REPRESENTING THE UNKNOWN: A COMPARATIVE STUDY OF CHESLEY BONESTELL AND DAVID KIPPING'S REPRESENTATIONS OF OUTER SPACE

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ABSTRACT:

The representation of space has long captivated the public, artists, and scientists alike, inspiring them to envision the uncharted expanses beyond our planet and make representations of the cosmic unknown. Chesley Bonestell, a pioneer of space art, enthralled audiences with his vivid paintings of distant worlds, while David Kipping, a contemporary astronomer, harnesses YouTube to transport viewers into speculative realms. Despite their differing mediums, both Bonestell and Kipping expand our understanding of outer space through cosmological representations that bridge the gap between naked-eye observation and advanced technological mediation. By examining how scientific inquiry and artistic creativity intersect, this study compares their works, explores their creations aligned with advancements in observational technology – particularly through the lens of Immanuel Kant and Edmund Burke's sublime – in the broader context of astronomy and cosmology.

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CHAPTER 1
INTRODUCTION

1.1 Introduction and Context

Astrophysics and space exploration may seem distant from everyday experience, as the universe's sheer scale defies comprehension. Throughout history, humans have sought ways to make sense of this vastness through observation, documentation, and artistic representation. Nicholas Mirzoeff (1999:13) suggests these moments of observation are more than passive acts, they are "visual events", dynamic interactions between the viewer, the object viewed, and the technology or medium that brings the image into focus. This drive towards meaning-making has shaped both philosophical inquiry and technological advancements, allowing us to attempt to represent and interpret the unknowns of the cosmos with increasing clarity and in new ways.

One central precept of this study is to examine how we engage with representations of the cosmos, from naked eye to advanced technological proxies. Through a comparative analysis of Chesley Bonestell's (1888-1986) astronomical paintings and David Kipping's (1983-) digital visualisations, this study examines a spectrum of engagement – unmediated observation (fully embodied), mediated embodied observation, and fully disembodied mediation – and its role in evoking the sublime, as theorised by Edmund Burke (2005 [1757] and Immanuel Kant (1914 [1790]). Whether gazing at the stars, peering through a telescope, looking at an artwork, or interpreting data from space telescopes, our experience is shaped by technology and translated through human perception, revealing more of the unknown as direct observation recedes.[1]

Moreover, this study also highlights the continual interplay between cosmology (theoretical interpretation) and astronomy (practical observational science) in the creation and interpretation of these representations, underscoring how awe and

[1] The spectrum of engagement and its paradox of greater technological distance revealing more is unpacked in Chapter 3.

wonder can emerge precisely in the overlap of these two domains.[2] The process of representation and engagement is complicated by the emotions it evokes. The vastness of space, its incomprehensible distances and scales, conjure feelings of the sublime as theorised by Immanuel Kant and Edmund Burke, oscillating between awe, terror, wonder and an overwhelming sense of insignificance. These emotional responses, not only to the subject matter, but also towards the technology that mediates it, form the lens of this dissertation.

These three modes of engagement contribute to this experience in different ways. Looking up at the night sky without instruments may provoke an existential sense of the sublime, a confrontation with the infinite. A magnified view through a telescope enhances the feeling, revealing the hidden details of celestial bodies. But does technology itself become a source of the sublime? The sheer scale, complexity, and cost of space telescopes like Hubble and James Webb might provoke a sense of wonder not only at what they reveal but at the machines themselves, machines built to extend human perception beyond earthly limits.

The act of representation itself is deeply tied to this interplay of observation and emotion. Before the era of space travel, artists like Chesley Bonestell crafted visual representations of distant worlds based solely on terrestrial telescopic observations. His paintings offered viewers a journey to places that could not yet be reached, evoking the sublime through both scientific accuracy and artistic imagination. These images became stand-ins for direct experience shaping public perception of the cosmos long before human spaceflight made actual photography possible. Even today, with advanced imaging technologies, artists and scientists alike continue to represent the unknown, offering interpretations of celestial phenomena that remain beyond direct human experience.

A contemporary example of this representational practice can be seen in the work of Professor David Kipping, whose digital visualizations bring the cosmos to life on his YouTube channel, Cool Worlds (Cool Worlds Lab, n.d). His speculative journeys are grounded in scientific knowledge but remain entirely conceptual. No human will ever

[2] The interplay between Astronomy and Cosmology is explored in section 1.2.2 of Chapter 1.

travel to these realms, yet his representations serve a similar function to Bonestell's paintings in that they translate the unseeable into something graspable, something that evokes wonder and curiosity. Here, representation does not merely depict the cosmos, it constructs it for human comprehension, shaping the way we engage with the unknown.

Our experience of space is always mediated, whether through direct sight, enhanced vision, or technological representation. Our interaction with these representations, and the emotional response to them is based on the mode of engagement which in turn continuously redefine our relationship with the unknown vastness of the universe.

1.2 Key Concepts and Need for the Study

Advancements in technology and the human species' hunger for exploration have systematically been unfolding and exposing the mysteries of space and the unknown. Labelled as one of the "oldest of sciences" (Ridpath 2006:16), astronomy has intrigued and fascinated human civilisation for centuries. Between the 16th and 17th century, remarkable progress was made in the realm of scientific experimentation and observation as Ridpath (2006:18) notes that "European astronomy was awoken from its dormancy" during the 16th century by Nicolaus Copernicus, a Polish clergyman and astronomer. Although religious tensions were at their peak, marked by the rise of fundamentalism and superstition, along with a surge in executions related to heresy and witchcraft, scientists began to perceive the universe as a structured entity governed by inherent and foreseeable laws (Adams 2007:627). Early astronomers such as Galileo Galilei made use of the first version of the optical telescope in 1609 and through his discoveries and research introduced us to Jupiter's four main moons, also known as the Galilean satellites (Ridpath 2006:22). Galileo's introduction to new possibilities of observation opened the door for "a technologically mediated view" (Kessler 2012:19) of space and the unknown.

1.2.1 Presenting, Representing, and the Unknown

The use of language in this study will often refer to representations of scientific hypothesis and complex astronomical ideas. These ideas, figures, distances, and

celestial depictions are often based on complex calculations, interpretations of scientific data, and the imaginative efforts of those attempting to render the inaccessibility of outer space comprehensible to the layperson. When this study refers to the unknown, it should be considered that the unknown does not necessarily refer to that which we do not know but rather to that which might be too complex to (re)present in an understandable way, or even that which may be interpreted in various ways depending on one's frame of reference. Bruno Latour (1987:69) refers to "inscriptions" or representations that emerge through the process of translation, where the incomprehensible is mediated into provisional forms – images or models – that bridge the gap between the unknown and the known. When these representations are made, they use visual techniques that "position the viewer at the threshold between the known and unknown" (Kessler 2012), effectively staging a perceptual space in which uncertainty can be contemplated rather than resolved. As Latour (1986:15) notes, "scientists start seeing something once they stop looking at nature and look exclusively and obsessively at prints and flat inscriptions", a shift that underscores how understanding often emerges not from direct observation but from engaging with visual representations designed to stabilise and communicate what cannot otherwise be seen.

Artistic depictions of that which we cannot physically experience, are found in both Bonestell and Kipping's work. These science fiction works present and represent the unknowns of astro-exploration even though the scientific information on which these creators base their work, is well proven and grounded in science fact. Kessler (2012) explains:

> Astronomers hold complex attitudes toward images, and they have carefully crafted images from Hubble Space Telescope in a manner that satisfies their need for a scientifically valid representation of the data as well as their desire to evoke a particular aesthetic response. The resulting views of the cosmos engage both reason and the senses, and to grasp them fully we must allow the images to activate both faculties, thereby replaying the experience of the sublime.

Kessler's observation underscores the synergy between scientific rigor (astronomy) and aesthetic expression (cosmology), showing how astronomical imagery is carefully constructed to convey empirically valid data while also prompting an emotional or

imaginative response. In the context of this study, it highlights how these images not only inform viewers about the realities of space but also invoke a sense of awe, bridging the gap between empirical understanding and the compelling mystery that fuels both scientific inquiry and creative exploration.

When examining the complexities in the understanding, exploration, and visualisation of the universe, it becomes apparent that it would be a futile venture without the assistance and advancement of technology. Kant (1914 [1790]:111) refers to "concepts of number" when exploring our understanding of the magnitude of natural concepts such as space. Even though space is nature, or forms part of these natural concepts, and cannot be classified within the bounds of human technologies, its exploration and essential definition, is limited to technological advancement over centuries, linking to Kant's concepts of the mathematical sublime. However, the numerical values linked to the size and distances associated with the cosmos remain beyond comprehension for most. Terms such as 'speed of light' and 'lightyears', or even numbers such as a billion present themselves as easily digestible linguistic explanations, but still the incredible size of these terms remain beyond possible visual representation. The universe is estimated to be around 13.8 billion years old (Phillips 2013). If a person attempted to count to 1 billion, they would have to count nonstop for almost 32 years. Even though this is an attempt to illustrate the magnitude of the number, it remains beyond comprehension for the human mind.

For most of human history, our fascination with the night sky relied on visual observations or what Kessler (2012:19) terms "naked perception", a visual experience where observers rely solely on their unaided eyes to perceive celestial objects. Kant (1914 [1790]:111) refers to the "measurement of the eye" and the aesthetical value of visual intuition. In this pre-technological context, the limited understanding of the cosmos produced limited representations related to the understanding of the cosmos. The Egyptian Pyramids and Stonehenge in England date back to 2500BCE and depict considerable alignment with astronomical significance (Ridpath 2006:16), since then observations of space have been clearly documented and shared as representations of the unknown. For hundreds of years these observations were limited to optical technologies, such as telescopes. Advancements in technology within the field of astronomy has seen mankind move beyond the visual as Kessler (2012:21) notes,

"new technologies and perceptions arise novel ways of representing phenomena" linked to space. That which was limited to visual observation, and the development of radio and infra-red telescopes lifted the veil on the unknownable of space and made the sky appear "radically different from what we see in visible light", (National Aeronautics and Space Administration 2010). Ironically, the depiction of radio and infra-red images are in effect a technological representation on the "electromagnetic spectrum", data that is "beyond the visual spectrum of light" rather than an actual visual image (National Aeronautics and Space Administration 2010).[3]

In addition, our perceived understanding of incredible scale when referring to light years, the speed of light, the size of, and distance between galaxies, or even large numbers such as a billion are merely mediated or represented due to the sublime nature of these scales. The concept of the sublime gets thoroughly unpacked in the literature review of this study as the concept of the sublime forms a framework or lens through which I examine the representation of space and the mysteries of the cosmos.[4] The focus is, however, not on delving into the intricacies of the sublime itself, but rather on applying the theories of seminal thinkers like David Nye, Immanuel Kant, and Edmund Burke as interpretive lenses. It becomes essential to highlight how these theories intersect with the realms of nature and technology in the context of space exploration and representation, but moreover perhaps, the personal emotions that are evoked through interaction with the subject matter. It is thus the aim of this study to investigate what it means to represent the incomprehensible, or unrepresentable cosmos, and how these representations might evoke the sublime.

The journey of attempting the comprehension of the cosmos has shifted from ancient naked perceptions of the night sky to contemporary technologically mediated representations. Overcoming the limitations of unaided human sight, innovative tools like the optical telescope propelled our understanding to new levels. However, even with these advancements, the enormity and complexity of space, defies easy visualisation. This study examines the interplay between human perception and technological progress, exposing how the imagination in collaboration with technology

[3] See Figure 22.
[4] See Chapter 1, page 36.

and science, may be able to provide representations of the incomprehensible. This study will examine selected contributions of Chesley Bonestell and David Kipping, delving into their distinct artistic techniques, use of medium, and thematic approach to producing cosmic representations of that which had not yet been explored. Evidently, representations of the cosmos are shaped by a dynamic relationship between the imagined and the factual.

1.2.2 Astronomy and Cosmology

The study of the universe is divided between two distinct yet interwoven disciplines: astronomy and cosmology. Astronomy, as Ian Morison (2008:1) notes, is an observational science that relies on empirical data to map and understand celestial objects. It is grounded in direct measurement, describing the positions, motions, and properties of stars, planets, and galaxies through observation. By contrast, cosmology, as Andrew May (2024:52) describes, is an inquiry into the “universe as a whole”. It is concerned not merely with what is seen but with theoretical structures that seek to explain the origins, evolution, and nature of the cosmos. While astronomy is rooted in the “practical” (what can be observed and quantified), cosmology is “entirely theoretical”, expansive, speculative, and deeply tied to “human imagination” (May 2024:52).

Astronomy as discipline is thus constrained by the limits of perception and technology, bound by what can be recorded and analysed. Morison (2008) acknowledges this distinction, emphasizing that astronomy can only validate theories through observation rather than controlled experimentation. Cosmology moves beyond this limitation as it is concerned with interpretation of the universe beyond its documentation, seeking to construct a coherent narrative about its fundamental nature. May (2024:52) points out how cosmology is not solely dependent on observation but rather extends into conceptualization. This distinction positions astronomy as a science of the known and cosmology as a study of the unknown, an attempt to theorize what cannot be measured.

Despite their difference, astronomy and cosmology remain deeply interconnected. Theories in cosmology require validation through astronomical observation, while

discoveries in astronomy often lead to cosmological speculation. For instance, Morison (2008:310) discusses how the study of the cosmic microwave background (an observational phenomenon) serves as crucial evidence for Big Bang models, anchoring cosmological theory in empirical data. Similarly, May (2024:52) highlights how scientific advancements in astronomy continually push the boundaries of cosmological thought, allowing speculation to be refined into structured theory. The relationship between these two disciplines is thus not one of opposition but of continual dialogue, where observation fuels imagination, and imagination, in turn, shapes observation.

Moreover, this interplay raises questions about the act of representation itself. Humans begin by perceiving celestial bodies at great distances, yet our minds extend these observations, envisioning details beyond reach. May (2024:52) suggests that technological advancements have enabled us to bridge the gap between what we see and what we imagine, yet representation remains an interpretive process. Morison (2008) acknowledges that while telescopes reveal ever more details of the cosmos, they do not eliminate the human need to construct meaning from what is seen. In this way, both astronomy and cosmology operate at the boundary between observation and conceptual interpretation, blurring the line between science and art.

Thus, while astronomy and cosmology serve different functions, they are ultimately sides of the same intellectual pursuit. Astronomy supplies the raw material of discovery, while cosmology frames these discoveries within broader existential questions. The constant exchange between them ensures that neither remains static. Each informs the other shaping our evolving understanding of the cosmos. In this intersection, the act of looking outward becomes not just an exercise in measurement but an engagement with the unknown.

1.3 Aims and Objectives

The representation of space has captivated artists and scientists alike, inspiring them to envision the unexplored frontiers beyond our planet. Chesley Bonestell, a pioneer space artist, captured the imaginations of millions with his vivid paintings depicting fantastical scenes of distant worlds. On the other hand, David Kipping, a contemporary

astronomer, utilises the power of YouTube videos to transport viewers into uncharted territories of space. Despite the disparity in their chosen mediums, both Bonestell and Kipping contribute to our understanding of the unknown realm of outer space through their cosmological representations. This study aims to compare and contrast their works, explore the role played by technology in their artistic processes, examine the sublime aspects of their creations and representations in the context of the intersection of astronomy and cosmology.

Through this comparative study, I embark on an exploration of the intricate challenges inherent in visually representing and technologically mediating the complexity of the unknowable or unexplored realms of space. The representation of space has long held a captivating allure for both artistic visionaries and scientific pioneers. As Campbell (2016:63) notes, “public interest and enthusiasm for space science imagery has made the space sciences one of the most deliberately visual of sciences”. Bonestell and Kipping inspire audiences by envisaging the uncharted frontiers that extend our imagination attempting to enhance our understanding or comprehension of the cosmic unknown.[5]

By comparing and contrasting the artistic works of Bonestell and Kipping, the study also sheds light on the pivotal role of technology in shaping the representations of the cosmos whilst understanding that the unique interaction between science and art in these representations may evoke feelings of the sublime. Thus, the use of the sublime as lens in the meaning making of these representations will assist in deepening our understanding of how we grapple with the immense and the unknown and how artistic representation may shape our experience of the cosmos.

The study focuses on the following aspects and objectives:

a. Comparative Analysis of Bonestell and Kipping:

[5] Although Bonestell and Kipping form the foundation of this study, numerous other artists and platforms have contributed significantly to the visualisation of the cosmos. These include figures such as Lucien Rudaux, Ron Miller, Jon Ramer, Jules Verne, and Scriven Bolton (Ramer 2021). Additionally, YouTube channels like those of John Michael Godier, Isaac Arthur, and Fraser Cain offer engaging and imaginative representations of space to wide audiences (Godier, Arthur, & Cain, n.d.).

The dissertation analyses selective works of Chesley Bonestell and David Kipping, focusing on their respective artistic styles, thematic approaches, and the unique qualities of their chosen mediums. By identifying commonalities and differences, the research demonstrates how these artists approach the representation of space and evoke a sense of wonder and exploration in their audiences.

b. Technology and Representation:

Drawing upon W.J.T. Mitchell's (1986, 1996, 2005, 2015) theories on images, the study examines the role of technology in the artistic process of Bonestell and Kipping. It explores how technological advancements, such as telescopes, digital tools, and social media platforms (such as YouTube), enable artists to create representations that bridge the gap between the known and the unknown. By analysing the use of technology in their works, the research highlights how these artists harness scientific advancements to depict the mysterious and sublime nature of space.

c. The Sublime in Representations of Space:

This study is grounded in the aesthetical concept of the sublime as outlined by Edmund Burke (2005 [1757]) and Immanual Kant (1914 [1790]). It examines how the works of Bonestell and Kipping convey awe, vastness, and transcendence, thus evoking a sense of the sublime in viewers. By analysing specific examples from their works, this study highlights the potent impact of these representations on the audience, while also investigating the role of technological mediation in shaping the experience of the sublime.

d. The Known and the Unknown: Representation and Accuracy:

Both Bonestell and Kipping base their representations of space on existing knowledge, theories, and observations (astronomy). The study explores the relationship between these elements, and how they inform the visual, technological, and ultimately imaginative (cosmology) representations of space.

Bonestell, known for his science fiction-inspired paintings, “combined his extensive knowledge of astronomy with artistic skill” (Voon 2014) to create imaginative depictions of planets. Despite the speculative nature of his works, Bonestell incorporated scientific principles and astronomical data to envision what space exploration might look like. Bonestell’s works would “shape American perceptions on space at the dawn of the Space Age” (Foust 2020). As technology advanced and humans ventured into space, it became apparent that Bonestell's artistic interpretations had an unexpected level of accuracy. Voon (2014) notes:

> Although his designs may seem antiquated today with their muted coloring and retro aesthetics, many ended up predicting actual developments in space exploration.

His ability to blend scientific knowledge with artistic creativity allowed him to present a plausible representation of the unknown.

On the other hand, Kipping takes a different approach to representing space through his YouTube videos. While his works may appear more speculative or fictional, they also draw heavily from scientific knowledge and current understanding of the cosmos. Kipping utilizes “novel methodologies and modern data science techniques” (Cool Worlds Lab, 2016-2025) to accompany the viewer on an impossible journey through the unexplored regions of the cosmos. By leveraging the available information, he constructs immersive experiences that transport viewers to distant celestial landscapes. Although Kipping's videos may currently be considered science fiction, they possess the potential to become validated representations in the future as our scientific understanding of the universe expands.

By comparing Bonestell's historical representations with Kipping's contemporary approach, the research highlights the common thread of using existing knowledge to represent the unknown. Both artists leverage scientific theories, observations, and technological advancements to bridge the gap between what is known and what is yet to be discovered in the vast expanse of outer space. They serve as creative interpreters, presenting visualisations that provoke curiosity and wonder while maintaining a connection to the scientific foundations of space exploration.

The study shows that the works of Bonestell and Kipping showcase the interplay between established knowledge and artistic imagination, highlighting the potential for accurate representations of the unknown through a combination of scientific understanding and creative vision. As humanity continues to explore and unravel the mysteries of space, these representations serve as glimpses into what may lie beyond our current understanding, blurring the line between science fiction and scientific reality.

1.4 Theoretical Framework

This study is located within the field of digital culture and media. The study takes a critical look at the digital technology that makes the representation of the cosmos possible but also considers the image and its impact on understanding of the complexities of space. Even though this study touches on technical aspects of astro-science, it is not necessarily a scientific interpretation of cosmology, but rather a philosophical discourse analysis through comparison and contrasting of the old and new (Bonestell and Kipping).

The visualisation and representation of the complexities, vastness, scale, or even imaginative interpretation of the unknown of space, ultimately relies on imagery. Consequently, this study's theoretical approach is significantly grounded in the study of the image, drawing on W.J.T. Mitchell's framework from *What Do Pictures Want* (2005). Whether it is interpretations of scientific data, imaginative exploration of the unexplored cosmos, depictions of that which lie beyond the visible light spectrum, or attempts to visually present the incomprehensible, the image plays a critical role in constructing meaning. Mitchell (2005) challenges traditional understanding of images as passive objects, instead proposing that images possess agency and intention – that they actively participate in communication and meaning-making. A key question by Mitchell (2005) however is, what do images want. Mitchell (2005:28) explains:

> When the question of desire is raised, it is usually located in the producers or consumers of images, with the picture treated as an expression of the artist's desire or as a mechanism for eliciting the desires of the beholder.

In the context of this study, this perspective allows for an exploration of space imagery not merely as a reflection of scientific knowledge or artistic imagination, but as dynamic agents that shape how we perceive and emotionally engage with the unknown. The image, in this sense, becomes a site of negotiation between the visible and invisible, the factual and the speculative. In Bonestell's instance, his paintings desire to transport viewers to alien landscapes, evoking the sublime through a fusion of telescopic precision and speculative wonder, while Kipping's digital visualisations seek to unravel cosmic mysteries, inviting awe at scales and concepts beyond human reach. Through Mitchell's lens, these images emerge as active mediators, bridging astronomy's empirical foundations with cosmology's boundless imagination.

Another theoretical approach of this study utilises the concept of the sublime, which serves as a lens through which the representation of cosmic unknowns is critically examined. This research draws specifically from the foundational theories of the sublime developed by Kant, Burke, and Nye. Burke's (2005 [1757]) emphasis on the sublime as that which overwhelms the senses – particularly through vastness, obscurity, and power – offers insight into the emotional intensity evoked by space imagery. Kant's (1914 [1790]) notion of the sublime, particularly the mathematical sublime, relates to the encounter with something so immense that it exceeds our capacity for direct comprehension, yet reaffirms the power of human reason to conceive of the infinite. Nye's (1994) articulation of the technological sublime helps contextualise the awe inspired by technological imagery of space – especially in an age dominated by telescopes, probes, and digital simulations. Rather than treating the sublime as central focus, this study strategically applies it to the works of Bonestell and Kipping, showing how their depictions of the cosmos elicit responses rooted in scale, uncertainty, and the thrill of imagined frontiers.

It is essential to clarify that the sublime in this context functions as a lens of understanding rather than a means of rigid interpretation. When identifying elements of the sublime in the artworks of Bonestell and Kipping, it should be viewed as a contributing factor in reaching the broader analysis of these representations. This approach recognises that individual responses to their works may vary, yet it seeks to uncover the artist's intent in provoking sentiments akin to the sublime.

A more direct application of the theory lies in the deliberate and conscious effort made by these artists to create depictions of outer space, scientific theories, and imaginative portrayals of the enigmatic and often incomprehensible aspects of the cosmos. This study consistently delves into the exploration of space beyond the realm of human experience which forms a recurrent theme throughout the comparison of Bonestell and Kipping's work. To effectively navigate these representations the study places significant emphasis on the role of the image as elucidated by Mitchell's theories. This approach underscores the pivotal role of technology and the diverse mediums employed to interpret visualize and communicate intricate ideas about space, ultimately culminating in the works of Bonestell and Kipping. These representations in turn are represented through vastly different mediums and make use of different technologies in both the interpretation of cosmic ideas, as well as the (re)presentation thereof.

In summary, the theoretical framework of this research is rooted in the sublime as a lens of understanding by comparing and contrasting representations of the unknown. The study identifies the sublime using strategic elements within the representations made by Bonestell and Kipping – such as scale, vastness, contrast, isolation, ambiguity, and light – to evoke awe and unease. Furthermore, the theoretical framework applied to this research focuses on the role of the image and technology in mediating our engagement with these representations.

1.5 Research Methodology

Discourse analysis forms the foundation of this study. Gillian Rose (2012:195) explains that discourse analysis "tends to pay rather more attention to the notion of discourse as articulated through various kinds of visual images and verbal texts than it does to the practices entailed by specific discourses". YouTube acts as a very densely populated medium of visual imagery and verbal text aligning itself as a perfect medium to be examined through discourse analysis. Rose (2012:195) explains that "discourse analysis can also be used to explore how images construct specific views of the social world, in which case ... visuality is viewed as the topic of research, and the discourse analyst is interested in how images construct accounts of the social world." When

examining the visual content shared by an individual online, discourse analysis acts as the ideal tool to understand depictions of the unknown.

Rodney H. Jones et al (2015:4) identifies four elements that discourse analysis engage on. When applying these elements to this study, the following methodology may be applied:

The first element refers to texts, which encompass not only written words but also the visual and symbolic elements that constitute the cosmic narratives of Kipping and Bonestell. “Different technologies of entextualisation allow us to combine semiotic elements to form socially recognisable texts” (Jones et al 2015:4) that may serve as a way of conveying our understanding of the cosmos.

Secondly it is important to consider the different contexts in which representations are interpreted (Jones et al 2015:4). Bonestell’s works emerge from an era before space travel, so understanding the historical conditions of that time is crucial in assessing their impact. By contrast, an analysis of Kipping’s work must account for the digital age and significant advancements in astro-science.

Linking to contexts, is the way the audience interacts with the text. Jones et al (2015:4) notes “what people do with texts” sheds light on the broader societal impact of the texts. These interactions may then range from sparking scientific inquiry and fostering collaborative knowledge-sharing to inspiring philosophical debates and artistic expressions.

Lastly Jones et al (2015:4) explores how texts are used to “dominate and control others and to create certain versions of reality”. Representations are thus not devoid of “power and ideology” (Jones et al 2015:4) and can be wielded to shape perceptions. By examining how cosmic texts are employed to construct a specific narrative, it is possible to gain insight into the broader cultural and social implications of these depictions.

Effectively, understanding the interplay of texts, contexts, actions, and power dynamics enriches the discourse around representations of space and the unknown.

This study makes use of a literature study, visual observation and analysis of video whilst also examining the context and development of both observational technology and art over time. Through a comparative analysis of the artistic creations of Bonestell and Kipping, the study highlights the significant influence of technology on the portrayal of the cosmos. It explores the distinctive interplay between scientific and artistic elements within these representations, focusing on the way in which these representations are made, both in medium and context.

Employing a qualitative research method, the investigation applies the philosophy of the sublime and its relevance to representations of the cosmos in the works of Bonestell and Kipping. Centered on the analysis of an array of visual imagery and video pertaining to astronomy and representations, the research draws on the works of Mitchell and the role of the image in conveying meaning. Its visual methodology is grounded in discourse analysis.

1.6 Review of Literature

This literature review explores the intricate relationship between art, images, technology, and the concept of the sublime in shaping our exploration and understanding of the cosmos. By examining the historical role of astronomical art, the transformative power of technology in depicting space, and the use of different mediums, this study gains a comprehensive understanding of how these elements have influenced our perception and representation of space. This literature review also attempts to fill a need or gap through its critical analysis of the evolving ways in which art, technology, and the sublime intersect, shedding light on their collective impact in shaping our exploration and comprehension of the cosmos.

1.6.1 Astronomical art

Space art or Astronomical art offers a unique perspective and visual language that allow us to explore and analyse how artists have envisioned and interpreted the mysteries of the cosmos. By examining the works of artists in this genre, one can gain insights into the cultural, social, and scientific contexts in which these representations

emerged. The International Association of Astronomical Artists (IAAA), *What is Space Art?* (2015) introduces the theme of space art as the "genre of modern artistic expression emerging from the knowledge and ideas associated with outer space, both as source of inspiration and as a means for visualizing and promoting space travel". The visual representations of space art cultivate a sense of awe and wonder but particularly intend to represent that which the viewer cannot experience first-hand.

Roger Malina (1991:145) describes artists and astronomers as "natural allies in the peaceful exploration of space". During the period preceding physical exploration of space, astronomical artists played a pivotal role in shaping the conceptualisation of the cosmos and its potential characteristics. The IAAA, *What is Space Art?* (2015) explains:

> For decades, practitioners of the visual arts have explored Space in their imaginations using traditional painting media. Many are now using digital media toward similar ends. Science fiction magazines and picture essay magazines were once a major outlet for Space Art, often featuring planets, space ships and dramatic alien landscapes. Chesley Bonestell, R. A. Smith, Lucien Rudaux, and Ludek Pesek were some of the major artists in the early days of the genre actively involved in visualizing space exploration proposals with input from astronomers and experts in the infant rocketry field anxious to spread their ideas to a wider audience. A strength of Bonestell's work in particular was the portrayal of exotic worlds with their own alien beauty, often giving a sense of destination as much as of the technological means of getting there.

In their comprehensive classification of space art, the International Association of Astronomical Artists (IAAA 2015) delineates distinct categories that encapsulate the expressions within the realm of space art. The first category, Descriptive Realism, centres on the portrayal of "scientifically accurate depictions of alien places in the cosmos" (IAAA 2015) where precision and authenticity take precedence. Contrasting this approach, "Cosmic impressionism" (IAAA 2015) ventures into the realm of artistic interpretation through the use of colour and form to convey the artists impression without necessarily being "scientifically precise" (IAAA 2015).

The third category, labelled Hardware Art, shares similarities with Descriptive Realism, but shifts its focus towards the technology used in space exploration. Artists in this category find inspiration in the intricate machinery of space, encompassing spaceships, probes, and various equipment that contribute to cosmic endeavours (IAAA 2015). In the domain of "Space Sculpture" (IAAA 2015) art transcends the two-dimensional canvas, manifesting as three-dimensional, symbolic, and abstract works that capture the essence of the cosmos (IAAA 2015). This category explores the fusion of art and space in a sculptural dimension.

Cosmic Zoology forms the fifth category and delves into the realm of speculation and depiction of extra-terrestrial life in the cosmos (IAAA 2015). Artists in this category envision and portray diverse forms of life beyond Earth, igniting the imagination and encouraging contemplation about life beyond our planet. The final category of "Astronomical Photography" (IAAA 2015) encompasses an unconventional yet captivating facet of space art that is often sourced from extra-terrestrial photography captured by space probes. These images are framed with a primary emphasis on aesthetics rather than purely scientific value (IAAA 2015). Artists in this category contribute a visual dimension to our understanding of the cosmos, merging the realms of science and art for a unique perspective on the universe.

Malina (1991:145) argues that over time, artists contributed to the promotion of space exploration. Ron Miller (1996:139) agrees with Malina in stating that "space art proved to be a major influence on the public's perception of the universe as well as on the development of space exploration". It is thus important to note the impact of space art on not only the scientific push for space exploration, but also the broadening of perspective on those who aren't necessarily scientifically gravitating towards space exploration. Artists thus play an important role in the promotion of space through their often easier to understand depictions of the cosmos. Kessler (2012:6) notes however that astronomers often refer to visual representations of space as "pretty pictures" and that they do not further the pursuit of pure scientific principals but could rather act as a diversion:

> The art historian James Elkins, who has written extensively on the relationship between art and science, has been emphatic in his dismissal of scientific images made for public display, seeing such

> pictures as contributing to what he calls “astronomy’s bad reputation” for producing flashy but scientifically uninteresting images. Elkins reject images made for display because he sees them as a distraction from what he considers to be far more interesting astronomical images, namely those that scientists use only for acquisition of knowledge.

When considering the period of Bonestell’s work and the impact it had on advancements in space exploration, it can be argued that his depictions were in fact much more than simply “pretty pictures”. What these artworks do, is effectively introducing the unimaginable and presenting the unknown, inspiring “a sense of wonder about the universe” (Miller 1996).

