

Southern Space Studies
Series Editor: Annette Froehlich

Annette Froehlich *Editor*

Outer Space and Popular Culture

Influences and Interrelations

Southern Space Studies

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The Southern Space Studies series presents analyses of space trends, market evolutions, policies, strategies and regulations, as well as the related social, economic and political challenges of space-related activities in the Global South, with a particular focus on developing countries in Africa and Latin America. Obtaining inside information from emerging space-faring countries in these regions is pivotal to establish and strengthen efficient and beneficial cooperation mechanisms in the space arena, and to gain a deeper understanding of their rapidly evolving space activities. To this end, the series provides transdisciplinary information for a fruitful development of space activities in relevant countries and cooperation with established space-faring nations. It is, therefore, a reference compilation for space activities in these areas.

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Annette Froehlich
Editor

Outer Space and Popular Culture

Influences and Interrelations

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Preface

The contemporary space arena is undergoing a phase of rapid expansion and transformation as the range of space actors, activities, and capabilities are increasing around the globe, including in the South. As new rising space actors enter the field, space is also playing an ever greater role in driving innovation and economic growth, further deepening its impact on the daily lives of billions of people. Indeed, it already forms part of the ‘invisible plumbing’ of modern society in areas such as telecommunications, banking, navigation, Earth observation, and weather forecasting, among others. For the most part, public attention is drawn on the more ‘glamorous’ aspects of space, which have also become deeply embedded in modern popular culture, especially through the visual and performing arts, with many examples of popular space-themed films and marketing campaigns. Despite this, the interrelationship between space and popular culture has been underexplored in scientific literature, particularly the ways in which space has become embedded in popular culture and consciousness—a gap this volume seeks to fill.

Accordingly, this publication provides a detailed description of how space and popular culture intersect across a broad spectrum of popular media including cinema, music, art, arcade games, cartoons, comics, advertisements, and others, with an analysis of how the space figures in the particular context/s chosen. This is a pertinent topic since the use of space themes differs based on cultural contexts, and space themes can be used to explore various aspects of the human condition and provide a detached context for social commentary on politically sensitive issues. Therefore, special attention is also paid to accounts of space and its effect on culture, language, and storytelling from the South.

Rondebosch, South Africa
May 2019

Dr. Annette Froehlich

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The Influence of Mass Media on Society's Views of Space Travel During the Cold War

1

Nicolas Ringas

Abstract

This article explores how the two world superpowers during the Cold War, the United States of America and the Union of Soviet Socialist Republics, used mass media as a tool to rally support and invoke nationalistic pride for their respective space programmes. Five specific examples of mass media, including magazine articles, films and posters, are analysed in this context. It also discusses the unique socio-economic setting of the Space Race and how the need for space superiority led to the unprecedented investment, development and breakthroughs in space technologies.

1.1 Introduction

“In my opinion, it will be possible to launch an artificial Earth satellite within the next two years.” Leonid Sedov’s above statement, delivered at a press conference held at the 6th International Astronautical Congress, on the 2nd of August 1955, commenced the Space Race. Four days prior to this, the Press Secretary of President

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Eisenhower, James Haggerty, formally announced America's plans to launch "Earth-circling satellites" as part of the International Geophysical Year (IGY).¹

These announcements were made during the peak of the Cold War, a geopolitical war raging between the United States of America (USA) and the Union of Soviet Socialist Republics (USSR). The war between the two world superpowers was a battle of two ideologies: capitalism versus communism. The war commenced shortly after the end of World War Two, with mistrust between the two superpowers at unparalleled highs.²

The two superpowers never engaged in combat with one another directly as the consequences were too dire to risk. Instead, the war was fought using proxy wars and client states, with the threat of Mutual Assured Destruction the main deterrent for combat. After World War II, both the Soviets and the Americans obtained brilliant German rocket scientists, initiating a frenzied arms race to develop nuclear warhead capabilities. Espionage became a vital role to both powers, with each trying to determine the full capabilities of the other. Massive propaganda campaigns were initiated, each with the intent of promoting their own ideology and discrediting the other.³ National pride soared in the two countries, with each small victory in sports, technology or industry being lauded as a huge success of either ideology. However, with this deep-rooted nationalism, fears of a nuclear apocalypse gripped the public.⁴

The above serves to contextualise the socio-economic setting of the Space Race. Space became an international stage on which the two superpowers could exhibit their technological advancements and military strength. Technological superiority in space became an issue of national security and national pride, the attainment of which became deeply ingrained in the general public's minds. These notions were further aggregated with the success of Sputnik 1 in 1957. Martin Summerfield of Princeton University's *Astronautics* editorial stated: "The success of the Russian Sputnik was convincing and dramatic proof to the people around the world of the real prospects of space travel. The fact that a 23 in. sphere weighing 184 lb has been placed in an almost precise circular orbit indicates that a number of important technological problems such as high thrust rocket engines, lightweight missile structures, accurate guidance, stable autopilot control, and large scale launching methods have been solved..."⁵

The national space programmes of the two superpowers grew exponentially during the Cold War. Military budgets, coupled with mass public support, fuelled advancements in space travel at a frenetic rate. In the year 1959, less than 30 tonnes

¹J. Logsdon et al., *Reconsidering Sputnik: Forty Years since the Soviet Satellite*, Psychology Press, 2000.

²W. McDougall, *The Heavens and the Earth: a Political History in the Space Age*, Basic Books, New York, 1985.

³G. Palotta, *Space Race Propaganda: USA vs USSR. A Matter of Posters*, Paolo Casoli Blog, 30 Dec 2014, URL: www.paolacasoli.com/2014/12/space-race-propaganda-usa-vs-urss-a-matter-of-posters/, last accessed 11 Mar 2018.

⁴W. McDougall, *The Heavens and the Earth: a Political History in the Space Age*, Basic Books, New York, 1985.

⁵M. Summerfield, *Problems of Launching an Earth Satellite*, Astronautics, USA, Nov 1957.

were launched into space across the globe. In 1969, more than 500 tonnes had been launched into space. Investment and development in the space arena accelerated at an unprecedented rate, which has not been surpassed to this day.⁶ Society's interest in space travel and exploration apexed during the Cold War. The Space Race consumed the world's attention: East versus West, Communist versus Capitalist, Russia versus America.

Another contributing factor to the Space Race was the general public's fascination with rockets following the devastating effects of the German Aggregat 4 rocket (commonly referred to as the V-2), and the American nuclear bombs dropped on Hiroshima and Nagasaki during World War II. The general public were well aware of, and feared, the capabilities and power of such rockets.⁷

This document will demonstrate how during the Cold War, both the USSR and the USA used mass media as a vehicle to promote public support for their respective national space programmes and the different techniques they employed, including the distribution of propaganda posters, lionizing astronauts and rocket scientists, and using pop culture to rally support from their people.

Five examples of different formats will be analysed in the context of the Cold War to highlight why this was such a unique period of human ingenuity and technological innovation.

1.2 American Media Examples

Three examples of relevant American media will be addressed, specifically, a magazine editorial from 1952, a Disney film from 1956 and an American propaganda poster from the early 1960s.

1.2.1 Collier's Magazine—1952

In the early 1950s, despite being enthralled by science fiction stories and anecdotes, the majority of the American public was sceptical that manned space flight was a possibility. To counteract this, the US government commenced initiatives focussed at increasing public interest in space travel and proving the feasibility of human space travel. On 12 October, 1951, the *First U.S. Symposium on Space Travel* was held in New York City. The symposium brought together leading physicists, scientists, notable authors, acclaimed artists and magazine editors to discuss space-flight and space exploration.

⁶D. Snead, *Sputnik, the Gaither Committee and the Escalation of the Cold War*, University of Richmond, USA, 1998.

⁷M. Wright, *The Disney-Von Braun Collaboration and Its Influence on Space Exploration*, Marshall Space Flight Center Historian, Southern Humanities Conference, 1993.

One of the presenters at the symposium was Dr. Wernher von Braun, a German aerospace engineer and rocket pioneer. His presentation on human space flight led to Colliers Magazine publishing a series of articles called “*Man Will Conquer Space Soon!*” in their weekly editorial. Collier’s was one of the four top-circulation general magazines during the 1950s. The managing editor of Colliers compiled a team of experts, including Dr. von Braun, Dr. Whipple, Dr. Kaplan, Dr. Haber, Mr. Ley and Mr. Schacter to create an eight part series, detailing the future possibilities of space travel and exploration.⁸

At the time of the editorial, magazines and newspapers were one of the major mass media formats and, along with radio broadcasting, this format was the most publicly distributed form of media dissemination.

The magazine employed the skills of renowned illustrators such as Chesley Bonestell, Fred Freeman and Rolf Klep to bring the imagined concepts and spacecraft to life. In the absence of personal computers and digital image manipulation software, all magazine illustrations were created by hand. As such, highly skilled artists were required to create the imagery contained in magazine articles. The role of these illustrators in elucidating space travel to the general public was paramount, and many illustrators became famous as a result.

The illustrations in Collier’s magazine editorial needed to be visually gripping as well as realistic and highly detailed to demonstrate human space travel was, indeed, an attainable goal. The articles contained within the editorial were so popular that they inspired a whole new genre of science fiction artists and writers, such as Frank Tinsley, who imagined grandiose and sometimes farcical scenarios in space.⁹ Science fiction became a favourite genre of the general public. Science fiction artwork is unique in that it allows artists to attempt to look into the future and derive conjectures based on existing technology during their time. While these imagined scenarios and technologies can come across as absurd at times, they often result in surprisingly accurate predictions of future technologies.

An example of such an artwork is Fred Freeman’s representation of an envisioned space station, which could house numerous astronauts while it orbited the Earth (see Fig. 1.1).

The selected illustration was accompanied with two other illustrations in the editorial that depicted the space station floating in space above the Earth. However, this specific illustration was selected due to its finite detail. The illustration offers a cross-sectional view of a portion of the space station, in order to demonstrate its inner workings. The objective of the artwork is to show the general public how a space station could be designed and constructed. The illustration is annotated with numbers to identify the different areas of the space station, including systems such as air locks, Earth observation quarters, view ports, emergency oxygen helmets and water-recovery plants. It is truly remarkable that the International Space Station (ISS), launched in 1998, (more than 40 years later) contains many of these systems.

⁸ *Man Will Conquer Space Soon!*, Issue 1 of 8, Collier’s Magazine, 22 Mar 1952.

⁹ F. Tinsley, *Assembling a Station in Space*, Thrilling Science Fiction Stories, Collier’s Weekly, Oct 1972, pp. 101–111.



Fig. 1.1 F. Freeman's representation of the Collier's panel of experts' prediction of a functioning space station (F. Freeman's painted illustrations for *Station in Space* by W. Ley, from *Man Will Conquer Space Soon!*, Issue 1 of 8, Collier's Magazine, 22 Mar 1952)

It should be noted that often the scale of these envisioned space craft were drastically exaggerated when compared to the technology of today. However, such exaggerations may be due to the fact that during the 1950s, electrical circuits were large and inefficient. When compared to their modern day counterparts.

The illustration depicts astronauts working in various sections of the space station, controlling the telescopes, communication systems and Earth observation systems, and using large screens and projectors to operate the systems. On the ISS today, most of these systems have become integrated with one another and the size of these systems has been drastically reduced. The illustration also shows a “landing berth” which is used to house a space taxi. This is not very dissimilar from the docking modules on the ISS. The illustration even includes “hook-on rings” on the exterior of the space station to allow for astronauts to connect their safety tethers to the station during spacewalks. Thus, not only did the editorial correctly predict that human spacewalks would become a reality, it also anticipated the need for protective space suits and safety tethers.

The illustration by Freeman is a good example of a piece of artwork brimming with practical information that can appeal to people with varying technical experience levels. To non-technical people, the visual impact of the artwork is critical. The deep dark background representing space comes across as desolate and intimidating. The busy hive of the space station is portrayed as exciting and pioneering, which creates a sense of exploration into the unknown. Even for

individuals whom do not posses a fascination with engineering aspects of space, this artwork enthrals viewers by exhibiting astronauts as they embark on an extra-terrestrial adventure. For the more technically-orientated viewer, the artwork contains enough detail to hold their attention and to critically question the inner-workings of the space craft.

The symposium held in 1951 and the Colliers “*Man Will Conquer Space Soon!*” articles were successful and the general public began to view human space travel as a feasible and necessary technological development.

1.2.2 Disney’s *Man in Space* Film

American society was now enraptured with the notion of human space travel, but the US government still had concerns that they did not have the capacity required to continue developments in the space arena. Following the success of the Colliers magazine, another initiative commenced: a short film entitled *Man in Space*.¹⁰

Man in Space is a 51 minute long film combining documentary footage and animations illustrating concepts relating to space exploration and travel. The film formed part of the *Disneyland* American television series and premiered on the 9th of March 1955 to an audience of approximately 40 million Americans. The film was well received and led to three follow on films, namely: *Man and the Moon*, *Mars and Beyond* and *Eyes in Outer Space*.

Man in Space was later edited into a featurette film and played prior to the main film in cinemas in July 1956. In 1957 the episode was released theatrically in Japan and Denmark. *Man in Space* was adapted and published as a comic book entitled *Walt Disney’s Man in Space: A Science Feature from Tomorrowland* by Dell Comics in 1956. Later, a hard cover book was released to schools in the United States¹¹ (Fig. 1.2).

The film comprises lectures by leading scientists coupled with explanatory animations and models (see Fig. 1.3) to offer insights regarding the science of rockets and the effects of space travel on humans. Discussed topics included orbits, air pressure, gravitational forces, radiation and weightlessness. The film was directed and animated by Ward Kimball and is presented by Walt Disney, Ward Kimball, Willy Ley and Wernher von Braun. Dr. von Braun, Mr. Ley (a critically acclaimed science-fiction author) and Dr. Haber (physicist and space researcher) were instrumental in writing the technical content of the film and advising the filming process (see Footnote 7).

In an article published by Galaxy Magazine, Ley highlights how the Disney animation techniques allowed for complex concepts to be easily conveyed to the audience and deemed animated cartoons to be “the most instructive device invented

¹⁰Disney, *Man in Space*, Disneyland Video Series, 1955. Available to watch at <https://www.youtube.com/watch?v=omWRxonewL4>, last accessed 11 Mar 2018.

¹¹J. Sisson, Article on *Man in Space: A Science Feature from Tomorrowland* (1956), Dreams of Space—Books and Ephemera, Online Blog, URL: www.dreamsofspace.blogspot.co.za/2009/07/man-in-space-science-future-from.html, last accessed: 09 Mar 2018.

