Cosmic Web: Mysterious Architecture of the Universe*.

ground-breaking developments for astronomers and cosmologists. Perhaps these latter items in the list were neglected by poets because their names are less belletristic than 'black holes' or 'big bang', and thus grabbed writers' attention less. If this oversight in poetry of such astronomical milestones as the Hertzsprung-Russell diagram perhaps suggests a superficial engagement with the sciences of astronomy and cosmology, poets' plying and probing of the phenomena at the top of this list nevertheless cannot be described as superficial, as this thesis attests. Their work is not in the discipline of astronomy but in language; the imaginative possibilities of terms such as 'black hole' and 'dark matter' thus matter more to poets than the implications and repercussions for the astronomical community of gravitational waves or the Higgs particle.

Although the poems considered together here share an interest in astronomy or the cosmos, they are not otherwise written as part of a defined literary movement and do not share a common approach to their theme. For that reason, this thesis does not endeavour to force upon them a single, homogenising narrative. Instead, in order to bring to light the specific features of each poem and specific approach of each poet, the four relatively discrete chapters are structured around comparative studies of poets who share similarities in their subject matter, but whose works are essentially different. As already mentioned, Chapter One proceeds with a discussion and analysis of selected poems taken from three different space poetry anthologies. Chapter Two is devoted to American poets Tracy K. Smith and Will Alexander, two decidedly different poets who nevertheless share an interest in the impact of the Hubble Space Telescope images on our knowledge and imagination of the cosmos. The chapter will discuss primarily two poems: Smith's 'My God, It's Full of Stars' and Alexander's 'Water on New Mars'. I shall show how an engagement with the universe and astronomy has led to two very different, almost opposed, poetic responses. While Smith's poetry reveals a focus on the human and the lyric I as a reaction against the vastness of the universe, Alexander's poetry delights in astronomical distances, the unknown, and an imaginative poetic cosmology that attempts to be completely devoid of a totalising human viewpoint. Chapter Three discusses poems by Scottish poet Edwin Morgan and American poet Amy Catanzano. These two writers are likewise very different from each other, yet they are paired together because of their uses of science fiction elements and their engagement with cosmology and space travel in their treatment of romantic love. Their vastly diverging poetics both centre around the notion that love essentially transcends language, remains '[u]nspoken', for which they use metaphors and imagery taken from space travel and astrophysics, such as the first spaceflights in the 1950s and 1960s and Einsteinian physics and black holes. The final chapter turns to Rebecca Elson, who spent most of her professional career as an astronomer in Oxford, in the UK. In this chapter, I shall demonstrate how poems can function as thought experiments, providing the poet-astronomer with a creative ground to test out and visualise cosmological mysteries of the day. This technique of using poetry as a laboratory for astronomical experiments is legitimised by the fact that astronomers rely on metaphors and similes in their research, as I will show. Before delving into

a discussion of the various anthologies, this chapter proceeds with a literature review of the field of poetry and astronomy.

1.2 Overview of the Field

This thesis treats poetry and science as two discourses of equal value. It does not consider poetry as merely a mirror to contemporary developments in the sciences, nor does it propose that the sciences are merely based in fallacious language and do not have a claim to truth, as some postmodernist theorists have done in their denial of scientific objectivity, realism, and empiricism (Baringer, 4). In the ensuing literature review, I position my own study and methodology in a context of poetry and astronomy scholarship that has gradually moved from a mainly historicist approach to literary texts (proponents of this view are, among others, Marjorie Hope Nicolson, discussed below) and towards treating poetry as an intellectual and artistic discourse with a cultural value equal to that of science. This move away from a historicist approach is largely indebted to the postmodernist approach to the sciences, which considers the sciences based in language and, like other human constructs, culturally embedded (Baringer 3). According to Martin Willis, this view of the sciences as human constructs and contingent on culture is 'one of the founding intellectual principles that supports literature and science as a field' (*Literature and Science* 21). Steven Meyer, in his introduction to *The Cambridge Companion to Literature and Science*, explains that the 'one-culture' phase of literature and science scholarship, which regarded literature and science as reacting to the same culture, and which was propounded by George Levine, Gillian Beer, and Katherine Hayles, was followed by a pluralistic approach in more recent work (5). In what Meyer defines as second-wave literature and science scholarship, the 'monocultural' approach continues to alternate with pluralistic approaches, which borrow tools and methodologies from other disciplines and applies them to a discipline not usually associated with those tools (D. Griffiths 75-76).

While this study does not technically apply a pluralistic methodology in its cross-disciplinary analysis of poetry and astronomy, the chapters on Amy Catanzano's highly experimental poetry and on Rebecca Elson's imagist and dense lyrics have required me to apply tools from outside the literary critic's toolbox: as Catanzano and Elson both very consciously seek to translate astronomical concepts into poetry, finding out how observational astronomers work and conduct research was necessary to understand the research that Elson's poems perform, as will be elucidated in Chapter Four. So, while I did not apply the scientific method to the reading of literary texts, the interdisciplinary nature of this study resides in the application of scientific principles to poetry and in an understanding of how the scientific method works in practice to gain a fuller understanding of the workings of Elson's astronomical poems.

While no extensive study of modern poetry and modern astronomy has been undertaken, the two disciplines have been the subject of a number of studies concentrating on earlier eras. Though many of the articles and books discussed in this section focus on nineteenth- and early-twentieth-

century poetry and astronomy, their methodologies and research questions are comparable to my own: just like the critics discussed in this review, I analyse, on the one hand, the metaphorical potentials of various cosmological or astronomical theories or objects, such as black holes or Mars in poetry (rather than, say, constellations or the second law of thermodynamics, favourite 'space' topics of nineteenth-century poetry). On the other hand, similarly to other cross-disciplinary critics, I also analyse in what ways the cosmos, as it is revealed through modern astronomy and cosmology, captures the imagination of the poets and what it symbolises to them.

One of the most important precursors of modern-day astronomy and poetry scholarship is Marjorie Hope Nicolson. Martin Willis characterises her research of the influence of astronomy upon literature as anchored in a history of ideas approach, which largely considers the relation between science and literature a one-way street (*Literature and Science* 60). This view of the interdisciplinary field is made clear at the opening of 'The Telescope and Imagination', where Nicolson writes: 'During the last few years – perhaps because of the dominant interest of our own time – students of literary history have become more and more aware of the importance of the scientific background in determining the direction of certain currents of literature' (233). From her research into the effects astronomy had on literature, Nicolson concludes that new metaphors and new vocabularies found their way into poetry and that some of the poetry served to popularise, for example, Newton's theories (*Newton Demands the Muse*). One of the main poets she discusses in *Newton Demands the Muse* is James Thomson, the early eighteenth-century Scottish poet whose poetry, especially his famous and influential narrative poem *The Seasons*, helped to popularise Newton's physics and praises the achievements of modern civilisation and science (Reid 672). Nicolson shows how Newton's impact is especially notable in Thomson's development of a symbolism of the spectrum in which red stands for beginnings (as it is often associated with the dawn) and violet with endings (*Newton Demands the Muse* 47). Furthermore, according to Nicolson, Thomson 'showed an exactness of expression and an accuracy of observation which marks him as a Newtonian poet' (*Newton Demands the Muse* 48). Although Nicolson does not engage as deeply with her poets as later critics, her attention to such tropes as rainbows and the use of colours and light in seventeenth-century poetry and how such seemingly common subject matter might betray a Newtonian influence is admirable and leads to interesting insights. Her analysis of how astronomical or physical discoveries adopt a certain symbolism in poetry is astute and, even though her research has slightly fallen out of fashion in recent scholarship, her ground-laying work in the field deserves to be mentioned in this review.

Another early critic who takes a broad approach to astronomy and poetry is A. J. Meadows, a professional astronomer. In *The High Firmament: A Survey of Astronomy in English Literature* (1969), he identifies and explains astronomical allusions in works of English literature from Chaucer to Wells, covering over five centuries in just two hundred pages. While this study does not engage with poetry as a serious cultural or aesthetic discourse, regarding it as a mere mirror of developments in astronomy, it proved valuable to later scholars in laying the groundwork for

astronomy and poetry scholarship (for instance in Anna Henchman's studies), by, for example, identifying those writers that engaged with astronomy (Henchman 277). The critics that follow in Nicolson's and Meadows's footsteps, and whose work is discussed next, engage more profoundly with astronomical poetry, seeking to understand what astronomical metaphors, for instance, can do in poetry. While the following critics conceive of literature and astronomy as discourses of equal value, they nevertheless refrain from making arguments such as those advanced by George Levine, Gillian Beer, and Katherine Hayles, proponents of the 'one culture argument' that sees both literature and science as influenced by prevalent concepts in contemporary culture, both 'draw[ing] mutually on one culture' (Levine 7). Nor do they claim that poetry can influence the sciences in any direct way. Instead the critics in this review regard poetry as an intellectual activity that allows writers to process developments in astronomy and cosmology and to understand the implications for human life of such theories as Einsteinian relativity, black holes, and the big bang. My own study follows their example.

The relation between astronomy and poetry has often been conceived in terms of interpersonal relationships: the constellations and the distance to the stars are used to emphasise isolation or loneliness but also the opposite, a sense of belonging. Ernest Fontana's discussion of the Victorian poet Coventry Patmore, famous for his gender politics, illustrates to what uses poets often put astronomy or the universe to write about relationships. He demonstrates how Patmore, far from merely mentioning astronomy or the constellations in his poetry, bases his personal philosophy and view of male-female as well as human-divine relationships around the science. The scholar focuses on Patmore's engagement with Pascal's pessimistic *Pensées* as well as John Herschel's *Outlines of Astronomy* and shows how the poet, who possessed a sound knowledge of astronomy, comparable to that of Tennyson, 'corrects' the morose mathematician's views of the cosmos by using Herschel's writings to demonstrate links between the universe and the divine and between the universe and human relationships, and to underline the sense of beauty and value inherent in his vision of the cosmos: 'Patmore uses exact astronomical metaphors, gleaned, it is evident, from Sir John Herschel's contemporary and influential *Outlines of Astronomy*, to counter Pascal and to assert a neo-baroque Catholic sense of the erotic intimacies that potentially link humans to an amorous God' (285). Especially the concepts of planetary disturbance and of the reflection of solar light, as they are explained in Herschel's book, are influential in Patmore's poetry. The poet uses these astronomical resources as metaphors for 'various forms of male-female interaction' (283).

John Cartwright, too, recognises parallels between astronomy and the human realm of emotions, and underlines to what extent poets engage and reflect upon astronomy and its implications for interpersonal relationships and subjective experience. In '"Star-Defeated Sighs": Classical Cosmology and Astronomy in the Poetry of A.E. Housman', Cartwright embeds A. E. Housman's poetry in a context of writers (like Tennyson, Hardy, Swinburne, and Browning) who seek to reconcile advances in astronomy, cosmology, and evolutionary biology with the subjective

reality of human experience (71). He primarily discusses Victorian poet A. E. Housman's engagement with contemporary astronomy, especially spherical astronomy, and Epicurean materialism and cosmology. In Housman's poetry, astronomy, especially constellations, is often referred to in poems expressing loneliness or the distance separating two people, as for instance in a poem about the poet's brother. George Herbert Housman was killed in the Boer War and buried in Africa. The southern constellations in the poem, invisible in the United Kingdom, serve to underline the distance separating the two brothers (84).

Contrary to Fontana, who argues that Victorian astronomy equipped poets with fertile metaphors to describe human experience and relationships, Cartwright finds that 'the images presented by mid nineteenth-century science: the vastness of space, the eternity of time, and the mutability of species, made it difficult to relate the physical world to a human scale and see in it any reflection of or correspondence to any sort of human striving' (87). As mentioned above, since the second half of the nineteenth century, our perception of the size of the cosmos has undergone several changes with Hubble's discoveries, the big bang, and dark energy. Some twentieth-century poets react to this cosmic vastness by contrasting the extremely short human life on this extremely small and insignificant planet with the incredible size of the cosmos. This is a stance that some of the poets in Bell Burnell's anthology, discussed below, represent. That this notion of the vastness of space is maturing, evolving from a source of dread to a source of enchantment, is demonstrated by Alexander: the poet, instead of feeling threatened by such an expanded cosmos, establishes an affinity with the universe by projecting the lyric I upon it and assigning a sentience to astronomical objects such as nebulae and objects.

If the two preceding studies concentrate on showing how poets sought to link astronomy to the human realm of emotions and relationships, Jason David Hall's article illuminates in what other ways astronomy and poetry could be connected: through our imaginative and creative capacities, which poets and scientists share. In an article about Dante Gabriel Rossetti's poem and painting of the same name, 'The Blessed Damozel', Hall finds evidence in Rossetti's poem to make a case for the artist's anticipation of relativistic physics in his situating the Damozel in the Pleiades. Hall justifies this anachronistic application of relativistic mathematics to a poem written in 1850 by suggesting that the poet's lively imagination, informed by contemporary physics and astronomy, led him to speculate about the behaviour of time in vast interstellar distances in a way that foreshadows Einstein's theories. He bases this discussion of pre-relativistic physics on a line in 'The Blessed Damozel' in which the Damozel is described as seeing 'Time like a pulse shake fierce' (qtd. 334). According to Hall, the poet-painter participates in a Victorian project to use the imagination when our senses falter 'to conceive of a knowledge that is not readily available via the senses' (339). In this context he cites John Tyndall and John Proctor, two nineteenth-century scientists, who emphasise the importance of 'the scientific use of the imagination' (Tyndall qtd. 339). The imagination and the roles it plays in astronomical research and poetic composition are also the main theme of the last chapter of this thesis, which, unlike the first chapters, focuses on the

crosspollinations between a poet-astronomer's creative writings and her astronomical research. In her poetry about the universe, as I will show, Elson tries out different analogies and metaphors for phenomena like dark matter and the evolution of the universe, metaphors which in turn influence her thinking as an observational astronomer.

Other critics have pursued the formal or thematic commonalities between astronomy and poetry. Dometa Wiegand Brothers investigates how the nature of astronomy, being both observation-based and highly abstract, lends itself well to poetic expression and experimentation in her 2015 monograph *The Romantic Imagination and Astronomy: On All Sides Infinity*. Brothers analyses Romantic poets, from Anna Laetitia Barbauld to Dante Gabriel Rossetti, and their engagement with contemporary astronomy, which, Brothers explains, is tightly linked to navigation and colonialism. She identifies a duality in the science of astronomy, which explains why it is so easily translated into poetry: 'This seemingly "natural" relationship between poets and the stars may have arisen because astronomy has at its core a duality: that astronomy is one of the exact, mathematical, observation-based sciences at the same time that it is perceived as being mystical or even divine' (50). It is this sense of the mystical or divine, or its sense of infinitude, that appeals to the poetic imagination, according to Brothers. In her analysis of various Romantic poets, she traces an arc from late eighteenth-century to mid-nineteenth-century poets whose engagement with astronomy moves from awe and delight, to scepticism, to rejection. Whereas Barbauld employs the trope of the cosmic voyage, steeped in sailing metaphors, which Brothers explains through the close relationship between astronomy and navigation, and betrays a fascination with infinity, Keats's obsession with beauty and destruction is related to the act of scientific discovery, the demystification of the natural world, a process during which something old is destroyed (103-104). Shelley is equally ambiguous about astronomy as he firmly links it to colonialism, navigation, and the destruction of indigenous peoples (138). In Rossetti, Brothers finds the strongest reaction against astronomy, while simultaneously also reading an attentive engagement with the science on the part of the artist-poet: 'Rossetti's art and poetry offers resistance to the new model, but it also attempts to hold the new and the older models side by side' (145). As with the ideology of the Pre-Raphaelite Brotherhood, of which Rossetti was a founding member, the poet's writings betray a fascination with the past and a wish to retrieve earlier models, in this case Cartesian vortices filling a plenum and Newtonian astronomy and physics (160). The different degrees of reticence exhibited by the various poets vis-à-vis astronomy lead Brothers to write towards the end of the book: 'Rossetti's medieval subject matter, Keats's mythology, and Coleridge's archaic ballads, all serve as points for forming the new model of the world that the nineteenth century mind must construct—a terrifying new world, made reconcilable by recalling characteristics of the older world models' (176). Thus, Brothers identifies two types of cultural work Romantic poetry does: on the one hand, poetry sheds a light on the ways that astronomy is related to poetry; on the other, poetry participates in the work astronomers have begun, which consists in shaping a new world model. If astronomy delivers new knowledge, poetry seeks to embed this new, and sometimes upsetting,

knowledge in a world picture that includes the human viewpoint. Modern poets are divided on the importance of the human perspective: as explained above, Alexander is preoccupied with moving away from an anthropocentric worldview, inhabiting nebulae and planets of other solar systems, whereas Smith and Morgan reveal a concern with the human's place in the vast cosmos and the obsession with technological advancement in the context of the space race.

In much of recent scholarship in astronomy and poetry, the appropriation of astronomy and cosmology in poetry is analysed in terms of metaphorical relationships. Astronomical discoveries and theories are used for their metaphorical potential to express emotions such as grief. This strand of criticism forms the basis of Anna Henchman's '"The Globe We Groan in": Astronomical Distance and Stellar Decay in *In Memoriam*' (2003). Here, Henchman discusses Tennyson's major work in light of contemporary astronomical knowledge. She argues that Tennyson used astronomy as a resource to explore the 'fragile relation between human sensory perception and conceptual ideas' (30). Just as a star is 'just on the cusp of perceptibility' – 'they seem to have neither substance nor dimension, but they can be seen' – so is the death of a beloved friend, Arthur Hallam, to whom *In Memoriam* is dedicated (37). Furthermore, Henchman finds similarities between the structural organisation of *In Memoriam* and the astronomical technique of parallax. Stellar parallax, the apparent shift of a star's position relative to the Earth's motion, is used to measure the distance to specific stars (30). Like stellar parallax, each section of *In Memoriam*, according to Henchman, offers a different perspective on Hallam's death in order to understand it better (30). Henchman also demonstrates that Tennyson's emotional reaction to the new astronomy becomes discernible in a passage which has often been interpreted as pathetic fallacy. Henchman, however, demonstrates that far from being a fantastical trope to mirror the poet's state of mind, the description of a doomed universe is based on contemporary astronomical developments: 'Tennyson draws these images of a dying sun, blind stellar motion, and waste places . . . from the very astronomical discoveries that he himself was convinced were true' (34). Henchman also stresses the difficulties and shortcomings of observational astronomy in Tennyson's uses of the science: on the one hand, just as with stellar parallax, in poetry multiple perspectives of one event are required to gain an understanding of it; on the other hand, astronomical refraction, the displacement of celestial objects from their true position by the Earth's atmosphere, signals to Tennyson the absolute impossibility of epistemological certainty and knowledge of other people (32). While Henchman sets out to analyse how 'astronomy infuse[s] the form and subject matter of [Tennyson's] poetry', her discussion of poetic form is, however, limited to her argument that the organisation of the different sections of *In Memoriam* are comparable to the astronomical technique of stellar parallax.

This article on Tennyson can also be found, though somewhat altered, in Henchman's book-length study of the impact of astronomy on literature, *The Starry Sky Within: Astronomy and the Reach of the Mind in Victorian Literature*, which was published in 2014. The chapter on Tennyson, however, is the only section in which Henchman discusses poetry. Her other primary authors are

Thomas De Quincey, Thomas Hardy, and George Eliot. Her discussion of *In Memoriam* fits in smoothly with the discussion of fiction and prose as she states clearly in her introduction that her analysis will focus on narrative, characters, and points of view. In her chapter on Tennyson, Henchman justifies her choice of *In Memoriam* thus: 'the poem's grand scale and fragmented form throw into relief many of the more familiar characteristics of the novel' (85). Indeed, Henchman focuses on those formal characteristics of the poem that poetry shares with fiction and prose, such as figurative language, tropes, perspectival shifts, and voice, rather than formal elements unique to poetry, like sound patterns, rhythm and meter, versification, or line lengths. The result is an inattention to what language and sound can contribute to a mood. For example, in her discussion of the following passage, Henchman focuses only on what the lines describe – the stars and the contemporary worry of a dying sun:

> O Sorrow, cruel fellowship,...
> What whispers from thy lying lip?
> "The stars," she whispers, "blindly run;
> A web is woven across the sky;
> From out waste places comes a cry,
> And murmurs from the dying sun (Tennyson qtd. in Henchman 91)

Henchman here argues that these gloomy descriptions of a dying universe are scientifically accurate (91). She comments on the content of these lines but neglects the sound patterns and rhymes. For instance, the rhyming words 'sky' and 'cry' suggest a link between the expression of sorrow and the (dying) universe ('sky'), while the rhyming 'run' and 'sun' suggest the idea, a worry of late Victorian science, that the sun is 'run[ning]' out of time (Gold, 45). Moreover, the striking iambic tetrameter, shorter and swifter than the more traditional iambic pentameter, contributes to the idea that the world, or the sun, or the universe, is marching onward towards the inevitable (heat) death.

The metaphorical relations between poetry and astronomy also form the focus of kitt price's study of William Empson's poetry. Their chapter in *The Cambridge Companion to Literature and Science* (2018), 'Empson's Einstein: Science and Modern Reading', engages with twentieth-century cosmology and William Empson's poetry. price considers Empson a metaphysical poet, one comparable to John Donne, whom he studied extensively, in his conviction that 'a love affair is the fundamental means of understanding the world' (98). A bisexual man, Empson recurrently used outer space as a trope of liberation; space holds the 'promise that outlawed love may find sanctuary at the outer reaches of space' (99). Empson is not the only queer poet to have found a liberating aspect in cosmology: Morgan, as I will argue, also identifies outer space with freedom from prejudice and the need to hide his sexual and romantic relationships with men. He writes with a certain envy of Laika's spaceflight aboard Sputnik 2, an envy which is also mingled with compassion. price further shows how Empson found fertile metaphors for his personal love life in

the new cosmology: being frustrated in love, the poet 'found in the curvature of space-time a means to universalize the personal pain of [his unrequited love]' (99).

Formal similarities between cosmology and poetry, the kinds that I intend to elucidate in this thesis, are also explored by Michael Whitworth, particularly in T. S. Eliot's poetry. Whitworth's seminal study of the intersections between physics and literature, *Einstein's Wake* (2001), concentrates primarily on physics and fiction. In this book, Whitworth employs a historicist methodology to analyse the movement of ideas and ways of thinking between physics and literature. He claims that writers' engagement with the hard sciences was primarily, whether consciously or unconsciously, metaphorical (13). As notions from physics, such as the curvature of space and cosmic entropy, find their ways into popular writing and literature (and Whitworth analyses these resources side-by-side), they become metaphors and partly divorced from their original contexts: 'Metaphors abstracted from science are no longer wholly identical to science, nor are they wholly divorced from it' (7). While Whitworth's study concerns above all physics (both late nineteenth- and early twentieth-century physics), popular science writing, and fiction, in his chapter on non-Euclidean geometries he briefly engages with cosmology (the study of the nature of and structure in the universe) and T. S. Eliot's *The Waste Land*. According to Whitworth, *The Waste Land* responds to the notion of non-Euclidean geometries through its form, which can be related to 'concepts of distortion, crumpling, puckering, and warping' (220). Whitworth also points out that contemporary reviewers of Eliot's long poem struggled to describe it in conventional ways and recurred to metaphorical descriptions of it that 'identify *The Waste Land* with the concepts of flatness and distortion' (222). Whitworth's comparison of Eliot's poem to non-Euclidean geometries has been influential on my reading of Catanzano's prose-poetry. If Eliot responds – perhaps unconsciously – to contemporary physics and mathematics in his poetry, then Catanzano intentionally seeks to recreate the mathematical and physical properties of space-time in literary writing. This is what sets Catanzano apart from most of the poets discussed in this thesis: Catanzano is actively involved in researching new ways to simulate cosmology, astrophysics, and physics in poetics. In Chapter Three, I shall show how Catanzano imitates the extreme curvature of space due to a massive object in her novella, in which the fabric of the plot is bent so extremely as to create a literary black hole.

This thesis was also influenced by another study of twentieth-century poetry engaging with astronomy and cosmology, Katherine Ebury's '"In this Valley of Dying Stars": Eliot's Cosmology' (2012). Here, Ebury presents a close reading of Eliot's 'The Hollow Men', a short poem which has often been considered an extension of *The Waste Land*, exhibiting a similarly pessimistic tone and mood (146). Ebury, however, makes a convincing case for the influence of (late nineteenth-century) astronomy and cosmology upon this particular poem. According to Ebury, hers is the first study to explicitly link the oft-quoted closing lines of the poem, '*This is the way the world ends* / *Not with a bang but a whimper*', with the idea of cosmic entropy, the heat death of the universe (Eliot qtd. 146, italics in original). Against the backdrop of a decaying universe, the hollow men

feel the weight of the ephemeral nature of all things: 'human emptiness and death are weighed against that of the wider cosmos' (151). Furthermore, Ebury suggests that the instability of the dying and finite cosmos is mirrored in 'a poetic universe that is not only moribund but which is also without stable markers of time and place', thus disorienting the reader (151). According to Ebury, 'The Hollow Men' was written at a time when Eliot was experiencing a personal crisis: he found that the new physics and cosmology were at odds with the notion of a divine creator and this poem reflects a certain revulsion against the materialism of science. Later in his career, Ebury explains, Eliot's work gained a certain optimism, partly because cosmology had become more optimistic, as the notion of an expanding universe lessened the threat of cosmic entropy, and partly because Eliot managed to reconcile the science with his personal faith (154).

Two years after the publication of this article, Ebury brought out her book on Irish Modernist writers and cosmology, titled *Modernism and Cosmology: Absurd Lights* (2014). This study focuses on William Butler Yeats, James Joyce, and Samuel Beckett. Ebury's analysis of the roles that stars play in Yeats's work is especially compelling. She argues that in Yeats's poetry, stars often appear as chaotic, disruptive, and even apocalyptic, threatening to destabilise the poem. They bring mystery and darkness to a poem, rather than clarifying it (36). They are also often mentioned in connection with sexual desire: 'Thus, when the stars enter these poems, the speaker is given a cosmological perspective upon his love, introducing a deep instability into the world of the poem' (41). Later poems by Yeats, appearing after the new cosmology (revolutionised by Einstein, Friedman, and Lemaître) had been divulged, are marked by the presence of images of spheres and curves, as well as cosmic eggs and other ovoid shapes, betraying an influence of Lemaître's proto-big bang idea of the cosmic egg from which the universe originated (52). At the same time, his later poetry also betrays an unease about the flux and apparent formlessness of the new cosmos, to which he reacts through the wish to impose order and structure upon the cosmos (60). In her discussion of Yeats's engagement with astronomy and cosmology, Ebury stresses the interrelations between the changing cosmos and human relationships, concluding that '[h]umanity and the cosmos are seen to be so intimately bound together in Yeats's system that astronomical and historical movements can be metaphors for sexual experiences (and vice versa)' (61). Ebury arrives at an interesting conclusion about the intersections between astronomy and Modernist Irish literature: 'the artists discussed in this book, from Joyce to Kenji, see the new cosmology as an opportunity for play, for the creation of difficult, absurd and desiring textual worlds' (187). Cosmology and astronomy have also encouraged the poets discussed in this thesis to play and experiment with poetry and language. The result is, as in the poems discussed by Ebury, the composition of partly difficult and complex texts, which, in their bending of literary conventions, border on the absurd. Chapter Three on Edwin Morgan and Amy Catanzano, in which I shall focus on the treatment of love and sex through astronomical metaphors and allusions, will also show to what extent these poetic experiments can express desire. To Ebury's adjectives describing the textual worlds these intersections between cosmology and poetry create – 'difficult, absurd and

desiring' – I would add 'unstable' and 'vibrating'. Especially Alexander's and Elson's poetic universes are filled with things that have agency, that move, and that present the human viewpoint, if they even contain one, as just one among a plethora of different perspectives, thus deemphasising the anthropocentric outlook.

1.3 Anthologies of Space Poetry

1.3.1 *Inside Outer Space*: Poetry and Spaceflight

Robert Vas Dias's anthology, *Inside Outer Space: New Poems of the Space Age*, came out in 1970 in the United States, one year after the moon landing and nine years after the first human astronaut ventured into outer space. The poems, written predominantly in the 1960s, present pessimistic or at least sceptical views on the space race and astronomical exploration. It was published by Anchor Books, a mass market publisher of intellectually fashionable paperbacks, whose target market was college students as well as the adult public. Vas Dias himself is also a poet, though *Inside Outer Space* predates the publication of any of his own poetry in book form. Even though Vas Dias is not a major representative of any twentieth-century poetic movements, his idiosyncratic anthology regroups many well-known poets from the mid-twentieth century, ranging from mainstream poets who had achieved fame and admiration for their work, such as W. H. Auden, to much more experimental poets, like Charles Olson and David Antin. The collection is a substantive one, containing 180 poems by 105 poets, which makes it one of the largest anthologies of poems about astronomy that I have come across (*Verse and Universe* is longer, yet it also contains areas of science other than astronomy and cosmology). The anthology also includes representatives from various mid-twentieth-century poetic movements, such as the Beat poets (Allen Ginsberg, LeRoi Jones before he was Amiri Baraka, Gary Snyder, Margaret Randall, and Michael McClure), the Black Mountain Poets (Charles Olson, Paul Blackburn, Robert Creeley, Larry Eigner, and Theodore Enslin), Objectivist Poets (Louis Zukovsky, Michael Heller, George Oppen, Carl Rakosi, and William Carlos Williams), Confessional Poets (Anne Sexton), poets associated with the San Francisco Renaissance (Jack Spicer and Ron Loewinsohn), poets associated with the ethnopoetics movement (Jerome Rothenberg and Rochelle Owens), and other poets that are not connected to any particular movement but who also wrote more experimental poetry (such as Jackson Mac Low's found poetry experiments and Mary Ellen Solt's concrete poetry). Foregoing any comment on poetic movements, thematic engagements, or poetic form, Vas Dias simply ordered the poets and their poems alphabetically, starting with Sam Abrams and ending with Louis Zukovsky. As the book thus alternates concrete poems with narrative poems and collage poems over a total of 370 pages, the reader is impressed by the scope of the poetry written about space exploration and space travel.

What this heterogeneity suggests is that interest in astronomy, and above all the space race and spaceflight, was widespread. The level of engagement with astronomy and spaceflight varies: while some poets write light, almost humorous, verse using astronomical imagery as a source of new metaphors to express old situations or emotions, others let the universe take centre stage, resulting in poems which present meditations on astronomical discoveries or specific events in the space race, such as the moon landing (examples of which are discussed below) or the discovery of pulsars (such as Mac Low's found poem 'Good-By, LGM's' [190]). Why is Vas Dias's anthology a valuable inclusion in this project? The scepticism of the NASA moon missions expressed by some of the poems in *Inside Outer Space* allows me to frame the poems discussed in later chapters; the resistance to technological progress voiced by Auden and Sexton, for instance, is echoed, to a lesser extent, by the main poets of this thesis, thus setting a precedent for their scepticism of Alexander's and Morgan's poems about spaceflight and space exploration.

No fewer than three anthologies with science fiction themes came out in 1969 and 1970, which is doubtless due to the historical moment of humankind's first ventures into outer space.[6] About Vas Dias's anthology, Joe Luna writes that it is 'a fascinating collage of the oneiric, often nightmarish calibrations of the human condition in the face of its contemporary aeronautical traumas' (114). Although Luna employs very strong language – 'nightmarish' and 'traumas' – to describe the Apollo missions and others of NASA's projects, his assessment of the poems in the anthology is perceptive. As Vas Dias himself points out in the introduction, and as I mention above, what is striking about this anthology is that a majority of the poems voice scepticism and criticism of space travel and exploration. Compared to later anthologies, such as *Verse and Universe* (1998) and *Dark Matter* (2008), *Inside Outer Space* is marked by an overall tone that is more suspicious or unconvinced of the exploits of the space race. According to the editor, this reticence about the space programme is expressed in the juxtapositions of spaceflight with urban pollution and famine:

> [A]gainst Aldrin's instinctive moon caper – and "the heel & toe to the end" of Yuri Gagarin – is set the vision of a dance of death on earth; against the agate swirl of the blue planet seen from the port of the command module 30,000 miles away is set the image of dark pollution hovering over our megalopolises; against the reports of instrument checks that tell Mission Control that all systems are go is set the frightening doublethink by which some governments attempt to control the governed . . . many cannot yet reconcile the enormous sums spent for just a portion of the space program ($24 billions for the Apollo series alone) with the inadequate amounts allotted for our cities and for the alleviation of the continuing plight of the poor, the disadvantaged, and the undereducated. (Vas Dias, introduction, xxxvi-xxxvii)

[6] The other two are John Fairfax's *The Frontier of Going* (1969), similar to Vas Dias's collection, only much shorter, and Edward Lucie-Smith's *Holding Your Eight Hands* (1970), an anthology of science fiction poetry.

This scepticism of the space programme is echoed by historian Kendrick Oliver's findings of the predominating opinions in that context. In his study of the intersections between religion and spaceflight, Oliver remarks on the indifference with which the American space programme was often viewed:

> By the end of the 1960s, even as the Apollo astronauts took their first steps on the moon, man's adventures in the cosmos were no longer held to be so definitive of their time. For many Americans, they represented a distraction from more important concerns: the war in Vietnam, the plight of the poor, inflation, the environment, and the state of the nation's cities. (3)

This view of the space programme chimes with the views that most of the poets included in *Inside Outer Space* express in their poetry, and with what Vas Dias sees as the main thread running through the anthology. Like the war in Vietnam that Oliver mentions in this excerpt, the American space programme was of course also firmly rooted in the West-East conflict, as the Cold War was also fought in outer space. In other words, the Apollo 11 moon landing and the planting of the American flag on the lunar surface were just as much a military victory, beating the Soviets to the moon, as it was a historical moment. This certainly also contributed to the disillusionment with the space race that some of the poets of Vas Dias's collection felt and voiced.

Ron Penoyer's poem 'Countdown' (1969) illustrates NASA's total disconnectedness from terrestrial matters and problems, such as urban and child poverty. The poem interweaves the countdown to the launch of an Apollo rocket at Cape Canaveral with lines that describe an underprivileged child's view:

> T minus 60 seconds
> and counting
> marbles on 4th Street
> which Joey collected
> since age 5½
> years ago the
> buildings were new
> but now they're
> falling down
> to T minus 50
> on the Cape
> and all systems are go
> up the street
> to Stuyvesant which
> is the end of the
> world and beyond

it are monsters breathing
jet propulsion fuel
now disconnected from
the pad at T minus 40
all systems are green
light at the corner
by the delicatessen
where meat is grown
in white wax-paper
and milk is made in
bottles like the ones
Daddy brings home to the
Pad now cleared at
T minus 30 while voice
communications with
the world through the
welfare worker are not
proceeding at T minus
20 and now removed
from the launching room
are 2 dead rats and
Mammy is screaming
10, 9, 8, 7 days till
the next check comes for
6, 5, 4, 3 dollars or even
2, 1, Zero, Ignition, Lift-Off
to buy a pair of brand
new shining rockets. (238-239)

Though formally simple, the poem cleverly creates intersections between the two very distant worlds of NASA ('the Cape', 'T minus', 'jet propulsion fuel', 'the pad', 'all systems are green', and 'launching room') and the child of a family who struggle to make ends meet ('counting / marbles', 'monsters', 'Daddy', and 'welfare worker'). The poem ends as the countdown arrives at lift-off, which is juxtaposed with the absurd idea of a low-income family buying 'new shining rockets'. The countdown to 'ignition' and 'lift-off' finishes a sentence that starts with the child's mother counting down the days until the paycheque arrives, a paycheque which, along with NASA's countdown, dwindles in size. The two worlds represented in this poem and their formal interrelatedness point to the doublethink in 1960s America: the reverse of Americans' prowess in the space race was widespread poverty. The fact of syntactically interrelating the two subjects – the

launch of a rocket at Cape Canaveral and the impoverishment of the working classes – underlines how the financing of NASA's Apollo missions by the American government also results in hardships of the country's poorest.

Around twenty-seven poems in the anthology are either about the moon or the Apollo missions, which is not surprising as it came out just one year after the moon landing. Many of those poems express a certain sense of loss with the advent of the lunar landing. As the astronauts of Apollo 11 set foot on the lunar surface, the moon changed into a palpable and real place and thus lost some of its magic. Jack Anderson writes: 'To set foot on it / even once / is to corrupt it utterly' (8). A similar sentiment is expressed in May Swenson's poem, 'After the Flight of Ranger VII', in which the moon is compared to a fossil, which, like an upended turtle, is ruthlessly and unrelentingly studied by scientists: 'pincers prepare to / pick your secrets / bludgeons of light / to force your seams' (317). The alliterative plosive sounds in 'pincers', 'prepare', and 'pick' contribute to an impression of violence or aggression, while the words 'bludgeons' and 'force' likewise present strong and downright brutal or cruel imagery.

W. H. Auden's poem, simply titled 'Moon Landing' (1969), does not pity the moon, but mocks the astronauts that landed on it and the mission that brought them there. Calling the Apollo mission a 'phallic triumph', he asserts that going up to the moon is pointless as it does not improve humankind in any way and that our furious desire for technological progress will merely write 'the usual squalid mess called History' (22). Here are the first four stanzas of the poem:

> It's natural the Boys should whoop it up for
> so huge a phallic triumph, an adventure
> it would not have occurred to women
> to think worth while, made possible only
>
> because we like huddling in gangs and knowing
> the exact time: yes, our sex may in fairness
> hurrah the deed, although the motives
> that primed it were somewhat less than *menschlich*.
>
> A grand gesture. What does it period?
> What does it osse? We were always adroiter
> with objects than lives and more facile
> at courage than kindness: from the moment
>
> the first flint was flaked, this landing was merely
> a matter of time. But our lives, like Adam's,
> still don't fit us exactly, modern
> only in this – our lack of decorum. (21)

At the beginning of Oliver's book on the American space programme and religion, he quotes a NASA astronaut on the eve of the launch of a Saturn I rocket: 'You must see it as a prayer because when we launch that thing it's like praying' (Theodore Freeman qtd. in Oliver 1). Auden here contemptuously undermines the often religious and spiritual undertones that the spaceflight was assigned by calling the launch of the Apollo 11 rocket a 'phallic triumph', so clearly a product of the male-dominated Cold War American politics. Later in the poem, Auden further belittles one of the most significant moments in spaceflight as well as in the Cold War by calling it a 'grand gesture', which, however, is devoid of any serious sense: it is 'less than *menschlich*' ('humane'), and it does not 'period' or 'osse' anything, the poet implies. The language Auden chose here borders on the obscure, or is at least surprising to British readers. Thus, the archaic verb 'osse', which signifies 'to presage, forebode, or prophesy', bears this note in the *OED*: 'Apparently revived by W. H. Auden from dictionary record'.

If 'osse' is an arcane term, then 'menschlich' is no less striking. Nina Martyris, in her review of 'Moon Landing' in the *Paris Review*, argues that 'menschlich' is Yiddish, which the poet might have picked up from his Jewish American partner Chester Kallman. While that is a plausible explanation, 'menschlich' is clearly the German spelling, while the Yiddish spelling of the word, in Romanised spelling, is 'mentshlekh'. It is possible that Auden picked up the German term in Austria, where he spent his summers. The German adjective might have been chosen because its intonation makes it a better fit for Auden's feminine verse endings than 'humane', which, with its last syllable stressed, would render the rhythm clumsier. Apart from being a smoother fit for the poem's meter, the word would also not be understood by the majority of Anglophone readers. Furthermore, the choice of a German word meaning 'humane', in a poem written twenty-four years after the end of the Second World War, is also surprising considering that nation's recent past and crimes against humanity. The German word, along with 'osse' and 'blithe' in the last line, contributes to the recondite and erudite character of the poem, forming a contrast to the simple 'phallic triumph', whose purpose, Auden suggests, was not sufficiently considered and analysed. The archaic language and the foreign 'menschlich' were possibly chosen to form a contrast to the simplified and utilitarian English astronauts use in their communications with mission control, such as 'all systems are go' (Penoyer 238).

Contrary to various poets included in Vas Dias's anthology who lament the loss of the moon's mystery when astronauts landed on its surface, Auden reaffirms the moon's eternal beauty, unfazed by any recent technological and scientific developments:

> Unsmudged, thank God, my Moon still queens the Heavens
> as She ebbs and fulls, a Presence to glop at,
> Her Old Man, made of grit, not protein,
> still visits my Austrian several (22)

Traditionally gendered as female and described by various capitalised and archaic words, the moon is elevated to the rank of a goddess and a queen. In this, 'Moon Landing' alludes to poems and plays from the Elizabethan age in which the moon is personified and addressed, through references to the Goddess of the moon, Cynthia, such as Walter Raleigh's 'Ocean to Cynthia', Ben Jonson's *Cynthia's Revels*, and Shakespeare's *Midsummer Night's Dream*. Here, the moon often symbolises Queen Elizabeth, but also stands for femininity and virginity, as well as ambiguity and mystery (Herron 101). In Auden's descriptions of the Earth's satellite, with their allusions to the classics of the English literature canon, there is no hint of any modern developments in astronomy and spaceflight. On the contrary, besides being hailed as a goddess and a queen, evoking the lunar mythology and symbolism as it is employed in the early modern period, the moon is also described in terms of the popular nursery rhyme about the 'old man in the moon'. To differentiate the legendary old man in the moon from the human astronauts bouncing about on the lunar surface, Auden adds that this man is 'made of grit, not protein'. The word 'grit', besides signifying sand or gravel, or in this case lunar dust, also has connotations of firmness or solidity of character, when applied to a person. The moon, then, is personified in various ways: it appears as a goddess, a queen, and as the scrappy 'Old Man'. These different instantiations of the moon persist despite the 'corruption' of its surface by the Apollo 11 astronauts.

Nina Martyris invents a new category for Auden's work: besides the 'early Auden' and the 'later Auden', she comes up with 'grumpy Auden', a category to which she assigns 'Moon Landing'. However, contrary to the impression the 'grumpy' 'Moon Landing' conveys, Auden was in fact interested in the sciences. For example, in his poem 'After Reading a Child's Guide to Modern Physics' (1961), he presents meditations on the physical laws governing the universe and concludes that we are lucky to be alive on Earth, rather than in 'the Greater Nebulae' or 'the atoms in our brains' (*Selected Poems* 257). In this poem, too, Auden reiterates the same complaint he has with science in 'Moon Landing': 'But I would rejoice in it more / If I knew more clearly what / We wanted the knowledge for' (*Selected Poems* 258). Auden is not 'grumpy' about the moon landing itself. Instead, what he criticises or laments is the absence of a defensible reason for pursuing ventures into outer space or explorations of the cosmos. Throughout 'Moon Landing', Auden establishes a contrast between the Apollo mission's values, which he considers immature and macho, and a different set of values, which he seems to ascribe to poetry and the arts. To NASA's 'phallic triumph' he opposes the mythological moon of poetry – through his personifications of the moon he evokes Elizabethan and Jacobean literature – expressed in elevated and partly archaic language to underline the fact that the moon was not discovered by megalomaniac politicians and NASA directors in the 1960s, but long before the invention of the sciences.

Like Auden, Anne Sexton personifies the moon in her selected poem for the anthology, entitled 'Moon Song, Woman Song' (1969). The moon is here personified through prosopopoeia, making the poem a dramatic monologue voiced by the moon. Sexton, like Auden, is very critical of the moon missions, though for different reasons. While Auden denounces the lunar landing because

he believes it was motivated by the wrong urges and desires, Sexton's feminist poem considers the landing on the moon a violation of the heavenly body, identifying it with the objectification and abuse of women. For this, Sexton employs martial imagery to underline the contrast between our satellite and menfolk:

> I am alive at night.
> I am dead in the morning,
> an old vessel who used up her soil,
> bleak and pale boned.
> No miracle. No dazzle.
> I'm out of repair
> but you are tall in your battle dress
> and I must arrange for your journey.
> I was always a virgin,
> old and pitted.
> Before the world was, I was. (287)

The poet creates an opposition, introduced by 'but', between the humble, sober, and female moon ('old', 'bleak', 'No dazzle', and 'her') and man, standing 'tall in your battle dress'. This is not the only moment in the poem where astronauts are compared to soldiers: towards the end of the poem, the words 'barracks' and 'bastion' are mentioned as well, turning the helpless celestial body into a siege assailed by NASA's astronaut-soldiers. The contrast between the bellicose colonisers and the female and passive moon is further sustained:

> So if you must inquire, do so.
> After all I am not artificial.
> I looked long upon you,
> love-bellied and empty,
> flipping my endless display
> for you, you my cold, cold
> coverall man.
>
> You need only request
> and I will grant it.
> It is virtually guaranteed
> That you will walk into me like a barracks.
> So come cruising, come cruising,
> you of the blast off,
> you of the bastion,
> you of the scheme.

I will shut my fat eye down,
headquarters of an area,
house of a dream. (288)

The moon's tone is one of quiet resignation, as it tells man to 'do so', if he really must. It again creates an opposition between humankind and itself: when it calls man 'my cold, cold / coverall man', the line echoes an earlier line, not quoted above, in which the moon talks about its 'gold, gold, / blinkedly light'. By rhyming 'cold' with 'gold', the moon stresses the coldness in human endeavours, set against the warm and valuable ('gold') moonlight falling onto the Earth.

The coldness in men and their opposition to the moon reach their climax in one of the most powerful moments of the poem, where the moon predicts that 'you will walk into me like a barracks'. Comparing the Tranquillity Base, where the Apollo 11 mission landed, to a barracks effectively equals the astronauts to soldiers. Neil Armstrong's words 'representing . . . men of peace of all nations' are thus lent an ironic undertone (qtd. in Wilford 1). Portraying the moon landing as a military triumph is not far from the truth, of course: the success of the Apollo 11 mission also represented a blow to the USSR in the context of the space race during the Cold War. The connection to the military in the context of the lunar landing is also mentioned in other poems in *Inside Outer Space*. Armand Schwerner, a poet associated with the ethnopoetics movement, has a poem titled 'men walk on moon times july 21, 1969', also included in this anthology. In this short poem, Schwerner interweaves extracts from an article on the moon landing from the 21 July, 1969 issue of *The New York Times* with original lines of poetry. Thus, the first stanza reads like this:

how do you read me
how do you read me how
has landed. We will update that.
Eagle is at Tranquillity his first steps
were tentative, to support
  on a more exorbitant scale than ever the
  military-industrial scientific establishment (276)

The 'military-industrial complex' is a phrase that was popularised eight years earlier by outgoing United States President Dwight D. Eisenhower during his farewell address to the nation. In this speech, Eisenhower warns of the increasing power of the military-industrial complex and the threat that this establishment represents to the freedoms that are deeply entrenched in American culture. In the wake of the Second World War, a permanent armaments industry of vast proportions emerged in the United States and Eisenhower urged American citizens not to succumb to its influence: 'the potential for the disastrous rise of misplaced power exists and will persist' (1038). Placing the phrase into the context of a poem about the moon landing, and, on top of that, adding the adjective 'scientific', presents an insightful, though provocative, comment on NASA and the moon missions. A similar scepticism of NASA's projects is detectable in Alexander's 'Water on

New Mars'. While Alexander does not establish direct links between space exploration, space travel, and the military, he represents his poetic and linguistic exploration of Mars as parallel to NASA's research, underlining that his own investigations are 'instantaneous', while he considers that NASA's are hindered by expensive machinery, such as the rovers and the Mars Reconnaissance Orbiter.