Astronomical art serves as a valuable source of inspiration and visualisation firmly rooted within cosmology, capturing the imagination, wonder, and vastness of the universe. It provides a visual bridge between scientific knowledge and artistic expression, offering a diverse range of creative responses to the complexities of the unknowns of space.

1.6.2 Mediating the Cosmos: Technology and Representation

This section explores how technology revolutionised our ability to depict space and the cosmos. Adrianne Santina (as quoted in Kiliçkiran, Alegra, Haddrell 2013:99) argues that “while today advanced technologies create photographic representations of outer space, just over half a century ago, such depictions appeared in an ancient technology: painting.” In the previous section this literature review examined the importance of astronomical art in understanding the universe. Technology has however “transformed what we see and represent of the cosmos” (Kessler 2012:22) and revolutionised our grasp on space and provided us with new ways of representing the unknown. By harnessing the power of telescopes, both terrestrial and space-based, we have expanded our vision far beyond the limits of the naked eye. Kessler (2012:22) argues that a “quest for greater resolution in many ways defines the history of astronomical observing”. The advent of space telescopes, such as Hubble and JWST, provided mankind with unprecedented clarity and resolution in capturing images of distant celestial objects. Furthermore, digital technologies, exemplified by platforms such as YouTube, allowed astronomers to create captivating videos taking

us on immersive journeys through space. Through an examination of these technological advancements, it is possible to appreciate the role of technology as mediator, bridging the gap between astronomy and cosmology and our limited human perspective and the vastness of space.

1.6.3 Land-based telescopes

Terrestrial or land-based telescopes have a long-standing history in the study of the cosmos. From the pioneering work of Galileo Galilei to the state-of-the-art instruments employed today, these telescopes have significantly advanced our understanding of celestial objects.

According to Miller (1996:139), our journey to comprehend the conditions existing beyond Earth's atmosphere started in 1610 when Galileo Galilei directed his telescope towards the sky. In doing so, he enlightened humanity about the existence of other worlds beyond our own. Kessler (2012:22) notes that "technology has transformed what we see and represent of the cosmos". There is however a very specific way in which we engage with optical land-based telescopes. Through telescopes, we extend our vision beyond the limits of our naked eye, bringing celestial objects closer and immersing ourselves in the wonders of the cosmos. Don Ihde (2009) refers to "existential technological relations with the world" as "embodiment relations". In essence he argues that the way we observe the world (the cosmos) through a telescope is a mediated way of seeing. But by using this technology (telescope) we are essentially embodied in the technology we use. Kessler (2012:21) agrees with Ihde's notion of "new perceptions" being afforded to those using new technologies such as Hubble describing the new perspective that Hubble gave us as "novel".

Ihde (2009) believes embodiment through technology refers to the integration of technologies into our perception and bodily experiences, forming existential relationships with the world. These relationships are also novel in nature which is perhaps exactly what makes them sublime. As Ihde (2009) highlights "vision is technologically transformed" through optics. As we peer through the telescope lens, our bodily presence is intertwined with the instrument, allowing us to experience the magnificence of the moon, stars, and galaxies in a way that transcends our ordinary

perception. This embodiment through optical telescopic technology exemplifies the dynamic interplay between humans and the tools we employ, shaping our perception and deepening our relationship with the vastness of the universe. It also identifies a need for a study such as this that aims to understand our interaction with technology to better comprehend complexities related to the cosmos. Here, one can distinguish a spectrum of astronomical engagement (embodied to fully disembodied) from direct unmediated stargazing, through the mediated optical views, to fully disembodied data-driven observation, each representing a unique form of embodiment that reshapes the connection to the cosmos.

1.6.4 Space telescopes

The ability to launch our telescopes into earth orbit, once again expanded the possibilities of the observation of space. Over time, technological advancements have allowed for increased precision, sensitivity, and resolution in what Kessler (2012:22) terms “precisely detailed images”. Hubble space telescope was launched in April 1990 and provided mankind with a “revolutionary view of the cosmos” (Kessler 2012) ever since. Kessler (2012:4) explains the impact of Hubble’s images:

> Because Hubble holds a seminal place within contemporary astronomy and its images have circulated widely – to near-universal acclaim – its views of the cosmos have become models for images delivered from other telescopes, including those produced in the service of science at world-class observatories as well as those taken by amateurs with backyard telescopes. Hubble images have also shaped depictions of the universe in popular culture, and it is common in science fiction films, TV shows, and video games to see spaceships fly through Hubble-inspired scenery.

On Christmas day 2021, the James Web Space Telescope (JWST) launched into space. JSWT serves as the replacement for Hubble and is stationed over a million miles from Earth. Jenna Goldschmidt (2022) explains that “because Webb’s mirror is far larger than its predecessor, it can observe much fainter objects and operates primarily at infra-red wavelengths, way beyond the scope of what we can see with our eyes or detect with ground-based telescopes on Earth’s surface.” JWST provides us with data that is beyond human vision. Again, technological mediation is necessary to

see the unknowns of space. Goldschmidt (2022) explains the complex workings of the multi-billion-dollar space telescope:

> We can't see what Webb has detected, its data has to be translated to visible light. The original detections are arrays of numbers recorded on a digital camera and converted to greyscale. These greyscale images are taken at different wavelengths which are then each assigned a colour, before being combined into a multi-colour image.

Space telescopes have revolutionised our understanding of the cosmos by providing unparalleled and often unimaginable views of the universe that is unobstructed by Earth's atmosphere. Instruments such as the Hubble Space Telescope and more recently the James Webb Space Telescope (JWST), have captured breath-taking images, unravelled cosmic mysteries, and deepened our understanding of celestial bodies, distant galaxies, and complex physical processes. "Many photos, such as those from the Hubble Space Telescope, cover astonishing distances in light years, making them difficult to relate to in human terms" (Kiliçkiran, Alegra, Haddrell 2013:100). The deployment of space telescopes allows for continuous observation, free from atmospheric interference, leading to new discoveries and insights into the nature of the universe.

1.6.5 YouTube as Space Exploration Medium

YouTube is the world's "largest and most visited online video-sharing service" (Chareen Snelson 2011:159). It has emerged as an accessible and influential medium for, amongst other things, educating and engaging the public on complex scientific topics. Numerous creators and channels dedicated to space exploration and astronomy have harnessed YouTube's reach to convey knowledge, explain astro-phenomena, and showcase new discoveries. Through visually compelling videos, animations, and expert explanations, YouTube has bridged the gap between scientific research and the general public, igniting a passion for space and inspiring the next generation of astronomers. To date, very little literature exists that specifically examines representations of the cosmos on the YouTube video sharing platform, highlighting a gap in the existing research for this study.

By using images from Hubble and JWST, amateur astronomers, science fiction content creators, and professional astrophysicist are using technology such as YouTube to depict both fictional as well as factually accurate representations of the cosmos and the seemingly unknowns of space. The platform has also increased the accessibility for the average person, to concepts, representations, and discussions that were much harder to come by previously. Chareen Snelson (2011:159) explains "the growth of online video is beneficial for those who teach and learn online, as access to video on a broad spectrum of topics becomes increasingly available." With limited space travel reserved for only a select few (the furthest any human has travelled into space is the moon, a mere 380 000 km from earth), the human species are currently restricted to a form of disembodied space travel through representations of the cosmos in computer generated video images as opposed to the embodied act of physically looking through a telescope at celestial objects. It could be argued that the embodied or disembodied interaction with the cosmos may be dependent on how and what technology we engage with. Physical engagement with an optical telescope may be defined as an embodied experience where the technology brings closer the physical celestial object that would otherwise be beyond reach through naked perception. On the other hand, engaging with a YouTube video that takes one on a journey of the cosmos, beyond what has ever been experienced by mankind, could be considered as a disembodied experience.

It can be argued that one of the key strengths of YouTube in the context of space exploration lies in its ability to harness the power of visualisation on a greater level than in print to a much wider audience. Complex theories, celestial mechanics, and cosmological concepts can be simplified and brought to life through visually engaging content. Whether this means illustrating the expansion of the universe, showcasing the immense distances between planets, or escorting a viewer on a journey to the edge of the universe as in Kipping's video, YouTube provides a captivating experience making space science more accessible and engaging to a wider audience.

1.6.6 The Image

The examination of Mitchell's notions on the image is central within the context of the representations of space and the cosmos when considering the works of Bonestell

and Kipping within the setting of astro-science. Mitchell (2015:24) speaks of “image science” stating:

> everyone knows that science uses imagery, both verbal and visual, as an essential part of its quest for ever more accurate accounts of material reality. Models, diagrams, photographs, graphs, sketches, metaphors, analogies, and equations are crucial to the life of science.

As per the previous section on space and technology, the portrayal of the cosmos relies on reproductions or visual representations to depict objects and phenomena that are inherently beyond direct human perception. It is crucial to note the importance of images and how astronomers do not necessarily always comprehend how “profoundly images shape their thinking” (Kessler 2012). When it comes to celestial bodies and the vast expanse of space, direct sensory experience is limited to what can be observed visually, often aided by telescopes or other instruments. The images we receive from these devices, despite their scientific accuracy and visual appeal, are still interpretations and representations of the cosmic reality. They serve as mediated depictions that enable us to access and comprehend the complexities of astrophysics. Mitchell (2015:15) argues that image science delves into the nature and significance of images as a means of communication and understanding. These images are not mere reflections or copies of reality, but rather active participants in shaping our perception and knowledge. They possess a transformative power and carry cultural, social, and ideological implications that influence our interpretations and engagements within the world. Santina (as quoted in Kiliçkiran, Alegra, Haddrell 2013:100) argues that Mitchell emphasises the role of spatial practices in creating space, a key element in understanding the implicit tensions in space art. Here, spatial practices refer to the ways images organise and simulate spatial relationships – such as scale, distance, and perspective – to render the cosmos tangible, bridging the embodied viewer to the disembodied unknown. In this study, Bonestell’s vistas and Kipping’s digital journeys exemplify these practices, crafting immersive spatial experiences that evoke the sublime. Santina continues by stating: “such images show wondrous features of the universe as if we witness them first hand; indeed, they transform their viewers into interstellar armchair tourists”. When considering limitations related to accessibility in space exploration, such as in Bonestell’s era, his paintings opened the frontier of

space exploration to everyone who engaged with his art works. His representations formed part of a “different tactic” (Santina as quoted in Kiliçkiran, Alegra, Haddrell 2013:100) where the imagined images are presented as if the viewer was present.

Mitchell (1986:7) asks “what is an image?”. This seemingly straightforward question invites us to delve much deeper into the complexities of understanding our world and the profound significance that arises when individuals engage with representations or images, allowing for personal extrapolation of meaning. The notion of meaning-making stretches back centuries and as Mitchell (1986:7) indicates, “in mid-seventeenth-century England the connection between social movements, political causes, and the nature of imagery was, by contrast, quite undisguised.” He continues to argue that in contemporary society our understanding of images and their power over us have not diminished, “certainly not because their nature is now clearly understood”, but rather that “images have power in our world undreamed of by the ancient idolaters” (Mitchell 1986:7). In other words, images are embedded with movements, ideologies, and explorations of mankind, perhaps even more than in the past. Furthermore, images have agency that reach beyond human control. But why is it then important to understand what an image is?

In the context of this study, understanding what an image is holds significant importance in comprehending complex subject matter such as the nature of the cosmos. Kessler (2021:227) believes “images force those who contemplate them to think beyond the categories or hierarchies that can limit efforts to gain knowledge and insight”. Images thus play a crucial role in shaping our understanding and interpretation. They serve as visual representations that communicate and convey ideas, enabling us to visualise and grasp abstract or intricate concepts.

When considering the question of what an image is, it is important to acknowledge that the term encompasses a “wide variety of things that go by this name” (Mitchell 1986:9). Representations of the cosmos and the complex elements of astrophysics may take many forms under the label of images. The works of Bonestell for instance, are artworks, paintings, that were later mass produced in print format in *Life* magazine. The medium used in this example does not detract from Bonestell’s ideas of representing the unknown but rather democratises it and extend in its reach of a wider

audience. In comparison, Kipping uses technology beyond what was accessible to Bonestell at the time and with a much greater reach. In both instances a distinction is made between an image and a picture. Mitchell (2015:16) draws the distinction as follow:

> The picture is a material object, a thing you can burn or break or tear. An image is what appears in a picture, and what survives its destruction – in memory, in narrative, in copies and traces in other media.

Bonestell and Kipping explore the idea of representations of the unknown through the image. The image in both cases, however, is made up out of representations of that which has not been experienced yet, using different elements. Mitchell (1986:10) refers to the "family tree" of images which categorise images according to graphic, optical, perceptual, mental, and verbal elements which he argues "designates a type of imagery that is central to the discourse of some intellectual discipline." Kipping uses a multitude of these "images" in his videos, yet ultimately aims to achieve the same outcome as Bonestell: to represent the unknowns of the cosmos.

One of the key focus areas of this study is centered on the depiction of the unknowability of the cosmos through images. Images can be interpreted in different ways. Mitchell (1986:31) discusses the concept of the image and the literal sense of the word as being understood as a "graphic, pictorial representation, a concrete, material object, and that notions such as mental, verbal, or perceptual imagery are improper derivations". He acknowledges that the image can rather be a "likeness" from this literal sense. In other words, the image is not necessarily a "pictorial representation" but rather a likeness to something. The interpretation of the word "image" is thus linked to spiritual likeness where the likeness refers to similarities and differences between the physical object. Once again, the physical depiction of space becomes near impossible and we are bound by interpretations (cosmology), or rather representations, of cosmic phenomena as a "likeness". Du Preez (2022:7) states, "to see an image is also in some sense 'to see' an idea, because ideas find likenesses in images". Cosmic imagery presents us with a likeness of that which we cannot experience directly, it makes "visible what might otherwise have remained invisible" (Du Preez 2022:7). Miller (1996:40) refers to the Victorian reader in the 19th century who would engage with the artworks in Julian Verne's novel *Hector Servadac (Off on*

a Comet!) where illustrations by P. Phillipoteaux depicted Saturn's rings (Figure 1) and instead of simply relying on "dry depictions of astronomers", the viewer could learn what Saturn was "like".

Figure 1: Rings of Saturn, by Paul Philippoteaux, 1877. (Miller 1996)

In the case of representations of the cosmos, Mitchell's insights can shed light on the inherent complexities involved. By applying his ideas around the nature of images, we can explore how these visual renderings of astronomical phenomena mediate our understanding and construct of the unknowable space. Whilst our understanding of what Mitchell defines as an image is important to take note of in this study, it can be argued an equal important question Mitchell pose is what do the images want? Do the representations of Kipping and Bonestell in fact ask anything of us? Mitchell (1996:82)

believes that the open interpretation of images is the true value of them. Mitchell's theories offer valuable perspectives on the role of images in constructing knowledge, conveying meaning, and influencing perceptions of the universe. Although artist intent in the representation of space images guide the viewer on a path of exploration, the true interpretation resides with the consumer of these images. Mitchell (1996:71) explains the interpretive and rhetorical questions around pictures:

> We want to know what pictures mean and what they do: how they communicate as signs and symbols, what sort of power they have to affect human emotions and behaviour, When the question of desire is raised, it is usually located in the producers or consumers of images, the picture threated as an expression of the artist's desire, or as a mechanism for eliciting the desires of the beholder.

The interpretation of Bonestell and Kipping's images is thus reliant on the interpretation of the viewer. Throughout this study, I explore whether what the image wants, in this specific case, is perhaps to evoke feelings of the sublime.

1.6.7 The Sublime

The use of the sublime as a lens to examine the representation of space and the unknown of the universe forms a central part of this study. This is, however, not a study on the intricacies of the sublime but rather an attempt to view the subject matter by applying the theoretical works of seminal sources such as David Nye, Immanuel Kant, and Edmund Burke. It would be important to note the difference in understanding of the sublime but more so its intersection between nature and technology when it comes to the exploration and representation of space and the universe. The theories on the sublime are explored with emphasis on the overwhelming vastness related to the experience of space.

1.6.7.1 Edmund Burke and the Sublime

Eighteenth century philosopher Edmund Burke's writings on the sublime revolves around that which evokes fear yet not to the point where the observer faces imminent danger. Burke (2005 [1757]:110) explains that "[w]hatever is fitted in any sort to excite

the ideas of pain and danger, that is to say, whatever is in any sort terrible, or is conversant about terrible objects, or operates in a manner analogous to terror, is a source of the sublime." Burke (2005 [1757]:111) continues by stating, "When danger or pain press too nearly, they are incapable of giving any delight, and are simply terrible; but at certain distances, and with certain modifications, they may be, and they are, delightful, as we every day experience." Burkes notions on the sublime focus on the emotional, the fear of the unknown, and the danger it might hold for the observer. Kessler (2012:5) agrees describing both Burke and Kant's sublime as an "extreme aesthetic experience". What is however important to note in Burke's writing is the fact that danger is observed from a distance. Similarly, because of the immense scale of the cosmos, we are confined to observing it from afar. Even astronauts who travel beyond Earth's orbit reach only a minute portion of outer space, and though telescopes can bring distant images into closer focus, the universe itself remains physically distant. Our observation of the cosmos links to Burke's notions of observing from a distance when considering that "light travels incomprehensible distances through both space and time to reach us" (Santina as quoted in Kiliçkiran, Alegra, Haddrell 2013:106). In terms of the cosmos and the observation thereof, mankind has no other choice but to observe its magnificence from a distance or through a mediator such as space-based telescopes and technology or art.

Burke identifies several passions caused by the sublime that may be applied to the representations of the cosmos. According to Burke (2005 [1757]:131) "the passion caused by the great and sublime in *nature*, when those causes operate most powerfully, is astonishment: and astonishment is that state of the soul in which all its motions are suspended, with some degree of horror." This state of astonishment can be initiated through different elements according to Burke. These include:

1. Terror or Fear
2. Obscurity
3. Power
4. Privation
5. Vastness
6. Infinity
7. Sound and loudness

Although Burke refers to some other elements such as “the cries of animals” (Burke 2005 [1757]:162), or “light in building” (Burke 2005 [1757]:158) these might not be as relevant to this study as the above listed ones.

Burke’s first element of the sublime refers to terror or fear. According to Burke (2005 [1757]:131) “no passion so effectually robs the mind of all its powers of acting and reasoning as fear”. Burke’s notion that fear robs the mind of its rationality is a compelling starting point when embarking on a cosmic journey. The argument could perhaps be made that the fear of the unknown pushes the boundaries of curiosity and that the innate human nature of exploration is based on the fear of the unknown. As Burke (2005 [1757]:132) notes “and to things of great dimensions, if we annex an adventitious idea of terror, they become without comparison greater.” The innate human nature of exploration is rooted in a primal fear of what lies beyond, pushing us to venture into the darkness of the universe. When we think of space, we often associate it with fear and awe, making the cosmos a boundless canvas for the sublime.

In terms of obscurity, it is precisely the unknown that ignites a sense of the sublime according to Burke (2005 [1757:133) who states “to make anything very terrible, obscurity seems in general to be necessary. When we know the full extent of any danger, when we can accustom our eyes to it, a great deal of the apprehension vanishes.” Obscurity influences the imagination and as such the nature of space exploration revolves around the unknowns or obscurity of the cosmos. Space with its vast expanses of uncharted territory, is a quintessential embodiment of the sublime through obscurity.

The third passion of the sublime according to Burke is that of power. Burke (2005 [1757]:139) rates power in the sublime as highly important stating “besides those things which *directly* suggest the idea of danger, and those which produce a similar effect from a mechanical cause, I know of nothing sublime, which is not some modification of power.” Burke draws comparisons between pain and pleasure and explains “pain is always inflicted by a power in some way superior, because we never submit to pain willingly. So that strength, violence, pain, and terror, are ideas that rush in upon the mind together” (Burke 2005 [1957]:139). The sublime of space can only

be experienced from a distance yet the idea that mankind was not made to survive and the premise of certain death away when removed from the safety of earth, is provoked by the power of the unknowns of the cosmos.

Burke's discussion of privation, encompassing "vacuity, darkness, solitude, and silence" (Burke 2005 [1757]:147) are all great because they are terrible. The vast void of space, the eternal silence, and the unending darkness are aspects that elicit a profound sense of terror and wonder. They encapsulate the experience of exploring the cosmos, where the absence of familiar earthly elements magnifies the sublime nature of space.

Vastness of space forms the fifth characteristic and undeniably a key aspect of the sublime. The incomprehensible dimensions related to our solar system and the universe in general resonate with Burke's idea that "greatness of dimension is a powerful cause of the sublime" (Burke 2005 [1757]:148). Our attempts to comprehend and visualise this vastness make space exploration an exercise in grappling with the sublime.

Another element of the sublime is infinity. Once more, this is very applicable to the study of representations of the cosmos. Burke (2005 [1757]:149) explains: "Infinity has a tendency to fill the mind with that sort of delightful horror, which is the most genuine effect, and truest test of the sublime". The vastness and infinite nature of space will be a key area of focus within this study as the unending expanse of space, with its countless galaxies and stars, is the truest test of Burke's sublime, inviting us to contemplate and explore the limitless.

Sound and loudness are identified as the seventh element of the sublime, specifically when examining the video representation of space by Kipping. As Burke (2005 [1757]:160) explains, "the eye is not the only organ of sensation by which a sublime passion may be produced." Sounds such as music used in these videos, the tone of voice of the narrator, sound effects, and even silence, all play a role in the production of the sublime. A clear distinction is made between sounds and words though. As Burke (2005 [1757]:160) explains, "words do not affect simply by their sounds, but by means altogether different".

As we delve into the representation of space, we find that Burke's elements of the sublime offer a rich framework for understanding our fascination with the cosmos. They remind us that the unknown, obscurity, power, privation, vastness, infinity, and even the sounds of space all play a role in shaping our perception of the universe as a place of sublime wonder and terror.

1.6.7.2 Immanuel Kant and the Sublime

In his *Critique of Judgement*, Kant defines the sublime as that "which is absolutely great" (Kant 1914 [1790]:107) and distinguishes between the mathematical sublime, which relates to experiences of vastness and infinity, and the dynamic sublime, which relates to experiences of power and force. He argues that the experience of the sublime is one linked to a feeling of pain "arising from the want of accordance between the aesthetical estimation of magnitude formed by the Imagination and the estimation of the same formed by Reason" (Kant 1914 [1790]:120). The pain arises from the disconnect between our imagination's aesthetic assessment of the vastness or magnitude of something, and our rational understanding of it. Our sensory faculties can't fully comprehend or represent the immense scale of the cosmos. Melissa McBay Merrit (2012:37) notes that it is important to understand Kant's notions on the sublime are linked to the individual, "any account of the Kantian sublime must examine and account for this state of mind". Kant refers to experiences rather than attributing the sublime to objects. Kessler (2012:5) argues that Kant's sublime "arises out of tension between the senses and reason" whilst Malcolm Budd (1998:2) highlights the subjective nature of the sublime experience but goes further to argue that its "determining ground cannot be other than the feeling of pleasure or displeasure". Kant's notions on the sublime thus revolve around the idea of the individual's emotional response to nature and the limitations of human understanding. The experience might be different for everyone, raising questions of dread related to existentialism or perhaps fill our mind with awe and wonder of the beauty of space. When observing the universe through a telescope or looking at representations of space in image format, the individual may easily experience a tension between senses and reason due to the challenge in comprehending how far away, or how gigantic, the

subject matter one is viewing is. Kant's predecessor, Burke, similarly presents the sublime as an emotional response to an object, where its beauty and terror coexist.

1.6.7.2 a. Mathematical Sublime

Kant's concept of the mathematical sublime refers to experiences of vastness and infinity that evoke a sense of awe and wonder, but also a sense of our own smallness and insignificance in comparison. This type of sublime experience is characterised by the mind's inability to fully grasp or comprehend the vastness of infinity of the object in question, but at the same time being captivated by it. Kant (1913 [1790]:116) states "the infinite is absolutely (not merely comparatively) great". Ones' experience and response to the magnitude of the cosmos and the infinite nature of space thus securely fits in to what Kant deems to be sublime. The representation of numbers, both in terms of distance, and size in relation to space directly links to Kant's notion of the mathematical sublime. Merrit (2012:39) echoes this by stating "an object can be represented as sublime when a subject attempts an aesthetic estimation of its magnitude and finds that it is beyond her capacity". Kant argues that the mathematical sublime is related to the idea of the infinite, and that our minds are inherently limited in their ability to comprehend it.

1.6.7.2 b. Dynamic Sublime

Kant's concept of the dynamic sublime refers to experiences of power and force, such as a raging storm, that evoke a sense of awe and wonder, but also a sense of our own smallness and insignificance in comparison. Kant (1913 [1790]:125) speaks of a "dynamic fear" when referring to the dynamic sublime. This type of sublime experience is characterised by the mind's ability to grasp the power and force of the object, but also by the mind's recognition of the potential danger and destruction that the object poses to the viewer and the fear it may invoke. Budd (1998:5) explains Kant's identification of what the beautiful invokes as follow:

> Kant's identification of the distinctive pleasure of the beautiful invokes his distinction between (passive) sensibility and (active) understanding, the sensuous as opposed to the intellectual, what is 'given' in perception as opposed to what is 'thought': the first

> constituting an 'immediate' relation with the object in its singularity, the second relating to the object 'mediately' through a universal characteristic, one that a number of objects may have in common.

A clear distinction is thus drawn between what is intended or understood and what we feel or think.

When applied to the images of Bonestell and Kipping, it can be argued that there is intent in terms of actual science (astronomy) related to their creations, and then the experience of those who might not be scientifically literate in the field, but still engage on a passive level with the works. Herein lies the possibility of experiencing the sublime of these works.

Kant moves away from the object being the focus but rather emphasises the mind as the determining factor of the sublime. Kant (1913 [1790]:130) explains that sublimity "does not reside in anything of nature, but only in our mind". For Kant the sublime deals with the overwhelming experiences of the natural world to a point where it surpasses ones' ability to fully grasp or understand them. Anoke Faruqee and David Driscoll (2009) explains that the Kantian sublime is a "mental process" with a "particular subjective experience". Exploration of space and the cosmos, the size and distance of planets and stars, and the vastness of the universe align with Kant's notions on both the mathematical sublime and the natural or nature of the dynamic sublime. "The Kantian sublime ultimately rests not in Nature itself, but in the human capacity to reason about Nature" (Faruqee & Driscoll 2009). According to Kant, such experiences bring about the feeling of awe and wonder but may also highlight a sense of insignificance. Kant distinguishes between two categories of the sublime namely the mathematical sublime, relating to experiences of vastness and infinity, and the dynamic sublime, which relates to power and force. Regardless of these two categories, for Kant, the subjective nature of the sublime is the key element of experience where it is not about the object but rather the reaction to the object.

Budd (1998:234) draws a difference between Kant's mathematic and dynamic sublime as follow:

> The mathematically sublime is concerned with the estimation of nature's size; the dynamically sublime with an awareness of nature's might; in the mathematically sublime the imagination figures an "aesthetic" estimation of magnitude, in the dynamically sublime in an appreciation of force.

Both Kipping and Bonestell's representations of the unknowns of the cosmos offers the viewer the platform of experience, a way to see the unknown. Kant's ideas on the sublime are at play in both artists' works. For Bonestell the application of Kant's dynamic sublime would be more prominent as his works are a depiction of nature. For Kipping on the other hand, the mathematical sublime comes to the fore in his engagement with complex scientific concepts. Ultimately both artists evoke a sense of Kantian sublime, that may be unique for each viewer, through their representations of the unknown.

1.6.7.3 Technological sublime

David Nye (1994:xi) refers to the Golden Gate Bridge by stating "like every sublime object, this magnificent piece of civil engineering cannot be comprehended through words and images alone. When visited, it outstrips expectations". Similarly, the development and engineering of cutting-edge space technologies like JWST, the Voyager probes, the Apollo program, and various other space-related innovations possess an aspect of technological sublimity, given the immense financial and time investments made to ensure their success. These technological breakthroughs have not only facilitated a deeper understanding of the universe but also deserve appreciation for their own inherent magnificence, a perspective often overshadowed by the practical benefits they provide.

The accessibility of space exploration is limited to a very select few at this stage. The furthest that human beings have travelled is to the moon, and the last time we went there was in 1972. It could be argued that the experience of space is limited to representations thereof instead of actual physical space exploration. We use images, words, and sounds to represent the unknown and that which we do know can only be attained using technology. On 25 December 2021 NASA launched the James Webb Space Telescope (JWST), a marvel of engineering that has been in the making since

2008. The astronomical price tag of $10 billion and a telescope orbiting 1.5 million kilometres away seems, to currently be, the best way for humans to access the unknown of outer space. Yet the JWST operates within the infrared spectrum and as a result the images that are presented to the public are mere representations of that which the human eye cannot observe. In this case, technology forms the medium through which we see.

In a sense, technology becomes the key to access the unknown and when considering the interest in space, science fiction films, the Mars missions, and recent launches by SpaceX and NASA, “the sublime underlies this enthusiasm for technology” (Nye 1994:xiii). The enthusiasm for technology and specifically space exploration is very apparent when seeing the amount of both amateur as well as professional astronomers generating YouTube content relating to recent developments in space exploration. Nye (1994:xiii) states that “the technological sublime is an integral part of contemporary consciousness, and its emergence and exfoliation into several distinct forms during the past two centuries is inscribed within public life”. It is important to note the sublime nature of space, yet a distinction is necessary to comprehend the sublime nature of the technology that provides us access to the sublimity of space.

Advancements in incomprehensibly complex technology has provided us with the tools to explore the unknown that is space. When considering the size, cost, planning, and science behind the successful launch of JWST as well as the public interest in the project, Nye’s assertions that the technological sublime is in fact integral to contemporary society, rings true. Would it be possible to represent space without technology? Perhaps, but such a representation would inevitably be limited in scope. Even with the most advanced tools, any depiction of space remains partial and interpretative, shaped as much by the limitations of our technology as by the immensity and subjectivity of space itself.

The purpose of this study, however, is not to explore the sublime nature of the technologies providing access to space exploration but rather to use the sublime as a lens in understanding the engagement with representations of space. This then includes the technologies that are used as tools in the interpretation and representation of the cosmos. Understanding and differentiating between the theories

of the sublime as explored by Kant, Nye, and Burke this study brings together a unique perspective on the sublime and how it can be applied to the experience of engaging with representations of the unknown. When considering Mitchell's question – what to images want by applying it to Bonestell and Kipping's images, it becomes apparent that their intent might be to invoke the sublime. In doing so, they move beyond merely representing the mysteries of the cosmos, they aim to elevate the viewer's experience by engaging with the profound. By employing Kant, Nye, and Burke's concepts of the sublime as interpretive lenses when exploring the works of Bonestell and Kipping, one can acquire a deeper understanding of the implicit and explicit intentions these artists had when crafting their creations.

1.6.7.4 Contemporary Notions on the Sublime

Amanda du Preez's (2022) *Art, the Sublime, and Movement: Spaced Out* offers a critical interdisciplinary exploration on how modern visual culture, technology, and human embodiment intersect to produce what she terms "spaced out" experiences. Du Preez (2022) identifies a crucial tension between an "upward and downward pull" competing for our attention between our inescapable gravity-bound existence and our aspiration to transcend physical limits. This tension is amplified through technological advances, different forms of mediation that erode the traditional sense of place and belonging. The result is a state akin to suspension where one is neither fully "here" nor "there" (Du Preez 2022:2).

Underpinning the spaced-out state is the concept of the sublime, a term Du Preez reworks through philosophical thinkers like Kant and Burke as well as phenomenological thinking by Martin Heidegger and Johann Herder. The sublime no longer denotes a distant, overwhelming landscape but emerges in immersive or disorienting encounters that collapse safe distances. Du Preez (2022:4) explains:

> We are thus dealing with a state akin to omnipotence where the subject is extended beyond human horizons into galaxies real and virtual, while simultaneously retracted to docility and even immobility. Spaced out is at once an enormous extension and contraction of space.