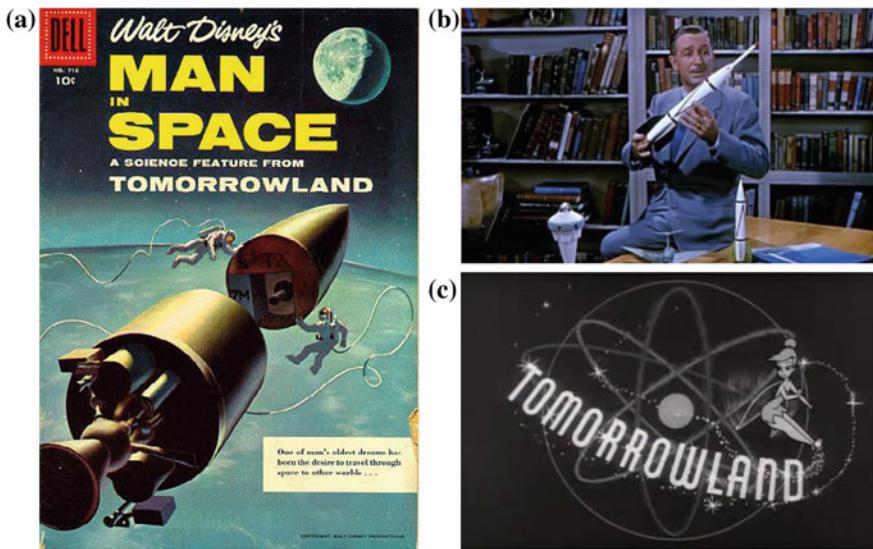


Fig. 1.2 **a** Cover of the adapted comic book by Dell Comics (see Footnote 11). **b** Screenshot from *Man in Space*—Walt Disney’s introduction to the film. **c** Screenshot from *Man in Space*—the film was part of Disney’s *Tomorrowland* series

so far”. He continued to explain how animation allowed producers to discuss complex ideas such as the function of combustion chamber cooling jackets and how satellites remain in orbit. Without animation, these concepts would require lengthy and cumbersome explanations, especially when speaking to an audience that is not involved in the space sector.¹²

The animations and well-written script resulted in the film realizing great success. This was one of the first times a space documentary was so well-received by the general public (see Footnote 7). Notwithstanding, the show was filled with technical information relating to space travel and was promulgated using mass media technologies. Space had now been fully ingrained into pop culture. People who viewed the film now had a good understanding of the fundamentals of space travel and the possibilities space exploration could offer. Society no longer viewed space as some abstract, complicated and unattainable arena. Rather, space became an exciting and exhilarating new frontier for exploration.

To accelerate the general public’s support of space exploration, the US developed new curricula for schools that focused on mathematics and sciences, installed space-themed playground equipment at schools and created the National Aeronautics and Space Administration (NASA). In doing so, the US ensured that the next generation of young graduates would be instilled with awe for space travel. The once naïve and sceptical American public was now fully aware of the

¹²W. Ley, *For Your Information*, Galaxy Magazine, Galaxy Publishing Corporation, New York, Oct 1955.

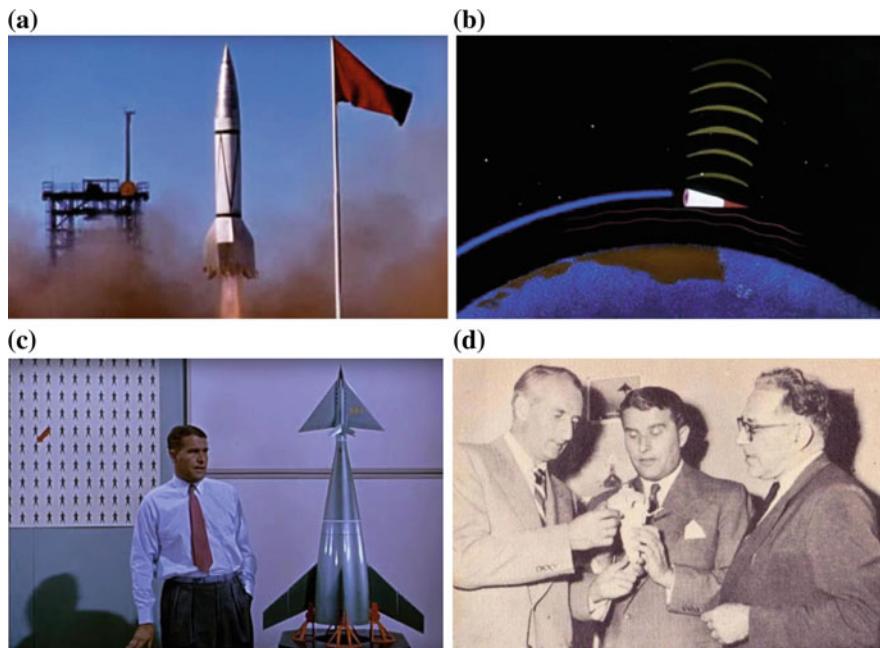


Fig. 1.3 **a–c** Screenshots from *Man in Space* showing the films different mediums—actual footage, animation techniques and lectures using models. **d** Dr. Haber (left), Dr. von Braun (centre) and Mr. Ley discussing spacesuits (see Footnote 8)

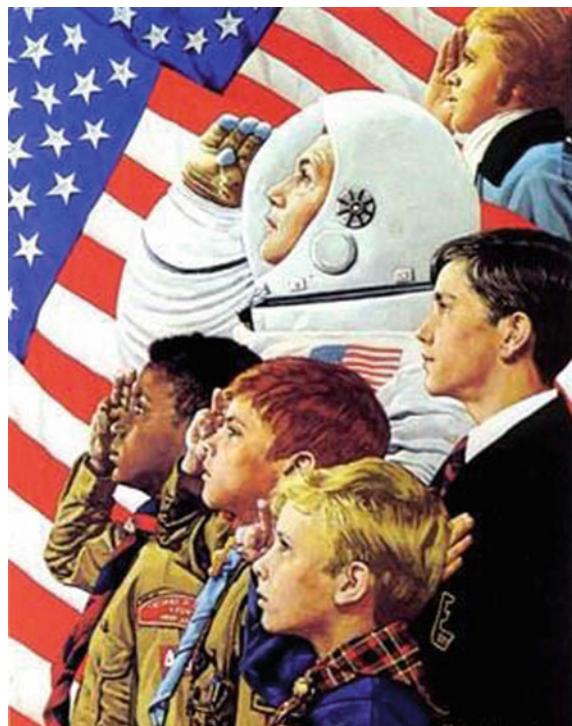
feasibility, desirability and most importantly, the necessity, for space travel and space exploration.

Both these American initiatives ensured sufficient future capacity for the national space programme and thus guaranteed its longevity. This, complimented with substantive public support for space travel and exploration, allowed the US government to increase their funding of space research and development and better their chances in the Space Race.

1.2.3 American Space Poster—Early 1960s

Unlike the previous two examples which were educational, this media extract is an illustration of American propaganda from the early 1960s (see Fig. 1.4). The poster shows six figures saluting in the foreground, with a large American flag waving in the background. The bright colours of the American flag make for a strong visual impact intended to instil a sense of national pride within Americans. The six figures depicted on the poster are all staring up towards the sky in a steadfast and determined manner. Their fixed gaze is confident and almost triumphant, possibly implying that they are witnessing a great success of the American space programme.

Fig. 1.4 American propaganda poster relating to space travel from the early 1960s (see Footnote 3)



The six citizens depicted in the poster represent a diverse demographic of the population. In the top right hand corner there is an American dressed in regalia from the 1700s. His inclusion in the poster serves to symbolically represent the founding fathers of the USA and to reflect on the pioneering attitude of that time. The central figure of the poster is an American astronaut dressed in a spacesuit with an American flag emblazoned on the left breast of the suit. The astronaut is slightly larger than the other characters and is thus the focal point of the poster. The audience's attention is immediately drawn to the astronaut with the bright American flag in the background. This serves to strengthen the notion that astronauts are American heroes and deepens feelings of nationalist pride. The four other figures in the poster are youths, indicating that through space travel, America is securing the future of the next generation of American citizens. The four children are dressed in differing attires and have a diverse ethnicity. This conveys a message that America and space travel represents equality across different income brackets, education levels and races.

The poster instils a sense of steadfast confidence and triumph in its viewers, which functions to boost public moral and strengthen the association between national pride and the American space programme. The poster's vividness invokes an emotive response from the viewer. No caption or text was included in the poster to ensure that this immediate emotive response was not jeopardized.

1.3 Russian Media Examples

Two examples of media from the USSR, specifically propaganda posters from 1959 and 1963 are now addressed to highlight the differing techniques and approaches of the USSR to the USA during this time.

1.3.1 Luna 2 Propaganda Poster—1959

The fourth media example is a Russian propaganda poster from 1959 (Fig. 1.5) and is significant due to its timing in the Space Race. After the Russian's success with Sputnik 1, the Americans were racing furiously to achieve a successful launch. They achieved this in 1958 with Explorer 1. The next goal was the moon with both the Russians and the Americans setting their target on a lunar flyby or, preferably, landing a lunar probe. Not long after the success of Explorer 1, the Russian's Luna 1 achieved the first space travel in the vicinity of the moon in January 1959. Thereafter, in September, the Russian Luna 2 became the first probe to make impact with the moon.¹³

Russian propaganda posters of the time were limited by the printing technologies available in Russia. Screen printing was employed to create the posters on a large scale. As such, the posters do not possess a high level of detail. Instead, they use large colour blocks and symbolism to convey national pride for the USSR. The majority of the posters use large captions expressing communist declarations of victory and references to "Mother Russia" to deepen the emotive responses they invoke (see Fig. 1.5).

The text in the poster reads "Sons of October—Pioneers of the Universe!".¹⁴ The poster makes reference to the Russian Revolution of 1917, commonly referred to as the October Revolution. The revolution marked the end of imperial rule in Russia, when the Bolsheviks overthrew the tradition of czarist rule. This is typically regarded as one of the most drastic revolutions of the twentieth century and is a crucial element of Russian heritage and national pride.

By referring to this revolution, the poster exploits the emotions Russians associate with the uprising. The revolution gave the Russian public their freedom and ended monarchical rule. Russians that viewed the poster may begin to associate space travel with the October Revolution and regard it as an essential battle for Russia. These words, combined with the imagery of Russian troops at the foreground of the poster demonstrate that the USSR was prepared to fight for space supremacy. The poster proclaims Russia to be pioneers of the universe, which

¹³J. Logsdon et al., *Reconsidering Sputnik: Forty Years since the Soviet Satellite*, Psychology Press, 2000.

¹⁴L. Stampler, *These Soviet Space-Race Propaganda Posters Retain Their Delusional Intensity 50 Years Later*, Business Insider, URL: <http://www.businessinsider.com/heres-the-soviets-extremely-intense-space-race-propaganda-posters-from-1958-1963-2012-4?IR=T>, last accessed: 10 Mar 2018.

Fig. 1.5 USSR propaganda poster relating to the success of the Soviet lunar probe Luna 2 in 1959 (see Footnote 14)



would have evoked immense national pride in its audience: not only could the Soviets reach the moon; they could conquer the entire universe!

The utilization of the primary colours red and blue makes the poster bright and bold, with the red Soviet flag the clear focal point of the poster. The flag is being carried forward by troops in battle which creates the impression that they are about to claim newly conquered land, in this case, the moon. The Earth is shown in the background, with the Russian continent in view and clearly demarcated with the Cyrillic abbreviation CCCP (the Russian abbreviation for the USSR). The communist star is shown above the Earth in red to further the symbolism of the poster as well as balance its composition.

This poster is an example of how the Soviet Union employed symbolism, text and national heritage to instil pride and support for both the national space programme and communism as a whole. The poster is resolute and unwavering and boldly proclaims the triumph of the USSR and its lunar probe.

1.3.2 Yuri Gagarin Propaganda Poster

The fifth media example is a Russian propaganda poster celebrating the achievements of cosmonaut Yuri Gagarin (see Fig. 1.6), the first human to complete an orbit of the Earth in 1961. The design of this poster is similar to the previous example: the poster uses emotive symbols, carefully designed compositional aspects, emotive captions in block letters and bold primary colours to maximize the emotive impact of the poster.

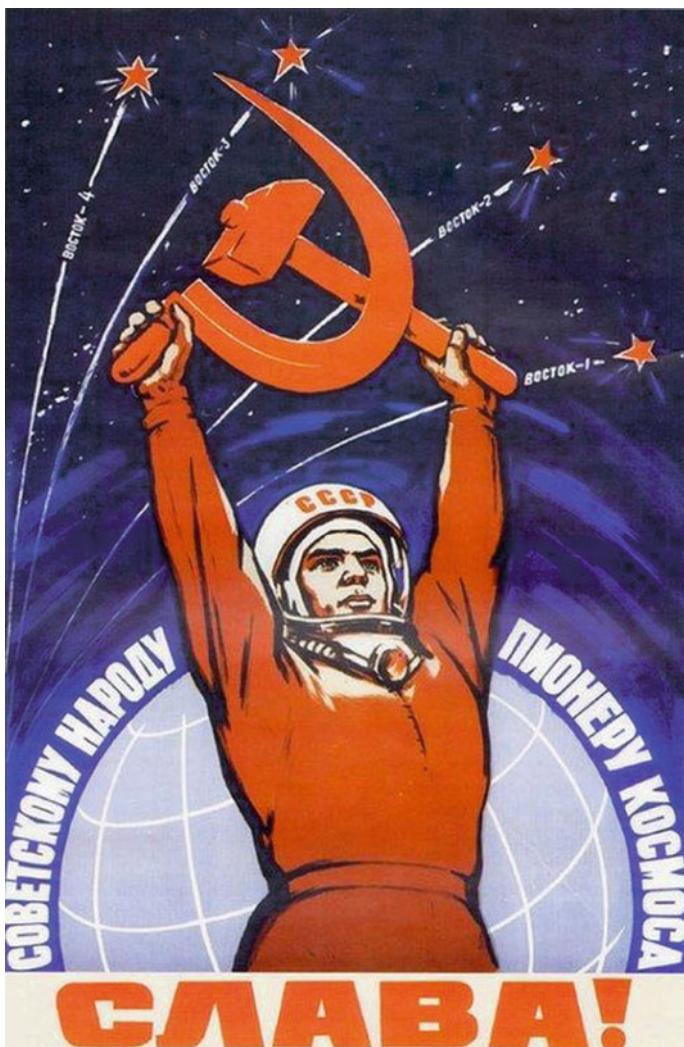


Fig. 1.6 USSR propaganda poster announcing the success of the Vostok space programmes (see Footnote 3)

The poster utilizes two important communist symbols: the sickle and hammer and the five point star. These symbols are immediately identifiable and have the strongest connotations to communist rule, with the sickle and hammer being conceived during the October Revolution. The sickle and hammer is being held up gloriously by a muscular cosmonaut dressed in a red spacesuit. The angle of the poster is such that the viewer looks up to the cosmonaut, giving an impression of power, demanding reverence for the cosmonaut. The Cyrillic abbreviation, CCCP, is clearly visible above the visor of the spacesuit's helmet. The poster is triumphant and exultant. The Earth is represented in the background, located behind the cosmonaut and is relatively small in size, only occupying the bottom third of the layout. The sickle and hammer are almost the same size of the Earth and stand out due to their deep red colour, offset by the dark blue space background, ensuring it is the main focal point of the poster. Furthermore, the symbol is directly above the Earth, implying the triumph of communism over the entire world. The four communist stars are depicted behind the sickle and hammer as shooting stars. In each of their trails, the letters "BOCTOK" are visible, followed by consecutive integers. This is the Cyrillic text for Vostok. The Vostok programme was the USSR's human space travel programme. Vostok 1 was piloted by Yuri Gagarin in April 1961 and became the first human flight into space. Vostok 2 was launched in August 1961 and was the first manned space flight that lasted a full day. Vostok 3 and 4 were launched in 1962, a day apart from one another, and achieved the first simultaneous manned space flights as well as the first ship-to-ship communication in space.¹⁵ The poster includes the names of these launches to celebrate each of the achievements, thereby reaffirming the heritage of the Russian space programme and to glorify the State and its communist ideology.

The text on the poster reads: "Long life to the Soviet population, the space pioneers!" (see Footnote 3). The Soviets selected this text to convince the people that the USSR space programme was securing the future of its people and ensuring their safety. The term "space pioneers" is used in numerous Soviet propaganda posters and serves to cement the notion of Russian superiority in space travel and exploration.