Returning to Sexton's poem above, the preposition 'into', instead of 'on' or 'towards', for instance, in 'walk into me like a barracks', also has upsetting connotations. The word 'into' suggests that the moon's space is being violated, and, in a more literal reading, there is a suggestion of rape. Again, recalling Auden's 'phallic triumph', Sexton also sees sexual imagery in the Apollo 11 mission and portrays the moon landing as a violation, or a rape, of the moon. Babette Deutsch, in her poem in *Inside Outer Space*, writes about our satellite: 'Now you have been reached, you are altered beyond belief' and further wonders if the moon is now 'a planet that men have, almost casually, cheapened' (61). Though she does not directly employ imagery that is suggestive of rape, she does mourn the loss of the moon as it used to be and also, like Sexton, uses the plural 'men' to refer to humankind, underlining the machismo inherent in the moon missions.

In the last lines, the moon invites the astronauts to 'come cruising, come cruising'. The verb 'cruising', with its connotations of aimlessness or purposelessness, seems strange considering the year-long planning and fine-tuning leading up to the moon landing. On the one hand, 'cruising' might point to exactly the fact that Auden already criticised, that the moon mission is aimless, because Sexton does not recognise the motivations behind the venture as legitimate. On the other hand, 'cruising' also signifies searching for a sexual partner. This reading is in keeping with the sexual predatoriness of the preceding line. The personified heavenly body proceeds to call the addressee 'you of the blast off', 'the bastion', and 'the scheme'. All three words have slightly adverse or pernicious connotations: though the phrase 'blast off' also refers to the launch of the rocket, the first word, 'blast', insinuates the explosion of bombs and thus sustains the military and warfare metaphor running through the entire poem; 'bastion', likewise, has a military signification, turning NASA headquarters into a fortified structure or encampment from which the astronauts attack the moon; and 'scheme', as the *OED* explains, is defined as 'a self-seeking or an underhand project' or 'plot', which portrays the lunar missions as a narcissistic and self-aggrandising venture.

How, then, does the moon 'arrange for your journey'? She reveals her reaction in the last three lines:

> I will shut my fat eye down,
> headquarters of an area,
> house of a dream. (288)

The 'house of a dream' that the moon once was – housing many different myths and legends throughout the ages – will vanish once man sets foot on its surface. This notion that the moon ceases to exist once menfolk land on it can also be found in Jack Anderson's poem:

now that I am here
it no longer exists: instead
I exist on it (9)

Man imposes a new personality onto the satellite: no longer a faraway and unreachable planet, or deity, or symbol of femininity and change, or the night, the moon has now become another battlefield of the Cold War, a new conquest, and a symbol of the moving frontier in American expansionism. Leah Ceccarelli hones in on the metaphor of the frontier in American scientific rhetoric, mythologising the sciences. In *On the Frontier of Science*, she demonstrates through a few case studies how science is promoted as a nationalistic project through the trope of the moving frontier. This narrative is dangerous because it encourages scientists, politicians, and policymakers, through its 'themes of competitiveness and economic exploitation', to consider the natural world a place that exists purely for the purpose of being investigated, exploited, commodified, and turned into monetary profit (139). In this discourse, science is mythologised as a heroic venture because it can go 'where no man has gone before', lending the scientist a 'hardy, risk-taking, self-reliant American identity' (10). In her analysis of Reagan's speech eulogising the *Challenger* space shuttle crew in 1986, Ceccarelli notes how the trope of the frontier is tightly connected not just to space voyage, but to the expansion of our (scientific) horizons (119). Jack Anderson's line above, 'instead / I exist on it', perfectly illustrates the commodification of the natural world, in this case the moon, that the frontier narrative in the sciences reinforces. The poem's speaker – the capital I, like a phallic symbol linking Anderson's poem to Auden's and Sexton's, sticking out as the astronauts or the American flag stick out on the lunar surface – embodies Ceccarelli's 'hardy, risk-taking, self-reliant American' (10).

The poems discussed in this section, especially Auden's and Sexton's, demonstrate an outspoken scepticism of the space race, and especially the moon landing.[7] They associate it with the military, a sexist and macho muscle-flex which is also linked to the abuse of women, the dilapidation of American cities, and the impoverishment of the working classes. Vas Dias's idiosyncratic anthology serves as a useful introduction to the subject of this study: this first group of poems define the relationship between poetry and astronomy as one in which poetry takes on the role of cultural commentator on the activities of the scientific and technological industries. Poetry is here shown as assuming a moral high ground, from which the ethically questionable technological and scientific advances are discussed. The moon is personified and both Auden and Sexton reject the idea that the moon landing has enriched our conception of the satellite, both preferring pre-scientific lunar personifications to its mid-twentieth-century image. The implication is that space exploration and space technologies have debased celestial bodies like the moon. This view of science changes with later poetry, as the other two anthologies will show: as poets become

[7] Of the approximately seventy-five poems in *Inside Outer Space* that are explicitly about spaceflight, two thirds have a sceptical or critical tone.

more fascinated with astronomy and the cosmos, their roles and their view of the relationship between poetry and astronomy also change. No longer cultural commentators, they find other roles for astronomical poetry. Furthermore, this section on poetry about the space race also helps to frame Morgan's poetry: Morgan, much less sceptical of the American and Soviet space programmes, captures the excitement, but also the consternation, surrounding Laika's spaceflight aboard Sputnik 2 in a highly ambiguous poem about his homosexual relationships. His treatment of the space race revolves around the difficulty of putting into words the experience of outer space, on the one hand, and the intimate relations between two men at a time when sex between men was illegal. So, unlike Auden and Sexton, Morgan generally met the space programme with enthusiasm, though his verse subtly harnesses the ambiguities surrounding it.

1.3.2 *Verse & Universe*: Poetic Form and Cosmological Structure

Verse & Universe: Poems About Science and Mathematics was edited by Kurt Brown and published in 1998 by Milkweed Editions in Minneapolis, a small non-profit publishing house releasing a handful of books a year in the genres of fiction, nonfiction, and poetry. Kurt Brown was a poet, but he is more famous for having founded the Aspen Writers' Conference and Writers' Conferences and Centers (WC&C), and as a poetry anthology editor and the former editor of the journal *Aspen Anthology* ('Kurt Brown'). Brown also edited the book *The Measured Word* (2001), which brings together essays about poetry and science by thirteen poets, many of whom also appear in *Verse & Universe*, such as Albert Goldbarth, Stephanie Strickland, and Alison Hawthorne Deming. In the introduction to *Verse & Universe*, an anthology which groups together poems about astronomy, zoology, palaeontology, cognitive sciences, mathematics, and genetics, Brown suggests that he sees this anthology as bridging the chasm between the sciences and the humanities because these poems underline the importance of the creative mind both in scientific research and artistic creation: 'If science and art have anything in common it exists in the resources of the human brain and our ability to create something unforeseen and revolutionary out of our dreaming' (xiv). In fact, the poems I discuss below demonstrate that poetry and astronomy share more than just creativity and imagination. Some of the poets included in the book actively seek parallels between developments in cosmology and poetic form. The resulting poems are not only formally striking, but also raise questions about the scientific method, the relevance of concise and condensed poetic forms in an expanding universe, and the functions of language in scientific communication. While these poems are much less sceptical of scientific progress than the ones collected by Vas Dias, they nonetheless establish complex relationships with astronomy and cosmology that go beyond simply illustrating and explaining the science to non-initiated readers.

Most of the poems in the collection can be characterised as mainstream lyric poetry, with a focus on the lyric subject and his or her affects, in which a poetic persona communicates his or her feelings or musings about the cosmos or other scientific fields to the reader. The collection excludes any more experimental poetry or avant-garde movements of the twentieth century, such as

concrete poetry, Language poetry, or surrealist poetry, to instead focus on realist and narrative poetry. Brown elaborates in the introduction that he essentially sees these poems as rendering a service to the sciences and to the lay public in that they communicate the abstract or technical sciences to us: the real purpose of this anthology is 'to bring science and mathematics to us in a form we might begin to understand, and in which we might take some unusual delight' (xiii). In other words, these poems seem to have a function comparable to popular science books and to be addressed to non-scientific readers, as well as readers not versed in poetics. If poems on science are primarily meant to explain the science to the non-initiated, then it makes sense that poems that do not require large efforts from the reader were chosen for this anthology.

That the book is highly readable and accessible is also the point made by two reviewers of the anthology. Barry Mazur, writing for the *Harvard Review*, calls the anthology 'wonderful' and 'delightful' (141, 146), praising especially those poems in which the science is only detectable in the poet's viewpoint and is not the main theme of the poem; the best poems, according to Mazur, are those that 'start with a mere spark of a scientific idea and [nurture] that flame to have it ignite some intimate meditation' (145). Robert Chianese, in his review for *Isis*, praises the anthology precisely for the absence of the kind of poems which appealed to Mazur: he appreciates the absence of any of 'the familiar love agonies or victimizations that limit much contemporary literature to personal interiors' (132). While his characterisation of much of mainstream poetry sounds unfairly harsh, it is true that, compared to Bell Burnell's *Dark Matter*, discussed below, the poems in Brown's collection have a more optimistic bent and have less of an introspective tendency.

Given Brown's predilection for poems that explain and popularise the sciences to non-scientific readers, it is little surprising that Robert Chianese criticises the anthology for neglecting to include poems with a more sceptical or negative outlook on science. While there are many poems that praise the findings of the natural sciences, the book does not include much humour or any 'sad or cranky speakers' (132). Indeed, a large number of the poems in *Verse & Universe* admire and celebrate individual scientists, the findings of the sciences, the scientific method, or even scientific jargon and terminology. Christopher Buckley's 'Star Journal' (1993) starts with the lines, '*Astronomy is for the soul – / the truth about what / and who we are / and will be*' (27). This is a strong defence of astronomy against accusations of the science being unimaginative, materialistic, or mechanistic.[8] Here, astronomy is associated with spirituality and the very nature of humanity, of what makes us human. Buckley's celebratory opening gives a taste of the rest of the anthology: a number of the poets represented in *Verse & Universe* base their poems around presumed similarities between the sciences and poetry, putting these similarities in dialogue with each other on the level of poetic form. If the poems in *Inside Outer Space* expressed scepticism of

[8] Even if scientists are passionate about their research, the nature of scientific writing leaves no room for the expression of personal emotions, as lamented by palaeontologist Norman MacLeod: 'Long training in the analytical style of scientific writing squeezes the ability to communicate this emotion, lyricism, and passion out of most of our writing' (142).

space travel, the poems in *Verse & Universe* assume a more celebratory tone of the sciences, which they combine creatively with the forms of poetry. Two of the poems analysed below find similarities between poetic forms such as free verse and the sonnet, and cosmological elements such as the unboundedness of the universe or the cosmic microwave background radiation. In this, they are similar to some of the other poems discussed in this thesis which also formally experiment with cosmology and astronomy, such as Catanzano's poems.

Albert Goldbarth's contribution, 'Farder to Reache' (1991), addresses many of the concerns that are also central to this thesis. Known for his eclectic subject matter and verbose, sometimes conversational, poetry, Goldbarth reflects on the intersections between cosmology and poetic form in this prose poem, which reads more like a very short essay than a poem. The piece starts with a description of Kepler's elegant and ordered cosmological model, which Goldbarth calls 'a planetarium dome', followed by Kepler's dreaded suspicion that the universe might not be bound by an 'outermost sphere' but that it is infinite. The poet then links such a notion of an infinite universe to free verse:

> This is, of course, the dread of free verse, that one might fall into Whitman and freefloat directionlessly forever. Whitman *calls* himself "a Kosmos," and in "Song of Myself" the vision of a creation whose parts are "limitless" and "numberless" – these words and their kin are used with manic glee and with a great intentionality. This is poetry's announcement of the given of 20th-century astronomy: the universe is, so far as we know, unbounded. (18)

The notion of an unbounded universe is treated with a sense of unease in 'Farder to Reache' in phrases like 'freefloat directionlessly' and in the fact that the notion of cosmic infinity 'terrified' Kepler ('terrified' is taken from an earlier line [18]). The idea of an absence of limits in space is paralleled to the idea of an absence of limits in poetry, which, for Goldbarth, is encapsulated in free verse. The poet finds in this absence of rules and limits a source of dread, whereas the poet he directly refers to – Walt Whitman – celebrated this expansiveness and infinitude. What are the full implications of Whitman's 'kosmos'? In 'Song of Myself', section 24, Whitman sings the praises of the 'kosmos', of himself, and of all of humankind. Whitman's cosmos is a powerfully positive world picture and is intimately linked to the fleshly, the earthly, the sexual, the holy, the pleasurable, but also the oppressed and the downtrodden. In 'Kosmos', a shorter poem, Whitman expresses a worldview that contains all facets of human life, all of nature, and all of the universe, which includes, importantly, 'other globes with their suns and moons' (294). Thus, the sensual and corporeal are joined to the cosmic in Whitman's worldview.

If Whitman celebrated the expansiveness of the cosmos, Goldbarth identifies a sense of unease in the modern cosmos. The unease with which Kepler considered the notion of cosmic infinity is also felt by contemporary students of poetry, Goldbarth suggests: 'Every year in beginning poetry classes hands startle up in protest of free verse, "it isn't *poetry*," which is metered

and rhymed, and so is a kind of map of Kepler's universe' (18). The implication is that the existence and respect of rules, laws, and constraints are found to be a positive addition both to cosmological structure and poetic form. Yet, it should be noted that the comparison is not perfect: the modern cosmos is not actually unilaterally believed to be infinite; neither is free verse truly free or devoid of any structure. The prevalent opinion among cosmologists and astronomers in the 1990s, when this poem was written, was that the universe was finite but unbounded; that the geometry of the universe was curved like a sphere. This means that an astronaut could travel around the universe forever without ever reaching an edge and would eventually return to his or her point of departure (Berman). Such a universe is governed by physical laws that are believed to be uniform and hold true everywhere in the universe. It is only in recent years that astronomers and physicists have started to accept the possibility that the universe might in fact be infinite and go on forever. An infinite universe poses a disturbing enigma to astronomers and cosmologists: if the universe is infinite, then the observable universe – everything known to astronomers about the cosmos – represents essentially zero per cent of the universe, reducing our knowledge to practically nothing (Berman). A metaphor from poetry to describe this conundrum would not be free verse, which is still characterised by rules (such as rhythm or metre) and does not in itself suggest infinity, but perhaps a poem like Ron Silliman's 1982 book-length prose poem *Tjanting*. *Tjanting* is a book consisting of only nineteen paragraphs, of varying lengths, spread over two hundred pages. The last paragraph in fact makes up forty-two per cent of the entire book (Watkin). The number of sentences in each paragraph is determined by the Fibonacci number sequence, in which each number is the sum of the preceding two numbers (1, 1, 2, 3, 5, 8, 13, 21, …). While Silliman's poem stops at 4,181 (the last paragraph, then, consists of 4,181 sentences), his ever increasing sequence at least suggests infinity. Furthermore, the visual representation of Fibonacci numbers in nature, or the golden ratio, which the ratio between the Fibonacci numbers is also called, can be found in spiral shapes, such as snail shells, pinecones, many plants, and spiral galaxies (Devlin 128). This suggestion of exponential growth inherent to the shape of the spiral, along with the suggestion of galaxies, also embodies the exponential expansion of the universe. Perhaps this is what Silliman had in mind when he composed *Tjanting*.

While Goldbarth's metaphor of free verse is less germane in its suggestion of infinity than poetic experiments with mathematical series, like Silliman's play with the Fibonacci sequence, his central metaphor still captures an aspect of twentieth-century cosmology and astronomy: the generally longer lines employed in free verse, as is visible in Whitman's poetry, and proliferation of language echo the immense size of the cosmos. Edwin Hubble's discovery of other galaxies outside of our own at the beginning of the twentieth century and the discovery at the end of the twentieth century of the exponential rate of expansion mean that our conception of the universe has exploded twice in the last one hundred years. Given this expanded and expanding universe, Goldbarth seems to suggest, it seems counterintuitive to continue employing compact and highly formalised poetic forms. In fact, Chapter Four shows how Elson plays with exactly this contrast in

her often highly condensed and imagistic poems tackling massive objects and concepts like dark matter and cosmological structure.

Another poem in the anthology that plays with poetic form and its scientific content is Emily Grosholz's 'Poems Overheard at a Conference on Relativity Theory' (1998). The title aptly describes the poem, which indeed consists of snippets of presentations and conversations about physics. The exclusive presence of technical jargon led Barry Mazur to call the poem 'exuberantly drunk with the words of science' (145). Yet, while Mazur's assessment sounds accusatory – the idea of drunkenness making it sound as if the poem were the result of uncontrolled, uninhibited, random, or even embarrassing word combinations – the poem offers an insightful study of the cultural work a poem filled with technical terminology can do. Grosholz, both a member of the philosophy department at her university and a member of the Center for Fundamental Theory in the Institute for Gravitation and the Cosmos, confirmed in a personal e-mail exchange that each poem of the sequence consists of notes she took at a conference in the mid-1990s and which she lightly edited, modified, added to, and put into verse form: they appear as short lines in relatively short stanzas (Grosholz, e-mail). The poems, which are more aptly described as found poems than as 'drunk', cover highly technical concepts such as quantum states, quantum probabilities, symmetry, indeterminism, the non-Euclidean geometry of space, holonomic fields, general and special relativity, the big bang theory, and the age of the universe.

Grosholz's sequence of poems raises questions about poetry and physics alike. What is the effect of putting physics terminology into a poem? As the addressee changes drastically through the transferral of an original text from a conference attended by practising physicists into a poem, published in an anthology of poems on science, how does the meaning of the scientific language change? If a sentence, like the following, is set into verse, attention is drawn to the materiality of the language itself, as the physical signification of 'comobile' or 'Robertson and Walker's tensor' is presumably unplaceable to most readers of the anthology:

> Within the usual hypotheses
> of a universe U containing
> a perfect, homogeneous, isotropic
> fluid identified
>
> by comobile coordinates, apply
> Robertson and Walker's tensor;
> then we may define t bar
> as cosmological time. (14)

Apart from integrating new language into poetry, this poem also celebrates physics research by transposing fragments of conversations and research papers into a poem, thereby propagating its terminology. The pleasing repetitions of /u/ sounds in 'usual', 'universe', 'U', and 'fluid', as well

as the mellifluous natural rhythm of the polysyllabic terms, and the doubly alliterative phrase ‘comobile coordinates’ make for a musically gratifying passage. So, when physics terminology is lifted from its normal context and transferred into a poem, the attention shifts from its signification to its sounds and rhythms. Jonathan Culler has much to say on the roles of sounds and poetic rhythm, which provides an apt guide for Grosholz’s transformation of scientific jargon. In *Theory of the Lyric*, Culler seeks to establish what exactly sets lyric poetry, which has been famously difficult to define, apart from other types of poetry and literature. In that context, he writes insightfully about the different roles that language plays in lyrics compared to other types of communication and language uses:

> Readers’ encounters with anomalous verbal combinations, along with the kinetic effects of rhythm, offer a challenge to homogenized experience. Song has always ministered to pleasure more than industry, and often has been a form of resistance to the political organization of life; and as the written version of song, lyric operates in the same fashion, but with greater verbal artistry and precision. Like song, lyric can work subliminally to these ends, enlisting its readers and performers in language processes that are not determined by communicational efficiency and propositional meaning but memorability, ceremoniousness, harmony, charm. (305)

Culler here calls the work that lyrics can do ‘a challenge’ and even ‘a form of resistance’ to the mundane aspects of life. This resistance to our commonplace, utilitarian, and routine employment of language, and thus to our (potentially materialistic) outlook on life, is achieved through such elements of the lyric as ‘memorability, ceremoniousness, harmony, charm’. Throughout his seminal exposition of the features of lyric poetry, from Sappho to Seamus Heaney, Culler stresses above all four parameters of the lyric: firstly, its ‘enunciative apparatus’, which he defines as the creation of ‘effects of voicing’, through triangulated address for instance; secondly, the idea that the lyric is itself an event, rather than just the representation of an event; thirdly, its ritualistic (and not fictional) aspect; and lastly, its hyperbolic quality (34-37). The elements of the lyric in Culler’s list quoted above, ‘memorability, ceremoniousness, harmony, charm’, are the results of these four parameters. Memorability is achieved through the sounds of words, rather than their meanings. A lyric can stick and reverberate in a reader’s mind for a long time not because of its message but because of its rhythm and sounds. In Grosholz’s poem, the physics jargon becomes memorable, not because of its designations, but because of its sonic and rhythmic patterns. As the original texts of Grosholz’s poem were already performed, having been part of oral presentations, the resulting poem is thus doubly performative. Moreover, unlike the semantic contents of these signifiers, the sounds and rhythms are not mimetic or representational; they do not express meaning, but instead underline the materiality of language. In that regard, ‘the superfluity [of sounds] installs us in a proliferation of echoing signs’ (Culler 180). Memorability is closely related to the lyric’s ceremoniousness, another item in Culler’s list: elements like lyric address, sound patterning, and

metre or rhythm mean that the 'content' of the lyric is subordinated to its formal aspects, turning the lyric into an event. Lyrics do not aim to represent a fictional event but are themselves events, according to Culler. They 'subsume representations of past events to an occurrence in the lyric present' (37).

In 'Poems Overheard at a Conference on Relativity Theory', it is not representations of past events, but physics and astrophysics jargon that is subsumed to 'an occurrence in the lyric present'. So, to return to the questions I ask above, the effect of transferring physicists' vocabulary into a poem is one of drawing attention to the language itself instead of its designations. The words overheard at a specialists' conference are elevated in a medium that accentuates the physical properties of those words, their sounds and rhythm, creating an aural and iterable event that contributes to the jargon's memorability. Further, according to Culler, these poetic events help to disrupt, 'challenge', or 'resist' the 'political organization of life', or in this case the medium of highly technical scientific communication. This disruption manifests itself in a questioning of the meaning-making devices of language: by highlighting other ways that language, especially language in a poem, can create meaning – through rhythm, sounds, and metre – the more conventional perception of language as a system of communication in which signifiers convey clear meaning is undermined. Though Grosholz's poem does not go so far as to suggest that the sciences, because they are based in language, are just a culturally constructed discourse and thus do not necessarily bear any relation to objective truth, her poem, by foregrounding other, aesthetic and enjoyable, functions of language, challenges the view of language as a transparent medium in science communication. This consideration of the lyric as a disruptive force is central to this thesis: through the examples of Alexander, Smith, Catanzano, Morgan, and Elson I will examine the relationship between astrophysics and astronomy and poetic form, paying careful attention to what formal experiments in poems can reveal about the poets' conceptions of the cosmos and cosmology.

Cosmological structure and poetic form are put into direct dialogue in Maura Stanton's sonnet, 'Computer Map of the Early Universe' (1994), about the cosmic microwave background radiation. If Goldbarth uses the metaphor of free verse to write about the notion of an infinite cosmos, Stanton uses the metaphor of the sonnet for the cosmic microwave background radiation. Unlike Goldbarth and Grosholz, however, Stanton is more suspicious of the scientific method:

> We're made of stars. The scientific team
> Flashes a blue and green computer chart
> Of the universe across my TV screen
> To prove its theory with a work of art:
> Temperature shifts translated into waves
> Of color, numbers hidden in smooth lines.
> "At last we have a map of ancient Time"
> One scientist says, lost in a rapt gaze.

I look at the bright model they've designed,
The Big Bang's fury frozen into laws,
Pleased to see it resembles a sonnet,
A little frame of images and rhyme
That tries to glitter brighter than its flaws
And trick the truth into its starry net. (10)

The map that the speaker refers to is the illustration of the cosmic microwave background radiation, made by the Cosmic Background Explorer (COBE) in 1992 (Singh 474-475). As noted above, the cosmic microwave background radiation is one of the most significant discoveries of twentieth-century cosmology as it confirms the big bang theory. The map in the poem, based on data from the COBE satellite, is an oval shape consisting of blue, green, and yellow flecks and dots. These dots and flecks indicate temperature fluctuations among these incredibly distant photons. The CMB photons come from any direction as they mark the furthest reaches of the observable universe (Gott 180-184).

What similarities does Stanton find between the map of the CMB radiation and so traditional and formal a poem as the sonnet? According to this poem, the similarities consist in 'laws', 'images', and 'rhyme', but also in their dubious relationship to truth. Like a sonnet, which commonly has such markers as iambic pentameter, fourteen lines, varying but defined rhyme schemes, and the expression of strong emotions or ideas, the map described in the poem consists of 'laws', 'images', and 'rhyme'. The line, 'A little frame of images and rhyme', directly refers to images such as the one being described in this poem, while 'rhyme' is also a feature of the CMB map. Rhyme is marked by the repetition of sounds in poetry. When this poetic feature is applied to an image like the map of the CMB radiation, 'rhyme' could then refer to the repetition of visual patterns. Indeed, the distribution of blue and green areas in the map seem to echo each other and to generally be distributed quite regularly, like a rhyme scheme.

Having thus established the formal parallels between the CMB map and a sonnet, Stanton then discusses, and questions, the implications of these similarities for the ontological and epistemological status of the sonnet and the CMB map. Throughout the sonnet, there is an emphasis on the artificiality of the map: not only is the map explicitly compared to a sonnet, a poetic form which requires a certain degree of artifice, but it is also called a 'work of art' – and indeed with its dots and splashes of colour it resembles a Jackson Pollock painting – and it is later called a 'bright model they've designed', with the words 'model' and 'designed' stressing the fact that the CMB is not observable with the naked eye and maybe even hinting at doubts as to its existence. The truth of its existence slips through its 'starry net', like a small fish. The rhyme, one of only three perfect rhymes in the poem, of 'laws' and 'flaws' suggests that what the scientific community regards as 'laws' is erroneous or misguided, putting the scientific project of mapping the size and age of the universe into doubt. Paralleling poetic artifice with the idea of scientific artificiality raises a problem. While the artificiality of the sonnet is universally acknowledged, and

in fact expected and praised, different criteria exist for models of the universe; a model such as the CMB map is not praised for its artistry and aesthetic appeal. On the contrary, the claim to objective truth of the scientific method requires such a map to be truthful above all expectations to charm the beholder.

In his 2011 book *Resistance to Science in Contemporary American Poetry*, Bryan Walpert briefly discusses *Verse & Universe* and also singles out Stanton's sonnet for a quote to illustrate his point about 'the creative use of form' being a similarity between science and poetry. He comments on her poem: 'Both art and science have their flaws – are perhaps not absolute representations of truth – but both seek truth, and part of the value of both endeavors lies in the aesthetic pleasures they provide' (26). However, while the aesthetic value of poetry and the arts are undeniable, arguably even their defining feature, it is debatable whether the aesthetic response to science is one of its main values. The expected outcome of the multi-million-dollar COBE satellite was certainly not the creation of an aesthetically pleasing work of art but rather the answers to questions about the age and size of the universe. The elegance of a scientific theory is, at most, of secondary worth, after the creation or achievement of new knowledge or understanding.

Walpert finds a certain resistance to the authority of the sciences in contemporary American poetry. He distinguishes between two arguments advanced by poets: the negative argument, which considers that the sciences alone cannot account for our reality, and the positive argument, proposing perception and imagination, both defining features of poetry, as an alternative way of knowing (63). Stanton's poem, and others in this thesis such as Alexander's 'Water on New Mars', subscribe to Walpert's view of a resistance in poetry to the sciences. By describing the CMB map as 'trick[ing] the truth into its starry net', Stanton represents science as fallible. By suggesting that the CMB map is a work of art rather than a peer-reviewed visual representation of microwave electromagnetic radiation, she questions the epistemological status of cosmology and the ontological status of the leftovers of the big bang. Alexander, too, finds issue with the technologies and machines employed in astronomical exploration, as I discuss later. In a not-wholly-logical line of reasoning, he laments that such expensive equipment can represent an obstacle to extra-terrestrial study and proposes imaginative exploration, as in poetry, as an alternative type of astronomical study. Stanton's and Alexander's resistance to and scepticism of cosmological and astronomical findings betray a certain distrust of scientific technologies developed to extend our limited sensual perception, like radio astronomy and planetary rovers. A critical engagement with the sciences, such as this one, walks a fine line between defending the value of the arts against the practically uncontested authority of the sciences and the type of misguided and uninformed scepticism of the sciences that has led to a fear of the 5G network and a disregard for the COVID-19 safety measures. In fact, Stanton's poem is not a challenge of the scientific method, as much as it points out how difficult the puzzling new discoveries in cosmology are to the uninitiated and the initiated alike.

All three of the poems discussed in this section engage with cosmological or astrophysical subject matter in poems that are self-referentially open about being poems: Goldbarth writes about free verse and infinite space in a prose poem; Grosholz's series of poems are found poems, presenting highly technical jargon as poetry; and Stanton's sonnet, in a metapoetic comment, compares the CMB map to a sonnet. By thus formally marrying the sciences of astronomy and cosmology to poetics, these poets explore the functions of language, the relations to truth in both disciplines, and the relevance of traditional forms of poetry in a changed cosmos. Whereas the poets in *Inside Outer Space* were predominantly critical of space exploration – condemning the corruption of the moon with the authority of the millennia-old tradition of poetic writing – the poets in *Verse & Universe* react with greater enthusiasm to the sciences, without, however, subordinating poetry to the sciences. They are successful examples of poems that, while celebrating astronomical and cosmological discoveries, resist succumbing to sheer veneration of the sciences. Moreover, instead of merely illustrating scientific discoveries, such as the cosmic microwave background radiation, the vast distances in the universe, and Einsteinian physics, these poems use these ideas in cosmology as departure points for imaginative and poetic experimentation with language.

1.3.3 *Dark Matter*: Poetry as a Home for Cosmological Unknowns

Dark Matter: Poems of Space (2008) was edited by poet Maurice Riordan, who also edited *A Quark for Mister Mark: 101 Poems about Science* (2000), and Jocelyn Bell Burnell. It is the third publication in the Gulbenkian Foundation's trilogy of poetry and science anthologies. The private foundation, headquartered in Lisbon with a UK branch, is focused on promoting the fields of the arts, education, and science. One of its aims is to encourage intercultural understanding and it is in this context that the foundation has also published interdisciplinary collections, such as *Wild Reckoning*, an anthology of ecopoetry, and *Signs and Humours: The Poetry of Medicine*, which contains poems about physical well-being and the body. Like the previous two anthologies, *Dark Matter* also includes a number of specially commissioned poems, which are mixed in with poems by canonical authors, such as William Shakespeare, John Donne, Anna Laetitia Barbauld, Walt Whitman, and Emily Dickinson. The commissioned poems resulted from discussions that the poets had with the various astronomers, astrophysicists, particle physicists, or physicians or physiologists working in space travel with whom they were paired for this project. Notes about the poets' discussions with the scientists in these different fields are included in the back of the book and are discussed in more detail below.

Listed as one of the ten best recent poetry books by Judith Palmer, the director of the Poetry Society, *Dark Matter*, especially in comparison to the other two anthologies discussed in this chapter, is more obviously oriented towards astronomy, with most of the poems presenting meditations on aspects of astronomical research ('Ten Best', J. Palmer). The reason for this is doubtless the fact that one of the two editors is astronomer Jocelyn Bell Burnell, who is famous for having discovered pulsars in 1967. Bell Burnell was approached by the Arts Director of the

Calouste Gulbenkian Foundation, Siân Ede, after the latter heard about her hobby of collecting astronomical poems (*Dark Matter* 9). The astronomer indeed has a large collection of poems about space, to which she has added over several decades, and which currently counts over 400 poems (Bell Burnell, e-mail). Bell Burnell explains in an essay in Robert Crawford's *Contemporary Poetry and Contemporary Science* that she likes to incorporate poetry into her astronomy talks to lay audiences, particularly to 'give fair space to the human side of science' ('Poetry and Astronomy' 125). She further elaborates in this essay that poetry makes the astronomy and physics parts of the lecture more accessible to the general public: 'Such material should help the non-scientists in the audience relate to the topic, may woo those who are suspicious of science or scientists, and demonstrate that astronomy is part of our cultural heritage' (126). One of Bell Burnell's assumptions is that poetry is more approachable than popular science, as it relates to the 'human' side and because it charms or 'woo[s]' us. This also explains the conspicuously astronomical inclination of the collection. However, while most of the poems in the collection do indeed celebrate Bell Burnell's profession by depicting a powerful universe full of menacing forces that threaten to wipe out life on Earth, they also go beyond the narrow role of humanising science by appropriating for poetry the gaps in astronomical knowledge, such as dark matter and extra-terrestrial life. In other words, what this collection demonstrates is the claim I make in the introduction, that the poems studied in this thesis go beyond merely popularising or promulgating scientific developments. They often engage profoundly with these findings and their implications, which often lead them to reconsider our relationship with and phenomenological experience of the cosmos and of the reality of readers and interlocutors.

The style of the poems in *Dark Matter* conform to Bell Burnell's reading of space poetry as essentially popular astronomy: in fact, many of the more recent poems selected for this anthology, including the commissioned ones, are written in a prose-like style, often presenting descriptive, anecdotal, or meditative short verse on the universe or different aspects of astronomical observation. Some poems can be described as popular science as they turn abstract or technical aspects of astronomy or astrophysics into accessible and relatable concepts. One such example would be Norman Nicholson's 'The Undiscovered Planet' (1994), which adopts an explanatory tone to describe an invisible and very distant planet in our solar system that can only be detected through the slight wobble of Saturn and Uranus. Many of them are written in the Romantic tradition, with an emphasis on the lyric subject and his or her affections or emotions concerning the universe. Thus, Julia Copus's 'Stars Moving Westwards in a Winter Garden', one of the commissioned poems, is written in a narrative style and characterised by pathos in its yearning to relive a scene with a deceased loved one, set against the backdrop of the ancient stars, the moon, and the moving Earth, which help to remind the speaker of the passage of time and the healing of all wounds (34-36).

As mentioned above, the commissioned poems are the results of conversations that the poets had with various astronomers or cosmologists. In the preface, Ede explains that the scientists 'were

approached to impart a little of their knowledge to the poets' (9). This formulation makes it sound as if the conversations between the poets and the scientists were a one-way street, with the poets acquiring new knowledge about the various fields of research, and the scientists not gaining any new insights. Indeed, this seems to have been the plan: the notes in the back of the book about the discussions between the poets and the scientists were written by the poets, not by the scientists, and present the poets' views on the encounters and what they learned. Except for one case, in which a particle physicist and popular science writer asked the poet with whom he was paired for suggestions for metaphors for matter and antimatter, there are no indications that the scientists benefitted from these collaborations (223). Thus, despite the admiration of the classics of English poetry, the assumption on the side of the scientists seems to be that there is not much that poets can teach the scientists. So, while *Dark Matter* is a laudable effort to overcome the gap between the sciences and the humanities, it also suggests that it is up to the humanities to close this gap by learning from the sciences.

The question also arises as to why the editors of *Dark Matter* felt it necessary to commission original poems, when previous anthologies have proven that there is already a significant number of poems about space. Bell Burnell provides an answer to this question in a radio programme in December 2008: apparently frustrated by the proliferation of poetry that merely treats the universe as 'wallpaper', the astronomer wished to breathe new life into space imagery in poetry by giving a small number of poets an insight into astrophysical and astronomical research. That is why selected poets were invited (by Riordan) to meet with volunteers among Bell Burnell's colleagues ('Start the Week'). If the aim was to have poetry with a deeper understanding and awareness of astronomy and astrophysics, then the commissioned poems are arguably not a success as they are rarely about the scientific technicalities of astronomical observation or computer software used to detect celestial objects.

This is also what Derek Hall lamented about the anthology. In his review for *Space Policy*, an interdisciplinary journal on activities in space, he is disappointed by the recent poems in the collection because 'there is relatively little on what could in any way be described as "space science"' (199). Of the commissioned poems, he writes, 'several . . . disappointingly, give little indication that such collaboration has been fruitful, and, to be honest, offer up not always terribly good poetry' (199). He concludes his review by insisting that the aim of the anthology is unclear, wondering if it is perhaps intended as a 'propaganda/educational exercise to bring the arts and sciences closer together' (200). As already mentioned, none of the poems employ highly technical jargon or explain in detail how an observatory works, for instance. But demonstrating a profound cosmological understanding of and appreciation for the cosmos is not necessarily the main role of poetry. Instead, these poems are successful at expressing awe and sometimes horror at the vastness of and the violence in the cosmos. The poems are especially effective in their treatment of the unknowns of astronomy and cosmology: ninety-five per cent of the observable universe is unknown and unknowable, according to astronomers, consisting of dark matter and dark energy for

which there are no explanations as yet (Bell Burnell 'Start the Week'). The poets seize these unknowns of the cosmos and reclaim the universe for poetry, which is a medium that is more comfortable with persistent questions, mysteries, and obscurity than science is, language being an unreliable and fallible medium. Poetic language delights in ambiguities and uncertainties, in gaps in knowledge; as such it is well-suited to playing with so vast and inscrutable a concept as the modern universe. The trope of the small-seeming human against a backdrop of the hidden cosmos, with its conditions that are utterly averse to human existence, is a leitmotif of the poems in *Dark Matter*. The effect is often one of unease, almost of horror, at the inhospitable universe which threatens to wipe out human life, represented by two lovers (as in Holub's poem) or a helpless astronaut (in Sleigh's).[9]

Tom Sleigh is one of the poets asked to contribute an original poem to *Dark Matter*. His poem illustrates the extreme differences in scale between the cosmos and the human realm in a tone that captures the unease that often accompanies such reflections about the vastness of the universe and the comparative puniness of human life. His contribution is also a good example of the role that Bell Burnell had in mind for the anthology: it humanises and popularises astronomy. The poem, 'For a Spacesuit Set Adrift', paints the universe as a dangerous and utterly hostile place. As the title and the short extract from a 2006 BBC article under Sleigh's title indicate, the poem is inspired by a news story in which astronauts from the International Space Station decided to put an old and discarded spacesuit into orbit. Born out of a plan by Russian astronauts to turn old spacesuits into useful satellites, a spacesuit was stuffed with clothes and equipped with a radio transmitter on top of its helmet. The first section (of four) imagines the lifeless spacesuit as a female being, floating in the vast universe, in complete isolation from humanity and Earth. In this section, the universe is portrayed as a menace in its vastness and its swamping of the human-like figure in the foreground:

> Under the starflood where
> the flood of earth confronts her,
> tiny, unmoored, drifting upside down,
> the ocean's pupil peers into her helmet's faceplate (154)

The vulnerability and forlornness of the lifeless astronaut suit are emphasised in the repetition of the word 'flood' in the neologism 'starflood' and 'flood of earth'. Against the backdrop of this 'flood' of stars and planets, the spacesuit is imagined as 'tiny', 'unmoored', and not even able to

[9] As this thesis focuses primarily on poetry and astronomy from the second half of the twentieth century onwards, poems by the classics of English literature, such as Shakespeare, Wordsworth, Whitman, Frost, and Shelley, also included in *Dark Matter*, will be omitted from this discussion. The inclusion of some of the classics of the English canon in *Dark Matter* serves to provide a context for and to legitimate the newer poems as they suggest that poems about the heavens have been written for many centuries. More precisely, they suggest a continuity in various themes occurring in poetry about the universe: the timelessness of the heavenly bodies (contrasted to the passage of time on Earth), the awe with which we have been contemplating the heavens, and the use of the night sky as pathetic fallacy by the lyric subject, to name a few.

bring herself into an upright position. Ocean imagery ('flood', 'unmoored', 'drifting', 'ocean') depicts outer space as a tumultuous place, threatening to swallow the tiny human-shaped object. The spacesuit, gendered as feminine, is seen as passive, while the universe around her and the Earth below her are animated. The gender roles are the inverse of Sexton's poem about the mission to the moon: if in 'Moon Song, Woman Song' space (represented by the moon) was portrayed as a passive female being and the astronauts as male, in 'For a Spacesuit Set Adrift' it is the astronaut who is passive and female, while space (albeit not gendered) is the threatening and active force. While outer space is treated as a vulnerable place that needs protection from the ruthless exploitation or conquest of man in Sexton's 1969 poem, in Sleigh's 2008 poem humans are seen as vulnerable against the backdrop of the vast cosmos. In the nearly forty years that separate the two poems, more and more photographs of the universe taken by both Earth-bound and space-borne telescopes have brought home the vastness of the cosmos, but also the potent forces governing it. This is possibly what motivated Sleigh to represent the human-shaped object as passive, vulnerable, and dwarfed by the vastness of the universe enveloping it.

In the second section, the description of the universe as 'void' gives way to a portrayal of the universe as filled with destructive forces. The spacesuit is no longer only 'marooned' but also threatened by the chaos and rampage of the cosmos:

> Think of mayhem out in space, matter-hungry black holes
> that flay their stellar neighbors, fields of gravitation
> that crush matter to nearly nothing, galaxies
> colliding and eating one another –
> all of it going on in invisible bands of the spectrum
> nobody at a funeral is aware of in the music,
> in the way the mourner leans over the coffin and strokes the wood. (155)

The poet uses graphic imagery and personifications to underline the violence of the cosmos. The imagery is striking in its stark contrast to the minuscule spacesuit floating amidst it. Cosmic phenomena are anthropomorphised, turning the universe into an immoral monster: galaxies are 'eating one another' and black holes 'flay their stellar neighbours'.

What could have motivated Sleigh to turn celestial objects into mythological monsters, ruthlessly feeding on other celestial bodies? I suggest above that photographs of the universe might have strengthened a sense that the universe is incredibly vast, almost infinite. In fact, as Sleigh explains in the back of *Dark Matter*, popular astronomy books have also played a large part in the dissemination of an image of the universe as a powerful and dangerous place. Sleigh was guided by Neil de Grasse Tyson's book *Death by Black Hole* (2007) in the depiction of the cosmic violence as well as cosmic loneliness in his poem (229). To what extent might Sleigh's dramatic and sensationalist rhetoric be a result of the type of contemporary popular astronomy and cosmology one can find in bestsellers, such as books by Brian Cox, Brian Greene, Carl Sagan, Neil de Grasse

Tyson, and Michio Kaku? Elizabeth Leane writes in *Reading Popular Physics* (2007) that popular astronomy books saw a boom in the late twentieth century. For instance, Sagan's *Cosmos* (1980) was on the *New York Times* bestseller list for seventy weeks, while Hawking's *A Brief History of Time* (1988) had sold twelve million copies by 1997 (Leane 35, 47). Apart from their commercial successes, the status and reputation of popular physics books also improved: Leane explains that the twentieth-century evolution of science publishing 'saw popular science writing lauded as a genre on equal footing with literature', while Hawking's famous book became a status symbol (1, 26).

Tyson is an American astrophysicist, bestselling popular science writer, and pop culture and social media figure who became famous in 2014 as the host of the remake of Carl Sagan's TV series *Cosmos: A Spacetime Odyssey*. In one section of his *Death by Black Hole*, titled 'When the Universe Turns Bad: All the Ways the Cosmos Wants to Kill Us', Tyson relishes in descriptions of the various ways humanity could collectively die a violent death, provided it survived for another few billion years (a dubitable course of events). In Tyson's writing style one can discern a certain hope or desire to shock or at least to impress the reader with enthusiastic accounts of the awe-inspiring, terrifying, and catastrophic scenarios to which we might be exposed. Thus, one section of the chapter, which concentrates on the threat of asteroids to life on Earth, starts with this hyperbolic sentence: 'One needn't look far to find scary predictions of a global holocaust by killer asteroids' (254). The adjective 'killer', with its pulp science fiction and pop culture connotations, and the reference to large-scale massacre contained in 'holocaust' make for an impactful opening of the section. In this chapter, he further explores different 'end-of-the-world' scenarios, such as the death of the sun, the collision of the Milky Way with our neighbouring galaxy in Andromeda, and the ultimate death of the universe (263-268). Lastly, in a chapter which lent the book its title, Tyson delights in a description of what would happen to a human body if it fell into a black hole, explaining the spaghettification and ultimate tearing apart of the body as it approaches the centre of the black hole. He closes the chapter with this gloating sentence: 'But no matter the mass [of the black holes], death and destruction are their business' (287).

Tyson's book, and especially this chapter, is an attempt to claim for science and scientists the emotional impact that the sciences are often denied in popular belief. Françoise Palleau-Papin argues that scientific writing 'leaves out feelings and ethics and philosophy, and in the volume of its conclusions, it replaces much of language by formulae' (124). In his popular astronomy book, Tyson compensates for the rigidity of the formalities of academic writing by relishing humorous or sensational exaggerations, which are of course also highly marketable. He thus fulfils the same function that Bell Burnell had in mind for *Dark Matter*: humanising science and filling it with emotion. Sleigh's poem performs the role that Bell Burnell had designed for *Dark Matter*: on the one hand, it glorifies outer space, the object of astronomy, by emphasising its awe-inspiring forces; on the other hand, Tyson's book equipped Sleigh with new metaphors to write about the universe. If Tyson used dramatic language and imagery to humanise cosmology and to create an emotional

impact, Sleigh further humanises the universe by populating it with one small human-like, and female, figure, thus underlining our vulnerability in this vast cosmos.

Whereas Sleigh's poem is essentially a form of popular astronomy, Seidel's poem is more complex and transcends the simple role that Bell Burnell devised for the poems in her collection. Even though his 'Invisible Dark Matter' starts with the assertion that he is unsettled by the idea of dark matter, the poet plays with the words 'dark matter', turning it into a poetic riddle that becomes quite independent of astronomy.[10] Seidel wrote a collection of poems titled *The Cosmos Poems* in 2000, which was commissioned by the American Museum of Natural History to commemorate the opening of the Hayden Planetarium (Mobilio). One of the poems included in *The Cosmos Poems*, which generally presents meditations on the modern universe, ranging from supersymmetry to the big bang, is called 'Dark Matter' and is part of Bell Burnell's and Riordan's anthology. Compared to Auden's 'Moon Landing', which employed archaic and foreign words as a contrast to the wrongly motivated moon landing, and perhaps also to the militarised shorthand of astronaut lingo, Seidel's poem almost seems childish in its use of very simple vocabulary and the high number of monosyllabic words, all contained in an iambic metre. The short poem also expresses a certain unease about the mystery pervading most of the universe:

> It is the invisible
> Dark matter we are not made of
> That I am afraid of.
> Most of the universe consists of this.
>
> I put a single normal ice cube
> In my drink.
> It weighs one hundred million tons.
> It is a sample from the densest star.
>
> I read my way across
> The awe I wrote
> That you are reading now.
> I can't believe that you are there
>
> Except you are. I wonder what
> Cosmologists don't know
> That could be everything
> There is.

[10] In fact, when Seidel wrote his poem, the scientific consensus was that dark matter actually accounted for ninety-five per cent of matter in the universe (Bell Burnell, 'Astronomy and Poetry', 136).

The someone looking at the page
Could be the everything there is,
Material that shines,
Or shined.

Dark Matter is another
Matter. Cosmologists don't know.
The physicists do not.
The stars are not.