This paradox of extension and restriction at once captures why she coins the term spaced out. One is pulled into different realms, whether digital, cosmic, or imaginative, while also remaining aware of one's dependence on technology as mediator of the experience.

Movement is pivotal to Du Preez's framework of spaced out as she frames the sublime not merely as a fleeting emotional jolt, but as a phenomenon that takes place within transitions, be it physical or virtual. She argues the "fact that the sublime is not only an event in time and an abstract space but occurs in a place means that the sublime event is at no time unplaced" (Du Preez 2022:7). Thus, the seemingly placelessness of spaced-out encounters till occurs somewhere, even if that somewhere is a digital screen or representation such as an illustration or artwork. Du Preez (2022:7) describes the sublime experience as becoming "dislodged from place" and rather relies on the "in-between" as vehicle for the sublime experience. This observation challenges the traditional view of the sublime as purely internalised reaction, instead, it is grounded in movement and mediation, revealing technology, screens, and representations as catalyst for awe, wonder, and even disorientation.

Du Preez's concept of spaced out offers a framework for understanding our engagement with the unknowns of space, particularly in the intersection of astronomy and cosmology. Spaced out becomes a state where the viewer is neither fully present nor entirely detached, floating between the tangible and the imagined, or in this case astronomy and cosmology. This resonates with how we engage with space through observation and interpretation where astronomy provide measurable, scientific observations while cosmology invites speculative, theoretical wonder. Through direct visual observation (naked eye and analogue telescopic observation), we are bound by the limits of human perception, our view constrained by distance, scale, and the physics of light. However, through technological mediation, we step into a realm where data is transformed into experience, and scientific observation blends with artistic rendering. This movement between real and constructed creates an in between state where we are suspended, both grounded in scientific fact and untethered by imagination.

1.6.8 *Literature Review Conclusion*

This literature review delved into the interplay between art, technology, and the sublime in the context of the exploration, comprehension, and ultimately representation of the cosmos. It traversed the historical significance of astronomical art, the transformative role of technology in visualising space, and the use of diverse mediums as innovative platforms for space (re)presentation and exploration. The power of the image as per the theories of W.J.T. Mitchell and the nuanced dimensions of the sublime has been explored in relation to how these theoretical works impact our interaction with the presentations of Bonestell and Kipping in their representations of the unknown.

The literature review aims to supply context on the theoretical perspectives and their influence on the shaping of understanding and representation of space as well as serve as a bridge between art, technology, and philosophy ultimately offering a deeper understanding of how we interact and engage with the complexities presented in representations of space.

1.7 Overview of Chapters

Chapter one establishes the study's core premise: that humanity's engagement with the cosmos fundamentally shapes our experience of awe, wonder, and the sublime. It introduces Chesley Bonestell and David Kipping as two case studies through which space is visually mediated, drawing on Kant and Burke's theories to explore how vastness, obscurity, and power elicit complex emotional responses. The chapter also outlines the overlap between astronomy and cosmology, and foregrounds the role of technology as mediator between these domains. Finally, it introduces the study's aims and objectives, and explains the methodological and theoretical frameworks through which the role of visual representation, mediation, and the sublime will be explored.

Chapter two traces the historical evolution of space art, showing how visual representations of the cosmos have served both cultural and scientific purposes.

Beginning with ancient depictions and early cosmological artifacts, the chapter highlights how imagination and observation have always been intertwined in humanity's attempts to represent the unknown. As observational technologies developed, the genre of space art evolved, merging scientific accuracy with speculative vision. Bonestell's work is positioned within this trajectory, helping to bridge artistic imagination and public engagement with scientific discovery. The chapter situates space art as a vital mediator between astronomy and cosmology, shaping both cultural imagination and visual language.

Chapter three explores the development of telescopes and observational technologies, tracing the shift from embodied, naked-eye observation to disembodied, data-driven seeing. The chapter demonstrates how each technological leap expanded what could be seen while simultaneously distancing the observer from direct experience. Drawing on Don Ihde's theories of embodiment and David Nye's technological sublime, it reflects on how instruments like the telescope became sources of awe themselves. This evolving technological mediation, the chapter argues, lays the groundwork for both Bonestell's realism and Kipping's digital visions, and reinforces the sublime tension between clarity and cosmic unknowability.

Chapter four focuses on Chesley Bonestell's astronomical paintings, analysing how his art combined scientific data with imaginative vision to visualise space during an era when interplanetary travel was still speculative. The chapter explores how Bonestell's work evoked the sublime by rendering scientifically plausible yet emotionally resonant images of the cosmos. It also shows how his work bridged the empirical rigour of astronomy with the philosophical openness of cosmology, turning speculative frontiers into believable representations that fuelled public enthusiasm for space exploration.

Chapter five turns to David Kipping's YouTube video *A Journey to the End of the Universe* as a contemporary case of space representation. It examines how digital media serves as a new mode of cosmic mediation, allowing complex astrophysical concepts to be translated into emotionally compelling visual narratives. The chapter explores YouTube's role as a technological platform that democratises the experience of the sublime, and analyses how Kipping's use of narrative, visual effects, and

speculative framing invites viewers into a participatory encounter with cosmic scale and the unknown. It also considers how digital mediation reconfigures the boundaries between astronomy and cosmology in the public imagination.

Chapter six brings Bonestell and Kipping's visual practices into direct comparison, examining how each creator mediates the sublime across different media, technologies, and eras. It highlights how Bonestell's painted imaginings and Kipping's digital visualisations both negotiate the boundary between the known and the unknown, bridging astronomy's precision with cosmology's speculative reach. The chapter explores shared themes such as scale, temporality, and the viewer's sense of disorientation, while also noting their distinct approaches to representation: Bonestell through static, speculative realism and Kipping through dynamic, data-driven storytelling. Together, their works reveal how the mediation of space has evolved while continuing to provoke awe and existential reflection.

Chapter seven concludes the study by synthesising its core arguments and reflecting on the broader implications of visualising the unknown. It reiterates how artistic and technological mediation shape humanity's relationship with the cosmos, and how the sublime remains central to these encounters. The chapter reviews key findings from the comparative analysis, identifies the study's limitations, and proposes directions for future research.

CHAPTER 2
SPACE ART

2.1 Introduction

This chapter examines the historical trajectory of astronomical art, from ancient celestial depictions to modern imaginative renderings, to establish its pivotal role in mediating humanity's engagement with the cosmos and shaping perceptions of the unknown. Focusing on the evolution of space art as a bridge between empirical astronomy and speculative cosmology, this chapter explores how artists have translated cosmic phenomena into visual forms that span a spectrum of observation: from unmediated stargazing with the naked eye, to mediated embodied experiences, through telescopic lenses, and toward fully disembodied representations blending scientific data with artistic imagination.

By situating Chesley Bonestell within this lineage and previewing its extension into digital forms like Kipping's visualisations, the chapter contributes to the study by framing space art as a dynamic mediator, actively constructing meaning, evoking the sublime, and inspiring cultural and scientific exploration. This historical and conceptual groundwork illuminates how such mediated representations possess agency to provoke emotional and intellectual responses, setting the stage for the comparative analysis of Bonestell and Kipping in subsequent chapters.

The relationship between observing or seeing and representing or imagining creates an interesting distinction that can be drawn between art and science. Of course, distinction between observation, representation, astronomy, and cosmology often overlap, and complete separation from visual experience remains improbable. Humans begin by perceiving stars from a great distance, yet imagination extends this observation, prompting us to envision their appearance up close. Through technological advancements, we strive to bridge this gap, bringing distant celestial bodies closer into view, nevertheless, they remain ultimately beyond physical reach. Art thus becomes essential in bridging empirical astronomy and speculative cosmology,[6] translating distant and abstract cosmic realities into tangible forms.

[6] See chapter 1 – Astronomy and Cosmology.

Despite technological assistance, the representation of celestial phenomena retains interpretive and imaginative dimensions, ensuring that our relationship with the cosmos remains profoundly personal and subjective. Either way, in both astronomy and cosmology, visual art emerges as a critical medium through which these domains are expressed and explored.

John Ramer (2021:xi) highlights the powerful communicative and emotional potency of cosmic imagery, noting that an "image can instantly explain the unknown, move you to tears, or lift your soul to the stars above". However, cosmic images do more than merely illustrate, as W.J.T. Mitchell (1992:82) argues, images pose their own agency. They are not passive reflections but actively engage viewers, demanding contemplation, awe, and emotional participation. Applying this idea to May's (2024) distinction between astronomy and cosmology implies that images of the cosmos might not only represent our understanding or imagination but may actually call for personal and emotional responses from us. Such images can stimulate deep introspection or summon profound emotions, suggesting a complex interplay between human perception and pictorial agency.

Throughout history, astronomical art, from ancient cave paintings depicting celestial events to modern digital representations of distant galaxies, has continually fostered a deeper emotional and intellectual connection to the universe. Philosophical concepts around Kant and Burke's notions on the sublime provide critical context. For Kant, the sublime embodies the overwhelming grandeur of nature that exceeds human understanding, while for Burke it evokes powerful emotional responses like awe and fear. Astronomical art captures this duality, presenting viewers with visions of the cosmos that inspire not only intellectual curiosity but profound emotional resonance. As Ramer (2021:137) emphasises, astronomical art communicates more than scientific fact, it touches upon deep-seated emotions and responses, awakening wonder, humility, and curiosity within us.

Beyond emotional resonance, astronomical art uniquely shapes human culture and social consciousness by rendering the vast cosmos accessible and meaningful. Dahlia Zaidel (2018:25) highlights that art has become "a defining feature of human culture" over millennia and in the context of space art, this manifests through depictions of

celestial realms that spark curiosity and wonder about the universe's unknowns (Kolodny et al. 2018:4). As humans are fundamentally explorers by nature (Ramer 2021), astronomical images – whether ancient star maps of Bonestell's alien landscapes – satisfy the innate desire to understand and imagine what lies beyond Earth's horizon. Zaidel (2018:27) underscores art's capacity to symbolise the absent, a role astronomical art fulfils by bringing distant galaxies and speculative worlds into cultural imagination, transcending the limits of direct observation. Adams (2007:1) describes art as a "window onto human thought and emotion", a function vividly realised when space art conveys the awe of cosmic scale and humanity's place within it. From prehistoric depictions of the Pleiades to modern renderings of exoplanets, astronomical art has long channelled humanity's cosmic aspirations, embedding them in collective memory. Mitchell (1992:82) further asserts that images actively shape cultural understanding, a dynamic evident in how space art demands engagement with the cosmos, claiming "equal rights with language" to articulate the ineffable vastness beyond our grasp.

The International Association of Astronomical Artists (IAAA) further situates astronomical art within the trajectory of cultural and scientific exploration. According to IAAA (2015), space art emerged as a distinct genre through collaboration between artists and astronomers, visualising speculative ideas and scientific theories.

These artists not only inspired public interest in space exploration – Lucien Rudaux with his detailed planetary depictions and Chesley Bonestell through his visionary Saturn vistas - but also contributed to the development of technology by visualizing concepts that scientists and engineers could aspire to realise, such as Bonestell's collaboration with Wernher von Braun on spaceflight concepts.[7] Their artworks served as catalysts for innovation, merging artistic imagination with scientific possibility. Michael Carroll (1982:210) explains that astronomical art transforms discoveries of astronomers, astro-physicists, and planetologists, into a "comprehensible form". By providing visual narratives of space travel and extra-terrestrial environments, they

[7] Later in this chapter, visual examples of space art by artists such as Lucien Rudaux, Schriven Bolton, and David Hardy are included.

played an essential role in promoting and legitimizing the idea of venturing beyond Earth.

Astronomical art thus serves not merely as a passive record of human thought but as an active participant in humanity's ongoing quest to understand the universe. Cosmic images significantly contribute to how we culturally construct worldviews and engage emotionally and intellectually with the cosmos, profoundly influencing societal relationships and cultural development.

This chapter, then, lays the conceptual and historical groundwork for the theoretical spectrum outlined in Chapter 1, tracing how space art evolved from unmediated stargazing to increasingly mediated forms. By foregrounding the role of visual art as both epistemological tool and emotional provocation, it prepares the framework through which the later case studies of Bonestell and Kipping can be understood not just as artists, but as mediators between empirical observation and speculative imagination. What follows is a chronological journey that maps this evolution, revealing how cosmic imagery has always been entangled with questions of knowledge, power, and the sublime.

2.2 In the Beginning of Space Art

Jon Ramer describes humans as a "species of explorers" and space art as the embodiment of a leap in human imagination (Ramer 2021:x). Artistic depictions form a bridge between the imagination (cosmology) and reality (astronomy), helping us visualise mysteries beyond physical reach. Artists enable experiences transcending earthly limitations, aligning with Ramer's (2021:4) observation that "the roots of the genre lie deep in our history and psyche". In this study, such depictions mark the genesis of a spectrum of observation, where unmediated stargazing – rooted in the naked-eye wonder of ancient skies – lays the groundwork for later mediated forms, reflecting an initial confrontation with Burke's (2005 [1757]) sublime terror and awe at the cosmos' vastness. Adrianne Santina (cited in Kiliçkiran, Alegra, Haddrell 2013:99) reinforces this by highlighting that artistic portrayals of space predate advanced photography significantly. The early fusion of imagination and attempted observation situates these artworks not merely as cultural artifacts, but as precursors to the

cosmological-astronomical continuum that underpins this study. The act of visualising the cosmos, whether speculative or informed, engages with the limits of human perception, and with that, the sublime.

Don Davis (2021:17) notes that “astronomical art has origins almost as old as art and human imagination”. Early humans created cave paintings and petroglyphs that some scholars interpret as representations of celestial bodies and astronomical events. Cody Cottier (2023) notes as example the Lascaux Caves in France with 17000-year-old paintings (Figure 2) featuring dots and patterns that may symbolise star clusters like the Pleiades. These primal marks, potentially mapping the heavens, speak to a proto-observational impulse, where meaning was extracted from the sky through visual form embodying early cosmology – an imaginative leap toward the unknown. Such gestures mark the origin of sublime engagement in being confronted with something vast, unknowable, yet intimately present.

Figure 2: A Stone Age painting in Lascaux caves. “Hovering above the image of one bull is an unexpected addition: a cluster of small black dots that some scholars interpret as stars. Perhaps it is the eye-catching Pleiades, which Palaeolithic hunter-gatherers would have seen vividly in the unpolluted sky” (Cottier 2023). Credit: JoJan/CC-BY-4.0/Wikimedia Commons (Cottier 2023).

Similarly, artifacts such as the Nebra Sky Disk (Figure 3) and Egypt’s Dendera Hathor Temple (Figure 4) illustrate ancient civilisations’ deep integration of astronomy into culture, religion, and art. These examples represent early attempts to stabilise the unknown through aesthetic form – a proves that continues in modern space art. They reflect a synthesis of cosmological meaning-making and merging empirical curiosity.

Their symbolic content resonates with what Kant (1914 [1790]) describe as the mathematical sublime: the overwhelming vastness that cannot be comprehended, only felt.

Figure 3: Nebra Sky Disk, 1600 BCE found in Germany, depicting sky symbols. Credit: Anagoria Wikimedia Commons (Davis 2021:18)

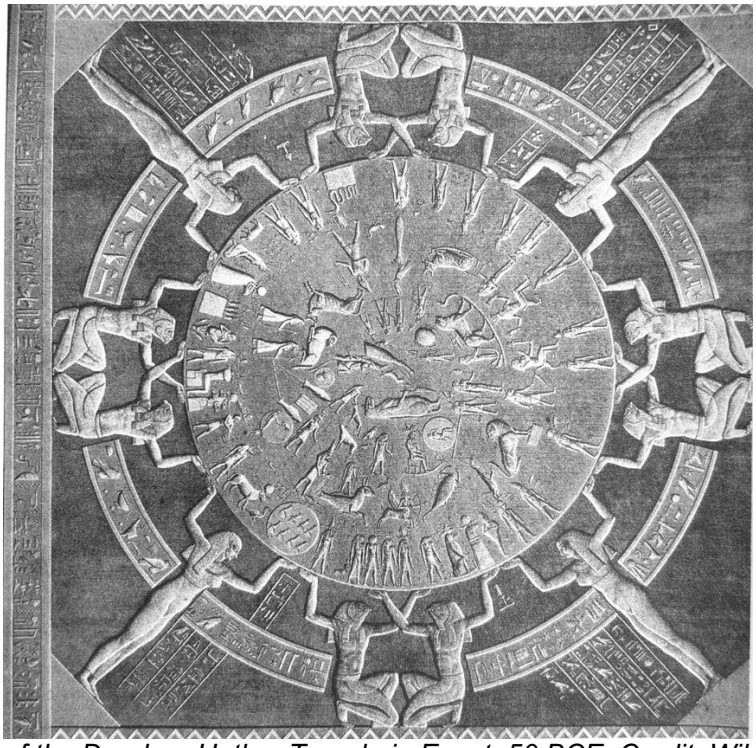

Figure 4: Ceiling of the Dendera Hathor Temple in Egypt, 50 BCE. Credit: Wikipedia Commons (Davis 2021:22)

These artifacts underscore humanity's persistent quest to understand the cosmos, demonstrating that curiosity and admiration for celestial phenomena predate modern telescopic observation. This quest, mediated through art, positions these works as precursors of the spectrum of engagement central to this study, where unmediated observation stirs the sublime resonance that evolves with technological mediation. In their raw depictions of the night sky, these early artworks reflect an unmediated encounter with the cosmos, evoking Burke's (2005 [1757]) awe at its vastness and Kant's (1914 [1790]) struggle with its infinite scale. As technology later enhances these representations, the sublime shifts from a direct, overwhelming confrontation to a mediated experience that deepens with detail and imagination, a trajectory this study traces through to Bonestell and Kipping.[8] Davis (2021) notes that as the second millennium approached, celestial imagery in Western art evolved from symbolic moral and divine interpretations towards more realistic depictions influenced by actual astronomical events, such as Giotto di Bondone's portrayal of Halley's Comet (Figure 5) and Giovanni da Moderna's Great Comet of 1402 (Figure 6).

Figure 5: Adoration of the Magi by Giotto di Bondone, showing a comet in the sky that might be based on Halley's Comet in 1301. Credit: Public domain image of the frescoes in the Scrovegni Chapel in Veneto, Italy (Davis 2021:26).

[8] Technological advancements in observation and the paradox of gaining unprecedented views of the cosmos while deepening our estrangement from direct, unmediated experience are fully explored in Chapter 3.

Figure 6: The Appearance of the Star 1412 by Giovanni da Modena showing people reacting to the Great Comet of 1402. Credit: Public domain image from the San Petronio Basiclica collection, Bologna, Italy. (Davis 2021:26).

Observational technology marked a pivotal shift in humanity's representation of the cosmos, a development explored thoroughly in the next chapter.[9] Ron Miller (1996:139) emphasises that advancements in depicting the unknown arose primarily from accumulating scientific knowledge about conditions beyond Earth's atmosphere. Galileo Galilei, with his telescope aimed at the night sky, exemplifies this turning point. Although not traditionally recognised as an artist, Galileo's detailed ink sketches of the Moon (Figure 7) offered ground-breaking perspectives to those lacking access to telescopic views. Davis (2021:32-35) explains:

> Galileo had artistic training and was a good observer. His only surviving sketches are the ink portrayals of his observations of the Moon…From the moment the telescope was invented, objects seen through it appeared in art. As curiosity and technology amplified our understanding of the skies, artists found fresh visual ground to explore, and incorporated the latest scientific concepts into their works.

[9] See Chapter 3, page 86.

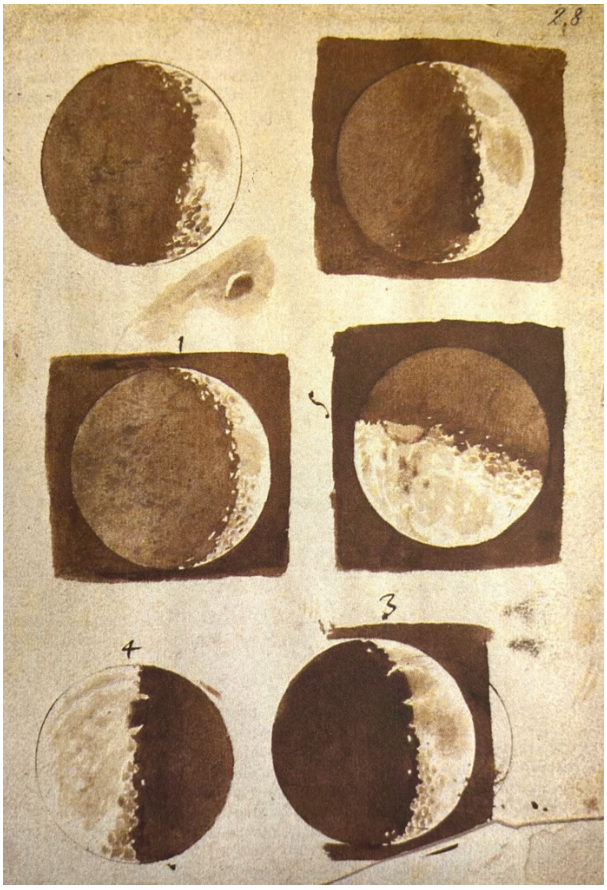

Figure 7: Ink drawings of the Moon by Galileo Galilei, early 1610. (Davis 2021:33).

Early artistic attempts to visualise the cosmos highlight humanity's intrinsic desire to bridge the gap between the known and the unknown. Cosmology and astronomy have profoundly shaped artistic interpretations of the universe reflecting both our fascination with celestial phenomena and an evolving sense of humanity's place within it. Across this history, space art's mediation aligns with this study's focus, constructing representations that oscillate between Burke's terror at the infinite and Kant's awe at its scale, laying a foundation for understanding how Bonestell and Kipping later evoke the sublime. This interplay suggests a reciprocal synergy, where scientific discoveries inspire artistic creativity and vice versa. Michael Carroll (1982:210) encapsulates this relationship by stating:

> The arts and sciences have shared a common characteristic: they have served to expand the mind of man, helping him to look beyond his horizons as well as into himself. Never before has art been so drastically affected by science.

It is within this exchange – between the imagination and empirical method – that the sublime is most powerfully evoked. As this study explores, the sublime in space art arises from the collapse of scale, the confrontation with vastness, and the attempt to contain it in visual form.

With advancements in observational tools, artists were no longer confined to mere symbolic representations, but could explore the unknowability of the cosmos through a lens of understanding. This lens of understanding refers to the newfound ability to depict celestial phenomena with greater accuracy and detail, informed by scientific observations – such as Galileo's lunar sketches - that revealed textures and distances previously unimaginable. These developments serve as a key inflection point in the trajectory of this study, setting the foundation for later comparisons between historical and contemporary visual practices in space art. In the next section, I explore how science and imagination intertwined, leading to rapid advancements in astronomy and technology that would ultimately expand the horizons of human knowledge and the impact of exploring the final frontier. This exploration reveals how the synergy of empirical data and creative vision propelled space art beyond observation into speculative realms, a dynamic central to this study's argument that such representations mediate the cosmos across a spectrum of engagement – unmediated, embodied, and disembodied – while evoking the sublime to bridge astronomy and cosmology in figures like Bonestell and Kipping.

2.3 Imagining the Final Frontier

Until the mid-1800s the development of space art had "moved fairly slowly", and artists produced observation-based depictions of the Moon and Sun as seen through telescopes, faithfully rendering what could be observed but not venturing into imaginative interpretations (Miller 2021:38). Rather than competing with technology to create photorealistic depictions of what was visible through telescopes, and with astronomical observations becoming increasingly accessible to the public, artists began to explore more experimental realms. They combined realistic scientific depictions with imaginative portrayals of the unseen and unknown, taking viewers on an imaginative journey that walked hand-in-hand with scientific realism. In this sense, Carroll (1982:210) believes that the role of the artists has changed from that of

informing the viewer, to enriching the experience of engaging with the unknown. This shift, pivotal to this study, marks the moment where visual representations began to serve not only as a form of communication but as a means of encounter with the sublime. As artists moved from documentation toward speculation, the visual medium became a site where cosmology and astronomy converge. Imagination and observation no longer function separately, but in dialogue. This dialogue forms the conceptual framework of the spectrum explored in this research.

A shift occurred from Mitchell's (2015:15) idea of image science where these early artworks filled their role as platforms for communication and understanding of observational data, to a something beyond mere observation. These artworks began to evoke experiences that resonated not only with scientific curiosity but with a profound sense of wonder. In many cases, this wonder aligns with the sublime as described by Burke and Kant, since the representations offered an imagined vantage point that transcended simple observation. By doing so, they brought the viewer closer to the unknown. Yet, as viewers draw nearer to this unknown through art's mediation, this study probes what is gained – an enriched awe at the cosmos' vastness – and lost – a direct, unfiltered connection to the stars – shaping a complex emotional an intellectual response. This act, visual and emotional, is thus not without consequence. The sublime does not simply comfort, it disorients, humbles, and reminds the viewer of their fragility within the vast cosmic order. In approaching the unknown, viewers are often left with more questions than answers, gaining a deeper awareness of their own limits of perception. Thus, space art does not just expand knowledge, it reshapes existential orientation.

Miller (2021:39) notes how the invention of photography in 1826 and its subsequent usage in astronomy brought about a change in how the cosmos could be viewed. Science fiction literature, accompanied by artistic illustrations, set in motion a new era of space art in the late 19th century. Ron Miller (2021:38) labels Jules Verne's 1865 novel *De la Terre à la Lune (From the Earth to the Moon)* as "the first example of true astronomical art" while John Derbyshire (2006) refers to Verne as "the father of science fiction". Verne's work marked a significant turning point because it combined imaginative storytelling with scientific plausibility, inspiring artists to envision and depict space travel in ways that had not been attempted before. This fusion of

astronomy's empirical base with cosmology's speculative reach amplifies the sublime. Burke's terror at the unknown melded with Kant's awe at its conceptualised scale, positions these images as mediators that invite viewers into uncharted realms.

The illustrations accompanying Verne's novels, often created by artists like Émile-Antoine Bayard (Figure 8) and Alphonse-Marie de Neuville, brought his visionary ideas to life. Their artwork visualized scenes such as the launch of the spacecraft from a giant cannon and the view of Earth from space, captivating the public's imagination. Miller (n.d) explains:

> The illustrations by Émile-Antoine Bayard and Alphonse-Marie de Neuville that accompanied Jules Verne's From the Earth to the Moon were the first attempts to depict realistically a space flight and the conditions that existed beyond Earth's atmosphere. The realism is due as much to the excellent illustrators that Verne's books invariably commanded as to Verne himself, who was in the habit of providing his artists with reference materials and checking the final results for authenticity.

These collaborations signalled a new mode of visual knowledge, one which did not rely solely on empirical observation, but on a speculative realism grounded in possibility. This kind of imagining sits at the cosmological end of the spectrum in this study yet remains tethered to astronomy through visual discipline. Such images did not simply inform, they made the cosmic emotionally legible.

Figure 8: The Projectile above the Moon by Emile Antoine Bayard from Round the Moon by Jules Verne (1870). (Davis 2021:41)

These images played a crucial role in shaping the visual language of space art, moving beyond mere observation to speculative and conceptual representations of the cosmos. In this context, Mitchell's question, what is an image? (1986:7) becomes highly relevant. These early space illustrations do not simply mirror reality, rather, they create a "likeness" (Mitchell 1986:31) that merges observed astronomy with imaginative speculating cosmology. This dual role (scientific and imaginative) also carries the potential for the sublime, as the viewer is confronted with both the vast unknown and human imagination that attempts to represent it. This confrontation with something at once recognisable and unknowable sits at the very heart of the sublime. In moving toward the unknown, the image becomes both a vessel of knowledge and a container of mystery. This study draws on such moments to argue that space art produces not clarity but tension – a visual suspension between awe and comprehension. Moreover, such images exemplify a disembodied mediation – neither

fully seen nor touched – gaining a visionary breadth that evokes wonder, yet losing immediacy of unmediated stargazing, a paradox that informs the emotional stakes of Bonestell and Kipping's representations.

This collaboration between science fiction literature and art opened new possibilities for artists to explore cosmic themes offering what Angelo Adamo (2016:509) terms "an accurate depiction of the possible views which mankind will one day observe". By blending scientific accuracy with creative imagination, they bridged the gap between what was known and what could be envisioned. This period opened the doors to artistic works that depicted space travel, extra-terrestrial landscapes, and imagined technologies, laying the groundwork for the future of space exploration.

At the turn of the 20th century, works began to emerge from individuals who possessed equal passions for astronomy and art. Astronomer-artists such as Louis Théophile Moreux (Figure 9), Thomas Simeon Scriven Bolton (Figure 18), and Lucien Rudaux (Figure 10) sought to provide viewers with a new perspective by depicting what it might look like to stand on the Moon. Miller (2014:43) explains how these depictions gave the "public its first real impression of what it might be like to visit the moon". Their efforts bring viewers closer to the unknown, offering a sublime immersion in alien vistas while distancing them from Earth-bound perception, depicting, a tension this study examines through later technological shifts.[10] The effectiveness of this experiential inversion lies in the fact that it decentres the human, destabilises the familiar, and repositions our sense of scale and belonging in the universe.

[10] See Chapter 3.

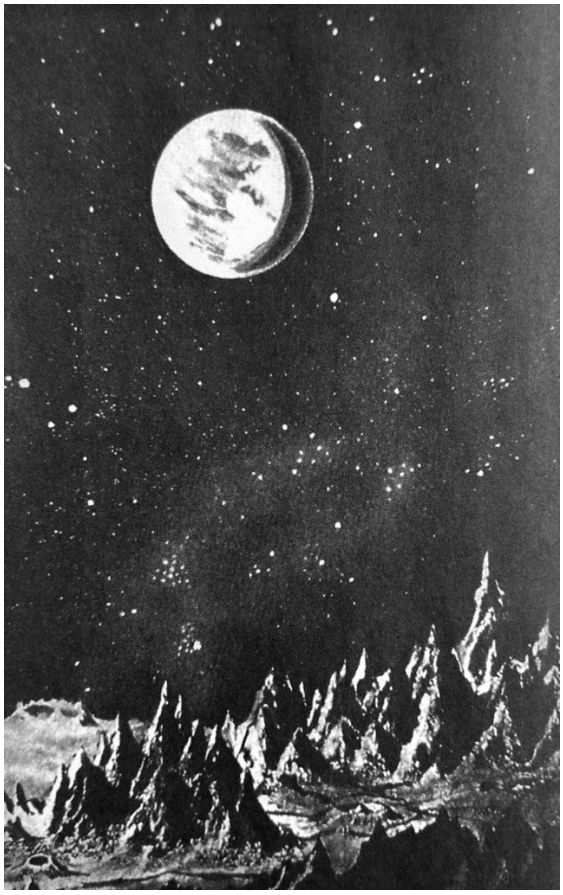

Figure 9: Earth from the Moon by Louis Théophile Moreux (1913). (Davis 2021:46).

To achieve this heightened realism, these artists employed innovative techniques. They built detailed lunar landscape models, which they then photographed to capture accurate lighting and shadows. Over these photographs, they painted the heavens and refined the terrain, seamlessly blending reality and artistry to produce super-realistic images. Adamo (2016:516) argues that “ultimately art and science provide representations of our reality which can, and should, cooperate.” This approach allowed them to create immersive depictions that took viewers on an imaginative journey to the Moon, bridging the gap between scientific knowledge and artistic expression. Miller (2021:46) notes that “never before had the planets and moons been depicted with such realism”. Miller (n.d.) argues in relation to Rudaux’s works (Figure 11), that for many of his depictions of the moon, Mars, and the satellites of Saturn “could just as easily have been done today”. Such realism does not reduce the sublime, it reframes it. The more vivid and believable the image, the more pronounced the dissonance between what we see and what we cannot yet experience. Here, the

sublime lies not in abstraction, but in precision: the almost real that remains out of reach.

Figure 10: Eclipse Seen from the Moon by Scriven Bolton. (Davis 2021:47).

Figure 11: Saturn seen from its moon Rhea by Lucien Rudaux from his 1939 book, Sur les autres mondes (Miller n.d.).