A salient point to discuss is the cosmonaut's facial features and expression. Firstly, the cosmonaut does not look like Yuri Gagarin and is not uniquely identifiable. This is an essential tool used in communist propaganda, where successes and triumphs are not attributed to an individual but rather to the State. Although the USSR lionized cosmonauts in general, they avoided creating specific individual heroes. They desired the praise and admiration to be directed to the State and not to any of its individual comrades. Moreover, the expression of the cosmonaut is not one of elation or happiness. In fact, he is firm, serious and uncompromising, with an absence of surprise on his face, denoting that failure was never a possible outcome. His success is one of duty, not personal victory or achievement. Again, this highlights the manner in which the Soviet Party claimed ownership of the

¹⁵A. Millbrooke, *History of the Space Age*, Handbook of Space Engineering, Archaeology, and Heritage, Taylor and Francis Group, London, 2009.

achievements of its population and ensured via propaganda that while certain members could be revered, no single person was greater than the State.

1.4 Conclusion

This document has investigated and explored the unique socio-economic climate of the Cold War and how it acted as an incubator for staggering state funding and investment into national space programmes. Without the incredible circumstances of the Cold War, the Space Race could not have achieved such breakthroughs.

By using media examples of the time, the document has shown how the two superpowers of the world employed mass media and pop culture to influence society's views of space. Through propaganda posters and educational drives, the Americans and the Soviets made space travel a core issue of national pride, thereby allowing them to increase their national space programmes and spending drastically. This led to the incredible developments and achievements attained by both nations during the Space Race. It can be argued that if it was not for the Cold War, and consequently the Space Race, space travel would not be as advanced as it is today and perhaps space exploration would still not be deemed as a feasible option by society as a whole.

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Space and Media

2

Eunice Pieterse

Abstract

Space has become an integral but invisible part of the fabric of modern-day life. Billions of people personally rely on the existence and operation of space systems as they go about their daily lives, yet this fact is largely unappreciated by those very same people. However, space has become deeply embedded in popular culture in visual and performing arts, including the media. This analysis aims to show the impact that the use of satire in popular culture had and continues to have on public perception of space and space related activities.

2.1 Introduction

Satire, like caricature, works by deforming a world and through that deformation producing a shock of recognition.¹

In this analysis, the many ways in which all facets of space have become ingrained in the fabric of society are illustrated.

Despite the entrenched relationship of space technology in modern day life; society, by and large, has a skewed ill-informed perception of space. This departure could easily be attributed to the complex nature of space and space-related activities, including space science, -policy, -technology and -applications. However, one should recognise the contribution that political history and the media had in forming (or misinforming) popular perceptions regarding space.

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¹Bernstein, R; 1996; For soviet space efforts, a satirist's send-down; The New York Times; www.nytimes.com/1996/06/12/books/for-soviet-space-efforts-a-satirist-s-send-down.html.

After more than 50 years of carefully controlled public images, propaganda, political agendas and creative journalism in the space arena, it is no surprise that the popular perception of space activities is so far removed from reality.²

In popular culture there are a number of ‘settled’ assumptions and feelings surrounding space, for example, the idealistic and romanticised images of astronauts, cosmonauts, and the like,³ as intrepid explorers and infallible heroes. Space-flight and exploration embodies a sense of hope and liberation among ‘normal folk’ who place astronauts in a hero category comparable to ‘Captain America’ and ‘Ironman’.⁴

These views were carefully crafted over decades by political forces, mainly in the Soviet and United States of America (“USA”), using, *inter alia*, the media to create favourable public images of space activities and deliberately concealing any negative publicity.⁵

This is borne from the reality that governments had to “sell” space to the nation and sold space exploration as the foremost activity that could restore national pride and show international prowess.⁶ On the flip-side, members of the public became disillusioned at these romantic notions of space activities and political opponents capitalised on this sense of discontent to win the favour of voters by ‘exposing’ excessive spending, ailing social programs, and military threats, caused by the ruling government.⁷

Both romantic and critical notions of space exploration, the space race, foreign policy and governmental spending, were and continue to be highlighted through political satire. In certain instances space issues are placed in juxtaposition with societal “earthly” issues, such as the disparity between financial resources allocated to socio-economic development versus space related activities. In other instances, satire is used to criticise the failure of governments to advance space activities. In fact, there is an entire satirical animated series called Heads of Space,⁸ which featured the 2016 USA electoral candidates, which is for the most part set in space. What both sides of the satirical coin have in common is that they divert in varying degrees from the truth and have no doubt contributed to the general public’s sense of scepticism for space activities in the hands of the state and thus indirectly leading

²Oberg, J; Soviet Space Propaganda: Doctored Cosmonaut Photos; Wired Magazine; <https://www.wired.com/2011/04/soviet-space-propaganda/>.

³All references to “astronaut/s” and/or “cosmonaut/s” in this analysis should be interpreted as including all spaceflight professionals from all nations.

⁴Launius, R D; 2005; Heroes in a Vacuum: The Apollo Astronaut as a Cultural Icon; Reno, Nevada; January 10–13; www.klabs.org/history/roger/launius_2005.pdf.

⁵Gerovitch, S. 2015; Soviet Space Mythologies: Public images, private memories and the making of a cultural identity; University of Pittsburgh Press.

⁶NASA; 1976; Questions About Aeronautics and Space; Washington, D.C.

⁷Dator, J A; 2012; Social Foundation of Human Space Exploration, SpringerBriefs in Space Development; 43–44; Tone down political rhetoric around space issues; www.spaceflightinsider.com/editorial/opinion-tone-political-rhetoric-around-space-issues/.

⁸Lemoine, O G et al.; Heads of Space; Univision.com; www.especiales.univision.com/heads-of-space/index.html.

to the general public's failure to fully appreciate the spill over benefits of space activities on earth.⁹

In this analysis, five such examples of satire which relate to the popular criticisms of foreign policy, space programs and space related activities are considered.

2.2 Analysis of Examples of Satire

2.2.1 Comrade, There Goes Something¹⁰

See Fig. 2.1.

The author/artist is Patrick Oliphant, a highly regarded Australian editorial cartoonist, who relocated to the USA and was working at the Denver Post at the time of publishing this cartoon in 1965.¹¹

In the cartoon, the cosmonauts appear mocking as they gaze towards the Gemini capsule, which is literally falling apart. Without the relevant background information, the cartoon gives the impression that the USSR have their ducks in a row while the USA machinists, striking for a wage increase, are producing inferior quality spaceships and damaging the reputation of the nation. Oliphant connects the strike with the Gemini capsule and in doing so appears to allude to the strike having led to the issues surrounding the Gemini capsule launch and that this has tarnished the reputation of the USA with the Soviets.

Several texts¹² were published during the same time period referring to an extended wildcat strike at McDonnell Aircraft Corp.¹³ Towards the end of 1965 International Association of Machinists and Aerospace Workers (IAM) announced that it would authorise the 16,000 person strong strike if machinists did not receive new contracts in which they sought, *inter alia*, a 20c per hour wage increase.¹⁴

Given the political and economic climate in 1965 it is unlikely that the general public had a critical understanding of the space technology of the day or were fully informed of the political strategies driving it. The available publications are conflicting in their reports pertaining to the connection between the Gemini's launch complications and the machinists strike. The result is that it is difficult to

⁹Wolfe, T; 1979; *The Right Stuff*; New York: Farrar, Straus & Giroux; 436.

¹⁰Oliphant, P B; *Comrade, There Goes Something We Could Never Build in Russia*; The Los Angeles Times Syndicate; www.comicartfans.com/gallerypiece.asp?piece=904562.

¹¹Yancey, K; *The Outspoken Oliphant*; Cable News Network, Inc.; www.edition.cnn.com/SPECIALS/1998/oliphant/.

¹²Astronautics and aeronautics; 1965; Washington Post; June 29 1965. Astronautics and aeronautics; 1965; UPI New York Times; June 25 1965; 28. Astronautics and aeronautics; 1965; AP Denver Post; April 15 1965. Astronautics and aeronautics; 1965. AP; Baltimore Sun; November 12 1965. 512-13.

¹³Pressure is Applied in McDonnel Strike; 1965; Tucson Daily Citizen; November 20 1965; www.studylib.net/doc/8909227/pressure-is-applied-in-mcdonnell-strike.

¹⁴Astronautics and aeronautics; 1965; AP, New York Times; November 18 1965. 27; AP, Washington Eve Star; November 18 1965.

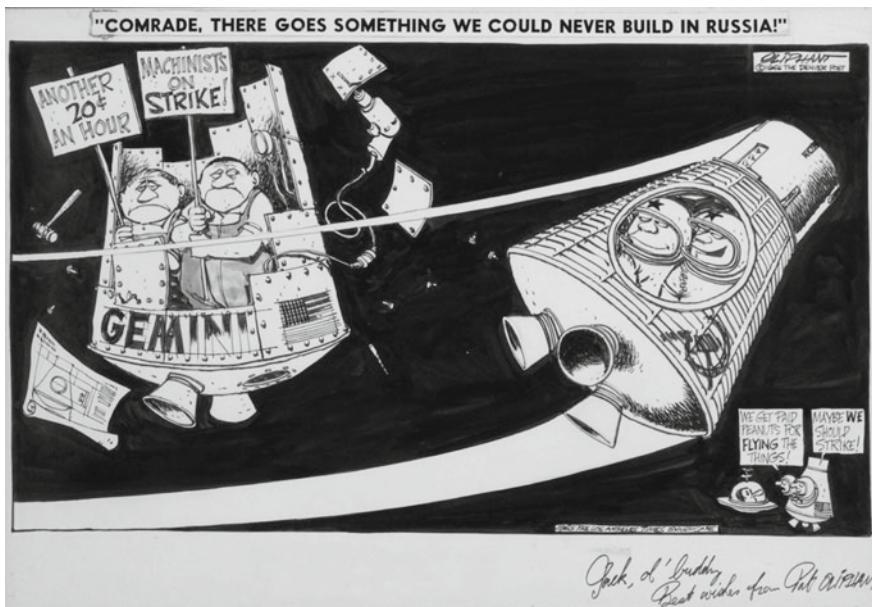


Fig. 2.1 Comrade, there goes something we could never build In Russia. The Los Angeles Times Syndicate

extract the truth from either formal publications regarding the strike and this particular cartoon does little to set the record straight.

It is regrettable that the author, who could have used this situation to amplify national pride in illustrating that 16,000 employees were given job security (and a wage increase with a three year contract)¹⁵ due to the space industry, but elected not to do so.

2.2.2 The New Space Race¹⁶

See Fig. 2.2.

According to the artist/author, Tim Kreider,¹⁷ this cartoon is based on the Bush Administration's proposal to go back to the moon and to Mars, and more specifically, the author's apparent outrage at the media and public for having been revitalised and excited by these announcements, when he appears to feel that Former President G W Bush has no intention to follow through on these intentions.

¹⁵ Astronautics and aeronautics; 1965; AP, Baltimore Sun; November 12 1965. 512–13.

¹⁶ Kreider, T; The New Space Race; The Pain—When Will It End; www.thepaincomics.com/weekly040121a.htm.

¹⁷Ibid.

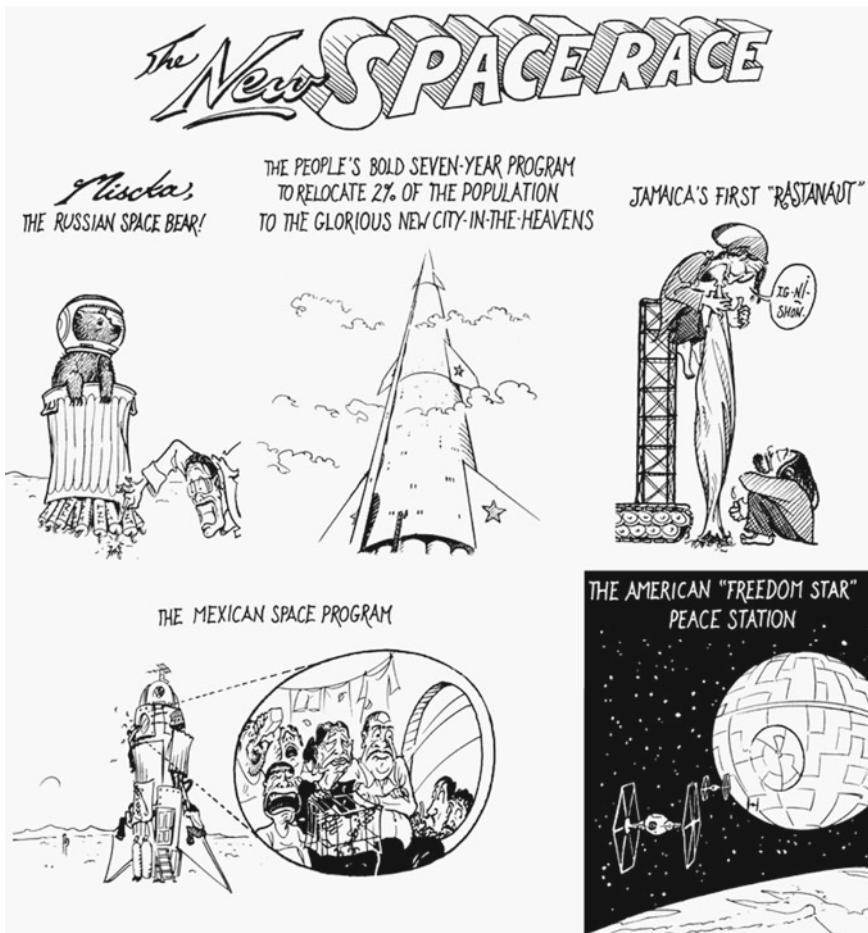


Fig. 2.2 The new space race the pain—when will it end, www.thepaincomics.com/weekly040121a.htm

The author further expresses his displeasure at the increase of “ethnic slurs” which he incorporates into his cartoon.¹⁸

The cartoon is not particularly imaginative or thought provoking, and his intended commentary stated above is poorly reflected therein.

On the face of it, he is highlighting certain racial stereotypes and mocking the Bush Administration’s space proposals and possibly using these racial stereotypes to make it even more ludicrous. He seems to imply that all of these space programs (even imaginary ones) are ludicrous.

¹⁸Ibid.

The public imagery surrounding the space race during the Kennedy Administration 50 years ago is starkly contrasted by the public perceptions surrounding space during the Bush Administration. It depicts a sense of public distrust and scepticism against government policies in general and furthermore the feeling that there are no worthy contenders in the so-called ‘space race’.

The author’s portrayal of the various space programs is also not accurately portrayed, given that there were various advanced space policies and programs in existence.

It interesting that the cartoon seems to embody the public opinion, if not in the West generally then in the USA, that the new space race is a circus and everyone in the arena is simply ridiculous and unrealistic. As such, this careless depiction of “space programs around the world” very possibly represented a ‘real world’ western view of what the lay public perceived to be reality.

2.2.3 I Remember When We Used to Make Giant Leaps¹⁹

See Fig. 2.3.

On 12 November 2014, Philae, carried by Rosetta, was the first spacecraft to have ever landed successfully on a comet.²⁰

The above cartoon was published in the Charleston Gazette²¹ on 14 November 2014, depicting the idea that the European Space Agency (“ESA”) is overtaking NASA in terms of space advancement and pioneering.

It is an accurate depiction insofar as ESA being a worthy space contender is concerned, but the cartoon is implying that they are leading the way which is not necessarily accurate.

It also rather ironically brings to the fore that space is often about making headlines.²² In reality, it is not that NASA is ‘doing less’ than before, but their activities are more in the background. The perception that if you are not making headlines you are sliding backwards is disingenuous.

Ironically, the public ridicules the various space programs and criticises the resources being allocated to space activities, however, when other nations make headlines in space, then the public appear equally critical of their country’s failure to meet their expectations. This appears to be especially true of the USA who expect NASA to be leading within the space arena, but express their outrage at the resources allocated to it, whilst indifferent as to the value of space technology.