Another thing beside
The row of things is
Standing there. It is invisible
And reads without a sound.

It doesn't matter
That it doesn't really.
I need to take its hand
To cross the street. (191-192)

The repetition of the word 'not', principally in its contracted form (as in, 'doesn't') – appearing eight times – emphasise what remains unknown about the cosmos. The idea that so much of the universe challenges us and remains mysterious is also mirrored in the end-stopped lines: the full stops at the ends of many of the short lines in the poem suggest the pauses in thought we encounter as we contemplate the cosmos. Right at the start of the poem, Seidel's speaker is very direct about his or her feelings about dark matter by stating, 'it is the invisible / Dark matter . . . I am afraid of'. Like Sleigh, Seidel finds a certain menace in the universe in this big unknown and worries that maybe dark matter 'could be everything / There is'. It is even more frightening because we are told that it pervades the entire universe and yet everything we know is not made of this matter. The dark matter and its unknown identity seem to put everything into question; suddenly a simple ice cube weighs 'one hundred million tons' and the existence of the 'you' is no longer assured.

In this doubting of the existence of a 'you', of anyone outside the perceiving and thinking 'I', Seidel draws parallels between the concept of dark matter and that of the reader. The 'you' the lyric subject addresses is the reader, and yet this reader does not yet exist as the poem does not yet exist while the lyric subject is writing it. The parallelisms that the poet creates between the stanzas about dark matter and those about the suspected or assumed reader suggest a connection between the cosmological mystery and a literary mystery. Thus, while dark matter 'could be everything / There is' in the fourth stanza, in the next stanza, the reader – 'The someone looking at the page' –

'could be the everything there is'. Also, just like dark matter does not interact with other matter and hence is invisible, or does not emit any electromagnetic radiation, so the reader 'reads without a sound'. Yet, while the cosmological dark matter fills the speaker with a sense of dread, the mysterious matter of the reader, whom the speaker-poet cannot see or hear directly, does not unsettle the poet. On the contrary, the comparison between the distressing dark matter and the reassuring presence of a reader creates a contrast, rendering the cosmological phenomenon even more alien: 'Dark matter is another / Matter'. Even stranger than the concept of a reader that one cannot hear or see, dark matter keeps eluding cosmologists and astronomers. Seidel also plays with the various significations of the word 'matter', when he uses its non-physical meaning in the line 'Dark matter is another / Matter' and as a verb in the phrase '[i]t doesn't matter'. The poem thus implies, through the proliferation of the word in the poem itself and in ordinary speech, that just like 'matter' infiltrates our language, appearing in many different contexts and forms, dark matter suffuses the universe. Furthermore, just as 'matter' is a word with many meanings, many of them imprecise, there are many different possible definitions of dark matter, which, as Seidel's poem insists, remains mysterious. Bell Burnell may well have selected this poem for its striking and assertive opening sentences – 'It is the invisible / Dark matter . . . That I am afraid of' – underlining the significance of the cosmological theory of dark matter. Yet, Seidel gradually and cleverly turns the dark matter of the universe into the philosophical conundrum of the reader and the roles of language, thus appropriating cosmology for poetry and turning the astrophysical enigma into a linguistic and poetic one. His poem is a good illustration of what I write in the introduction: the poets in this thesis recurrently appropriate astronomical theories to open up metaphysical reflections on the phenomenological experience of reality. Here, dark matter is used to show how language projects the existence of an 'I' and a 'you' before a reader even exists.

If Sleigh's poem paints a terrifying picture of the cosmos and Seidel's poem captures the anxiety surrounding the unknown in the universe, then Miroslav Holub's poem emphasises our 'deep, cosmic loneliness', to borrow a phrase from Diane Ackerman's poem printed five pages before Holub's (*Dark Matter* 79). Miroslav Holub's poem 'Night at the Observatory' (1963) paints a romantic scene taking place between two lovers at night at an observatory. He projects this scene into the larger picture of everything that is happening around the couple, both in their immediate surroundings and in outer space. Thus, one stanza describes natural and human-made sounds surrounding the couple, from a beeping car to cracking trees and the wind, while another stanza zooms out much further and describes the cosmological circumstances of that instant: 'somewhere a rock was falling / its second thousand years' while the observatory 'beamed' 'signals' 'to a civilisation / which had died / just before the dawn / of eternity' (83). Holub's intimate scene between two lovers set against a backdrop of the universe underlines the vastly different time scales of the cosmos and human relationships. The phrases 'its second thousand years' and 'eternity' stand in contrast to the mere seconds of the lovers' kiss. Besides the contrast, the juxtaposition of cosmological events with the tender gestures exchanged between lovers also

creates another relationship: there is a parallel between the man touching a spot 'beneath [his partner's] left shoulder' and the telescopes at the observatory 'reaching out' to the stars. The human relationship is thus compared to the collective wish of humankind to reach out to the cosmos, or, depending on what kind of observatory Holub is describing in this poem, even to an extra-terrestrial civilisation.[11] The poem movingly captures humankind's tragic search for life other than terrestrial by juxtaposing it to a lovers' embrace: just like individual humans are drawn to others, the entire species is reaching out to potential non-terrestrial contacts.

Like Sleigh's and Seidel's poems, there is a negative, almost morose, undertone in this poem, especially discernible in the last stanza:

> From somewhere a rock was falling
> its second thousand years.
> And the stars were taking in
> signals on a frequency of ten megacycles,
> beamed to a civilisation
> which had died
> just before the dawn
> of eternity. (83)

Against the vast interstellar distances and time scales, the two lovers' kiss seems inconsequential. Added to this sense of insignificance of human relationships is the sense of utter loneliness inherent in the last stanza. The only ones that receive the radio signals we send off into the universe are stars and an extra-terrestrial civilisation that disappeared a very long time ago, making terrestrial species the only life forms in the universe.

The poems in *Dark Matter* predominantly convey an image of the cosmos as a powerful, and dangerous, place, which in its vastness and brutality lets humankind appear as puny and insignificant, at least in Sleigh's and Holub's poems. As the poems were selected by Bell Burnell for an anthology meant to inspire non-astronomical readers, one can assume that she found that these poems perform a service to astronomy and astrophysics: in their depictions of an awe-inspiring cosmos, they celebrate the science that studies this cosmos. The poets concentrate on those aspects of astronomy and cosmology – the vastness of space and our vulnerability and loneliness, the mysteries of the universe, and the violence governing cosmological events – that unsettle them in favour of questioning the findings of astronomy or astrophysics, as the poets in *Verse & Universe* and *Inside Outer Space* did. Yet, some of the poems in the collection outstrip what Bell Burnell might have anticipated: by focusing on the unknown in the science – the nature of ninety-five per cent of matter in the universe, which also lent the collection its title, and the

[11] Although international efforts in SETI (the search for extra-terrestrial intelligence) only really started taking off in the 1980s, the first SETI experiment was conducted in 1960, three years before Holub's poem appeared, by Frank Drake from Cornell University ('A History of SETI').

question as to extra-terrestrial life, as Holub's poem suggests – these poets emphasise to what extent the sciences of astronomy and astrophysics are filled with gaps in knowledge and thus, in a certain way, reclaim the universe for poetry. Bell Burnell explains on *BBC Radio 4* that astronomers and cosmologists 'actually only understand or can even attempt to understand about five per cent of [the cosmos]' ('Start the Week'). If ninety-five per cent of space remains a mystery, then the universe is an apt subject matter for poetry, which revels in unknowns and gaps in knowledge. The poets discussed in this section fill these gaps with poetic explorations of human subjectivity in the face of the vastness and expansive cosmos. Poet-astronomer Elson, on the other hand, uses the limitations in astronomical knowledge as departure points for extravagant poetic speculations about cosmological riddles like dark matter and cosmic structure. Elson's poetic thought-experiments start when astronomical knowledge ends, thus providing her with a testing ground for elaborate metaphors and imagery to think about the cosmos, in turn informing her scientific research.

What do the discussions of a selection of poems from each of these anthologies reveal about poetry that engages with astronomical themes? The three collections, spanning four decades, show that poets react very differently to developments in astronomy and astronautics. In Vas Dias's anthology, the poets were mostly sceptical of the American space programme, condemning its supposedly narcissistic conquest of the moon through military imagery, in Sexton's case, or through contrasting it to the veneration of Cynthia, goddess of the moon, in early modern poetry, in Auden's poem. The implication of this poetic resistance to science is that the two fields are quite separate from each other and that poetry enjoys a centuries-old authority that modern science and technology do not. The poets in *Verse & Universe* employ a much more enthusiastic and even celebratory tone in their engagement with astronomy and cosmology, all the while juxtaposing the sciences with poetic creation. Through the poems' often self-referentially formal experiments, they establish similarities between cosmological features, such as the CMB map and the notion of an unbounded universe. By emphasising the formal commonalities between the two areas, Goldbarth and Stanton, in particular, suggest that the search for patterns and the handling of truth are common endeavours to both astronomy and poetry. In *Dark Matter*, the relationship between astronomy and poetry is configured still differently: here, through their concentration on those areas of astronomical research at the hearts of which are big unknowns, the poets reclaim the cosmos for poetry. They fill the gaps in astronomical knowledge with the doubts and fears of human existence.

While the poems discussed in this section on anthologies are very heterogeneous, ranging from an enthusiastic endorsement of the sciences that study the cosmos to a highly critical challenge of space exploration, there are nevertheless some common aspects uniting the poems in Vas Dias's, Brown's, and Riordan and Bell Burnell's collections. Most of the poems in this section turn towards the night sky and the universe, not to popularise the findings of astronomy or as a mere pretty backdrop for personal musings on subjective experience, but in order to present new perspectives on terrestrial affairs or questions. In Vas Dias's anthology, Auden's and Sexton's

personifications of the moon allow them to assume a wider perspective on the military and nationalistic endeavours to reach the moon, which appear vain and short-sighted. In the case of the poems in *Verse & Universe*, an awareness of the enormous scales of the universe entails a reconsideration and an adjustment of poetic form to reflect the vastness and expanse of the universe. Lastly, an embrace of the vastness of the cosmos in *Dark Matter* results in poems that put humans and human endeavours, such as the indirect address of a conjectural reader or an embrace between lovers, in the foreground. A consideration of the incredible distances and time scales that astronomy and cosmology face in their studies of the cosmos gives the poets in these anthologies a new or changed perspective on terrestrial and human activity. Thus, these poems demonstrate that astronomical knowledge about the universe not only interests poets, but veritably also has an impact on our conception of human existence and artistic creation. This profound effect of the universe and astronomy on poets is also discernible in the poems discussed in the remaining three chapters.

Chapter 2 The Hubble Universe in Poetry

Science writer and space historian Robert Zimmerman writes of the Hubble Space Telescope, launched in 1990, that it 'lifted a curtain from our view of the universe, changing it so profoundly that no human can look at the stars in the same way again' and that it 'has given us the first detailed and clear glimpse of what lies hidden in the black untouchable horizon above us' (xiii, 241). Indeed, apart from allowing astronomers to gain a fuller picture of our solar system – the Hubble led to the discovery of Pluto's moons – of planetary and stellar formation, and of exoplanets, it has also led to a more thorough grasp of the age and size of the universe (Chaisson 288, 255, Zimmerman 169, Leverington 464). Observations carried out with the Hubble helped to determine that the big bang occurred approximately 13.8 billion years ago, and that dark matter makes up around twenty-three per cent of matter in the universe, while dark energy, the mysterious force that is responsible for the accelerated rate of expansion of the universe, accounts for seventy-four per cent of cosmic matter (Zimmerman 174, Chaisson 284-286). Yet, as Zimmerman's quote above suggests, the famous Hubble images have not only allowed astronomers and cosmologists to conduct valuable research about our universe; they have also profoundly influenced the public's perception of our larger sense of home. Even though since Edwin Hubble we have known that the universe is many million times larger than our Milky Way, the images from the Hubble Space Telescope, in their splendour and detail, have driven home the vastness of the cosmos, allowing the lay public to visualise this universe.

The two poets in this chapter, Tracy K. Smith and Will Alexander, have both found inspiration in the Hubble images for their poems. As Smith's father worked on the Hubble as an engineer, she would probably have seen the first images captured by the telescope, while Alexander finds that the Hubble has unveiled an infinite universe ('Hauling up Gold' 196). The two poets' reactions to the Hubble images, however, starkly differ. Whereas Smith finds in the Hubble images a universe that is essentially familiar, safe, and connected to humans, Alexander responds to the Hubble images and modern astronomy in general with a representation of a poetic universe that is almost totally devoid of humans and is portrayed as a space utterly unfamiliar and incommensurable with our terrestrial realm. If Smith's engagement with the cosmos works to resist the tendency to other the universe, painting it instead as an anthropomorphised being filled with extra-terrestrials who are strikingly similar to humans, Alexander's 'Water on New Mars' shows a resistance to the anthropocentric and hierarchical thinking that puts life at the pinnacle of being. In Alexander's poem, Mars, and everything the planet contains, appears active and alive, and above all utterly independent of human intervention. This chapter will compare and contrast the two poets' poetic responses to the modern cosmos, as revealed by the Hubble. It will show how an engagement with the cosmos has produced poems that belong to two different modes of poetic

writing, which are, nevertheless, equally representative of contemporary poetry. Smith's emphasis on the lyric I in a poetics which mixes confessional moments, in which the lyric I reminisces about her childhood, with personal meditations about the universe is representative of a turn to the introspective and an emphasis on subjective experience that lyric poetry has taken in the twentieth century (a trend that started earlier, in the nineteenth century). Moreover, the preoccupations with astronomy tropes and Hubble images also align Smith with Afrofuturism, an aesthetic and political movement of Black artists engaging with futurist images in speculative art. On the other hand, Alexander experiments with the dramatic monologue and destabilises and multiplies first-person speakers. His poems are in the tradition of a reader-oriented (the idea that there are as many texts as there are readers) avant-garde poetics. They are more aligned with the work of the Language poets, who saw language as a playground with an unstable system of signification instead of a mimetic medium for the narration of subjective experience.[12] The chapter will proceed with a close reading of Smith's 'My God, It's Full of Stars', a long poem from her 2011 collection *Life on Mars*. The second half of the chapter is devoted to Alexander's 'Water on New Mars'.

2.1 Tracy K. Smith's Universe

2.1.1 Introduction

Smith's Pulitzer-Prize winning *Life on Mars* (2011) engages with various astronomical and cosmological themes, making her poetry core to the body of work under study in this thesis. *Life on Mars* mixes imagery of mid-twentieth-century science fiction with astronomical imagery, yet it is also, in parts, an elegy to her father, Floyd Smith. Smith's father was one of very few African American engineers to have worked for NASA.[13] In fact, an electronics engineer, he worked for Perkin-Elmer, an optics manufacturer contracted by NASA to build the mirror that was used in the Hubble Space Telescope, which was launched in 1990 (Floyd Smith obituary; Leverington 428). In the 1980s, Floyd Smith was thus, very directly, participating in cutting-edge science, and contributing towards our astronomical knowledge about the universe and the cultural imaginary

[12] Culler, in *Theory of the Lyric*, maps a brief history of the lyric and concludes that the 'model of the lyric as the passionate expression of the poet', which originated in the Romantic era, remains a dominant approach to both the writing and reading of lyrics in the twentieth century. Contemporary poets position themselves in relation to this prevalent model of the lyric as the expression of subjective experience, resisting it just as often as conforming to it (Culler 77). Helen Vendler, writing in 1997, expresses a similar view of the lyric: lyric poetry 'remains the genre that directs its *mimesis* toward the performance of the mind in *solitary* speech', thus adjusting John Stuart Mill's influential definition of the lyric as 'feeling confessing itself to itself, in moments of solitude' (Vendler 1-2, italics in original; Mill qtd. in Jackson and Prins 4). In other words, both Vendler and Culler recognise the continued popularity of the expressive and subjective view of lyric poetry, which, according to Culler, is met with opposition by many poets, resulting in modernist, avant-garde, and experimental poetry.

[13] In fact, there were only four Black aeronautical engineers and four Black electrical and electronics technicians in Alabama, where Floyd Smith grew up, in 1960 (Paul and Moss 230). In 1970, only one per cent of all American engineers were Black (Shetterly xiv).

about the cosmos (Smith, e-mail). This personal connection of the poet to the Hubble telescope, and thus also to the view of the cosmos given to us through those images, is important and a leitmotif of the poem, which imagines a universe that revolves firmly around the humans at its centre. This is how the poem describes Floyd Smith's work:

> When my father worked on the Hubble Telescope, he said
> They operated like surgeons: scrubbed and sheathed
> In papery green, the room a clean cold, a bright white. (*LoM* 12)

The analogy to surgeons here helps to underline the seriousness and relevance of the project, yet also the required years of training to be qualified for the job as well as the long hours. Also, during the production of the mirror for the Hubble Space Telescope, it was necessary that the room be completely sterile and free from contamination, just like an operating room.[14] In a subsequent line, Smith describes her father as 'perfectly at ease in the never-ending / Night of space' (12). By thus firmly tying the Hubble images, and how they have affected our conception of the cosmos, to her father's work, Smith's five-page poem 'My God, It's Full of Stars' is dedicated not only to the Hubble Space Telescope, which popularised the idea of colourful celestial objects, but also to her father's work. By establishing a connection between the universe and her father, she also links the universe to her personal past, her family, and, ultimately, to herself. This connection of the cosmos to the self, on the one hand, and, on the other, to humankind and human activity, through comparisons to films for instance, is emphasised recurrently throughout the poem, as I shall show in this chapter.

Smith's poem is different from the other poems in this thesis in more than one way. Firstly, if the poets discussed in the previous chapter obtained their information about the universe from popular astronomy books, like Sleigh, or from the news, like poets discussed later in this thesis (such as Morgan and Alexander), Smith turned to science fiction films (and the Hubble images) for inspiration for her collection. In a PBS interview, Smith said that she wanted to write a collection of poems about our place in the universe and, as preparation, watched science fiction films from the 1960s ('Tracy K. Smith reads from "Life on Mars"' 00:10-01:00). Here, she explains that she preferred science fiction to popular science because that genre inadvertently reveals more about the hopes and fears of the people living in a given age. Indeed, her poem stands out in this thesis as being very anthropocentric; the human is at the centre of Smith's cosmological exploration. 'My God, It's Full of Stars' presents the cosmos as a familiar place peopled with beings that resemble us. If Sleigh, Goldbarth, and Seidel expressed anxiety about cosmological phenomena such as the concept of infinity, dark matter, and cosmic violence, Smith's cosmos is safe, welcoming, and

[14] Eric Chaisson explains that after the glass used for the primary mirror in the Hubble was polished for three years, it was made reflective through the coating of an extremely thin layer of aluminium. This was done in an ultra-high vacuum in a stainless-steel chamber, which was especially made for the occasion. This procedure demanded so much precision and expertise that Perkin-Elmer engineers practised it for nearly a year (Chaisson 152-153).

familiar; where other poets' universes are dark and hidden, Smith's is bright and colourful. Throughout 'My God, It's Full of Stars', the universe is presented through fictions, whether Stanley Kubrick's *2001: A Space Odyssey* or even the Hubble images, which fictionalise the cosmos by presenting it in a dramatic and aesthetically appealing manner, in order to present a personalised cosmos (the Hubble images and their dramatic effects are discussed at greater length later). Less concerned with explaining or 'humanising' the sciences, a goal Bell Burnell set for her project, Smith is more interested in creating a cosmological narrative for humankind: her poem is not about the science governing the universe but about our relationship to this cosmos.

Smith, born in 1972, has four collections of poems: *The Body's Question* (2003), which was the 2002 winner of the Cave Canem Poetry Prize, *Duende* (2007), *Life on Mars* (2011), and *Wade in the Water* (2018).[15] She also published her coming-of-age memoir, *Ordinary Light*, in 2015. Her books mix the very personal realm of her private life – *Life on Mars* contains a poem addressed to her unborn child ('When Your Small Form Tumbled Into Me' 69) – with the public and political realm of justice for ethnic minorities, respect for our environment, and indignation at news stories about egregious murders, for instance.[16] Some of her poems are also aligned with the Black Lives Matter movement, such as 'Unrest in Baton Rouge' (*Wade in the Water* 46). Many poems have elegiac elements in which she mourns her mother, who died when Smith was at university, or her father, whose passing coincided with her composition of the poems in *Life on Mars*. Her often moving subject matter is rendered in a generally accessible poetics. Smith mixes confessional modes of lyric poetry, often tinged by nostalgia for her childhood or adolescence, with at times quite outspoken political views concerning racism, ecological disasters and the general ill-treatment of our planet, and sexism and violence against women. During her term as the US poet laureate (from 2017 to 2019), Smith revealed one of her most important motivations as a poet: she wishes to make poetry more accessible to the masses by stressing the ways in which poetry can very directly relate to human experience, regardless of readers' or listeners' backgrounds.[17] It is perhaps therefore not surprising that her poetic style is quite accessible and easy to read: her diction is best described as narrative and at times realist or anecdotal, with carefully chosen and precise words and underlying subtleties that risk being overlooked. Her personal lyrics are more concerned with

[15] Cave Canem is an organisation, based in Brooklyn and founded in 1996 by poets Toi Derricotte and Cornelius Eady, designed as a safe and welcoming space for African American poets and with the goal to redress the under-representation of Black writers from the mainstream world of American poetry (Derricotte 974). Stephen Burt describes the organisation as 'a major incubator for the current renaissance in black poetry', among which he counts poets Smith and Claudia Rankine.

[16] Examples of the latter include 'Life on Mars', 'Ransom', and 'They May Love All That He Has Chosen and Hate All That He Has Rejected' in *Life on Mars*, and 'The World Is Your Beautiful Younger Sister', 'Theatrical Improvisation', and 'Watershed' in *Wade in the Water*.

[17] It is in this spirit that she launched 'American Conversations: Celebrating Poems in Rural Communities', a project in which she saw herself as playing the role of a 'literary evangelist' and which took the poet to rural areas across the United States (Alter). The desire to bridge the gap between university towns with flourishing poetic scenes and more isolated areas not having easy access to poetry also motivated her creation of the podcast 'Slowdown' in 2018, a daily five-minute programme during which the poet reads poems by American writers (Anne Holmes).

exploring complicated personal emotions, mixing euphoric moments with meditations on death in often exuberantly lyrical passages, than with more experimental poetic forms, such as reader-oriented genres or Language poetry. Her poetry is above all about people and relationships, whether her own to her partner, parents, siblings, or children, or marginalised personas whose perspectives she likes to assume, such as immigrants, a Flores woman, or Persephone. Her poetic form ranges from free verse to more traditional and established forms such as the sonnet, the ghazal, and the villanelle.[18] While her latest collection, *Wade in the Water*, includes erasure poems and found poetry – consisting in parts of 'letters and statements of African Americans enlisted in the Civil War, and those of their wives, widows, parents, and children' – most of her poetic output can be described as more mainstream lyric poetry (Smith, 'Notes', 77). Smith cites Seamus Heaney, Elizabeth Bishop, Philip Larkin, Yusef Komunyakaa, and William Matthews as her chief influences (*Ordinary Light* 336).

Though *Life on Mars* was reviewed widely and glowingly, being described as 'vital', 'incomparable', and 'extraordinary' by Terrance Hayes and Patricia Smith, it has received comparatively little attention from literary critics (*Life on Mars*, back cover). Reviewers are most enchanted by Smith's use of astronomical and science fiction metaphors in the first two parts of the book to describe the sense of loss she experienced as a result of her father's death and the sudden alienation from the world, expressed through astronomical imagery (Sharp, Ford, Mlinko, Brouwer, Chiasson, Kriner). Joel Brouwer writes in his review in *The New York Times*: 'outer space serves both as a metaphor for the unknowable zone into which her father has vanished and as a way of expressing the hope that his existence hasn't ceased, merely changed' (15). Many of the critics stress the elegiac nature of Smith's collection. In a longer review of the book, in which he reads Smith's poems through the lens of a long tradition of Black poets engaging with the cosmos in their elegies, Ford concludes that, for these authors, space represents a place for consolation and self-reflection (165). I argue, however, that more than simply offering a useful metaphor for introspection and meditation, Smith's cosmos is itself the main theme of 'My God, It's Full of Stars'. The poem presents attempts to come to terms with our place in the cosmos.

Not surprisingly, Smith's writings have caught the interest of critics promoting Afrofuturism as a culturally significant development in American Black aesthetics. Erin Ranft, in her review of Smith's volume, writes about the connection between Black authors and science fiction elements or astronomical imagery. She analyses two poems by Tracie Morris and Smith alongside each other and argues that the poems are examples of Afrofuturist texts as they touch on the same questions and themes that are developed in Afrofuturist fiction and music. 'Afrofuturism' is a term that loosely designates an aesthetic and political movement of Black artists engaging with futurist

[18] These characters of Smith's appear in her poem 'A Flores Woman' (*Duende* 15), 'After Persephone' (*Duende* 40), and 'Refuge' (*Wade in the Water* 73), a poem about refugees. An example of the sonnet, though not a conventional one, can be found in her poem 'When Your Small Form Tumbled Into Me' (*Life on Mars* 69); she used the ghazal in her poem of the same name (*Wade in the Water* 38); and her poem 'Solstice' is an example of a villanelle (*Life on Mars* 43).

images and technology in speculative fiction, art, music, cinema, and other media. The term was coined by cultural critic Mark Dery in 1994 in a series of interviews he conducted with science fiction author Samuel R. Delany, cultural critic Greg Tate, and sociologist Tricia Rose, in which they discuss African American science fiction and music. Dery defines Afrofuturism as '[s]peculative fiction that treats African-American themes and addresses African-American concerns in the context of twentieth-century technoculture – and, more generally, African-American signification that appropriates images of technology and a prosthetically enhanced future' (180). Tiffany Barber describes Afrofuturist texts as aiming 'to subvert science fiction tropes to highlight and complicate issues of racial difference and representations of blackness that are often left out of generic plots or eclipsed altogether' (137).[19] It is therefore fruitful, according to Ranft, to read Smith's poetry through an Afrofuturist lens, 'one that attends to and questions race and racial identity, alongside the future and technology' (82). She ends her article by insisting on the importance and even necessity of the inclusion of poetry in the Afrofuturist canon (84). Indeed, Afrofuturist scholarship considers a wide range of texts, from cinema to digital art and music videos, though much less often poetry, as pertaining to the Afrofuturist canon. This oversight of poetry is odd especially because there has been a significant amount of poetry with cosmic, astronomical, or cosmological themes published by Black writers since the beginning of the twenty-first century.[20] Further studies in Afrofuturism will hopefully fill the gap in scholarship about poetry with Afrofuturist themes.

Notwithstanding the importance and value of the movement, Afrofuturism will not be a focus of this chapter. Smith herself has never openly acknowledged any affiliation with this movement and the poem analysed in this section, although it engages with the sciences and science fiction, displays less of the political activism that is often part of Afrofuturist writing and leaves African American issues implicit. Hence, this chapter approaches the poems not as case studies of Afrofuturist poetry, but, akin to other poems in this thesis, as creative attempts to come to terms with our place in the universe, with what this universe represents, and with how our relationship with it can be reconfigured. A close reading of Smith's 'My God, It's Full of Stars' will suggest that an engagement with the deep-seated questions of human existence results in a poetry that positions the lyric I, but also the collective first person plural, referring to humankind, firmly at the centre of such explorations: her poem tackles existential questions by employing strong visuals, like *2001: A Space Odyssey* and the Hubble images, resolutely locating the human at the centre of the cosmos.

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[19] If Afrofuturism was started in North America, the movement has since been joined by Caribbean and African artists (Reynaldo Anderson 228). The movement has allowed Black writers and thinkers to create more inclusive visions of the future that combat the marginalisation of ethnic minorities, women, and queer people.

[20] Apart from Smith and Alexander, Adrian Matejka (*Map to the Stars*), Lyrae van Clief-Stefanon (*]Open Interval[*), Ed Roberson (*Atmosphere Conditions*), Terrance Hayes (*Lighthead*), and Tracie Morris have all published poems with references to the universe, space travel, and astronomy.

'My God, It's Full of Stars', the third poem of the collection, is a collage of different genres and topics, ranging from scenes in a domestic setting to collective memories of the late twentieth century to metaphysical meditations on the cosmos. It takes its title from the novelisation of Stanley Kubrick's film *2001: A Space Odyssey*. Kubrick and science fiction writer Arthur C. Clarke worked together on the novel, which came out just after the film in 1968. (The novel's protagonist utters this phrase, which is not in the film, just before entering the mysterious monolith, which turns out to be a stargate or wormhole.) 'My God, It's Full of Stars' is a poem of 104 lines split into five very different sections. Throughout the collection, the reader is confronted with an imaginary universe, the rendition of which, except for the mentions of the Hubble telescope, is totally free of any references to astronomy or astrophysics, but full of familiar beings and things, such as flowers and humanoid extra-terrestrials, as I will show. 'My God, It's Full of Stars', one of its longest poems, is representative of the collection as a whole with its elements of sci-fi, elegy, and the relationship between humans and the cosmos, which rhythm the entire collection.

In what follows, I will focus on the last three of the five sections of the poem as it is here that Smith engages with the cosmos, the Hubble, and her scientist father. Section three of the poem follows a section in which a lyric I has a conversation with Charlton Heston, the star of films like *Planet of the Apes* (1968) and *Ben-Hur* (1959), who reminisces about '*another time*', '*before the world went upside down*' (9, italics in original). Perhaps this nostalgia is for a time when our universe was believed to be much smaller, before the twentieth century, when our species and our home seemed more important in the more limited scale of the universe. The Hubble has helped us to determine that the observable cosmos is almost ninety-three billion light years across, shrinking our sense of importance in the universe (Baraniuk, Zimmerman 464). Our world has not only become significantly vaster, but also more complicated. It is a world in which Smith's imaginary and conservative Charlton Heston does not feel at home.[21] Section three explores this more complex world through a portrayal of a universe that is 'bursting at the seams with energy', and which leaves Charlton Heston behind ('My God, It's Full of Stars' 10).

2.1.2 Smith's Non-Othered 'Others'

In the third section of the poem, the lines are double-spaced and the tone is inquisitive rather than narrative or anecdotal, as is the case in the preceding section. Here, Smith offers descriptions of an anthropomorphised cosmos that is buzzing with energy and activity:

[21] Heston was in fact quite a controversial figure: when his acting career took a downward curve as he hit his fifties, Heston turned from a liberal Democrat into a conservative Republican, campaigning for Reagan, George H. W. Bush, and George W. Bush (Raymond 214, 240, 276). Many associate him with the National Rifle Association, which he presided over from 1998 until he resigned in 2003 (Raymond 315). Smith was doubtless aware of Heston's right-wing politics, which possibly influenced her choice to cast him as a character who is completely out of touch with reality and nostalgic for a time when the authority of white men was uncontested.

> Perhaps the great error is believing we're alone,
> That the others have come and gone—a momentary blip—
> When all along, space might be choc-full of traffic,
> Bursting at the seams with energy we neither feel
> Nor see, flush against us, living, dying, deciding,
> Setting solid feet down on planets everywhere,
> Bowing to the great stars that command, pitching stones
> At whatever are their moons. They live wondering
> If they are the only ones, knowing only the wish to know,
> And the great black distance they—we—flicker in. (*LoM* 10)

The adverb at the beginning of this section – 'Perhaps' – signals to the reader that this section diverges from the others in its speculation about and fictionalisation of the universe. It is a departure from the simpler universe Charlton Heston misses in the preceding section. Astronomical space is imagined here as filled with 'other' beings, as 'bursting at the seams with traffic', and as 'choc-full'. It is teeming with life, things, and action: 'traffic', 'energy', 'planets everywhere', 'great stars', 'moons', 'the dead', 'a million galaxies', 'engines', 'horns', and the 'frenzy of being' (some of these expressions are taken from the subsequent stanza, not quoted above). The notion that space is 'bursting at the seams with energy' is mirrored on the level of form: the first sentence in the stanza is long, syntactically unstable, and paratactically multiplying information, like the expanding universe. If Sleigh imagines the universe as filled with 'matter-hungry black holes', 'fields of gravitation', and 'colliding' 'galaxies', Smith's poem paints a picture of the cosmos that is filled with beings: though the syntax is murky, it is discernible that the grammatical subject of the verbs 'living', 'deciding', 'dying', and '[s]etting' are 'the others' (Sleigh 155). Who are the others? What is the significance of imagining a cosmos filled with active subjects? And what role does the Hubble Space Telescope play in these visions of the cosmos?

In its vision of a cosmos that is peopled by active subjects, Smith's poem shows an influence from the Hubble images, which, as I shall argue, help to render the universe not alien, but more familiar to us. One of our perceptions of the universe prior to the Hubble telescope was that it is mainly empty and dark.[22] This view has changed with the advent of the Hubble images: whether they show mainly one object, such as the Cone Nebula, or a galaxy, or whether they depict hundreds, if not thousands, of galaxies in the Hubble Deep Field images, they have removed the totally empty distances between celestial objects from the cultural consciousness. Smith's space, 'choc-full of traffic', could be informed by the Hubble images, to which Smith would have been

[22] Before the introduction of space-borne telescopes, observational astronomers relied on photography, spectroscopy, and photometry at optical wavelengths. It was only after World War II that radio engineers and physicists started to observe the night sky at radio wavelengths using army equipment, thus leading the way to radio astronomy. Much of the electromagnetic radiation shown in the Hubble images was not discernible by pre-war optical astronomy, which created the notion that the universe was 'emptier' than it is (Leverington 289).

exposed early on as her father worked on the telescope. However, the Hubble photographs do not necessarily present the objective and scientific truth. Elizabeth Kessler analyses the production and presentation of Hubble photographs and their impacts on our cultural consciousness in *Picturing the Cosmos: Hubble Space Telescope Images and the Astronomical Sublime*. Here, the visual culture scholar shows how the famous Hubble photographs are created: the data gathered by the telescope are often in wavebands of the electromagnetic spectrum that are invisible to the human eye, which forces the image processors to take decisions about the representation of these wavebands, so that the colours are often not strictly representative of the objective truth (25).

It is in the tweaking of the empirical data gathered by the telescope that the Hubble images contribute to a project of anthropomorphising the universe and of rendering it familiar to the viewer, a project in which Smith's poem participates, too, as I shall show below. If the colours of the photographs are chosen or enhanced for aesthetic effects, so are the objects in the photos themselves. Kessler argues that the Hubble images are doctored to the extent that they resemble Romantic landscape paintings of cliffs and mountains, and especially of the American West (28). Despite their other-worldliness, she argues, they suggest that the universe is ultimately knowable because the pictures show it as a (American) frontier that can be explored. In fact, Kessler explains extensively how the Hubble images are really not just untouched photos of the universe (127-175). They are modified so that the objects they show appear horizontal or vertical, rather than diagonal (33). The result is that they always look familiar as they resemble landscape paintings. For example, the close-up of the Cone Nebula on the cover of *Life on Mars* appears to rise from the bottom of the image and vaguely resembles a hill or other geological features of our planet. However, a wide-angle photograph of the region surrounding the Cone Nebula taken by Utkarsh Mishra, using the Chilescope, shows the Cone Nebula at a completely different angle: it is pointing towards the bottom right corner of the image (Mishra). Kessler concludes that the Hubble images capture our imagination so much because, through the resemblance to earthly features, they present a combination of the eerily unfamiliar and the familiar. The effect is that the cosmos appears as a space 'parallel to what we know' (to quote the beginning of 'My God, It's Full of Stars'), as a place that can be explored and known, while still retaining a certain mystery (8).

By imitating idealised landscape paintings of the American West from the nineteenth century, the photo processors working on Hubble data, then, actively participate in the propagation of the frontier narrative discussed by Leah Ceccarelli, whose work *On the Frontier of Science* I discuss in Chapter One. As she argues throughout her book, politicians and leaders recurrently represent the sciences as the new frontier. Thus, the westward expansion of nineteenth-century America is now displaced to the literal and figurative spaces the sciences investigate, such as genetic sequencing or interstellar space. By manipulating the Hubble images so that they resemble paintings from the American Romantic period, the astronomers working on the Hubble Heritage Project create a direct link between nineteenth-century American expansionism and the exploration of outer space, perpetuating a narrative of conquest and the displacement of indigenous peoples.

What does the dual quality of the Hubble images contribute to Smith's poem? In fact, the self-contradictory ambivalence about the Hubble images, simultaneously mysterious and familiar, also describes the beings in this stanza: they are 'the others', and the fact that they live in other worlds makes them extra-terrestrial, the ultimate unknown, yet they are also humanised. Thus, they are described as 'living, dying, deciding'; like terrestrial dwellers they walk on 'solid feet'; they are spiritual or religious, 'bowing to the great stars'; similarly to us, they might also attempt to travel to their moons, as the phrase 'pitching stones / At whatever are their moons' suggests; and lastly, they ask the same questions of the universe as our species: are 'they . . . the only ones?' The rhythm of these lines contributes to the sense that something familiar and simultaneously unfamiliar is being described as it creates two opposite effects. The double-spaced lines slow down the reading pace, especially as they follow two sections composed of tercets, which often make for a livelier or quicker rhythm. The syntax, on the other hand, encourages an accelerated reading pace: the paratactic series of loosely connected clauses, only culminating in a full stop in line eight, lead the reader to go through these lines faster. In the poem's deep-lying questions – are we the only ones? what is the universe? – Smith identifies what makes us human.

Yet, if, as Kessler suggests, the Hubble images create a parallel between the romanticised notion of the moving frontier in the American West, which entailed the displacement and the destruction of Native American tribes, what are the implications for these 'others' populating Smith's cosmos here? In fact, if at the beginning of the stanza quoted above these extra-terrestrial beings are referred to as 'the others', the poem gradually changes them into beings akin to humans. As already noted, the behaviour and thoughts of these beings are described as very similar to human behaviour and thoughts over the course of the stanza. At the end of the stanza, this affinity with the human species culminates in a grammatical identification, through the subtle use of pronouns, with these 'others': 'They live wondering / If they are the only ones, knowing only the wish to know, / And the great black distance they – we – flicker in' (10). The third person pronoun 'they', standing for 'the others', is changed to the first person 'we' at the end of the stanza, underlining our shared humanity with the 'others'. The poem thus overcomes, in a matter of a few lines, the ultimate unknown, the cosmos and any non-terrestrial beings it might contain, by reaching out to these beings and portraying them as not only similar, but identical, to us. What exactly those beings are, whether they are Smith's idea of extra-terrestrials or a form of afterlife, is less important than the fact that they are imagined in our image. Smith's space is not a source of horror but of comfort. Her resistance to the othering of any nonhuman beings also presents a political statement on the problematic colonialist mentality contained in the metaphor of Western expansionism in both the Hubble images and the metaphor of the scientific frontier as Ceccarelli explains in her book on scientific discourse and the metaphor of the moving frontier.

In Smith's treatment of the cosmos in the third section of the poem, the mysterious and unknown – the possibility of extra-terrestrial intelligence, the eerie Hubble images alluded to throughout the poem – are ultimately overcome by the familiar: the Hubble cosmos, already

strangely familiar through its allusions to landscape paintings of the nineteenth century, is filled with beings that are fundamentally human in their aspirations, beliefs, and existential questions. If the third section imagines the cosmos as a familiar place, then the next section similarly resists a perception of the universe as utterly mysterious, unknowable, or even threatening. In section four, Smith approaches visual representations of the cosmos, not through Hubble images, at least not directly, nor through astronomy, but through Stanley Kubrick's *2001: A Space Odyssey*, and particularly through the famous frames set in a wormhole. In what follows, I shall show how Kubrick's stargate scene, though quite eerie and uncanny in itself, serves the poet to further present the cosmos as a familiar and safe place, thus going against the vast majority of the engagements with astronomy by other poets in this thesis.

2.1.3 The Stargate Sequence: A Prelude to the Hubble

In section four of 'My God, It's Full of Stars', Smith finds meaning in the colours of Kubrick's stargate sequence during which Dave, the only surviving astronaut on board *Discovery One*, the spaceship in *2001: A Space Odyssey*, is travelling through a wormhole near Jupiter towards the end of the film. These scenes follow Dave's last uttered sentence in the novel, which is also the title of the poem. The scenes marked cinema-goers because of their psychedelic explosion of colours: hypnotic frames showing slow-moving splashes of colour follow frames in which the viewer is travelling through tunnels consisting of bright colours, frames in which a bright horizon is perpetually receding, culminating in scenes showing vaguely familiar terrestrial landscapes whose colours have been manipulated so that they look like brightly coloured negatives. Smith renders these frames in the following way:

> In those last scenes of Kubrick's *2001*
> When Dave is whisked into the center of space,
> Which unfurls in an aurora of orgasmic light
> Before opening wide, like a jungle orchid
> For a love-struck bee, then goes liquid,
> Paint-in-water, and then gauze wafting out and off,
> Before, finally, the night tide, luminescent
> And vague, swirls in, and on and on. . . . (11, ellipsis in original)

The loose syntax and the preponderance of long vowels here mirror the long scenes without dialogue that these lines describe. The stargate scene in *2001: A Space Odyssey*, in which the protagonist is travelling through a wormhole, is almost ten minutes long and devoid of dialogue. Besides the colours, described as 'an aurora of orgasmic light', 'a jungle orchid', and 'luminescent', the emphasis is on the movement of the colours: space 'unfurls', 'open[s] wide', 'goes liquid', 'waft[s] out and off', 'swirls in', and behaves like 'paint-in-water'. This sense of movement is strengthened by the fact that it is rendered in one long, flowing, paratactic sentence.

Thus, the tone of the poem matches the hypnotic frames the stanza describes. The metaphors and similes that Smith chose for these ghostly visuals, however, mark a departure from the film. At first glance, the imagery – natural and almost idyllic images taken from the jungle featuring orchids and bees – seems almost excessively positive but also homey in its evocation of such well-known animals and plants as bees and orchids. Even if the depths of the rainforest remain unfamiliar, most readers can picture orchids and paint in water. The universe, contrary to the story behind the production of these scenes, for which Kubrick risked his health, seems not only beautiful and safe, filled with colourful flowers, but also familiar.[23] Yet, accompanying these reassuring and mesmerising images are sexual undertones: the adjective 'orgasmic' and the 'love-struck bee' (of the 'bees and birds talk') fertilising the 'jungle orchid', which is 'opening wide' turn the wormhole through which Dave is travelling into a fecund ground; the universe is alive and reproducing. If in the preceding section, space was conceived as a home peopled by lively 'others', then in this section it is the universe itself that is shown to be alive, flexible, with almost an agency of its own. This idea of a live universe is also conveyed through the grammar: 'space' is the grammatical subject of the active verbs 'unfurls', 'opening wide', and 'goes'. This is the view of a cosmos that is evolving and changing, reproducing, beginning again. As I shall show in the second half of this chapter, in this portrayal of the cosmos Smith is similar to Alexander, whose universe is also vibrant and active. Yet, whereas Alexander's cosmos is utterly unfamiliar in its abundance of concepts and things that have agency, Smith's lively cosmos is organic: the colours move and the universe reproduces not through some unknown physical law, but because it is conceived as akin to terrestrial life (such as bees and orchids).

This stanza, with its proliferation of bright colours, raises an important question: why does Smith turn to Kubrick's film to write about the universe? Smith's concentration on the colours in Kubrick's stargate scene suggests that colour is an important feature of the poet's conception of the modern universe. I argue that this belief – that the universe is filled with colourful objects – is a product of the Hubble Space Telescope images. The bright and colourful Hubble images are a link to Kubrick's careful and long emphasis on colour in *2001: A Space Odyssey*. One of the most striking elements of the film was the ten-minute-long scene consisting entirely of what looks like LSD-induced visuals of the cosmos, devoid of any dialogue or plot.

The Hubble Space Telescope, like Kubrick before it, has injected the universe with colour. Kessler explains that 'the multiple hues of the Hubble images distinguish them from older astronomical images. Color is a relatively recent addition to astronomical photography' (154). While colour photographs have existed for a while, the subtle play with different hues, as well as the fact that the Hubble was the first telescope to be equipped with charge-coupled devices (a

[23] Michael Benson, in his book on the making of *2001: A Space Odyssey*, describes how Kubrick experimented with huge tanks filled with black ink, 'a particularly noxious World War II-era paint thinner called banana oil (isoamyl acetate)', paint, and high-intensity film lights to create the now-famous scenes towards the end of the film (81).

brand-new technology at the time which records images electronically, has a much wider spectral range, and requires shorter exposure times) revolutionised our perception of the cosmos (Chaisson 124). Representations of the universe – drawings and photographs – prior to the Hubble Space Telescope were primarily black with a few light spots representing stars and galaxies, while some might have included red hues as well. The world-famous Hubble images, on the other hand, with their psychedelic explosions of colour, changed how we conceive of the cosmos (Kessler 153). These colours for which the Hubble images are famous are, however, not inherent to the objects photographed. Kessler shows how colour is added to the images. As 'the Hubble Space Telescope records more information about the universe than any telescope before it', 'there are many possible ways to pictorially represent those data' (130). While it cannot be said that the Hubble images convey false information about the universe, they are designed, nonetheless, to 'appeal to the senses as well as reason' (138). Kessler explains that the move from the celestial objects themselves to digital images represents a move 'from the exact to the messy, from the objective to the subjective, from the indexical to the symbolic' (129). So, even if the Hubble images do not technically misrepresent celestial objects, it can be argued that they fictionalise the cosmos through their stress on their emotional impact and 'the heightened sense of drama' in these pictures (149). Even if the Hubble has contributed valuable astronomical research, the pictures circulating among the wider public are deceptive and, to a certain extent, manipulative: they do not merely directly translate numerical value as the astronomers play with contrast and gradations of light to convey a cosmos in constant motion, for instance. By showing a vivid and colourful universe, Kubrick was thus ahead of his times, anticipating the glorious explosions of colour of the Hubble images.

So, the emphasis on colours is what Kubrick's scene, Smith's stanza, and the Hubble images have in common. But why did Smith choose to write an almost ekphrastic poem about Kubrick's famous frames instead of the Hubble images themselves? Why is a science fiction film included in her poem? Smith approaches the perplexing 'great black distance' through the lens of a popular and famous science fiction film for the same reason that she imagines this cosmos as filled with anthropomorphised beings ('My God, It's Full of Stars' 10). If other poets express their alienation from the vast and expanding cosmos, Smith works to render it familiar, safe, knowable. By drawing a parallel between the awe-inducing Hubble images and a film that was made more than fifty years ago, she stresses the familiarity and human side of the Hubble images, and the degree to which the images are wrought by human hands. Thus, not only are the majestic Hubble images reminiscent of American Romantic landscape paintings, as demonstrated by Kessler, but they are also similar to visualisations of interplanetary space by a filmmaker in the 1960s.