Up until this point, astro-artists primarily focussed on depicting unknown landscapes, the night sky, and mysteries that lay beyond our reach. Their work centred on visualising celestial bodies and imagined extra-terrestrial environments, captivating viewers with scenes of distant planets and star-studded skies. However, a new direction started emerging where artists began to envision not just the destinations in space, but also the means to get there.

This shift was exemplified by figures like Max Valier, who Miller (2021:48) describes as one of the "first specialists in *hardware art*". Valier and other artists started to conceptualise and illustrate spacecraft, rockets, and other technological innovations that could transport humanity into the cosmos. These artworks moved beyond speculative landscapes to include detailed depictions of vehicles and equipment

designed for the exploration of the unknown. British space artist David Hardy's work (Figure 12) has played a significant role in shaping the public's perception of space and the possibilities of space travel. Inspired by Chesley Bonestell's realism in his artworks, Hardy aimed to "to produce pictures that would show people what it's really like out there — not just as rather blurry discs of light through a telescope" (Atkinson 2012).

Figure 12: Hardware art by David A. Hardy. BIS Moonship Leaves Earth, FIAAA (left) (Davis 2021:119) and Moon Landing (right), one of Hardy's earliest paintings done in 1952 when he was 15 years old (Atkinson 2012).

The development of hardware art also intersects with David Nye's (1994) technological sublime. As rockets, spacecraft, and telescopes become more sophisticated, they themselves evoked awe, merging cosmic sublime with the marvel of human engineering, and the possibility of these machines fulfilling the promise depicted in these artworks. These artworks thus capture a double-layered sublime. One being rooted in the traditional Burke and Kantian sublimes related to vastness, whilst the other is concerned with the ingenuity that dares to traverse it. This duality gains us a vision of cosmic possibility but loses the primal immediacy of the unmediated sky, a trade-off this study probes in its spectrum and emotional analysis.

Following World War II, the world entered a transformative era where the technologies of warfare were reimagined for peaceful exploration. Rockets once designed as weapons became the means to break free from Earth's gravity, igniting the pursuit of space exploration. This period, marked by the intense rivalry of the Cold War, saw the

United States and the Soviet Union embark on the space race, a competition that would push the boundaries of human achievement. The collective ambition and technological advancements of this time ultimately led to one of humanity's most monumental accomplishments, something that has been envisioned by space artists for decades, putting a man on the moon (Figure 13). Miller (2021:56) notes:

> The period following World War II up to the first Apollo flights to the Moon might be called the Golden Age of Space Travel. Not, as might be expected, because of all the space launches taking place (after all, the first Earth satellite wasn't launched until more than a decade after the war), but because no time before or since had there been such public mania over the subject of space travel. Everywhere one looked, there seemed to be spaceships. Space travel was the subject of books, comic books, magazine articles, motion pictures, TV shows, toys, games, and consumer products that ran the gamut from rocket-shaped pencil sharpeners to the Oldsmobile Rocket 88 hood ornament.

Figure 13: Before Neil Armstrong walked on the lunar surface Norman Rockwell provided a compelling depiction of what the first step on the moon would look like. Artwork by Norman Rockwel (Ulrich 2024).

Following the first successful human spaceflights in 1962, NASA administrator James Webb established the NASA Art Program with the goal of capturing not just the images of spaceflight but "its spirit and emotional impact" (Miller 2021:67). Despite criticisms questioning whether space artists still held relevance in an era of technological advancements in imaging and space travel, Webb recognized that art could convey aspects of the cosmic experience that technology alone could not. French artist, Honoré Daumier, once noted "the camera sees everything and understands nothing", and it is exactly this "emotional impact, interpretation and hidden significance" within the artists vision that would transform the process of interpretation of representing the cosmos (Ulrich 2024). As the unimagined became within reach and what was once depicted only through art could now be experienced first-hand, at least by a select few, the role of artists began to evolve. Ludek Pešek, a renowned space artist, articulated this transition in Miller (2021:66):

> It is true, there are now close-up photographs of the lunar surface but the number of features that have been photographed is still very small. Close-up photographs of the Martian surface have not as yet been taken. Detailed photographs of other planets and of their satellites cannot be expected for many years. Thus, the landscapes I paint, based on the best information I can obtain, still serve a practical didactic purpose, even if one neglects their aesthetic qualities.

Even as technology allowed humanity to physically explore space, vast realms remained that could only be imaginatively presented through art. Kara Szathmáry et al (2021) refers to humanity's "deep-seated desire to explore" leading to the development of modern space art. This next push in space art was to explore these new frontiers of the unknown, depicting celestial bodies and phenomena beyond the current limits of exploration. Artists embraced the challenge of envisioning what lay beyond the reach of telescopes and spacecraft, continuing to inspire wonder and fuel the desire for discovery (Figure 14). Through their imaginative creations, space artists extended the boundaries of human perception, offering glimpses of the cosmos that technology had yet to unveil and reminding us that the universe still holds countless mysteries awaiting exploration. In these moments, the image becomes both a telescope and a mirror – extending vision outward, while turning attention inward. The

sublime is not only spatial, but psychological: what is evoked is not just a scale, but the unsettling realisation of how little we know. Szathmáry et al (2021:116) describes the importance of space art within the context of exploration and representing the unknown:

> Eventually, humankind will make permanent colonies on the Moon, Mars, and other worlds. We will no longer be restricted to a single home as the ancient urge to explore pushes us farther and farther into the cosmos. And as we explore those distant vistas, our innate desire to express our imagination and create works of art will go with us. In some far distant future, art depicting the wonders of our cosmos will be the most important genre of all.

In many of these depictions, the sense of awe can be understood in terms of Burke's (2005 [1757]:148) "greatness of dimension" where it evokes a visceral terror and delight as the cosmos' sheer expanse overwhelms the senses, a reaction intensified in art that stretches beyond observable skies to imagined frontiers. Simultaneously, Kant's mathematical sublime (1914 [1790]:120) engages the mind's struggle to comprehend infinite distances and scales, evident in attempts to rationalise the vastness depicted, prompting a reflective awe that complements Burke's immediacy. These images thus become powerful mediators of both scientific data and existential wonder asking the viewer not just to see, but to experience an emotional and intellectual engagement with the unknown. This mediation, bridging astronomy and cosmology, gains us speculative access to the cosmos' depths but loses the visceral immediacy of direct observation enriching our understanding of the sublime's evolving resonance.

In this process of mediation, the viewer enters a paradoxical space: they are visually drawn closer to the cosmos while simultaneously reminded of their epistemic and physical distance from it. The distance is where the sublime lives – not in possession of knowledge, bit in the tension between seeing and knowing. As images extend our vision beyond Earth's atmosphere, they shift our engagement from empirical observation to an imagined proximity. The resulting experience is not one of control, but of confrontation. The sublime thus emerges as an effective response to being

cognitively overwhelmed by both the cosmos' magnitude and our inability to fully comprehend it.

This is where the power of the image-based representation becomes central to the study's argument: it is not the accuracy of depiction alone that matters, bit the affective and philosophical space these visuals present. They position the viewer within the cosmology-astronomy field, where imagination and observation interlace. And yet, in approaching the unknown through images, something is inevitably lost – tangible presence of the real, the irreducible mystery of space that no simulation can replicate. This loss is as significant as the gain. It reminds us that the sublime is not only a by-product of what is revealed, but of what remains unreachable despite our best attempts to visualise it.

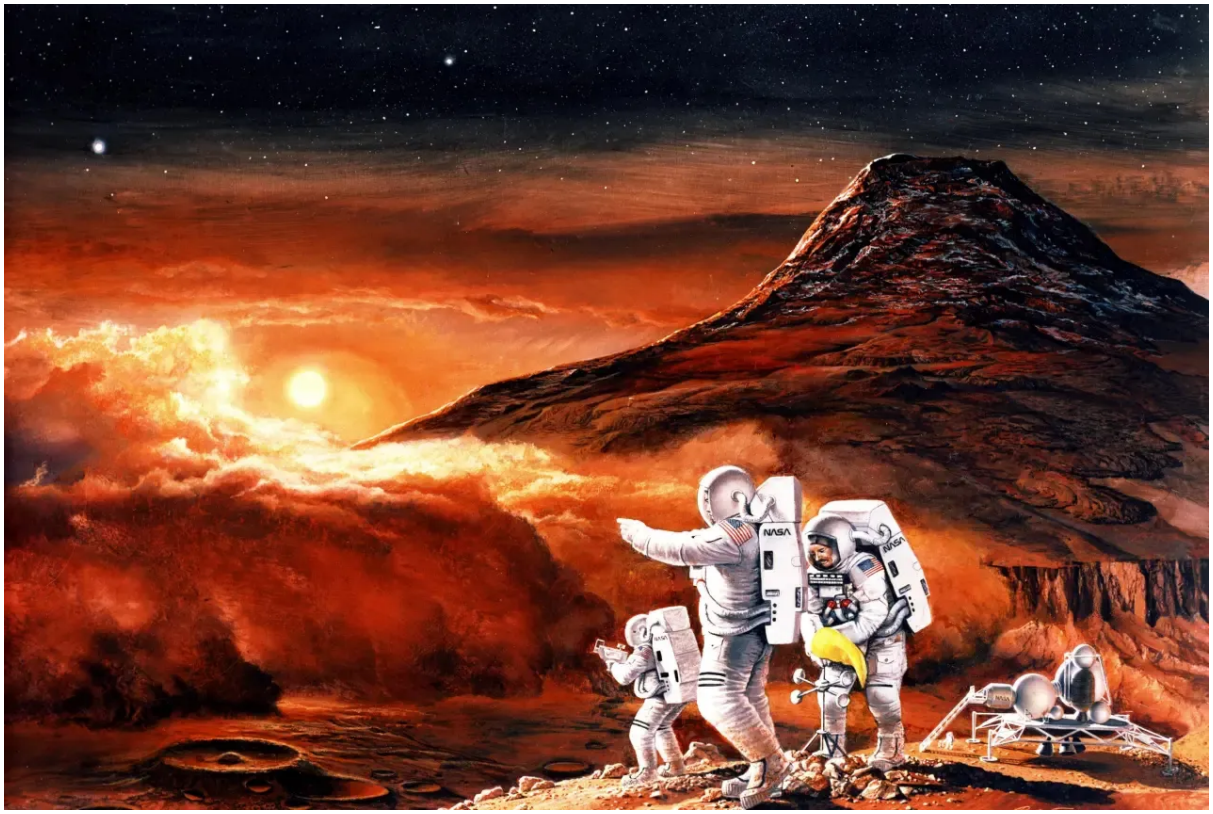

Figure 14: Oil on masonite painting by Ren Wicks. Wicks' painting depicts Martian explorers conducting scientific observations, recording wind speed with an anemometer and planetary features with a hand-held camera. A dust storm is approaching the crater area near the landing site, but views of the moons Phobus and Deimos are available in the twilight sky. A Mars excursion vehicle in the background serves as crew quarters for the mission. Artwork by Ren Wicks. (Ulrich 2024).

2.4 The Diverging Paths of Space Art

As space art evolved, its practitioners charted differing paths to represent the cosmos, a divergence that illuminates this study's exploration of observation, mediation, and the sublime. The International Association of Astronomical Artists (IAAA 2015) captures this split: some, like Chesley Bonestell, pursued Descriptive Realism, crafting scientifically precise alien landscapes with "informed knowledge" from astronomers (Carroll 2021:155). These works, rooted in mediated embodied observation — telescopic views translated into tangible vistas — evoke Kant's (1914 [1790]:120) mathematical sublime, as viewers wrestle with the vast, measurable scale of moons and planets Bonestell brought to life. Others veered toward speculative realms, blending astronomy's data with cosmology's imagination, as in Lucien Rudaux's lunar scenes or Jules Verne's illustrated flights (Miller 2021:38), or Cosmic Impressionism (IAAA 2015), which departs from strict accuracy to use colour, form, and abstraction – such as Sean Yarbrough's *Cosmosis* (Figure 15) – to capture "emotional" and "subjective" experiences of space (Judith Broome-Riviere et al 2021:191). This approach, leaning toward a fully disembodied spectrum, conjures Burke's (2005 [1757]:148) "greatness of dimension", a thrilling terror at the unknown's expanse untethered from empirical limits.

These paths shaped more than aesthetics; they influenced humanity's cosmic ambitions. Ron Miller (1996:139) argues that space art "proved to be a major influence on the public's perception of the universe as well as on the development of space exploration," a claim Bonestell's work exemplifies. His paintings, far from static, inspired engineers and dreamers alike, merging science and vision to propel the space race (Malina 1991:145). Yet, this potency draws scepticism: Kessler (2012:6) cites art historian James Elkins, who dismisses such images as "pretty pictures," arguing they distract from science's pursuit of knowledge with "flashy but scientifically uninteresting" displays. Elkins' critique stings, but Bonestell's impact rebuts it — his art didn't merely decorate; it mediated the unimaginable, sparking wonder (Miller 1996) and bridging astronomy's facts to cosmology's possibilities. This mediation, central to this study, gains us speculative access to the cosmos while losing the raw immediacy of unmediated stargazing, a tension that evolves from Bonestell's realism to Kipping's disembodied digital sublime.

Figure 15: Cosmosis by Sean Yarbrough. (Broome-Riviere et al 2021)

2.5 Conclusion

In this chapter I have shown how space art evolved from ancient unmediated stargazing to modern disembodied speculations, tracing a spectrum of observation that mediates the cosmos through an interplay of astronomy's empirical rigor and cosmology's imaginative reach. This chapter has demonstrated how artists bridged the known and unknown evoking terror and awe to render the sublime through a visceral and intellectual encounter. This historical arc, culminating in the diverging paths of realism and imagination, reveals art's agency in shaping cultural perceptions and inspiring exploration, a dynamic that prefigures the comparative analysis of Bonestell and Kipping in chapter 5 and 6.

Space art stands at the crossroads of humanity's enduring curiosity, scientific advancement and creative vision embodying Mitchell's belief in the transformative power of images. Far from being passive mirrors of the universe, space art actively shaped perceptions, emotions, and understandings underpinning the cosmos. Space art engages the viewer in an ongoing dialogue that unites astronomy with the speculative in cosmology. Mitchell's (1986; 2015) notions that the image carries agency and begs for interpretation is what lies at the centre of the emotional response requested from space art.

By rendering the unknown visible, space art bridges the gap between what lies beyond human reach and what can be felt in the psyche of human imagination. It does more than illustrate celestial bodies, it conveys the sublime wonder and emotional resonance of encountering the unknown. In this sense, images of space are not simply pictures, but catalysts for reflection on our place in the universe. They exist in collective memory, shaping cultural, social, and ideological narratives guiding us toward awe, humility, and curiosity.

Ultimately space art is not just scientific or artistic representations, but rather instruments of meaning-making. When considering what these images want, one may realise that they reveal an open-ended potential of visual expression where the observer has a personal experience of interpretation right at the intersection of what we know and that which is unknown.

Having illuminated how space art mediates the cosmos through a spectrum of observation and evokes the sublime to bridge astronomy and cosmology, this chapter set the stage for an exploration if the technological evolution that underpins such representations. In Chapter 3, I shift from the artistic lens to the telescopic one, examining how technological achievements transform observation from an embodied act into a fully disembodied, data-driven encounter. This progression deepens our understanding of the interplay between technology, perception, and the sublime, revealing how tools not only extend our vision but reshape our relationship with the unknown, a dynamic that informs the visual strategies of Bonestell and Kipping in subsequent chapters.

CHAPTER 3
BEYOND THE NAKED EYE – TELESCOPES AND OBSERVATIONAL TECHNOLOGY

3.1 Introduction

Understanding how humanity has visualised the cosmos requires more than analysing artistic representations – it demands a parallel exploration of the technological evolution that has shaped our capacity to see and represent the unknown. This chapter traces the history of observational technology not as a mere prelude to the analyses of Bonestell and Kipping in Chapter 4 and 5, but as a critical foundation for comprehending how their works emerge from and respond to a shifting spectrum of mediation. The technological progression from naked-eye observation to telescopic and data-driven views is essential to this study because it reveals how tools extend our vision while paradoxically distancing us from direct experience, a dynamic that informs both the sublime resonance and representational strategies of space art. Without this context, the interplay of astronomy's empirical precision and cosmology's imaginative reach in Bonestell and Kipping's work lacks depth, as these artists build upon centuries of mediated seeing.

The aim of this chapter is thus two-fold: to chronicle the development of telescopes and observational tools as they transform humanity's cosmic engagement, and to weave this trajectory into the study's theoretical framework, exploring how technology mediates the cosmos along a spectrum, evoking a sublime that shifts from natural wonder to technological awe. Drawing on Don Ihde's (2009) embodiment relations, where technologies reshape perception as "an existential relation with the world," and David Nye's (1994) technological sublime, where engineering feats inspire grandeur, this chapter interrogates how tools like telescopes reconfigure seeing from direct bodily immediacy to abstracted precision, setting the stage for Bonestell's embodied realism and Kipping's disembodied digital visions. This interplay – where the cosmos' vastness and the instruments unveiling it both evoke awe – underscores a two-fold sublime that shapes our mediated cosmic imagination. Alongside Edmund Burke's (2005 [1757]) natural sublime of vastness and Kant's (1914 [1790]) mathematical sublime of infinite scale, Amanda du Preez' (2022) "Spaced Out" frames technology's

collapse of distance, enriching this evolving sublime. This is not a passive history; it's an active argument about how mediation amplifies the cosmos' astronomy-cosmology bridge, prefiguring the artists' strategies explored later. This chapter thus contributes to this study by grounding the sublime and mediation in technological shifts in order to set the stage for understanding how Bonestell and Kipping's visions reflect and extend this legacy.

3.2 The Natural Sublime Unmediated

Before telescopes, humanity's cosmic encounter began with the naked eye, an unmediated act that rooted observation in bodily perception and evoked a primal sublime, a foundation Bonestell and Kipping later reinterpret. Our understanding of "outer space" is inherently shaped by contrast with "inner space," as Adrianne Santina (Kiliçkiran, Didem, Alegra Christina, Haddrell Carl, 2013) notes. Given its boundless nature, comprehending outer space challenges the mind, often barely allowing us to negotiate its complexity. How much do we truly understand of that which we have not experienced? We rely on visual representations – images that simplify the complex – to grasp what eludes direct perception, a need rooted in our inherent curiosity. Ramer (2021:x) observes:

> It is in our very nature to wonder about what is over the hill, across the river, beyond that mountain – or on the next planet. And when we can't go and explore ourselves, we send the imagination.

In ancient times, people mapped the stars not only for navigation or agriculture but to connect the heavens to their daily lives and belief systems (Ridpath 2016). Structures like Stonehenge or Egypt's pyramids, aligned with celestial bodies, blended observation with cultural and spiritual significance, allowing re-experience of the cosmos even without direct access to the sky. These early acts of representation tapped into deeper emotional responses, suggesting that our drive to depict the universe is as much about existential inquiry as scientific accuracy.

This impulse aligns with the sublime's vast dimensions. Burke (2005 [1757]:148) claims that "greatness of dimension is a powerful cause of the sublime," while Kant (1914 [1790]:107) defines it as that which exceeds ordinary comprehension or is "absolutely great." As Jason Kalirai (2019:251) describes, telescopes extend "one of

our most important senses, sight," fuelling curiosity about what we see but do not understand, and what we believe exists but cannot see. Still, representation struggles to convey space's true scale – two-dimensional illustrations falter against its complexity, underscoring that our cosmic grasp remains mediated. With physical exploration limited – the Moon, last visited in 1972, marks humanity's furthest reach – most encounters occur through media: photographs, videos, digital renderings, and illustrations. Nye (1992:xiii) suggests "the sublime underlies this enthusiasm for technology," evident in public fascination with JWST's images and centuries of observational tools. Technology becomes the medium through which we see, its scale, cost, and complexity evoking awe akin to the cosmic phenomena it captures. This dual sublime – cosmic and technological – sets the stage for exploring how observation began, with the naked eye confronting the vast unknown.

Labelled as one of the "oldest of sciences" (Ridpath 2006:16), astronomy has captivated human civilization for centuries. Before the invention of telescopes, the human eye served as the primary instrument for celestial observation. The vast, unpolluted night sky presented an overwhelming spectacle that was both knowable and unknowable. This duality speaks to Burke's (2005 [1757]) concept of the sublime where the immensity of space evokes both awe and terror. It also resonates with Kant's (1914 [1790]) idea of the mathematical sublime where the human mind, in attempting to grasp infinity, reaches the limits of comprehension.

Although their cosmological models were shaped by mythology, the Babylonians' astronomical observations and predictions were astoundingly accurate (Bell 2022). They documented celestial observations on clay tablets (Figure 16) detailing the motion of the stars and planets, providing clear evidence of "a long-standing tradition of celestial observation" (Ridpath 2006:16). In an interview with Yale Assyriologist Professor Eckart Frahm, Bess Connolly (2022) notes the beginning of humanity's fascination with the night sky:

> In the age before light pollution, the vivid night sky made such a strong impression on our ancient ancestors that they thought that the stars and various other heavenly bodies represented deities, says Yale Assyriologist Eckart Frahm. The ancient stargazers were so intrigued by the mechanics of the heavens — and the possibility of being able to make predictions from what they saw in the night sky — that, from the 8th century to

> the 1st century BCE, they observed very closely on a daily basis the movements of the stars to determine what exactly was happening in the sky.

Figure 16: A "uranology" tablet from the Yale Babylonian Collection, written between the 3rd and 2nd centuries BCE in the city of Uruk in southern Iraq, provides on the right side a description of celestial constellations and on the other left side the topography of the city of Uruk.
Photo: Wagensonner, Klaus (Bell 2022).

The Babylonian practice of night sky observation offers one of the earliest examples where the empirical and the spiritual coexisted within the same act. Abraham Sachs (1974:44) notes that omen predictions were appended to recorded planetary data, such as the Venus tablets, indicating that these observations were not only astronomical but also cosmological and theological. This dual purpose reflects a worldview in which celestial bodies functioned as both measurable phenomena and divine messengers. The Babylonians' observations were thus not separate from the emotions they evoked. Their nightly practice of observing the night sky was both scientific and spiritual, reinforcing the tension between the predictable and the mysterious. The Babylonians' direct, embodied stargazing – unfiltered by technological mediators – evoked a natural sublime, where Burke's (2005 [1757]) terror at the vast unknown intertwined with Kant's (1914 [1790]) rational striving to comprehend the complexities of the cosmos through recording them. Their nightly ritual, both scientific and spiritual, underscores the paradox central to this study:

observation grants insight yet leaves the cosmos profoundly distant, a dynamic that prefigures the mediated visions of Bonestell and Kipping. This historical root illuminates how the interplay of astronomy and cosmology shapes our evolving relationship with the universe. The unmediated cosmic sublime, rooted in direct awe, sets the stage for a technological layer that emerges with tools like telescopes, blending natural wonder with engineered marvels.

Building upon earlier traditions, Greek astronomers sought not only to document celestial phenomena but to uncover the fundamental laws governing them. Unlike the Babylonians, who intertwined celestial observation with astrology, the Greeks introduced a systematic framework that initiated “the separation of science from superstition” (Ridpath 2016). This transition marked a shift from an embodied, mythological experience of the sublime to a rational, mathematical representation of the universe.

Mike Reynolds (n.d) notes that the Greeks, starting around 500 BC, were credited with developing scientific principles, marking a shift toward systematic inquiry into the cosmos that informs this study’s spectrum of mediation. Among them, Greek astronomer Claudius Ptolemy crafted the geocentric model of the universe (Figure 17). This model posited a cosmos with Earth as its fixed centre as Schilling (2024:23) explains, “according to Ptolemy, Earth sat motionless at the centre of the Universe, and the Sun, the Moon, and the planets circled around it in complicated orbits.” This model, despite its inaccuracies, exemplifies an early attempt to contain the sublime within an ordered framework. The tension between vastness and comprehension echoes Kant’s (1914 [1790]) sublime where reason strives to impose structure upon what ultimately resists full understanding. Yet, even within this rationalization, wonder remained central. It would take centuries and a radical shift in technological mediation before this view was challenged, and it wasn’t until the 17th century that an alternative theory emerged, one that was still met with resistance from the church.

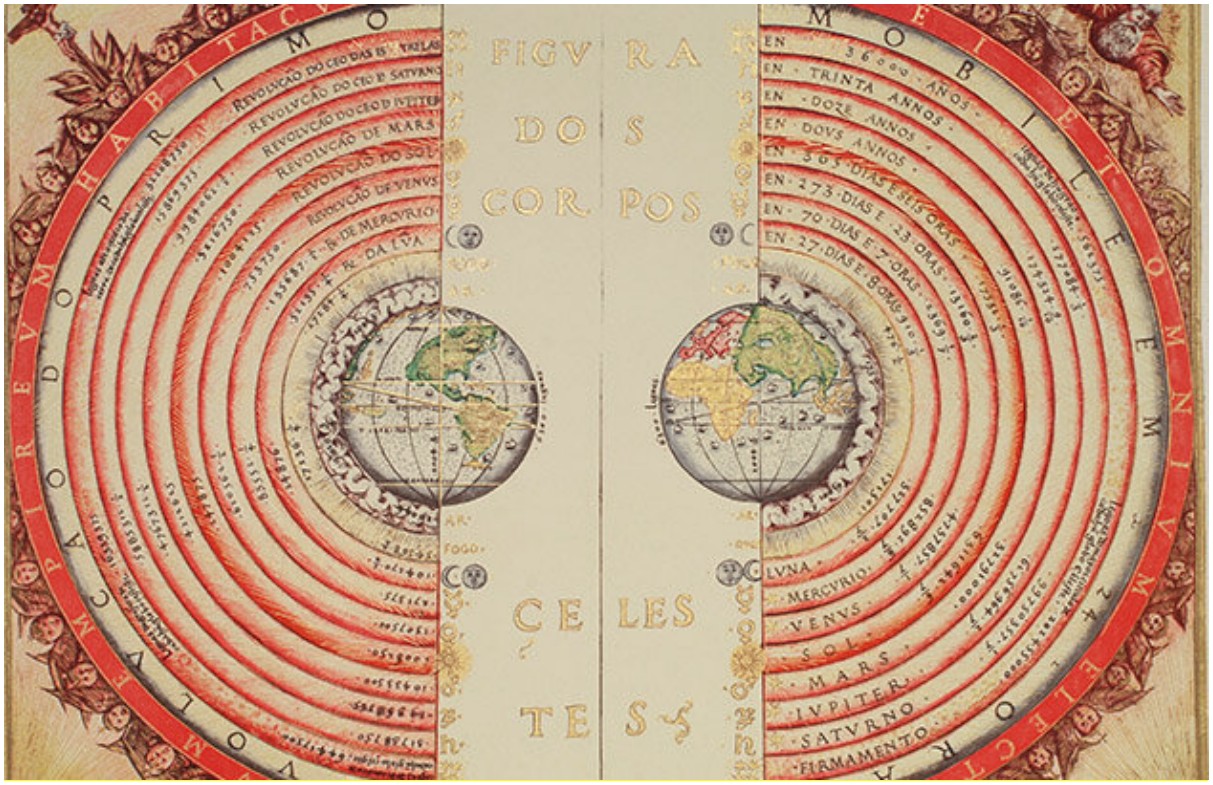

Figure 17: Illustration of the Ptolemaic conception of the universe from Cosmographia, by Bartolomeu Velho, 1568. Credit: Cosmographia by Bartolomeu Velho (Bell 2022).

This unmediated cosmic sublime, rooted in the naked eye's direct confrontation with the vast unknown, establishes a primal foundation that the advent of telescopes would soon transform. In the next section, I examine how early modern astronomy and the telescope introduce mediation, shifting the observer's embodied stance and reconfiguring the sublime into a blend of precision and awe – a threshold that prefigures Bonestell's tangible realism and shapes the chapter's exploration of technology's role in cosmic perception.

3.3 The Embodied-Mediation Threshold

Where ancient unmediated awe rooted the natural sublime, the transition to early modern astronomy and the telescope introduced mediation, shifting the observer's stance and prefiguring Bonestell's embodied realism. In the 16th to 17th centuries, Copernicus awoke European astronomy with his heliocentric theory (Ridpath 2006:18), despite church resistance (Schilling 2014:23). Amid religious tensions, scientists saw the universe as law-governed (Adams 2007:672), and Keppler refined this with elliptical orbits (Ridpath 2006:18), shifting the sublime from mystery to

mathematical elegance – a pivotal step toward technological mediation. Kepler's mathematical precision introduced a new kind of sublime, one that emphasized underlying order within the apparent chaos of celestial motion. This rationalization of the cosmos, while diminishing mystery, did not eliminate the sublime but transformed it into an appreciation of mathematical elegance. In Kepler's harmonies, the sublime arises not from the terror of the unknown but from the staggering coherence of cosmic law, a beauty grounded in precision. The experience of confronting such order, knowing it can be expressed through human-devised formulas, positions the observer in a humbling place being both intellectually elevated yet existentially dwarfed.

Despite these advances, early astronomers relied exclusively on naked-eye observation marking this period as a pinnacle of embodied (unmediated) observation within this study's spectrum of mediation. The experience of standing beneath the stars, where the universe might have felt simultaneously graspable and utterly beyond reach, remained a direct, embodied encounter with the sublime. This embodied sublime resonates more with Burke's (2005 [1757]:148) account of the "greatness of dimension," where awe is triggered by vastness and obscurity through the sheer scale of the night sky pressing in from all directions. Unlike the rational sublime evoked from Kepler, this response is visceral. Here, the sublime emerges from vulnerability and physical proximity: the sensation of being enveloped by cosmic immensity, of seeing without fully understanding. It is this tension between the known and unknown that defines the sublime in early modern sky-watching.

In this unmediated act, no technological lens intervenes between eye and cosmos: the observer's body – its sight, its stance beneath the heavens – is the sole instrument of perception. Mediation only enters later when Copernicus and Kepler published their observations as texts and diagrams. These representations mediated understanding for others, translating embodied seeing into a shared rational framework. Yet this mediation shapes comprehension, not the initial observation itself. The naked eye beholds the stars directly, while illustrations guide subsequent interpreters toward what was seen, bridging the gap between personal experience and collective knowledge. This distinction illuminates a paradox central to this study: unmediated observation offers an intimate, sublime encounter, yet its translation into published

forms begin the distancing process, a precursor to the fully mediated visions of Bonestell and Kipping, where technology amplifies both sight and separation.

The invention of the optical telescope did not simply resolve the sublime by making the cosmos more visible; instead, it reconfigured it. Kant's (1914 [1790]) mathematical sublime describes the mind encountering the limits of comprehension when faced with immensity. This is precisely what occurs when one looks through a telescope. The instrument does not reduce the unknown but expands it, revealing layers of complexity that destabilize prior conceptions of the universe. The act of seeing becomes more precise, yet also more overwhelming. Albert van Helden (1974:55) captures this dual effect, noting that "the telescope was an extension of man's senses" that "opened up a whole new dimension of the cosmos." Beyond revealing cosmic depths, the telescope itself – its lenses and novel mechanics – emerges as an object of wonder, initiating a technological sublime that parallels the cosmos' grandeur. With each use, he argues, "the planets were brought closer to the earth and the stars became farther removed." Beyond revealing cosmic depths, the telescope itself emerges as an object of wonder, initiating a technological sublime that parallels the cosmos' grandeur. The cosmos is now filled with new complexities, distant galaxies, and invisible forces. The observer experiences an inverted sublime where what once seemed singular (the Moon and planets) is now part of an infinite web of celestial structures.

Burke's dynamic sublime, centred on power and terror, is also intensified through telescopic observation. Through the telescope, the cosmos is no longer a serene clockwork but a turbulent, unknowable force. Telescopic vision does not just reveal, it unsettles. What emerges is not clarity, but a sense of exposure to something vast, cold, and indifferent, positioning the observer in a fragile, vulnerable relation to the cosmos. The telescope uncovers not a comforting, orderly cosmos but a chaotic and unbounded one, where celestial objects exist at unimaginable scales and distances. Schilling (2014:52) highlights this destabilization of cosmic order, noting that the improvement of optical instruments forced astronomers to confront an ever-expanding, ever more knowable universe. Yet, paradoxically, the more we see, the more we recognize how much remains unseen.