¹⁹Koterba, J; NASA ESA Rosetta Comet; Charleston Gazette-Mail; www.wvgazettemail.com/article/20141120/DM04/141129992#sthash.-uul1n4n0.dpf.

²⁰Beatty K; Philae Lands on Its Comet—Three Times!; Sky and Telescope; www.skyandtelescope.com/astronomy-news/philaе-lands-three-times-111220143/.

²¹Charleston; West Virginia, USA; 14 November 2014.

²²Lewis, C S. 2008. The Red Stuff: A History of the Public and Material Culture of Early Human Spaceflight in the USSR. Ph.D. diss. George Washington University.

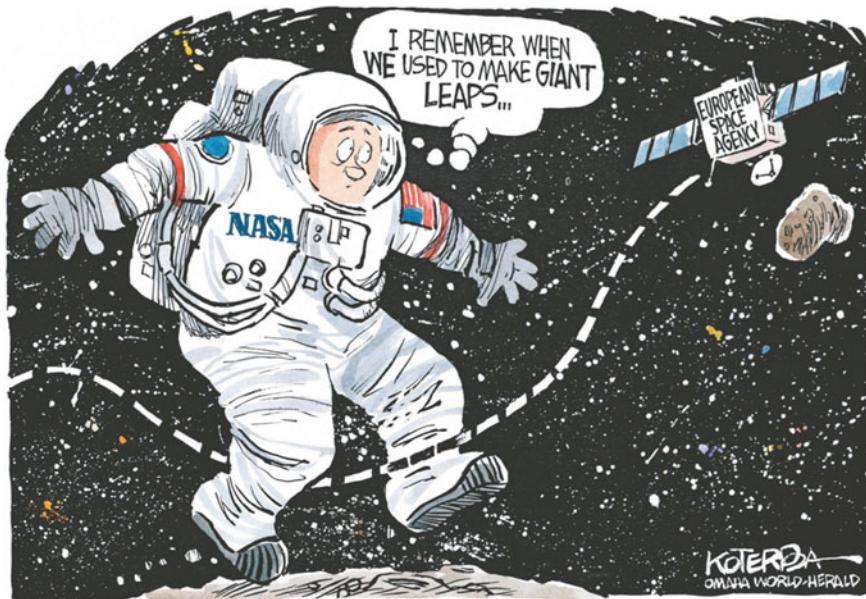


Fig. 2.3 I remember when we used to make Giant Leaps. Charleston Gazette-Mail

2.2.4 Excuse Me Sir, We Have a Mission²³

See Fig. 2.4.

More recently, Newt Gingrich announced that he would personally ensure that there would be a permanent USA base on the moon should he be elected president.²⁴

The author, Ian Bell, states that “given the USA military’s tendency to proliferate permanent bases around the world, why not in the heavenly bodies?... (H)e also proclaimed that he believed there would be a continuous propulsion system that would allow travel to Mars in more practical time frames. It sounds like he plans to be busy in the back yard of the White House with his slide rule and some bottle rockets, as well.”²⁵

The author illustrates his displeasure that every USA electoral candidate makes ambiguous claims and promises about space activities and advancements that appear blatantly unrealistic whilst ignoring the existing threats demanding their attention.²⁶

The depiction is of the said candidate indulging in a childish pastime, in stark contrast to the extant war on terror. There is also a real issue in that “space” has

²³John Cox and Allen Forkum; Mission Priorities; Cox and Forkum Editorial Cartoons; www.coxandforkum.com/archives/000262.html.

²⁴Ibid.

²⁵Ibid.

²⁶Ibid.



Fig. 2.4 Mission priorities. Cox and Forkum Editorial Cartoons

become a buzz-word in the media used to sell papers, rather than a topic which is discussed in an appropriate context of a meaningful space strategy. The public seldom hears about the space developments save during campaign time, which reinforces the belief that space programs and the space agency are for all intents and purposes dormant, draining much financial resources and only comes to the fore during election time. The reality is that space developments are continuous and exciting, but not exciting enough to make headlines and sell newspapers... And when ESA makes headlines Americans are equally offended. This hones in on the global perception that space programs are too expensive and fail to contribute meaningfully to the current, pressing socio-economic and safety issues that plague just about every country of the world at present.

Again, this is borne from the fact that the general public is ill-informed of the real benefits of space and thus fail to appreciate the importance of their ongoing support for space advancements. The benefits of these space programs are not adequately communicated to the public and the public is untrusting and critical of the space information made available...

2.2.5 We Win After All²⁷

See Fig. 2.5.

The author, Scott Stantis, is an editorial cartoonist for the Chicago Tribune.²⁸ The cartoon depicts Russian scientists reading about the announcement that the USA Space Shuttle program will come to an end and exclaiming that “we won after all!”

There are two issues at play: The first relating to the aforementioned expectation by the American public that NASA is meant to be leading the space race, and expressing their disappointed at the decision to retire the Space Shuttle program. The second issue relates to realistic goals.

The Russian spacecraft, the Soyuz, is not an elegant rocket, it is an old “analogue” rocket and during the space shuttle era it was particularly unglamorous.

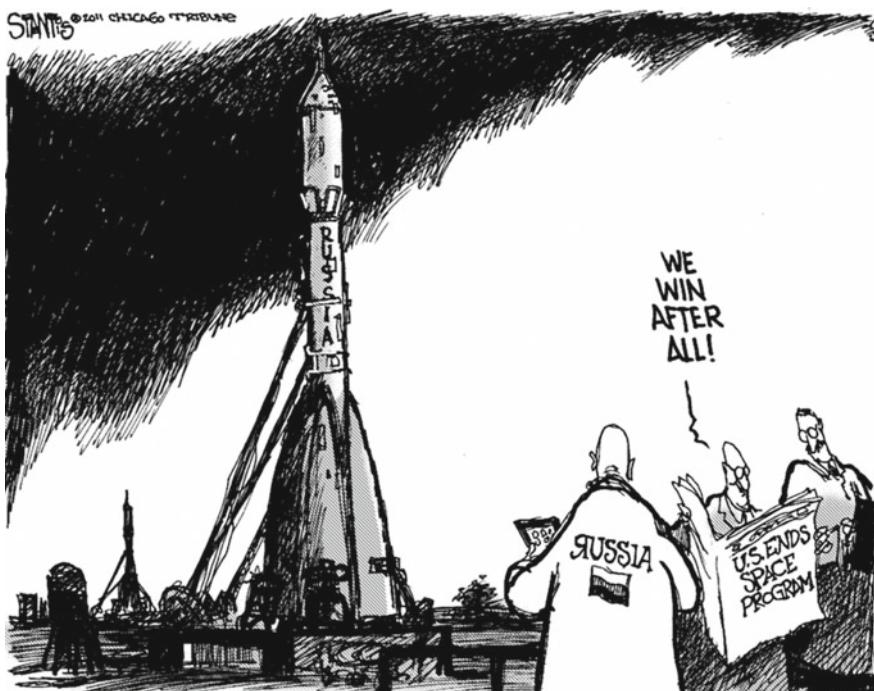


Fig. 2.5 Space Race Lost. Chicago Tribune

²⁷Scott Stantis; Space Race Lost; Chicago Tribune; www.newsblogs.chicagotribune.com/taking-a-stantis/2011/07/space-race-lost.html.

²⁸Scott Stantis; Scott Stantis Editorial cartoonist; Chicago Tribune; www.chicagotribune.com/news/opinion/chi-edistantis-story.html.

But it is reliable and Russia has been launching and relaunching Soyuz for some time. In reality, it was cheaper and more reliable than the Space Shuttle program.

The space shuttle was shiny but expensive and, at times, prone to catastrophic failure. The USA had to undertake a careful balancing act between selling space to the public in a way that they could get excited about whilst having to be realistic of the financial resources available to it. Ultimately the shuttle was not financially viable and (all things considered) politically sustainable. Slow and steady wins the race...

The Space Shuttle program successfully captured American pride, but at the end of the day drained the budget and disillusioned the oversight committees, finally leading to USA's human space-flight launching program being suspended.

The cartoon is both accurate and not: The space race is not over yet. On the contrary, even though it meant that the USA would no longer have human space-flight launching capabilities, this would be a good opportunity for NASA and the USA to educate the public about the vast array of space related activities which do not involve human space-flight. The cartoon does however accurately portray the public's feelings toward the Space Shuttle program being terminated, possibly due to the USA having successfully, through decades of media campaigns, deeply connected the American public's status as a nation and national pride with their space capabilities.

2.3 Conclusion

In conclusion, bringing it all together, space and space related activities are criticised and loved simultaneously. In some instances, the lack of advancement was criticised, while at times the claims to reinvigorate space development were criticised.

What the satire pertaining to space generally highlights is the general public's skepticism and criticism of their governments' space activities whilst exposing the intrinsic patriotic value placed thereon. At times, it reflects the unfortunate misuse of space to gain political support and, regrettably, fails to emphasise the public's lack of appreciation and understanding of space advancements and the beneficial application of space technology on earth.

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The Use of Space in a Meaningful Manner as Part of Popular Culture in the Form of the Science Fiction Film

3

Anton de Waal Alberts

Abstract

The depiction of space in films was a natural merging of technologies borne out of the Renaissance and Industrial Revolution: one that could create alternative worlds and others that created the expectation that new worlds could actually be explored. However, the mental device of estrangement embedded in science fiction as a narrative genre was strengthened when the power of story became amplified with the arrival of film. The mirror of self-reflection that estrangement gave to humankind transformed into a more immersive experience in film with its visual illusions. It allowed the exploration of narrative settings in space and led to the creation of new genres as forms of estrangement. This article sets out to explore the emblematic films that form part of cinematic science fiction and endeavours to establish their meaning and importance in popular culture as it relates to space.

3.1 Introduction

Science Fiction (“SF”) as a literary and cinematic genre is relatively new and historically connected to the rise and democratisation of technology since the Renaissance and the ensuing Industrial Revolution. This article, by way of a brief historical overview, establishes an exposition of the unfolding nature of science

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fiction cinema in popular culture with a focus on those films that use space in a meaningful and intellectual manner in accordance with science fiction's defining nature.

3.2 Science Fiction as a Genre

Suvin defines SF as follows¹:

SF is, then a [literary] genre whose necessary and sufficient conditions are the presence and interaction of estrangement and cognition, and whose main formal device is an imaginative framework alternative to the author's empirical environment.

Suvin further explains that SF is the “literature of cognitive estrangement”. Hereby SF is regarded as a mirror whereby humankind confronts issues otherwise too close for comfort.² The same device is used by the myth. Furthermore, this estrangement must be supported by cognition of the surrounding world and the sense that it can be manipulated. Unlike the myth, with its mechanistic pre-ordained world view, science allows humans to intervene in the historical flow. SF is thus an empowering literature. By extension, the same can be said about other media-forms of SF, like cinematic science fiction (“CSF”).

In accordance with this definition space, due to its mystery and humankind's unfolding knowledge thereof, has over time established itself—for authors—as an ideal alternative framework to the usual human empirical environment, namely, planet earth. It is within space that many authors have created stories exhibiting the characteristics of estrangement and cognition that found its way into popular culture in the form of literature and cinema, amongst others.³

3.3 Historical Background to Science Fiction and Cinematic Science Fiction

SF is closely linked to the history and rise of technology in society. Innovation in technology in itself has led to the media of film that has enabled CSF. It is indeed also cinema that has become one of the critical methods of interrogating certain aspects of life with technology (which is a product of science). In fact, many themes of technology have been coded in CSF since its dawn in 1902 with the Georges Méliès' film entitled *Le Voyage dans la Lune* (A Trip to the Moon) with space as its notable setting.⁴

¹Suvin, D. 1972. On the Poetics of the Science Fiction Genre. College English.

²Ibid.

³It should be noted that for this study space-related films include those films that show very little of space itself or only references space as part of the narrative.

⁴Nagl, M., & Clayton, D. 1983. The Science-Fiction Film in Historical Perspective. *Science Fiction Studies*.

CSF is a younger media version of literary science fiction (“LSF”). Therefore, Freedman regards CSF as trailing LSF in qualitative depth beyond the visual spectacle.⁵ While CSF embodies the same characteristics as that of LSF, it is restricted in its nature due to the emphasis of the visual that is conjured up on behalf of the audience and not by the imagination.

The history of CSF consists of certain distinct periods. Freedman identifies two periods of greatest prominence, namely the 1950s Eisenhower era and the 1980s Reagan era.⁶ He, therefore, connects these periods to political and social intervals. Of further interest is the fact that he discovers a cinematic aberration in between these two periods. It is this aberration that he dubs as the greatest SF film of all time, namely *2001: A Space Odyssey*, a film mostly set in space. This film finds its place in the following historical setting where space has become “an imaginative framework alternative to the author’s empirical environment.”⁷

3.3.1 The Main Periods (Social, Economic and Political Contexts)

The following periods can be discerned:

3.3.1.1 1902–1949

This period marks the start of CSF but popularity with the broader public is not immediate. It starts with the space-based *A Trip to the Moon* in 1902 followed by notable films, like *Metropolis* and *King Kong*.

3.3.1.2 1950–1960 (The Eisenhower Era)

Freedman regards this as the first seminal period in CSF history as the public has started taking a special interest in SF films.⁸ This occurs against the background of the conservative social and political environment of the escalating Cold War conflict where CSF has become escapist commercial entertainment. These films codify and reflect some of the anxiety of this time back to the audience, thus making proper use of the method of estrangement. Notable space films are *The Day the Earth Stood Still*, *Forbidden Planet*, and *War of the Worlds*.

3.3.1.3 1968—The Aberration

Freedman establishes that in the year of 1968 the greatest CSF achievement to date was created in the work titled *2001: A Space Odyssey* (“2001”), directed by Stanley Kubrick and written by Arthur C Clark.⁹ This film is to be regarded as the blueprint for all SF films of the future.

⁵Freedman, C. 1998. Kubrick’s “2001” and the Possibility of a Science-Fiction Cinema. *Science Fiction Studies*.

⁶Ibid.

⁷Ibid 2.

⁸Ibid 6.

⁹Ibid 6.

3.3.1.4 1970–1980s (The Reagan Era)

The second seminal period coincides with the Reagan Era. Films of great prominence are: *Star Wars*, *Close Encounters of the Third Kind*, *Alien*, *Blade Runner*, *ET* and *Terminator*. This period is characterised by the huge popular appeal of SF films, many taking place in or referencing space.

3.3.1.5 1990 to Date

These films built further on the special effects-consciousness created by the previous SF films. New subgenres were also further explored, like the cyberpunk theme in films like *The Matrix*. New technology drives new films with new “green” themes, like *Avatar*. *District 9* made South African-made films, narratives, talents and accents acceptable to international audiences.

3.3.2 The Emblematic Films—A Brief Analysis

According to Freedman, the paragon of the CSF is 2001.¹⁰ This 1968-film brought CSF from B-movie quality into the mainstream. Not only did it change the look and feel of the genre, it brought a cognitive quality that deepened the estrangement experienced and thus intensified the philosophical and intellectual dimension and emotional engagement of the film.

Later films in the second period of prominence built further on the visual dimensions to a degree that made them paragons of the special effects-domain. These included *Star Wars*, *Close Encounters of the Third Kind*, and the later *Terminator*. However, these films did not truly follow in 2001s intellectual footsteps. The plots were simple, as in *Star Wars*, or seemingly designed around the visual domain, like in *Close Encounters of the Third Kind*.