Moreover, by focusing on colour in the universe, the opposite of darkness and obscurity, Smith also stands out from the poets in this thesis. In Chapter One, I show how Seidel poetically explores the cosmological mystery that dark matter presents, while Sleigh meditates on cosmic phenomena playing out on 'invisible bands of the spectrum' and Holub imagines civilisations distant both in time and place (Sleigh 155). Alexander likewise considers the invisible, mysterious,

and little understood areas in astronomy a departure point for his own poetic investigations. His 'Water on New Mars' embraces the obscure and alien universe, or planet, to map his own de-anthropocentralised, defamiliarised, post-human, and strangely vibrant cosmology. Catanzano and Elson, as I will show in later chapters, also show a fascination with gaps in astronomical knowledge: their poems engage with black holes and dark matter, respectively. Smith's poem is not drawn to these lacunae in our understanding of the cosmos. Her engagement with the cosmos rejects the darkness and invisibility that form part of astronomy to concentrate instead on colour and light, features of terrestrial life. Smith's night sky is not dark but an explosion of colour, like Kubrick's film and the Hubble images. Her cosmos is one taken from popular culture and is filled with beings who are strikingly similar to us. The human and terrestrial are firmly located at the centre of Smith's cosmos.

2.1.4 A Conscious Universe?

The idea that Smith's cosmos is a fundamentally humanist cosmos is also expressed in the final section of the poem, in which the cosmos becomes capable of intelligent thought. Here, Smith reminisces about the late 1980s, when her father was working on the Hubble, and mixes personal childhood memories ('we tied postcards to balloons') with public memories ('Prince Charles married Lady Di' and 'Rock Hudson died' [11]). The last section culminates in the most powerful line of the poem, which describes the first images of the Hubble when it was finally operational and when the flaw due to its imperfectly ground mirror was corrected: 'We saw to the edge of all there is – / So brutal and alive it seemed to comprehend us back' (12). Smith does something in these lines that other poets in this thesis do too when writing about the universe: she employs the vague 'it', a neutral stand-in for the universe. The choice of 'it', instead of more precise words like 'outer space' or 'the cosmos', suggests that these more precise words are insufficient, or rather too narrow, to include 'all there is'. The use of 'it', isolated from an antecedent, almost works as a blank space left open for the reader to fill in with whichever term she likes, personalising the universe and adapting it to the individual reader.

Furthermore, unlike most expositions of the universe in either science fiction, film, or popular science, Smith's 'it' is capable of understanding humans, of thought: it 'seemed to comprehend us back'. The line, apart from sagaciously capturing the emotions with which one gazes into the deep of space ('brutal' and 'alive'), raises questions. No scientist, philosopher, or thinker has yet claimed to understand the cosmos. So why does it 'comprehend us *back*' (emphasis mine)? Moreover, the verb 'seemed' adds doubt to this observation: does the universe 'comprehend us back' or does it only *seem* that way to us? In any case, the cosmos is anthropomorphised here, behaving as if it were a sentient being. Is this merely a literary trope, almost like pathetic fallacy, which portrays the environment as aligned with our own thoughts and wishes, or is there any philosophical or scientific notion inherent to a universe that 'seem[s] to comprehend us back'?

The question of consciousness, how it originated, and if it is limited to humans preoccupies philosophers and scientists alike. The philosopher Thomas Nagel propounds an anti-naturalist *Weltanschauung* in *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False* (2012), which opposes the naturalistic, or materialistic, worldview that frames almost all the modern sciences. In his book, Nagel demonstrates the 'failure of psychophysical reductionism, a position in the philosophy of mind that is largely motivated by the hope of showing how the physical sciences could in principle provide a theory of everything' (4). One of his main problems with naturalism and Darwinian materialism is the failure to explain the emergence of consciousness. In his alternative to a naturalist worldview, Nagel proposes a sort of 'teleological naturalism', in which he sees an overarching purpose in the universe, for which Darwinian naturalism cannot account. In his conclusion, he explains that his book is an exercise in pushing our cognitive limits in thinking of alternatives to the dominant scientific paradigm: 'Above all, I would like to expand the boundaries of what is not regarded as unthinkable, in light of how little we understand about the world' (127). Nagel's philosophical reflections on the roles that consciousness, emotions, morality, and intentionality play in life are put into dialogue with a physicist's radical proposition that the universe might be conscious in an article on *NPR*. Marcelo Gleiser, after a brief summary of Nagel's ideas, introduces Greg Matloff's paper on observational panpsychism, or how to potentially find empirical evidence for the extravagant idea that the universe might be conscious. Greg Matloff, physicist and astronomer at the New York City College of Technology, in an article from 2017 writes how Olaf Stapledon's story *Star Maker* inspired the astronomer to pursue Stapledon's metaphysics in astronomical research. He asks: 'Is there any scientific evidence to support Stapleton's [sic] opinion that the entire universe is in some sense conscious, and a portion of stellar motion is volitional' (9)? Matloff then goes on to propose the idea that a universal proto-consciousness field could interact with stars, which would mean that stars, and the universe at large, are self-aware. This proto-consciousness field is to be understood as an alternative to dark matter, for whose existence astronomers and astrophysicists still have not been able to deliver evidence. Matloff's version of panpsychism has a number of prominent proponents, including philosopher and cognitive scientist David Chalmer, neuroscientist Christof Koch, and physicist Sir Roger Penrose (Powell).

By discussing Nagel's challenge to the inherent materialism in the dominant framework of Western science and Matloff's astronomical research into panpsychism, I do not mean to imply that they served as influences or inspiration for Smith's line about the universe, not least because Smith's poem predates these studies by several years. Rather, I am suggesting similarities between Smith's version of the universe, seemingly conscious but also highly and self-consciously fictionalised, and Nagel's cosmology, which essentially interrogates Western science's assumed and uncontested authority on the natural world. While celebrating her father's engineering work on the Hubble, a telescope which cost the American government around two billion dollars and is definitively a product of Western science, Smith also subtly suggests, in the last line of the poem,

that this telescope has opened the doors to a metaphysical study of the universe, one that includes alternative questions to mainstream science (Chaisson x). Furthermore, the embedding of this seemingly conscious universe in a stanza which includes autobiographical elements about the poet's own childhood and father strengthens the personal connection to the Hubble images and to the cosmos that Smith seeks to express throughout the poem. Smith's emphasis on the lyric subject, which is given a personal past, and on humankind more generally in her references to science fiction films and anthropomorphised aliens, could be seen as a reaction to the unnerving and persistently mysterious nature of the cosmos, a view that is strengthened by modern observational astronomy (and the Hubble). Though she does not directly express any anxiety about the vastness and obscurity of the universe, and our comparative insignificance, her tendency to emphasise the human side of astronomy and the lyric I, or the lyric 'we', could itself be a response to the hidden and expanding universe in which the 'I' risks becoming lost. As announced already, Alexander finds the infinitude of the modern cosmos, as it is revealed to us in the Hubble images, not threatening or unnerving, but an opportunity to rethink our relationship to the cosmos. As I shall show, even if his poem abounds in the first person, this lyric I is not the stable and coherent persona of Smith's poem, but a persona consisting of multiplicities and alternatingly assuming the consciousness of nonhuman and even non-organic things. This expanded sense of self in Alexander's poetry contributes towards an ecopoetic engagement with the cosmos.

2.2 Will Alexander's 'Explorational Blankness'

2.2.1 'Astronomical Space: Our Collective Psychic Challenge'

If the Hubble images are suggestive of a vivid, anthropocentric, and inclusive space for Smith, Will Alexander finds them representative of an expanded sense of consciousness and self:

> We're getting to the point where the old boundaries are being eroded. We're going to need to go back and go forward at the same time, recovering the old knowledge that the original cultures put into the world. Civilization did not start from a reduction, but an expansion. Our systems of knowledge and education have to recover the expansiveness of the first mind. Our minds have been reduced. The Hubble telescope has given us a glimpse of infinity of which we are part. ('Hauling up Gold' 196)

This is Alexander's answer to Harryette Mullen's question about poetry's potential to grant access to an 'altered state of consciousness' in an interview conducted in 1997. There is a stress in this passage, and indeed in Alexander's poetic work as a whole, on expansiveness. This expansiveness, according to Alexander, is not present in our modern sciences and education, which taxonomically tend to hone in on infinitesimal details, thus neglecting more holistic approaches. Earlier, non-Western and pre-Enlightenment, cultures, Alexander explains, were not driven by the division of

knowledge into separate disciplines, by the breaking of the subject and reality into mind and body, subject and object; not by 'reduction' but, on the contrary, by 'an expansion'.

Disconnecting our systems of knowledge from the notion of expansiveness and expansion, according to Alexander, is a mistake because the result is that modern cultures are then no longer aligned with the expansiveness of the universe. Since Hubble observed the redshift in the spectra of galaxies in the 1920s, it has been known that the universe is expanding, which is perhaps what Alexander has in mind when he speaks of expansion in this passage. He also connects the idea of expansiveness to the notion of an infinite cosmos: 'The Hubble telescope has given us a glimpse of infinity of which we are part' ('Hauling up Gold' 196). The last five words are important because here Alexander underlines why it is essential to retain an expansiveness in our thinking and systems of knowledge: it is because we must maintain a connection to the cosmos, which Alexander sees as infinite. Given the vastness of the universe, which surrounds us, it would be paradoxical not to aspire to an expansiveness in our thinking and knowledge, especially because the 'original cultures' had already achieved such expansion.

Astronomy holds a special position in Alexander's thinking because, in his opinion, it is the strangest of the sciences: 'Astronomy . . . is so strange. We've come to this point that when you look at astronomy, it explodes completely into another zone. None of our ideas of God – how can I put it? – none of our ideas about religion are capable of understanding it' ('A Profound Investigation' 209). This idea of astronomy and the study of the universe defying our understanding is also expressed in an e-mail the poet sent me in response to my question about a specific poem of his: 'Astronomical space remains our collective psychic challenge. It does not come from us. We come from it'. In what ways can the universe be understood as a 'challenge'? Why is it described as 'psychic'? To which 'collective' is Alexander referring? If Alexander refers to the study of the universe as a scientific project – he calls it 'astronomical', which also, again, has connotations of vastness and expansiveness – he finishes the sentence on an esoteric note: he calls space a 'psychic' challenge. The adjective has various significations. While it is synonymous with 'psychological' and 'mental', it is also associated with the supernatural or parapsychological, such as clairvoyance and telepathy. Alexander here juxtaposes scientific study with esoteric exploration. In what ways might the understanding or exploration of interplanetary, interstellar, or even intergalactic space be a psychic undertaking? Alexander himself gives a hint in the same e-mail when he explains that his own studies of the Martian terrain for his poem 'Water on New Mars', during which his 'imagination was stretched to an unbelievable degree', took him 'through darkness into blindness in order to begin to see'. Alexander's astronomical poetry, in which he assumes the consciousness of organic and inorganic things, such as lightning and water on other planets, presents an answer to the question as to how the exploration of the cosmos might be a psychic, and a poetic, challenge.

In this section, I shall analyse what Alexander's exuberant verse contributes to our understanding of the cosmos and our place in it. If the study of the cosmos is primarily left to the

realm of astronomy, astrophysics, and cosmology, on the one hand, and to pseudo-scientific and disreputable fields like astrology, on the other, Alexander seeks to appropriate astronomy and cosmology for poetry. His poetry adds to the scientific pursuit of knowledge about the universe a philosophical, existential, and metaphysical dimension, which is steeped in non-Western, often African, cosmologies.[24] In New Materialist Jane Bennett's terms, Alexander's poetry serves to enchant the cosmos (*The Enchantment of Modern Life*). In some of his poems he conceives of poetry, which allows for open-mindedness, expansive thinking, and spirituality, as opposed to science, which he sees as mechanistic and materialistic.[25] While this is an unfair assessment of science, it is true that the modern sciences are characterised by dichotomous thinking: the split between subject and object, originating in the Enlightenment and preventing the human from realising her embeddedness in the cosmos, is one of the most important flaws that Alexander finds in the sciences. In his poetry, he combats this subject-object dichotomy by adopting an expanded consciousness encompassing the alienating and mysterious universe in order to achieve a kind of communion with the cosmos. As I shall show below, the deconstruction of the subject-object dichotomy is also a central tenet in the writing of Black theorists such as Fred Moten, who argues that the commodification of Black people in slavery led to a complete objectification and dehumanisation of African Americans (*In the Break: The Aesthetics of the Black Radical Tradition*). While in Smith's poem the post-Hubble cosmos is linked both to fiction and to a humanised cosmos, Alexander also uses scientifically informed images of the universe which he marries to a cosmology he identifies as African, a cosmology based in imagination, intuition, and expansiveness. Yet, unlike Smith, whose universe is recurrently compared to the familiar and human realm, such as Hollywood films, Alexander constructs a universe that is completely devoid of humans and human viewpoints. As I will show, his cosmos is completely de-anthropocentralised.

Alexander was born in 1948 and, since the mid-1980s, has published over twenty books of poetry, essays, fiction, and plays. His style, though homogeneous throughout his works, is particularly idiosyncratic and, as Aldon Nielsen claims, 'is unlikely to be mistaken for that of any other living poet' (410). The poet delights in complex, free-flowing, maximalist sentences employing obscure and often highly technical jargon taken from fields as disparate as palaeontology and jazz, interspersed with the occasional neologism. Many of his poems have lines

[24] Throughout his poetic work, essays, and interviews, Alexander recurrently mentions African cultures and cosmologies. For example, he expresses his admiration for Kemet, which is an ancient name for Egypt, but which also designates a neo-pagan revival of ancient Egyptian religion: '[In ancient Kemet] if you were studying geology, astronomy, poetry, you got into the whole activity of the cosmos as a whole rather than a part' (Krogh and Pillifant 168; 'A Profound Investigation' 206). The poet also recurrently mentions other African civilisations, such as the Dogon tribe in Mali, who had an excellent astronomical knowledge ('The Caribbean' 124).

[25] In 'Ventriloqual Labor', Alexander points out the shortcomings of the sciences and technology, which need to be complemented by other forms of exploration and investigation: 'The nature of cosmic space being of such bizarre and invincible distance can never be apprehended by mechanical inquisition, never giving us the evolved level of communion which the race has subconsciously yearned for' (170).

that are compact and contain whole sequences of specialised terminology taken from a plethora of scientific or technical fields. The linguistic fireworks – examples of which include 'imploded detonation of a swan' (*the Brimstone Boat* 35) and 'oasis as savage dialectical rotation' (*Compression & Purity* 9) – have led some critics and commentators to claim that Alexander's poetry is largely the result of automatic writing, in which a trance-like state dictates the poem rather than the active and rational mind (Mullen 'Collective Force' 424, Sloboda, Vancrevel). However, while his lavish and copious juxtapositions of references to disconnected areas of knowledge, together with a paucity of verbs and the absence of recognisable characters and narrative voice, do indeed render his texts opaque, his poetry does reveal recurrent metaphors and imagery, clearly develops various themes, and is thus more than just the subconscious pouring out of words. Some of the most recurrent themes are the ecology of our planet, including the vegetable and animal kingdoms, indigenous traditions and beliefs, the hard sciences, and the oppression of peoples by various entities (such as the Catholic Church).[26] Furthermore, a closer look at some of Alexander's phrases in 'Water on New Mars' reveals fertile meanings or connotations for which his subconscious mind alone cannot account. Alexander has been cagey on his writing process, preferring to avoid explaining how his poems are composed. What he has revealed in an interview is that he almost constantly uses technical dictionaries, such as a dictionary of astronomy, while he is writing ('Paradigm Shifting'). This suggests that he does not entirely give control over to his subconscious but guides his writing with the help of various specialist lexica, which also demonstrates his predilection for rare and technical vocabulary.

Even though Alexander does not clearly belong to a well-defined poetic movement, his seemingly unconscious compositions of language-oriented, uninhibited, and free-flowing verse, packing together references to nebulae and telepathy, for instance, would best be described as surrealist. His interests in the workings of thoughts, his belief in higher levels of reality and consciousness, and his critique of Euro-American cultural imperialism indeed suggest his affinity with this group.[27] While there are aspects of surrealism in his poetry, and in his visual art, which often accompanies his poetry, Alexander resists straightforward categorisation both unintentionally as his poetry does not fit the description of any avant-garde poetic movement, and intentionally – he has said that he finds the label 'black poetry' limiting ('Hauling up Gold' 185). In his challenge

[26] For example, his poem 'Song in Barbarous Fumarole of the Japanese Crested Ibis' is a dramatic monologue by the endangered bird, who laments the loss of his habitat and the deterioration of the natural world. 'The Sri Lankan Loxodrome' abounds in references to different cultures, such as Egyptian demonology, West Indian voodooism, or Sri Lankan beliefs. His book *Asia & Haiti*, consisting of two poems, 'Asia' and 'Haiti', presents the struggles of oppressed peoples. Mullen writes that the book explores 'the political weakness and the political strength of the inhabitants of two countries, Tibet and Haiti, the one overwhelmed by communists and the other by capitalists' ('A Collective Force' 418). Alexander also shows himself highly critical of the Catholic Church in the poem 'The Pope at Avignon', in which the pope is shown as an evil and hypocritical being.

[27] Especially his essay 'My Interior Vita' demonstrates his interest in surrealist notions of alternative levels of reality and consciousness, while his critique of Euro-American cultural imperialism is clearly visible in *Asia & Haiti*, referenced in the preceding footnote.

to the reader (through his obscure vocabulary, for example), he can be described as an avant-garde poet, yet his emphasis on emotions and the imagination distances him from the Language poets and aligns him with the Romantic tradition of lyric poetry. Even if his focus on spiritual and emotional material, the importance of the imagination in the apprehension of the cosmos, and the absence of any ironical distance to his subject matter suggest a similarity to Smith, Alexander is a more philosophical poet than the author of *Life on Mars*. Moreover, while both Smith and Alexander engage with the universe and astronomy, their uses of the universe differ: Alexander's poetry presents meditations on the universe and outer space, identifying shortcomings of the science and offering alternative explorations of outer space to scientific explorations. Contrastively, Smith presents reflections on terrestrial matters and the significance of the individual in the face of the vast cosmos. She is, on the whole, much less interested in astronomy and cosmology and instead finds inspiration in visual culture – the Hubble images and film.

What exactly is meant by Alexander's alternative to astronomical exploration of the universe is best illustrated in an example. In what follows, a brief discussion of 'Solea of the Simooms' helps to clarify Alexander's notion of a dynamic and vibrant universe, which is informed by the sciences but not dominated by them. In the long poem, written in 2004, Alexander portrays a universe suffused by a feminine energy which is responsible for all movement and change in the universe. This energy is one of infinite possibility. The poem was published in *Exobiology as Goddess*, which consists of two poems of approximately forty pages each, 'Solea of the Simooms' and 'Exobiology as Goddess'. In both poems, there are above all two characters, the 'I', who seems to be a terrestrial male, and the goddess, or Solea, whom the poems address. Solea is a type of flamenco music, but its orthography also points to the sun as a possible inspiration for the name. Both have connotations which are in keeping with Alexander's work as a whole: the sun, as a rich image in religions, features prominently in his poetry, while the art forms of ethnic minorities (flamenco music was originally performed by the Roma in southern Spain) influence his work too (Bennahum). Though the term 'goddess' might imply a religious deity, Solea seems to be the incarnation of a cosmological energy that serves as a muse to the poet or the speaker of the poem. The emphasis is on her omnipresence; she is described as an energy that infuses the entire cosmos:

> Solea roams in a zone without mass
> she is void & negation as density
> spiraling
> through scorched titanium as emptiness
>
> not a tedium
> but an endlessness
> as though the sun were stretched by blinding cyclical blankness (16)

The universe is here rendered through nouns that connote nothingness: 'void', 'negation', 'emptiness', 'endlessness', 'blankness', and the expression 'zone without mass' all gesture at the total absence of matter. The sense of nothingness is mirrored in the sound patterns of the first line of the quote. The assonance in 'roams' and 'zone', together with the long vowel sound in 'mass', stretches the line phonetically and slows the reading pace down, reflecting, to a certain extent, the endlessness mentioned in the following lines. Whereas these terms might have negative connotations, suggesting that the universe is utterly empty and lifeless, Alexander clarifies that these descriptions are not to be understood as a negative: 'not a tedium / but an endlessness'. The 'void' and 'emptiness' 'without mass' are not tedious or boring; on the contrary, they suggest an 'endlessness' – endless possibilities, or the absence of an end, or death; perhaps even a multiplicity. The ensuing line – the last line of the excerpt – also implies the expansion of the universe in the verb 'stretched'. Moreover, the length of the line, which in the context of the short passage is exceptionally long, further embodies the idea of expansion and stretching. In that regard, all the words ending in '-ness' in the quote above receive a meaning of expansiveness and possibility, instead of nothingness and nonexistence.

The third line in the passage quoted above, consisting of just one word, 'spiraling', broaches a theme that is central to Alexander's poetry. 'Spiraling' has various relevant significations which reverberate throughout the entire collection. Firstly, the verb suggests moving along a spiral, or 'to go and especially to rise or fall in a spiral course' (*OED*). Secondly, the verb also denotes a state of panic or loss of control as in the expression 'spiralling out of control'. In this sense, Solea appears as a powerful force or source of energy that cannot be checked. The concept of spiral repetition is one that Jane Bennett discusses at length in her 2001 book *The Enchantment of Modern Life*. She distinguishes between 'bare repetition' and 'spiral repetition' and argues that in a 'spiral repetition, things repeat but with a twist. And this twist makes possible . . . new formations . . . new identities and new social movements' (39). The spiral, whose ends, unlike a circle, never meet, also signals perpetual growth or expansion. Bennett's notion of spiral repetition, which essentially implies change and development as the repetition of a slightly changed idea or item resulting in 'new formations' or 'new identities', adds another layer to Alexander's spinning and spiralling universe. Included in the sense of expansion and rotation is one of development and becoming. It is portrayed as an endless process of change and growth. This view of the cosmos as changing and evolving, as alive, has been encountered before in the poems in this thesis. Thus, Smith's 'love-struck bee' fertilising the 'jungle orchid' likewise conveys an image of the universe as reproducing and changing. In the final chapter, Elson's 'lambada dancers' in the night sky tie in with Alexander's cosmic energy bearing the name of a type of Flamenco dance. As I shall argue, imagining the universe as a lively and moving entity possibly marks a change in our thinking about subject-object dichotomies, in which the object under study is no longer viewed as passive and static, but as possessing agency.

While Alexander has published poetry for four decades and though he is a serious and thoughtful poet, only a handful of literary critics and poets have published scholarship, commentaries, and reviews on him. Nevertheless, his popularity seems to grow as his poetry has been the focus of several articles as well as conference papers of the 2010s.[28] Aldon Nielsen and the aforementioned Harryette Mullen were among the first to recognise the poetic potency of Alexander's work in an issue of *Callaloo* that included a special section on the poet.[29] In their contributions to this issue, Nielsen and Mullen, both poets themselves, embed Alexander's work in a tradition or a genre of surrealism by Black writers. Nielsen argues that Alexander's poetry shares many elements with the Négritude and Negrismo movements, one of whose main figures was Caribbean poet Aimé Césaire, and that he uses his art to achieve an 'interior liberation' (411, 415). Mullen, in her review of Alexander's *Asia & Haiti*, also identifies a striving for liberation in Alexander when she writes that 'Black writers in the U. S. are attracted by surrealism because it is felt to be a potentially liberating aesthetic' (423). Later critics include literary scholars and have shifted the focus away from Alexander's affiliation with a Black surrealism to his ecopoetic concerns (Megan Simpson and Joshua Schuster), his predilection for non-Western cultures and cosmology (Evie Shockley), his use of the dramatic monologue and the consequences for a sense of self and identity (Michael Leong), and his interest in astronomy and cosmology (Joshua Schuster).

Joshua Schuster is the only critic to explicitly link Alexander to the science of astronomy in an article which draws parallels between Alexander's poetry and SETI, the search for extra-terrestrial intelligence.[30] According to Schuster, exobiology and the search for exoplanets share many concerns with poetry: both disciplines worry about the reception of their message across vast time scales and the possibly alien addressees of their message. Thus, both disciplines imply imagining what such future recipients and their world might look like (151). Schuster then coins the term 'exopoetics', which he defines as the 'study of how specific poems reflect in their form and content issues of durability, readability across cultures, and the mechanics and emotional investments in casting our expressions to an unknown fate' (154). In this context, Schuster discusses Alexander's long poem 'Exobiology as Goddess', which he sees as an attempt to imagine alternative Earths by describing Earth's deep-time past and future. Schuster's creative call to think of SETI and poetics as joined ventures makes for a compelling article, yet what he defines as the commonalities between exobiology and poetry – the wish to transcend time and space – are not unique to these two fields, while other possible interactions between SETI and poetry are ignored, as for instance the alienation effects in poetry as well as the problem of lyric address and the as yet

[28] See book chapters by Evie Shockley and Barry Maxwell, articles by Michael Leong and Joshua Schuster, and a conference paper by Ryan Dobran.
[29] This special section on Alexander consists of eight pieces by Alexander, an interview with Mullen ('Hauling Up Gold'), two critical essays on his work by Mullen and Nielsen ('A Collective Force' and 'Will Alexander's "Transmundane Specific"'), and a short artistic appreciation of Alexander's work by Julian Semilian.
[30] Evie Shockley's discussion of 'Exobiology as Goddess' also engages with Alexander's cosmology, though less with the hard sciences.

unanswered search for alien civilisations. As already indicated, rather than analysing to what extent astronomy and poetry are similar ventures, in this section I will explore how Alexander amends what he sees as the deficiencies of astronomy, namely its materialism and pragmatism, by infusing the cosmos with a spiritual dimension, stressing the connection between the universe and all existence. The rest of this chapter focuses on his long poem 'Water on New Mars'. With its highly unusual and unstable speaking subjects (which switch between extra-terrestrial water and other similarly unlikely speakers) and its painting of the Martian terrain as utterly unfamiliar, but at the same time as alive, moving, and agential, the poem offers many valuable insights into what poetry on astronomy has to say about life and our place in the cosmos, while also forming a stark contrast to Smith's familiar and anthropocentric universe.

2.2.2 De-Anthropocentralisation in 'Water on New Mars'

Our neighbouring planet, Mars, has been the focus both of extensive scientific research led by astronomers and of capitalist ventures pursued by entrepreneurs, as well as the setting for countless fantasies and science fiction narratives in fiction and film. The fascination with Little Green Men on Mars, which inspired writers, amateur astronomers, and scientists alike (from Percival Lowell to Ray Bradbury), has given way, in the last few decades, to an interest in Mars as a potential second home for humanity. The idea, popularised and championed by Carl Sagan and lately Elon Musk, of moving the human species to the red planet to guarantee a future for humanity that should outlast our current home, has fuelled new research and fictional narratives.[31] In these views of Mars, the planet is usually regarded as a passive object, similar to terrestrial deserts, that needs to be changed to allow human life. The assumed similarities of our neighbouring planet to our own planet are made clear in this problematic quote by the founder of SpaceX, Elon Musk, in which Mars is compared to American colonies:

> There needs to be an intersection of the set of people who wish to go [to Mars], and the set of people who can afford to go. And that intersection of sets has to be enough to establish a self-sustaining civilisation. My rough guess is that for a half-million dollars, there are enough people that could afford to go and would want to go. But it's not going to be a vacation jaunt. It's going to be saving up all your money and selling all your stuff, like when people moved to the early American colonies. (qtd. in Ross Anderson)

From these words, it becomes clear that, apart from a voyage to Mars being reserved for the rich and affluent (contrary to Musk's delusional comment about it being affordable), the colonialist and

[31] Carl Sagan was fascinated by the idea of travelling to Mars and, shortly before his death, recorded a message to future explorers of Mars in which he said, 'Whatever the reason you're on Mars is, I'm glad you're there. And I wish I was with you' (qtd. in Daly). The red planet also inspired Kim Stanley Robinson's highly realistic *Red Mars*, the first of the Mars trilogy, in which the planet is terraformed over many years and becomes a second home to humankind.

imperialist mentality of conceiving of the universe as a place to conquer and exploit at our will is what motivates private enterprises such as SpaceX. In projects like Musk's colonisation and terraforming enterprise, Mars is seen as a passive, utilitarian place representing the new frontier, a metaphor I discuss above already. These types of narratives surrounding the planet are essentially anthropocentric in that they either view Mars as a new home for the human species or imagine a Martian past in which life, as we know it, flourished.[32]

In 2005, Alexander wrote a poem, entitled 'Water on New Mars', that thoroughly challenges this conventional view of Mars as either a home to an extra-terrestrial civilisation or a potential second Earth.[33] In 'Water on New Mars', the poet disowns the dichotomy between observer and observed, between the active subject and the passive object, and imagines an expansive cosmology, represented by the fourth planet in our solar system, teeming with life and energy. Alexander's poem is thus a continuation and exploration of the type of cosmos Smith describes in the *2001* scenes, in which the universe appears as animate and moving. 'Water on New Mars' is a poem of fifteen pages, spoken in the voice of the water that has always existed, in one form or another, on the planet. It is difficult to summarise the poem as there is no coherent voice, character, plot, or narrative. The best way to describe it is as a song in which the unstable speaker – unstable because the speaker changes identity constantly, from water to energy – describes the surface of Mars in semantic fireworks, in free-flowing, unpunctuated, predominantly hypotactic verses. I use the word 'song' to describe the poem because, firstly, its tone is celebratory, revelling in the combination of obscure, Latinate, and highly specialised jargon from different disciplines and fields. Secondly, the entire poem is set between quotation marks, as if the poet distanced himself from this poem or song, which is uttered or sung by someone else, the fluid persona of water. Thirdly, the many repetitions and play with sound patterns give the poem a song-like quality. 'Water on New Mars' uses the planet as a backdrop for celebrating the oddities of the universe, including organic and non-organic matter, emphasising its mysteries which are in a constant state of change, just like the view of the universe in 'Solea of the Simooms'. In its kaleidoscopic and psychedelic juxtapositions of strange imagery, it sustains the image of water in all the forms it might have had on a planet throughout its history. Yet, water is not the only character that appears on Mars; the planet is teeming with energy, forces, crocodiles, and birds, which are all connected to the central protagonist, the water.

[32] In fact, the notion that extra-terrestrial life would use the same twenty amino acids to make proteins and DNA and RNA molecules to store information as earthly life was challenged in 2020. In April 2020, complexity scientist Stuart Bartlett and astrobiologist Michael L. Wong proposed a more inclusive definition of life, 'lyfe', of which 'life' is just one specific instance. Lyfe is based on four criteria: dissipation, autocatalysis, homeostasis, and learning (Bharmal).

[33] Although the poem was published in his 2011 collection *Compression & Purity*, he explains in our correspondence that he wrote the poem in 2005 (e-mail).

The opening stanzas are emblematic of the poem in their wildly imaginative collision of nouns and adjectives, often resulting in oxymorons, and in their assertion of the identity of the speaker ('I am the voltage of rocks'), which simultaneously is fluid and unstable:

> "Being water
> I am the voltage of rocks
> of algid suns in transition
> flying across a scape
> of bitter Martian dioxide
>
> moving boulders by abandoned fossil premonition
> the poles quaking
> the Sun misjudged through my aperture of prisms
>
> my oceans pre-existent
> & trembling as a soil inside iridium constellations
> like invisible glacial misnomers
> like dark magnetic rivers
> strange & totemic with current (47)

A close reading of these lines will reveal Alexander's intricate interweaving of scientific concepts with esoteric notions in a poetics that foregrounds the potency of linguistic world-building. By putting the hard sciences – such as geology, planetary science, and palaeontology – into dialogue with esoteric or pseudo-scientific practices, the poet suggests that a holistic approach to the apprehension of our surroundings is needed, not just one that specialises in one field. His extravagant word combinations do in fact suggest that very different areas of human knowledge and exploration can collaborate to acquire insights into the cosmos, as they are successful at creating meanings or suggesting ideas about Mars that go beyond the limits of the sciences studying the planet. In what follows, my discussion is focused on sciences other than astronomy or astrophysics as the exploration of Mars also involves planetary science, geology, and even biology.

So, as already indicated, the scientific terminology in this stanza is coupled with vocabulary from different domains and at times forms oxymorons. For example, the phrase 'algid suns' combines very cold with burning hot, and 'fossil premonition' is not only a paradox uniting pre-history ('fossil') with a notion of the future ('premonition'), but also links palaeontology with the pseudo-scientific notion of clairvoyance. The effect of these stark juxtapositions, however, is not one of an opposition between the sciences and other modes of investigation, but rather a fruitful combination of these two modes. Even though 'fossil' and 'premonition' seem opposed to each other in both their significance and their disciplines, the combination of these two terms is inherently meaningful. Fossilised remnants of extinct species on Earth not only allow biologists

and palaeontologists to learn about the past; they also teach them about the future of each species: eventually every species will become extinct and their remains will be engulfed by the Earth. The phrase ‘voltage of rocks’ might also seem oxymoronic as rocks, especially non-porous and non-metallic rocks, are not good conductors of an electric current. Yet some rocks, especially porous rocks trapping fluids and those containing metallic minerals, do allow electrical conduction (Yoshino 270). Moreover, the phrase ‘voltage of rocks’ also lets the Martian surface appear alive: it is buzzing with energy, an idea also contained in the verb ‘rock’.

The theme of life is also very indirectly evoked in the phrase ‘iridium constellations’. While the phrase may look like the product of automatic writing, when unpacked it becomes significant, indeed central, to the theme of ‘Water on New Mars’ through its various scientific connotations and associations. The metal iridium is very rare on the Earth’s surface but can more commonly be found in the Earth’s molten centre and in asteroids. It plays an important role in the Alvarez hypothesis, according to which the dinosaurs were wiped out between the Cretaceous and Tertiary period by the impact of an asteroid: a large concentration of iridium has been found in the Earth’s crust at the layer of sedimentary rock formed at the time when dinosaurs became extinct (Lucas 305). So, the phrase ‘iridium constellations’ points towards asteroids, which in this hypothesis are responsible for a mass extinction, but in others are believed to have started life on Earth.[34]

Finally, the last line injects a notion of non-Western spirituality into the scientific jargon: ‘totemic’, to refer to the Martian oceans, suggests that astronomy and exobiology alone cannot account for the existence of water on Mars. The allusion, through ‘totemic’, to the culture and traditions of an oppressed community or people is representative of ‘Water on New Mars’ as a whole. Western science and technology are repeatedly set off against different modes of investigation or different belief systems, such as the Mayan Codices, the Akashic records, and astrology (56, 53, 49). In this, the poem forms a stark contrast to Musk’s colonialist attitude evidenced above; by combining vocabulary taken from the hard sciences with non-scientific and non-Western cultural practices, practices which were often destroyed or displaced by European settlers and colonialists (in the case of the Mayan Codices), the poem underlines the value of disciplines that did not originate in the European Enlightenment (‘Mayan Hieroglyphic Writing’). Furthermore, the resistance to the imperialistic outlook on the solar system also connects Alexander to Smith, whose treatment of the ‘others’ in the third section of ‘My God, It’s Full of Stars’ also warns of the arrogance with which human settlers have encountered other places.

Thus, while juxtapositions between scientific vocabulary and esoteric practices, such as in the phrase ‘fossil premonition’, can work together to construct new meaning, these juxtapositions can also point to the shortcomings of science, as in the last stanza of the quoted passage. Above all, these stanzas, through their surrealism and linguistic aerobics, provide Mars with a dimension and a

[34] One of the hypotheses about biogenesis on Earth is that life arrived to our planet on meteorites, which stored small amounts of microorganisms (this hypothesis is known as ‘cometary panspermia’ [Wickramasinghe et al.]).

depth that it does not receive in other types of narratives, such as hard science fiction, or conquest projects like Musk's, or perhaps even astronomical reports about findings on the Martian surface, which seek to limit metaphysical speculation. If the sciences are undermined as the sole authority on the natural world through their combination with non-scientific and even pseudo-scientific concepts and practices, such as 'premonition', they are further subverted by the fact that these insights into Mars are not given to us from an objective viewpoint, but by the object under study itself, the water. In what follows, I shall discuss Alexander's use of the dramatic monologue for his poetic explorations of Mars and how the defiance of a stable, human speaker in his poem suggests alternative conceptions of our relationship to the cosmos. This relationship is marked above all by the breaking down of the subject-object dichotomy, which, as I shall show, ultimately also offers a critique of race politics.

From its beginning, the poem is clearly established as a dramatic monologue. The identity of the speaker, however, is indeterminable. From the first line, it seems that the speaker is water, but in the second line it describes itself as the 'voltage of rocks'. The loose syntax also creates confusion about the subject of the verbs 'flying' and 'moving', as the grammatical subject could be both the lyric I or 'algid suns in transition'. Later on in the poem, the lyrical I also defines itself as a 'greenish sonar heron', a 'blizzard', 'transmuted grain', and 'astonishing spectre'. Thus, it assumes the identity of both organic beings, such as birds, and inorganic, more abstract and complex things such as a 'blizzard'. Instead of a more scientific description of the red planet, like those given to us by films like *The Martian* or the photos captured by Martian rovers – in which the hard sciences are the sole authority on Mars – the reader receives the water's perspective on our planetary neighbour and the universe at large. Not only is the slippery identity of the speaker mainly construed as water, which is unusual as a lyric subject, to say the least, the poem also abounds in active constructions in which the subjects are things: accordingly, Alexander writes that 'lichen de-exists', a 'holograph / . . . vibrates', and 'light evolves' (47, 52, 56). Despite the absence of humans or any human-like intelligence, 'Water on New Mars' is filled with matter or things that evolve, grow, exist, vibrate, and move around, creating mystery around the planet, which is quickly becoming more complex and enigmatic.

Michael Leong discusses Alexander's poetry alongside John Yau's work and argues that both poets use the dramatic monologue in their poems to challenge the racist notion of authenticity that ethnic writers are expected to deliver in their works, and to 'promote alterity rather than identity' (502). The dramatic monologue, through the creation of 'fake' identities, allows these poets to challenge the identities that have been imposed upon them. Leong reads the doubleness inherent in a dramatic monologue – Isobel Armstrong called the dramatic monologue a 'double poem' – as parallel to the doubleness that suffuses many surrealist poems (Armstrong qtd. in Leong 515). The notion of doubleness inherent in writing by ethnic minorities was also theorised by W.E.B. Du Bois. In 1903, Du Bois wrote in 'The Souls of Black Folk' that African Americans live with a double consciousness, with two souls, in the 'sense of always looking at one's self through

the eyes of others, of measuring one's soul by the tape of a world that looks on in amused contempt and pity' (3). In other words, then, it is institutionalised racism which imposes a disvaluation and prejudice upon non-white peoples living in a white-dominated society. According to Leong's reading of Alexander's poetry, the poet seems to complicate this concept of the African American double consciousness, not by engaging directly with racist prejudices imposed upon African American writers and poets, but by resisting any kind of categorisation or notion of authenticity often attached to Black writers altogether. Leong writes on the subject of the dramatic monologue: 'What might seem like a belated form from Victorian England is, in fact, a crucial tactic for the contemporary ethnic writer; it allows him not only to attempt to disentangle his voice from an "always already" interpellated identity but also to form a new series of identifications' (516).

To Leong's interpretation of Alexander's fluid lyric subjectivity as a stance against racism, I would like to add a partly ecocritical reading of Alexander's many different lyric personae. As Leong justly points out, the poet does not content himself with adopting just one viewpoint that is not his own. In his Joan Miró poems, Alexander multiplies identities and plays with different sides of the famous painter so that the poem engenders a 'proliferation of subpersonae' (Leong 523). Yet, these lyric personae and subpersonae are not necessarily always human, and not even organic at times. It is the assumption of these shifting and inorganic identities, ranging from terrestrial things such as water to cosmological phenomena such as nebulae, that lead me to see Alexander as an ecopoet who, in a way, explodes the lyric I into the cosmos at large. Megan Simpson reads Alexander's poetry as ecopoetry. The scholar presents her musings on Alexander's 'The Stratospheric Canticles' in an informal article that touches upon compelling insights into the poet's work. She finds in the long poem a critique of the objectification of the other, of nature, and a deconstruction of the opposition between subject and object, and between representation and reality, in how the poem ascribes the function of seeing to the perceived, rather than the perceiver, even if the perceiver is implied (121-122). In her informal meditations on the effect 'The Stratospheric Canticles' had on her experience of hiking along the International Appalachian Trail, Simpson presents insightful comments, which are, however, not always backed up by a close analysis of Alexander's poetry. I agree with Simpson that Alexander's poetry achieves a breaking down of the dichotomy between subject and object and that it presents a cosmological consciousness (to which Simpson refers as 'a decentered or intersubjective consciousness' [122]). However, I argue that this blurring of the lines between subject and object is an effect of the innovative use of the dramatic monologue, multiplying organic and inorganic speakers. Simpson argues that 'Alexander eschews the first person altogether' in 'The Stratospheric Canticles'. 'Water on New Mars', by contrast, abounds in the first person pronoun, all while humans are completely absent from the poem. It is in this sense that Alexander achieves a de-anthropocentralised perspective on the cosmos.

This decentralisation of the human is a notion that Alexander shares with a line of theoretical thinkers active in the arts, humanities, and social sciences, who proffer a new focus on matter. New

Materialism is a contemporary movement that seeks to emphasise the materiality of the world, including organic and non-organic things, as well as social or theoretical constructs. It also designates a turn away from a poststructuralist focus on texts and social construction. In its attention to things as they exist independently of humans, New Materialism shares many ideas with Posthumanist theory, object-oriented ontologies such as Timothy Morton's hyperobjects (which will be discussed in Chapter Four), and Bruno Latour's Actor-Network Theory, which all advocate a horizontal and non-hierarchical organisation of matter, in which humans are simply one among many actants. One of the most popular and most cited publications summing up various New Materialist ideas is Jane Bennett's 2010 book *Vibrant Matter*, which I also mention in Chapter One. In this book, Bennett develops a philosophical and ultimately political theory of vitalism. Vitalism, a philosophy with Aristotelian roots that asserts that life cannot be reduced to mechanistic explanations, became prominent in the nineteenth century with Henri Bergson's *élan vital*, which was a continuation of a reaction against the mechanistic philosophy of the scientific revolution of the eighteenth century. Sausman locates the philosophical genealogy of Bergson's vitalism in Nietzsche, Schopenhauer, and the German *Naturphilosophie* (18-19). Bennet's version of vitalism is different from early twentieth-century vitalism as she completely uncouples it from any onto-theological theories and as she sees a certain agential force in all things, whether natural or human-made. This view of all matter as being vibrant and agential reinforces the recognition that reality is not governed by mechanistic causality or material teleology. Bennett's theory is above all a political one in that she urges the reader to start thinking, and above all acting, according to this horizontal organisation of matter, which no longer excludes any nonhuman beings or things, and essentially to adopt an ecological philosophy.

Her justification for her elimination of this hierarchy is that matter possesses a certain inherent agency that can be neither predicted nor even understood. Using the examples of food and the 2003 power blackout in North America, she demonstrates the relationality of all matter and of how things such as junk food and electricity can have a profound effect on human life, even changing the form of our bodies and our moods. These examples show that not only are humans part of different assemblages consisting of many different kinds of matter, but that humans also consist of countless things that are in themselves nonhuman, such as omega-3 fatty acids and sugar, but also, and ever more so, plastic – 'the *it*s outnumber the *me*s' (112). Bennett explains that the aim of her book 'is to articulate the elusive idea of a materiality that is itself heterogeneous, itself a differential of intensities, itself a life. In this strange, vital materialism, there is no point of pure stillness, no indivisible atom that is not itself aquiver with virtual force' (57). Here, Bennett equates life with movement, activity, and heterogeneity. Furthermore, the fact of blurring the lines between biological life and the intervention on different bodies by other bodies has as an effect the decentralising of life, and, consequently, the decentralising of those things which are alive in a classical sense, such as people and animals. It also suggests that the difference between bodies and things is one of degree and not of kind.

Bennett's New Materialism is a helpful lens to apply to Alexander's 'Water on New Mars' as the poem is dominated by nonhuman beings and even non-organic matter that veritably comes alive, not just through its agency in relation to other actants, but through the way it is described as being full of energy, as changing, as pertaining to time scales outside of the human one. Here is an excerpt taken from the middle of the poem:

> as presence
> I am of profound feeding
> being sonar in fabulous solar nurseries
> where hidden suns transpose from my presence
>
> I create an animate visual ether
> where light evolves (p. 56)

These two stanzas hint at why water is so fundamental in the universe: it sustains life. The passage abounds in notions of movement, growth, and vitality, to which water is seen as indispensable. Thus, water depicts itself as a substance which enables life. It refers to itself as being 'of profound feeding', as a vital ingredient, and of offering 'solar nurseries'. The latter phrase is a paraphrase of the astronomical term 'stellar nurseries'. Stellar nurseries are areas of dense gas and dust, which, when compacted, result in the formation of new stars (Cowen 293). Alexander opted for 'solar' instead of 'stellar' possibly because it rhymes with 'sonar' in the same line, the echo enacting, to some extent, the role of a 'sonar'. Moreover, the two words are another example of the type of internal rhyme and repetitive sound patterns that Alexander likes to employ throughout his poetry. The preference for 'solar' to 'stellar' also points to another one of Alexander's preferred images: throughout the poem, Alexander never uses 'star' or 'stellar', while using the word 'sun' eight times. (His predilection for solar imagery is also detectable in the name 'Solea' in the poem discussed above.) This suggests that the poet prefers the associations and connotations of the word 'sun' to those of the word 'star'. 'Sun' is a richer term in symbolism, spirituality, and religion. For example, in ancient Egyptian mythology, the sun god Ra is the most important of the deities, and was hailed as the creator of all forms of life (Pinch 34). In many other cultures throughout the ages, the sun has been worshipped as the giver of life and the cycle of life.[35] In this sense, the sun's astronomical attributes and its cultural and symbolic attributes are united fruitfully in Alexander's image of the 'solar nurseries'.

Even though the poet does not mention any organic life forms in this passage, the lines are filled with matter and things that are changing, growing, and evolving. Thus, the active constructions 'hidden suns transpose', 'I create', and 'light evolves' all have things that are

[35] See Campion's book *Astrology and Cosmology in the World's Religions* for information on the roles of the sun in Jewish cosmology, Islamic prayer, Incan rituals, and Egyptian cosmology.

traditionally seen as having no agency, or at least no free will and consciousness – suns, water, and light – as their grammatical subjects. Not only do these verbs have things as their subjects, they also denote actions that are not usually ascribed to things, such as 'transposing', which in its archaic meaning signifies 'transforming', and 'creating'. The notion of growth, change, and evolution is also conveyed by the structure of the stanza: the lines become gradually longer, creating a sense of advance or progress, of things to come.