Per Ihde (2009), this telescope marks the embodied-mediation threshold, extending sight yet estranging the observer, a tension Bonestell resolves through tangible realism, grounding the sublime in familiar forms.

The telescope's introduction of mediation, bridging embodied awe with an expanding cosmic complexity, lays the groundwork for a deeper technological evolution that amplifies both precision and the sublime. In the next section, I explore how advancements in telescopic design intensify this mediation, blending cosmic wonder with technological marvel and shifting the sublime from visceral terror to a dual awe of universe and instrument, a dynamic Bonestell's realism later inherits and refines within the chapter's spectrum of observation.

3.4 Mediating Precision and Power

As telescopes evolved, they deepened mediation, amplifying precision and power while shifting the sublime from visceral awe to a blend of cosmic and technological wonder, a dynamic Bonestell's realism inherits. Technology has "transformed what we see and represent of the cosmos" (Kessler 2012:22), reshaping not just our scientific grasp of space but also our aesthetic and emotional engagement with the unknown. As we've seen thus far, before telescopes, astronomy was an embodied practice, wherein celestial motion was directly experienced. With the advent of telescopes, observation became mediated, introducing a separation between observer and object. Unlike reading glasses, which seamlessly integrate into our perception and become an extension of our vision, early telescopes presented a distinctly noticeable experience of observation. Don Ihde (2009) describes this shift as an "existential technological relation with the world." The telescope, as an instrument of mediation, extends perception while simultaneously distancing the observer from the act of seeing. One does not wear a telescope as an extension of their own sight; it requires deliberate effort to use. The observer must physically align themselves with the instrument, adjust perspective, and interpret an image that is no longer a direct extension of their bodily perception. However, the act of seeing remains connected to the earlier, naked-eye experience, even though it is now mediated. Consequently, I argue that early telescopic observation still fits within the embodied experience – what

may be called mediated embodied observation – in contrast to the more fully disembodied interactions afforded by later digital telescopes.

Don Ihde (2009) refers to "existential technological relations with the world" as "embodiment relations," where tools become so integrated into our experience that they disappear from conscious use. However, telescopes do not vanish into the background of perception; rather, they impose a new mode of seeing that is actively mediated. Kessler (2012:22) notes that "technology has transformed what we see and represent of the cosmos," but this transition is not purely seamless; it distances the observer from the direct act of seeing.

By introducing an intermediary between the eye and the cosmos, telescopes shift observation from an immediate, embodied experience to an interpretive embodied one. The observer is not simply looking; they are engaging with an apparatus that reshapes how celestial bodies appear. As Kessler (2012:21) describes, these "new perceptions" afforded by technology are not merely extensions of human sight but "novel" ways of seeing, that alter our understanding of space itself. Ihde (2010:80) agrees by explaining that the person viewing through a telescope becomes a "perceiver and a practitioner within a now technologically mediated, enhanced world." This shift underscores the tension between intimacy and detachment in astronomical observation where the more we see, the more we experience the cosmos as something mediated, distant, and reconstructed through technological intervention. This act of mediated seeing introduces both amplification and estrangement – bringing distant phenomena into view while simultaneously reminding us of our dependency on instruments to perceive them. The telescope does not simply reveal the universe; it reconfigures the act of seeing. In this sense, the sublime is no longer merely located in what is seen, but also in the structure of seeing itself. Thus, the telescope does not bring the viewer closer to space; rather it opens a new horizon, one that is abstracted and filtered. The result is a double bind: the observer gains access to the unseen, yet must surrender the immediacy of unmediated presence.

Yet it is precisely this mediation that can itself be sublimely impressive. When NASA launched JWST, the telescope's capacity to orbit 1.5 million kilometres away from Earth and capture infrared images became a defining moment of the technical sublime, reminiscent of Nye's (1994:xiii) argument that "the sublime underlies this

enthusiasm for technology." This technological feat amplifies the cosmic sublime – distant galaxies and invisible light made visible – while itself becoming an object of awe through its intricate design, the precision of its deployment, and its $10 billion cost. Thus, the JWST and its images emerge as dual sites of sublimity, resonating in the vastness of the universe they unveil and the monumental scale of the apparatus that makes such visions possible. The public awe at JWST's images rivals the marvel of its engineering, exemplifying how our cosmic fascination is inseparable from the tools that frame it.

Telescopes granted access to new layers of reality, but they were not always widely accessible. Thus, accurate depictions of celestial bodies became vital for those who couldn't directly observe them. Scientific illustrations, star charts, cosmic art, and eventually, photographs and computer-generated representations provided a way for individuals to visualize and understand the cosmos, even from the confines of their homes or classrooms. By harnessing the power of telescopes, both terrestrial and space-based, we have expanded our vision far beyond the limits of the naked eye. Kessler (2012:22) even argues that a "quest for greater resolution in many ways defines the history of astronomical observing." The relentless pursuit of clarity, from Galileo's crude lenses to JWST's infrared precision, sharpens our grasp of cosmic detail yet paradoxically heightens the sublime by revealing an ever-receding vastness that defies full comprehension. This transition embodies the tension between inner and outer space, known and unknown, rational and irrational. The more we attempt to quantify the cosmos, the more its sublime nature reasserts itself.

Would it thus be possible to represent space without technology? Perhaps, but such representations would be limited and fragmentary, as the naked eye or simple sketches – like those of ancient stargazers – can only grasp a fraction of the cosmos' vastness and intricacy. This highlights the central role of disembodied, technologically mediated views in extending our perceptual reach, since instruments like telescopes and data processors reveal distant galaxies, invisible wavelengths, and cosmic structures otherwise inaccessible to unaided human senses. Yet, even these advanced tools offer only partial glimpses of an unimaginably vast universe. It is precisely this tension, between what is revealed and what remains out of reach, that fuels the evocation of the sublime. Burke's sublime of overwhelming vastness

emerges as technology reveals an ungraspable expanse, Kant's mathematical sublime arises from the mind's effort to comprehend infinite scale, and Nye's technological sublime reflects awe at the instruments themselves, pushing viewers beyond expectation into a mediated sublime that Bonestell and Kipping later visualise.

While space itself embodies the natural or cosmic sublime, the vast engineering feats that grant us access to cosmic scenes can themselves become objects of sublime wonder. Our fascination with probes, telescopes, and spacecraft is often as potent as our fascination with the stars they reveal. This dual layered approach, where both the cosmic subject and the instruments that capture it elicit awe, reinforces that our relationship with the universe remains mediated by representation and shaped by a profound, two-fold sense of the sublime.

The telescope represents not merely an extension of vision but a fundamental shift in how humanity perceives the cosmos. From the early instruments of Galileo to the advanced observatories of today, each technological leap deepened our engagement with the sublime, both revealing and complicating our understanding of the universe. The history of telescopic developments is not just a progression of improved optics but a story of increasing mediation, where the more we see, the more we realise how much remains unseen.

Galileo's 1610 telescope (Figure 18) (Miller 1996:139) expanded cosmic knowledge, shifting perception from embodied immediacy to mediated interpretation, a technological leap that deepened the sublime by revealing new layers of the universe.

Figure 18: Galileo's telescope. Credit: DLR (ESA 2003).

Advancements in telescopic power unveiled an ever-expanding universe, shifting perceptions from a finite cosmos to an infinite expanse. Beyond extending vision, the optical telescope redefined the observer's relationship with space, revealing celestial depths that transformed how the cosmos was understood, as each observation underscored its overwhelming vastness.

Refracting telescopes suffered chromatic aberration (Ridpath 2006:22), prompting Newton's 1668 reflecting telescope with a mirror for clearer images (Schilling 2014:52). This innovation deepened mediation, unveiling fainter stars and amplifying the technological sublime through enhanced precision but also greater separation from direct observation through an added layer between the viewer and the stars: a mirror.

This additional medium further solidified the shift from direct, eye-based observation to a mere mediated relationship, in which ever more sophisticated apparatuses intervene. While this removal from immediate sensory contact can be seen as a loss of directness, it simultaneously enables a profound extension of our vision. What once lay far beyond the scope of human perception and understanding became accessible,

inaugurating a continuous interplay between technology and the limits of human sight. Yet it also signalled a gradual shift toward disembodied seeing where our senses are increasingly dependent on instruments that filter, magnify, and interpret cosmic data on our behalf. This dependency arises as these technologies translate the invisible and the distant into perceivable forms, often revealing realities that our unaided senses could never grasp. In doing so, they not only augment our vision but also redefine it, outsourcing the act of perception to machines that mediate and dictate what we see and how we understand it. William Herschel's 40-foot telescope (Figure 19) – the largest in the world at that time – revealed even more cosmic layers in the late 18th century (Schilling 2014).

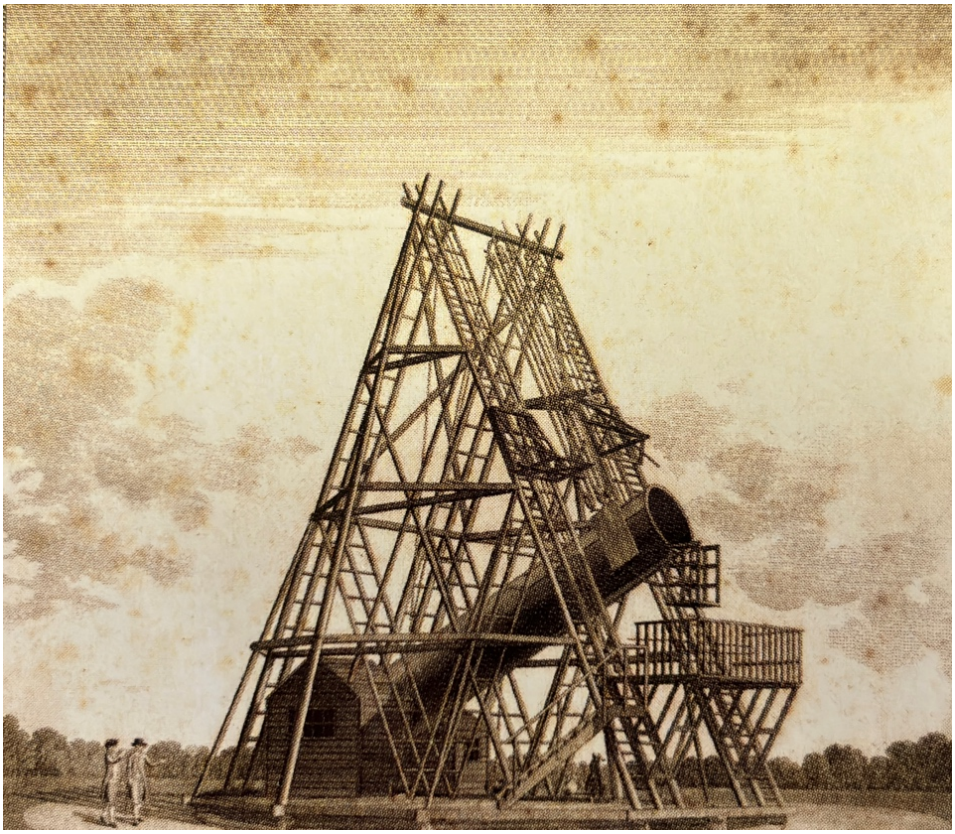

Figure 19: William Herschel's giant 40-foot (12.19m) telescope was the largest in the world at the end of the eighteenth century (Schilling 2014).

In 1845, William Parsons, 3rd Earl of Rosse (Lord Rosse), completed the Leviathan Telescope, which remained the world's largest for over 70 years (Schilling 2014:52). With a 6 ft (1.8 m) mirror and a 54 ft (16.45 m) focal length, it was used to study nebulae, star clusters, and galaxies (Ridpath 2006:21). As humans extended their sensory reach, they did so through ever larger mechanisms whose very presence

inspired profound awe, blending technological wonder with the sublime immensity of the universe they revealed. These telescopes shift Burke's (2005 [1757]) terror to Nye's awe (1994), as engineering precision mirrors Bonestell's tangible cosmos, bridging astronomy and cosmology."

Moreover, Parsons was able to depict what he saw in detailed drawings, representing his discoveries to those who did not have access to the telescope. According to *Frontiers for Young Minds* (2022), people flocked from across the world to view this marvel of engineering and observe the night sky. Under Parsons' guidance, his pioneering telescope played a pivotal role in 19th-century astronomy. By meticulously observing and sketching (Figure 20) what were then known as "nebulae," (Frontiers for Young Minds 2022) he identified the distinct spiral structures within these celestial objects. His detailed drawings marked a breakthrough in our understanding of these formations, which we now recognize as spiral galaxies. This discovery fundamentally shaped future astronomical research and our perception of the universe. *Frontiers for Young Minds* (2022) explains:

> Parsons' drawings were of spiral galaxies, a class of galaxies containing their own stars and dust with spiral arms extending from the center. Many of these drawings can be seen on display in Birr Castle today, with their detail and passion clear. One of the first of these drawings was of the now infamous Whirlpool galaxy, M51 (Messier object 51), a galaxy that is 31 million light-years away from Earth (equating to around 6 trillion miles). Parsons' comprehensive drawing, created around 1845, remarkably resembles modern day photographs - an unbelievable triumph using an incredible telescope.

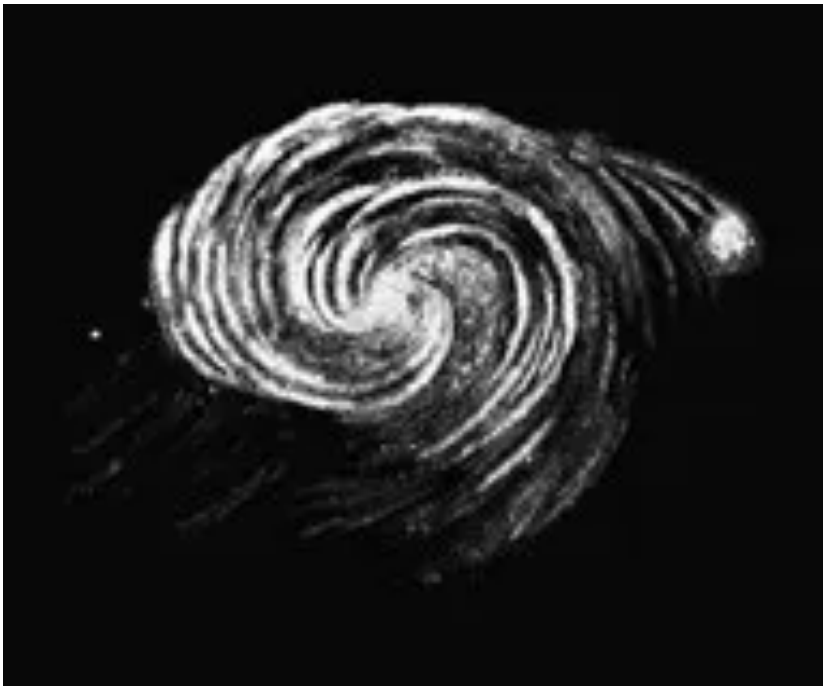

Figure 20: Sketch by Lord Rosse of the Whirlpool Galaxy in 1845. Public Domain (Frontiers for Young Minds 2022).

Beyond showcasing the remarkable skill of Lord Rosse as an observer, these drawings illustrate yet another step in the ongoing process of mediated engagement with the cosmos. Not everyone could look directly through the enormous telescope, but many could see its results captured on paper, a form of visual translation that made distant galaxies accessible to the broader public. This underscores how each new technological or creative practice introduces a fresh layer of interpretation between human perception and celestial reality. The telescope's magnification was itself a transformative device, but sketches added an additional interpretive filter, one where the astronomer's hand and artistic judgment shaped how the wider community came to view and understand these cosmic objects. In a sense, the drawn image became a shared representation of the unknown, extending the telescope's power of revelation far beyond the few who could stand at the eyepiece to look inside. Here we also see a distinct relationship between astronomy and cosmology where the visual interpretation based on scientific observation is transferred to the masses who are not able to observe the phenomena directly through the telescope. This also marks a clear event where the shift between embodied (looking through a telescope) and disembodied (making sense of representations) can be seen.

When comparing William Parsons' artistic depiction of the Whirlpool Galaxy (Figure 20) to the view captured by the Hubble Space Telescope for its fifteenth anniversary in 2005 (Figure 21), it's remarkable how closely Parsons' 160-year-old representation mirrors the modern image. Despite the limited technology of his time, Parsons was able to accurately depict what he observed through his optical telescope. In contemporary society, we have space telescopes like Hubble, which rely on data and advanced imaging technology rather than the naked eye, dramatically improving the clarity and depth of what we can see. Yet, the similarities between Parsons' image and Hubble's demonstrate how far early astronomers were able to reach in their visual interpretations of the cosmos, despite the constraints of their era.

Figure 21: The Grand Whirlpool Galaxy, M51, and Its Companion as taken by Hubble. Credit: NASA, ESA, S. Beckwith (STScI), and the Hubble Heritage Team (STScI/AURA) (National Aeronautics and Space Administration n.d.).

Du Preez's "Spaced Out" foreshadows how telescopes collapse safe distances, contracting cosmic space into human grasp yet estranging direct sight—a precision Bonestell harnesses to render the sublime tangible.

The evolution from early optical telescopes to their increasingly precise successors marks a deepening of mediation that both amplifies cosmic wonder and distances us from direct perception, setting the stage for a more radical shift in observational technology. In the next section, I examine how the advent of radio telescopes and advanced optics pushes this trajectory toward a fully disembodied horizon, where invisible wavelengths and data-driven representations redefine the sublime as a fusion of astronomy's empirical reach and cosmology's unseen realms – a dynamic that prefigures Kipping's digital abstractions and underscores the chapter's focus on technology's transformative role in shaping cosmic engagement.

3.5 Expanding the Disembodied Horizon

Optical precision paved the way for radio telescopes and advanced optics, pushing observation toward a fully disembodied horizon where astronomy's data meets cosmology's unseen realms, prefiguring Kipping's digital abstractions. Don Ihde (2010:80) describes Galileo as both "a perceiver and a practitioner" within this "technologically mediated, enhanced world." This observation highlights Galileo's role in shaping the relationship between humanity and technology. As a perceiver, Galileo represents the observer who, through technology (the telescope) extends the natural capabilities of human sight. This enhanced perception allowed him to see beyond the limitations of the naked eye, making him one of the first to witness what was previously unknown. His role as perceiver emphasizes how technological advancements enable a deeper understanding of the cosmos by revealing previously hidden aspects.

However, Galileo was not just a passive observer but also a practitioner through his active engagement in the manipulation and refinement of technological tools. By improving the telescope and applying it to astronomical inquiry, Galileo transformed it from a mere curiosity into a powerful scientific instrument. The role of practitioner highlights the experimental nature of his work; he was not merely seeing the cosmos but actively shaping ways in which it could be seen or represented. Galileo's dual role reflects a broader theme that would develop through future advancements in space observation, the intertwining of human perception with technological innovation. Technology becomes not just a tool but an integral part of how we experience and interpret the cosmos.

At the same time, these inventions also introduce additional layers of mediation between the observer and the universe. The further we push into the unknown with increasingly sophisticated instruments, the more our embodied engagement recedes behind the technologies that enable us to see beyond our natural limits.

As telescopic technology continued to evolve into the 20th century, instruments like Lord Rosse's became stepping stones toward the construction of even more powerful telescopes. These advancements set the stage for the technological explosion that would follow, particularly with the advent of space-based observation.

The shift from optical to radio telescopes in the 20th century further intensified the disembodiment of astronomical observation. Optical telescopes provided a mediated yet still visual connection to space. Radio telescopes, however, introduced an entirely new mode of perception, one reliant on data conversion rather than direct sight. Ridpath (2006:42) describes this as "invisible astronomy" where celestial phenomena are no longer observed in visible light, but detected through radio waves, x-rays, and infrared radiation, all beyond the visible spectrum (Figure 22).

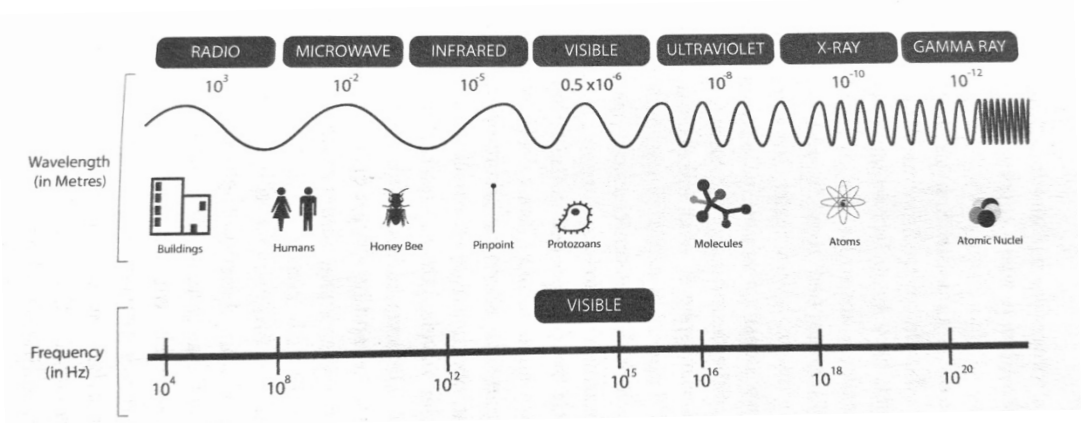

Figure 22: The Electromagnetic Spectrum. Jonathan Urie (May 2024).

Instruments like the Square Kilometre Array (Figure 23) capture signals imperceptible to human senses, translating them into numerical data that scientists reconstruct into visual representations of the invisible that can then be "seen" (SARAO 2024). This process of translating radio data into visual representations allows us to visualize and understand aspects of the universe that are otherwise inaccessible to human senses.

The unknown “suddenly became visible” (May 2024:21), and our exploration of the cosmos advanced rapidly in a short period of time. May (2024:21) explains:

> The results, within a few years of the first large radio telescopes being constructed, were staggering. Almost as many new astronomical phenomena were revealed through radio astronomy as had been discovered in three centuries of observations with optical telescopes.

Figure 23: The existing antennas of South Africa's MeerKAT radio telescope (on the right; actual photo) will be incorporated into SKA-Mid (the SKA dishes are on the left in this composite image) (SKAO 2024).

The advent of radio telescopes dramatically transformed astronomers’ ability to explore the cosmos, revealing previously hidden phenomena and expanding the understanding of the universe. As technological developments became more advanced through tools like the Square Kilometre Array (SKA), the potential for ground-breaking discoveries grew exponentially. These technologies, combined with optical and other telescopic methods, offer an unprecedented view of the universe, unlocking mysteries that were once beyond our reach and continuing to reshape our comprehension of space and the fundamental laws that govern it. May (2024:21) explains:

> (Astronomers) knew they now had to look at the rest of the electromagnetic spectrum in just as much detail, as well. The timing of this realisation couldn't have been better, since we're talking about the end of the 1950s and the beginning of the 1960s, which just happened to coincide with the beginning of the space age … Aside from radio and visible wavelengths, astronomy in other parts of the electromagnetic spectrum…is all but possible to do from the Earth's surface, due to the cloaking effect of the atmosphere.

Nye's (1994) technological sublime emerges here, where the sheer scale and complexity of these instruments and their operation evoke a profound awe that transcends their functional purpose. This awe stems not only from the cosmos they unveil but also from the technologies themselves, which stand as monumental testaments to human ingenuity, ambition, and the relentless drive to explore the unknown. In this convergence, the sublime becomes two-fold: it is the sublime of the infinite universe, once hidden beyond the reach of our sense of sight, now rendering intelligible, and the sublime of the human-crafted machines that mediate this revelation. These instruments, born from the legacy of Galileo's dual role as perceiver and practitioner, extend his foundational interplay of perception and innovation into a modern era where technology no longer merely augments sight but redefines it entirely. This Radio telescopes like SKA not only unveil a hidden cosmos but stand as engineering feats that captivate, merging the sublime of the unseen universe with the wonder of the tools that detect it. However, as mediation increases, our connection to the cosmos becomes progressively indirect. Optical telescopes initiated the disembodied observation experience, but radio telescopes furthered the level of separation whilst simultaneously revealing phenomena invisible to the naked eye. The result is a processed visual representation. This shift means that rather than perceiving the universe as it is, we now rely on constructed images to interpret what lies beyond human sight. Each achievement moves us further from direct observation, reinforcing the idea that our understanding of the universe is not just about seeing but about interpreting what is made visible through technology.

This disembodied horizon, per Ihde, fuses astronomy's empirical data with cosmology's speculative frontiers, a synergy Kipping's digital constructs amplify into sublime abstraction.

The trajectory of increasing disembodiment, from optical precision to radio telescopes like the SKA, sets the stage for an even more profound shift with the advent of space-based observatories, where the technological sublime reaches its apex. In the following section, I explore how instruments like the Hubble Space Telescope, and James Webb Space Telescope (JWST) construct a fully mediated cosmos, amplifying the dual awe of cosmic vastness and human ingenuity to an unprecedented degree. This culmination is critical to the chapter, as it not only extends the legacy of Galileo's perception and practice into the realm of complete technological abstraction but also redefines the sublime as a product of curated, data-driven representations, a dynamic that mirrors Kipping's digital visions and underscores the evolving interplay between observation, mediation, and wonder.

3.6 The Technological Sublime Constructed

Radio's invisible astronomy extends this disembodiment, culminating in space telescopes like Hubble and JWST, where the technological sublime constructs a fully mediated cosmos, echoing Kipping's data-driven visions. The launch of space telescopes such as Hubble and James Webb represents the culmination of this mediated trajectory. Ground-based telescopes, limited by atmospheric distortion and light pollution,[11] still offered a relatively direct experience, at least one bound by the familiarity of our planet. Space telescopes, however, operate entirely beyond human reach. Hubble's (Figure 24) images, for instance, are not true visual snapshots but composite constructions derived from various wavelengths of light, digitally processed and enhanced for clarity and aesthetic appeal (May 2024:34). Kessler (2012:5) notes, these images are designed to elicit emotional responses, providing humans with a "revolutionary view of the cosmos" (Kessler 2012) encouraging them to experience the cosmos as both vast and intimately graspable. This duality aligns with Burkean concepts of the sublime in terms of vastness and obscurity inspiring awe. The role of technology is no longer just to enhance vision but to curate perception, shaping how the universe is framed for human understanding. Our awe at JWST's images of

[11] Govert Schilling (2014:130) explains:
Even in a cloud-free sky, the atmosphere contains dust and moisture; the air vibrates continually, and many kinds of radiation are absorbed by the atmosphere, so they cannot be observed from the ground. Long before the dawn of the space age, astronomers already dreamed of overcoming these obstacles by using telescopes in orbit around Earth.

ancient galaxies matches our wonder at its distant orbit and intricate design, cementing a dual sublime where cosmos and technology captivate in tandem. May (2024:5) notes visual imagery, specifically considering those emanating from Hubble, formed a “language” that everyone could understand.

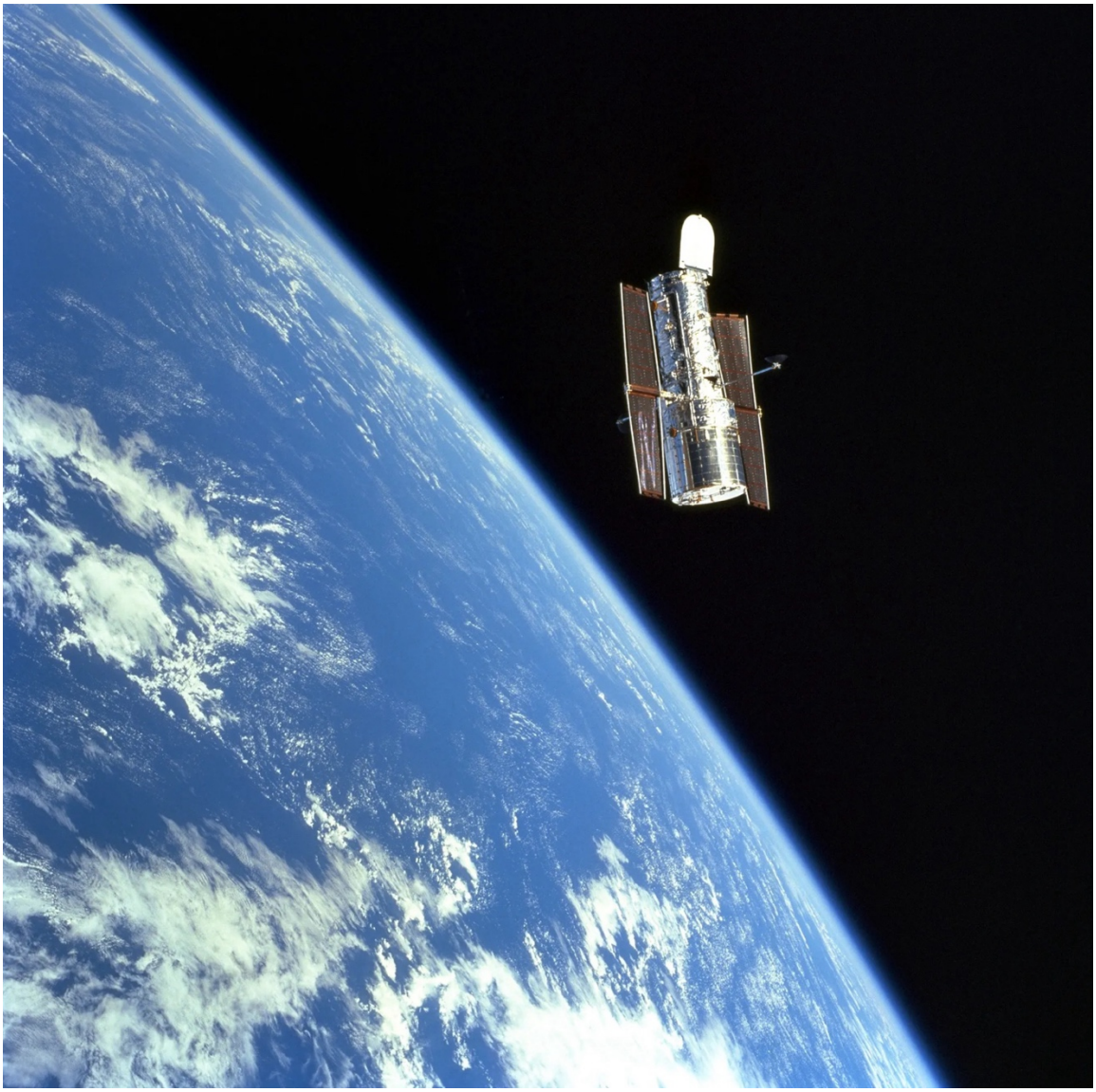

Figure 24: Hubble Observatory. Credit: NASA (National Aeronautics and Space Administration n.d.)

The James Webb Space Telescope (JWST), launched in 2021, extends this paradigm further. Positioned 1.5 million kilometres from Earth, it captures infrared light, revealing celestial structures beyond optical capability. Unlike traditional telescopes, which rely on visible light, JWST detects heat signatures from distant galaxies, necessitating even greater levels of interpretation. Jenna Goldschmidt (2022) explains:

> Because Webb's mirror is far larger than its predecessor, it can observe much fainter objects and operates primarily at infrared wavelengths, way beyond the scope of what we can see with our eyes or detect with ground-based telescopes on Earth's surface.