There are two exceptions in this regard. Ridley Scott managed to create two SF films that had as much intellectual gravity as the works’ incredible visual code. In *Alien* and *Blade Runner* one finds narrative-driven works that, in plot, subject matter and theme have no equal.¹¹ In fact, the works surpasses the narrative and dialogue in 2001 which is so low key to the degree that a reading of the screenplay would not assist to make sense of the narrative. The low-key dialogue in 2001 is of course intentional and plays into the theme of the human condition as stale and soulless that needs some great intervention. In contrast, *Alien* and *Blade Runner* are strongly embedded in detailed narrative.¹²

¹⁰Ibid 6.

¹¹*Blade Runner* is one of the many SF films based on the literary works of the prolific SF author, Philip K. Dick. Others are, amongst others, *Total Recall*, *Minority Report*, *Impostor*, and *Paycheck*.

¹²*Blade Runner*’s narrative does not take place in space, but its setting is a future dystopian space-faring earth society with references to space travel.

The visuals in *Alien* and *Blade Runner* are ground breaking and place them on a par with 2001. It could be said that the sequel to *Alien*, namely James Cameron's *Aliens* followed Scott's vision of SF film and earned Sigourney Weaver an Oscar nomination for Best Actress, a first for CSF.

Two later films broke new ground in both content and style, namely the non-space-based *Matrix* (during the 1990s) and the space-oriented *Avatar* (during the 2000s). Both used newly developed special-effects and both used estrangement effectively to question reality, history, and choice. *Avatar* delved into issues of environmentalism and indigenous people's rights on an unprecedented level. Other SF films that prominently use space as a setting to bring a cognitive quality that deepens the estrangement experienced are to this author's mind: *Star Ship Troopers*,¹³ *Apollo 13*, *Contact*,¹⁴ *Red Planet*, *Solaris*,¹⁵ *Prometheus*,¹⁶ *Interstellar*, *Gravity*, and *The Martian*.¹⁷ Five of the referenced films will be analysed within the paradigm of the definition of SF and its use of space while being compared with the benchmark set by 2001, which is also the first film to be discussed. Having regard to the definition of SF and the unique aspects of 2001, the analysis will take place with reference to the following factors: (1) Plot Essence and Space-Setting; (2) Estrangement Theme; (3) Empowerment; and (4) Technological Realism.

3.3.3 The Definitional and Benchmark Analysis

3.3.3.1 2001—A Space Odyssey (1968) (The Benchmark)

Plot Essence and Space-Setting: Most of the film takes place in space in search of the meaning of the alien monolith that is discovered on the moon and another one hovering in space above Jupiter.

Estrangement Theme: The film further explores deep philosophical issues about the origin of humankind and humankind's reaction to contact with intelligent life in the universe—life more advanced to humankind—and to the duplicity and mistakes made by humankind's own creation, namely artificial intelligence in the form of HAL—'life' less than human. The film hereby explores the human condition of trying to comprehend where we come from, why we are here and where we are heading, but in a context removed from earth. Stanley Kubrick, the director, himself stated as follows: "I think one of the areas where 2001 succeeds is in stimulating thoughts about man's destiny and role in the universe in the minds of people who in the normal course of their lives would never have considered such matters".¹⁸

¹³Based on a military science fiction novel by the well-known SF author, Robert A. Heinlein.

¹⁴Authored by the famous cosmologist Carl Sagan.

¹⁵Based on a novel written by Polish author Stanislaw Lem.

¹⁶Ridley Scott's off-shoot of his original ground-breaking *Alien*.

¹⁷Another Ridley Scott film.

¹⁸Gelmis J, "An Interview with Stanley Kubrick (1969)", Stanley Kubrick, <http://www.visual-memory.co.uk/amk/doc/0069.html> (accessed on 01 March 2019).

In a certain sense it is the search for God: why did he create us and what are we supposed to do? The estrangement is magnified by the fact that very little dialogue takes place in the film and that the human environment is depicted in a sterile manner as if humankind had become detached from itself—or has been so since the start—due to its own inability to connect with the truth regarding their meaning and purpose in the universe.

Empowerment: SF is empowering in nature in so far as the human will, ingenuity and technological development allows humans to explore and find answers to our existential questions. In 2001 our technological ability to travel in space assists with our investigation of the alien monoliths and possibly finding answers to our existential questions. In the film many of the questions are left unanswered by way of symbolism (like the monolith and the Star-Child staring down at earth in the end of the film) that leaves the answer open to the viewer.

Technological Realism: This is the first film that managed to create a realistic technological setting using existing technological design of the 1960s extrapolated into the future. All effects were performed using models and real-life cinematography without any computer visual methods. This film's seminal characteristic that allows it to stand apart from any SF film made up to that point is its incredible cinematic reality and approximation of what scientific human space technology would look like in the future.

3.3.3.2 Alien (1979)

Plot Essence and Space-Setting: This viscerally realistic film surpasses 2001 in its raw gritty portrayal of future space-based technology and life in a setting where a cargo ship and its crew is attracted to a distress call on a small celestial body only to discover alien life and confronted with its only purpose: to procreate and kill.

Estrangement Theme: Unlike 2001, it does not create a myth around the extra-terrestrial intelligence the humans are facing, but confronts the viewer directly with its crude, effective and deadly biological reality. In that sense estrangement is used to explore the questions of survival against nature, especially parasitism and disease (given the manner the Alien procreates). It emphasises humankind's helplessness against the unknown origins of disease and their frightful reactions to it despite our better knowledge of the universe and technological prowess.

Empowerment: Technology coupled with human ingenuity allows at least one of the human crew to adapt and survive. Sigourney Weaver as Lieutenant Ripley show cases a brave performance where she—despite her almost debilitating fear and lack of understanding—rises above an almost impossible adversary and changes her own destiny to be continued in the remainder of the sequel films.

Technological Realism: This film creates a technological environment that is gritty and real and a more realistic version of the “used space” technological concept initiated by Star Wars where equipment and spaceships look used within a real-world environment. *Alien* manages to bring to the fore the ‘space trucker’ setting where hardened people live and work in an environment that is metallic,

robotic, and harsh machinery-oriented that surpasses any SF film in realism created up to that point. Like 2001 this realistic world still seems relevant and timeless, despite the modern ability to create any environment with computer-generated imagery (CGI).

3.3.3.3 Solaris (2002)

Plot Essence and Space-Setting: This film takes places in a space station just above a star-like celestial body called Solaris where the protagonist is investigating the strange effects Solaris has on the crew and inevitably himself succumbs to its suggestive or real powers by its ability to interact intellectually with humans and bring their desires to life.

Estrangement Theme: Space far away from earth here serves as the symbolism of the main character's own estrangement since the loss of his wife. Solaris seems to have the power to bring her back although the protagonist is not sure if this is real. Solaris thus creates an environment where the characters confront themselves more than they try to understand Solaris itself and in this sense Solaris is merely a device to create a mirror. The protagonist himself is confronted with an inner conflict between following his desire and the morality of accepting death as final. As a meditative psycho-drama in space the film approximates 2001 in its existential questions regarding the human condition, but on a more personal level with questions posed on the meaning of loss, love, death and ultimately reality.

Empowerment: In a sense the film is empowering as technology is used to kill off the various manifestations of people created by Solaris based on the fact that they might be dangerous to humankind. However, the film ends in such a manner that implies that the overpowering intellectual ability of Solaris was still in control. This aspect is a close approximation of 2001's own ending with the humans not in control and placed in a benign environment so chosen by extra-terrestrial intelligence.

Technological Realism: This film makes use of a realistic setting by making ample use of the power of CGI. It continues in the 2001-tradition of creating a realistic universe.

3.3.3.4 Prometheus (2012)

Plot Essence and Space-Setting: This film is an off-shoot prequel to *Alien* and also created by Ridley Scott. It mostly takes place in space and on a celestial body in the search for extra-terrestrial intelligence after having found an ancient star map on a cave wall in Scotland. An exploratory party is sent to the star system where they land on a celestial body as indicated by the star map.

Estrangement Theme: The philosophical and existential questions posed in 2001 is once again strongly explored in this film: who made us, why are we here, can we live forever, is there life after death, does God exist? In that sense this film's theme goes much deeper than that of the original *Alien* that focuses on survival in a very

hostile setting. However, *Promotheus* ultimately places its human crew also in a very hostile setting leaving open the questions so posed as they face off against parasitism/disease and a malignant super extra-terrestrial presence (the creator of the parasites and possibly humans themselves). The estrangement theme of 2001 is comprehensively revisited in this film, but within a more dystopian survivalist setting.

Empowerment: Once again technology empowers the protagonist to escape death and to continue the search for answers to the existential questions. While human technology brings the crew to the celestial body, it is alien technology that allows the protagonist to escape.

Technological Realism: Ridley Scott continues his technological realism founded in *Alien* but makes ample use of CGI. He creates a visceral super-modern technological environment that seems a plausible extrapolation from current technological developments.

3.3.3.5 **Interstellar (2014)**

Plot Essence and Space-Setting: The film takes place both on earth and in space. Humankind has lost control over nature and will not survive on earth. Therefore, a project to search for other habitable planets is created right at the same time a ‘wormhole’ opens in our solar system. A crew is sent through the wormhole with the understanding that they will return to a much older earth while they would have experienced little change in time.

Estrangement Theme: Human relations on earth, especially between father and daughter, is explored as well as the human relation with the universe itself. Environmental issues are also brought into play by virtue of the implication that humans have made the earth uninhabitable. Within the paradigm of our current understanding of the laws of nature and the universe, relationships are explored within the context of the relativity of time and choice within the context of quantum physics.

Empowerment: Science empowers humankind to better understand the universe and technology to change human destiny by searching out a new celestial home. However, there is an emotional disempowerment at play here as the protagonist underestimates the emotional effect the search for a new home would have on him as a father to his daughter, something that science and technology cannot compensate for.

Technological Realism: In making this film the current understanding of science and technology was intensely interrogated and used in creating an approximation of reality.

3.4 Conclusion

Since the advent of 2001 CSF has truly advanced into main stream popular culture to the degree that it is SF films that achieve the highest profits at the box office. It has most certainly reignited deep thought regarding the existential questions of humankind and keeps on probing those philosophical dimensions. Not all SF films stand up to the benchmark set by 2001, but there is a consistent stream of SF films that stay true to the definition of SF and push the boundaries set by 2001. The SF films analysed above is emblematic of the effect 2001 has had on the development of SF and in some respects have surpassed some of its qualities. For instance, *Alien* surpassed the technological environment created by 2001 and created a super-realistic dystopian setting that can be found in any industrial complex today; *Solaris* continued with the pensive attitude about the meaning of life posed in 2001 in a more emotionally engaging manner; *Prometheus* aggressively reframed the ‘meaning of life’ question within an action-filled dystopian survivalist setting in step with *Alien* as an off-shoot narrative from the Alien-film itself, thereby breaking from the slow pensive philosophy of 2001; and lastly *Interstellar* bravely took on the current understanding of the complex scientific paradigms of relativity and quantum mechanics to pensively interrogate human relationships between themselves and its own relationship with earth and the universe in a contemporary fashion, thereby overshadowing the science used and the lack of human emotion in 2001.

In their own way some of the later SF films reached beyond certain elements found in 2001, but in its overall nature and myth, no film has been able to comprehensively overshadow 2001. This seminal film has brought the reality of space into sharp focus and has pulled the SF genre into the mainstream of popular culture with the concomitant growing understanding of the importance of space in real life.

2001 has made space real and meaningful.

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The Role of Space in Aesthetic and Practical Design of Automobiles: A Look at Five Examples

4

James Wilson

Abstract

This chapter contains an examination of the space influence on car design. Before actual spaceflight, car-designers added aeronautical influences after the travesty of WWII, creating a sense of fun and wonder in the everyday machine, largely different to the seriousness of the automobile before the war. Following early Soviet and American rocket achievements, the additions of wings, fins and space age details only increased in number, eventually reaching a peak in the mid 60s. This eventually fell out of favour with a change in fashion, however certain cars such as the Lamborghini Countach grew even more similar to the rocket industry, due to the performance benefits that aerospace technology gives cars. Perhaps nothing relates cars more to space than Elon Musk's Tesla in orbit, or the Bloodhound SSC which is actually powered by a rocket.

4.1 Introduction

The automobile is only a few decades older than the space-faring rocket, and in the context of human history, both can be considered modern technology.

However, pre-WWII, cars had a certain air of classic design, resembling homes or horse-drawn carriages rather than the relatively modern wonder of the car at the time. Futuristic designs did appear but even these were based on the early age of aeronautics, which can be considered a precursor to the space age.

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As such, it is quite interesting to examine the way aerospace technology began to factor into the design of cars, something the average person could own, while a plane or rocket would be both figuratively and literally out-of-reach of personal ownership. Post-WWII, people were looking at space following the gigantic progression of technology due to the developments of the wartime efforts, especially in the US, which was experiencing a burst of wealth into the late forties and fifties.¹

This era could also be thought of as the birth of consumerism. Suddenly families had more disposable income and households could own many mechanical appliances and other luxuries not previously available. This also led to even the middle-class consumer wanting some sense of style in their possessions, where previously a car may have been considered as just a tool to those earning moderate incomes.

These two factors allowed car designers to capitalise on this and create some truly space-age looking and working vehicles. Even though the direct focus on this “space craze” may have weaned into later decades, society still wants products that look and perform like rockets. Also, actual space-age technology has appeared more and more in many automobiles even up to the present.

Five key examples of space-based design were identified and highlight the clear influence of rockets on cars.

4.2 Use of Aerospace in Car Design—A Closer Look at 5 Icons

4.2.1 Cadillac Series 62 (1948 Onwards)

See Fig. 4.1.

The third generation Cadillac series 62 was the first car to have tailfins resembling plane stabilisers. Designed by Frank Hershey but authorised by Harley Earl (head designer at General Motors), these became iconic and a staple of American car design for the next decade-and-a-half.

Interestingly however, these fins were not based on rockets as not many had been developed as yet. Rather, they were based on the twin-tailed Lockheed P-38 Lightning WWII fighter plane.² This can be seen clearly in the comparison in Fig. 4.2 of the P-38 to a 1948 Series 62.

Furthermore, as the US and Soviet Russia actually developed rockets of their own into the fifties, the tailfins became larger, pointier and more aerodynamic looking in general. This can be seen in the photo (Fig. 4.3) of a 1959 Cadillac Series 62, which compared to the 1948 model, looks far more “space-age”.

¹Mercatus Center. 2018. Economic Recovery: Lessons from the Post-World War II Period. [ONLINE] Available at: <https://www.mercatus.org/publication/economic-recovery-lessons-post-world-war-ii-period>. [Accessed 07 March 2018].

²Design History of General Motors. Worldcarfans.com. 2006-05-11.



Fig. 4.1 1948 Cadillac Series 62. (Photo taken by Flickr user sv1ambo and licensed under Creative Commons Attribution V2.)



Fig. 4.2 Cadillac Series 52 tailfins versus Lockheed P-38 Lightning. (Photo of Cadillac again taken by sv1ambo and licensed by Creative Commons Attribution V3 and Lockheed taken by the US Air Force and is in the public domain.)

Other manufacturers copied this design, with Chevrolet, Ford and even European manufacturers such as Mercedes-Benz (shown in Fig. 4.4) all having tailfins of varying size and poignancy added to their cars.

These tailfins, even though offering a very small amount of if any aerodynamic benefit, became extremely successful with the consumer. For the first time, cars were perceived as fun, rather than being higher-class and serious machines. This, as well as the unsubtle fact that they directly suggested that the cars may travel at a speed like rockets, fascinated the youthful target audience of the cars.