Another stanza further sustains the notion of life existing in some form on Mars:

> where proto-jaguars advance
> where lichen de-exists
> where the cells blaze at the cusp of a hovering fahrenheit (47)

These three lines depict a planet filled with simple organisms, such as lichen, cells, and 'proto-jaguars', the prefix suggesting an early ancestor of the mammal. In *Red Mars*, the first book of his Mars trilogy, Kim Stanley Robinson imagines the world, or Mars, ending in 'jaguars falling from the sky' (14). This image, which is taken from an Aztec myth, according to which the world ends with the descent from the skies of evil creatures and jaguars which devour humankind, is here turned on its head so that instead of symbolising the end of life, the prefix 'proto-' turns jaguars into the harbingers of life (Olivier 94). The following line also contains a play with a prefix resulting in a neologism: 'lichen', a simple and slow-growing plant usually covering rocks, is here said to 'de-exist'. The *OED* defines the Latin prefix 'de-' as 'having the sense of undoing the action of the simple verb, or of depriving (anything) of the thing or character therein expressed'. Alexander here pushes language to its limits. Instead of using a semantically recognised term such as 'non-existent', he opts for the ambivalent neologism 'de-exists', which, through the prefix 'de-', undermines its own meaning. In addition, the active structure of the phrase – 'lichen de-exists' – complicates the matter: the subject, 'lichen', engages in an action which paradoxically implies its non-activity and even non-existence. In the context of the poem, however, this is less confusing. Throughout 'Water on New Mars', previous as well as future states of matter or organisms are imagined as happening at the same time. Thus, the lyric I often uses prefixes such as 'fore-', 'proto-', and 'pre-' to indicate time scales that transcend the human one: the phrases 'this being my proto-water as it flowed a billion years ago' (54), 'a fore-knowledge' (55), and 'no pre-preparation' (58) illustrate the poet's predilection to go beyond the present or the human time scale. Yet, as the poem exclusively employs the simple present as the main tense, the effect is one of conflating the deep past with the present and possibly with the future. In this instance, the poet seeks to find new ways to use language so as to uncouple it from its conventional, anthropocentric usages.

Lichens have often been imagined as a tough organism, able to survive many different and challenging conditions. Thus, in *The Time Machine*, H.G. Wells describes how 'liverworts and lichens' are the only remaining life forms on Earth thirty million years into the future (84). The writer might well have been inspired by a lecture by his former teacher T.H. Huxley entitled

'Evolution and Ethics', in which he explains that the commonly misunderstood notion of 'survival of the fittest' does not imply the success of the most intelligent or complex species but mainly the one best adapted to the conditions. He then uses the example of lichens to illustrate the idea that the 'fittest' species could also be 'humbler organisms', such as lichens (82). Alexander's choice of 'lichen' here then serves to emphasise the equality, the horizontal organisation, of all matter; lichens are as valuable or as agential as any intelligent civilisation, just like Huxley and Wells suggested as well.[36]

Apart from observing reality from unstable and nonhuman speakers, Alexander's poem also breaks down the subject-object dichotomy, a product of Enlightenment thinking, through the hybridisation of his speaking subjects. Alexander's fluid and metamorphosing lyrical subjectivity – which slips into the consciousness of extra-terrestrial water before it assumes the identity of birds or other nonhuman animals – adopts a sense of hybridisation. There is a constant sense of evolution and fluidity, in which the identities of the subjects he assumes consist of various elements. Jane Bennett, in her earlier book *The Enchantment of Modern Life*, includes a chapter on cross-species encounters in which she develops an argument for hybridity being a source of enchantment. Bennett concludes that these hybrid forms demonstrate a desire or a longing for the new, for metamorphosis, which she finds both pleasurable and commendable. She writes: 'Metamorphosis carries within it the lure of the new, the green of the grass on the far side, the pleasure of the feeling of movement, and the magic of transformation' (28). Crossings, the way Bennett sees them, then, are a source of pleasure, enchantment, and transformation.

Bennett then makes an argument for an ethics in politics by underlining the importance of a sense of hybridisation not just as it is often imposed on minorities (as verbalised by W.E.B. Du Bois, for instance), but also in 'privileged constituencies' (29). She wonders if 'such a project [might] render one more open to novelty, less defensive in the face of challenges to norms that one already embodies, and thus more responsive to the injustices that haunt both cross-cultural and cross-species relations' (29). By the 'injustices' she means racist or xenophobic prejudice towards any minority group, on the one hand, and the continued and ruthless exploitation of the environment and all nonhuman animals for economic gain, on the other. Bennett adds that the ability to 'self-morph' and the recognition of the hybrid within ourselves will lead to a 'magnanimous mood', which is necessary to empathise with groups of people or beings that are different from ourselves (32).

This blurring of the lines between object and subject, between human speaker and nonhuman or even non-organic speaker, is a tendency not only discernible in Alexander and New Materialist

[36] Wells and Alexander are not the only authors to write about lichens. British poet Drew Milne has written numerous lichen poems, gathered in the sequence 'Lichens for Marxists' (*The Darkest Capital: Collected Poems*). According to Milne himself, his 'Lichen poetics engages with questions of symbiosis and solidarity, mutualism and collective voicing, sketching the turn away from humanist poetics as a critical characteristic of contemporary ecopoetics' (883). Thus, lichens are here too chosen for their challenge of an anthropocentric view of nature.

or Posthumanist writers such as Jane Bennett, Timothy Morton, and Donna Haraway. Reconfiguring the parameters of object and subject has been a mission of Black theorists as well, as a reaction against slavery's dehumanising treatment of African Americans as commodities. Thus, Fred Moten, in his opening chapter to *In the Break*, in which he discusses the relationships between Black performance and a 'freedom drive', which he defines as a type of resistance to the objectification African Americans have had to fight, writes: 'The history of blackness is testament to the fact that objects can and do resist' (1). *In the Break*, as a whole, argues for the very close relationship, almost equivalence, between Black radicalism and Black performance, which he sees, essentially, as improvisation. The opening sentence to his work, following which he discusses the violence and inhumanity of slavery as it is portrayed in Frederick Douglass's retelling of his aunt's beating, serves as a reminder of what African American writers resist and revolt against: it is a racism that, at its roots, dehumanised, objectified, and commoditised African Americans.

The racist dehumanisation and objectification of African Americans is also a problem Evie Shockley identifies in nature poetry by Black writers. At the beginning of her chapter on Harlem Renaissance poet Anne Spencer, whom she qualifies as a nature poet, she laments the unfair stereotypes with which Black writers have to grapple:

> Many of the familiar (and false) binaries that structure these paradigms – male/female, white/black, active/passive, rational/emotional, and so forth – can be mapped onto the binary that divides culture (or the realm of the human) from nature. In each case, that is, the term on the right side of the divide represents that which is to be dominated and controlled, that which is to serve and be of use to its Other. When African American poets engage nature in their poetry, they risk not only marginalization . . . but also the reinforcement of an association between black bodies and passive nature that has worked against African Americans for centuries. (121)

It is in his attack on these binaries, which are not only detrimental to our attitude towards the natural world but also to ethnic minorities, as Shockley demonstrates in this quote, that Alexander can also be described as an ecopoet. Alexander's ecology comprises the entire universe, and not just Earth's ecosystems. So, while I agree with other critics who claim that Alexander is less overt about racist discrimination, his poetry manifestly engages with race in two ways: firstly, his challenge of Western science through the proposal of alternative ways of apprehending reality aligns itself with African worldviews and the cosmologies of 'original cultures', which, according to the poet, embraced a holistic worldview free from the splintering into highly specialised yet disparate fields; secondly, his dismantling of the split between subject and object likewise connects his poetic philosophy to a line of thinkers such as Fred Moten and other African American ecocritics who critique the objectification of African Americans. In Alexander's poems the universe serves as a backdrop to express an ecocritical philosophy, bridging the gap between

subject and object, and to promote non-Western worldviews, often rooted in non-Western, African cosmologies.

2.3 Conclusion: The Contradictory Universes of Smith's and Alexander's Poetics

In this chapter I have shown that Smith and Alexander react to the expansiveness of the cosmos in two different ways. While poets in the anthologies discussed in the previous chapter respond to the incredible vastness of the cosmos by often contrasting the apparent puniness of human life and activity to the formation and disappearance of stars and faraway galaxies, as Holub's and Sleigh's poems show, Smith reacts to the size of the universe by 'familiarising' it, by combatting the alienation one might feel when contemplating the night sky ('so brutal and alive') by peopling it with human-like beings and by recurrently comparing it to earthly and familiar things, such as films. Alexander, on the other hand, while also responding to the baffling size of the universe – he calls it 'infinity' – fully embraces the alienation one feels in the face of this cosmic infinity by utterly defamiliarising the universe: his cosmos is filled with 'proto-jaguars', 'wayward trilobites', and 'primordial mineral flaring' (*Compression & Purity* 47, 59). Moreover, his lyric subjectivity dissolves into an all-encompassing ecopoetic universal viewpoint, from which, in 'Water on New Mars' at least, the human viewpoint is completely absent. This tendency to render the cosmos familiar (Smith) or alien (Alexander) is also reflected on the level of form. Smith's poem treats language as a transparent medium, creating a cosmological narrative out of the universe in science fictions and the Hubble Space Telescope images. In Alexander's poem, on the other hand, language is opaque and enacts the overcoming of the split between subject and object. In his avant-garde poetics, Alexander also, like Seidel and Holub, reclaims for poetry the unknowns and unknowables in astronomy for poetry. Recognising in the planetary exploration of solar system objects a gap in knowledge, the poet seizes these mysteries and poetically scouts the Martian surface. Both poets in this chapter find in the cosmos an inherent contradiction, which they exploit for their poems: the universe is at once filled with hard scientific truths and facts – Mars has been visited by rovers, which have collected real and reliable data about the planet – and an imaginary place as, except for the immediate space surrounding our planet, no living being has ventured into the universe, or even been able to conceive of a sustainable method to travel the large distances to other planets or stars.

Chapter 3 Cosmology and Lovers in Poetry

3.1 Lovers, Poetry, and the High Firmament

Poets have recurrently created links between the firmament, the sun and moon, the cosmos at large, and love and lovers. Writing at a time when astronomy and the world picture underwent dramatic changes, John Donne and John Milton incorporated imagery from the changing heavens into their love poetry.[37] Catherine Gimelli Martin compares Milton's and Donne's attitudes towards romantic and sexual relationships and the links they establish between love and the new astronomy – 'new' as the Copernican revolution was taking place at the time when they were writing, gradually replacing the geocentric worldview with a heliocentric one. In her analysis of the treatment of love, lovers, and sex in Donne's and Milton's poems, Martin concludes that the spaces the poets imagine for their lovers are heavily influenced by astronomy. In Donne's poems, the worlds created for the lovers are 'concentrically rotating about a divine axis', while in Milton, writing around fifty years later and therefore having had more time to adapt to the new cosmology, these spaces in which the lovers – Adam and Eve in *Paradise Lost* – find themselves expand 'into boundless and still unexplored deeps' (164). Martin elaborates: 'Donne's spaces are typically spheres, fields, latitudes, and horizons (all older meanings of space), while Milton's wedded pair, like their God, dwell [in] voids, abysses, wastes, wildernesses, and other newfound spaces' (155). In other words, the two seventeenth-century poets diverge in the type of metaphors they employ and in their conceptions of contemporary astronomy. If Donne's lovers dwell in geocentric and ordered worlds, Milton's embrace what Dennis Danielson terms 'the multiverse' (qtd. in Martin 155). Yet, both poets were deeply inspired by the changing cosmological horizons and found in them appropriate imagery for the portrayals of romantic and sexual relationships.

The tradition of employing imagery and metaphors taken from astronomy and space travel persists in modern poetry. If poets like Donne and Milton turned to astronomy to reach for the largest possible concepts, both in terms of time and space, in order to create metaphors for emotions that no other natural image can provide, the poets analysed in this chapter turn towards astronomy and space travel for similar, though slightly different, reasons. As I shall show, Edwin Morgan and Amy Catanzano, in their engagements with romantic relationships, turn towards the ever more complex and counterintuitive developments in contemporary astrophysics and astronomy, such as Laika's flight aboard Sputnik 2 and black holes, in order to find metaphors and images for the ineffable or the indefinable qualities of love and intimate relationships. Morgan was a prolific writer and his remarkably heterogeneous body of poems makes proof of the poet's varied

[37] For example, in 'A Valediction: Forbidding Mourning', the 'trepidation of the spheres' is compared to the stability of Donne's and his lover's affection for each other. John Milton also makes use of astronomical imagery in his portrayal of Adam and Eve's relationship in *Paradise Lost,* as Martin explains (164).

interests. Morgan is famous above all for his love poems and his science fiction poems, and sometimes the two themes can be found combined in one poem. Morgan had a great interest in the sciences and was fascinated by the technological progress, especially in matters of space travel, which ultimately resulted in the moon landing. He even put his name on the waiting list for the first civilian spaceflight before the *Challenger* disaster in 1986 (J. Palmer, 'Interview'). Catanzano, though writing at a different time (in the twenty-first century) and place (in the USA), is comparable to the Scottish poet in various ways: she, too, has a keen interest in cosmology and astronomy, and how they can be used to describe romantic bonds, and engages with these disciplines in each of her volumes of poetry and numerous essays. In *Starlight in Two Million: A Neo-Scientific Novella*, she plays with physics and cosmological principles in an innovative portrayal of love and romantic relationships.

In this chapter, astronomy, cosmology, and spaceflight become synonymous with that which lies outside of language, which cannot be described adequately. The cosmos is suited to this task because, in its expansiveness in time and space, it defies our Earth-bound intellectual capacities. While in the preceding chapter, the strangeness of the universe was either celebrated (in Alexander's poetry) or resisted (in Smith's work), in the writings of Morgan and Catanzano it serves as a source of metaphors for human emotions which are typically difficult to express. Apart from their shared engagement with the themes of love and sex, both Morgan and Catanzano also engage with science fiction tropes, such as spaceflight to very remote planets and galaxies and human civilisations in other galaxies. Science fiction, astronomy, and cosmology meet and overlap occasionally in this thesis, as already shown in Smith's engagement with the science fiction film *2001: A Space Odyssey*. As a way to imagine and visualise the cosmos, science fiction narratives are clearly relevant to this study, and in this chapter they play a more prominent role, as will become evident.

This chapter analyses, in seven parts, how Morgan and Catanzano have embedded their discussions of love in imagery taken from the cosmos, spaceflight, science fiction, and astronomy. The first half of this section concentrates on Morgan's work and analyses especially two poems, 'The Unspoken' and 'Spacepoem 1: From Laika to Gagarin', while the second half is dedicated to Catanzano's novella (consisting of poem-chapters) *Starlight in Two Million: A Neo-Scientific Novella*. The examples of these two poets will suggest that the cosmos and the sciences that study it offer apposite metaphors and imagery for that which is ineffable and thus at the very edges of poetry: the silence of space and the nihilism of black holes, among others, are used by these two poets to parallel the mysteries, censorship, or speechlessness surrounding complex emotions.

3.2 Edwin Morgan: Seizing the 'Imaginative Possibilities' of Spaceflight

In an essay entitled 'A Glimpse of Petavius', Morgan insists on the responsibilities to the sciences of a poet writing in the twentieth century:

> [I]f science enters everyday experience, as X-rays enter the hospital ward or the comptometer enters the office or the television set enters the living-room, then it will be the poet's job to bring these things into his poetry, and he will have (ideally) three tasks to fulfil – to seize their imaginative possibilities, to understand them as far as he can (so that he won't merely use science as a new springboard into the romantic), and to see how they fit into people's lives. (4)

For Morgan, such responsibilities included the rapidly growing sciences of astronomy, astrophysics, and the newly formed science of cosmology. Of the over 400 poems in his *Collected Poems*, forty-two treat of the universe or space travel in one form or another, while another seven engage with computer language. His space travel poems show Morgan seeking to understand technological developments, 'seizing' the imaginative potentialities of events like the moon landing, and packaging the science in a way that makes it entertaining or compelling for readers. Morgan represents the universe as a previously inaccessible void that is beginning to be an accessible and therefore tangible place. Yet, despite his insistence on a poet's responsibilities towards the sciences and towards his or her readers, Morgan's poems rarely merely serve to inform or instruct, or even enchant, his readers. Morgan recognised the ambivalent 'imaginative possibilities', which are split between concern for the dangers and unethical dimensions of the space race, on the one hand, and enthusiasm and celebration of the scientific and technological progress, on the other. As shown in Chapter One, the space race, with its military and strategic significance in the context of the Cold War and the pressure on the USA to win against the Soviet Union, was marked by both technological marvels and ethically questionable decisions. I shall show in this section that Morgan was sensitive to and harnessed the uncertainties, ambivalences, and the changing roles that language played in the context of the space race to write about, of all things, love and intimate relationships in his poems.

Mostly associated with the Scottish Renaissance, Morgan, the first Scots Makar from 2004 until 2011, as well as the first Glasgow poet laureate, remains one of the most popular poets in Scotland of the twentieth century (McAllister 1). Though Morgan also published literary criticism, a trilogy of original plays, and numerous translations of European poets and playwrights, he is mostly famous for the substantive and very heterogeneous volume of poetry he wrote in a career spanning more than sixty years (Nicholson, *Inventions* 4). Overall, he published over twenty-five books of poetry, not including his translations and his plays. Most of his poetry was published in *The Collected Poems* in 1990 by Carcanet. His poetry knew an immense success, with his *Selected*

Poems (1986) having sold over 20,000 copies by 2000, an impressive number for the world of poetry sales (Gardiner 134). He died in 2010, at the age of ninety, in the same city in which he was born, Glasgow. On the one hand, his verse is usually characterised by a resolutely optimistic outlook, which often puts the human condition and a human sensibility at its centre. Many of his poems, whether they be the celebrated Glasgow poems, the love poems, or the science fiction poems, treat of the positive potentials of change, of the overthrowing of the status quo. A large number of these poems are written in more conventional poetic forms, often in the sonnet form, which Morgan explored recurrently throughout his oeuvre, or in narrative forms. On the other hand, a considerable number of his poems also demonstrate Morgan's sense of humour and playfulness with language. Thus, he also experimented with different, more avant-garde, poetic forms, such as concrete poetry, found poetry, and sound poetry. His space travel and science fiction poems, on which this chapter concentrates, fall into both categories. While most of his purely science fiction poems, such as 'From the Domain of Arnheim' and 'Memories of Earth', are long narrative poems – Morgan himself hints that they might be epic poems – written in free verse, other poems about outer space demonstrate a more playful or experimental approach to language ('When Poets Get up Into Space' 20). Examples of the latter include 'Thoughts of a Module', 'Spacepoem 3: Off Course', and 'Spacesonnet & Polyfilla'.

Many of his astronomical poems present science fiction stories, while others present scenes based on contemporary advancements in spaceflight. One of the most famous examples of the first category is 'In Sobieski's Shield'. In this long poem, written in free verse, a family 'dematerialize' on a dying Earth and 'rematerialize' on a different planet in a different solar system (*CP* 196). The poem has staple science fiction elements such as the fictional 'rematerialization' process. 'Translunar Space March 1972' is an example of the second category; it is a poem about the flight of Pioneer 10, the first probe to make its way beyond Mars and onto Jupiter, and the infamous golden plaque it contained. The plaque, designed by astrophysicist and television host Carl Sagan, was meant to communicate to an alien species who and where we are (Sagan, *Dragons*, 246). The poem heavily criticises the sexism of the plaque, which shows a naked man, raising his hand as if greeting an extra-terrestrial civilisation, and a naked woman. In the poem, the 'male chauvinist pig' is described as a 'deodorized American man / with apologetic genitals and no pubic hair', while the woman 'is not allowed to hold up her hand' and 'is obviously an inferior sort / of the same species' (*CP* 224). Although 'Translunar Space March 1972' shows Morgan as mocking and denouncing Pioneer 10 and its plaque, the language in the poem still betrays his fascination with space travel and the universe: 'Meanwhile, on to the Red Spot, / Pluto, and eternity' (224). These closing words of the poem reveal the flights of the imagination that the notion of space travel triggered in the poet. In fact, more than personal fascination, space travel and astronomy play such a prominent role in Morgan's writings that it is fair to say that he considered these developments to be representative of the age. His poetry captures this lure of outer space by populating the galaxy with spacefaring characters.

While his translations, Glasgow poems, and sound and concrete poems have generated a considerable amount of literary criticism, comparatively little attention has been brought to his science fictions.[38] In fact, a significant amount of what has been written on Morgan's science fiction poetry is in the form of reviews, which engage with Morgan's poems only on a superficial level and predominantly delight in the poet's inventiveness and optimism. Except for Douglas Dunn, who questions the ethics of such an optimistic outlook and even calls it 'antic and juvenile', most of Morgan's reviewers praise this optimism as a defining and brilliant feature of his work (88). For example, Robert Crawford writes of Morgan's science fictions: 'Morgan's imagination sides with the energy of change and what it may bring, rather than with the wailings of prophets and criers of doom' (18). Marshall Walker expresses a similar view of Morgan when he claims that for the poet 'science fiction is essentially a mode of hope' and that he uses 'the genre of science fiction to express a positive view of the human condition' (54, 60). Both Marco Fazzini and Roderick Watson focus on the defamiliarisation effects or alienation effects of Morgan's science fiction poems, a feature of Bertolt Brecht's work, which he translated. While Fazzini finds that Morgan's characters experience defamiliarisation in their encounter with the alien Other, Watson argues that defamiliarisation is acted out on the level of language, which disturbs 'our familiar modes of perception' (Fazzini 225, Watson 171). Watson's argument is very close to Steve Sneyd's argument about 'interferences' in Morgan's poems. According to Sneyd, linguistic 'interferences' in poems like 'The First Men on Mercury', in which English is gradually turned into Mercurian, 'catalyse individual or collective change' (56).

Of the commentary on Morgan's science fiction, Brian McAllister's study stands out as engaging more profoundly with his texts. In his essay, in which he concentrates on poetic form, he convincingly argues that Morgan's science fiction poems combine the ontological concerns of science fiction with the aesthetic and political concerns of the avant-garde, and particularly the aesthetic experiments of the Russian futurists. What McAllister's analysis demonstrates is that there are subtleties of form and content in Morgan's poetry that have been largely overlooked by a majority of commentators and reviewers. I shall argue in what follows that Morgan's poems about spaceflight cannot in fact be reduced to sheer optimism. Especially 'The Unspoken' and 'Spacepoem 1: From Laika to Gagarin', which form the focus of the present section, are characterised by hesitation and uncertainty about humankind's venture into outer space, which, in his poetry, becomes a creative ground for thinking about the difficulties of communication and language.

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[38] Many of Morgan's critics focus on Morgan's identity as a Scottish as well as a European and international poet, as he recurrently voiced his views on Scottish independence while also corresponding with and translating European and South American poets. For comments on Morgan's political and national identity, see James McGonigal's 'Edwin Morgan, Hugh MacDiarmid and the Direction of the MacAvantgarde', Alan Riach's 'The Poetics of Devolution', Shona Allan's 'Responding, Rewording and/or Resisting: Edwin Morgan', Tom Hubbard's 'Doing Something Uncustomary: Edwin Morgan and Attila Jozsef', and W. N. Herbert's 'Morgan's Worlds'. Robyn Marsack positions Morgan in relation to the Movement Poets and confessional poetry ('A Declaration of Independence').

Despite the word 'science' in 'science fiction', the influence on Morgan's work of the sciences and developments in technologies related to spaceflight has garnered very little attention. Many commentators in fact read his science fictions as epics featuring heroes, simply set in the modern space age, rather than as reflections on contemporary scientific progress (Crawford 12, Walker 56, Kinloch 55). Colin Nicholson is one of the only critics of Morgan's poetry who has written about the impact of the hard sciences upon Morgan's work. He finds that 'Memories of Earth', a narrative poem in which alien explorers are reduced in size in order to enter Earth, which is an electron circling a nucleus, is an illustration of Heisenberg's Uncertainty Principle. His justification for this analogy is not made clear, however: Nicholson apparently finds a similarity to the Uncertainty Principle as the poem deconstructs 'realism's assumed equation of epistemology and the representation of external facticity for experiencing subjects' ('Remembering the Future' 226). Moreover, according to Nicholson, Morgan's 'Particle Poems' internalise the hunt for the quark, which was a current research area in particle physics at the time. Indeed, Morgan mentions the word 'quark' and plays with the different significations of 'charm', which among others also denotes 'the quantum properties that distinguish different quarks' (*Inventions* 126). Stephen Fox finds the impact of the hard sciences on Morgan's poetry most salient in his emergent poem 'Message Clear', perhaps the most famous in a series of poems in which Morgan plays with famous lines (taken from Arthur Rimbaud, the Bible, and *The Divine Comedy*, for example), and erases different letters so as to foreground other meanings hidden in these lines.[39] In his discussion of 'Message Clear', which is a rewriting of Christ's utterance, 'I am the resurrection and the life', Fox argues that while the immediate effect of the poem is 'technological' and 'mechanical', it reveals a depth of emotion, sensuousness, and spirit (73-75, 86). It is in this sense that Morgan combines the two cultures in his poetic work, according to Fox. It is true that the poem combines the two cultures, represented through the 'technological' form or shape and the more emotional content. Yet, as will become clear in the following sections, Morgan also likes to engage with the sciences, not merely through form, but also on the level of content. In my reading of his space poems, I will demonstrate that his direct references to contemporary efforts in spaceflight and space exploration serve as metaphors for, and offer comparisons to, the limits of language in the expression or description of emotions.

Critics often focus on the poet's representation of technology in space, on his anthropomorphism of machines and computers, rather than on the universe itself, and Morgan's representation of this universe that has now become accessible and a concrete place. In 'The Unspoken', the poet explores both dismay at the utter inhospitality of outer space, spelling certain death for the canine cargo of the Soviets' Sputnik 2, and its promise of an elsewhere, representing the ultimate escape from a less-than-perfect world. Morgan is sensitive to the ambivalence inherent

[39] Other emergent poems by Morgan include 'Nightmare', which plays with a line from *The Divine Comedy*, and 'Manifesto', which de- and reconstructs *The Communist Manifesto*'s slogan ('Workers of the World, unite!').

to the space age, which he exploits to channel his own feelings surrounding his romantic relationships. 'The Unspoken', a poem published in his influential collection *The Second Life* in 1968, perfectly embodies this hesitancy, and at times contradiction, of sentiments characterising both Morgan's private life and the public perception of Laika's flight in 1957. He artfully intertwines references to Laika, whose space journey gave rise to contradictory feelings, with the elusiveness of his love for John Scott. A close reading of 'Spacepoem 1: From Laika to Gagarin' will complement my argument about Morgan's use and treatment of outer space. The poem was published in the same collection as 'The Unspoken', in 1968. A close reading of these two poems helps to elucidate how meaning is created or evaded, and how poetic form contributes to the expression of various sentiments.

3.2.1 'The Unspoken': The Silence Surrounding Laika and Love

'The Unspoken' was originally published in *The Second Life* in 1968, yet it was written a few years earlier, on New Year's Eve, 1963 (McCaffery). *The Second Life* is often considered Morgan's first representative volume of poems, even if it was published when the poet was in his forties. Morgan describes the 1960s as a very prolific time both because he was inspired and stimulated by the international poetry scene, and, on a more personal note, because he met John Scott, the love of his life, about whom he wrote most of his published love poems ('Power From Things Not Declared' 174). 'The Unspoken' counts among these love poems and, as it was written shortly after Morgan and Scott met, it is safe to assume that the 'you' the poet addresses in the poem is Scott. The title of the poem, with its negative prefix, is well-chosen. It designates both the elusiveness of a powerful emotion like love and the secretiveness of Morgan's romantic relationships, but also, as I will show, the struggles to describe spaceflight. Critic and Morgan biographer James McGonigal writes about 'The Unspoken' that it is marked by the potency of falling in love, an emotion so intense that it trumps all other moments described in the poem, regardless of the joy Morgan might have felt as a young man in the Royal Army Medical Corps, and the excitement with which he was following Laika's flight on board Sputnik 2 in 1957, two other scenes the poem describes ('The Once and Future Pilot' 22). I argue that the poem, while it does indeed celebrate the love Morgan felt for Scott, is above all marked by elusiveness and uncertainty surrounding the universe and space travel and the bond between two people, a bond which, because it involved two men, also had to remain '[u]nspoken' until the late twentieth century. Neither his private life nor his reaction to Sputnik can be reduced to a simple feeling of joy or excitement. Furthermore, the poet plays with the idea that love, like the subjective experience of outer space, cannot be put into words; it resists language and stays '[u]nspoken'. The poem complicates each of these scenes with mixed imagery connoting both positive and negative ideas. Here is the poem in its entirety:

> When the troopship was pitching round the Cape
> in '41, and there was a lull in the night uproar of

seas and winds, and a sudden full moon
swung huge out of the darkness like the world it is,
and we all crowded onto the wet deck, leaning on
the rail, our arms on each other's shoulders,
gazing at the savage outcrop of great Africa,
and Tommy Cosh started singing 'Mandalay' and
we joined in with our raucous chorus of the
unforgettable song,
and the dawn came up like thunder like that
moon drawing the water of our yearning
though we were going to war, and left us exalted,
that was happiness,
but it is not like that.

When the television newscaster said
the second sputnik was up, not empty,
but with a small dog on board,
a half-ton treasury of life orbiting a thousand
miles above the thin television masts and mists
of November,
in clear space, heard, observed,
the faint far heartbeat sending back its message
steady and delicate,
and I was stirred by a deep confusion of feelings,
got up, stood with my back to the wall and my
palms pressed hard against it, my arms held
wide
as if I could spring from this earth ---
not loath myself to go out that very day where
Laika had shown man, felt
my cheeks burning with old Promethean warmth
rekindled --- ready ---
covered my face with my hands, seeing only an
animal
strapped in a doomed capsule, but the future
was still there, cool and whole like the moon,
waiting to be taken, smiling even
as the dog's bones and the elaborate casket of

aluminium
glow white and fuse in the arc of re-entry
and I knew what I felt was history,
its thrilling brilliance came down,
came down,
comes down on us all, bringing pride and pity,
but it is not like that.

But Glasgow days and grey weathers, when the
rain
beat on the bus shelter and you leaned slightly
against me, and the back of your hand touched
my hand in the shadows, and nothing was
said
when your hair grazed mine accidentally as we
talked in a café, yet not quite accidentally,
when I stole a glance at your face as we stood in a
doorway and found I was afraid
of what might happen if I should never see it again,
when we met, and met, in spite of such differences
in our lives,
and did the common things that in our feeling
became extraordinary, so that our first kiss
was like the winter morning moon, and as you
shifted in my arms
it was the sea changing the shingle that changes
it
as if for ever (but we are bound by nothing, but
like smoke
to mist or light in water we move, and mix) ---
O then it was a story as old as war or man,
and although we have not said it we know it,
and although we have not claimed it we do it,
and although we have not vowed it we keep it,
without a name to the end. (*CP* 182-183)

The title of the poem – suggesting the elusiveness of and the imposed silence upon this, at the time illicit, emotion – is enacted on the level of form in the suspension of a conclusion. What strikes one immediately upon reading 'The Unspoken' is the hesitation, the delay of a resolution, a resolution

which is not in fact ever fully given, expressed in the hyperextension of the syntax: the whole poem consists of only four long sentences, with the first sentence being grammatically incomplete as it consists of only a subordinate clause. Even if the other three sentences are grammatically sound, they do not present a satisfactory resolution to the build-up of tension through the repeated use of 'when', 'and', and the prolonged subordinate clauses at the beginning of the sentence. The repeated phrase 'but it was not like that' only helps to exacerbate the tension as it denies the reader (and author) an answer or a conclusion. This withholding of a conclusion is central to the theme of the poem itself, as I shall show.

The lines, except for the last five lines, are also unusually long. The line breaks in the version above derive from the version of 'The Unspoken' as it is printed in *The Collected Poems*. However, in the original publication, the line length would have been more conspicuous as the format of *The Second Life* was square in shape, allowing more room for the long lines in various poems (Kinloch 43). The fifth-to-last line, beginning with 'O then', seems to introduce a type of resolution to the syntactic tension built up over the course of the entire poem. Yet, the anaphora of 'and although' again create more subordinate clauses, whose accompanying main minimalist clauses, each consisting of only three words, hardly offer any resolution either. The result is that the poem, through its syntactic and formal structure, enacts a yearning or a desire to express an emotion, which itself is rendered in nebulous terms. Through its frustrated attempt to express this emotion, the poem also articulates the impossibility of unimpeded communication, the central theme of the poem.

If the form of the poem is striking, the content is no less bizarre: sandwiched in between descriptions of homoerotic and romantic relationships, the Laika episode seems somewhat out of place at first glance. What is the significance of a street mongrel travelling into outer space in a poem about the author's love life? In fact, I argue that, apart from Laika symbolising for the poet the ultimate escape, Morgan also saw in the divergent public reactions to the canine cosmonaut's ventures on board Sputnik 2, which ranged from fascination and excitement at the first 'manned' spaceflight to anger and pity for the sacrificed dog, a channel for his own ambivalent feelings surrounding his romantic and sexual relationships, which needed to stay secretive in 1950s and 1960s Scotland. If Auden and Sexton, whose poems I discuss in Chapter One, find a grotesque contrast between the eternal moon and the megalomaniacal and violent defilement of the moon by earthly governments, thus passing judgment on the comparative insignificance (because ephemeral) of Cold War politics, Morgan likewise finds in the space race something that transcends the political and technological moment of the 1960s: outer space, as it appears in news broadcasts, is deeply ambivalent and fundamentally opposed to language, which renders it, in Morgan's eyes, an appropriate metaphor for romantic relations between two men, both a silenced and, like perhaps any romantic and sexual relationship, an indefinable bond.

The refrain of the poem, 'but it is not like that', closing a reminiscence of his time with the Royal Army Medical Corps in the Second World War and the homosocial and homoerotic tensions

among the soldiers, rhythms the poem and adds to the sense that a specific emotion cannot be fully put into words, which is underlined by the use of the vague pronouns 'it' and 'that'. The 'that' possibly refers to the feeling and mood he describes in this first episode. The 'it', however, is less easy to pin down. The neutral pronoun 'it' is chosen precisely because the thing for which it stands cannot easily be put into words. Like the 'it' Smith uses to refer to the vastness and complexities of the universe in 'My God, It's Full of Stars' ('So brutal and alive it seemed to comprehend us back' [*Life on Mars* 12]), Morgan's 'it' seems to contain a multitude of meanings that cannot be defined at this moment of the poem; it is like Alexander's 'explorational blankness'. The fact that the line is repeated at the end of a second, even longer, stanza, in which he describes a separate event, suggests that the poet is seeking to describe something by comparing it to various moments and episodes in his life. This 'something' can only be expressed as an unnamed 'it' as it cannot be put into accurate or precise terms – 'but it is not like that'; it is '[u]nspoken'.

If the hesitance in the first stanza is expressed primarily on the level of form and linguistics, it is explored on the level of content in the second stanza. Here, the poet remembers and fully explores and exploits the contradictory reactions, both public and private, to the Russian dog's spaceflight. Laika fills the poet with both hope for the future of space travel and exploration – and Laika did indeed lay the groundwork for human space travel – and grief for the canine cosmonaut who had to sacrifice her life for the second Sputnik mission. In fact, Laika's survival was never part of the plan as the Soviets had not yet developed the technology to safely prepare Laika's capsule for re-entry and a safe return to Earth (Burgess and Dubbs 147). The contradictory reactions to Laika's exploit are plainly depicted in the second stanza. The poet even says directly that he 'was stirred by a deep confusion of feelings' and that Sputnik 2 brought both 'pride and pity'. The stanza alternates positive ('smiling' 'future', 'thrilling', and 'pride') with negative ('doomed', 'casket', and 'pity') terms. The hesitance is also expressed on a grammatical level: while the first stanza also consists of just one sentence spread over very long lines with minimal syntactical structure, the lines in the second stanza are much shorter. The flow of the sentence is also interrupted by more commas than in the first stanza and by a number of dashes, lending the speaker an air of uncertainty and hesitation. Furthermore, this stanza, because it is considerably longer than the first one, also keeps delaying the resolution to the grammatical tension built up over the consecutive subordinate clauses.

The mixture of 'pity' and 'pride' that the poet feels about Laika was a sentiment shared by most people around the world. Thus, on the one hand, historical accounts of the Sputniks and the animals that travelled to space describe how members of the Royal Society for the Prevention of Cruelty to Animals protested in front of the Soviet embassy in London, while the National Canine Defense League called for a nationwide moment of silence every day at 11:00 am to mourn the dog that sacrificed her life to the space race ('Animals: The She-Hound of Heaven'). On the other hand, in spite of the criticism with which the Soviet canine dog programme was met, Sputnik 2 also

garnered great enthusiasm, both in the USSR and in the West. Burgess and Dubbs also describe the enthusiasm Sputnik 2 provoked especially in the USA:

> Block-long lines formed outside New York's Hayden Planetarium to attend a programme about the Sputnik satellites and hear a recording of radio transmissions from the new satellite. Sputnik-viewing became a popular sport. Thousands rose in the pre-dawn darkness for a chance to glimpse this space age phenomenon. (163)

With the first Sputnik, which was launched only a month before the satellite carrying Laika, the press had informed the public of the precise times the satellite would be flying over different countries or regions, so that those interested in the space capsule could observe it appearing above the horizon in the morning (Burgess and Dubbs 156). The second satellite, which circled above the entire world less than one month later, was even more thrilling as it carried a living being. What Laika demonstrated, even if her survival in space was extremely short-lived, was that the universe, into which, up until this point, only artificial satellites and radio waves had ventured, became penetrable and more real as an actual place that can be visited by sentient beings.

There is a sense in the poem that this space, which has been transformed by the fact that a living being has ventured out into it, is liberating. In the second stanza, Morgan writes:

> I was stirred by a deep confusion of feelings,
> got up, stood with my back to the wall and my
> palms pressed hard against it, my arms held
> wide
> as if I could spring from the earth ---
> not loath myself to go out that very day where
> Laika had shown man (*CP* 182)

These lines reveal a poet-persona that is inspired by, and almost envious of, Laika's voyage. The poet's odd posture – pressed against the wall with the arms stretched out and the palms pushed against the wall – gives the impression that he is readying himself to jump off something, perhaps the world. It reads as if the poet felt envious of the dog who managed to escape the streets of Moscow to soar into the boundless universe, a place with no laws prescribing a certain code of conduct, while the poet himself was stuck on Earth. Space thus becomes a metaphor for liberation: outer space is imagined as completely untethered from the Earth, with its restrictive and homophobic laws. The poem was published in a Scotland in which homosexuality was not yet decriminalised. In fact, the Sexual Offences Act of 1967, which legalised sex in private between two men, applied only to England and Wales. Sexual relations between same-sex adults were finally only decriminalised in 1980 in Scotland (Davis and Davidson 67). The Glasgow that Morgan was living in, then, was not a very liberal place and fantasies about escaping from it are understandable. This reading is bolstered by considering the poet's wider collection of science

fiction poems, which often feature travellers to other planets or the stars who find joy in leaving everything behind and starting anew in a foreign environment ('In Sobieski's Shield', 'A Home in Space'). These poems, like 'The Unspoken', in which the poet-persona identifies with the dog, demonstrate a certain wish to escape the bigoted world in which he lived. Chris Jones notes this almost therapeutic use of imaginative writing elsewhere in Morgan's work: '*Beowulf* [which Morgan translated] was a palliative against the loneliness of having to live a secret life as a gay man in Glasgow in the late 1940s' because of the homosocial and homoerotic overtones of Old English Poetry (2-3). Thus, as Morgan found refuge in *Beowulf* and other medieval poems he translated in the 1940s, he also found comfort in the image of the remoteness of outer space in the 1960s.

Moreover, the fact that Laika's voyage was a one-way ticket without any plans for a return to Earth epitomises the poet's wish for evasion, or his fantasy for an elsewhere. This escapism is also discernible in others of Morgan's love poems. In 'Floating Off to Timor', for example, the poet daydreams about 'snap[ping] up' and 'carry[ing]' his lover away to a faraway land of 'flying-fish', 'a pace of dolphins', and 'copra ports' (233). The notion of cutting all ties with the Earth and flying to new worlds is also expressed in 'A Home in Space', in which the astronauts decide to 'cut communication' with Earth and to '[launch] themselves outwards' (388). Outer space symbolises an imaginary place that is free from discrimination against minorities, and, in some of his poems, it embodies the opportunity for a new start.

So, as I have argued, the Laika episode serves Morgan in two regards: on the one hand, it embodies an escape to the absolute elsewhere, one that far outdoes Timor in its remoteness and distance to Glasgow. On the other hand, it serves Morgan in the contradictory emotions it triggered across the globe to express his own feelings surrounding the enforced clandestine nature of his romantic relationship. However, 'The Unspoken' cannot be reduced to a simple or straightforward confessional reading. Through its artful integration of a public event that defined a decade, 'The Unspoken' transcends the limits of the merely personal. In fact, it is fair to say that this poem fulfils the three tasks Morgan set for himself in his essay 'A Glimpse of Petavius', quoted at the beginning of this chapter. Morgan's three tasks for a poet – capturing the imaginative possibilities of technological and scientific advances, gaining an accurate understanding of them, and working out how they fit into everyday life – clearly indicate that he is not just interested in personal musings about his private life. Indeed, 'The Unspoken' presents the scientific and technological progress at its centre – Laika's flight – in a way that its cultural and social significance is emphasised, which also reveals that the poet gained an accurate, if perhaps not technical then political and cultural, understanding of Sputnik's flight. By combining the torn international reactions to Laika's sacrifice with the personal, the poet also suggests how this event 'fit[s] into people's lives' ('Glimpse' 4). By recognising the ambiguous, yet also indefinable and '[u]nspoken', nature of the historical moment of the first mammal in space, Morgan found a powerful metaphor for the often ambivalent and usually hard-to-define nature of romantic relationships. I use the adjective 'ambivalent' not to

describe Morgan's feelings for Scott but for the bittersweet nature of a relationship that needed to stay hidden and silenced.

The third stanza implicitly draws parallels between the Laika episode and Morgan's personal relationship with Scott. Here, ambivalent and tenebrous imagery is used to express the complicated nature of Morgan and Scott's affair, which links the last stanza to the middle stanza about Laika. Despite the enforced secrecy with which the two lovers had to act, Morgan describes his feelings for Scott with such lyricism and elegance in the third stanza that 'The Unspoken', along with 'Strawberries', another one of his poems addressed to a genderless 'you', counts as one of the poet's most well-known love poems. The (partly) climatic metaphors of the 'winter morning moon', the 'sea', 'smoke', 'mist', and 'light' to describe their relationship are suggestive of ephemerality and instability. These images are in line with the idea of the '[u]nspoken' in the title, which is reiterated in the last line of the poem, 'without a name'. As their relationship was by law required to stay undefined and in fact completely repressed in public, these images of such abstract substances as smoke and light, which cannot be fixed and yet which are real, are appropriate metaphors.

The 'winter morning moon', like smoke, light, and the sea, is another image that has both real and abstract characteristics. Apart from connoting night-time, the primary time during which Morgan and Scott could meet as meeting in the day-time would have put them at risk of being outed, which in the 1960s would have meant the end of Morgan's career and potentially even a prison sentence, the moon, in a poem about Sputnik, has other connotations too (David and Davidson 42). Especially in the late 1950s, when the poem is set, and the early 1960s, when the poem was written, the moon vacillated between being a real and tangible place that could be visited by humans, and the eternal heavenly body, witness to countless romantic trysts and symbol of a goddess. As shown in Chapter One, Auden and Sexton celebrate the moon as a divine symbol whose existence predates homo sapiens by many millions of years and condemn the arrogant and immature territoriality of the context of the space race. Morgan, less indignant than Auden and Sexton, is excited by the prospect of humans landing on the moon but retains the double image of the moon both as an abstract and beautiful feature of the night sky, evoking surreptitiousness and illicitness (fitting for two male lovers' rendezvous), and as a symbol of change and technological advance.

As already mentioned, the closing lines of 'The Unspoken' trick the reader into believing that they present a resolution to the poem, when, in fact, they still abstain from providing the reader (and author) with a neat and straightforward conclusion to the complexity and confusion of the poem. An incantation-like ending is created through several factors: the anaphora, which extend to the middle of each line and so form a refrain; the regular rhythm; and the line breaks which coincide with the ends of each succinct clause, forming a contrast to the ambling sentences of most of the poem. The solemnity, which is stressed by the use of repetition, with which the poem closes is suited to the content of these lines:

> O then it was a story as old as war or man,
> and although we have not said it we know it,
> and although we have not claimed it we do it,
> and although we have not vowed it we keep it,
> without a name to the end. (*CP* 183)

The expression of the elusiveness surrounding the affections of the poet for his lover reaches its climax in these closing lines: these last five lines are a declaration of love without ever using the word love, but instead the mysterious pronoun 'it', which has puzzled the reader in other moments of the poem. The neutral pronoun, also appearing in the phrase 'it was not like that', here occurs seven times, bringing the lovers together around 'it'. If there is any resolution to the poem, it is that Morgan and Scott are united in love, regardless of whether it is repressed by the government, or whether it can even be put into words. It is thus an emotion that Morgan locates outside of or beyond language. Ian Gregson, in his chapter on Morgan, describes 'The Unspoken' as a 'restless love poem' and insists on the personal aspect of the poem, rather than the social, especially because it refers to personal memories (154). However, I have shown that Morgan was not interested in merely embedding hidden allusions to his personal life and feelings in his poetry. Contrary to Gregson's argument, I am suggesting that the social, and even universal, aspect of Laika's example plays an important role in the poem, too. Morgan is aware of the social, political, and cultural implications of the Sputniks and uses their 'imaginative possibilities', to re-use Morgan's own phrase, to adumbrate the complicated and at times contradictory feelings surrounding his personal relationships. The contradiction, vagueness, and delay of a (ultimately withheld) resolution are also expressed by the poetic form. By continuously withholding a conclusion to the sentence and the relative clauses, Morgan achieves an effect that a prose text or speech could not have produced: 'The Unspoken' creates patterns and affinities between areas of life – the Soviets' Sputnik and romantic and sexual relationships – that in a different form or genre would have appeared as completely separate and distinct, as irreconcilable. If 'The Unspoken' appropriates the contradictions surrounding Laika's flight, a poem about Laika, 'Spacepoem 1: From Laika to Gagarin', plays with the changes language undergoes with the advent of spaceflight, implicitly raising the question of whether our current linguistic systems can hold up in space.