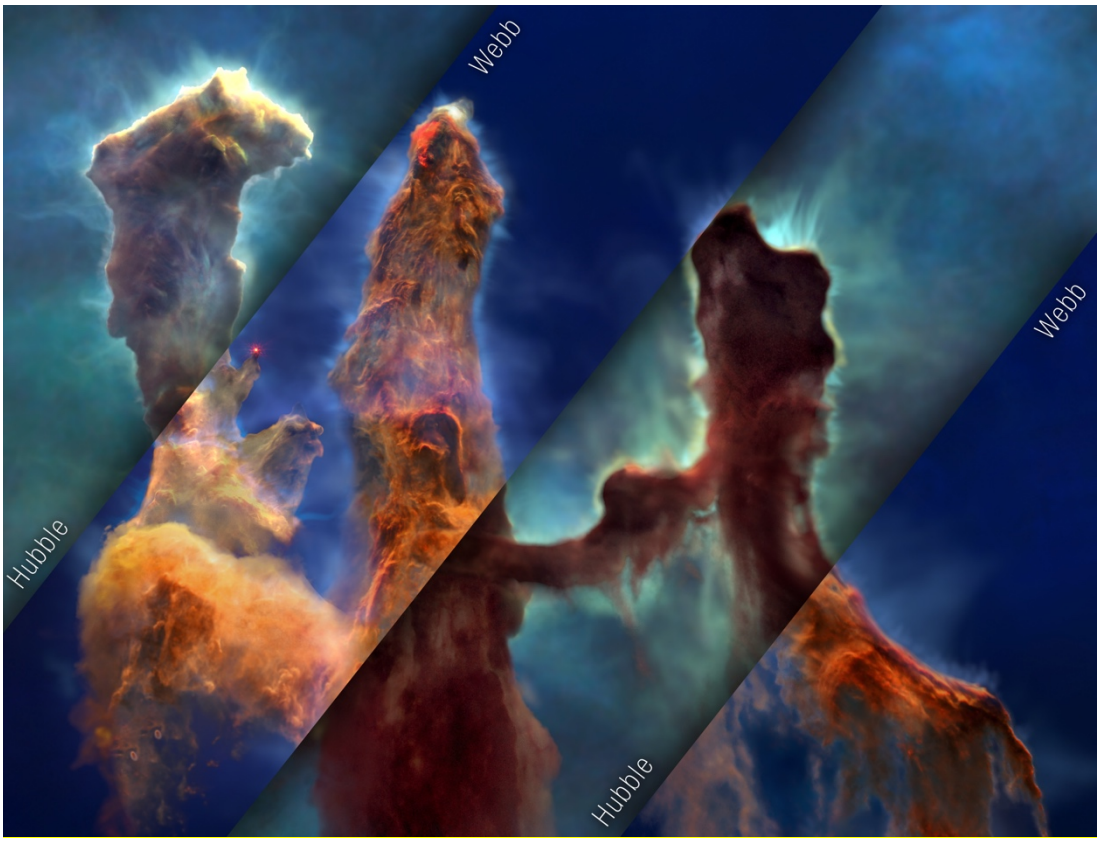

Figure 25: Pillars of Creation as mosaic strips to indicate the difference between Hubble (visual light) and JWST (infrared light). Credit: Greg Bacon (STScI), Ralf Crawford (STScI), Joseph DePasquale (STScI), Leah Hustak (STScI), Christian Nieves (STScI), Joseph Olmsted (STScI), Alyssa Pagan (STScI), Frank Summers (STScI), NASA's Universe of Learning (Space Telescope Science Institute n.d.).

JWST is the furthest space telescope humanity has ever deployed, orbiting at a distance that is beyond human cognition. JWST exists in a realm that no human can access. It has no eyepiece through which an observer might peer. This telescope is not simply a tool of seeing; it is a machine that sees on our behalf, producing an image that must be reconstructed, interpreted, and mediated before it reaches human eyes.

This ultimate mediation raises profound philosophical implications, positioning our relationship with JWST through the overwhelming expansion beyond human horizons coupled with the simultaneous restriction of embodied experience. JWST extends human vision into the deepest reaches of space, allowing us to witness the earliest

moments of the universe, yet it simultaneously, completely removes us from the act of looking. Unlike Galileo's telescope, which required physical engagement, JWST demands trust in algorithms, sensors, and computational processing, severing the tactile, immediate connection an observer once had with the cosmos. In many ways, it stands akin to space art, where imagined images of the cosmos filled in for what could not yet be observed, rendering our perception a product of technological imagination rather than direct experience. This detachment is central to the sublime experience as Du Preez (2022:4) explains it as a "state akin to omnipotence" where one experiences an "enormous extension and contraction of space." In other words, the JWST embodies a paradox of boundless reach and profound isolation, where we gain godlike insight into the universe's origins while being confined to a mediated, disembodied vantage point that underscores our separation from the reality we seek to know.

The sublime, as traditionally conceptualized by Burke and Kant, hinges on the tension between the observer and the overwhelming magnitude of the observed. For Burke, the sublime evokes terror in the face of boundless vastness, while Kant sees it as an internalized cognitive struggle to grasp the infinite. Du Preez (2022) reworks these ideas through the lens of technology, arguing that the sublime no longer emerges from direct encounters with overwhelming natural forces but from immersive, mediated experiences that collapse safe distances. JWST's images exemplify this shift as they create awe not through direct confrontation, but through hyper-mediated representations that extend human vision while severing it from bodily perception.

Does this then imply that observation has reached its final abstraction? Or does it signify a new frontier, one where vision itself is no longer a biological function but a technological construct? The more we strive to see, the further removed we become from the act of seeing itself. Yet, paradoxically, this very removal enables a depth of vision unimaginable to our predecessors. The sublime, once rooted in the tension between presence and absence, now manifests in the gap between observer and observed. JWST does not simply show us more; it redefines what it means to see.

This paradox positions JWST's mediated vision as the latest iteration of what Nye (1994) describes as the technological sublime. The technological sublime does not arise from unfiltered encounters with the natural but rather from the awe that emerges

from human-made spectacle. JWST in this sense, is the pinnacle of the technological sublime as it generates an overwhelming sense of scale and wonder, yet it does so through layers of mediation that make direct observation impossible. We are not merely observing space; we are observing the representation of space, suspended in an “in-between” state where we are neither fully here nor fully there (Du Preez 2022:7).

This tension is further amplified by the fact that JWST does not simply provide images; it constructs them. Unlike direct optical telescopes, JWST’s data must be translated, colorized, and reconstructed before becoming visible to the human eye. The cosmos it unveils is one we will never truly see through naked perception. Ironically this representation now becomes fully situated within astronomy as the technical data that constructs the image is devoid of imagination and cosmology.

Thus, JWST does not merely expand our ability to see; it fundamentally alters what it means to see. We no longer observe space in the traditional sense but experience it through complete technological mediation and construction. This represents the ultimate abstraction of observation, where vision itself is no longer a biological function but a technological construct. The further we reach into space, the more disembodied our vision becomes, exemplifying the contemporary sublime where awe born not from direct confrontation, but from the realisation that our perception is both limitless and fundamentally mediated.

JWST’s curated images mirror Kipping’s cosmological leaps, where the technological sublime constructs a cosmos beyond direct grasp, uniting astronomy’s data with cosmology’s vision.

3.7 Conclusion

The evolution of telescopic technology has fundamentally reshaped how we engage with the cosmos, tracing a spectrum of mediation—from the embodied immediacy of naked-eye stargazing to the fully disembodied, data-driven constructs of JWST. This progression reveals a paradox at the heart of astronomical observation: the more we see, the more mediated and abstracted our experience becomes. This arc – from naked eye primal awe to a dual sublime of cosmos and technology – reframes our cosmic bond as a mediated interplay of natural and engineered wonder. Don Ihde’s

philosophy of technological mediation underscores how tools like telescopes do not merely enhance human faculties but redefine perception itself, introducing a separation between observer and object, or what Ihde (2009) terms “seer” and the “seen”. This shift from observing the sky directly with our senses to engaging with images filtered through lenses, mirrors, and later, digital sensors, shifts us from embodied seeing to an ever-increasing reliance on representation, raising the question of whether technology brings us closer to the cosmos or alienates us from the sky we once knew. This spectrum - from ancient unmediated awe to JWST’s technological abstraction - evokes a sublime that evolves from Burke’s natural vastness and Kant’s rational struggle to Nye’s technological marvel and Du Preez’ “Spaced Out” collapse of distance, grounding Bonestell’s embodied realism and Kipping’s disembodied digital sublime.

From the unaided human eye tracing patterns in the night sky to Galileo’s first telescopic observations, and finally to the sophisticated data-driven images of JWST, each technological achievement has extended our vision while simultaneously distancing us from the direct act of seeing. The transition from early optical telescopes to space-based observatories and radio telescopes marks a shift from the natural sublime, where the night sky on its own evoked awe, to the technological sublime, in which both the scale of the universe and the engineering feats enabling us observation become sources of wonder.

At the extreme end of this spectrum, instruments like JWST epitomize the final abstraction of astronomical observation. Positioned beyond human reach, it does not merely capture images but constructs them, shaping our perception of the cosmos. This ultimate mediation raises the question of whether the extension of observational reach moves us closer to the universe or increasingly alienates us. While technology grants access to unimaginable cosmic depth, it simultaneously severs immediacy and direct experience.

Thus, disembodiment does not however diminish the sense of the sublime but rather transforms it. The awe inspired by space is no longer solely tied to its vastness but also to the technology that reveals it. The relationship between humanity and the cosmos thus remains one of fascination and wonder even as our means of perception and representation become increasingly mediated.

Ultimately, the history of observational technology is not just a history of scientific achievement but of shifting modes of representation. Each innovation redefines the boundaries between presence and distance, known and unknown, embodiment and disembodiment. This technological arc — from naked-eye wonder to JWST's abstraction — bridges astronomy's empirical precision with cosmology's imaginative reach, a dynamic Bonestell embodies through tangible vistas and Kipping disembodies through digital constructs. This two-fold sublime – where the cosmos' grandeur and the instruments unveiling it equally enthral – defines our mediated relationship with the universe, a legacy Bonestell and Kipping reinterpret. While we may no longer gaze at the night sky with the same immediacy as our ancestors, the sublime endures, reshaped and refracted through the ever-expanding lens of technology.

Having traced the technological evolution from embodied observation to disembodied abstraction and its interplay with the sublime, this chapter sets the stage for a deeper exploration of how these dynamics manifest in artistic representations of the cosmos. In Chapter 4, I turn to Chesley Bonestell's astronomical art, examining how his paintings mediate the unknown through a fusion of scientific realism and imaginative speculation, evoking the sublime to inspire both public imagination and scientific ambition, a legacy that resonates with Kipping's modern digital visualisations.

CHAPTER 4
CHESLEY BONESTELL – FATHER OF ASTRONOMICAL ART

4.1 Introduction

The vastness of space has long captivated humanity, evolving from the unmediated awe of ancient stargazers, as traced in Chapter 2, to the technologically mediated visions enabled by telescopes in Chapter 3, where the sublime shifted from primal wonder to a fusion of cosmic and engineered marvels. Into this trajectory steps Chesley Bonestell, a pivotal figure whose astronomical art transformed speculative science into vivid, believable realities, (PrintMag 2018) bridging the empirical precision of astronomy with the imaginative expanse of cosmology.

Arising during an era when interplanetary travel remained confined to the domain of science fiction, Bonestell's work captured the imagination of scientists, the general public, and space enthusiasts alike. His paintings, widely published in magazines, not only illustrated celestial bodies with remarkable precision but also projected a future where space travel was within reach. His ability to merge scientific accuracy with a profound sense of the sublime placed his work in a unique category, one that straddled art, science, and philosophy.

This fusion positions Bonestell's art as a pivotal point on the spectrum of observation traced across Chapter 2 and 3 – from unmediated stargazing to telescopic precision – extending it into a speculative realm where imagination (cosmology) supplements empirical limits (astronomy). His paintings embody Ihde's (2009) notion of technological mediation, acting as perceptual extensions that render the unseen cosmos tangible, amplifying the sublime from Burke's (2005 [1757]) primal awe to Kant's (1914 [1790]) intellectual overwhelm and Nye's (1994) awe at engineered possibility.

This chapter explores Bonestell's contributions to astronomical art, situating his work within the broader discourse of the sublime and technological mediation of space. Drawing on the theories of Burke, Kant, and Nye, it examines how Bonestell's

paintings evoke the overwhelming vastness of the cosmos while maintaining a scientific believability that fostered a deep emotional engagement. The chapter also considers how his work aligns with contemporary digital mediations of space, such as those by David Kipping, and how Bonestell's representation of the unknown continue to shape our perceptions of space. Ultimately, Bonestell's legacy extends beyond illustration. His art serves as both historical record of humanity's evolving cosmic perspective and a catalyst for further exploration, blurring the lines between imagination (cosmology) and reality (astronomy).

Chesley Bonestell, a painter, designer, and illustrator born in 1988 ventured into the science fiction side of representations of space in the 1940s and 1950s. Bonestell is considered the "father of astronomical art" (Miller 1996). His artworks depicted the Earth and planets along with futuristic elements concerned with space travel and what Newell (2014) describes as an "improvement on the scientific visualizations" of scientists who couldn't depict scientific findings into aesthetically pleasing representations. In Bonestell's paintings, science was as much on display as aesthetics (Newell 2014). Bonestell's work represented the unknowns of space, giving access to the un-accessible at the time. *Life* magazine published a series of his paintings depicting what "worlds beyond our own might actually look like – a stunning achievement for the time" (PrintMag 2018). His work "inspired generations of astronomers, engineers, astronauts, and space enthusiasts" (Voon 2014) which contributed to the space race, but it would be another 20 years before we would launch humans into space. Newell (2014:165) explains:

> Bonestell's paintings – along with Ley's writing and von Braun's plans – reinvigorated America's belief in their spiritual purpose as conquerors of the frontier and united space exploration with the nostalgia for the American West…His paintings of other worlds created a nostalgia for the frontier so powerful that in 1969 – 20 years after the publication of *The Conquest of Space* – two Americans walked on the Moon.

The accuracy of Bonestell's representations only became apparent once we advanced further in terms of technology and space exploration.

Chesley Bonestell stands as a pioneering figure in astronomical art, often referred to as astro-art. Working mostly in the mid-20th century, Bonestell used painting, illustration, and sometimes model building to craft images of distant planets, satellites, and spacecraft at a time when actual space travel was still an inspiration rather than a reality. His work, published in multiple magazines helped shape popular conceptions of the cosmos and arguably paved the way for the American public's enthusiasm about space exploration. Bonestell's work fits within the category of what the IAAA (2015) terms "Descriptive Realism" where his works are rooted in scientific accuracy and imaginative depiction of extra-terrestrial landscapes. Bonestell shows overlap in the fields of astronomy and cosmology.

Bonestell's paintings played a role similar to how David Kipping's modern YouTube videos mediate our understanding of cosmic distances and possibilities. Both serve as vehicles that translate the incomprehensible vastness of space into something tangible. Du Preez (2022:2) introduces the term "spaced out" to describe a state of being metaphorically and phenomenologically suspended between the familiar terrestrial realm and the cosmic unknown, experiencing both extension and vertigo. As Du Preez (2022) argues, such "spaced out" experiences destabilise our everyday perceptions, immersing us in impossible vantage points, such as viewing Saturn's moons up close. Even a 1940s magazine illustration can disrupt the ordinary, suspending our usual bearings and evoking the sublime.

This aligns with Burke's (2005 [1757]:148) notion of the sublime, where astonishment arises from the tension between the familiar and the unknown. Bonestell evokes this sensation by balancing scientific precision with overwhelming visual grandeur. Ramer (2021:137) describes this as an "emotional response" to vastness and power, which resonates with Kant's concept of the "mathematical sublime" (Kant 1914 [1790]:190), where the sheer magnitude of a representation surpasses normal human comprehension. Bonestell achieves this on two levels. First, his images explicitly convey a scale so immense that it defies human experience, particularly in the historical context of his time. Second, he creates an intellectual tension where the viewer recognises the scientific accuracy of the depiction yet struggles emotionally to grasp its sheer enormity. The sublime is then a result of this tension between "reason",

knowing the planets exist, and "imagination", struggling to represent their immense scale up close (Kant 1914 [1790]:120).

4.2 Astro-Art as Medium/Mediator

Before the Space Age, close observation of planetary surfaces was impossible, positioning Chesley Bonestell's art as a critical extension of the mediated spectrum traced in Chapter 3 – from naked-eye immediacy to telescopic precision.[12] His paintings acted as a visual prosthesis, offering audiences a glimpse of alien landscapes through a blend of painting techniques, astronomical data, and model building. Miller (1996:142) highlights an "intense believability" in Bonestell's work that immerses viewers emotionally, evoking wonder and curiosity akin to the sublime responses to early telescopic views.[13] These canvases served as vantage points, peering beyond Earth's horizons decades before satellites, aligning with Chapter 1's notion of representations bridging the known and unknown.[14] Miller (1996:143) argues that this believability – more than strict accuracy – defines their power, suggesting that the emotional resonance of the unknown trumps its precise depiction, a dynamic echoing the curated imagery of JWST discussed earlier.[15] Bonestell's work mediates between imaginative speculation and scientific plausibility, amplifying the emotional tension of exploration through a medium that enhances sublime experiences, as technology itself becomes a source of awe.[16]

Echoing W.J.T. Mitchell's question, "What do pictures want?",[17] Bonestell's images sought to persuade viewers of other worlds' reality, evoking awe, curiosity, and a desire for discovery. His meticulous rendering of shadows, planetary rings, and scale relationships invested them with credibility, mediating between speculation and

[12] See Chapter 3, Section 3.1, for the spectrum of mediation from unmediated observation to technologically enhanced views.
[13] Refer to Chapter 3, Section 3.3, where telescopic mediation shifts the sublime from natural awe to a blend of precision and wonder.
[14] See Chapter 1, Section 1.2.1, on representations as translations of the incomprehensible into provisional forms.
[15] See Chapter 3, Section 3.6, on JWST's constructed images prioritizing emotional impact over raw data.
[16] Nye's technological sublime is introduced in Chapter 1, Section 1.4, and expanded in Chapter 3, Section 3.4, as awe inspired by technological feats.
[17] Mitchell's framework is outlined in Chapter 1, Section 1.4, emphasizing images as active agents in meaning-making.

science to render spaceflight imaginable – a goal prefiguring the technological leaps later realised. Du Preez (2022) notes that a painting, or any other visual interface, heightens immersion by balancing plausibility with radical unfamiliarity, a tension akin to the "Spaced Out" sensation Chapter 3 tied to advanced mediation.[18] Bonestell's crisp ring shadows, realistic rock formations, and careful angles reassure the viewer scientifically, yet also emphasise the unsettling distance from the known providing an emotional reaction that is central to feeling "spaced out".

This interplay reflects the embodiment levels explored in Chapter 3m where Ihde's (2009) framework positions technologies like telescopes, and in this instance Bonestell's paintings, as extensions of human perception. His art mediates not just sight but a bodily sense of presence, situating viewers within the spectrum of observation at a point where scientific data and imaginative projection converge, intensifying the technological sublime (Nye 1994) through this hybrid sensory experience.

4.3 Bonestell artworks analysis

Through an analysis of selected paintings by Chesley Bonestell, this study seeks to demonstrate his profound influence on the popular imagination, capturing the sublime by depicting the cosmos as both breathtakingly beautiful and awe-inspiringly vast.

4.3.1 Artwork Title and Context

In 1944, *Life* magazine featured a series of Bonestell's paintings, including *Saturn Seen from Mimas* and *Saturn as Seen from Titan*. These titles position the viewer on distant moons, suggesting vantage points a human might experience if standing on these remote surfaces. The "as Seen from" phrasing evokes an imagined presence on these otherwise inaccessible worlds, inviting audiences into a visceral, travel-like encounter with the cosmos.[19]

[18] See Chapter 3, Section 3.6, where Du Preez' "Spaced Out" frames the collapse of distance in advanced technological mediation.
[19] This imaginative immersion aligns with the study's broader exploration of cosmic representation, as examined in David Kipping's digital work in Chapter 5.

Contextually, these works emerged at the height of World War II, an era of turmoil and technological leaps. Aldo Spadoni (2021:174) notes:

> The influence of the German V-2 as a real rocket capable of flight above the atmosphere popularized the idea that all spacecraft would have a similar appearance, such as the classic spacecraft painted by Bonestell.

Rocketry was thus being transformed from a wartime weapon (the German V-2) into a potential vehicle for humanity's greatest aspiration: leaving Earth's atmosphere to explore space. Bonestell's paintings thus tapped into Burke's sublime elements (2005 [1757]:131) of anxiety or "fear" through the uncertainty of space exploration, while simultaneously maintaining a safe observational distance. Here, Du Preez's (2022) notion of feeling "spaced out" becomes especially relevant. For readers in 1944, the concept of standing on Mimas or Titan would've been unimaginable. This imaginative leap creates astonishment through confronting the unknown from a safe, mediated distance. The bodily and spatial limits of this era, pre-physical space exploration, amplifies the shock and awe. Bonestell's images collapsed these limits, offering a surreal yet hyper-real window to a vantage no one thought achievable, thus heightening the sublime tension born from being "spaced out".

4.3.2 The Sublime Vantage Point: Saturn as Seen from Titan

Bonestell's painting *Saturn as Seen from Titan* (Figure 26) portrays Saturn as an immense orb dominating the sky, suspended behind jagged, mountain-like formations. The partially lit ringed planet evokes awe; a visceral astonishment teetering on terror, triggered by the overwhelming "power" of its sheer magnitude. The framing of Saturn between towering cliffs intensifies this grandeur, rendering it almost impossibly vast in the viewer's perception.

Figure 26: Saturn as Seen From Titan, by Chesley Bonestell, 1944 (PrintMag 2018).

Lighting plays a crucial role in shaping this sublime effect. Bonestell employs a dim, dusk-like illumination, casting eerie shadows across the scene that mimic the faint glow of a crescent moon seen from earth. This subdued lighting not only softens the landscape but also deepens the sense of mystery, as the full extent of Saturn and its surroundings remains partially concealed. “Obscurity” (Burke 2005 [1757]:133) a key element of Burke’s sublime, takes prominence here: the incomplete visibility heightens both fear and astonishment by withholding a total revelation of the scene’s scale and detail. This lunar-like reference – familiar to viewers as a sliver of light against darkness – grounds the alien vista in something recognisable, yet the confrontation with Saturn’s colossal presence swiftly overshadows any comfort of familiarity, thrusting the viewer into the unknown.

This overwhelming scale also resonates with Kant’s mathematical sublime, a concept where the mind grapples with phenomena too vast to fully comprehend. He describes this as an encounter with something “absolutely great”, where the imagination struggles to measure or contain the object’s immensity, leading to a dual response: a humbling recognition of human limitation and a simultaneous wonder at the mind’s capacity to conceive such grandeur. In *Saturn as Seen from Titan*, the planet’s

disproportionate size against the rocky foreground defies easy calculation, producing both awe at its majesty and a profound sense of insignificance as the viewer's ability to grasp its dimensions falters. This tension – between the beauty of the scene and the intellectual challenge it poses – mirrors Kant's idea, amplifying the sublime experience beyond Burke's immediate terror into a reflective, almost philosophical astonishment.

In line with W.J.T. Mitchell's idea that images possess agency and can desire something from their viewers, *Saturn as Seen from Titan* seeks to compel audiences to confront the cosmic immensity it portrays and stretch the mental boundaries of what they perceive as possible or known. Mitchell (2005:28) suggests images are not passive but actively demand engagement, urging viewers to respond emotionally and intellectually to their constructed realities. In this painting, the towering presence of Saturn, its rings slicing through the dim sky above Titan's rugged cliffs, does more than depict a scene, it challenges viewers to grapple with the planet's staggering scale and alienness, evoking a sense of the unattainable made tangible. The painting acts as a mediator, fusing factual astronomical knowledge, such as Saturn's ring structure and Titan's rocky terrain, with imaginative, emotive aesthetics—like the eerie dusk lighting and dramatic framing—that stir awe and curiosity. By blending the precision of astronomy with the evocative power of art, Bonestell's work beckons viewers to imagine standing on Titan's surface, transforming scientific observation into a visceral experience that bridges the known cosmos with its uncharted mysteries.

Bonestell's mastery of lighting and atmospherics, a hallmark of his style, enhances this effect. Employing twilight shadows and subtle contrasts, he conjures a dreamlike aura that lends both scientific plausibility and cosmic wonder, bridging the known with the unknown through a painterly medium that rivals modern multimedia's immersive power.

4.3.3 Expanding the Frame: Saturn Seen from Mimas

In a related painting, *Saturn Seen from Mimas*, (Figure 27) Bonestell magnifies Saturn's presence further, so it consumes even more of the frame. The mountains in the foreground are similarly large, but they appear almost trivial against the planet's

dominating disk. Here Burke's element of "vastness" is explicitly depicted, intensifying the viewer's astonishment at humanity's insignificance against the cosmos. Tiny human figures in blue spacesuits are rendered almost invisible in this painting in order to convey the magnitude of the planet they are looking at. The vulnerability of these humans against the backdrop of the overwhelming force of the planet in the background speaks to Burke's sublime element of "power". This interplay of the minuscule human form against the cosmic grandeur intensifies a sense of the sublime. Drawing explicitly from Kant's dynamic sublime the scene confronts viewers with nature's overwhelming force, visualising the sublime experience that emerge from this juxtaposition of tiny human figures against the immensity of nature. Burke lists "privation" as element of the sublime.

This dramatic emphasis on scale uses faint human figures in spacesuits to magnify the grandeur and foreignness of the celestial landscape, paralleling the compositional techniques that underscore humanity's smallness against cosmic vastness.

Figure 27: Saturn as Seen From Mimas, by Chesley Bonestell, 1944. (PrintMag 2018).

Humanity is shown as placed into a vast cosmic expanse that transcends normal experiences of scale. Thus, the painting effectively visualises a tension between human technological aspiration and the raw magnitude of a universe that might be indifferent to our presence.

4.3.4 Interplay of Realism and Speculation

Despite never having left Earth himself, nor having access to the advanced telescopic images commonplace today, Chesley Bonestell insisted on scientific plausibility in his depictions of the cosmos.[20] Wernher von Braun (as quoted in Miller 2021:52) praised this commitment, stating, "Bonestell's pictures present the most accurate portrayal of those faraway heavenly bodies that modern science can offer," reflecting how Bonestell's art aligned with the best astronomical knowledge of his time. His method often involved constructing three-dimensional models of landscapes and using photography to study shadows and perspective (Miller 2021:51), a meticulous process that, as PrintMag (2018) notes, resulted in "Bonestell's astonishingly accurate representations." This painstaking approach imbued his works with a quasi-photographic realism, a quality Ron Miller (2021:52) captures vividly: "His illustrations gave immediacy and verisimilitude to dry astronomical data. What had once been columns of numbers and blurry telescopic images took on a new, compelling reality." Through these techniques, Bonestell transformed abstract science into tangible vistas, grounding his speculative art in a believable authenticity. Such realism functions as a crucial mediator of belief. As Don Ihde suggests, the painting serves as an embodiment relation, a technological extension where scientific data – drawn from the limited telescopic observations of the 1940s – is integrated into a visual form that simulates the bodily experience of standing on a distant moon.[21] By situating familiar human figures, carefully calculated shadows, and physically accurate rock formations, Bonestell bridges the gap between the empirical limits of his era's telescopes and an imagined, immersive encounter with the cosmos, fostering the technological sublime.

[20] See Chapter 3, Sections 3.4-3.5, for the evolution of telescopic technology, which demonstrates that 1940s instruments lacked the resolution of modern space-based observatories, underscoring Bonestell's reliance on speculative yet informed methods in the pre-Space Age era.
[21] Ihde's (2009) "embodiment relations" describe how technology mediates perception, extending human senses while reshaping experience. Here Bonestell's painting acts as a surrogate for direct observation, embodying astronomical data in a way that feels lived (See Chapter 3, Section 3.4).

This aligns with Chapter 3's spectrum of observation, where Bonestell's work occupies a midpoint between the telescopic glimpses of his era and the uncharted vistas beyond, embodying scientific data in a form that prefigures the direct observation later achieved by space probes. The sublime here evolves from Chapter 1's Burkean terror to a technological marvel, as Nye (1994) describes, where human ingenuity amplifies cosmic wonder. Viewers do not simply confront the immensity of Saturn, but also the imaginative leap made possible by then-emerging rocketry and scientific prediction.

4.3.5 Prefiguring Spaceflight: Ship Ready for Return Trip

In *Ship Ready for Return Trip*, (Figure 28) Bonestell extends his vision beyond alien landscapes to depict the vehicles that might enable such cosmic voyages. The rocket in this painting strikingly evokes the shape and technology of the German V-2 Rocker (Figure 29), a deliberate nod to the scientific realities of the 1940s. The resemblance is unmistakable: both share a sleek, tapered fuselage, stabilising fins at the base and a streamlined silhouette designed for aerodynamic efficiency. Bonestell's rocket, poised its wartime legacy into a vessel of exploration. This visual and conceptual linkage positions the ship as a symbol of human ambition, bridging the gap between the destructive technology of World War II and the promise of peaceful spaceflight.

Figure 28: Ship Ready for Return Trip, by Chesley Bonestell, 1948. (PrintMag 2018).

Figure 29: The German V2 rocket was the world's first large-scale liquid-propellant rocket developed between 1936 and 1942 in Nazi Germany. Credit: Getty Images (Harvey 2022).

Tiny human figures scurry around the base, preparing for departure. This sense of busy preparation suggests the future as a realm of possibility, rather than despair, highlighting how the same technology that wrought devastation during World Warr II could be repurposed to support humanity's hunger for exploration of the unknown. Again, the sublime elements of the momentous scale of the rocket and man's journey beyond Earth, as well as the precariousness of venturing into the vacuum of space, and the existential leap required to even imagine a return trip from a celestial body far beyond human reach in 1984 serves to evoke an emotional response from the viewer.

Here Bonestell bridges science and imagination, thematically reframing wartime rocket technology as a vessel of hope. This atmosphere of optimism guides the viewer from conflict's shadow toward a future of constructive exploration, amplifying the sublime with humanity's aspirational potential.

4.3.6 Space Stations and the Technological Sublime

In his later painting, *Space Station, Ferry Rocket, and Space Telescope 1075 Miles above Central America* (Figure 30), Bonestell envisions a space station orbiting Earth, accompanied by a ferry rocket and a space telescope, long before such technologies materialised. Rendered in 1952, the scene captures Earth as a vivid, blue-green sphere suspended below, its continental outlines stark against the black void. This dramatic contrast between the planet's immense, curved vastness and the station's slender, metallic fragility, frames a futuristic scene. A lone astronaut, tethered to the telescope, floats in the vacuum, diligently adjusting or repairing the instrument. This figure dwarfed by both the station and Earth, prefigures the real-life maintenance missions of the Hubble Space Telescope decades later, grounding Bonestell's speculation in a prescient human element.

Figure 30: Space Station, Ferry Rocket, and Space Telescope 1075 Miles above Central America 1952, by Chesley Bonestell. (PrintMag 2018).

This composition encapsulates what might be called the visual forecasting role of Bonestell's art, depicting not just the physical apparatus of space exploration but also the human engagement with it. The astronaut's presence is pivotal: a tiny, suited figure wielding tools amidst the vastness, he embodies humanity's tentative yet determined interaction with advanced technology. His delicate manoeuvring around the telescope highlights a symbiotic relationship – technology extends human reach into space, while human skull sustains and directs it. This interplay amplifies the painting's technological sublime, a concept rooted in Nye's (1994:xiii) notion of awe inspired by engineered marvels.[22] The viewer marvels not only at the station's intricate design – its rotating wheel evoking stability in orbit – but also at the astronaut's agency, suggesting humanity's capacity to master and inhabit an alien environment.

Beyond mechanics, Bonestell hints at a philosophical shift, inviting viewers to see themselves as cosmic citizens. The sublime emerges from the convergence of Earth's grandeur, the infinite star-studded backdrop, and the precariousness of human-made machines suspended in orbit. The astronaut intensifies this effect: his solitary labour underscores humanity's smallness against the boundless universe, yet his purposeful action imbues the scene with a fragile optimism. The painting draws the viewer into a vision of the future that is simultaneously awe-inspiring and unsettling, posting a

[22] See Chapter 1, Section 1.4, for Nye's technological sublime.

vantage point then inaccessible (1075 miles above Earth), where human presence teeters between triumph and vulnerability, reinforcing our minuteness in a physically unexplored cosmos.