Fig. 4.3 1959 Cadillac Series 62 tailfins. (Photo taken by Wikipedia user Liftarn and licensed under the GNU Free Documentation License.)



Fig. 4.4 Mercedes-Benz W112 300SE with its subtle tailfins. (Photo provided by Wikipedia user Nordhorst and released into the public domain.)

It should also be noted that eventually the cars' aerials resembled early satellites' antennae, also adding a sense of wonder and exploration into the designs.

4.2.2 Oldsmobile 88

See Fig. 4.5.

In 1949, the Oldsmobile 88 was released. This first generation did not have the large tailfins of the Cadillac but was influential in two other ways.



Fig. 4.5 1949 Oldsmobile 88. (Photo taken by Wikipedia user Regushee and edited by Tony Patt. Shared under the Creative Commons Attribution V3 license.)

Firstly, its engine was called “The Rocket”, as it was large and powerful. This V8 engine prompted the start of another piece of Americana, the muscle car, leading to the design of the classic Ford Mustang and others.³ Interestingly, this engine was initially going to be called “The Kettering V8” after the chief engineer, but company policy prevented this, so it was named “The Rocket” instead, and became extremely iconic with that name. The 303 version of this engine can be seen in Fig. 4.6.

Furthermore, the Oldsmobile 88 used a rocket symbol a rocket on its rear badge. This rocket design was based on the Nazi V2 (clearly shown in Fig. 4.7) as no other large-scale space capable rockets existed at the time. Since the US captured this German technology and began to reverse-engineer it for practical space applications, it was necessary for the public to dissociate the rocket from the terror of warfare, and instead relate it to the possibilities of space travel. As one of the first consumer products to show a rocket, the Oldsmobile 88 was paramount in achieving this.

Also, the Oldsmobile 88 eventually had subversions such as the Golden Rocket and Starfire directly named after space technologies and travel. Following this a whole slew of other manufacturers also used this naming method such as the Ford Thunderbird and Galaxy and Chevrolet Nova, however the Oldsmobile with its Rocket engine was definitively the first.

³Pomona Swap Meet. 2014. Was The 1949 Oldsmobile Rocket 88 America’s First Muscle Car? [ONLINE] Available at: <http://www.pomonaswapmeet.com/blog/2014/04/11/was-the-1949-oldsmobile-88-americas-first-muscle-car/>. [Accessed 07 March 2018].

Fig. 4.6 The Rocket V8 303 Engine. (Photo taken by Wikipedia user Zandom and released into public domain.)

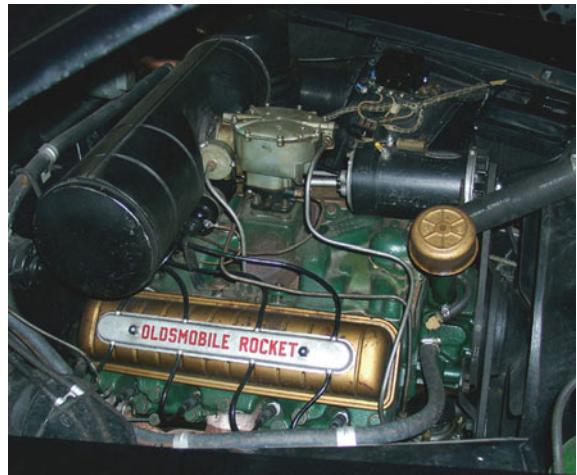


Fig. 4.7 1950 Oldsmobile 88 badge resembling V2. 88 badge resembling V2. (Photo taken by Wikipedia user Alvanbeem and licensed under Creative Commons V1.)



Soon after its release, the Oldsmobile 88 was advertised with the slogan “Make a Date with the Rocket 88”. Figure 4.8 shows an example of this with a hand painted concept of what a rocket was thought of as in the early fifties.

Astonishingly, the Oldsmobile 88 spawned another whole area of popular culture. Understood by many as the first rock ‘n roll record,⁴ the song Rocket 88 was released in 1951 featuring the first use of the distortion sound of rock and portraying the free and fun era of the start of the space age.

⁴Joe Blevins. 2016. “Rocket 88,” the first rock song ever, turns 65 today. [ONLINE] Available at: <https://news.avclub.com/rocket-88-the-first-rock-song-ever-turns-65-today-1798244943>. [Accessed 07 March 2018].



Fig. 4.8 Oldsmobile 88 advert circa 1951. (Available at <http://www.vintag.es/2012/10/1950-oldsmobile-rocket-88-adverts.html> along with further examples.)

4.2.3 Lamborghini Countach

See Fig. 4.9.

The Lamborghini Countach, released in 1974, is a very interesting example of a space age designed automobile. At the time when the US was fully embracing this rocket culture, the Europeans were still basing their designs around classic curves and a sort of grown-up personality. Their sports cars were on-the-whole still much better performing than the average American sports cars, but they did not have the extreme design features. They did however benefit more from practical innovations of the aerospace industry, while the Cadillac Series 62 and Oldsmobile 88 had little technological advancement from the previous era of cars.



Fig. 4.9 Lamborghini Countach LP400. (Photo provided by countachinfo.de and licensed by the Creative Commons Attribution V3 license.)

This changed with the release of the Lamborghini Countach, which had both the styling of a rocket and technology to match. The European Space Agency was formed just the year before, and finally Europe had far less-serious looking cars. The designers at Lamborghini did not directly say the car was based on a rocket, but the design influence is clear. Stated as many to be the first true supercar because of its performance and styling, the Countach was the first wedge-shaped road rocket, which many other car designers have followed since.

In terms of its practical design, it was also directly related to the aerospace advancements of the time. Possibly the most iconic features of the car are its large and menacing NACA ducts⁵ (seen in Fig. 4.10). Designed by NACA (the precursor to NASA) these allow large amounts of air to travel straight into the mid-mounted V12 engine, providing a massive power output for the time, while also adding to the style of the car. It was the first notable car to feature them.

Another key feature of the car is its aircraft-grade aluminium body,⁶ making it both extremely light and strong, benefitting all areas of its performance. This does not add any styling but does not take any away, making it a worthwhile design feature considering the performance gains.

⁵Ten of the Greatest Uses of NACA Ducts in Automotive History—Winding Road. 2013. Ten of the Greatest Uses of NACA Ducts in Automotive History—Winding Road. [ONLINE] Available at: <https://www.windingroad.com/articles/news/ten-of-the-greatest-uses-of-naca-ducts-in-automotive-history/>. [Accessed 09 March 2018].

⁶Mark Wan. Lamborghini Countach. [Autozine.org](#).



Fig. 4.10 Countach NACA ducts. (Photo taken by Wikipedia user Mr choppers and falls under the Creative Commons Attribution V3 license.)

4.2.4 Tesla/Tesla Roadster

See Fig. 4.11.

In 2008 the Tesla Roadster was released. It marked the start of the modern electric car era, both with useful range and high performance. It was the first to use full lithium batteries as well as an inverter for an AC motor. Every other major



Fig. 4.11 2008 T Roadster. (Photo taken by Alexandre Prévot and licensed by Creative Commons V2.)

brand is now fully developing electric cars, both in the luxury and normal segment, which are completely different to the “eco” or small city electric cars that came before the Tesla. This may not seem to have any direct link to space, but the parallels are massive.

Also, in 2008, the SpaceX Falcon 1 became the first liquid-fuelled rocket to reach orbit from a private company. Elon Musk’s new companies virtually started the era of private and relatively affordable space access and the era of mainstream electric cars.

However, there is also a lot of shared infrastructure and development between the companies and their products, due to having the same founder. Both have the same production process of fast evolutionary development. Both employ highly modern technology.

In terms of SpaceX technology directly present in Tesla, they both share similar lightweight composite materials. Furthermore, they use similar software for control and data management. Also, the Tesla interior relies more on computerised displays than traditional dials.⁷

The Tesla Roadster does not necessarily look space age apart from its smooth surface due to lack of the vents needed for a traditional engine. It looks very similar to the Lotus Elise it was originally based on. However, the vision of it will be cemented in pop culture forever.

This is due to the launch of the Falcon Heavy, and its specific payload being Elon Musk’s personal Tesla. Perhaps one of the most iconic images to come out of 2018 will be the Roadster floating in space against a backdrop of earth, shown in Fig. 4.12. This has helped lead to a renewed fascination⁸ with space, while also very successfully marketing Tesla.

4.2.5 Bloodhound SSC

See Fig. 4.13.

This automobile does not really relate to the others, as it was never designed as passenger transport or to change consumer direction. However, it is the car that relates the most to space than anything that came before, as it is a practical horizontal rocket.

It was not designed with any aesthetics in mind apart from its bright blue and orange paintjob. However, due to its predicted ability to reach 1600 km/h⁹ it was designed to be, and hence, look like a rocket.

⁷Matt Pressman. 2017. Here’s how Tesla uses rocket science to beat its rivals. [ONLINE] Available at: <https://evannex.com/blogs/news/heres-how-tesla-uses-rocket-science-to-beat-rivals>. [Accessed 09 March 2018].

⁸The Guardian. 2018. The Observer view on the future of space travel. [ONLINE] Available at: <https://www.theguardian.com/commentisfree/2018/feb/11/observer-view-on-future-space-travel-elon-musk-tesla>. [Accessed 09 March 2018].

⁹Bloodhound SSC. 2018. The Car, Bloodhound SSC. [ONLINE] Available at: <http://www.bloodhoundssc.com/project/car>. [Accessed 09 March 2018].



Fig. 4.12 Elon Musk's personal Tesla in orbit. (Photo donated to public domain by SpaceX.)



Fig. 4.13 Bloodhound Supersonic Car in 2015. (Photo taken by Katie Chan and Licensed by Creative Commons V4.)

2019 will mark the date of its land speed record attempt in the Northern Cape of South Africa, and while a consumer will never be able to drive it, the average person will be enthralled by its speed and it will help to further excite people about not only space but science in general.

The Bloodhound has both a Eurofighter's jet engine and a custom-made hybrid rocket. It was designed using fluid mechanics simulation just like modern orbital vehicles, and also using two stages just like a rocket.¹⁰

It may not be a road-going car but if it is successful in its attempt it will capture the imagination of many and be remembered at least until the land speed record is broken again.

4.3 Conclusion

The relationship between the car, the most accessible form of motorised transport, and the rocket, the most inaccessible but also the most exciting has been very interesting over the decades since space first captured the interest of the average person. It has shaped design, sales and public interest of what is essentially basic human transport ever since the end of WWII. It will only grow as time goes on and maybe cars are developed into personal flying and possibly even personal space travelling objects.

James Wilson graduated from Electrical Engineering at the University of the Witwatersrand in 2017. He has a large interest in Space technology and hence pursued a Master of Philosophy in Space Science at the University of Cape Town in 2018. He has a sizeable knowledge of and interest in cars and is a guitar player in an alternative rock band. He aims to work with rocketry as he completes his Master's dissertation designing a control system for a liquid rocket test stand.

¹⁰Johnathan Amos. 2017. Bloodhound supersonic car fires up Eurofighter engine—BBC News. [ONLINE] Available at: <http://www.bbc.com/news/science-environment-41446557>. [Accessed 09 March 2018].



Space Robots

5

Karmini Konar

Abstract

Robots form an integral part of everyday life. When surveying the average home one may find numerous devices that are remote controlled or include integrated chips that contain forms of artificial intelligence. This shows the importance of robotics however this document does not cover the commercial robotics used on earth but rather explores a variety of fictional robots used in popular culture and compares their real-life counterparts in space. Each robot is discussed in isolation however many of the robots bare resemblance and therefore intertwine features and comparisons e.g. Robonaut who bares resemblance to humanoids in general and therefore is contained in an independent section rather than falling under “Accuracy” as with other space robots. There is also a brief section on some of the benefits delivered to humans from robotic technologies used on the International Space Station, merely to corroborate the importance of robotics and the reason for opting for this topic.

5.1 Introduction

As research and knowledge of the universe continues to grow at a fast and constant pace, and technology is quickly adapting to meet the demands of further space exploration, it cannot be denied that some things were better achieved in a world of science-fiction than in reality. Unlike humans, space robots do not need food or

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water, can sustain inconsistent conditions and are relatively cheaper to maintain and repair. Luckily robots in space is a reality however, have they lived up to their science-fiction counterparts? Here we shall look into the capabilities of a few popular however fictional robots and compare those capabilities to a number of real-life space robots and robotic technologies.

5.1.1 What is a Space Robot?

A robot is essentially a machine that can be automated to perform certain tasks or actions. A space robot is any such robot that performs said actions in space. Minimum requirements for a good operational space robot include¹:

- remain intact and fully operational after launch
- operates under difficult environmental conditions (stress tested before launch)
- weigh as little as possible as any mass is expensive to launch
- use little power and have a long operational life
- operate autonomously
- be extremely reliable.

5.1.2 Droids and Star Wars

The term “droid”, inherent of android, was trademarked by George Lucas, the creator of Star Wars, a series of seven films thus far. To explain the magnitude and impact this series of films has had on society one could look at the associated figures:- reportedly \$8.5 billion (US dollars) in box-office revenue and a total estimated value of \$65 billion which includes profits from cinema ticket sales, gaming franchise and DVD sales.² The original trilogy led to the outbreak of Star Wars related books, television series, computer, mobile and video games, comic books and various attractions in Disney theme parks. In December 2015 cinema theatres were fully-booked for days, even right here in South Africa, as fans lined up to watch the latest release in related costumes and merchandise.

One may question the popularity and almost cult-like following movies like Star Wars have spawned. My response would be that the concept of species living and travelling between planets, operating space vehicles with acceleration speeds and agility similar to playing a computer game or simulation, and droids that could communicate with us, understand emotions and basically be our friends whilst also

¹Brian Wilcox, Robert Ambrose, Vijay Kumar. (2008) “Chapter 3: Space Robotics”: <http://www.wtec.org/robotics/report/03-Space.pdf>, Imperial College Press.

²“Star Wars—Box Office History”. The Numbers. (2019). <https://www.the-numbers.com/movies/franchise/Star-Wars>, Nash Information Services, LLC.

performing their intended duties, drew me in immediately. It allowed me to live in a make-believe galaxy.

Almost forty years following the original movie release, many of the concepts are becoming a reality. Humans continue to explore the universe and look into survival capabilities on other planets. Automation and artificial intelligence in robotics has increased from basic human-like movements to learning and building knowledge databases within robots, essentially building a “brain” of some sorts. The droids seen in Star Wars including R2-D2, C3P0, StarTroopers and BB-8, still have far more independence and intelligence than most space robots that exist today. Most robots have limited artificial intelligence and require direct commands to work or specific programming calls or conditions to trigger.

While many independent researchers and companies try to develop artificial intelligence that can handle more complex problem solving and adapt to different conditions autonomously, the world is still a long way from having a robot with the same level of intelligence and independence as R2-D2.

5.2 R2-D2-Star Wars (1977–2015)

5.2.1 Overview

R2-D2 (Second Generation Robotic Droid Series-2) is an astromech droid, responsible for maintenance and repairs on starships and appearing in all seven of the Star Wars films from 1977 to 2016.³ He was in-fact the first character to appear in the 1977 movie along with two fellow droids. Whilst watching the evolution of R2-D2 through the years it is surprising that minimal new features were introduced to the character. This possibly illustrates the complexity of humans i.e. creating a real machine with human-like traits is still behind the sci-fi adaptation of robots.⁴

As a child of the 1980s, a time when the original trilogy was repeatedly broadcast, R2-D2 was one of my favourite characters due to his bravery, resourcefulness, loyalty, diminutive appearance and playful attitude. He was equipped with hidden compartments for useful storage of lightsabers, the right tool appendages to disable traps on the Death Star or to re-assemble C3PO, and holographic projections of important messages at opportune times.

as seen in popular culture

R2-D2 merchandise has been in surplus and high-demand following the release of the original movie in 1977. As far back as I can remember there was always an R2-D2 toy in the toyshop, character on an arcade game, or featured on t-shirts or travel bags.