3.2.2 'Spacepoem 1: From Laika to Gagarin': Problems of Communication

That space travel, and the experience of the universe, is in some sense also '[u]nspoken', or rather unspeakable or inexpressible, is made clear in Morgan's other poem about Sputnik 2 and Laika. 'Spacepoem 1: From Laika to Gagarin' is a sound poem consisting of partly made-up Russian words with very few English words interspersed. Only from the title, and perhaps the fragmented Russian names of the space dogs that followed Laika into outer space, does the reader know that this poem is about the Soviet space programme of the late 1950s (Nelson 204, 212). A discussion

of this poem will help to elucidate my argument about how space travel is linked to the notion of impeded or altered communication. If ‘The Unspoken’ revolves around a repressed or inexpressible emotion, ‘Spacepoem 1’ takes the fragility and unreliability of language one step further by performing the disintegration of our conventional linguistic means of communication. Meaning-making techniques thus shift attention from semantics to other linguistic features, such as phonetics and punctuation. Here is the poem in its entirety:

ra ke ta ra ke ta ra ke ta ra ke ta ra ke ta ra ke ta
sputsputsputsputsputsputsputsputsputsputsputsputsput
nik lai nik bel nik strel nik pchel nik mush nik chernush nik zvezdoch
kakakakakakakakakakakakakakakakakakakakakakakakakakakakaka
spu spu tink spu kak spink spu sobak spu ka kink tak so
nikka laika kalai kanikka kanaka kana sput
nikka belka kabel kannika kanaka kana stup
nikka strelka kestrel kanikka kanaka kana pust
nikka pchelka kapchel kanikka kanaka kana psut
nikka mushka kamush kanikka kanaka kana tusp
nikka chernushka kachernush kanikka kanaka kana tsup
nikka zvezdochka kazvezdoch kanikka kanaka kana upst
barker whitiearrow beespot blackie star
whitie arrowbarker beeblackie star spot
arrow barkerbee whitiestar blackie spot
bee arrowwhitie barkerspot star blackie
barkbark! whitewhitewhite! blackblackblackblack!
star! spot! sput! stop! star! sputsput! star! spout! spurt! start!
starrow! starrow! starrow!

putputputputputputputputputputputputputputputputput
nikniknikniknikniknikniknikniknikniknikniknikniknikniknikniknikniknik
ka kra keta ka kra keta ka kra keta ka kra keta ka kra keta
kaktok kaktok kaktok kaktok kaktok kaktok kaktok kaktok
dakakvos dakakvos dakakvos dakakvos dakakvos dakakvos
dadadadadadadadadadadadadadadadadadadadadadadadadadadada
daga daga daga daga daga daga daga daga daga daga daga
dagaga dagaga dagaga dagaga dagaga dagaga dagaga dagaga
dakakgaga rin dakakgaga rin dakakgaga rin dakakgaga rin
vostok! mir! vladi! yuri! mir! vladi! vladimir! vladivostok! yurimirny
vladimirny! yurilaika! nikitaraketa! balalaika!
raketasobakaslava! vladislava! (*CP* 194)

The poem, with its strangely robotic babble and radical approach to the building blocks of language, is quite extraordinary for the mid-1960s, when it was written.[40] What it intimates is the profound change language undergoes when it is transported to the incredibly faraway places that rockets were taking dogs, space probes, and eventually humans (like Gagarin's Vostok, which also figures in this poem). 'Spacepoem 1: From Laika to Gagarin' suggests that conventional language, consisting of grammatically correct sentences with a subject, verb, and object, as well as dictionary-recognised words, is inadequate in interplanetary space. Nonetheless, the apparently preconscious gibberish notwithstanding, the poem and its striking sound patterns are not without meaning, which is mainly conveyed through non-semantic means. The rhythmic (because repeated) sound patterns, which in some lines appear as pulsating beats, are reminiscent of the beeps emitted by Sputnik, which could be detected by amateur radios. The Soviet satellites emitted a signal that terrestrial radios received as pulsating beeps, and this signal became omnipresent in the news coverage of the events (Logsdon 78). In a recording of Morgan reading this poem for BBC Radio 3 in 1982, the poet masterfully manipulates the sound effects by moving closer to and then further away from the microphone so as to mimic movement ('The Sound of Edwin Morgan'). He also puts on a robot-like voice with barely any intonation, lending the recitation of the poem a technological air. The performance, stressing the rhythmical nature of the poem, reminds the listener of the radio pulse of Sputnik.

Even without listening to Morgan's artful performance of the poem, it is clear that 'Spacepoem 1: From Laika to Gagarin' has a strong rhythm. Especially in the second stanza, this becomes obvious: trochaic metre in 'kaktok kaktok' and 'daga daga' alternates with dactylic metre in 'dakakvos dakakvos' and 'dagaga dagaga'. The effect of this quite regular rhythm, on a line-by-line basis at least, that gradually adds unstressed syllables, is one of acceleration, finally culminating, like the first stanza, in a series of stressed words which are composites combining two or more Russian words and followed by exclamation marks: 'vostok! mir! vladi! yuri! mir! vladi! vladimir! vladivostok! yurimirny vladimirny! yurilaika! nikitaraketa! balalaika! raketasobakaslava! vladislava!'. These closing words of the poem riff on parts of Russian words and names. The words 'slava' and 'sobaka' mean fame or glory and dog, which means that the second-to-last word literally means 'rocket-dog-glory'. It seems that the poem undergoes a certain change of mood, then. From the hesitating and uncertain stutter of the second line, the poem arrives at the evocation of glory and patriotism in the mention of the Russian folk song instrument, the balalaika. However, given the fact that the celebratory tone at the end is conveyed through word fragments, nonsensical word formations, and non-semantic symbols such as punctuation, it also announces the end of semantic communication.

[40] Sound poetry, in which sound elements either reinforce lexical sense or even take precedence over lexical sense, was popular with the Italian futurists, Dadaist poets writing in German, and Russian constructivists, but was by no means mainstream in English poetry (Feinsod 1327-1328).

Semantic communication disintegrates, ceding its place to non-semantic means of meaning-creation: the repeated ‘ra ke ta’ of the first line, through its disintegration into the components of the Russian word for ‘rocket’, emphasises the onomatopoeic qualities of the word over its lexical ones. The plosives /k/ and /t/ gesture towards the unbearable noise that Laika was subjected to during lift-off. Moreover, the first two syllables of the Russian word sound like the English word ‘racket’, which likewise connotes loud noise. Furthermore, the repeated plosive consonants and especially the alliterations in /sp/ and /st/ in the last two lines of the first stanza, together with the exclamation marks which appear gradually more frequently until they turn the monosyllabic words into staccatoed accents, convey a sense of urgency. The alliterative ‘star’, ‘spot’, ‘sput’, and ‘stop’ in the second to last line create an audible effect of sputtering or stuttering. These onomatopoeia possibly simulate the machinery inside the Sputnik spacecraft that starts to rattle under pressure. The disintegration of semantics, the distortion of language even on the level of phonemes, and the reduction of language to phonetics, exemplified in such word fragments as ‘sput’, ‘nik’, and ‘lai’, symbolise the break-down of conventional language-based communication, foregrounding the materiality of language instead.

Repetition, or the play with seriality or infinity, in which the laws of cause and effect are relinquished, is also among the recurring features of literary nonsense, according to Wim Tigges. ‘Spacepoem 1: From Laika to Gagarin’, with its neologisms and puns, personifications of animals, objectifications of humans, and absence of an affective lyric subject, also confirms Tigges’s most important defining characteristic of literary nonsense, namely the unresolved tension between a multiplicity of meaning and the absence of meaning (57). He elaborates that ‘if successful, nonsense is communication without communicating’ (248). This provocatively self-contradictory statement is an apt description of how early artificial satellites communicated with terrestrial bases: communication did take place, but in a new form; without words but with bleeps. Nonsense literature, then, allows the author to engage with serious subject matter, such as love and death, without having to resolve this tension between meaning and unmeaning, a resolution that a joke, for example, provides (249). That is why he further calls literary nonsense an ‘aesthetic form of resignation’ (254). ‘Spacepoem 1: From Laika to Gagarin’ does indeed allow Morgan to attack a serious topic, that of the ethics of sacrificing mammals for technological progress in space travel. In fact, the repetition ad absurdum of the syllables ‘dada’, which later turns into ‘gaga’, suggests that sending a dog into space is ‘gaga’, and that the mission shares the absurdity and irrationality of the anti-aesthetics art movement of the early twentieth century (‘dada’). Just like the ambiguities surrounding Laika in ‘The Unspoken’, ‘Spacepoem 1: From Laika to Gagarin’ also abstains from straightforward commentary on Sputnik 2 and the space race, delighting instead in the proliferation of nonsensical words. Thematically, the two poems are linked as well in their skirting of meaning, and in their eschewal of a straightforward expression of the ‘[u]nspoken’ or taboos, which Tigges also associates with nonsense literature (247). ‘Spacepoem 1’ hovers around the edge between meaning and non-meaning, subtly raising questions about the ethics of giving a dog a one-way

ticket into the exosphere by rendering Laika's fear and panic as short and staccatoed onomatopoeia, suggesting barks and yelps, while 'The Unspoken' likewise withholds a resolution of the poetic tension by not naming the 'it' the poem seeks to describe or define.

In Adam Piette's reading of 'Spacepoem 1', the exclamations at the end of the poem stand for both the Western and Eastern propaganda that had come to fill outer space in the context of the space race, glorifying either the American capitalist ideology or the Soviet *Weltanschauung*, anchored in communism. Piette's politicised reading of the poem leads him to raise this question: 'What space does poetry have when space itself has succumbed to the *slava*-propaganda of the superpowers'? (97). Piette identifies the barking dog in the poem as an allegory for the poet who feels impotent and tongue-tied in the oppressive East-West conflict (97). I argue, on the contrary, that far from being silenced by power-hungry governments, Morgan, like other poets before and after him such as Seidel, Smith, and Alexander, reclaims outer space for poetry by identifying those aspects of the universe, or astronomy or spaceflight, that are not fully articulated, researched, or known and by drawing parallels to other areas of human activities. In Seidel's case, the mysterious cosmological dark matter is compared to the dark matter of the reader, or of interpersonal communication, while in Alexander's poems the expanded cosmos is used for its opportunities for expanding our horizons in terms of thinking about our relation to the wider universe. In Morgan's poems, humankind's first ventures into outer space offer the potential to think and talk about inter-human relationships and communication. There are parallels between spaceflight and Morgan's personal and romantic life: open communication about his personal life remains impossible, '[u]nspoken', just like straightforward communication with Laika aboard Sputnik 2. While the existence of Morgan and Scott's relationship stays hidden, all we perceive are beeps, or in Morgan's case stolen glances and accidental touches that speak of the intimacy between the lovers. More generally, love as an emotion between any two people, whether of the same sex or the opposing sex, is also famously difficult to define, to fathom, or to explain, as countless song lyrics and love poems attest. Morgan's poem, then, is also successful because of the universality of the treatment of its central theme. In both poems, spaceflight and the universe are used as sources of metaphors to express the limits of language, both in the context of the expression or definition of an emotion, which, in Morgan's case, was not even considered legal, and in terms of communication with outer space. In the next section I shall argue that, although they write in vastly different contexts, Morgan's turn towards space travel and the universe to talk about the complexities or difficulties of romantic relationships is shared by a contemporary American poet, Amy Catanzano. In her avant-garde poetics, which mixes prose poems with science fiction tropes and principles taken from physics, Catanzano enfolds discussions of love in its various guises.

3.3 Amy Catanzano's Quantum Poetics

Catanzano has made the study of the relationships between hard science and poetry integral to her poetic work, often presenting herself as a scientific poet.[41] Like most of the poets in this thesis, she also does not conceive of this relationship as one in which poetry is merely a vessel used to propagate scientific theories and developments. Instead, and unlike the other poets in this thesis, Catanzano experiments with principles and metaphors taken from astrophysics and cosmology and applies them to poetic form: she exploits the imaginary potentials of theoretical and physical concepts like the theory of relativity, the multiverse, and black holes to inform the structure and formal aspects of her innovative poetics. If the previous chapters have demonstrated how poetry can offer a critical comment on developments in astrophysics and astronautics, as Sexton, Auden, and Morgan have partly demonstrated, or attempts to define or reconfigure our relationship to the cosmos, as Smith's and Alexander's works do, the following sections develop a different view on the relationships between poetry and science: in Catanzano's work, the aesthetics of the principles governing the cosmos are used for her formal poetic experiments, which, in turn, she believes, can inform our perception of the universe.

While Catanzano's work has been published in many poetry journals, her first book-length volume, *iEpiphany*, was only published in 2008, which was closely followed, in 2009, by the publication of her second volume of poems, *Multiversal*. This volume put Catanzano on the map of contemporary and avant-garde poets. It received the PEN USA Literary Award in Poetry and was selected for publication by Michael Palmer as the recipient of Fordham University's Poets Out Loud Prize. Her third, and most recent, collection, *Starlight in Two Million: A Neo-Scientific Novella*, came out in 2014. In its insistence on the active and even participatory role of the reader to construct meaning out of the poems (sometimes literally, as in the poems 'flatland' and 'Choose Your Own Adventure'), in its emphasis on the signifier, in its multiplicity, disjunction, and avoidance of narrative forms, her poetry is grounded in the tradition of the Language poets and Objectivist poetics (Catanzano studied with Lynn Hejinian at Iowa [Celona 5]). Catanzano foregrounds the materiality of language by, for instance, transposing scientific jargon, lifted from highly technical areas of the hard sciences, such as 'supermultiplet' and 'orbifold' (the titles of two poems in *iEpiphany*), into a poem and juxtaposing it with staple science fiction terms like 'warp drive' ('Neuro.') and 'time machine' ('Anti-Guardian 6:7:9').

With regard to contents, her three works are concerned with phenomenology, the nature of reality and the cosmos, the perception thereof, and, ultimately, the description or expression of

[41] On her personal webpage, she lists her residencies at various scientific research centres (such as CERN, the Cerro Tololo Inter-American Observatory, and the National Radio Astronomy Observatory site in West Virginia, to name a few [*Amy Catanzano*]). She makes proof of an extensive knowledge of astrophysics and cosmology in both her essays and her poems. In 2019, Catanzano was also the convenor of a conference which invited poets and scholars who work in the intersections between science and poetry. Presenters included Will Alexander, Rae Armantrout, Andrew Joron, Ming-Qian Ma, and Ed Roberson (*Entanglements*).

reality in language. In the exploration of what constitutes the real and in an attempt to define things as they are, uninfluenced by preconceived notions of perception, Catanzano's poetry shows the influence of Gertrude Stein. 'The Book of Imaginary Planets', like Stein's *Tender Buttons*, provides meditations on imaginary planets in short prose poems (*Multiversal* 2-4). Especially *Multiversal* is preoccupied with consciousness, unconsciousness, and dreams: Catanzano writes of '[d]reaming in extreme geographies', while elsewhere she asks the reader, '[d]o you know who built that little pyramid of dreams / in your head?' (43, 6). In this exploration of dreams and altered states of consciousness, or the state between consciousness and unconsciousness, *Multiversal* also includes surrealist elements, which can also be found in *iEpiphany*. In *iEpiphany*, the sparse, gnomic, and often aphoristic verse sometimes looks like automatic writing, especially in lines like '[m]y camera like an / accordion plays diamonds as I search' (11). While the verse is challenging in its eschewal of circumscribed meaning, both volumes delight the reader in their luscious lyricism, as in this line: 'nebulae are Rorschach tests in space', a line in which the transdisciplinary imagery raises questions about the roles of human perception, preconceived ideas about reality, and aesthetics in the apprehension of our cosmos (*iEpiphany* 58).

Highly relevant to this thesis and its analysis of the relationships between the hard sciences and poetry is a series of essays Catanzano wrote around ten years ago. 'Quantum Poetics: Writing the Speed of Light' was published in four parts, appearing on Jerome Rothenberg's blog, *Poems and Poetics*, from 2009 to 2012, and revised in July 2020 (the revised version appeared on her personal website).[42] In her essays, Catanzano defines quantum poetics as the application of 'principles in theoretical physics and other sciences to the composition and interpretation of literary works' (*Starlight* 97-98). She starts her essay by giving a lucid and concise overview of twentieth- and twenty-first-centuries physics, ranging from Einstein's redefinition of gravity as an effect of space-time, to quantum mechanics, to the big bang start of the universe, to dark matter and dark energy, to string theory and the notion of the multiverse. Her expositions of these developments in cosmology and physics are accompanied by reflections on their implications for literature and poetry in particular. Thus, she asks provocatively whimsical questions like, 'where does the poem's universe warp?' and 'is poetry a form of space/time travel?' (Part One). Her tone is exploratory; her essay suggests consequences of the new physics for poetry without being overly assertive. Her sentences often start with 'perhaps' and use constructions such as 'seems to be', and her essay abounds in questions rather than answers.

[42] Rothenberg, who is most well-known as a poetry anthologist and theorist, as well as the founder of ethnopoetics, a movement bringing together poetry, performance, and ethnography, started his blog in 2008 in order to encourage 'the free circulation of works (poems and poetics in the present instance) outside of any commercial or academic nexus' (Rothenberg). Besides Catanzano's essay and some of her poems, Rothenberg's blog has also featured work by such avant-garde poets as Bob Perelman, Rae Armantrout, Charles Berstein, Christian Bök, Will Alexander, as well as English translations of Turkish, Tunisian, and Japanese poetry.

In her conclusion, Catanzano writes that a poem could work as a 'multiversal technology' in that it 'ricochets between pattern and the clinametic swerve toward novelty within multiple scales of physical reality through known and unknown dimensions' (Part Four). In this sentence describing a highly ambitious (and perhaps not entirely realistic) programme for poetry, involving Lucretian atomism ('clinametic'), Catanzano combines aspects of poetic language with the world as it is conceived in theoretical physics positing the existence of multiple dimensions unknown to us.[43] Thus, while a telescope allows astronomers to apprehend the age and size of the universe, for instance, a poem, thought of as a tool similar to the telescope, can perform similar work in that it moves the writer and reader 'toward novelty'. Poetic language, as conceived by Catanzano, can thus challenge and modify mental frameworks. This is how the poet sees her poetic work as influencing our perception of reality. The notion of innovation and innovative language is central to 'Quantum Poetics'; the essay advocates innovation in poetry in order for our 'consciousness [to] evolv[e] toward novelty' and apprehend reality in new ways. These reflections on the roles of poetry come very close to Alexander's ideas on poetry's ability to allow 'one to see areas of reality that heretofore had remained elided or obscured' (Alexander, 'My Interior Vita', 66). Indeed, Catanzano writes that she has been influenced by this surrealist poet (Higgs). Yet, compared to Catanzano, Alexander assigns a less important role to the sciences than to poetry. According to Alexander's surrealist ideas, innovative poetry unlocks the access to higher planes of reality and helps to study the cosmos. Catanzano, on the other hand, finds value in combining principles from theoretical physics with innovative poetics: her poetics finds her thinking along such speculative ideas as multidimensionality in poetry as well as the idea of finding subatomic and astronomical scales in poetry at the level of the sentence and of narration. She also explores the implications of principles taken from astrophysics, such as event horizons, to describe human relationships.

Catanzano has published widely (on blogs and online journals like *Jacket*) about her ideas: discussions of the crosspollinations of astrophysics and poetry are spread over twenty-six posts in total. For a poet who insists that the reader creates the text as much as the author, Catanzano has written extensively about how to understand her explorations in quantum poetics. The availability of her own key to her at-times-obscure poetry might also raise the question whether her prose writings on her poetics render her poetic creations redundant. If she explains everything she wants to achieve in her poetry in her essays and interviews, why would we still read her poetry? In fact, I shall argue that she is not a complete or exclusive authority on her own poetry and that her poetry raises questions that she does not address in her prose. Like Morgan, who repeatedly advocated the need for a poet to stay up-to-date with developments in the sciences so as not to become an irrelevant anachronism, Catanzano has also written substantively in favour of the need of our

[43] Catanzano is not the first to turn to the Lucretian clinamen, the sudden swerve of atoms falling in the void, which leads to collisions and subsequently to all of creation, in her discussion of modern physics. Most notably, Michel Serres found in the clinamen of Epicurean atomism as it is developed by Lucretius the origins of modern physics (S. Brown 10).

language and poetry to 'catch up' with quantum mechanics and relativity; in other words, the need of our poetry to adapt to the physical world as it is revealed in quantum mechanics. Yet, her essays reveal less about what poetry can do that physics cannot ('Impossible Poems'). In *Starlight in Two Million: A Neo-Scientific Novella*, Catanzano explores the realm of romantic relationships, a topic which lies outside the limits of the hard sciences she admires in her essays. It is in her poetic creations that Catanzano explores this quality of poetry, which sets it apart from physics. As I shall show in this section, Catanzano employs imagery, allegories, and metaphors taken from the hard sciences to represent the effects and functions of love in a story which is predominantly about the union of two lovers. While her essays revere the sciences as a discourse to which other areas of human activity and knowledge must aspire, her poetic and experimental writing convincingly claims the chaotic and tangled field of human relationships for literature. In *Starlight in Two Million*, rich networks of metaphors and allusions create a four-dimensional textual fabric, which the author treats like the four-dimensional space-time upon which gravity and massive objects act. Through complex metaphors, Catanzano represents love as a physical force that distorts and bends her novella the way black holes distort cosmic space-time. In her book, literary experimentation, cosmological and astrophysical metaphors, and notions of romantic relationships are entangled, creating poetic singularities (to mix physics terminology with poetry, as Catanzano does). Although Catanzano is not the first poet to experiment with metaphorical black holes, her original embedding of these astrophysical mysteries in a complex, partly metafictional, and multilayered text, using language like scientists might use a lab, has not been attempted before, to my knowledge.

Catanzano's work has not garnered much attention from literary critics, perhaps because with only three publications she is still at the beginning of her writing career. Tina Brown Celona is among the few critics to have engaged with the poet's writings. In her extensive review of Catanzano's first two collections, *iEpiphany* and *Multiversal*, Celona argues that the poet's work bears similarities both to the open forms of Language poetry and to Romantic poetry, which the Language poets criticised for its problematic treatment of 'pure experience' (Celona 5). According to Celona, Catanzano's different political context from the Language poets means that younger poets no longer feel the need to be suspicious of more conventional poetries and are 'beginning to investigate formerly disgraced poetic concepts and modes such as confessionalism, realism, closure, and intentionality' (5). Celona finds this openness to more traditional poetic forms in Catanzano's exploration of the subject's perception of reality, lyric address, and the constitution of a lucid lyric I, whose integrity refuses to be publicly interrogated (6, 7). Indeed, Catanzano's poetry is perhaps better described as post-Language: while her poems bear many of the markers of Language poetry, such as the openness of texts, the treatment of language as an opaque system, and the defining of poetry as an intellectual activity instead of an aesthetic one, her poems also abound in sensuous lyricism.

Catanzano's third work, which this chapter focuses on, further explores her ideas on the intersections between physics and poetry outlined in 'Quantum Poetics'. The recipient of the

Noemi Press Book award, *Starlight in Two Million: A Neo-Scientific Novella*, in contrast to her earlier books, does not look like a typical collection of poetry, in that it firstly is a novella, and secondly in that its various chapters mostly look like prose, except for the occasional section in verse. Yet, despite its appearance and subtitle, *Starlight in Two Million* is certainly not a straightforward, realist novella either. The ninety-three-page story consists of forty-four chapters or sections, varying in length from just a title and no body, to ten pages. As these chapters sometimes work as isolated sections without continuing the plot, and especially as they play with form, rhythm, imagery, lyricism, and sound patterns, all aspects of poetry, one could also argue that these chapters are not segments of a novel, but more or less free-standing poems in free verse. At the end of the volume, the poet has included an essay, entitled 'Author's Statement: An Artificial Intelligence', which presents her inspirations and reflections on her novella. It also explains that the novella illustrates her notions on quantum poetics, repeating some of the ideas expressed in the essay and posts discussed above.

As Catanzano explains in her 'Author's Statement', the book mixes many different genres, thus eschewing easy categorisation. Most obviously, it mixes prose and poetry, but it also includes elements of autobiography, science fiction, epistolary novel, philosophical treatises, and concrete poetry. It also celebrates intertextuality by referencing a novel (Alfred Jarry's *Absolute Love* and *Eploits & Opinions of Doctor Faustroll, Pataphysician*), a philosophical publication (Heidegger's *Poetry, Language, Thought*), a comic book (Peter Milligan and Brendan McCarthy's *Rogan Gosh: Star of the East*), and a book by anarchist writer Peter Lamborn Wilson / Hakim Bey, among many others (*Starlight* 103). Besides these directly referenced sources, the novella also alludes to countless science fiction stories and films through its vocabulary lifted from the genre (such as 'offworld' [1], 'multiverse' [6], and 'time machine' [18]). Catanzano's hybrid form, which she tried out for the first time in this work, her other collections being more homogeneous, can thus be described as a constellation of different forms coalescing to create an anti-realist science-fiction-y prose poetry, which is highly conscious of its own amalgamation of forms and genres. The book tells of two characters, Aletheia and Epoché, who join forces to stop a war. The pacifist message that the story conveys is that love, shown in Aletheia and Epoché's relationship, is stronger than war.[44]

So, like Morgan, Catanzano is a poet who incorporates science fiction elements into her work. However, Morgan's 'The Unspoken' and 'Spacepoem 1' are examples of hard science fiction: they describe scenes or events that either have taken place in real life – events like the

[44] The names of the protagonists play a role in this pacifist message as well: Catanzano explains that the lovers are named after philosophical concepts (99). Indeed, 'aletheia' plays an important role in Heidegger's philosophy about 'Dasein', or the nature of 'Being', while 'epoché', also an ancient Greek term, is used by Husserl to describe the bracketing off of our presuppositions, convictions, and beliefs in order to allow for a detached description of the content of consciousness ('Heidegger', 'Husserl'). By uniting two characters whose names stand for two seemingly opposed notions of ontology and who eventually stop the fictional war, Catanzano underlines the importance of a holistic approach to reality.

Moon landing and Laika's flight – or scenes that could very plausibly take place given the scientific advancements of the mid-twentieth century, or at least the scientific advancements of the foreseeable future. Morgan has many poems that fall into the latter category, such as 'A Home in Space' in which spacefaring astronauts decide to cut ties with the Earth and continue to drift in space forever ('A Home in Space', *CP* 387). Catanzano, on the other hand, writes a science fiction that is almost completely uncoupled from contemporary developments in space travel technologies. In *Starlight in Two Million* she creates a supergalactic civilisation and has her characters travel distances that are totally inconceivable given our modern technologies. She is also not interested in providing any realistic explanation of the functioning of this hyper-advanced future race. In other words, Catanzano's science fiction is a soft science fiction, in which the scientific details behind the fictional technologies are irrelevant.

Starlight in Two Million is her most reviewed book. Jace Brittain and Rachel Zavecz's collaborative review of *Starlight in Two Million* relies largely on Catanzano's own writings on her novella published with the book, praising the book's multiplicity of perspectives, nonlinearity, hybridity of form, experimental play with letters so as to imitate string theory, and its intentionally unstable characters. Cindra Halm eloquently describes the work as 'a mind-full, mine-filled, field of literary, aesthetic, scientific, and imaginative constructs', and as 'a neo-hippie, alternative-future creation myth in which space-time limitations disappear and characters forge ever-developing notions of freedom, responsibility, and relationship, in settings of nowhere and everywhere'.

In what follows, I shall concentrate on a central chapter of *Starlight in Two Million*, 'Shared Axiom'. In this chapter, Catanzano fully develops her complex metaphorical engagement with love, cosmology, and poetics. Not only has the author described this chapter as a ''pataphysical sex scene' (the word ''pataphysical' will be explained later) between the two main protagonists, but it is also here that Catanzano's recurrent metaphors of black holes to describe both the effects of a poem and the effects of a romantic relationship reach their climax ('R. U. Sirius'). The ensuing section explores the image of black holes and other distortions of space-time, which is treated as an equivalent of the fabric of the novella. In a later section, I move from an analysis of these metaphors to a discussion of how these metaphors are used and what effect they have on Catanzano's text. Comparisons to Michael Whitworth's writings about literary writers' appropriation of physics to create new metaphors and to Tom Idema's argument about the experimental nature of science fiction will help to contextualise and clarify how Catanzano's play with physics contributes to poetic innovation.

3.3.1 Black Holes and Other Distortions of Space-Time

Catanzano's story, for all its allusions to and play with theoretical physics, is above all a love story. In a universe informed by classical science fiction visions of a future featuring an intergalactic super-civilisation and easy interstellar travel, the reader encounters first Aletheia and then Epoché. Epoché spends the first part of the book trying to join Aletheia, which we learn from the letters

they write to each other. Once the two central protagonists have come together, they join forces to stop the war raging at the centre of the novella, which is also described as an 'epiphenomenon' 'fought on several fronts' at the same time (10). They do this with the help of a modified telescope, which lets them travel to faraway and abstract places, a mysterious script called 'blissymbols', a book named 'iEpiphany' (incidentally also the title of Catanzano's first volume), and a third character, later named 'The Enduring Karmanaut'. Thus, the pacifist message of the book is intertwined with its love story between the two central protagonists. In one of the final chapters, the author writes, as if surprised by the love theme in her book, 'It also seems to be a love story entering itself by performance' (85). The word 'performance' is key: rather than writing about love, offering meditations and views on romantic relationships, Catanzano has her two characters perform a love story, which has repercussions for the plot and the behaviour of the fabric of the novella as a whole. Just how this is done is the focus of this and the ensuing sections.

'Shared Axiom' is the eighteenth chapter (out of forty-four) and thus arrives more or less at the half-point of the novella. It occurs right after Aletheia and Epoché, who until then have only written to each other, have been united in Aletheia's lab. References to the body, sex, and orgasms do indeed suggest that this chapter describes the sexual union of the main characters. 'Shared Axiom' is quite different from the preceding chapters in its resistance to straightforward and closed meaning-making. Instead of advancing the plot in a realistic or narratological way, the chapter steps back from the action of the novella and explores the effects of the different forces at play at this point in the plot: cosmological principles are applied to the protagonists' relationship with each other in a study embedded in poetic experimentation. Imagery of black holes and general relativity is used to depict the influences and effects of love. The author intrudes upon the action of the novella with comments on the plot, disrupting its self-contained world, while rich and ever more complex networks of metaphors create relations between disparate areas like poetics, biochemistry, and astrophysics.

Halfway through the chapter, Catanzano arrives at this complex metaphor, connecting the notion of a multiverse to a book and to romantic relationships:

> Saying that the multiverse = book has a shape is much like saying that love has a story, which it does sometimes, though its story deforms the narrative toward a broadening event horizon. (26)

Before analysing the implications of this extravagant equation, the different elements in it need to be picked apart. The concept of the multiverse, coined by philosopher and psychologist William James as early as 1895, was developed in science fiction in the second half of the twentieth century, and has only recently been creeping into the realm of the hard sciences (Siegfried 247, 249). Physicists have long marvelled at our universe's perfect conditions for life. For example, if gravity, which in our universe is incredibly weak compared to the three other fundamental forces governing matter, were stronger by just a few units, matter would not have formed and life would

certainly have been impossible. One attempt to explain the incredible coincidence that all the universe's physical laws and features are just right to allow the existence of a planet like ours is the hypothesis of the multiverse. In this theory, there is an endless number of universes with different values for gravity, the electromagnetic force, the weak force, and the strong force. In the multiverse, there might well be a universe, or branes (higher-dimensional areas of the universe), where gravity is so strong that it collapsed within seconds after the big bang (Randall 60-61). Thus, in a rare instance where influence is directly flowing the other way and cosmology took inspiration from science fiction, theoretical physicists have appropriated the concept of the multiverse, which dwarfs our universe by several orders of magnitude.

As the rules of algebra allow the items on either side of a = sign to be switched, the multiverse is also an analogy for the book. In other words, 'the book is a multiverse'. Does Catanzano mean a specific book? In fact, there are hints that the author has her own book in mind in this instance. As already mentioned, Catanzano likes to occasionally intrude upon the action of her own novella to comment on it. For instance, a chapter simply titled 'Novella' only consists of these four sentences: 'The first person to read the novella is distraught. As if it narrates our war. I don't think we are at war. But I rewrite the novella so no one will cry' (39). The 'I' here refers to Catanzano herself and her personal life, the 'first person to read the novella' possibly being someone close to the author, whose comments made her rewrite the novella. It raises the question as to which version of the novella we are actually reading. There are more comments like this one in the novella, as for example when Catanzano remarks on the love story aspect in a line already quoted above (85). One can thus assume that the 'book' she mentions in the passage above refers to her own novella and that this is another example of the author's metafictional interferences.

What does it mean to call her novella a multiverse? Imagining the book as a multiverse implies that there are an endless number of different outcomes of the story, slightly different alternative realities where the characters have taken slightly different decisions, just as the theory of the multiverse posits the existence of an infinity of universes, all with slightly divergent characteristics from our own. Introducing thus a multiplicity into her novella, Catanzano's ninety-three-page story can be compared to the observable universe: the slim book hints at a vast depth of parallel novellas, which remain, however, not observable by the reader. The astrophysicist Lisa Randall, whom Catanzano references in 'Quantum Poetics: Writing the Speed of Light', employed the analogy of a book for the multiverse containing universes of multiple dimensions in one of her popular astrophysics books. Just like a book is a three-dimensional object made up of two-dimensional pages, so the multiverse might be a higher-dimensional object containing different universes (or branes) of fewer or varying dimensions (22). Like Randall's multiverse-book consisting of infinite layers of universes with different numbers of dimensions, Catanzano's book-multiverse is conceived of as a richly-layered text with dimensions that remain out-of-sight for the reader. Furthermore, in an interview, Catanzano uses another metaphor that is in keeping with the 'multiverse = book' image: she refers to the middle of the novella as its wormhole ('Impossible

Poems'). In that metaphor, the novella is imagined as folding in on itself so that the two halves can be joined by a tunnel, which allows the characters, author, and reader to jump to a different location and time in the novella. In the passage quoted above, then, the novella's textual fabric is represented as possessing not only depth and multidimensionality – as suggested by the notion of the multiverse and the author's metafictional intrusion – but also pliability, as the concept of the literary wormhole turns the plot into a mellow literary space-time which can bend back on itself.

These conceptions of the text of *Starlight in Two Million* are important prerequisites for the central metaphors of love to work. In the quoted passage, it is, in fact, not the metaphor of the book for the universe that Catanzano is interested in, but the shape of this equivalence. As suggested by her comment about the wormhole, the author is preoccupied with the shape of the textual space-time and how this shape can be influenced by various factors. At an earlier point in the chapter, the author writes: 'the shape of the multiverse = book is dependent on the way in which its geometry of spacetime is curved' (26). This question about the shape of the universe is related to general relativity as the curvature of space, which depends on the mass of the universe, determines its shape. Depending on the total mass of radiation and matter in the universe, its geometry might be curved like a sphere or like a saddle, or it might be flat (Gott 23-24). This also determines whether the universe is finite or infinite (Gott 24). What do the image of the multiverse, the shape of the universe, and the curving of space-time have to do with love, which is at the centre of 'Shared Axiom'? The shape, or topology (the mathematical discipline of defining shapes in non-Euclidean and higher-dimensional geometries), of the universe matters here because the equations Catanzano creates in this chapter establish the novella ('book') as commensurate to the universe: just like the universe's space-time is shaped by matter and radiation, the novella's space-time is influenced by its contents (its characters, human or other, and plot), by the love story at its centre.

When Catanzano writes, 'Saying that the multiverse = book has a shape is much like saying that love has a story', the equation becomes more complex. On one side of the equation, the author places the idea that the multiverse, which is equivalent to the book, has a shape, while the other side of the equation describes the notion that love has a story. The second half of the sentence complicates the statement about love having a story further: 'love has a story, which it does sometimes, though its story deforms the narrative toward a broadening event horizon' (26). The 'broadening event horizon' is a feature of black holes. It describes the boundary marking the limits of a black hole at which the escape velocity, or the speed an object would need to escape from the black hole, exceeds the speed of light. The name 'event horizon', poetic in itself, derives from the impossibility of observing any events taking place close to the singularity from outside the event horizon. As light itself is engulfed by a black hole, the singularity cannot be observed. A black hole forms in regions of space-time where the gravitational force is so strong, because matter is extremely compressed, as to attract everything, including light (Gott 203-204). Saying that a love story can act like the event horizon of a black hole, swallowing everything in its path and dramatically warping the space-time of a story, is quite a vivid rendering of love as a powerfully

destructive force. It is imagined as so dense and massive as to annihilate all matter and light, or characters, in its path.

The image of the black hole is a recurrent one in *Starlight in Two Million* and its rich metaphorical functions are exploited fully throughout the novella. For example, in one of the epistolary chapters, Aletheia tells Epoché that '[b]lack holes are a site where information disappears from perception, never to be redistributed in any detectable form' and that they are an 'endpoint of spacetime' (7). In a later letter, Epoché exhorts Aletheia to '[f]irst, locate the poem's equator' and then to '[f]ind the black hole at the center of its galaxy' (18). The first image suggests a more conventional conception of black holes, that of the total inaccessibility of information that has fallen into the black hole. The second mention locates these singularities at the centre of poems. As already discussed, Catanzano likes to transfer physical phenomena into her poetry and to imagine fictional texts as being governed by the same cosmological laws as objects on astronomical scales. Here the author applies this nihilistic cosmological phenomenon to poetry: there seems to be a point in a poem, perhaps not easy to find, that swallows up information, 'never to be redistributed in any detectable form'. What could that possibly entail for a poem? Is a poem to be understood as a similarly dynamic and unstable system as a galaxy, swirling around a super massive black hole in its centre?

Catanzano is not the first poet to use the figurative implications of black holes in her poetic writings. kitt price (then writing as Katy Price) analyses William Empson's astronomical poetry in the context of a study of the popular and literary response to developments in physics and cosmology at the beginning of the twentieth century. *Loving Faster than Light* makes a case for the appearance of the notion of a black hole in a poem before its theorisation in astrophysics. In 'Letter I' (1935), Empson, who is primarily known for his *Seven Types of Ambiguity*, imagines what might happen to a star like the sun if it became impossibly dense:

> Our jovial sun, if he avoids exploding
> (These times are critical), will cease to grin,
> Will lose your circumambient foreboding;
> Loose the full radiance his mass can win
> While packed with mass holds all that radiance in
> Flame far too hot not to seem utter cold
> And hide a tumult never to be told. (*Collected Poems of William Empson* 20-21)

price recognises in the last line an image of a star so incredibly massive and dense that it swallows up, or 'hide[s]', all matter, or 'a tumult never to be told'. According to price, Empson combines in one image two hypotheses in theoretical physics: a hypothetical massive dense star that might cause 'space [to] close up round the star', postulated but subsequently dismissed as an absurd scenario by astrophysicist and Einstein populariser Arthur Eddington, and speculations about our sun's future as it turns into a white dwarf at the end of its life (183, Eddington qtd. in price 178).

That this notion of impossibly dense and massive stars, defeating the laws of physics, was ruled out-of-bounds by a leading astrophysicist appealed to Empson, 'whose love life tended to run against convention', and who used it in his love poetry (161). The poet composed verse in which he exploited the implications and imagery associated with these cosmological singularities, resulting in desperate love poetry lamenting the loneliness and disconnection from the object of his desire. price argues:

> the theory itself [the theory of relativity] offered metaphors for intense disconnection. The banished lover's predicament in the "Letter" is "too non-Euclidean" because, like a particle traveling faster than light, his passion has worked to "crumple up round itself the whole of space-time". He is now wrapped up in his own private universe, closed off from any contact with others. (176, quotes from Empson's notes)

Thus, the metaphor of the impossibly dense star, swallowing up all of matter and radiation and bending space-time in on itself, has connotations of extreme isolation for the poet. price argues that these love poems were addressed to a heterosexual male friend with whom Empson, a bisexual man, was in love. The singularity of space-time was thus well-suited to represent the lover's feeling of disconnection from others and from the object of his desire.

If Empson was struck by the implications of isolation and loneliness inherent in black holes, Catanzano uses different connotations of these cosmological singularities in *Starlight in Two Million*. In fact, Catanzano is less interested in black holes themselves than in how they affect space-time, how they shape the space, or novella, around them. She writes: '[a love] story deforms the narrative toward a broadening event horizon' (26). In other words, the love between two characters distorts the plot, or the 'narrative', as the event horizon of a black hole warps space and time and matter in the universe. While to Empson the 'closing up of space round' a black hole signified isolation and disconnection, this occurrence in space has an altogether more sinister and destructive flair in Catanzano, even if only in the world of the novella (price 184). The poet suggests that a love story must necessarily deform the plot in which it is set through its physical properties. This is indeed what happens: the powerful love story between Aletheia and Epoché, who are finally united in chapter eighteen, has strong repercussions for the novella. In 'Shared Axiom', in which the two central characters presumably sleep with each other, the plot is warped, dilated, sped up, and even torn apart. None of the characters or places important in the novella are mentioned in this chapter. Furthermore, as the chapter mixes references to black holes with mentions of the objects of study of microbiology, 'Shared Axiom' could be described as a literary wormhole taking the reader from the infinitesimally small microcosm of DNA strands to the unfathomably vast macrocosm of the multiverse and its various dimensions. The extreme warping of the space-time of the novella is also symbolised in the fact that there is a tear in the fabric of the novella when the author herself intrudes to comment on the shape of her book. So, to return to my question above – is poetry to be understood as a similarly dynamic and unstable system as a galaxy,

swirling around a super massive black hole in its centre? – Catanzano's treatment and experimentation with literary and poetic form seem to suggest that the answer to that question is 'yes'. The comparison is in keeping with the principles of Language poetry and Hejinian's open text: a poem, or other literary text, is not under the author's control; on the contrary, its own properties – such as black holes lurking at its centre – could overwhelm or even destroy the poem. Catanzano's conception of literary texts as dynamic texts possessing depth will be analysed in more detail in the next section, which will discuss the rich metaphorical layers in 'Shared Axiom'.

Of all the twentieth-century developments in cosmology and astrophysics, none have kindled the collective imagination as much as black holes. Their ominous and slightly threatening character has spawned countless science fiction novels, films, board games, computer games, a British punk band, a rollercoaster, rock-band songs, and a *The Simpsons* episode.[45] In the first science fiction novels appearing soon after black holes were theorised in the late 1960s, and after they received their name by John Wheeler in 1967, writers often made a link between black holes and psychological processes (Hawking, *Black Holes* 16). Then, in the 1970s, the threatening nature of the mysterious and unknowable black holes was emphasised in science fiction scenarios involving intelligent black holes. Later on, black holes became tools for travelling vast intergalactic distances, in which they essentially played the roles of wormholes ('black holes'). Thus, combining love with black holes and event horizons, as Catanzano does in *Starlight in Two Million*, not only suggests that love is a massively dense and destructive force bending lovers' lives in on themselves, but that love also receives the amoral and sinister characteristics of a mysterious alien intelligence, as suggested in tales like Charles Sheffield's *Proteus Unbound* and Gregory Benford's *Eater* (both novels containing intelligent black holes ['black holes']). Catanzano's poetic black holes are thus richer images than the proto-black hole employed by Empson. Empson's 1935 image did not yet exist in the cultural imaginary, so that he could not play with the fantastic associations of these objects.

What do these images entail for love, the central theme of the chapter? Firstly, as demonstrated above, the love story between two protagonists bends the fabric or the space-time of the narrative, threatening to tear it even when the author intrudes upon the plot with metafictional comments. Catanzano admitted in an interview that *Starlight in Two Million* was written after she experienced a loss of love in her personal life ('Impossible Poems'). In that regard, employing the powerful image of a black hole to write about love also suggests that her personal love story had a disruptive, maybe even distorting, effect on her life. As the poet writes in the 'Author's Statement' that *Starlight in Two Million* is partly autobiographical, one can assume that the love story in the novella is entangled with the destructive side of love, which, in turn, might have motivated the

[45] See for instance Mark Steven Grove's film *The Black Hole* (2016), Gary Nelson's film *The Black Hole* (1979), *Black Hole*, a board game developed by Metagaming Concepts, *Blackhole*, a 2015 video game by FiolaSoft Studio, 'Supermassive Black Hole' by British rock band Muse, and *The Simpsons* episode 'Treehouse of Horror XXIII' (2012).

choice of the powerfully destructive and threatening image of the black hole (100). Secondly, as a side note, Catanzano's emphasis on non-straight geometries, in the insistence that '[l]ove is like curving', also possibly presents a comment on LGBTQ rights (26). Straight lines, binaries, and rigidity are overthrown in favour of curves, multiplicity, and fluidity, indirectly celebrating non-heteronormative versions of love. Thirdly, the implications of a black hole are the total absence or annihilation of matter and information: a black hole swallows up matter and radiation, which disappear from the universe forever.[46] A black hole in poetry, then, entails the absence of signification, of meaning. In this, Catanzano's treatment of love is very close to Morgan's. Both poets use astronomy and cosmology to represent love as reeling on the fringe of the unspeakable, the '[u]nspoken', of the absence of all information and signification. At the centre of a black hole, at the centre of a love story, lies a phenomenon that cannot be put into words; it is a poetic singularity. Like Morgan's love, which stays 'without a name to the end', Catanzano's conceptions of love are ultimately '[u]nspoken', unable to be put into words (Morgan, *Collected Poems* 182-183). Like other poets in this thesis, Morgan and Catanzano appropriate gaps in astronomical knowledge for poetry, a medium which is comfortable with the double nature of language as both a universal and real system and a slippery phenomenon transcending the poet.

The idea that love dismantles language like a black hole dismantles space-time, that love lies outside of language and remains '[u]nspoken', returns in a later chapter in *Starlight in Two Million*. 'Aftermaths/Beginnings' takes place right after the main protagonists enter the war. The title hints at the dissolution of linear time, a motif of the novella, so that it is not clear, and perhaps also irrelevant, where in the story the characters now are. The chapter abandons the characters of the novella and instead is written in the voice of a first-person speaker, whom the author identifies as an 'authorial I' ('Author's Statement' 100). The letters of the words in this chapter are spaced out, tearing the words apart and forming new words with other letters. Over the course of laborious lines of speech – laborious both for the speaker as she has a tendency to interrupt herself and not to finish her thoughts as if they were difficult or painful and for the reader as the spaced-out text is challenging to read swiftly – the authorial I speaks of personal disappointments: 'I f ell apart . . . asking how can that be?' (57). The last page of 'Aftermaths/Beginnings' is composed entirely of four letters: 'l', 'o', 'v', and 'e'. Yet, these four letters, which are strung together in different orders, never meet successfully to spell 'love'.

On the one hand, this orthographic and semantic failure implies that love has disintegrated, or that it is no longer possible in the aftermath of war. On a semantic level, it also suggests that love, quite literally, cannot be put into words, or even into one word. This is the sense I discuss above: whatever mystery lies at the heart of a love affair cannot adequately be put into words. It is like Morgan's love – '[u]nspoken'. On the other hand, the long succession of 'l', 'o', 'v', and 'e',

[46] It is, admittedly, not strictly accurate to say that nothing can escape from a black hole as Stephen Hawking calculated that a black hole emits particles and radiation. This effect became known as 'Hawking radiation' (Hawking, *Black Holes* 30).

which never form a recognisable word, also suggests the unlikeliness of encountering love in the modern universe. In a novella inflected by a substantive knowledge of cosmology, one could argue that this failure of the four letters to spell ‘love’ in this random jumble of letters is an approximation of the theory of the multiverse. As explained above, the multiverse is a hypothesis that helps to explain how it is possible that our universe, with its accumulation of incredible coincidences which favour the emergence of life, exists, and not any other universe with slightly different values. Thus, the universe of ‘Aftermaths/Beginnings’ is one where the letters composing ‘love’ never successfully meet and thus never spell out the word. It describes a universe, a part of the multiverse, in which the physical laws are unfavourable to the emergence or existence of love.

Another reading of the last page of ‘Aftermaths/Beginnings’ offers itself too. In an interview, Catanzano says that ‘Aftermaths/Beginnings’ is an homage to bpNichol’s poem ‘Blues’. ‘Blues’ is one of the Canadian poet’s visual or concrete poems, for which he was famous:

```
          l       e
          o   e
      l o v e
      o     e v o l
l o v e     o
      e v o l
   e    o
e       l
```

(qtd. in Wershler-Henry 16)

bpNichol’s poem presents a constellation of the word ‘love’ written eight times. The different positions of the word are interlinked in such a way that the vowels each occur eight times, while there are six ‘l’s and only four ‘v’s. The shape of the poem resembles a spark or a twinkling star, perhaps hinting at the chemistry that lovers are stereotypically said to feel. The ascending line of ‘e’s in the middle creates an axis of symmetry: the two halves to each side of the line consisting of ‘e’s are mirror images. The symmetry governing the poem has provocative implications for the mirror image of ‘love’: spelled backwards, ‘love’ is very close, at least phonetically, to ‘evil’. The poem suggests that the mirror image of love, just a short distance from the supposedly elevating emotion, is something destructive or morally reprehensible, or perhaps even dangerous.