This evokes the cosmic sublime thematically, harnessing awe and existential unease through the staggering scale of Earth and the star field beyond, brought up close in a way observational technology of 1952 could not achieve, underscoring humanity's philosophical shift toward cosmic habitation.

4.3.7 Sublime, Unknown, and the Desire of Images

Across these works, Bonestell cultivates a pervasive sense of the unknown. Planets loom in partial shadow, stars recede indefinitely into the background. The vantage points, always from an imagined surface or station, anchor the viewer in a plausible yet speculative scenario. We experience Mitchell's (2005) question "What do pictures want?", with renewed urgency. Bonestell's images want us to accept that these representations could be real. They want us to yearn for exploration and to sense the paradoxical combination of fear and exhilaration that the cosmic sublime suggests. In so doing, they mediate our relationship with the uncharted depths of space, nudging us closer to the era in which these visions would partially come true. The inescapable sense of dislocation accompanying the uncharted or unknown also aligns with Du Preez's concept of being "spaced out". The viewer is perfectly aware that they are holding a magazine or looking at a painting, yet the image insists that they are on a distant moon. This collision of two locations, the here-and-now and the imagined out-there, naturally evokes awe at Saturn's looming presence and a terror at confronting a vantage point far outside normal human boundaries. Bonestell's work thrives on this destabilising interplay of wonder and anxiety.

The dual sensation of terror and awe profoundly reshapes the human condition within this cosmic frame. To feel both is to confront our fragility and insignificance against the universe's vastness, yet it simultaneously ignites a recognition of our capacity to imagine and aspire beyond Earth's confines. As viewers, we are jolted from the familiarity of our terrestrial home, forced to reconsider our place not as mere inhabitants of a single planet but as potential explorers of an infinite expanse. This

shift destabilises our identity: we are no longer just Earth-bound beings but beings capable of envisioning ourselves elsewhere, tethered to machines and dreams that stretch toward the stars. The terror of the unknown humbles the viewer, reminding them of their physical limits, while the awe elevates them, suggesting a latent potential within humanity. Bonestell's paintings thus transform the human into a figure, poised between rootedness and transcendence, prompting a re-evaluation of who we are: creatures defined as much by our smallness as by our audacity to gaze outward and imagine occupying the sublime unknown. Bonestell's images tap into the unknown thematically, placing viewers at vantage points no human had occupied, compelling us to contemplate worlds beyond reach – expanding conceptual horizons in a manner resonant with Mitchell's (2005) insights into the agency of images.

This transformation situates Bonestell's art within the observation spectrum's progression from Chapter 2's unmediated awe to Chapter 3's telescopic mediation, now extended through his paintings as embodied interfaces (Ihde 2009) that simulate cosmic presence. The sublime, rooted in Burke and Kant (Chapter 1), merges with Nye's technological sublime (Chapter 3), as viewers oscillate between Earth-bound limits and the engineered possibility of cosmic citizenship.

4.3.8 Between Imagination and Reality

Chesley Bonestell's astronomical paintings preceded the actual achievements of spaceflight, functioning as catalyst for public fascination and scientific curiosity. Operating at the crossroads of art, technology, and science, his works exemplify how visual media can bridge the unknown and render it momentarily comprehensible without diminishing its intrinsic mystery and vastness.

In an era defined by global conflict and swift technological change, Bonestell transformed the rocket from a symbol of destruction to one of exploration and hope. By masterfully balancing realism and speculation, his paintings illustrating cosmic scales far beyond ordinary human experience or accessibility. Today, as spacecraft images of Saturn, Titan, and deep space saturate our screens, we can look back at Chesley Bonestell's work and recognise its profound influence on how we visualise and emotionally respond to the cosmos, a legacy underscored by Ron Miller

(2021:51), who notes that “an entire generation of scientists, engineers, and astronauts were inspired in their choice of careers by Bonestell’s images”.

Ultimately, Bonestell’s work underscore the power of images to seek involvement. They beckon us to step into alien landscapes, to stand in awe of the unknown and to dream of returning safely from these explorative journeys. As mediators, they remind us that the unknown need not be paralysing, but rather, it can serve as a push for humanity’s boundless curiosity, inspiring both scientific endeavour and a deep sense of wonder at our place in the cosmos.

4.4 Conclusion

This chapter has demonstrated that Chesley Bonestell’s astronomical art constitutes an imaginary intervention in the mediation of space, effectively synthesising scientific plausibility with the evocative power of the cosmic sublime to reshape humanity’s engagement with the unknown. Far from merely illustrating celestial vistas, his paintings bridge the empirical domain of astronomy and the speculative reach of cosmology, extending the spectrum of observation traced in Chapters 2 and 3 of this study. By integrating Burke (2005 [1757]) sublime terror, Kant’s (1914 [1790]) mathematical and dynamic sublime, and Nye’s (1994) technological sublime, Bonestell’s work amplifies the emotional and intellectual tension between the known and the uncharted, positioning viewers within Du Preez’ (2022) “spaced out” phenomenology of cosmic dislocation.

Bonestell’s paintings, crafted before the space age’s direct observations, functioned as perceptual prostheses, simulating vantage points that were then beyond human reach. This mediation, rooted in meticulous realism, collapsed the bodily and spatial limits of his era, offering a hyper-real window into the cosmos that prefigured later technological validations. His reframing of wartime rocketry into vehicles of exploration exemplifies Nye’s technological sublime where human ingenuity transforms destructive tools into symbols of aspiration, fostering a cultural shift toward spaceflight as a feasible endeavour. This aligns with Mitchell’s (2005) notion of images desiring engagement, as Bonestell’s work compel viewers to imagine themselves within these scenes, igniting curiosity and emotional resonance.

Theoretically, Bonestell's art situates the sublime as a dynamic interplay of scale, power, and technological mediation, as evidenced by the analyses of Saturn's looming presence and the fragile optimism of human figures amidst vastness. This not only evokes Burkean astonishment and Kantian intellectual struggle but also reconfigures human identity from Earth-bound observers to potential cosmic participants. Such a shift underscores how Bonestell's paintings extend perception beyond the telescopic limits, rendering the sublime a catalyst for reimagining humanity's place in the universe.

Historically, this chapter has established Bonestell's influence as a precursor to the space age, priming public and scientific imagination for milestones later realised. His work's persistence in the digital era affirms its role in an ongoing dialogue between representation and reality, where speculative art anticipates and complements empirical discovery.

Bonestell's astronomical art does not merely reflect a historical moment but actively constructs a framework for understanding space as both sublime and accessible, as Miller (2021:283) notes, "the artist adds scale and context and, as a consequence, comprehension". This chapter's findings reveal how his paintings, through their fusion of science, technology, and imagination, mediate the cosmos in ways that parallel and prefigure contemporary efforts like Kipping's digital visualisations, sustaining a conversation between what is observed and what is envisioned. The sublime, as articulated here, thus serves not as an end but as a theoretical lens through which Bonestell's art illuminate humanity's enduring negotiation with the unknown.

CHAPTER 5
DAVID KIPPING - A JOURNEY TO THE END OF THE UNIVERSE

5.1 Introduction

In an era where scientific knowledge is more accessible than ever, digital platforms like YouTube have become powerful mediators of meaning, able to present and represent information to the masses, transforming the way we engage with the cosmos. Professor David Kipping's *Cool Worlds* YouTube channel exemplifies this shift, blending astronomy[23] with cosmology to create an immersive, thought-provoking experience. His video, *A Journey to the End of the Universe*, takes viewers on a conceptual voyage that stretches the limits of human understanding whilst (re)presenting the cosmos by illustrating the vastness of space, the implications of relativity, and the existential questions that arise from contemplating the unknown. Much like Chesley Bonestell's space art, Kipping's digital storytelling bridges the divide between scientific knowledge and cosmic wonder, offering representations of the universe that are both imaginative and deeply informed by contemporary astrophysics.

By building on Chapter 3's exploration of observational technology's evolution – from the embodied immediacy of naked-eye stargazing to the disembodied, data-driven constructs of telescopes like JWST – Kipping's work extends this trajectory into the digital realm. Here, YouTube acts as modern mediator akin to the telescopes discussed earlier, collapsing the distance between observer and cosmos while amplifying the sublime. This digital mediation evokes a dual awe between cosmology and astronomy, understanding and the unknown. YouTube's accessibility and Kipping's employment of the platform with data-infused visualisations link astronomy's precision with cosmology's speculative reach whilst resonating with both Burke's (2005 [1757]) natural sublime and the intellectual struggle of Kant's (1914 [1790]) mathematical sublime.

[23] See Astronomy and Cosmology in chapter 1.

By utilising YouTube as technological mediator, Kipping democratises access to these sublime encounters, allowing global audiences to participate in what was once an experience reserved for specialists or privileged observers. His work illustrates how digital media fosters a collective engagement with the unknown, where viewers are not merely passive recipients of information but active participants in a shared discourse on the mysteries of the cosmos. This chapter explores how Kipping's video constructs a modern, digitally mediated sublime experience, examining its use of visual aesthetics and narrative techniques to evoke awe, disorientation, and intellectual curiosity in ways that resonate with both historical representations of space and contemporary scientific achievements.

Professor David Kipping is an Astronomer and assistant Professor of Astronomy at New York's Columbia University. Kipping is the presenter and face of the YouTube channel *Cool Worlds*. The channel has more than 971 000 subscribers and has posted 238 videos to date. The channel covers content relating to multiple aspects of astronomy, including hypotheses surrounding extraterrestrial life and intelligence, Astro engineering, exoplanets, astronomy, and space (Cool Worlds – YouTube, n.d.).

In his popular video, *A Journey to the End of the Universe* (2019), Prof Kipping takes his viewers on a journey that explores numerous topics, including: the scale of the universe, Einstein's theory of relativity, the speed of light, time dilation, and ultimately the question of existentialism. Kipping introduces numerous factors of the unknown in this video, taking its viewers on a journey into the physically unexplored regions of space. Much like Bonestell's representations of what we have not yet physically experienced or seen, Kipping provides representations of the unknown that may someday be proven to be as accurate as Bonestell's artworks of the time. Notably, Kipping - a practicing astronomer - communicates astronomy through a distinctly cosmological lens, employing imaginative journeys that situate his viewers in hypothetical yet scientifically grounded scenarios. This illustrates how YouTube does more than disseminate knowledge; it actively shapes our engagement with cosmic inquiry, making it a site of sublime mediation that extends beyond traditional representations of space found through telescopes or artistic renderings.

Kipping's digital voyage thus exemplifies a new mode of cosmic engagement, one made possible by YouTube's transformative role as technological mediator, which the next section explores as a democratising force reshaping our collective encounter with the sublime.

5.2 YouTube as a Digital Mediator

Janet Wasko and Mary Erickson (2009:373) refers to YouTube as a "democratizing force in new media" highlighting its role in making information widely accessible – a transformation vividly illustrated by Kipping's YouTube videos. In earlier decades, experiences of the cosmic sublime, such as peering at distant galaxies through large terrestrial telescopes were rare and exclusive.[24] Access to those massive telescopes was restricted to a small circle of professionals or fortunate enthusiasts who could reach remote observatories. However, the advent of mass media has expanded access. For Bonestell, this meant the distribution of his paintings through widely circulated magazines whilst for Kipping, it is the global reach of a free, interactive platform: YouTube. Anandam Kavoori (2015:2) describes YouTube as much more than a website: it is a key element in the way we think about our online experience and (shared) digital culture.

Phil Benson (2015) underscores YouTube's role as a technological mediator, shaping the reception and interpretation of scientific concepts through multimodal engagement. Unlike passive media, YouTube fosters dynamic interactions, enabling audiences to partake in discourse rather than merely consume it (Benson 2015:82). Anandam Kavoori (2015:5) similarly describes YouTube as an active, two-way medium, reinforcing the idea that participation transforms spectators into co-creators of meaning. This aligns with Snickars and Vonderau's (2009:11) argument that YouTube, as the "epitome of digital culture", thrives on interactivity and audience engagement.

[24] Refer to Chapter 3, Section 3.4 which explores how the public responded to gaining access to Parson's telescope.

The experience of the sublime is inherently personal, yet it can also create collective awe. Nye (1994) notes that in multicultural societies, shared experience, such as witnessing the vastness of the Grand Canyon or the technological marvels of Cape Canaveral, foster "solidarity through participation", even when individual interpretations differ. Nye (1994:xiv) explains:

> The crowd's infectious enthusiasm is an essential part of the atmosphere surrounding a world's fair, the celebration of a new technology, or an Independence Day celebration. At such events organizers mediate the crowd's response through speeches, music, fireworks, and spectacular demonstrations, but unanimity is not necessary. The specific advantage of the sublime as a shared emotion is that it is beyond words.

YouTube, by extending the reach of Kipping's cosmic explorations, offers a similar form of mediated participation. Viewers from diverse backgrounds can engage with astronomical wonder, experiencing a digital representation of the unknown. The "participatory culture" (Kavoori 2015:1) of YouTube enhances this shared encounter, as comment sections and algorithm-driven recommendations create an ongoing dialogue about the mysteries of the cosmos. In this way, Kipping's work does more than educate, it invites collective awe, bridging individual encounters with a broader cultural experience of the sublime. For Nathan Stormer (2004:219) sublimity centres on "any aesthetic that presents the possibility of the unrepresentable". Kipping's video invite viewers to find awe in many facets of cosmic exploration, reinforcing Stormer's broader point that the sublime transcends any one grand subject and can arise wherever there is a sense of something surpassing ordinary experience.

Kipping employs YouTube as platform to transform complex theoretical physics (astronomy) into an accessible and personalised experience, making the abstract tangible through digital mediation. Through the screen the viewer experiences a form of cosmic overview that merges scientific data, computer-generated animations, and personal narration. This triangulation between technology, information, and human imagination (cosmology) conditions the experience of the viewer and leads to a sense of feeling "spaced out" (Du Preez 2022). The video creates a disorienting sense of presence in multiple realms: the viewer is invited to envision and enter a spacecraft

capable of accelerating at impossible speeds, conceptually feel artificial gravity, and experience an impossible cosmic journey along with Kipping. Despite the virtual nature of the experience, its psychological impact is real, drawing the audience into a suspended, in-between state of awe (confronting the infinite openness of space) and terror (experiencing a detachment from Earth), all whilst grounded at home in front of their screen. Stormer (2004:219) stresses that we do not need to experience a full "spasmodic state" of awe each time we see a grand depiction. The heart of sublimity, he argues, is not exclusively bout authentic emotional upheaval. Kipping's audience is unlikely to be overwhelmed in a purely visceral sense. Nevertheless, Stormer's insight helps explain how this digital journey still functions as a sublime encounter. YouTube provides a contemporary digital immediacy that blends wonder and fear while keeping the viewer suspended between earthly grounding and an expanded cosmic perspective. The viewer can sense that normal discourse or typical imagery can't quite capture the cosmic vastness.

In what follows, this chapter delves into the specifics of Kipping's video, *A Journey to the End of the Universe,* unpacking how it constructs a digitally mediated sublime experience.

5.3 Analysis

5.3.1 A Journey to the End of the Universe

The title, *A Journey to the End of the Universe,* suggests both an invitation and an impossibility. On the one hand, the word 'journey' implies an embodied, shared experience where viewers are encouraged to imagine themselves traveling alongside the narrator. Yet, 'the End of the Universe' invokes a concept of finality that modern astronomy challenges. As has been shown throughout this study, each technological advancement over time has revealed cosmic thresholds beyond what was once considered the limit. The presumed boundaries of the cosmos have consistently been expanded. This paradox aligns with Kant's (1914 [1790]) sublime where imagination struggles to grasp the infinite while reason transcends sensory limits to conceive of boundlessness. Kessler (2012:50) describes this as a "mental motion", a dynamic oscillation in the conflict between reason and imagination. Kipping's title places the

audience within this oscillation, between the desire to explore and the recognition that the universe may have no absolute boundary or ‘End’.

The video’s thumbnail (Figure 31) visually reinforces this conceptual paradox. An astronaut stands on a spherical surface surrounded by what appears to be cosmic dust reminiscent of a supernova. A bright light, akin to artistic depictions of galactic cores, sits directly behind the astronaut, with a gamma-ray-like beam emanating from its centre. In the distance, a celestial body underscores the vastness of space. The composition evokes Cosmic Impressionism (IAAA 2015) a genre of art concerned with the “impact of space travel on the human psyche” (Miller, Szathmáry, Broom-Riviere, Ramer 2021:191). Much like traditional Impressionism, Cosmic Impressionism captures not just the appearance of space but the psychological and existential weight of confronting the unknown and to “sense the wonder and majesty of both the vastness and the journey there” (Miller et al 2021:198). The faceless astronaut, turned away from the viewer, embodies anonymity in the infinite cosmos. This explorer dwarfed by the universe, evoke the themes of “Power” and “Privation” from Burke’s (2005 [1757]) sublime. The interplay of darkness and luminous energy deepens the sensation of “Fear” and “Terror”, emphasising human vulnerability before the cosmic void.

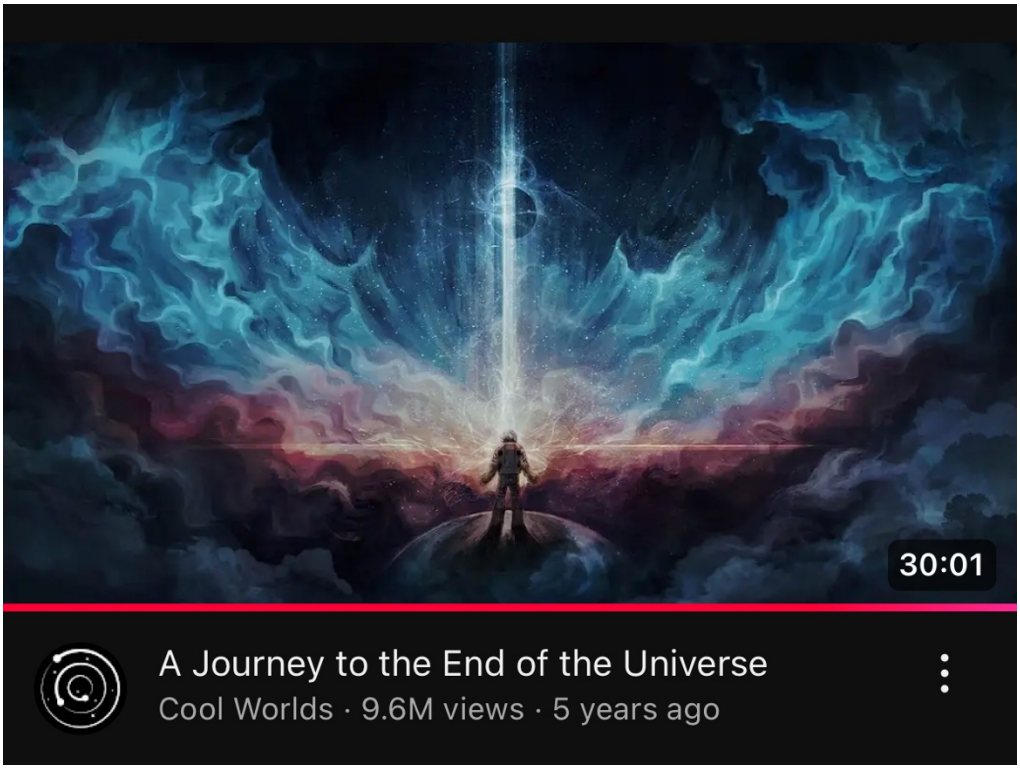

Figure 31: A Journey to the End of the Universe video thumbnail (Cool Worlds - YouTube n.d)

Stormer believes sublimity centres on “any aesthetic that presents the possibility of the unrepresentable” (Stormer 2004:219). Kipping’s representation of an astronaut looking out at the universe operates within this tension. An example is his attempt to depict an infinite or ever-receding horizon, while also implying that these cosmic stretches ultimately lie beyond total comprehension. This tension echoes Stormer’s (2004:219) definition of the sublime as a “representational conundrum” because Kipping’s video, though visually impressive, serves as reminder of how humanity strains to portray what may exceed both speech and imagery. This representational tension sets the stage for the video’s runtime, which the next section examines as a sublet yet profound extension of the sublime into the realm of time.

5.3.2 The 30-Minute, 1-Second Runtime

The 30 minutes and 1 second runtime underscores a symbolic notion of ‘beyond’. Thirty minutes might neatly signify a self-contained, perfectly measured interval, yet the extra second hints at a universe that extends past our neat human compartmentalisation. It is a subtle but evocative nod to the idea that no matter how we try to package or define cosmic phenomena, there will always be something just beyond the edge of our understanding. This deliberate addition of a single second disrupts the symmetry of a round, human-imposed duration, mirroring the way the cosmos resists containment within our frameworks of time and comprehension. It suggests a temporal sublime, where the precise 30-minute structure aligns with our desire to order and quantify – an impulse akin to astronomy’s measured focus – while the extra second gestures toward cosmology’s speculative reach, the infinite expanse that eludes final definition. In this way, the runtime becomes a microcosm of the video’s broader narrative: a journey that seeks to chart the universe’s limits yet acknowledges their perpetual retreat. This subtle excess evokes Kant’s (1914 [1790]) mathematical sublime, where the mind confronts magnitude that exceeds its capacity to fully grasp, leaving us suspended between comfort of structure and the unease of the unknowable. Moreover, an alignment is noticeable with Du Preez’ (2022) “spaced out” state, suspending the viewer in an in-between realm – neither fully anchored in the tangible, ordered 30 minutes nor wholly lost in the boundless unknown hinted at by the extra second – where digital mediation of YouTube amplifies a sense of movement

between the real and imagined, grounding the sublime in a disorienting yet awe-inspiring tension. This temporal sublime hints at the vastness to come, which the prologue amplifies through sound and visuals, as explored next.

5.3.3 Prologue: Establishing Scale and Setting the Tone

The video opens with ominous yet tranquil music, set against footage of countless galaxies drifting by. This haunting yet serene soundscape immediately establishes a dual tone, blending a sense of foreboding with calm wonder, as if preparing the viewer for a journey that is both thrilling and unsettling. Of course, no actual footage of intergalactic travel exists, but the animated simulation attempts to give viewers the briefest sense of moving among galaxies, an otherwise impossible experience given that even our farthest probes have not ventured beyond the solar system. These visuals, though constructed, evoke an impression of cosmic drift, pulling the audience into a realm beyond earthly reach. This artificial glimpse of intergalactic motion sets the stage for the vast scales to come, priming the viewer for an encounter with the incomprehensible.

Kipping's voiceover conveys the magnitude of cosmos through his using of the words "immense" and "inconceivable". By describing 70 sextillion stars and likening this figure to the grains of sand on all of Earth's beaches, he transforms the abstract statistic into a vivid analogy that bridges the abstract with the tangible.[25] The comparison not only underscores the sheer number of stars but also connects the cosmic to the familiar, making the scale feel both relatable and overwhelming. This narrative choice amplifies the prologue's visual prelude where the drifting galaxies hinted at enormity. Now, Kipping's words anchor that enormity in a way that invites contemplation of the universe's boundless expanse, seemingly linking the sensory experience of the simulation to the intellectual grasp of its scope.

[25] Kipping illustrates the vast distances in space using a grain-of-sand analogy: if a star were the size of a grain of sand, the average distance between stars would be approximately 6 miles (9.6 kilometres), which corresponds to about four light-years (where light travels at 300,000,000 meters per second for four years). He further highlights the challenge of space travel by noting that Voyager 2, currently 986 billion kilometres from Earth and moving at 15,341 kilometres per second, would still require another 80,000 years to reach the nearest star, Proxima Centauri. For scale, the closest galaxy is about 2.5 million light-years away—roughly half a million times further than Proxima Centauri. This demonstrates how even intuitive analogies fail to make such scales fully comprehensible, aligning with Kant's notion of the mathematical sublime.

Kipping's direct address, in which he looks into the camera and breaks the fourth wall, personalizes the experience. It is as if he invites the individual viewer into his space, bridging the conceptual chasm between everyday life and this cosmic experience. The use of direct eye contact and direct speech fosters a mediated form of embodiment where the viewer feels involved despite the medium through which the interaction takes place, or moreover that it is in fact a fictitious journey that is being undertaken. Du Preez's (2022) notion of "spaced out" is particularly relevant in this instance, as it encapsulates the paradoxical sensation of simultaneous presence and absence. The viewer watches the spaceship travel billions of kilometres, their imagination catapulted beyond the solar system, yet their bodies never leave their chair. This mediated sublime experience invites the viewer to imagine embarking on the journey themselves. For the viewer, this feels like a disorienting suspension, a pull between the "upward" lure of cosmic exploration and the "downward" tether of physical immobility, as Du Preez (2022) describes – an extension into galaxies both real and virtual that leaves one feeling omnipotent yet docile, awestruck by the vastness yet acutely aware of their earthly confines. This in-between state stirs a restless wonder, where the mind races to grasp the ungraspable while the body remains static, amplifying the sublime through a tension that is both exhilarating and unsettling. This disorientating wonder primes viewers for the speculative journey ahead, which the next section grounds in the imagined engineering of a relativistic spaceship.

5.3.4 Simulated Travel

Kipping's hypothetical spacecraft (Figure 32) accelerates at 1g, gradually approaching relativistic speeds, a concept that draws from speculative technologies such as warp drives and wormholes yet remains grounded in Einstein's Theory of Relativity. This interplay between scientific possibility (astronomy) and speculative aspiration (cosmology) reflects a historical pattern where visionary depictions often precede and inspire real technological advancements, blurring the line between dream and theory. Marco Caracciolo (2015:76) argues that narratives engaging with cosmic realities often rely on two key strategies namely, "metaphorical blends and embodied involvement". He believes that physical gestures can anchor difficult concepts helping the viewer experience complexity without having to think about it. Kipping asks viewers

to imagine themselves inside a spaceship, feeling acceleration, weight, and motion. This aligns with Caracciolo's (2015) embodied simulation, where the viewer mentally acts out what they see. By combining movement, voice, and images, Kipping does not just explain the scientific principles, he creates a felt experience of the sublime. Within this imagined vessel, the constant 1g acceleration effectively creates what Kipping terms "artificial gravity" for the ship's passengers, a feature that carries profound psychological weight on two fronts. This artificial gravity grounds the viewer in the astronomy being presented yet also embodies them in a context they can relate to. In an otherwise alien environment, the familiarity of Earth-like gravity provides an existential tether to our home planet, reminding us that despite venturing into unprecedented territory, we retain a core semblance of terrestrial life. Du Preez (2022) underscores how vital gravity is in grounding human experience, where "down" is our familiar anchor, while "up" or deep space represents weightlessness and the unknown. Here, Kipping's scenario situates passengers in an odd yet pivotal in-betweenness: they continue to walk and function much as they would on Earth, yet the knowledge that Earth has been left behind entirely introduces a tension between bodily continuity and existential rupture. This in-between state, neither fully earthly nor wholly cosmic, challenges the dualism of here versus there, rooted versus lost, offering a liminal space where human perception stretches beyond binary categories. It suggests that such representations, by suspending us between the tangible and the ungraspable, invite a rethinking of our place in the universe, not as fixed within oppositional frames but as fluid, relational, and open to the unknown. This tension also underscores how hostile space truly is - lethal radiation, the vacuum environment, and the threat of collisions with even small debris demand extraordinary shielding for any journey at relativistic speeds - amplifying the "danger" related to Burke's sublime, where the power and privation of the cosmos evoke both awe and terror. This liminal tension foreshadows the relativistic effects that define the journey, which the next section explores through the sublime distortions of time and space.

Figure 32: The Constantly Accelerating Spaceship – Screenshot (Cool Worlds - YouTube n.d)

5.3.5 Time Dilation and Relativistic Awe

As the spacecraft accelerates beyond the heliosphere, Kipping cites the Lorentz factor, a key concept in relativity that measures how time dilates for the travellers versus observers on Earth. When the spaceship travels at relativistic speeds, [26] distances once measured in light-years become theoretically traversable within a human lifetime, at least from the traveller's frame of reference, yet for observers on Earth, decades, centuries, or millennia might pass. This radical discrepancy in elapsed time produces a sense of awe, disorientation, and even existential dread, amplified as the journey progresses toward Alpha Centauri, where our Sun eventually becomes just another point of light among countless stars. The Copernican principle is harshly felt here: Earth, once central to existence, is rendered indistinguishable in the cosmic expanse, and the loss of real-time communication further isolates the travellers, severing their temporal and emotional ties to home. Nick Kanas (2011:578) terms this experience as

[26] Kipping explains how constant acceleration enables spacecraft to cover vast distances within human timeframes. In 2.5 hours, the craft would pass the Moon (a journey that normally takes three days), reach Mars in 1.5 days (compared to 9 months), and overtake Voyager 2 in three weeks. It would then exit the solar system at 64,373,760 million km/h—just 6% of light speed. Voyager 2, launched in 1977, has taken 47.5 years to reach its current distance. These figures illustrate how speed builds up exponentially (compound acceleration) and highlight the vastness of even our solar system, reinforcing the improbability of journeys aiming for the universe's edge.

"Earth-out-of-view phenomenon" where the known, in this case planet Earth, is completely removed from the frame of reference. Burke's (2005 [1757]) sublime manifests vividly in this scenario, particularly through the category of "privation"—the vast, silent void of space and the absolute separation from Earth evoke a terror of emptiness and abandonment (Burke 2005 [1757]:147), while the "infinity" of relativistic time stretches this isolation into an unending horizon of disconnection, stirring a delightful horror (Burke 2005 [1757]:149). Simultaneously, Kant's (1914 [1790]) mathematical sublime surfaces in the mind's struggle to conceptualize the incomprehensible discrepancy between the compressed years and Earth's sprawling centuries, a temporal magnitude so vast it overwhelms imagination yet demands rational contemplation of the infinite (Kant 1914 [1790]:107). This dual sublime intensifies as the crew could return to an Earth where their loved ones have aged, died, or become part of a future society unrecognizable to them, confronting the viewer with an unsettling philosophical question: does the pursuit of knowledge justify the loss of human continuity? The fading Sun, reduced to a mere speck, further deepens this sublime encounter, blending Burke's "vastness" (Burke 2005 [1757]:148) with Kant's dynamic sublime, where the overwhelming power of cosmic scale diminishes humanity's uniqueness, evoking both awe at the universe's grandeur and dread at our own insignificance. This interplay of relativity and perspective thus stages a profound sublime experience, where the measurable (time dilation) and the immeasurable (cosmic isolation) converge to unsettle and elevate the viewer's perception of existence. These relativistic ruptures propel the journey beyond the local, setting the stage for the intergalactic voyages examined next.

5.3.6 Gradual Expansion: Voyaging into the Sublime

Kipping expands the journey from Alpha Centauri to the Local Bubble, eventually reaching the Milky Way's edge. An elegant parallel emerges between Kipping's systematic progression and humanity's measured expansion of observational capabilities. Historically, the move from naked-eye observation to optical telescopes, to reflecting telescopes, radio arrays, and eventually space observatories detecting

infrared, ultraviolet, and X-ray emissions happened gradually and over centuries.[27] Each technological leap, as Kessler (2012:22) notes, "transformed what we see and represent of the cosmos" revealing new wonders while deepening the sublime tension between comprehension and the unknown. This tension lies at the heart of the sublime of Burke (2005 [1757]) and Kant (1914 [1790]) where a simultaneous confrontation with vastness and mystery that overwhelms reason yet compels reflection takes place. Each development brought new discoveries along with incremental shifts in our worldview, allowing society to assimilate potentially disorienting information at a pace that preserved psychological equilibrium. Kessler (2012:8) refers to a "sense of familiarity" in the presentation of cosmic images that helps the viewer navigate the exploration of the unknown. Had we jumped directly from the naked eye to advanced space telescopes capturing detailed images of exoplanets or even mapping the cosmic microwave background, our cultural and philosophical structures might have struggled to cope with such an avalanche of data and its existential implications.