³“R2-D2”—AI Artificial Intelligence! <https://artifintell.weebly.com/r2-d2.html>.

⁴Star Wars. 1977–2019 [Film Series], George Lucas. USA: LucasFilm.

5.2.2 Technical Abilities

The following are some of the mechanics and appendages R2-D2 is equipped with⁵:

- 2 x Booster Rockets to propel him into space/air and travel short distances—added in the 2nd trilogy
- Buzz saw
- Data probe
- Electric shock prod
- Fusion Welder
- Hologram Projector and recorder
- Motorised, all-terrain treads
- Navigational abilities
- Power recharge coupler under each leg.

Original blueprint of R2-D2⁶: <https://twitter.com/TheRobotMaster/status/409777933243252736/photo/1>.

5.2.3 Accuracy

It is difficult to find a space robot that incorporates the numerous features and skills that R2-D2 has, however many specialise in specific features and can be compared to the astromech droid. The rover including lunar and mars rovers to name just two, display advanced navigational skills. The lunar rover was used to transport astronauts and other equipment after Apollo missions 15, 16 and 17 landed on the moon.⁷ Although R2-D2 is not used for loading and transporting, he does have advanced navigational skills which are also true for the rovers as they manoeuvre through the landscape and are able to re-orientate themselves. Unfortunately rovers such as the first mars rover, Spirit, that got stuck and is now un-operational still have a lot to learn from R2-D2.⁸

R2-D2 is also equipped with many mechanical tools used to repair space crafts. This can be compared to the Mobile Servicing System (MSS).

The MSS is a robotic system on the International Space Station. It is made up of three parts: - the Space Station Remote Manipulator System, also known as Canadarm2 which is a robotic arm, the Mobile Remote Servicer Base System which is a base platform for the robotic arms and allows both arms to travel along the ISS

⁵“R2-D2”—StarWars.com. <https://www.starwars.com/databank/r2-d2> (2016), ™ & Lucasfilm Ltd.

⁶Tony Dyson via Twitter [online]. Available at <https://twitter.com/TheRobotMaster/status/409777933243252736/photo/1>. (Accessed February 2016).

⁷“Lunar Rovers”| Encyclopedia.com. (2002). <https://www.encyclopedia.com/science/news-wires-white-papers-and-books/lunar-rovers>. The Gale Group Inc.

⁸“Mars Exploration Rover—Spirit”. [online] <https://www.jpl.nasa.gov/missions/mars-exploration-rover-spirit-mer-spirit/>. Jet Propulsion Laboratory, California Institute of Technology.

whilst loaded, and the Special Purpose Dexterous Manipulator, also known as Dextre or Canada hand, a smaller two-arm robot which can attach to the Canadarm 2. The MSS has the ability to capture, dock, undock and re-launch spacecrafts. It also assists with internal and external maintenance of the ISS.⁹

Similar to R2-D2 the MSS has the extendible arm of the Canardarm 2 which can reach lengthier distances. In many scenes R2-D2 extends his tool-tipped appendages to reach tricky areas. He also has variations to his robotic arms, sometimes welding and sometimes repairing, similar to the Dextre and all-terrain threads comparable to the base system on the MSS. The maintenance aspect is therefore common in both machines.

R2-D2 also displays advanced A.I. and unique communication skills. These aspects are similar and further discussed in subsequent robots.

5.3 BB-8—Star Wars (2015)

5.3.1 Overview

BB-8 is a revised astromech android, appearing only in the latest Star Wars film. What makes him interesting is that whilst R2-D2 was a mixture of computer-generated imagery and remote controlled models, BB-8 is an actual robot.¹⁰

as seen in popular culture

Following the release of The Force Awakens, many companies have released BB-8 merchandise including smart technology accessories and toys, more notably an app-enabled toy. The toy, created by Sphero, is Android, iOS and Windows compatible and features autonomous patrolling, mapping of the area travelled and learning/adapting during patrolling, remote control via the app and holographic messaging capabilities.

<http://www.sphero.com/>¹¹

BB-8 also has an active twitter account which includes images of his visit to NASA and the 2016 Oscar Awards:

<https://twitter.com/BB8>¹²

⁹“Mobile Servicing System Overview”, NASA [online]. Available at https://www.nasa.gov/mission_pages/station/structure/elements/mobile-servicing-system.html. (Accessed February 2016).

¹⁰Star Wars. 1977—2019 [Film Series]. George Lucas. USA: LucasFilm.

¹¹“BB-8™”, Sphero [online]. Available at <https://www.sphero.com/>. (Accessed February 2016).

¹²BB8 via Twitter [online]. Available at <https://twitter.com/BB8>. (Accessed February 2016).

5.3.2 Technical Abilities

BB-8 offers similar abilities to R2D2 having tool-tip appendages and hologram projector, however he lacks all terrain threads and we have yet to see if this droid includes rocket boosters. Having signed on for two additional Star Wars films it will be interesting to see additional features implemented.¹³

5.3.3 Accuracy

BB-8, the newer version to the original astromech android, is smaller, lighter and faster than R2D2, all characteristics viewed today as optimal due to reduced expenditure. However according to Nasa's roboticist, Brett Kennedy BB-8 is the least favourable design for space ventures due to its spherical design making it difficult to travel over varied terrains. In addition the design appears to lack traction due to its wheel-like body and rolling motion.¹⁴

5.4 Rosie—The Jetsons (1962–1990)

The Jetsons is an American animation series originally set in 1962–1963 however re-adapted into a futuristic space-age version in the 1980s.¹⁵ Similar to humans in Star Wars, the Jetsons live on a fictional planet amongst aliens, embellished technology and inventions, and their household robot, Rosie. Rosie was responsible for all household chores and care-giving. Most of her chores were completed by the push of a button, something which is still uncommon. She was a combination of a humanoid and an astromech robot.

Unlike the other featured robots and droids Rosie did not become a household name. I do not recall any toys being built and renamed after her or merchandise capitalising on her unique characteristics. What does interest me about Rosie is that she was originally conceptualised in 1962, a time when our ventures into space had merely began.

In terms of technology and innovation Rosie was not an advanced robot however she displayed human characteristics and emotions, displaying the importance of Artificial Intelligence (A.I.) in robotics. Ideal A.I. characteristics in robots would be the ability to learn, to reason and to formulate new and original ideas. The basic learning aspect can be seen in many of our current technologies e.g. games which adapt and learn to play against your strategy or smartphones which adapt to various

¹³Star Wars, 1977–2016. [DVD] George Lucas. Hollywood: LucasFilm.

¹⁴Janey Tracey. (2015). "NASA Roboticist Says BB-8 Isn't Designed as Well as R2-D2 or C-3PO". Science NASA.

¹⁵The Jetsons via Wikipedia [online]. Available at https://en.wikipedia.org/wiki/The_Jetsons#cite_ref-ReferenceA_2-0. (Accessed February 2016).

dialects. In terms of the remaining two traits I am certain there is a far and interesting road ahead.

In addition to the A.I. portrayed by Rosie, she makes my list because as a child we all wanted a Rosie to complete our chores.

5.5 C3PO—Star Wars (1977–2015)

5.5.1 Overview

C3PO is a humanoid robot character or a protocol droid originally created by Anakin Skywalker/ Darth Vader (in later years) as a human slave.¹⁶ His primary feature is as a translator as he is fluent in over seven million forms of communication which was useful as Star Wars featured species of various planets. In the latest edition of the Star Wars series, The Force Awakens, C3PO is shown to have had his database updated to include several additional forms of communication, a technique often used in updating software or operating systems of our devices.¹⁷

as seen in popular culture

C3PO can be seen on various merchandise, toys and accessories as with R2-D2 and BB8. He has also features on many tv shows and arcade games.

The meccanoid is a build-able robot which featured in many top-10 toy lists in 2015.

<http://www.meccano.com/meccanoid-about>.¹⁸ Humanoid robots as toys has been in the market for quite some time and is a favourite amongst children.

5.5.2 Accuracy

C3PO can be compared to real-life Robonaut, further discussed below, or to Kirobo, the first Japanese robot astronaut that was launched in August 2013 and resided aboard the International Space Station for 18 months. Kirobo communicated with astronauts on the ISS which differs from many other humanoid robots.¹⁹

From a design perspective it is also interesting to note that C3PO has a gold coating. Gold is known to be a good reflector and used commonly on astronaut's visors and various other components. His movements exceeds that seen of Robonaut and other humanoid robots developed as C3PO was at times played by an actor

¹⁶Star Wars. 1977–2019 [Film Series]. George Lucas. USA: LucasFilm.

¹⁷Star Wars Character Encyclopedia: Updated and Expanded (First ed.). DK Publishing. 2016. p. 36.

¹⁸“About Meccanoid”, Elector by Meccano Engineering and Robotics. <http://www.meccano.com/meccanoid-about>. Spin Master Ltd.

¹⁹KIBO ROBOT Project. 2016 [Online] Available at: <http://kibo-robo.jp/en/>.

in costume, and therefore displayed the use of additional joints and advanced spinal movement. We often see the wires and components that make up C3PO as he is being built piece-by-piece in the 2nd trilogy. This bears high resemblance to the resistors, decoders, diodes and various other components we see in engineering or in devices we have in our homes such as the television or circuit board within hard drives.

5.6 TARS—Interstellar (2014)

5.6.1 Overview

Tars is a robot and crew member missioned to travel into space in the movie Interstellar,²⁰ along with fellow robot Case and human crew members. He is largely used for navigation and has been programmed to exhibit human characteristics such as wit and compassion.

The design of Tars is one that is uncommon in robotics. Its movement shows less agility as compared to C3PO, over 30 years Tar's senior, however is much quicker paced. The simple design also makes you wonder if 3D printing spares would be easier for Tars as compared to more complex humanoid designs.

Comparisons to modern technologies which are commercially available would include navigation systems such as GPS. Mobility and interaction of Tars with others has been compared to Honda's Asimo robot, however Asimo lacks the A.I. built into Tars' conversational skills.²¹ Although advanced in A.I. there are scenes in which Tars explicitly mentions that he is required to obey instructions from humans and even risks his life-span in order to save a crew member. Unlike other fictional characters he does not seem to have a sleep mode and works throughout the day, which is a real-life requirement of robots i.e. full-time monitoring and control.

5.7 Comparison of Humanoids to Space Robot, Robonaut 2 (R2)

The concept of humanoid robots can be traced back to 1495, or earlier, when an automated humanoid design created by Leonardo da Vinci was rediscovered in the 1950's. The robot, when reconstructed from original designs, could stand, sit and

²⁰Interstellar, 2014. [Movie] Christopher Nolan. Dir. USA: Legendary Pictures.

²¹ASIMO by Honda, “The World’s Most Advanced Humanoid Robot”. 2016. ASIMO by Honda, The World’s Most Advanced Humanoid Robot. [Online] Available at: <http://asimo.honda.com> (Accessed February 2016).

displayed arm, jaw and visor motions, all controlled by pulleys and cables.²² This affirms that remote controlling human-like objects is a historic concept.

Humanoid robots are merely robots resembling the human body form in order to simulate human-like motions and experiments. The original purpose of building such robots was to better orthosis and prosthesis for human beings.

Robonaut 2, designed and built at NASA's Lyndon B. Johnson Space Center in 2010, is the first US built humanoid robot in space. It was launched in February 2011 and now resides in the International Space Station.²³ R2 is made up of various technologies and integrated systems including:-

- image recognition
- vision
- integrated sensors
- tendon hands
- control algorithms etc.

It was built to assist and work alongside humans in space e.g. simply adding an extra pair of hands to hold onto something whilst working on that item or to pipeline tasks that need to be resolved quickly due to the emergence of risks such as space debris. Improvements to the existing model could soon see R2 executing mundane tasks such as changing air filters on the ISS. A further advantage, should the amendments allow R2 to carry out tasks with the same dexterity and precision as a human would, may be to perform tasks of higher risk. This can be compared to the risky tasks that Tars performed in Interstellar.

R2 is installed with software that allows it to perform actions based on input via various algorithms and pre-programmed procedures, thus allowing R2 an improved reasoning mechanism. This also makes R2 viable for software upgrades and routine maintenance which is far less costly than creating a new Robonaut should the additional features be of a software nature. As previously raised, this is an additional feature which bears resemblance to C3PO's software upgrade in the latest release.

5.8 Benefits of Robotic Research

The benefits of improving and adapting robotic research and technology would exponentially assist humanity. In addition to space robotics aiding space missions, research and experiments on the ISS and space related institutions have led to significant advancements in technology here on Earth. The following are a few examples reported in the 2015 edition of an ISS report²⁴:

²²Rosheim; Mark Elling. "Leonardo's Lost Robots". (2006). Springer. p 69.

²³Julia Badger. (2016) "Robonaut R2" [Online] Available at: <https://robonaut.jsc.nasa.gov/R2/>. (Accessed February 2016).

²⁴International Space Station—"Benefits for Humanity 2nd Edition". (2015). [PDF] Developed collaboratively by the members of the International Space Station Program Science Forum.

Robot technology was introduced into surgical procedures using neuroArm, the first robot to perform hard-to-reach and complex procedures in MRI machines. NeuroArm was built using principles used in CanadaArm, CanadaArm2 and Dextre.

Astronauts may take days or weeks to regain normal functionality after a space flight. Research and devices used to monitor senses have been adapted to be used in laser surgeries to track the eye.

Thermal regulation research on ISS has also led to the use of sensor technology for monitoring during surgery. A lightweight, easy-to-use device to measure nitric oxide in air exhaled by astronauts on ISS is used to study possible airway inflammation before health problems are encountered. This device is now used at some health centres to monitor levels of asthma control leading to more accurate medication dosing, reduced attacks, and improved quality of life.

There are countless other examples of how research and experiments on the ISS are being used in everyday practices on earth within robotics as well as various other fields.

5.9 Conclusion

Space robots certainly have huge importance in the future of exploration. Solutions and methods of handling space debris, automated response to earth observations, missions to Mars are just some of the areas in which robotics would be beneficial. Space robots have already vastly surpassed humans in the exploration of space. Space robotics in some form have visited the moon, Mars, Venus, Titan and Jupiter, as well as a few comets and asteroids, whereas humans have only visited the moon.

The fictional adaptation of robots assists the imagination. As engineers we sometimes get absorbed into the logistics of algorithms and creating functional devices, however the imagination let's us explore the universe and new ideas without the need for a spacecraft. It is highly possible that a large number of innovative concepts were brainstormed at Comic Con, which is the largest pop-culture event in the United States, and that those same concepts transpired into modern technology.

As seen, there is a web of entanglement between fictional robotic functionalities becoming a reality and those realities becoming a physically implemented robot in space which in-turn has led to research and technologies used back again on earth.

Robots and robotic technology are clearly paving a way for humans to follow.

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Artificial Gravity in Popular Culture

6

Carl Eriksen

Abstract

This article focuses on artificial gravity in popular culture. We begin with a brief discussion on the mechanics of gravity before giving a critical analysis of the artificial gravity observed in the films “Elysium”, “the Martian” and “Interstellar” as well as the book “Ender’s Game”. Finally, we look at the methods used in the “Star Wars” universe using tractor technology. The first four examples illustrate a rotating toroid with varying degrees of real-world viability. The Star Wars example highlights a more absurd attempt at using a scientific principle to justify a technically impossible scenario.