How does bpNichol’s visually playful riff on ‘love’ enrich the reading of Catanzano’s mangled repetition of the word? While ‘Blues’ delights through its symmetrical architecture, both in the typography and in its suggestion of a mirror image of love, the last page of ‘Aftermaths/Beginnings’ is marked by chaos and semantic failure. While ‘Blues’ plays with the significations of love by turning it around and with the idea that ‘love’ is a symmetrical word in that it consists of two pairs, which each consist of a consonant and vowel, Catanzano’s treatment of ‘love’ shows the feeling in a more hopeless light in that it deconstructs the word to its building blocks, which are then reconstructed to build new sequences of letters, which nevertheless do not form words, or at least not English words. Love is shown as simply not being possible in this

world, whether because it only exists at the core of space-time singularities like black holes or because our local universe does not contain the properties necessary for love to emerge. Whereas Morgan celebrates love in spite of (or perhaps because of) the impossibility of rendering it in words, Catanzano's engagement with love is more nihilistic: if language fails to describe love, does it then still exist? Catanzano's 'Aftermaths/Beginnings' suggests the answer to this is 'no'.

3.3.2 Pataphorical Interrelations

What are the implications of Catanzano's complex, innovative, and interweaving metaphors and their workings for poetic language? In what ways does the poet conceive of a new relationship between poetics and physics? No other poet analysed in this thesis has so thoroughly sought to bring physics and poetry together, both on the level of content and form, as Catanzano. That is why her complex metaphorical interrelations – astronomical objects' effect on cosmological space is equated to a plot device's effect on literary writing – warrant more comment and a comparison to how critics have conceived of these relationships in other writers. This is what I intend to do in this section.

In the previous section, my analysis was focused on metaphors describing love and thus neglected the rich entanglement of complex metaphors in 'Shared Axiom'. The chapter starts with a speculation of what might happen 'when an *a-quark* couples with a *b-quark* in the poem', mixing poetics with subatomic physics. In *Jacket2*, Catanzano explains that she relied on the final chapter in Richard Feynman's book, *QED: The Strange Theory of Light and Matter*, for the language in 'Shared Axiom' ('Coupling'). The book, which is usually commended for its mathematical detail packaged in a popularisation of physics, is based on a series of lectures Feynman gave to a nontechnical audience at UCLA in the mid-1980s. As the title suggests, the book explains quantum electrodynamics (QED). The last chapter is less about quantum electrodynamics than about the nuclear forces and the plethora of subatomic particles that have been discovered and how they all fit into modern nuclear physics. Phrases such as 'when an *a-quark* couples with a *b-quark*' are partly taken from this chapter. While no 'a-quark' is mentioned by Feynman, he does mention the 'b quark', with 'b' standing for 'beauty' and describing a flavour a quark can have (146). 'Shared Axiom' then builds on these terms, partly lifted from physics and partly invented by Catanzano, and combines them with ever more varied imagery, culminating in the complex and mutual metaphors of the poem for the universe, the book for the multiverse, the body for the poem, and the universe for the body:

> Thus, the equation, the image, the story, or the poem that has as its degenerate era a coupling ∞ expresses its orbital path as if such a path is taking place in a solar system – character-planets revolving around a story-sun. Which is to say that the solar system as a controlling conceit for the body might be more useful to the coupling ∞ as a function of astronomical space ≠ its subatomic counterpart in molecular space. (25-26)

The mixture of images taken from physics and literature points to the root of Catanzano's beliefs about how physics and poetry can fruitfully interact. In what follows, I will explain that Catanzano's intersections of cosmology and poetry are not merely based on metaphor, but on the allegorical implications of the images employed by astrophysicists, before explaining how these formal innovations in poetry are related to Catanzano's depictions of love and sex in *Starlight in Two Million*. As reviewers Brittain and Zavecz argue, the superposition of these metaphors – the poem is the universe is the body is the poem – is an example of a pataphor, the 'pataphysical metaphor, which is 'essentially a metaphor of a metaphor (and so on) which abandons its first tenor' ('Collaborative Review'). Firstly, what is 'pataphysics (the apostrophe is part of the name)? As mentioned above, Catanzano also refers to 'Shared Axiom' as a ''pataphysical sex scene' and calls Aletheia and Epoché's union a ''pataphysical response to war' (*Starlight* 99, 'Coupling'). ''Pataphysics' is a word that French proto-surrealist writer and dramatist of the Absurd Alfred Jarry coined at the end of the nineteenth century. Jarry's avant-garde ideas about poetics and literature became widespread after he died in 1907. Over the course of the twentieth century, his experimental writings gathered a cult-like following, with the Collège de 'Pataphysique having over one thousand members, including Umberto Eco, and the London Institute of 'Pataphysics counting one hundred fee-paying members (Corbyn). A pseudo-science that delights in paradoxes and irrationality, it counts among its students artists such as Samuel Beckett, Jean Baudrillard, John Cage, Jorge Luis Borges, the Marx Brothers, Gilles Deleuze, and James Joyce (Hugill).[47] Catanzano references Jarry directly several times in the novella, by naming various chapters after Jarry's writings (the chapters 'How to Construct a Time Machine' and 'Let There Be Love' are examples of this). She herself defines 'pataphysics as the 'science of imaginary solutions, where improbable, imaginative hypotheses are more fruitful to investigations of reality than ordinary, verisimilar approaches' (*Starlight* 99). That Catanzano identifies as a pataphysician is unsurprising, given her fascination with the imaginative possibilities that theoretical physics and cosmology open up, which is also a preoccupation of 'pataphysics. It also aligns her with a tradition of experimental and surrealist writers whom she admires.

Now that 'pataphysics has been explained, we can move on to 'pataphorical'. American writer Pablo Lopez invented the term 'pataphor', based on Jarry's 'pataphysics. On his own website, Lopez defines the pataphor thus: 'As Jarry claimed that 'pataphysics existed "as far from metaphysics as metaphysics extends from regular reality," a pataphor attempts to create a figure of speech that exists as far from metaphor as metaphor exists from non-figurative language'. Lopez

[47] Roger Shattuck's definition of 'pataphysics in his introduction to Jarry's *Faustroll* chimes with Catanzano's and adds to it the role that poetry and love play in this context: 'pataphysics is the idea that 'the virtual or imaginary nature of things as glimpsed by the heightened vision of poetry or science or love can be seized and lived as real' (ix). In his doctoral thesis on Jarry's 'pataphysics, the Canadian poet Christian Bök argues that Jarry's pseudo-science 'synthesizes the romantic schism between a literal, scientized discourse and a figural, poeticized discourse' and identifies among his followers the Italian Futurists, the French Oulipians (who also founded the Collège de 'Pataphysique), and the Canadian 'Pataphysicians' (iv).

cites string theory as an example of a mathematical pataphor because 'as string theory is speculation based on ideas that are *themselves speculative* (in this instance, theories of general relativity and quantum mechanics), string theory is not in fact physics, but 'pataphysics'. Catanzano's complex metaphorical system of a body, a poem, and the universe can indeed be described as an example of pataphor in that it does not merely compare two models or systems, but three, along with all their implications, terminologies, and functions.

Paradoxically, in her writings, Catanzano does not seem interested in metaphorical relations between the hard sciences and poetry. In one interview, she even claims that the intersections between the sciences and poetry according to her convictions are not to be understood as merely metaphorical connections: 'Seeing poetry as a shorthand, a wormhole, a warp drive capable of moving space and time around it is one of my bolder claims in quantum poetics because I'm not just figuratively speaking' ('Impossible Poems'). If Catanzano does not mean the figurative implications of comparisons between cosmology and poetry, what other similarities or connections could there be? The relation between such apparently unconnected areas as the natural sciences and literature can also be described as allegorical or as analogical, the latter playing an important role in scientific research, as the next chapter of this thesis will demonstrate. Catanzano's definition of the relation between these two fields is based on allegory: she is interested in how various aspects of scientific concepts point to new ways of conceiving literary practice. Yet, Catanzano's interest in the application of physical phenomena and hypotheses to poetry diverges from other kinds of writing that draws on the hard sciences.

How does Catanzano's practice differ from critics' engagement with poetry and physics or astronomy? In *Einstein's Wake*, already discussed in the introductory section in Chapter One, Whitworth explains that the parallels between the two areas of activity are to be found in the use of metaphors circulated by science popularisers. These metaphors are then consciously or subconsciously employed by the modernist writers of the period (3-4). The metaphors that the physical sciences of the early twentieth century engendered and that slowly crept into literary works included the curvature of space, entropic leakage of energy, the porosity or translucency of matter, fields of force, and the depths of non-Euclidean geometry (234-235). Whitworth relates the form of T. S. Eliot's *The Waste Land* to non-Euclidean geometry. He justifies this comparison by the abundant allusions and metaphors, and the intertextuality of *The Waste Land*: 'The literal utterance is characterized as an unadorned flat surface, while the metaphorical utterance is characterized as a decorated or curved surface' (220). The adjective 'curved' encourages one to link this statement to Catanzano's poetic engagement with curved space-time, which is also achieved through many layers of metaphors super-imposed upon one another. However, Catanzano is not merely interested in the abstractions of metaphors or ideas in physics, such as electromagnetic radiation and black holes, but the physical features themselves. In her radical juxtapositions and complex layering of metaphors upon metaphors in 'Shared Axiom', for

example, she claims to be interested in the fundamental and literal implications of the hard sciences for poetic writing.

Tom Idema reads science fiction as biotechnological research in itself. He believes that some science fiction novels present attempts to think with the sciences, rather than about the sciences, about the future of the human species (38). This can be done because science fiction is interested in the potentials of science, which offer themselves for literary experimentation as literature is free from the methodological or disciplinary restraints of the sciences. This type of science fiction also develops new types of narrativity as the narrative is guided by and based on particular physical or biological environments, which no longer merely serve as the, albeit spectacular, backdrops of human interactions (45-47). In that sense, Idema calls science fiction works 'experiments with human subjects and their habitats', instead of just being 'experiments by human subjects' (50). Idema concludes that speculative writing can contribute to 'reciprocally problematizing the sciences and humanities, producing "gatherings" of human and nonhuman actants, and moving beyond the modern categories of subjectivity and objectivity, mind and matter, nature and culture' (59).

Idema's ideas on the roles of literature are close to the relationships between the sciences and poetry that Catanzano develops. Catanzano sees her poetry as thinking along with the sciences rather than merely commenting on them. Peter Middleton explains that poetry that only reacts to scientific developments, while potentially engaging and insightful, sees itself as playing 'a secondary role, as if the poet were a columnist responding to the discoveries publicly announced by scientists, adding his or her own reflections on the likely social and aesthetic impact of those findings, whose scientific and epistemological veracity has to be conceded to the sciences' (*Physics Envy* 39). Catanzano's continual and passionate turn towards physics and cosmology for her poetic material without any scepticism towards the hegemony of the sciences as the sole authority over the natural world might suggest that the resulting poetry is the kind of poetry Middleton describes as playing a secondary role with regard to scientific investigation. Yet, while she admires scientists and the scientific method, her turn towards physics and cosmology also serves a poetical goal: the writer alludes to scientific developments, cosmological phenomena, and physical hypotheses to develop a new avant-garde poetics and to guide her innovations in language. The principle behind gravity as it is described in Einstein's general relativity, the principle of quantum theory with its inherent uncertainty as to the momentum or position of a particle and the notion that an observer changes reality, the liberating and potentially democratic idea behind the multiverse, to name but a few, all kindle her imagination and are in keeping with her politics, which is translated into a poetics that celebrates multiplicity, openness (the absence of closure), the giving up of authorial authority to the reader, nonlinearity, simultaneity, and a shaking up of literary or poetic conventions. In other words, Catanzano turns towards modern developments in physics and cosmology to develop a poetic form that better reflects the modern world, a poetic form that no longer relies on linearity, a small and comprehensible and mechanical universe, an ordered and

intuitive subatomic world, but that instead complicates reality, and, as a consequence, the writing and reading of poetry. Above all, in *Starlight in Two Million*, the author turns to cosmological principles and phenomena to describe the effects of love on a plot, and, by implication, on the lives of two lovers.

What is the effect of the complex network of metaphors (connecting the multiverse to the book, and the book to the body, among others) which conflates various areas of scholarship and research to represent a love scene? Is Catanzano simply looking for new metaphors to describe love in the modern world? What distinguishes the multiplicity of metaphorical relations in this chapter from the metaphor of the 'trepidation of the spheres' to refer to the two lovers' faithfulness in John Donne's 'A Valediction: Forbidding Mourning', or Morgan's use of the Sputnik missions to describe his feelings about his romantic relationships (38)? As 'Shared Axiom' shows, what is different or innovative about Catanzano's use of multiple metaphors and complex metaphorical relationships to write about love and sexual attraction is the complexity of the sciences that Catanzano's metaphors imply. The model of the solar system to describe the inside of an atom has been overhauled with the advent of quantum mechanics. The implication is that sexual attraction, which is one of the dominant themes in 'Shared Axiom', it being a 'pataphysical sex scene, is more complex than Newton's mechanical theory of gravity, which keeps the planets of a solar system bound to each other. Instead, the much less well-understood laws governing the subatomic world in quantum mechanics or the astronomical scales of intergalactic space, Catanzano hints, are better suited to providing an analogy for sexual attraction and love. The indirect reference to the subatomic world with its counterintuitive behaviour and realities in a chapter (or poem) about love suggests that love cannot be described using only classical physics. If Catanzano's study of love, drawing parallels to developments in cosmology, is accurate, then she is implying that our understanding of love grows as our understanding of the cosmos grows. It is in this sense that Catanzano's poetry and fiction raises questions and even performs literary research that she does not address in her essays and interviews. While her essays overemphasise the importance of the sciences and the imaginative possibilities that arise from concepts like string theory and the multiverse, her poetry studies concepts that are rarely studied by the hard sciences. By drawing parallels between love, poetic and literary form, and Einsteinian physics, Catanzano implies that love is a dynamic emotion, warping and bending lives and perspectives.

3.4 Conclusion: Physics, Space Travel, and the Ineffable Nature of Love

The examples of Morgan and Catanzano demonstrate that modern poets continue turning towards celestial objects and cosmological phenomena in their pursuit of new ways to write about love. However, unlike Donne, who resorts to astronomical metaphors to express or describe his love – Donne compares the stability of his marriage to the constancy of planets – Morgan's and

Catanzano's engagement with astronomy and the cosmos is more complex than merely metaphorical. As I have shown in this chapter, Morgan juxtaposes Laika's space voyage aboard Sputnik 2 with scenes taken from his private life and romantic relationship with Scott. Instead of drawing any direct parallels between the different episodes described in the poem, as a metaphor would, Morgan abstains from commenting directly on the juxtaposition of Laika and the intimate scenes depicted in the poem. In Morgan's poem, Laika's spaceflight symbolises various ideas.

Firstly, the ambivalence surrounding the historical event, which was met with consternation and excitement, complemented the ambivalence in Morgan's personal life, which was marked by both intense moments of happiness and fear of being found out. Secondly, there are hints in 'The Unspoken' that the speaker envied Laika, who had the chance to venture into outer space, which appears as almost liberating compared to the homophobic Scotland that the poet lived in. Lastly, the interlude of Laika's spaceflight in a poem titled 'The Unspoken' underlines the difficulties of communication. There is a parallel between the silence surrounding same-sex relations in 1960s Glasgow and the silence (in the sense of the absence of language) of space. Not only is outer space a quiet place, except for the pulsating beeps that came to be associated with Sputnik, but communication with astronauts, whether human or canine, is not straightforward. One of the first sentences spoken in outer space and relayed to the Earth – Neil Armstrong's famous 'That's one small step for man, one giant leap for mankind' – is in fact not what the astronaut said. The original utterance was, 'That's one small step for a man', which also makes more sense. The indefinite article, however, was lost in the transmission of the message to Earth, which underlines how fallible and unreliable communication is in space travel ('A Small, Belated Step'). When the astronaut is a dog, communication is even more challenged. Morgan exploits this difficult aspect of space travel and astronomy in his lyric addressed to Scott, whose declaration of love can only be an indirect declaration, hidden behind 'stolen glances' and 'accidental . . .' 'grazes'.

Catanzano, likewise, has insisted that she is not interested in merely metaphorical relationships between the hard sciences and poetry. Instead, she turns towards the sciences to guide her innovative experiments with form, and, simultaneously, to describe the effects of love. Rather than using a black hole as a straightforward metaphor for love, Catanzano pataphorically uses the black hole as a literary device in her treatment of love. In other words, rather than directly writing 'love is a black hole', the poet chooses to represent love as functioning like a black hole: it influences, stretches, bends, curves, and even threatens to tear the fabric, or the space-time, of the novella. Furthermore, Catanzano's recurrent use of the image of the multiverse suggests that our cosmology, in the philosophical sense, has changed as much in the last 120 years as Donne's contemporaries' cosmology had as a consequence of the Copernican revolution.

Where Morgan and Catanzano converge in their use of astronomical and cosmological concepts to write about love is in the suggestion that love is situated in a realm beyond language. As mentioned above, Morgan's 'The Unspoken', through its structure which is characterised by delay and hesitation, performs the taboo of homosexual love. His romantic and sexual relationships

are censored, both by Morgan himself through the avoidance of the masculine pronoun in his poem about Scott, and by society, which did not accept homosexual relationships yet. As explained above, this taboo, this silence surrounding queer love and relationships, is equalled to the silence invading the cosmos. In *Starlight in Two Million*, too, Catanzano plays with the verge of language. The black hole motif Catanzano uses for love and relationships complements the suggestion of the break-down or impossibility of language and communication: as a black hole swallows up all information, communication is no longer possible and love becomes '[u]nspoken'. The fact that black holes remain areas of space-time where the universal language, mathematics, breaks down too, as it is described as a singularity where the existing physical laws stop making sense, describing love as a black hole suggests that love ultimately remains outside of our comprehension and of any known physical laws. It, being equalled to a black hole, is a singularity; and as such love escapes understanding and remains ineffable.

Chapter 4 The Poetry of Astronomers, the Astronomy of Poets

4.1 Introduction: The Roles of the Imagination

So far, this thesis has analysed relationships between cosmology and poetry that are oriented more towards poetry than cosmology or astronomy; all of the poems discussed at this point were written by people with a background in the humanities, even though they may have been more or less well informed about the hard sciences. In this chapter, I shall analyse the poetry and views of the cosmos that emerge when an astronomer writes verse. Truly interdisciplinary poets who are also trained scientists are rare in the twentieth century, and so is critical engagement with their work.[48] Helen Small is one of a few critics who have discussed the poetry of professional scientists. In her discussion of the poetry of two practising scientists, immunologist Miroslav Holub and chemist Roald Hoffmann, she analyses the relationships between poetry and science established in their poems. She finds that many of Hoffmann's poems play out imaginary conflicts between the sciences and poetry and argues that poetry always wins the argument by for example stressing the superiority of complexity and imprecision, a feature of poetry rather than mathematics, over elegance of expression and concision (29-30). In Holub's poetry, on the other hand, she discerns a certain surrealism that his loyalty to scientific knowledge and attitude lends his poetry. She also engages with Holub's own argument in his essay on the differences and interactions between science and literature, called 'Rampage, or Science in Poetry', in which the poet argues that the hard-centred scientific mentality acts as an 'anchor in the high seas of feelings, sympathies, hates, impressions, and memories' (23). Small adds to Holub's assessment of his poetry the idea that just as the science anchors the poem, the poem also anchors the science by underlining the ephemerality of scientific theories and truths (37).[49]

Peter Middleton admits to the difficulties of writing precisely and definitively about the contributions of poetry to knowledge because '[m]ost of the terms of praise for poetry – imagination, fictiveness, play, deconstruction – are formulations of negativity' ('Strips' 957). Indeed, imagination is defined as *not* being bound to fact or truth, as the ability to create mental images that are *not* real. As such, it is defined as the opposite of reality, truth, and fact. However, this view of the imagination downplays its significance both in poetry and science. While it is true

[48] Apart from Rebecca Elson, Italian chemist Primo Levi, William Carlos Williams, who as a physician was not technically a scientist, Miroslav Holub, and Roald Hoffmann, discussed in this chapter, count among the most well-known poet-scientists of the twentieth century.

[49] Parts of this chapter have been published in the *Journal of Literature and Science* in 2019 (Heuschling, Sophie. '"Don't Ask the Questions You've Been Taught by Science": Rebecca Elson's Astronomical Poetry'. *JLS*, vol. 12, no. 2, 2019, pp. 43-61) and have been submitted as 'Travail de Candidature' in Luxembourg as part of secondary school teacher examinations.

that the imagination and scientific fact can be antithetical, it is often the imagination that has led to scientific truth, that even permits scientific investigation. This is the contention, for example, of philosopher of science Paul Feyerabend, who insists on the fundamental role of the imagination, of original and creative thinking, in scientists' ability to formulate ideas and hypotheses that even go against the current scientific paradigm. His ideas will be further analysed below.

In this chapter, I will demonstrate the usefulness of the imagination in astronomical poetry: poetry offers a breeding ground for fruitful metaphors and analogies, which can contribute to astronomical research, and it can fulfil the role of thought experiments, which are particularly useful in a science which studies objects as intangible as dark matter and distant galaxies. While the imagination is doubtless important in any science, it plays an essential role in astronomy and astrophysics, which largely deal with invisible objects and forces, or with phenomena that, in their abstractness, defy our understanding, such as the big bang, dark matter, or dark energy. Such abstract and highly mathematical objects require similes and metaphors before even specialists can visualise or comprehend them.

If the preceding chapters of this thesis discussed poems that presented various views on the cosmos and astronomy, poems that at times accuse scientists of being too materialistic or unimaginative (as in Alexander), or that appropriate astronomy and astrophysics for legitimate poetic and formal experimentation (as in Catanzano), or that even reject astronomy altogether in favour of science fiction (as in Smith), this chapter should be seen as presenting a response to the preceding chapters by an astronomer. In this final chapter, the example of a poet-astronomer will help to show how poetry can be credibly employed in research, rather than focusing on how astronomy can be appropriated by poets. Elson, who worked as an observational astronomer at the Cambridge Institute of Astronomy in the 1990s, researched stellar formation and evolution and, of all the scientific teams working with the Hubble Space Telescope, her team was allotted the largest portion of time for the use of the telescope (Hill). This chapter will demonstrate that, contrary to some portrayals of scientists in popular culture and some of the poems discussed earlier in this thesis, astronomers are not exclusively preoccupied with data and computer software, even if those do indeed play an important role in their daily tasks. In fact, I shall show that astronomers and astrophysicists, perhaps more than other scientists, are in need of visual metaphors and analogies to conduct valuable research and do good science. The use of appropriate and original analogies requires an active imagination. These activities – forming metaphors and thinking creatively and imaginatively – are also the domain of poetry. It is in that sense that astronomy and poetry are in fact complementary disciplines, as I shall argue throughout this chapter. In what follows, the arguments of two philosophers of science, Paul Feyerabend and Mary Hesse, about the importance of unconventional methods in science and creativity, and about the primacy of analogies in science, will help to underpin my argument about Elson's poetry and astronomical research. Insights into how astronomical research is conducted will further help to underline the similarities between the two fields. Before delving into Elson's work, this chapter includes a section on other (historical and

contemporary) poet-astronomers, the examples of whom will serve to provide a narrative for Elson's interdisciplinary work. The last sections of this chapter are devoted to close readings of Elson's poems.

4.2 Poet-Astronomers

The case of poet-astronomer Rebecca Elson has a few, though not many, precedents. Before the nineteenth century, when the different areas of knowledge and cultural activity had not yet splintered into highly specialised disciplines with little, if any, exchange between them, polymaths who studied the heavens while also writing verse were more common. Tycho Brahe and John Herschel fall into this category. The Roman poet and philosopher Lucretius would sometimes be considered to belong to this list, too, because his only surviving work, the long didactic poem *De Rerum Natura*, presents a cosmology in verse. However, despite the lasting influence of Lucretian thinking, the Roman poet is not included in this list as he was not an astronomer, but primarily a poet and a philosopher. In modern time, even if the extreme specialisation of the sciences might present an obstacle to interdisciplinary work, there do remain a very small number of astronomers and astrophysicists who write verse. The French astrophysicist Jean-Pierre Luminet and the American astrophysicist Aimee A Norton are evidence of this.

4.2.1 Tycho Brahe

The Danish astronomer (1546-1601) is one of the last astronomers to observe the night sky without the aid of a telescope, which was invented at the beginning of the seventeenth century (Nicolson, 'Telescope', 235). From his observations of comets and calculations of the positions of countless stars, Brahe created his own Tychonic system, which adapted parts of the Ptolemaic world picture and combined them with ideas from Copernicus, whose revolutionary 1543 work he largely rejected (Christianson, 'Legacy', 238-239). Poetry played a very public role in Renaissance Europe: many poems were addressed to kings and scholars and celebrated or lamented events and people. They were often treated as ornaments and were written by men who considered themselves to be cultured and erudite intellectuals, like Brahe. In Brahe's time, astronomy and poetry were not considered separate occupations and poems, either by Brahe himself or by a friend, would often open and close Brahe's astronomical treatises, which he printed at his own research centre in Hven (Christianson, *Tycho's Island*, 91-92). For example, the astronomer's exposition of what came to be known as Tycho's star, a 1572 supernova of type Ia in Cassiopeia, *De Nova Stella*, includes a poem by Johannes Franciscus Ripensis and a Latin elegy to Urania, the muse of astronomy, written by Brahe himself (*De Nova Stella* 23, 115-123). 'Elegy to Urania' is a poem in the Ovidian tradition and takes the form of an allegory: the poet-speaker has an epiphany in the form of Urania, the muse of astronomy, who urges him to devote himself entirely to his astronomical investigations (in contrast to the world of sensory experience) and to conquer the universe (Christianson, *Tycho's*

Island, 46-47; Thoren 71). The following excerpt from the long poem offers a glimpse of the functions of poetry, which served Brahe to sing the praises of the study of the cosmos:

> Like blind moles, lethargic mobs see
> No more than earthly, perishable things.
> So very few Apollo grants to see
> The riches which Olympus hides away,
> For they must show contempt to earthly gain
> And lift their eyes unto the heavenly beams.
> And Venus cannot lure them, nor the glass
> Of wanton Bacchus, riches, power, fame.
> More beautiful by far the goal they seek,
> For it is not a goal unknown to gods:
> Through mental force control the heaven's stars,
> Subject the ether to his conquering spirit. (qtd. in Christianson, *Tycho's Island*, 52)

If the connections between astronomy and poetry have changed over the course of the centuries, so has the style of astronomical poetry. While modern poets, as shown in this thesis, tend to emphasise our connection to the cosmos, our insignificance in the face of the vast universe, and our lack of knowledge about the fundamentally mysterious outer space, Brahe does not shy away from singing his own praises and stressing the importance of his own role in the cosmos. This overconfidence and emphasis on the perceiving and thinking I is perhaps a product of a Neoplatonic and Cartesian philosophy, which was very influential in Renaissance Europe and which assigned superlative powers to the human intellect (Christianson, *Tycho's Island*, 47-48). According to Plato, the true *forms* of reality are objective and ideal, so they can accordingly be apprehended by the theorising mind (Christianson, *Tycho's Island*, 50). Moreover, Neoplatonists held that beautiful things in the perceptible human realm were merely poor reflections of the ideal, incorporeal beauty of the world of ideas (Remes 207). In that sense, then, poetry, as the pursuit of beauty, was not merely a frivolous activity, but was actively involved in creating a model of reality as it helps to reach the highest level of the natural world, the world of ideas.

4.2.2 John Herschel

John Herschel (1792-1871), William Herschel's son, is another astronomer who occasionally wrote poetry. While Herschel is mainly known as an astronomer – he studied the gravitational forces in binary star systems and surveyed the southern skies during his four-year sojourn in Cape Town – he also worked in the fields of mathematics and chemistry, and even helped develop photography (Cannon 215, 219). If for Brahe poetry was an intellectual pastime, on a par with the study of the heavens, in Herschel's time poetry played only a secondary role in a context of the gradual professionalisation and specialisation of the sciences over the course of the nineteenth century. The

verse Herschel wrote is not generally considered of high quality – Tennyson called Herschel's translation of the *Iliad* 'a burlesque barbarous experiment' – but harks back to a time, like Brahe's in fact, when poetry and science were regarded as two joint and mutually supportive disciplines engaged in the study of the world (Brooke-Smith 315). Herschel wrote a handful of original poems, and his 'Prose and Verse' offers an interesting insight into his views on science and poetry:

> High truths, and prospect clear, and ample store
> Of lofty thoughts are thine! Yet love I well
> That loftier far, but more mysterious lore,
> More dark of import, and yet not less real,
> Which Poetry reveals; what time with spell
> High-wrought, the Muse, soft-plumed, and whisperingly
> Nightly descends, and beckoning leads to cell
> Or haunted grove; where all inspiringly
> She breathes her dirge of woe, or swells my heart with glee. (*Essays* 732)

In this second verse of a poem in which Herschel compares science and poetry, the two disciplines are pitched as opposites which, nonetheless, complement each other: where science is painted as a more straightforward pursuit, affording access to the '[h]igh truths', poetry, which might also be a stand-in for the arts more generally, is portrayed as a more complicated occupation. This is because science is involved with facts and truths, while poetry speaks to our emotions ('woe' or 'glee'). Science is adorned with adjectives and imagery that evoke clarity and brightness: it is described as 'fair', 'clear' (twice), and the realm of 'lofty thoughts'. Poetry, in contrast, is rendered in metaphors that connote obscurity: it is 'dark of import'; and the Muse descends 'whisperingly' and at night, and leads the poet to a 'cell' or a 'grove', where she alternately inspires 'woe' or 'glee'. While Science leads Herschel to the light, Poetry guides him only towards darkness, and towards extreme emotions, alternating between sorrow and joy. This view of the neatly separated realms of science and poetry – facts and emotions – has been challenged repeatedly in modern poetry (and by modern scientists), as the examples of the poets discussed in this thesis have demonstrated. The following examples of poet-astronomers equally cast this simple relegation of poetry to the realm of feelings into doubt.

4.2.3 Jean-Pierre Luminet

Jean-Pierre Luminet, an astrophysicist studying black holes and cosmic topology at the Laboratoire d'Astrophysique in Marseille and the Centre de Physique Théorique (CPT) of Marseille-Luminy, is among the very small number of contemporary astrophysicists and astronomers who also write poetry. Apart from several books about popular astronomy and cosmology, he has also published four volumes of poetry and an anthology of astronomical poetry (Luminet 'e-Luminesciences'). Many of his poems, predominantly short lyrics written in a Romantic style showing an impassioned

lyric I contemplating nature or the cosmos, engage with his profession, the observation and study of the universe. He sees the two disciplines as related and as conducting parallel research: ‘ma vie de chercheur et d’écrivain est ainsi la quête d’une double mesure: celle du cosmos et celle des profondeurs de l’âme humaine’ (*Illuminations* 481).[50] The following short lyric, published in *Itinéraire céleste* (2004), is representative of Luminet’s florid revelries in the romanticised cosmos:

> M’envoler hors du sombre cachot
> laisser l’horreur
> la boue immonde
> Monter jusqu’à toi
> étoile brasillante
> pleur de flamme qui coule
> sur les pentes de la nuit
>
> J’aspire à toi espace (37)[51]

In Luminet’s poetry, the cosmos is usually conceived as an extension of idealised nature, as a glorified space into which the lyric I wants to escape, full of mesmerising phenomena, some of which are informed by contemporary physics and others of which are purely fanciful.

4.2.4 Aimee A. Norton

A last example of a contemporary poet-astronomer, before turning to Elson’s work, is Aimee A. Norton, an astrophysicist researching the sun’s magnetic fields and sunspots at Stanford University (‘Aimee A. Norton’). Her poems, published on blogs, in journals, a chapbook, and an anthology of poems from the Mullard Space Science Laboratory, only sometimes treat of astronomical subject matter and include a few experiments in concrete poetry (available on her personal Stanford webpage, ‘Aimee A. Norton’). Her poems can be described as feminist, realist, confessional, and narrative. Her playful ‘Sputnik, Listen Up’ exhibits her often celebratory tone about her occupation, addressing and personifying space-borne telescopes and probes, as well as her clever choice of words, playing with the different significations and connotations of a word like ‘ovum’:

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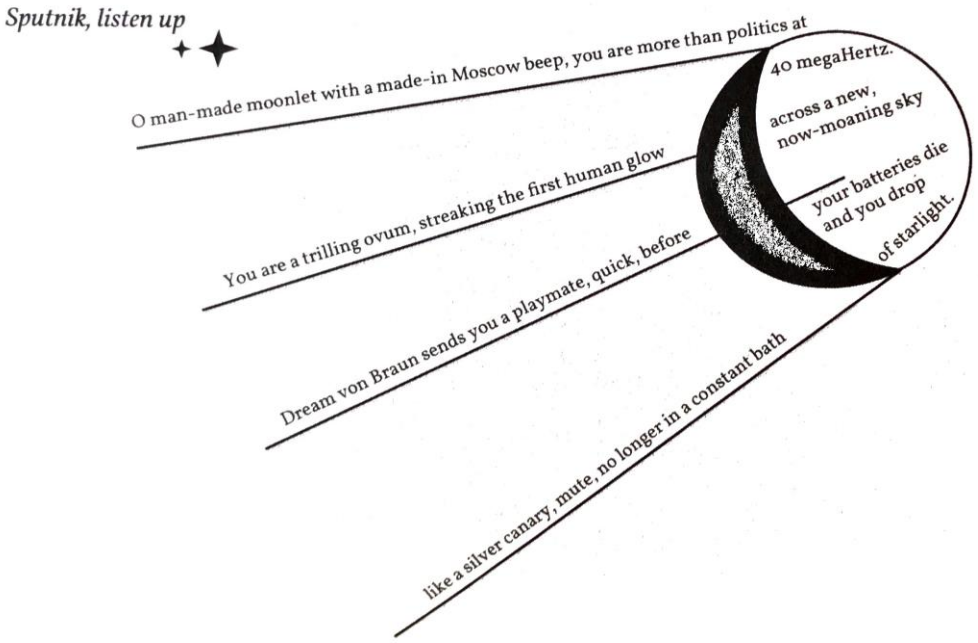
[50] ‘my life as a researcher and writer is thus a two-pronged pursuit: one towards the cosmos and the other toward the depths of the human soul’ (my trans.).

[51] I fly away from the gloomy prison
leaving behind the horror
the squalid mud
I go up towards you
scintillating star
tear of a flame flowing
on the slopes of the night
I aspire to you space (my trans.)



(*Laboratorio* 41)

When I asked about the relationship between her poetry and her astrophysical research, Norton explained that her astronomical training 'provides texture to [her] poetry' and 'blends into [her] vocabulary', but that her poetry does not influence her research (e-mail). Further research on astronomers who also write poetry would afford compelling insights into how the two disciplines fit together and might also discover more poet-astronomers whose poems have not been published and whom I have not been able to find during my research. This study, however, is not intended as a review of modern polymaths engaging both in astronomy and poetry, but as an analysis in what ways poetry can contribute to astronomical research, which I shall argue Elson's poetry does. The brief overview of historical and modern poet-astronomers, from Brahe to Norton, shows that there is a long tradition for the joint activity of conducting astronomical research and writing poetry. The Irish Astronomer Royal William Rowan Hamilton (1805-1865), though a mathematician above all, also wrote poetry and deserves a mention in this list of poet-astronomers. The examples of Hamilton, Brahe, Herschel, Luminet, and Norton show that their professional occupations often find their ways into the poetry they write. These poems can play the roles of escapism, as in Luminet's poem; of playful, typographic, or linguistic exercises, as shown in Norton's poem; or even of parallel research, as Brahe's Neoplatonic verse indicates. Though Elson does not subscribe to the Neoplatonic philosophy, I shall argue in what follows that her poems are also employed in her astronomical research.

4.3 Astronomy, Metaphors, and the Scientific Method

While some of the poet-astronomers listed above conceive of poetry and astronomy as quite separate spheres, various scientists, philosophers, and poets believe that the two disciplines are united in their uses of metaphors and analogies. In an *American Scientist* article, poet, chemist, and Nobel prize laureate Roald Hoffmann writes this about the roles of metaphors and analogies in science: 'These thought mappings (let's loosely call them metaphors) also pulse deep in the heart of science. By this I mean they exist in the daily practice of doing research – in the way scientists generate hypotheses, theories and experiments' (406). In this article, Hoffmann explains the benefits of writing for scientists: writing for popular audiences or readerships encourages the use of narrative, metaphor, and analogy, which, in turn, helps the scientific researcher to better understand his or her research domain. This didactic approach is also discernible in Hoffmann's poetry, which often employs analogies for chemical processes in order to explain them to his non-scientific readership (Small 32). He emphasises the pedagogic uses of analogies, but does not go into much detail about how comparisons to different systems can help to generate new hypotheses and further scientific research itself. The fecundity of analogies for scientific researchers has, however, been demonstrated by philosopher of science Mary Hesse. In her influential work on the roles of analogy in science, Hesse explains that analogies are potentially very useful for a scientist: 'one of the main functions of an analogy or model is to suggest extensions of the theory by considering extensions of the analogy, since more is known about the analogy than is known about the subject matter of the theory itself' ('Operational Definition' 291). So, Hesse argues that analogies are valuable not only for the popular science writer but also for the researcher because an analogy can help to develop a theory and help the researcher to gain a better understanding of his or her domain by comparing it to a different system. Hesse's claims about metaphors in science are thus helpful to understand what exactly metaphors and imagery in poetry can contribute to scientific research.

Others, following Hesse, have written about the usefulness of metaphors in science: Ernan McMullin (1984) makes a case for the importance of metaphors in science in an article in which he defends scientific realism against the antirealism of philosophers like Bas van Fraassen, who postulates that scientific theories are only useful in that they help to make predictions about the observable world, not in the way that they explain structure as it really exists. McMullin points out the benefits of believing in and taking seriously the ontological status of scientific theories such as black holes, because it allows scientists to treat these models as metaphors (33). Metaphors in science work similarly to metaphors in poetry, according to McMullin, in that they make tentative suggestions (31).

When approaching the work of a poet-astronomer, one question that arises is how exactly the literary occupation of poetry-writing fits into the daily routine of an astronomer, and what this routine consists of in reality. In his helpful study of what modern astronomers actually do, for which he interviewed 478 US astronomers, Timothy Spuck reveals that, contrary to popular belief,

astronomers spend just ten to twenty hours a year collecting data at a telescope on average. By contrast, the majority of their time is spent interpreting the gathered data, reading new publications in their fields, discussing the research with colleagues, and doing administrative work (55-56). Even though Elson practised astronomy in the 1990s, around twenty years before Spuck's study, it is safe to assume that she also spent a considerable portion of her time working with computer software and programmes, as indicated by her scientific publications.[52]

Furthermore, astrophysicist Poshak Gandhi, who worked with Elson during the time he was researching his postgraduate thesis, explains that there has been a tendency in modern astronomy towards ever larger teams because the research has become more complex and the telescopes and other astronomical instruments more powerful and expensive to fund (personal interview). Although individual work is still required of an astronomer, that kind of occupation – the romantic trope of the lone astronomer observing the heavens – is disappearing. We know from the editors of *A Responsibility to Awe* that Elson handwrote her poems in journals, at least at a first stage (65). The switch in medium – from the computer screen to the pencil, and from abstract mathematical data to poetic play – probably encouraged her to reflect on her astronomical work, which might have set the stage for poetic thought experiments. In this context, it is little surprise that Elson, again and again throughout her career, sought refuge and inspiration in the solitary writing of poetry, which allowed her to reflect on her profession independently of her colleagues' views and away from administrative and technological distractions. In a notebook entry from September 1993, she writes:

> If one day you are ~~out~~ riding in the forest
> And the universe ~~reveals itself shows~~ appears to you
>
> …….
> Don't ask the questions you've been taught by science
> Ask it everything ~~in your heart~~ you ever wanted. (*ARTA* 83)

These lines suggest Elson found that a turn away from scientific training – which in its rigorous adherence to logical and mathematical truths can be limiting – was sometimes welcome in her research about the cosmos. The crossed-out 'in your heart' even suggests an antithesis between matters of the mind, such as mathematical and logical reasoning, and matters of the heart, which

[52] For example, Elson's paper 'Halo Stars, Starbursts, And Distant Globular Clusters: A Survey of Unresolved Objects in the Hubble Deep Field' mentions the programme 'DAOPHOT', which is a software designed to find stars in telescope images, and which the authors of the article used to detect stars in the data obtained from the Hubble Space Telescope (2). In an earlier article, from 1994, entitled 'The Nuclear Colors and Morphology of Field Galaxies at Moderate Redshift', Elson and her co-authors explain that they used 'a modified version of the IRAF task NEWIMCOMBINE', which is a computer software that combines images (17, STScI). Practically all of her papers mention in the methodology section the different computer programmes that they used to process data and telescope images.

connotes her more creative, intuitive, and emotional faculties. Her poetry offers a creative ground that encourages her to ask the universe 'everything [she] ever wanted'.

Another area where astronomy and poetry intersect is in the use of metaphors. In the article quoted above, Hoffmann writes about the fecundity of analogies for scientists not only when they write for lay audiences, but also for their own research processes. He explains how, in order fully to understand a chemical process, he usually employs an analogy to visualise his area of research (406). Poshak Gandhi, whose main field of interest is black holes, uses the same method. Along with his team at the University of Southampton, he studied a type of jet plasma that is ejected by black holes. In order to better visualise and understand this phenomenon, the group of astrophysicists likened it to laser beams shot by the Death Star in *Star Wars*. This analogy was also used in the press release by the University of Southampton, which targeted a wider, non-astronomical audience ('Scientists Penetrate Mystery'). However, Gandhi's account of the use of the *Star Wars* analogy made it clear that this pop-culture image was not merely chosen for its popular explanation, but also for the astronomers themselves because the visual image helped them to grasp this highly theoretical concept (personal interview).

Both Gandhi and Hoffmann point out one other useful feature of using models that are analogous to the object being studied. Hoffmann writes about how insightful the limitations of a metaphor can be: 'A naked metaphor clearly shows the analogy's limitations, its capacity for misinterpretation and its productive extensions. It aids its creator as well as its audience' (407). Gandhi is likewise interested in those aspects where the analogy breaks down:

> But the physics of black hole jets has nothing to do with lasers or the fictional Kyber crystals that power the Death Star. Nature has found other ways to power jets. . . . Gravity and magnetic fields play the key roles here, and this is the mechanism we are trying to unravel. ('Scientists Penetrate Mystery')

Both scientists describe what Hesse called the benefits of a 'neutral analogy'. The philosopher distinguishes between three different analogies or aspects of an analogy: 'positive', 'negative', and 'neutral'. The first two describe similarities or dissimilarities between two models that are being compared to each other. A 'neutral analogy', the most useful kind of analogy for Hesse, describes those 'properties of the model about which we do not yet know whether they are positive or negative analogies; these are the interesting properties, because . . . they allow us to make new predictions' (*Models and Analogies* 8). The philosopher uses the analogy of billiard balls to visualise the behaviour of gas molecules: some parts of the analogy are described as negative (for example, the colours of the billiard balls), while others – the motion and impact of gas molecules and billiard balls – are called positive aspects. The useful parts of this analogy are what she terms neutral aspects: the comparison between billiard balls and gas molecules invites the researchers to make predictions about the expected behaviour of gas molecules (8-9).

In other words, the imperfect fit between the analogy and the scientific phenomenon can actually further scientific investigation. This imperfect fit that Hesse describes is closer to how a metaphorical explanation of science works. Metaphors are different from analogies in that they do not necessarily compare two systems that are analogous or similar to each other. Philosopher Max Black distinguishes between analogy and metaphor by explaining that 'metaphor creates the similarity' rather than 'formulat[ing] some similarity antecedently existing' (285). In addition, while it has long been established that scientists recurrently think along metaphors and analogies, the metaphors and imagery that Elson, or any poet, uses in her poetic compositions do slightly different work: whereas scientists employ mainly visual analogies, such as Gandhi's Death Star image and Hesse's billiard balls, the linguistic metaphors found in poetry establish more complex relationships between the two models through the use of semantics, grammar, syntax, wordplay, and lineation, as I will demonstrate below. Poetry, through its playfulness and experimentation, is a medium that can take these metaphors further by suggesting connections between the two models that a more straightforward scientific thought experiment or visualisation would not. It is in this sense that poetry can be credibly employed as a tool of investigation.

If metaphors and analogies are vital tools in science and especially in a science that deals with faraway objects that cannot be analysed and studied in a laboratory, then an active imagination, unrestrained by the limits of the scientific method and the current scientific paradigm, is essential too. As explained above, the nature of the objects of study in astronomy precludes astronomers from conducting controlled experiments and performing direct empirical observational research. My thesis is that Elson's poetry fulfils the role of experiments in astronomy. In the absence of controlled experiments, her poems serve as thought experiments and exercises of the imagination, which must work independently of the current scientific doctrine or principles. This is also philosopher of science Paul Feyerabend's conviction, which he expounds in his controversial and provocative 1975 book, *Against Method*. Here, Feyerabend presents a critique of the sciences based on the notion that the standards by which a new scientific theory is tested are too restrictive and present in fact an obstacle to scientific progress. The reason that Feyerabend advances for his rejection of the scientific method is that the justification of a new discovery or the testing of a new hypothesis are hindered both by the grammatical structures of our language and by what he calls 'natural interpretations', or mental structures, the current paradigm through which our perceptions are filtered (58).

In Feyerabend's eyes, the problem with contemporary science further lies in the fact that an original and potentially correct hypothesis is discarded as soon as it is falsified by facts and observations. However, these facts and observations and their linguistic expression are heavily influenced by our language (which is fallacious) and natural interpretations (which are unreliable). The philosopher regrets that '[t]heories are abandoned and superseded by more fashionable accounts long before they have had an opportunity to show their virtues' (35). As a result, Feyerabend calls for a suspension of the judgment of a hypothesis until the hypothesis can be

supported by further theories. For this reason, he calls for a proliferation of theories, including theories that are inconsistent with observed facts, as it is through these refutations that the fallacies of our observations and facts become clear (61). In order to allow for a 'pluralism of theories', the scientific method needs to be adapted (38). In fact, Feyerabend champions an 'anything goes' attitude in science, or, as his critics have called it, 'epistemological anarchism' (Russell 444).