Likewise, Kipping's framework shows that interstellar or intergalactic ventures are not just questions of propulsion and travel time, they also involve deeply human concerns about community, identity, and continuity with home. Kanas (2011:580) questions whether "traveling beyond the Earth's neighourhood is worth the effort and risk" when considering the psychological impact. The familiarity thus grounds us in a sense of understanding while the unknown leaves us in a place of discomfort. Each incremental step into deeper space, just like each improvement in our observational technology, provides a necessary buffer. We adapt our sense of purpose, refine our definition of home, and develop cultural narratives to handle these expanded horizons. This underscores that the pursuit of knowledge and exploration, whether through physical voyages across eons or through telescopes pushing the limits of our cosmic sight, must unfold in way that allows our collective psyche to adjust. Too sudden a leap forward risks not only a crisis in understanding but also a rupture in the very sense of who we are and where we belong in the cosmos. It is precisely this tension that Kipping's video encapsulates in its brief span, thrusting viewers into a disorienting journey from the familiar Earth to the vast unknown, evoking the sublime and leaving

[27] See Chapter 3 on the development of observation technology and the shift in levels of mediation over time.

us in what Du Preez (2022) calls a "spaced out" state - a suspension between extension and contraction. On one level, this manifests as the viewer is catapulted beyond human horizons into the cosmic expanse, a movement that mirrors Du Preez's (2022) notion of the sublime as an overwhelming encounter that collapses safe distances. On another, it unfolds in the paradox of sitting motionless before a screen, tethered to the here-and-now of Earth, yet mentally adrift in the in-between of mediated space, where technology amplifies both wonder and dislocation. This gradual expansion of perspective prepares us for confronting the cosmic edge, as the next section reveals through the limits of observation and expansion.

5.3.7 The Cosmological Limit

Eventually Kipping confronts the largest theoretical boundary, the edge of the observable universe. Modern cosmology suggests that the universe expands at an accelerating rate, attributed to dark energy, a phenomenon still not well understood. As Kipping's rubber band analogy, the metric expansion of space means that galaxies recede from us faster than we can ever travel. Even moving at near light speed, we can never catch the horizon of a universe whose every dimension is continually stretching.

Kipping highlights a cosmic point of no return beyond which a spacecraft could never come back, since space between the ship and earth would expand faster than the speed of light. This evokes a deep sense of cosmic isolation. Eventually every star and galaxy might redshift out of view until on is left floating in a perfect darkness. Here, the philosophical stakes intensify. Time itself loses its significance without an external frame of reference, and the travellers become monuments to a universe that was. The 'end' of the universe in the video's title thus takes on a metaphorical meaning. It is less about reaching an actual boundary than about being stranded in a timeless void, cut off from any recognisable cosmic landmarks.

This moment resonates deeply with Cecilia Lippai's (2009:74) account of the sublime as a boundary experience, not a leap beyond understanding, but a confrontation with its limit. Where Kant ((1914 [1790]) sees the sublime as pointing to something transcendent, Lippai (2009:74) insists the sublime is what happens when "the

experience comes to be interpreted in a different way and with a different approach", specifically as an encounter between subject and nature at the limit of comprehension. In Kipping's video, this boundary is not overcome, it is occupied. The sublime arises not because the viewer escapes the universe, but because they become aware of their position within it, completely exposed.

Lippai (2009:74) argues the sublime "does not just name an experience, but it also interprets it", helping us recognise our place in nature. Kipping's dark horizon is an enactment of what Lippai (2009:78) then calls "nature manifesting its presence independent of anything we do or think about". The expanding void, indifferent and unreachable, is sublime not for its threat of terror, but because it offers a peek into a whole new reality, as if without us (Lippai 2009:77). This boundary is not a failure of representation, but a presentation of the world's inhuman reality, a universe that "asks no questions and answers no questions from us" (Lippai 2009:77).

In this way the end of the universe becomes a metaphor not for finality, but for the limit of cognition itself. Kipping's speculative voyage stages a representation that cannot be comprehended, only represented. This echoes the central tension within both cosmology and astronomy: the drive to visualise and narrate the unknown, even when it resists full understanding. As observational tools reach further and theoretical models grow more abstract, the role of representation becomes less about clarity and more about encountering what Lippai (2009:77) calls an "ungraspable" complexity of natural forms, a nature that appears not as answerable, but as inexhaustibly strange.

5.4 Conclusion

David Kipping's *A Journey to the End of the Universe* exemplifies how digital media can mediate the sublime, drawing viewers into an experience that oscillates between empirical precision of astronomy and the speculative vastness of cosmology. By seamlessly blending scientific accuracy with imaginative storytelling, Kipping's work evokes both Kantian mathematical sublime, where the mind strains to comprehend infinity, and Burkean sublime of terror, as the vast cosmos confronts human fragility. His video encapsulates the paradox of modern space representation. It is at once

grounded in observational astrophysics and propelled by the limitless aspirations of cosmological speculation.

The overlap between cosmology and astronomy is central as vehicle of the sublime. Astronomy provides the measurable data, distances, speeds, and cosmic structures, while cosmology extends these into philosophical and existential inquiries, asking what lies beyond observation and how we make meaning of an ever-expanding universe. Kipping's digital voyage highlights this interplay, using technological mediation to render the unknown momentarily accessible, only to remind us that our comprehension remains finite.

This chapter builds on earlier discussions of mediated observation in Chapter 3, extending them into the digital realm. YouTube becomes a telescope of a new kind, not merely showing distant realities, but constructing affective journeys that unsettle, inspire, and transform the viewer. The viewer is invited into a "spaced out" state (Du Preez 2022), a suspension between grounded presence and imagined transcendence, where awe and disorientation converge.

Ultimately, *A Journey to the End of the Universe* does not just educate, it invites viewers to inhabit an impossible space of wonder and disorientation, mirroring the sublime tension between knowledge and mystery. Through YouTube as technological mediator, Kipping extends the sublime experience beyond the privileged few, transforming what was once an esoteric pursuit into a shared digital awe. The synthesis of astronomy and cosmology, fact and fiction, science and imagination, ensures that even as we push the boundaries of knowledge, the unknown universe remains a sublime enigma.

CHAPTER 6
COMPARATIVE ANALYSIS OF CHESLEY BONESTELL AND DAVID KIPPING

6.1 Introduction

Building on the individual explorations of Chesley Bonestell's astro-art in Chapter 4 and David Kipping's immersive digital storytelling in Chapter 5, this chapter examines how each artist bridges science and imagination to evoke a sense of cosmic wonder. Through a comparative lens, the discussion highlights how both creators represent space in ways that transcend mere illustration. While Bonestell relied on the medium of painting in the mid-twentieth century and Kipping employs multimedia on the digital platforms of the twenty-first, both share an enduring commitment to expanding our conceptual horizons regarding the cosmos. By placing their works in dialogue, we see not only contrasts of technique and historical context but also shared sensibilities that invite the viewer to contemplate humankind's place in the vast, and often incomprehensible, expanse of the universe.

Though separated by nearly a century and the technological gulf between traditional painting and online video, Chesley Bonestell and David Kipping share a unifying goal: to expand our conceptual and imaginative engagement with the cosmos. By examining their distinctive artistic styles, thematic emphases, and the broader contexts in which they operate, this chapter situates both creators as key mediators of cosmic wonder. It explores how each bridges empirical science and expansive speculation, and how their portrayals evoke a sense of the sublime, thus contributing to ongoing scholarly dialogues on space representation, media, and human curiosity about the vast unknown.

6.2 Bonestell's Paint on Canvas: Descriptive Realism

As discussed in Chapter 4, Chesley Bonestell emerged at a time when rockets were primarily war instruments, and telescopes could only offer limited glimpses of distant celestial bodies. By blending fine-art techniques with the astronomically informed data of the 1940s and 1950s, Bonestell developed a mode of "Descriptive Realism" (IAAA 2015) where scientifically accurate depictions of alien landscapes prioritise precision

and authenticity.[28] This approach conferred a believable quality upon alien vistas: towering planetary rings, windswept surfaces, and small human figures shown gazing at otherworldly landscapes. Through painstaking detail, he made the unimaginable look plausible, framing scenes from vantage points no human had then occupied.

Although his images were static, they functioned as technological mediators in Don Ihde's (2009) sense, extending human perception beyond Earth-bound constraints.[29] Bonestell's era lacked robotic probes or real photos from deep space, but his paintings served as stand-ins, prefiguring what satellites and astronauts might one day encounter or even look like, evoking Nye's (1994) technological sublime through the fusion of (envisioned) human ingenuity and cosmic wonder. The result was an imaginative leap that unified astronomy with an emotional resonance typical of Burke's (2005 [1757]) concept of astonishment. In this manner, Bonestell's canvases helped shift a broad public consciousness from merely accepting space travel as science fiction to envisioning it as a concrete, even inevitable, future.

6.3 Kipping's Digital Storytelling: Multi-Sensory Immersion

David Kipping, in contrast, harnesses modern digital platforms that allow near-instant sharing of advanced scientific data. On his YouTube video *A Journey to the End of the Universe* he constructs a multi-layered experience: calm narration, CGI animations, borrowed footage from science fiction cinema, and references to real images from space telescopes.[30] Through these techniques, Kipping leads viewers well beyond current scientific frontiers, inviting them to imagine spacecraft traveling at relativistic speeds or universe-scale phenomena like dark-energy-driven expansion. This speculative reach invokes Burke's (2005 [1757]) sublime of vastness and infinity.

Kipping's visual storytelling also situates him within the broader spectrum of engagement from unmediated to mediated embodied to fully disembodied experiences.[31] While Bonestell's art embodies a mediated yet bodily contemplation, requiring stillness and private reflection, Kipping's YouTube content exemplifies

[28] See Chapter 4, Section 4.3.4 on the interplay of realism and speculation in Bonestell's work.
[29] Chapter 3 traces a spectrum of observation from naked-eye stargazing to telescopic precision, positioning technologies like telescopes as embodiment relations that extend human perception.
[30] See Chapter 5, Section 5.2 – YouTube as Technological Mediator.
[31] See Chapter 1, Section 1 for engagement spectrum.

disembodied mediation. Here, the viewer is cognitively and affectively transported through layers of digital media, engaging with the cosmos not through physical presence, but through technological immersion and conceptual abstraction. This shift redefines how the sublime is experienced: no longer a solitary awe before the stars, but a shared, networked astonishment at simulations and speculative possibilities.

Here again, the viewer receives technological mediation, although now it is more interactive and immediate. YouTube's comment sections transform spectators into participants who ask questions, posit alternate theories, and collectively interpret the cosmic scenarios Kipping proposes. As Kavoori (2015) observe, this participatory dimension distinguishes digital media from earlier, one-way forms of mass communication. Indeed, where Bonestell's magazines asked viewers to wonder quietly, Kipping's online presence draws them into collaborative discussion and intensifies their emotional and intellectual investment.

Comparing Bonestell's representative paintings with Kipping's online video reveals a trajectory in how artistic practice adapts to and leverages available technology for cosmic representation. Where Bonestell's descriptive realism framed the cosmos as an attainable, lifelike spectacle, Kipping's multi-sensory immersion expands that invitation by integrating real-time dialogue and multimedia storytelling. Bonestell acted as a vital bridge between wartime rocket science and the collective imagination of a peaceful space age. Kipping, building upon decades of further research and digital innovation, demonstrates how global audiences now collaborate in exploring vast scientific questions. Both creators thus underscore the evolving ways in which humanity not only depicts but also participates in cosmic wonder, shifting from static, magazine-based awe to a fully interactive, networked discourse that continues to broaden the representation of outer space.

6.4 The Sublime as Conceptual Anchor

In both Bonestell's paintings and Kipping's video, there is a persistent emphasis on massive scale and cosmic vistas that outstrip ordinary human comprehension. Edmund Burke's (2005 [1757]) concept of the sublime, which hinges on awe infused with a hint of terror, resonates throughout Bonestell's images of colossal celestial bodies looming over diminutive human explorers. Likewise, Immanuel Kant's (1914

[1790]) “mathematical sublime” where the mind’s struggle to grasp phenomena of boundless magnitude, applies equally well to Kipping’s discussions of galaxies receding beyond the speed of light or time dilation that leaves cosmic travellers effectively out-of-sync with their home planet. Despite their differing dimensions of the sublime to bridge the gap between scientific abstraction and human experience, crafting representations that not only depict the cosmos but also provoke a shared sense of astonishment and humility before its unfathomable expanse.

David E. Nye’s (1994) technological sublime expands upon Burke and Kant by highlighting modern awe arising from human engineering. Bonestell’s art revealed the promise of space-age technologies, rockets refashioned from wartime weapons into hopeful tools of exploration. Kipping’s approach similarly foregrounds engineered marvels, but with a twenty-first-century twist: his imagined spacecraft as explored in Chapter 5, envision interstellar travel made possible by imagined innovation such as a vessel capable of relativistic speeds. In both contexts, the technological sublime emerges from human resourcefulness. Bonestell’s pictorial transformation of rockets into symbols of discovery parallels Kipping’s digital depictions of crafts that defy current limits, each bridging cosmic immensity with imagined human ambition.

In both cases, the sublime is not only located in the distant stars, but also in the apparatus that enables us to imagine or visualise them. Drawing from Ihde’s (2009) notion of technological mediation, these representations become perceptual extensions that distort and reframe human perception.

A particularly instructive idea in analysing the cosmic awe and partial dislocation that Bonestell and Kipping evoke is Du Preez’ (2022) notion of “being spaced out.” This phenomenon describes the individual as caught between the familiar terrestrial realm and an otherworldly vantage: on the one hand physically grounded, yet mentally transported to vistas of daunting magnitude. Bonestell’s viewers, flipping through a mid-20th-century magazine, could only imagine the vantage from a distant moon, a thoroughly disorienting notion at that historical moment. Kipping’s audience, though, experiences an even more pronounced form of this suspended transfer, as they may be simultaneously skimming comments, viewing representations of intricate astronomy, and contemplating existential questions about humanity’s cosmic future. In both cases, the viewer is invited on a journey. Bonestell’s static canvases propel

the mind across planetary landscapes, while Kipping's dynamic videos launch it toward interstellar frontiers, yet this traversal occurs while sitting still, a paradox that exemplifies the "Spaced Out" state. Through mediation if paint and pixels, this imagined motion suspends the audience between departure and arrival, intensifying the fusion of awe, disorientation, and curiosity that pushes the ordinary limits of perception and comprehension.

6.5 Science, Speculation, and Accuracy

Both artists straddle the line between astronomy - anchored in empirical observation - and cosmology - where theoretical extrapolation drives speculation about realms beyond direct proof.[32] For Bonestell, this meant painting detailed surfaces of Saturn's moons decades before the first space probes arrived, basing his visions on limited telescope data and imaginative inference. Many elements turned out remarkably accurate, while others such as towering rock forms on the Moon (Miller 2021:285) were revised by later missions.

Kipping, by comparison, astrophysical knowledge: time-dilation equations, cosmic expansion rates, exoplanet data, and more. Yet his exploration of near-light-speed spacecraft or unobservable regions at the cosmic horizon remains speculative, awaiting future technological breakthroughs. In both instances, accuracy is provisional and evolves as science marches on. Miller (2021:285) notes:

> Where a scientist may focus on just one aspect of a planet or moon – its geology, atmosphere, magnetic field, cratering, etc. – the space artists must of necessity take all of these things into account when creating a painting. The result can be a valuable amalgamation of data into a single entity that is more than the sum of its part.

Their shared achievement is to reveal how art and science can collaborate: data suggests a framework, imagination fills the gaps, and audiences are then invited into the unknown with just enough realism to believe the journey is worth taking. This balance between astronomy and cosmology allows Bonestell and Kipping to craft representations that neither overreach into pure fantasy or shrink from the vastness of

[32] See Chapter 1, Section 1.2.2 - Astronomy and Cosmology.

the unproven, offering a compelling vision of the cosmos as both knowable and mysterious.

6.6 Representing the Unrepresentable

The cosmic visions of Bonestell and Kipping confront a profound challenge: representing realms no human has directly experienced, crafting the unrepresentable from the astronomical known. Stormer (2004:219) frames sublimity as an encounter with the "unrepresentable," phenomena so vast or elusive they defy lived perception or complete depiction. For Bonestell, this manifests in vantage points like standing on Titan or Mimas, perspectives no one in his era could have occupied, painted with astronomical data yet unseen by human eyes. His work imagines alien surfaces based on telescopic hints, offering a glimpse of what was then beyond physical reach. Kipping, meanwhile, envisions a relativistic journey no human has undertaken, weaving time dilation, near-light-speed travel, and cosmic expansion into a narrative grounded in astrophysical science but unrealised in lived experience. His spacecraft, accelerating at 1g toward unobservable horizons, presents a voyage that exists in theory yet remains beyond our grasp. Both artists thus depict the unrepresentable by anchoring their art in empirical knowledge - Bonestell's telescope-informed realism, Kipping's equations of relativity - while thrusting viewers into unprecedented scenes, evoking awe at the unseen and unexperienced. This fusion of the known with the never-before-witnessed stretches representation beyond the tangible, inviting contemplation of a cosmos that, though informed by science, remains fundamentally out of reach, a sublime testament to humanity's imaginative leap into the uncharted.

Here, as Mitchell (2005) argues, the image functions not as a passive mirror but as an active agent that provokes, desires, and shapes meaning. Bonestell's images 'want' to transport the viewer, while Kipping's seek collaborative interpretation, reinforcing the image as a site of affective and intellectual negotiation.

6.7 Engaging and Inspiring Public Imagination

Bonestell's rockets alien terrains helped spur interest in science and space exploration. By offering visions of possible futures, he reshaped rocket technology's wartime connotations into vehicles of discovery, thereby prefiguring the cultural pivot

that ushered in space exploration's golden age. This shift reflects Chapter 1's spectrum of engagement, moving from the unmediated awe of stargazing to a mediated embodied experience where his paintings act as perceptual bridges, translating astronomical data into cosmological visions of humanity's cosmic potential. Kipping, in turn, leverages widespread internet access and the participatory nature of platforms like YouTube to democratise cosmic wonder. His blend of charismatic narration, advanced visualisations, and two-way audience engagement fosters a broad, global discourse, embodying the disembodied mediation described in Chapter 1, where technology extends perception beyond physical limits into speculative realms. The underlying optimism of each creator's work endures: Bonestell's futuristic scenes portrayed a better tomorrow, grounded in astronomy yet reaching toward cosmological possibility, while Kipping's digital tour underscores that curiosity transcends national boundaries or educational hierarchies, inviting a collective exploration of the unknown. This optimism, as Chapter 1 suggests, evokes the sublime, not just through cosmic scale but through the interplay of science and imagination, inspiring awe at humanity's capacity to envision and pursue the uncharted.

A key distinction between their respective media is the degree of interactivity. Bonestell's viewers could only dream in private or perhaps write letters to editors, engaging with his art as a mediated embodied experience that stirred the sublime through static yet vivid representations of the cosmos. Kipping's community, on the other hand, can participate actively, echoing Kavoori's (2015) argument that YouTube is a "key element in how we think about our online experience and digital culture." This two-way engagement fosters ongoing discourse on cosmic inquiries expanding the cultural resonance of Kipping's presentations well beyond the initial broadcast. This disembodied mediation transforms viewers into co-creators, bridging astronomy's empirical precision with cosmology's speculative reach in real time.

Kipping's digital presence exemplifies a mode of experience where viewers are cognitively suspended between grounded reality and cosmic abstraction. This disembodied mediation is intensified through interactivity such as comments, suggestions, and fan theories that become part of the artwork's afterlife, turning viewers into co-producers of meaning. This phenomenon aligns with Mitchell's notion

of image agency and extends Chapter 1's assertion that representation is never neutral but emotionally and ideologically charged. Furthermore, Kipping's videos exemplify what Chapter 3 frames as the disembodied end of technological mediation, a space where perception is entirely contingent on simulation, proxy, and mediated scale.

Thus, each artist catalyses shared awe, but Kipping's digital platform turns it into an evolving conversation, crystallising a community of cosmic enthusiasts who, as Mirzoeff (1999:13) might describe, partake in "visual events" that dynamically reshape their relationship with the unknown. This participatory dialogue amplifies the sublime, blending Burke's astonishment with Kant's intellectual struggle, as audiences not only witness but actively interpret the vastness of space.

6.8 Conclusion

This comparative analysis of Chesley Bonestell's astronomical paintings and David Kipping's digital visualisations reveals both distinct approaches and profound similarities in their quest to represent the unknown cosmos, each leaving an indelible mark on humanity's engagement with space. Bonestell wielded paint and canvas to craft static yet vivid scenes of unvisited moons and reimagined rockets, transforming limited telescopic data into a believable representation that prefigured the space age. Kipping on the other hand harnesses multimedia and interactivity to propel viewers on speculative journeys grounded in advanced astrophysics yet unexperienced by any human. Their mediums diverge sharply: Bonestell's embodied mediation offers a solitary, magazine-bound contemplation, while Kipping's disembodied mediation fosters a dynamic, participatory dialogue via YouTube. Yet, both artists bridge astronomy's empirical foundation with cosmology's imaginative reach, merging science and speculation to depict realms beyond direct observation.

The similarities between Bonestell and Kipping lie in their shared commitment to evoking the sublime and inspiring wonder at the unrepresentable. Both anchor their work in the known while thrusting viewers into the unseen, whether standing on Titan's cliffs or drifting toward an expanding universe's edge. This fusion confronts the unrepresentable, evoking Burke's (2005 [1757]) terror, Kant's (1914 [1790]) intellectual overwhelm, and Nye's (1994) technological marvel at human ingenuity.

Their representations, though separated by time and technology, resonate with Du Preez' (2022) "spaced out" phenomenon, suspending audiences between terrestrial familiarity and cosmic dislocation, a journey undertaken while physically still. This shared sensibility underscores their role as mediators, not merely illustrators, of the cosmos.

The impact of their work diverges in scope but converges in influence. Bonestell's paintings informed a cultural shift, a legacy of optimism rooted in a pre-spaceflight era. Kipping's videos, by contrast, democratise this wonder, engaging a global audience in real-time discourse that transcends traditional boundaries, amplifying curiosity through collective interpretation. Both, however, expand conceptual horizons - Bonestell by making the unattainable plausible, Kipping by rendering the theoretical tangible - shaping how we perceive and pursue the unknown. Their representations serve as "visual events" (Mirzoeff 1999:13), dynamically intertwining science, art, and emotion to evoke the sublime, not as an endpoint but as a catalyst for ongoing exploration. Ultimately, Bonestell and Kipping illuminate the cosmos as both knowable and mysterious, their distinct yet kindred approaches affirming humanity's enduring drive to gaze outward, imagine boldly, and engage with the vastness that defines our universe.

Ultimately, this comparative study reaffirms the theoretical lens established in earlier chapters: that representation of the cosmos occurs along a spectrum of engagement, from embodied to disembodied; that such representations are shaped by both astronomy's data and cosmology's dreams; and that images carry agency, as Mitchell (2005) proposes, in shaping how we think and feel about the unknown. In Bonestell and Kipping, we encounter the sublime not just in what is seen, but in the act of seeing itself, always mediated, always partial, yet deeply transformative.

CHAPTER 7
CONCLUSION

7.1 Introduction

This study engaged with the intersection of astronomical art and digital representation to explore how the unknowns of space are mediated through visual culture. Specifically, it examined the works of Chesley Bonestell and David Kipping applying a theoretical framework, grounded in the sublime to analyse how their representations of space evoke awe, wonder, and contemplation. It also showed the intricacies and nuances associated with attempts to depict the unknown. This chapter concludes the study by summarising the outcome of its central arguments, offering an overview of the key findings that emerged through the comparative analysis of Bonestell's paintings and Kipping's digital visualisations. While these insights have been explored throughout the study, this chapter formally outlines their contribution to discussions on representation, technology, and perception in cosmic visualisation. The chapter then turns to the broader implications of the study reflecting on its limitations and suggesting avenues for future research. Finally, a few closing remarks encapsulate the significance of representing the unknown in contemporary astronomical discourse.

7.2 Summary of Chapters

This study examined the representation of the unknown in space art and digital media, focussing on the works of Chesley Bonestell and David Kipping. It gave context to the evolution of cosmic observation and representation by situating their work within the interplay of astronomy and cosmology. The study also utilised notions on the sublime as lens for interpretation of these representations. Each chapter contributed to this exploration by addressing key themes related to technology, artistic mediation, and theoretical perspectives on the sublime.

Chapter one introduced the study's central concerns related to the challenges of representing space and the unknown, the relationship between cosmology and astronomy, and the role of technology in shaping our perception of the cosmos. It

outlined the aims and objectives, which included a comparative analysis of Bonestell and Kipping's work, an exploration of technology's role in representation, and an application of theories of the sublime. The chapter also introduced the theoretical framework surrounding the image and the sublime.

The second chapter provided an overview of the history and evolution of space art, situating Bonestell's work within this tradition. It examined the different categories of space art and explored the role of artistic imagination in bridging scientific knowledge and public perception highlighting how early space art influenced public interest in space exploration. The genre of space art was also situated in its role as contributor to cosmology whilst drawing from astronomy.

Chapter three examined how technological advancements have transformed our ability to visualise and understand space. It traced the historical development of observational tools, and discussed how these instruments mediate our perception of celestial bodies. The chapter introduced the distinction between embodied and disembodied ways of seeing, demonstrating how observational technology extends human perception beyond natural limits, but in turn removes our direct engagement with the natural cosmos.

Chapter four focused on the work of Chesley Bonestell analysing his artistic style, thematic approach, and the accuracy of his representations of space. It examined how his paintings balanced scientific knowledge (astronomy) with artistic imagination, offering viewers a glimpse into a cosmos that was largely unexplored at the time. Through an analysis of key artworks, the chapter explored how Bonestell's representations evoked the sublime by positioning viewers at the threshold between the known and the unknown.

The fifth chapter shifted the focus to David Kipping's digital visualisations in his YouTube video, *A Journey to the End of the Universe*. It explored how digital media serves as a contemporary form of astronomical representation, shaping public engagement with space. Through an analysis of Kipping's visual and narrative techniques, the chapter examined how digital representations contribute to an experience of the digitally mediated sublime, particularly through mathematical

sublime, by rendering the incomprehensible scales of the universe into graspable visual narratives.

Chapter six provided a comparative analysis of Bonestell and Kipping's works, highlighting how each creator blends science and imagination to render the cosmos both accessible and awe-inspiring. It explored their differing media while showing their shared use of technological mediation to evoke the sublime. The chapter also emphasised their common commitment to bridging astronomy's empirical limits with cosmology's speculative reach, offering evolving visions of the unknown across time.

The final chapter synthesises the study's findings, summarising the ways in which Bonestell and Kipping's work contribute to our understanding of space representation. It reflects on how artistic and technological mediation shape human engagement with the unknown and how the sublime operates within these representations. The chapter also discusses the study's limitations and suggests areas for further research, including the evolving role of digital media in space representation and the broader implications of technological mediation in shaping perceptions of the cosmos.

7.3 Contribution of the Study

The study contributes to the discourse on space representation by examining how visual culture mediates human engagement with the unknown. By conducting a comparative analysis of Chesley Bonestell's astronomical art and David Kipping's digital visualisations, the research highlights the evolving role of artistic and technological mediation in shaping perceptions of space. Through the application of Kant, Burke, and Nye's theories of the sublime, the study provides a new interpretive lens for understanding how representations of the cosmos evoke awe, wonder, and existential contemplation.

A key contribution of this study lies in its exploration of the intersection between astronomy and cosmology in visual representation. It demonstrates how Bonestell's painting functioned as speculative yet scientifically grounded depictions of space during the early space age, while Kipping's digital content reimagines space through contemporary computational and cinematic techniques. This analysis underscores the

shifting boundaries between scientific accuracy and imaginative speculation in space visualisations.

Additionally, the study contributes to discussions on technological mediation, particularly in differentiating between embodied and disembodied experience of space. By tracing the historical progression from naked-eye observation to telescopic enhancements and digital simulation, the research contextualises how advancements in imaging technology transform the ways in which space is represented and understood.

Furthermore, this study engages with Mitchell's theories on the image to interrogate the role of visual representation in making the unobservable comprehensible. By applying discourse analysis to Bonestell's paintings and Kipping's digital work, it reveals how images of space function not merely as passive depictions but as active construction that shape public engagement with the cosmos.

Finally, by integrating perspectives from both art and science, this study broadens the scope of research on the sublime in visual culture. It provides a framework for future inquiries into how emerging media such as AI generated imagery, virtual reality simulations, and real-time astronomical visualisation may further redefine human encounters with the vast and unknown realms of space.

7.4 Limitations of Study and Suggested Further Research

While this study provides a detailed exploration of the representation of space in the works of Chesley Bonestell and David Kipping, it is not without limitations. One primary constraint is the selection of case studies. Although Bonestell and Kipping represent two distinct approaches to space visualisation namely traditional astronomical art and digital media, other artists, filmmakers, and scientific communicators also contribute to the evolving discourse on cosmic representation. Expanding the study to include additional creators, particularly those working with emerging technologies such as virtual reality or AI generated imagery, could provide a broader perspective on contemporary space visualisation.

Another limitation lies in the historical scope of the study. While Bonestell's work offers a mid-20th century perspective on space representation, and Kipping's digital content reflects contemporary visualisation practices, the study does not fully explore he transitional periods between these two eras. A more comprehensive historical analysis, considering the impact of space photography, CGI advancements, and the commercialisation of space imagery would enhance our understanding of how space representation has evolved over time.

Space itself is infinitely vast, and discussions on its representations reflect this complexity. The sheer range of subjects within space representation presents challenges in maintaining focus. Future research could benefit from a more specialised approach, concentrating on a particular aspect of space representation. For instance, a study focusing exclusively on the observation and visualisation of black holes could yield deeper insights into how extreme astrophysical phenomena are visually constructed and understood. Examining how black holes are represented across scientific simulations, artistic interpretations, and popular media could provide a refined perspective on the mediation of the unknown in space representation.

The study also focuses primarily on Western traditions of space representation, particularly within the framework of European and American artistic and scientific traditions. A more global perspective, incorporating representations of space from diverse cultural and philosophical backgrounds, could provide a more inclusive understanding of how different societies conceptualise the sublime in the cosmos.

Finally, the rapid advancement of digital media and space exploration technologies suggests that new forms of representation will continue to emerge. Future research could examine the role of AI generated astronomical images, real-time space simulations, video games, or immersive VR experiences in shaping contemporary perceptions of the unknown. Investigating how these new technologies influence public engagement with space, and whether they evoke the same sense of the sublime as traditional artistic representations, could provide valuable extension of this study's findings.

7.5 Concluding Remarks

This study was born out of both curiosity and the fundamental human need to make sense of the incomprehensible. The challenge of representing the vastness of space is not merely technical or artistic. It is deeply emotional. Engaging with images and concepts that evoke the sublime brings us face-to-face with existential questions about our place in the universe. The sheer scale of the cosmos, whether measured in numbers beyond comprehension or in the ungraspable nature of the unknown, fuels both frustration and wonder. Yet, in attempting to communicate these ideas, there is an undeniable excitement in sharing even the smallest glimpses of understanding, watching as other experience their own struggle to process the absolute greatness of space.

One of the most striking realisations in this study is that the human impulse to represent the cosmos has existed across generations. From ancient celestial maps to Bonestell's imaginings of space travel, artists and scientists alike have sought to bring the unknown within reach. Bonestell's work, created in an era before human space exploration, stands as a testament to the power of scientific imagination where his extrapolations from astronomy led to artistic visions that would later prove remarkably accurate. This suggests that artistic and scientific speculation is not just a means of representation but a step toward realisation.

In the same spirit, Kipping's digital visualisations push the boundaries of contemporary cosmological imagination, offering speculative journeys to the edge of the universe. While his representations remain theoretical today, they stand as an invitation to future generations, to those who perhaps millennia from now may one day trace the paths he has visualised and find themselves looking back at our era in the same way we now reflect on Bonestell's work. In the end, the study of space representation is not just about the images themselves but about how they shape our collective curiosity, inspiring us to explore further into the unknown.

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