The philosopher uses the example of Galileo and his wish to prove Copernicus right despite the many inconsistencies of Copernicanism with observed astronomical phenomena. He analyses how the early modern cosmologist managed to attract attention with the absurd and 'counterinductive' claim that the Earth moves (counterinductive because, to Earth dwellers, it looks as if the heavens were turning). His answer is that Galileo used propaganda and psychological tricks to spread theories that were completely contradicted by observations. According to Feyerabend, these linguistic tricks 'obscure the fact that the experience on which Galileo wants to base the Copernican view is nothing but the result of his own fertile imagination, that this has been *invented*' (65). In other words, Galileo ignored the rules dictated by science and let his imagination run wild. What Galileo slowly created was a new scientific language, bringing about a changed worldview, which accommodated the Copernican system. Analysing Galileo's successful vindication of Copernicus, Feyerabend concludes that support for new ideas, such as Copernicanism, can only be found in 'irrational means, such as propaganda, emotion, *ad hoc* hypotheses, and appeal to prejudices of all kinds' (114). This then leads the philosopher to advocate the significance of the arts: when empirical proof becomes irrelevant to the question as to the quality of a theory, 'style, elegance of expression, simplicity of presentation, tension of plot and narrative, and seductiveness of content become important features of our knowledge' (118). Thus, the parts of language that have conventionally been relegated to the margins of scientific discourse are given emphasis in Feyerabend's view of scientific progress.

The philosopher's insights into the 'irrational' arts and how they can serve scientific development offers a helpful guide to read Elson's poetry. I argue that Elson uses her poetic meditations and musings to try out different scientific theories, such as the form dark matter might take or the nature of the cosmos. While Feyerabend seems to equate the arts with propaganda, engaging its readers or audience on an emotional level, the poems in *A Responsibility to Awe* do not serve to convince readers of one astronomical theory or another. Rather, I base my reading of Elson on Feyerabend's ideas about the essential roles that 'style, elegance of expression, [and] simplicity of presentation' play in propounding different scientific theories. Instead of using her poetry to propagate a certain view of astronomy, Elson uses her poetry for *herself*, to visualise and experiment with different astronomical and cosmological hypotheses.

Elson was an observational astronomer at the University of Cambridge during her PhD in the late 1980s, and again from 1991 until her premature death from Non-Hodgkins lymphoma in 1999, when she was only thirty-nine. Using the Hubble Space Telescope, she conducted research on globular clusters in both our own galaxy and in very distant galaxies. She studied star formation

and evolution as well as dark matter. At the same time, Elson wrote a significant number of poems, which were published posthumously by her husband Angelo di Cintio and her friend Anne Berkeley in 2001. *A Responsibility to Awe* contains fifty-two meditative and at times personal poems, the subject matter of which ranges from her childhood memories to her disease, as well as journal extracts and an autobiographical essay. About one third of her poems muse upon the cosmos and the different forces governing it.

These astronomical poems are where Elson could conceptualise some of the hard-to-understand findings from her astronomical research. Through a series of close readings of a selection of Elson's astronomical poems, the next section will demonstrate that, through the use of metaphors, analogies, and imagery, these poems serve to reflect on and in fact complement her astronomical research. A number of critics and commentators, such as Rachel Crossland, Jocelyn Bell Burnell, and Peter Howard, have read Elson's poetry as a type of popular science meant for non-scientific readers.[53] Elson's collection was also widely reviewed with both *The Economist* and *The Observer* naming it book of the year. Although it has been slow to emerge, interest in Elson's work is growing: Sam Illingworth, in his book on poet-scientists, *A Sonnet to Science: Scientists and Their Poetry* (2019), includes a chapter on Elson, which presents valuable biographical information on the poet-astronomer. In this chapter, the science communication scholar argues that Elson's poetry demonstrates her optimistic pragmatism, even in the face of her own mortality (170). Moreover, a second edition of *A Responsibility to Awe* was published in 2018, which likewise testifies to its continued relevance and popularity.

Writing poetry is beneficial to Elson the astronomer because it gives her a licence to free speculation. The poetry she writes, with its vivid imagery and speculative metaphors, encourages her to train her scientific mind. Her poetry fosters a freeing up of imagery, which also helps her astronomical research. Employing different metaphors and thinking through their implications means that she disrupts her own thinking habits as a scientist, which is necessary to perform good science. Furthermore, her science, astronomy, is concerned with vast distances and conceptually very challenging phenomena. The science deals with objects that cannot easily be controlled or reduced. In her poetry, Elson parallels this vastness and mystery of the universe with exuberant imagery such as dancers and spider-webs, analogies far less available in her more rigorous scientific practice. Not unlike other poets encountered in this thesis, her astonishing metaphors for cosmological phenomena provide the night sky with an agency, let it appear alive, as I shall show. Overthrowing the image of a still and passive universe which is being observed by astronomers, as her condensed poems do, encourages Elson to reconsider the roles of dark matter and astronomical observation, for instance. The image of the spider-web plays a central role in a poem that will be

[53] Bell Burnell mentions Elson in her essay, 'Astronomy and Poetry'. As mentioned in Chapter One, the astronomer explains here that she likes to use astronomical poems such as Elson's to open her lectures to the lay public as this opener 'should help the non-scientists in the audience relate to the topic, may woo those who are suspicious of science or scientists, and demonstrate[s] that astronomy is part of our cultural heritage' ('Astronomy and Poetry' 126).

analysed in the next section, which is devoted to Elson's questions around the cosmological phenomenon of dark matter.

4.4 Rebecca Elson's Interdisciplinary Poetry

4.4.1 Dark Matter

Elson worked at a time when the biggest unknown in astronomy and cosmology – the study of the cosmos as a whole – was dark matter, the mysterious missing ingredient in the universe. Dark matter captured the poet-astronomer's imagination and figured extensively in her poetry and, to a lesser extent, in her research. While she returned again and again to the visual representation of dark matter in her notebooks, she only has one finished poem about this scientific phenomenon. The haiku-like poem presents a still-life in nature:

> Above a pond,
> An unseen filament
> Of spider's floss
> Suspends a slowly
> Spinning leaf. (*ARTA* 15)

What does this serene nature scene of a leaf stuck in a spider's web near a pond have to do with the title 'Dark Matter'? Upon a closer look, Elson's poem metaphorically incorporates the various functions of dark matter. In order to fully appreciate the metaphor in the poem, a more detailed explanation of this cosmological phenomenon than the one provided in the introduction is needed.

The discovery of dark matter is generally credited to Fritz Zwicky. In the 1930s, Zwicky conducted research on galaxies and galaxy clusters. During his work, which consisted in cataloguing numerous galaxies, the Swiss astronomer attempted to understand what held those clusters together. He also observed, contrary to the orbital velocities in our solar system, that the stars in the outer arms in spiral galaxies revolve much faster than the stars at the centre of the galaxy. He wondered why those stars in the outer reaches of the galaxies were not dispersed and flung away into space due to their high velocities. He concluded that there had to be much more mass for gravity to act on and to keep the stars in place. From his observations and measurements of the Coma Cluster, he obtained a mass that was about ten times larger than could be accounted for by the light emanating from it. It was Zwicky also who invented the term 'dunkle Materie' ('dark matter'). Despite these baffling results, this research area lay dormant for several decades until the 1970s, when renewed interest in the structure and evolution of the universe led to a revival of interest in dark matter.

In the 1970s, Jeremiah Ostriker and Jim Peebles studied our own galaxy and found that the high velocity of stars in the outer arms of the galaxy meant that the Milky Way should be unstable

and that, as a result, it must be embedded in a halo of dark matter that stabilises it. Following the publication of their findings in a paper called 'The Size and Mass of Galaxies, and the Mass of the Universe' in 1974, there was sustained interest in studying this mysterious component of space especially because it played a crucial role in predicting the fate of the universe. Knowing the quantity of dark matter would allow scientists to determine the percentage that dark matter and baryonic (or ordinary) matter constitute of the critical density. The critical density describes the point at which the universe would be in balance and at which gravity would slow down and eventually stop expansion. By measuring the gravitational force that galaxies exert on other objects, through microlensing for example, scientists have concluded that dark matter is six times as abundant as baryonic matter. As astronomers assume that we are living in a critical density universe – a universe that will eventually stop growing – and as this critical density can be calculated, they have found that visible matter and invisible (dark) matter only constitute around twenty-six per cent of the critical density. However, during Elson's time, it was believed that dark matter constituted up to ninety-five per cent of the matter in the universe, which explains why astronomers were so fascinated with it at this time (Bell Burnell 136). It was very perplexing indeed that almost all of the universe consisted of something that kept eluding astronomers and cosmologists.

In the 1990s, the most popular contenders for dark matter could be grouped into two categories (with very suggestive names): MACHOs and WIMPs. MACHO is an acronym for massive compact halo objects, and by it scientists designate dim, low-luminosity objects such as old white dwarfs, dim red dwarfs, brown dwarfs, neutron stars, black holes, and massive planets such as Jupiter. Currently, MACHOs are ruled out as the main candidates for dark matter. WIMP stands for weakly interacting massive particles and signifies mainly exotic and, so far, purely theoretical particles. WIMPs have become the more popular contender for dark matter in the last twenty years of research (*Nature Astronomy* March 2017). Some WIMP contenders for dark matter are the supersymmetric partners of ordinary elements (for example the neutralino or the gravitino), axions, Kaluza-Klein particles (string theory particles associated with extra dimensions), and the Wimpzilla. Neutrinos have also been considered a likely candidate for the missing matter.[54]

The nomenclature for dark matter candidates, with its pop culture references ('Godzilla') and its slangy suggestion of virility ('macho') and weakness or cowardice ('wimp'), respectively, confirms what Hoffmann said about the importance of metaphors in science. The allusion to the popular Japanese monster resembling a mutant dinosaur, whose Japanese name signifies a cross between a gorilla and a whale, connotes strength and mass, which is fitting for the 'wimpzilla', since that is a super-weakly interacting but super-heavy particle, trillions of times more massive

[54] The information presented in this introduction to dark matter is taken from a few different popular astronomy books. My sources are Richard Gott's *The Cosmic Web* (2016), Jeremiah Ostriker and Simon Mitton's *Heart of Darkness* (2013), Iain Nicolson's *The Dark Side of the Universe*, and Simon Singh's *Big Bang*.

than other WIMPs (I. Nicolson 71). Yet, the reference to the 'king of the monsters' (a phrase from the Americanised version of *Godzilla*), which wreaks havoc and destruction upon humankind, and which is itself a metaphor for the threat of nuclear weapons, also leaves a vague trace of menace (*Godzilla: King of the Monsters*; Bunch). It suggests the fear of finding out the true identity of dark matter, which might be shocking or upset previous cosmological knowledge. The Wimpzilla gestures at the fear that a more sinister type of force might govern the universe, perhaps disturbing our existing cosmological knowledge and our hopes of an eternal, or almost eternal, universe.

Returning to Elson's poem, the different parts of the metaphor that compares two different systems can now be identified. The pond stands for the flat disc of our galaxy, while the spider's floss above it represents the invisible halo of dark matter encircling the Milky Way, gravitationally suspending stars or star clusters, or in the poem's case a leaf. The metaphor is further sustained by the words 'unseen' and 'filament'. 'Unseen' is an obvious hint at the invisible matter. 'Filament' becomes a more obvious allusion when one considers the role that dark matter plays with regard to structure in the universe. A photograph capturing the universe from a distance would reveal that matter is organised in a sponge-like fashion; or, in other words, that galaxies are grouped together in clusters, which form part of filaments (Gott 166). This behaviour is attributed to the workings of dark matter. The orthographical similarity between 'filament' and the biblical 'firmament' suggests how a religious view of the cosmos is superseded by a secular one. Furthermore, the haiku-like format that the poet chose here is well-suited to conveying a single strong metaphor. While haikus traditionally contain a juxtaposition of two images or fleeting moments in nature, the juxtaposition in 'Dark Matter' resides in the title and the body of the poem. The analogy of the spider's web and its implications raise a few questions about the purpose of dark matter. What was dark matter designed to catch? And, as the leaf in this imagined model for dark matter is not the spider's prey, what does that suggest about the universe? Are galaxies (and indeed life) merely side effects of dark matter?

These neutral parts of the analogy – where the similarities between the two models stop – are what drives Elson's poetry. This becomes clear in a poem entitled 'Some Thoughts about the Ocean and the Universe', in which, as the title indicates, the universe is compared to the ocean:

> If the ocean is like the universe
> Then waves are stars.
>
> If space is like the ocean,
> Then matter is the waves,
> Dictating the rise and fall
> Of floating things.
>
> If being is like ocean
> We are waves,

Swelling, travelling, breaking
On some shore.

If ocean is like universe then waves
Are the dark wells of gravity
Where stars will grow.

All waves run shorewards
But there is no centre to the ocean
Where they all arise. (*ARTA* 25)

Throughout the short poem, Elson draws comparisons between the behaviour of waves in the sea and the behaviour of matter in space. The imperfect fit between these models raises questions about the extensions of the analogy. Can matter and energy in fact be compared to the movements of waves? Is their origin similar to the origins of waves? The wave metaphor for matter in the universe is highly relevant especially in quantum mechanics as subatomic particles like the electron, but also the photon, demonstrate wave-particle duality, acting both as waves and as particles (Randall 136). In this poem, Elson thinks through the implications and the extensions of the oft-used and somewhat trite comparison between the universe and an ocean. By setting the cliché in the context of scientific research, she allows the poem to raise questions that encourage her to conceptualise the objects of her research in different ways.

In 'Dark Matter', it is also the gaps in the metaphor of a spider-web for a galaxy that raise useful questions. Especially the notion of a spider's web casts doubts on conventional views of the universe. In popular science accounts authors often write from a purely anthropocentric viewpoint. The narrative of our world, our solar system, and our galaxy is embedded in teleological language that suggests that dark matter exists to attract ordinary matter, and Jupiter exists to prevent asteroids from crashing into our planet, and the Earth is the perfect distance from the sun so as to enable humankind to prosper. Thus, Richard Gott describes the formation of matter in the early universe in these terms: 'This allows the density fluctuations due to cold dark matter to get a big head start on growth, *a feature of the model that is very helpful in making galaxies*' (101, emphasis mine). Narratives of the story of the universe, such as this one, typically use vocabulary that depicts the different stages of the universe as conducive to the emergence of life, especially human life. This is the anthropic principle, according to which the universe is believed to have the qualities it has in order to allow human existence (Gott 201). Thinking about cosmology according to the anthropic principle, then, presents a skewed perspective as it is limited to the human point of view. Highly trained astronomers, like Elson, are probably not in need of a reminder, in poetic form, of the idea that humanity and our solar system do not constitute the centre of the universe, as, ever since the Copernican revolution, astronomers have had to learn that we are not in any particularly privileged place. The metaphor of the spider-web, hence, is not only able to resist an

anthropocentric mentality; it also gestures at the notion that dark matter could be something ominous or threatening to human conceptions. The resistance, and conversely the submission, to an anthropocentric point of view is one of the leitmotifs of this thesis, as Alexander, Smith, Holub, Seidel, and Sleigh suggest in their poems. Elson's challenge of a centralising human viewpoint indicates that the trend of de-anthropocentralising the cosmos, also detectable in Alexander's poetry, can also be found in the thinking of an astronomer. In what follows, I shall analyse just how Elson's poems can aid this conception of a universe that is devoid of a human viewpoint yet that possesses agency.

The effect of such a distortion of reality is a central theme in Timothy Morton's object-oriented ontology, whose quest to find new ways of representing the invisible or massive objects that defy comprehension and conventional pictorial representation shares similarities with Elson's project of thinking through new models of dark matter. Morton's book *Hyperobjects* (2013) offers guidance for the conceptualisation of an 'object' like dark matter from a non-anthropocentric viewpoint. Morton starts his book by providing a few examples of what he terms 'hyperobjects' and cites a black hole among the first ones (1). On the same page, he explains that:

> [hyperobjects] are *viscous*, which means that they 'stick' to beings that are involved with them. They are *nonlocal*; in other words, any 'local manifestation' of a hyperobject is not directly the hyperobject. They involve profoundly different temporalities than the human-scale ones we are used to. In particular, some very large hyperobjects, such as planets, have genuinely *Gaussian* temporality: they generate spacetime vortices, due to general relativity. Hyperobjects occupy a high-dimensional phase space that results in their being invisible to humans for stretches of time. And they exhibit their effects *interobjectively*; that is, they can be detected in a space that consists of interrelationships between aesthetic properties of objects. (1; italics in original)

While Morton never mentions dark matter as an example of a hyperobject, his description suggests that the invisible matter does fall under its definition: dark matter can only be detected through its interaction with other objects, an interaction which only affords a glimpse of the hyperobject dark matter. Moreover, dark matter has a temporality that humans can hardly comprehend. Elsewhere, Morton describes hyperobjects as pertaining to a higher dimension 'that makes them impossible to see as a whole on a regular three-dimensional human-scale basis' (70). It is because of all these obstacles to human perception that hyperobjects force us to reconceptualise our ways of thinking about them. Morton cites as examples global warming, planets, plutonium, or the cosmic microwave background radiation: 'Like the image in a Magic Eye picture, global warming is real, but it involves a massive, counterintuitive perspective shift to see it' (49).

If, as my comment above suggests, this 'counterintuitive perspective shift' might be a result of a scientific training in objectivity, Morton disagrees. He argues that the perspectival shift can and should be effected through the arts. He calls for an art that creates a link between the human

and the nonhuman, and which helps us to deal with hyperobjects. Art should attune its audience to this new reality which is governed by hyperobjects and other nonhuman entities. He calls the work that art necessarily has to do 'demonic' because it alienates us from a once-familiar reality. He concludes his section on the discussion of the roles of art by claiming that art 'in these conditions is grief-work. We are losing a fantasy – the fantasy of being immersed in a neutral or benevolent Mother Nature' (196). It is the recognition that we are merely objects among other objects that art is supposed to help us to face. While his views about art and reality are not exactly innovative – many of his ideas about defamiliarisation were already expressed in Modernist texts and theorised by Czech and Russian formalists – his efforts to develop similes and metaphors to talk about large-scale and abstract objects and events that challenge our comprehension can be compared to Elson's use of strange metaphors, such as a spider's web to refer to dark matter.

As already indicated, the refusal to subscribe to the anthropocentric narrative of the universe in Elson's 'Dark Matter' also anticipates some ideas expounded in *Hyperobjects*. In fact, her short poem is an exercise in defamiliarisation by turning the popular anthropic principle on its head: instead of showing dark matter as attracting and fostering the growth of galaxies and galaxy clusters when the universe was young, she imagines dark matter as a trap – the spider-web – in which galaxies like ours accidentally got caught. The fact that the 'unseen filament / Of spider's floss' is the subject of the sentence further contributes to the reversal of points of view. Most popular accounts of dark matter would cast our galaxy as the subject and describe dark matter's behaviour in passive syntactical structures. For example, in his account of the discovery of dark matter, Gott writes: '[Jeremiah Ostriker and Jim Peebles] proposed that [our galaxy] must be stabilized by a spherical halo of invisible dark matter', not that 'a spherical halo of invisible dark matter stabilizes our galaxy' (32). Furthermore, not only is dark matter likened to a hunting tool, but the thing that gets stuck in it – the leaf – is only a side effect of the hunting technique. The notion of the leaf, which happened to get caught in a spider's web, which, in turn, has the purpose of catching flies and other edible insects, underlines the fundamental roles that chance and accident play in the cosmos. Visualising dark matter as a trap and assigning it (grammatical) agency introduces new ways of thinking about this missing ingredient: for example, the notion that dark matter 'suspends' the entire cosmos implies that it plays an even greater role in cosmology than had been assumed until then. In fact, Elson's analogy of the spider-web is not far off later analogies for structure in the universe: as mentioned above, Gott imagines matter to be organised like a sponge or Swiss cheese, with dark matter determining higher and lower density areas (125-130).

The short imagistic poem also reveals a close attention to regularity and form. The poem is written in an iambic metre – the last two lines are in fact an iambic tetrameter split in two, as by caesura. The only irregular line is the second line, containing a series of spondees, thus forcing the reader to slow down and pause on the words 'unseen' and 'filament', two of the most important words in the poem. Moreover, the repetitive sound effects of /sp/ in 'spider', 'suspends', and 'spinning', as well as the alliterations in /s/, draw the poem together. Lastly, the visual form of the

poem on the page is equally striking, lending it an almost perfectly square shape. This close attention to form, making the poem very regular in rhythm, sound patterns, and typographic shape, stands in contrast to the chaos and whims of chance, which are the subject of the poem. The simplicity and elegance of the poetic form of 'Dark Matter' mirror the striving for simplicity and elegance in physics and astrophysics. Astrophysicists have been searching for a simple formula, a Theory of Everything, that encapsulates all known physical laws in one equation (Gott 225). So far, such an attempt has been unsuccessful because the theory of relativity cannot be satisfactorily combined with quantum mechanics.

Elson's short poem, which represents the chaos of a universe ruled by the mysterious dark matter and chance in an elegant, haiku-like poem of only five lines, raises the question as to whether natural and cosmological phenomena can even be accurately represented through a human-made language, be it poetry or mathematics. It could thus be seen as a provocatively ironic comment on mathematics, which forces order onto natural occurrences. Historically, poems about the universe and our place in it have often taken the form of epics, such as Dante's *The Divine Comedy* and Milton's *Paradise Lost*, or even Alexander's 'Water on New Mars', which multiplies speakers, visualisations of Mars, and cosmological imagery. The condensed 'Dark Matter' stands in stark contrast to such texts. It is the author's training in the concise and elegant language of mathematics that might explain the brevity and elegance of the poem, while simultaneously passing judgment on the possibility of embodying the chaos and inscrutability of the cosmos in mathematics. If Elson's short lyric presents a comment on the incongruity of encompassing the entirety of the cosmos in five lines of poetry, Alexander's sixteen-page poem, unbounded by punctuation and syntactical rules, seeks to match the expansiveness and vastness of the cosmos by developing a linguistic attitude which, in its expansiveness and periphrases, approximates the multiplicity and seeming infinitude of the universe.

While she only has one finished poem on dark matter, Elson grappled more with this mystery in her notebooks. In other notebook entries, which look like poem fragments or draft poems, Elson imagines dark matter as a dark meadow that can only be inferred from the presence of fireflies, the force governing human relationships, and a fish that creates ripples on the surface of a pond (71, 108, 107). One journal entry from October 1993 includes a poem also entitled 'Dark Matter'. The poem plays with the idea that parts of our world are invisible but can be inferred from the behaviour and properties of visible things:

> Seeing, like that, only purple
> You would understand your world
> From a few iris,
> A few bolts of silk,
> And emptiness.
>
> And knowing the gravity of iris

You might postulate stems,
Though green were unimaginable
And seeing the silk fall in folds,
A body, though flesh could not be thought.

And speaking in purple
You might acknowledge still
The universe outside of sound. (*ARTA* 86)

Here, the search for dark matter is compared to a type of visual impairment which renders all colours except purple invisible. In Elson's poem, the person she addresses lives in a limited reality that renders the perception of touch ('silk' and 'flesh') and other colours impossible. The play with colours in this poem brings to mind the astronomical principle of detecting gases in stars or planets: in spectroscopy, the Fraunhofer lines, or the absorption lines, in the spectra of celestial bodies allow astronomers to determine the chemical make-up of a star, for instance. The radiation of a star like the sun is absorbed at specific wavelengths by the gases contained in the star (North 423-424). Spectroscopy, then, like the detection of dark matter and black holes, deals with what is invisible in the universe. If in Frederick Seidel's poem about dark matter, the speaker is uneasy about the existence of dark matter – 'It is the invisible / Dark matter . . . / That I am afraid of' – Elson's poem is marked by pleasant sensations, such as the feel of silk and the sight of flowers, delighting in its mystery (*Dark Matter* 191). Yet, the loveliness of the imagery notwithstanding, the poem is not without a certain unsettling undertone.

While the imagery in this poem is less ominous or threatening than the image of the spider's web, it still contains a slightly disconcerting thought: rather than dark matter turning out to be merely a concentration of particles possibly already known to astrophysicists (which many instruments for the detection of the mysterious matter take it to be), Elson's image of the extremely restricted vision suggests that the detection of dark matter would open doors to a reality so different as to be utterly disorienting. The detection of dark matter, Elson suggests in her poems, could thoroughly challenge astronomers' view of the universe and our place in it, forcing them to completely rewrite textbooks (a worry which is also indicated in the word 'Wimpzilla'). Further, not only might dark matter turn out to reframe our understanding of the universe, but her imagery also hints at a certain menace that lurks in dark matter. Elson seems to believe that it has the potential possibly to bring about another revolution in astronomy, one like the Copernican revolution, whose repercussions affected every realm of cultural and intellectual life. The next section studies how others of Elson's poems add, to a universe constituted by spider-webs and iris, a cosmos made up of dancers. It then addresses how these poetic metaphors help to reconceptualise astronomical research and the way we think about the universe.

4.4.2 A Cosmic Dance

Elson's astronomy poems also cleverly use puns. Apart from analogies and metaphors serving to represent visually astronomical or cosmological phenomena, puns, as a poetic trope, can also be a tool for scientific investigation. Janine Rogers, in her book about the similarities between science and literary form, includes a short discussion on the fertility of puns in poems, which produce 'linguistic instability' (95). She argues that wordplay is a 'balance between singularity and multiplicity' and 'produce[s] multiple realities', which she compares to the infinite quantum realities of the atom (95). However, while she acknowledges the pun's potency to create new meanings, she does not explore this potency as a mode of scientific investigation. In his study of the poetic writings of nineteenth-century scientists, Daniel Brown argues for the epistemological efficacy of puns in James Clerk Maxwell's 1853 essay 'Analogy in Nature'. Somewhat like metaphors, and according to Maxwell the inverse of analogy, puns are playful ways of creating links between seemingly unrelated ideas, but unlike metaphors the links reside in often nonsensical and merely semantic or even just phonetic similarities (88). Thus, in a certain sense, puns follow a similar principle as analogies, but they are more liberating in that they create links between areas of knowledge that do not appear to be connected. Brown argues that puns 'teeter on the brink of nonsense, as . . . the relation between their . . . twin terms, understood literally, is unmeaning' (40). This leads him to point to the fecundity of language: 'Truth is seen as relational and latent in language, intrinsic to the riddling phenomena of puns and analogies, which accordingly require an act of mind to bring them to consciousness' (80).

Elson's poem 'Constellations' excellently illustrates the hermeneutic possibilities of puns. The short poem challenges the ancient view of the night sky as representing the images of different gods and creatures by likening this view to the rather sinister image of cases displaying dead beetles and butterflies:

> Imagine they were not minor gods
> Mounted in eternal *in memoriam*
> Or even animals, however savage,
> Pinned like specimens upon the sky. (*ARTA* 22; italics in original)

In this first stanza, the night sky with its stars is presented as a dead, two-dimensional display of objects meant for scientific analysis. Quite morbidly, the twinkling stars here become the shiny pins with which insects are held in place in their cases. The second stanza moves away from this sinister image and introduces an alternative way of thinking about the night sky:

> Imagine they were lambada dancers
> Practising their slow seductions
> On the manifolds of space. (*ARTA* 22)

Instead of picturing minor gods and mythological animals, Elson invites the reader to think of them as 'lambada dancers'. 'Lambada' is a Brazilian dance that became internationally known and popular in the late 1980s and 1990s, presumably thanks to a widely successful song with the same title by the French group Kaoma, who covered earlier Brazilian and Bolivian versions of the same song. The *OED* defines the lambada as 'a fast erotic Brazilian dance which couples perform in close physical contact'. In that regard, the 'lambada' fits very well with the theme of the rest of this second stanza: based on the definition above, lambada dancers can certainly be described as seductive. Portraying the constellations as erotic dancers for those who study the heavens changes the dynamic between scientific object and scientific observer: no longer merely a passive object subjected to scientific scrutiny, the night sky dazzles and seduces the astronomer. In this new picture, Elson conceives of the cosmos as having a certain power over the astronomer, who cannot help but be attracted by the sensual dance of the stars.

The metaphor of lambada dancers for constellations is strengthened by a pun in 'lambada'. The choice of the lambada seems peculiar when the salsa or the merengue are much more famous and similarly erotic Latin dances. What motivated Elson to use the word 'lambada' here? The word 'lambada' may well have been chosen for its similarity to the word 'lambda' and for the useful associations that this near-miss pun opens up. In cosmology, the Greek letter lambda (Λ) represents the cosmological constant, which Einstein introduced into his field equations in order to stabilise them and to counter-balance gravity. Then, after Edwin Hubble discovered, in the 1920s, that space is expanding, Einstein's cosmological constant became obsolete and was discarded; the expansion (initiated by the big bang), in fact, worked as a counter-balance to gravity.[55]

The Greek symbol implied in the word 'lambada' and its cosmological signification become especially relevant in the third stanza. The double meaning of 'lambada / lambda' is sustained throughout the remaining poem, containing explicitly sexual overtones:

> Then in the name of science
> We might ride their studded thighs
> To the edge of our hypotheses,
> Discover there the real constants
> Of the universe:
>
> The quick pulse,
> The long look,
> The one natural law. (*ARTA* 22)

[55] A new development in the 1990s complicated the matter of the cosmological constant: thanks to the observation of type Ia supernovae, whose specific luminosity allows them to be used as standard candles for extragalactic distances, astronomers discovered that the universe is in fact expanding at an accelerating rate. The cosmological constant, or rather dark energy, as astronomers came to call the mysterious force tearing the universe apart, was studied again.

The remainder of this poem depicts a universe that is ultimately knowable but that also seems to tease the astronomer with hidden or false truths. In order to arrive at 'the real constants', the astronomer has to think beyond her hypotheses. The allusion to lambda is repeated here: Einstein's cosmological constant, designated by lambda (Λ), turned out to be unnecessary. In fact, astrophysicist George Gamow recorded Einstein as saying that the cosmological constant was 'the greatest blunder' of his life (qtd. in Gott 27). The adjective 'real' to describe the 'constants / Of the universe' possibly alludes to the mistaken lambda in early twentieth-century physics. The 'real constants' are yet to be discovered and existing hypotheses might need to be discarded. The last line of the poem even suggests the greatest ambition of contemporary physics, also mentioned above: a Theory of Everything. 'The one natural law', which Stephen Hawking, in *A Brief History of Time*, promised was at physicists' fingertips, would encapsulate the entire universe in one elegant all-encompassing theory (193).

Like the poem 'Dark Matter', the notion of the lambada dancers also invests the night sky (or the constellations) with an agency that it rarely possesses in popular accounts of cosmology. Just as dark matter is cast as the grammatical subject of the sentence in the previous poem, the night sky, far from being a passive research object, is here actually responsible for making itself understood. It is relevant to quote Morton again: 'The more we know about radiation, global warming, and the other massive objects that show up on our radar, the more enmeshed in them we realize we are' (160). Like Bruno Latour's Actor network theory (ANT) and Jane Bennett's New Materialism, Morton's object-oriented ontology imagines a network or a mesh in which humans are just some among many objects. As in Alexander's poetry, imagining a lively cosmos filled with active and changing objects, the dichotomy between subject and object, or astronomer and night sky, is broken down and reconfigured. So, in Elson's case, thinking of the universe in terms of lambada dancers seducing astronomers is an exercise of the imagination that seeks to redefine the relationship between scientist and research: 'If . . . the universe ~~reveals itself shows~~ appears to you' (*ARTA* 83).

What new light, then, does the pun in 'lambada' throw on 'lambda', or the cosmological constant, or constellations? One of the main implications of dancing is movement, and in the case of the lambada, rapid movement. This image of a dynamic or energetic night sky full of movement ties in with the new cosmology: since Edwin Hubble's discovery of the expansion of the universe in the 1920s, the notion of a static, eternal, and fixed universe has disappeared and the opposite view of the cosmos has been strengthened with every new theory. Thus, the discovery of the cosmic microwave background radiation in the mid-1960s, the inflationary theory proposed by Alan Guth in the 1970s, according to which the early universe experienced a period of exponential growth, and, most recently, the discovery of the accelerated rate of expansion in the 1990s, which is designated by the updated cosmological constant, or dark energy, have further contributed to a vision of a lively cosmos, not filled with ancient gods and dead animals ('pinned like specimens upon the sky'), but rather with 'lambada dancers'.

The idea of an ever more complex universe is also discernible in Elson's poem 'Girl With a Balloon':

> From this, the universe
> In its industrial age,
> With all the stars lit up
> Roaring, banging, spitting,
> Their black ash settling
> Into every form of life,
>
> You might look back with longing
> To the weightlessness, the elemental,
> Of the early years.
>
> As leaning out the window
> You might see a child
> Going down the road,
> A red balloon,
> A little bit of pure Big Bang,
> Bobbing at the end of her string. (*ARTA* 12)

Here, the current age of the universe, which is commonly called the age of the stars, is described as the industrial era. Indeed, the onomatopoeia in the fourth line and the image of 'black ash' suggest images of a noisy and dirty factory and heavy machinery. The stars, in contrast to the elegant lambada dancers in 'Constellations', are here depicted as polluting space with 'black ash'. The romantic notion that we are made of star dust – carbon, a necessary element to life, is in fact created in stars – is undermined here: we are made of 'black ash' instead. In fact, the poem reveals a certain nostalgia for an earlier and simpler age of the universe, an era before even the first stars appeared. The loud industrial age of the stars is compared to a past and calmer stage of 'weightlessness'. The first chemical elements in the universe were helium and hydrogen (Kragh 181). Heavier elements, such as carbon and metals, were only created when the first stars exploded. Although helium is not directly mentioned in the poem, it is evoked in the last lines, which describe a girl holding a balloon – the word 'bobbing' suggests that the balloon is filled with a gas that is lighter than air, such as helium.

The contrast between the first stanza, with its unpleasant images of a loud and dirty factory, and the last lines of the poem, which connote simplicity and elegance, as well as an image of childhood and play, suggests a sense of frustration with the current cosmos. While 'Constellations' is more celebratory in its tone, 'Girl With a Balloon' to some extent expresses the struggles of stellar astronomy: not only has structure in the universe become much more complex, but

astronomers' understanding of the cosmos has also become vastly more complex, making the science ever more intricate. Studying the earlier stages of the universe, by contrast, is – perhaps unfairly – represented as a more straightforward task.

Katherine Hayles, in *The Cosmic Web*, analyses the interactions between literature and science and starts her study by observing that different epochs conceived of the cosmos utterly differently. Thus, while the universe has been thought of by the Deists in terms of clockwork and by romantic pantheists as an animated organism, Hayles identifies the predominant image of the modern cosmos as one of a dance (15). She draws parallels between the Romantic notion of an organism and the twentieth-century one of a cosmic dance based on the common idea of the 'dynamic, fluid nature of reality' and that the 'whole cannot adequately be represented as the sum of its parts' (17). If this notion of fluidity, instability, and change was based on the vitalist hypothesis of a living force in the Romantic era, these features are nowadays due to the 'breakdown of universal objectivity' (18). It is doubtless this uncertain apprehension of reality and the belief in a dynamic and changing cosmos that led Hayles to adopt the phrase 'cosmic dance' to describe our current conception of the universe. One of the most distinct features of twentieth-century thinking – the blurring of the lines between subject and object and the limits to our knowledge this entails – is in line with a Romantic philosophy, which was marked by a belief that reality could not be apprehended by rational thought alone and that the imagination played an important role in the study of the world as well (Hayles 18).

Thus, Elson's lambada dancers conform to Hayles's conception of the twentieth-century cosmos as a dance: not only do the lambada dancers suggest that the imagination is as important a tool in scientific investigation as rational thought; the way the lambada dancers and the astronomers are played with in the poem also suggests that there is no strict separation between object and subject. The notion of the dance also underlines the idea of the 'dynamic, fluid nature of reality' (Hayles 17). So, poetry and a science like Elson's can, to a certain extent, be seen as generically complementary. In fact, both poetry and astrophysics are concerned with identifying patterns and organising information. As noted earlier, astronomers spend much of their time sorting through the data they receive from the telescope or other instruments of observation. In that regard, Elson was trained in looking for relations and proportions between phenomena, an activity that poets are well-versed in, too. In her poetry, as in her science, Elson seeks patterns, analogies, models, and parallelisms in the world.

4.5 Conclusion: The Investigatory Properties of Poetry

The group of poet-scientists writing and working in the second half of the twentieth century is small, and so it is helpful that one of them voiced his views on the relationship between science and poetry. In fact, while the Czech immunologist and poet Miroslav Holub, already mentioned at several other points in this thesis, generally agrees with Elson in that the two disciplines can inform

each other, he diverges from Elson in his belief that his scientific training is of advantage to his poetry. Here is Holub writing in 1998 about how poetry is enriched by a scientific mentality:

> My argument is that there may be something like a scientific approach incorporated into something which may still be poetry, but not vice versa. Science in poetry may be represented by the hard-centred scientific thinking, by the elegance or incisiveness of scientific questions, and temporary solutions, but not by interpretations or versifications of scientific data of the sort seen in many learned magazines where biochemists may publish verses on the action of prostaglandins or physicists on quarks. ('Rampage' 11-12)

Holub believes that it is the 'hard-centred scientific' attitude, rather than scientific content, that enriches poetry. In this account, poetry seems to learn from the sciences a certain focus and rationality. Contrary to Roald Hoffmann, who claims that the composition of poetry trains the researcher's scientific writing skills, Holub sees the influence as running the other way: the scientific attitude improves poetry (Hoffmann 406). The rather dismissive description of what sounds like the kind of poetry Elson wrote – 'interpretations or versifications of scientific data' – makes it clear that Holub has little patience for poetry that explains scientific content. Later in his essay, Holub adds that 'scientific allusions in a poem . . . are some kind of anchors in the high seas of feelings, sympathies, hates, impressions, and memories' (23). Holub's reductive description of what sounds like romantic poetry would indeed benefit from the contrast that a scientifically minded poet would bring to it. Thus, while Holub and Elson both find a place for science in poetry, they have divergent opinions as to which of the two disciplines is improved by the other one.

Holub finds his poetry augmented by his scientific mind because he sees an opposition between poetry and science. This assessment of the intersections between poetry and science are not applicable to Elson's work because she does not conceive of the two as opposed to each other, but as complementary. My readings of Elson's astronomical poems have shown that rather than astronomy acting as an 'anchor' to her poems, her poems have unmoored her astronomical investigation. By turning the popular scientific narrative on its head and by giving celestial phenomena like dark matter and constellations agency, by imagining lambada dancers and traps in the night sky, the poet-astronomer uses the medium of poetry to shake up her astronomical research, to look at her work from a different viewpoint. In that regard, her transdisciplinary work is opposed to Catanzano's: if Catanzano uses principles and metaphors from cosmology and physics to find new directions in her poetic compositions and formal experiments, Elson uses techniques and tropes that are usually the realm of poetry and literature to guide her astronomical research. The resulting poems, far from being merely notes aiding the scientist, have value as stand-alone poems through their original metaphors and visualisations of the cosmos, which often dethrone the thinking and observing scientific subject and present a lively and agential universe.

As Elson's science precludes the possibility of creating controlled experiments in a laboratory, she conducts thought experiments in her poetry instead. Her thought experiments, however, are more creative and involve more elements than merely thinking through the implications of a given situation, which, for example, is the purpose of a thought experiment like Schrödinger's Cat. Elson's poems are not merely exercises of her deductive reasoning skills, but offer her a space where she can rely on her intuition and imagination and experiment with perspectival shifts and different visualisations of cosmic forces and phenomena. Elson's poems help her astronomical work by raising difficult, elusive questions, which emerge through the new relationships that she imagines between humans and the cosmos and astronomy and astronomers. What if galaxies are the by-product of dark matter, which fulfils a different role entirely? What instruments should be designed to detect dark matter? What if observers of the night sky are being duped by the constellations? In the opening poem of Elson's collection, the poet writes about how easily she can get lost in the innumerable data about the universe: '[a]nd I forget to ask questions, / And only count things' (9). In fact, her poems serve Elson as a space where she can ask the right questions and where she can reflect on her at times mechanical astronomical investigation, which, unfortunately, too often consists of many hours of making sense of and sorting through data on a computer. Her poems demonstrate that astronomical investigation is 'our collective psychic challenge', to use Alexander's phrase; it is an activity open not just to trained astronomers, but also to poets (Alexander, e-mail). What Elson's example demonstrates, then, is the investigatory properties that poetry can have. Instead of viewing poetry and science as two disparate activities, I have suggested that, in the case of Rebecca Elson at least, poetry and scientific research can interact fruitfully and perfect one another.

Conclusion: A Myriad of Universes

Given the very heterogeneous nature of the poems discussed in this thesis, one straightforward and holistic conclusion to the discussions and readings of these poems is not possible. Instead, I wish to stress the diversity of the poems in the corpus I charted in this thesis. Modern poems engaging with the universe and astronomy or cosmology range from lyric poetry in the Romantic tradition dominated by a feeling and wondering lyric I to more experimental and avant-garde poetry, characterised by open texts which foreground the materiality of language and the role of the reader in the creating of meaning and sense. Furthermore, if the poems exhibit a wide variety in forms and genres, the nature of their engagements with astronomy and cosmology differs too, ranging from wonder at the size of the cosmos to mining these sciences for their metaphorical potentials. In fact, even though the poems discussed here all refer to the modern cosmos and modern astronomical and cosmological knowledge about it, and despite the shared awe or alarm at the vast distances in space, the universe evoked by each poem is wildly idiosyncratic and unique to each poet. These poems demonstrate that the universe often serves as an abstract creative space for various political agendas and social activism, for literary and formal innovation, and, indeed, for astronomical research as well. In other words, Smith's humanist cosmos is remarkably different from Catanzano's surrealist cosmos, which is still very different from Alexander's lively and agential cosmos. The universe, as a vast unknown, is thus exploited by the poets in this thesis to project their own worries, fears, interests, and aspirations. In these findings, this study diverges from other studies of poetry and astronomy, such as Brothers' and Ebury's, whose primary texts reveal a more homogeneous engagement with contemporary astronomy.

The introductory chapter tackled the guiding questions I set for this project by analysing the collections of astronomical poetry edited by poets and astronomers with a similar interest to mine. The chapter analysed and discussed three anthologies in particular. The very different political and economic climates surrounding each publication notwithstanding, the three anthologies demonstrated that fascination with the universe and astronomy transcends generic borders and poetic movements. My discussions of the different poems' ways of creating sense, through their forms, prosody, and imagery, suggested that, in these anthologies, an engagement with the cosmos, astronomy, or aeronautics gives rise to changes in perspectives on human activity and existence. Thus, for Auden and Sexton, the personification of the moon allows them to create tacit links between misogyny, colonialism, imperialism, and the blind compulsion for technological progress. Holub's, Sleigh's, and Seidel's poems, on the other hand, express a certain alarm at our comparative insignificance in the face of the vast cosmos by juxtaposing human figures with the vastness of the cosmos in poems which foreground the emotive and affective human subject. Stanton's and Goldbarth's pieces demonstrate attempts to understand the implications of the

puzzling discoveries of cosmology. Their short poems are efforts to poetically evoke the incredible distances contained in such discoveries as the cosmic microwave background radiation.

Having established that some poets, although they remain largely invisible to literary critics, do react to contemporary findings in astronomy and cosmology in their writings, the thesis proceeded with a discussion of two American poets, Smith and Alexander, whose works reveal opposing approaches to cosmology. While they both take as departure points the immensity of space as illustrated in the Hubble Space Telescope images, they engage with this expansiveness in diverging ways. Smith fights the alienation one might experience when contemplating the cosmos with a focus on what is familiar and by filtering the experience of the universe through human-made objects and artefacts. Thus, her poem imagines space as populated by beings that are strikingly similar to humans while the psychedelic scenes of Kubrick's science fiction film it evokes put the cosmos itself at a remove from the perceiving subject. When the lyric subject does finally confront the cosmos, she is rendered speechless (because the poem ends on this note) by how 'brutal and alive' this cosmos appears (*Life on Mars* 12). The idea that the universe is alive and has agency is a leitmotif of Alexander's astronomical and cosmological poetry. The poet uses the cosmos and modern astronomical knowledge to construct an ecocritical and political argument about the importance of reconfiguring our relationship to our surroundings, in the grandest sense. He achieves this by dissolving lyric subjectivity in extra-terrestrial water and assuming the consciousness of a plethora of nonhuman and non-organic things and concepts, thus portraying a superbly weird Mars that diverges starkly from the Mars we know from photographs. A poem like Alexander's that delights in surreal and strange representations of an alternative Mars, filled with life and movement, challenges the hubristic belief that we can command our surroundings by suggesting that we are part of a cosmos we do not completely understand.

If Chapter Two considered two poets' emotional, intellectual, and artistic reactions to the inconceivable distances and time scales in the universe, Chapter Three studied how two other poets, Morgan and Catanzano, found in cosmology and spaceflight complex imagery and metaphors to theorise about the limits of language, the border between the sayable and the ineffable. Specifically, the early steps in the history of spaceflight and the implied difficulties of experiencing outer space as well as the images of black holes, the distortions of space-time, and the multiverse served Morgan and Catanzano in their writings about love and romantic relationships. Morgan's poem about his clandestine yet life-changing relationship with Scott performs the taboo of same-sex love on the level of form: not only does the syntax, through the extended withholding of a conclusion to the subordinate clauses, preclude a denouement to the built-up tension, but the venture into outer space in the form of the episode of Laika in the middle stanza, which is preceded and followed by stanzas depicting homoerotic scenes, acts as a type of hole swallowing up or censoring Morgan's secret. Catanzano's play with black holes and Einsteinian physics in textual form skirts the edges of language too. In her novella, in which love disintegrates into its composite parts (as shown in the jumble of letters composing 'love'), imagery and complex metaphors taken

from astrophysics and cosmology fuse in a four-dimensional text which suggests that love and romantic bonds between people lie outside of language (and physics, as black holes are singularities).

Chapter Four investigated my research questions from the perspective of somebody who works in both fields – astronomy and poetry. Close readings of the intricate and astonishing metaphorical relationships that Elson's poems establish with cosmology showed how her poetic thought experiments allow her to approach her astronomical research from a different angle. Thinking of her science in terms of analogies and metaphors is not unusual as the examples of astrophysicist Gandhi and chemist Hoffmann demonstrate. Her dense, almost imagist, poems go beyond the role of providing helpful analogies and metaphors for the research, however. As the metaphors are established in poetic language, their networks are complex, creating links between words and concepts that are grammatically, syntactically, or even phonetically bound to each other. In this these metaphors are more complex than the simpler analogies used in science writing. Furthermore, their implications are far-reaching: conceiving of the cosmos as such a richly connotative idea as a spider's web has ramifications for scientists' ideas and perceptions of the universe. It tacitly suggests the idea that dark matter might play a much more important and perhaps sinister role in cosmology than most astronomers assume, and that our galaxy is analogous to an autumn leaf stuck in this spider-web.

Further research in this practically unmapped field of modern poetry and modern astronomy will hopefully bring to light more poets who engage with astronomy and cosmology. As a larger body of astronomical poetry is established, more general conclusions about this type of poetry may be drawn than this study has been able to find. Moreover, as public perception of the sciences is shifting, from viewing them as an uncontested authority on the natural world to viewing them with a growing scepticism (fuelled by populist political leaders) in the recent political climate, different relationships between poetry and science might be mapped in which, rather than perceived as rivals, the two disciplines are seen more to complement one another.

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