6.1 Introduction

Gravity is the phenomena where all objects that have mass are attracted to each other. We shall not give a thorough explanation of the physics in this report, but rather a simple overview using the Newton’s law of universal gravitation shown in Eq. 6.1:

$$F_g = G \frac{m_1 m_2}{r^2} \quad (6.1)$$

where F_g is the force due to gravity, G is the universal gravitational constant ($6.674 * 10^{-11} [\text{Nm}^2/\text{kg}^2]$), m_1 and m_2 are the objects masses and r is the distance between their centres of mass.

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This inverse square law states that the force due to gravity acting on two objects is directly proportional to the product of their masses and inversely proportional to the distance between their centres of mass.

Applying this to Newton's second law ($F = ma$) we find that the acceleration due to gravity is the same for all objects at the same altitude and is equal to 9.81 m s^{-2} which is referred to as a standard gravity denoted by the SI unit g . This report shall analyse the attempts to create an effective gravitational acceleration in popular culture.

6.2 Elysium Artificial Gravity

Elysium is a good example of the rotating torus space station concept. Konstantin Tsiolkovsky is credited with coming up with the concept in 1903 and the concept has been used extensively in popular culture and conceptual mission designs ever since.¹ The most famous design being the Stanford Torus conceptualised in 1975.²

The concept works on the principle of centripetal force. A rotating object has an acceleration vector pointing towards the centre of the rotating circle. In a rotating torus, a normal force on the outer edge would result in an acceleration towards the centre shown in Fig. 6.1.

The magnitude of the acceleration can be obtained using dynamics equations and is given by Eq. 6.2.

$$a = \omega^2 R \quad (6.2)$$

where ω is the angular velocity m/s and R is the torus diameter m .

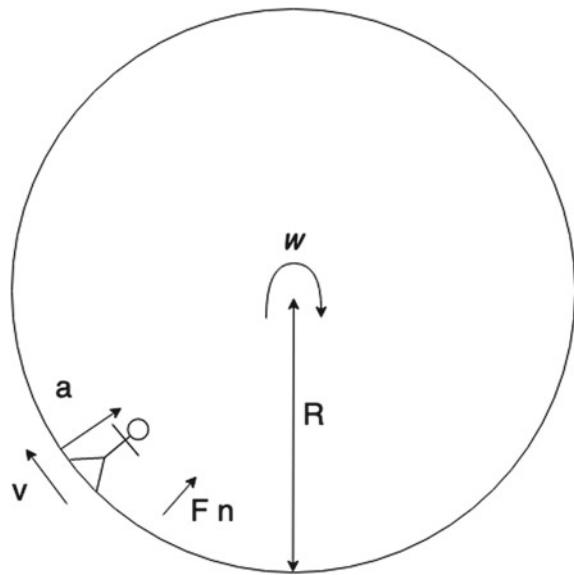
The problem then becomes relatively simple, all that is needed is to determine at what angular velocity ω the station needs to rotate in order to have an effective acceleration equal to one g for a fixed radius r .

According to the production crew the diameter of Elysium is 60 km. This means that it would need to rotate at $1.635 \times 10^{-4} \text{ rad/s}$. A journalist for wired magazine did an analysis of the trailer and found the angular velocity to be $0.017 \pm 0.003 \text{ rad/s}$ about one hundred times greater than the required angular velocity. At this speed the acceleration would be 102 m/s^2 which means that it would be extremely difficult to even stand on Elysium. Additionally, the station is supposed orbit at 120 km which would result in a rapid orbit. However, during the film it appears to be almost geo-stationary. It would perhaps be a good idea for the film-makers to brush up on their astrodynamics.

¹Steven D. Bloom, *The Physics and Astronomy of Science Fiction*, 2016. Accessed on: 2017:02:24.

²Nikolas Martelaro, “Powering the Stanford Torus,” 2017.

Fig. 6.1 Diagram illustrating the effects of centripetal force



6.3 The Martian Artificial Gravity

The Hermes spacecraft in the Martian has a rotating module to allow the astronauts relief from the debilitating effects of long-term exposure to zero gravity. Werner von Braun initially recommended this for a Mars expedition in the 1950s. He recommended a 76 m diameter module rotating at 3 rpm to provide one third g.³

Again, using data from Wired, the unit was found to rotate at 0.109 rad/s.⁴ The toroid radius was estimated using two screenshots from the movie. This resulted in an estimated diameter in the region of 50 m. Combining this with the angular velocity found by Wired and Eq. 6.2 we get an effective acceleration of 0.3 m/s².

6.4 Interstellar Artificial Gravity

The film Interstellar features another long-duration space-flight spacecraft design. The concept design is extremely well documented and has its own website <http://endurance.interstellarmovie.net> which has an interactive user interface.

³“10 Facts About The Elysium Space Station From ‘Elysium: The Art of the Film,’” geeksod doom, 2013, <http://www.geeksofdoom.com/2013/08/09/10-facts-about-the-elysium-space-station-from-elysium-the-art-of-the-film>. Accessed on: 2017:02:24.

⁴Rhett Allain, “How That Spinning Spacecraft From The Martian Would Work,” Wired, 2015, <https://www.wired.com/2015/08/spinning-spacecraft-martian-work/>. Accessed on: 2017:02:24

Various modules for different applications are arranged in a wheel behind the command module. This includes two habitat modules for the crew to live in during interstellar flight. According to the producers of the film, the diameter of the wheel is 64 m⁵ and it is rotating at 5.6 rpm = 0.59 rad/s.⁶ Using these figures and repeating the same calculations as the previous sections we find the apparent gravitational acceleration to be approximately 11 m/s². Again, we find an error. However, the documented 64 m would be the outer diameter. Measuring the habitat pod we find its height to be approximately 12.8 m. The Endurance website states that water and air recycling units as well as primary life support are housed below the cabin section of the module to provide additional radiation shielding. While we do not have the dimensions for the section below the cabin, it is possible to calculate that a realistic 3.4 m high section would result in an apparent gravity of one g. Finally, we have an example of a film where the artificial gravity calculations more-or-less check out.

6.5 Ender's Game Artificial Gravity

Ender's Game is a novel by Orson Scott Card published in 1985. There was also a film made more recently but this report is going to focus specifically on the book.

In the novel, children are sent to a space station called Battle School to train in outer space combat. The interesting part of battle school is thus the combination of artificial gravity in the living quarters and zero gravity in the nine battle arenas where trainees conduct military training games. The book mentions that Battle School is also a torus style space station and that the gravity diminishes the closer towards the centre. So far this makes sense as we know from Eq. 6.2 that acceleration is proportional to radius. The battle rooms are in the centre of the torus and are not rotating. This allows the trainees to instantaneously go to zero gravity upon entering a battle room. This adds a new element of complexity due to the relative velocity between the rotating and non-rotating sections. The station would have to be extremely large to have a low enough angular velocity to allow one to simply walk down a corridor and enter the battle room as described in the book.

There are obstacles referred to as stars in the battle rooms. If they manage to secure these obstacles in position it suggests that there is control over gravity in the room. Additionally, the students have a device called a hook that can manipulate gravity. The author states that they use technology from the alien species that attacked Earth to influence gravitons. Gravitons are hypothetical massless sub-atomic particles sometimes used to describe gravitation.

This book has some interesting concepts, but we can safely say that the fiction element is far stronger than the science element in this science fiction novel.

⁵Warner Brothers, "Endurance," 2015, <http://endurance.interstellarmovie.net/>.

⁶Allain Rhett, "The Physics of a Spinning Spacecraft in Interstellar, WIRED," 2014, <https://www.wired.com/2014/10/physics-spinning-spacecraft-interstellar/>. Accessed on: 2017:02:24.

6.6 Artificial Gravity in the Star Wars Universe

The artificial gravity in the Star Wars universe is created using tractor technology. These so-called gravity generators create tractor beams that use light to attract objects. Whilst tractor beams were invented as part of science fiction, there have been successful attempts at creating small-scale tractor beams that have managed to pull microscopic objects. The two main methods of using light to move objects are optical tweezers and solenoids.

Optical tweezers operate on the principle of momentum transfer associated with the bending of light. To understand how light has an associated momentum we begin with Einstein's theory of special relativity which gives the relative energy of a particle from Eq. 6.3.⁷

$$E^2 = (m_0 c^2)^2 + p^2 c^2 \quad (6.3)$$

where E is the energy of the particle, m_0 is its mass, c is the speed of light and p is the particles momentum.

A photon has no mass and thus Eq. 6.3 reduces to:

$$E = pc \quad (6.4)$$

Einstein introduced the concept of relativistic mass which helps to conceptualise the interactions of light on particles. The photon at “rest” would satisfy $E = mc^2$. If we accept that light has relativistic mass and momentum, the principle of conservation of momentum means that a very small force will be exerted on an object reflecting or refracting light in order to undergo an equal but opposite change in momentum.

Optical tweezers use this concept to create optical traps as shown in Fig. 6.2.

Optical solenoids use the same principle but bounce lasers off a projector to produce a hologram of intense light that is in the shape of a solenoid. Using this solenoid in a similar fashion to an Archimedes screw, scientists at New York University have managed to move glass beads approximately the size of a human cell.

The force exerted by a light beam in these is given by Eq. 6.5⁸

$$F = \frac{n P}{c} \quad (6.5)$$

where P is the power of the light beams and n is the refractive index of the surrounding medium.

⁷J.E. Molloy, “Lights, Action : Optical Tweezers” 43, no. 4 (2002): 241–58.

⁸Molloy.

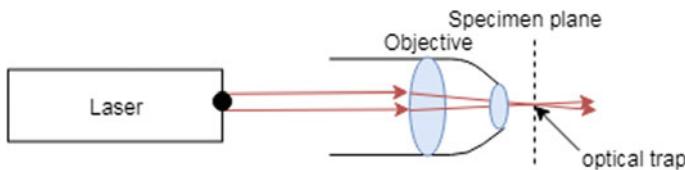


Fig. 6.2 Diagram showing a basic overview of an optical tweezer arrangement

If we could hypothetically create a gravity generator that used this principle to create multiple optical traps that somehow managed to remove the radiometric (heating) effects of light, then how much power would need to be generated?

According to the Star Wars Wiki site (<http://starwars.wikia.com/wiki/Chewbacca>) Chewbacca weighs approximately 112 kg.⁹ To supply a force that would give one g using the refractive index of air ($n = 1.00027$) the required power is

$$P = \frac{mgc}{n} = 3.3 * 10^{11} [\text{W}] \quad (6.6)$$

This is over twenty times the power generating capacity of China.¹⁰

To conclude it is apparent that as far as we can currently see, artificial gravity is only realistic when using rotational motion to induce an apparent gravitational acceleration that is dependent on the size and angular velocity of the rotating element. Whilst the concepts are often well represented, the actual calculations could do with some improvement in the cases discussed here.

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⁹“Chewbacca, Wookieepedia, FANDOM Powered by Wikia,” accessed February 24, 2017, <https://starwars.fandom.com/wiki/Chewbacca>. Accessed on: 2017:02:24.

¹⁰Michael Davidson, “China’s Electricity Sector at a Glance: 2013,” The Energy Collective, 2014, <http://www.theenergycollective.com/michael-davidson/335271/china-s-electricity-sector-glance-2013>. Accessed on: 2017:02:24.



Youngsters, Dreams and Motivation for Space Exploration

7

Nasir Mehmood

Abstract

In every culture cradle songs, poems, stories, cartoon movies are produced for children. In Pakistani culture and society also, the more exciting aspects of space have become deeply embedded in cultural values, visual and performing arts. Motivation of youngsters for outer space exploration is the main theme of this chapter. This chapter presents examples to show the motivation for space exploration exists in the deep roots of Pakistani culture and how the young generation is influenced towards the space exploration.

About the Theme

Space exploration has been a topic for human generations. Our fascination with outer space is particularly significant because it is humanity's least explored frontier. Nowadays we have movies like Star Wars, Interstellar, Star Trek, The Martian, Gravity; and a list of movies and TV shows addressing various aspects of space that made people to think about space. We have romanticized space exploration through our myths, stories and poetry. Our fascination with space travel is merely a return to our roots, where we again have to struggle with the urge to explore and the urge to settle.

This chapter presents five examples, with a unifying theme of the use of space in culture and to demonstrate how in each example space is used. To address the problem statement of the assignment, the examples are chosen from the Pakistani culture and the unified theme is "Youngsters, Dreams and Motivation for Space Exploration".

In every culture, cradlesongs are sung to make a child asleep, poems and stories are written, and cartoon movies are produced for children, and children love to have

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all this. Some of these more are related to a specific region and language like poems, cradlesongs etc. while some are common in the global culture like cartoons, reading story books, internet resources etc. In Pakistani culture and society also, there exists some space related content in poetry and songs. Some events are also organized with an aim to increase awareness about space. Although the participation of Pakistani youth is not satisfactory in space sector, it is mainly because there are not enough opportunities and attraction for youngsters to join space sector as career. But still there are many examples that demonstrate how, in different manners, youngsters are motivated for space exploration. In the following text five such examples are discussed.

7.1 Dr. Allama Muhammad Iqbal's Poetry

Dr. Allama Muhammad Iqbal (1877–1937) is one of the most prominent poets of Indian subcontinent. His poetry is highly admired by Pakistani, Indian, Iranian and other international scholars of literature. With most of his work in Urdu and Persian, he is also regarded as “the National poet of Pakistan” and “Sage of the Nation”. Beside his philosophical thoughts, in his poetry, he also gave his views on many other topics related to science, technology and exploration. For example, speaking about nuclear fission and the resulting amount of energy, he says,¹

حقیقت ایک ہے ہر شے کی حن کی چوک نوریج
لہو خوشیدہ کاٹیں اگر تے مارل پیسیں

*Haqiqat Aik Hai Har Shay Ki, Khaki Ho Ke Noori Ho
Lahoo Khursheed Ka Tapake Agar Zarre Ka Dil Cheerain*

Translation: *There is one reality for everything, be it of earth or fire;
The blood of the sun will drip, if we split the heart (nucleus) of an atom.*

In Iqbal's eyes youth is representative of the nation, not only for the current nation, but also for the generations to come. In his messages, he urges youngsters to explore the universe. So, in his poetry collection “Bal-e-Jibril” (060-Sitaron_Se_Aagay_Jahan_Aur_Bhi_Hain),² he says to the young generation that:

¹Allama Iqbal Poetry, (Bang-e-Dra-163) Explanation of Tulu-e-Islam, <http://iqbalurdu.blogspot.com/search?q=tulu>, Accessed [08-Dec-2018].

²Allama Iqbal Poetry, (Bal-e-Jibril-060) Sitaron Se Agay Jahan Aur Bhi Hain, <http://iqbalurdu.blogspot.com/2011/04/bal-e-jibril-060-sitaron-se-agay-jahan.html?m=1>, Accessed [08-Dec-2018].

ستاروں سے اجے جہاں اور بھی ہیں ابھی عشق کے متحاں اور بھی ہیں
*Sitaron Se Agay Jahan Aur Bhi Hain
 Abhi Ishq Ke Imtihan Aur Bhi Hain*

Translation: Other worlds exist beyond the stars—
 More tests of devotion (love) are still to come.

تھی زندگی سے نہیں فیض آتیں یہاں سایکروں ہاؤں اور بھی ہیں
*Tehi, Zindagi Se Nahin Ye Fazaen
 Yahan Saikron Karwan Aur Bhi Hain*

Translation: This vast space does not lack life—
 Hundreds of other caravans are here.

He further says:

اسی روز و شب میں الجھ کرنے رجا کہ تیرے زمان مسکان اور بھی ہیں
*Issi Roz-o-Shab Mein Ulajh Kar Na Reh Ja
 Ke Tere Zaman-o-Makan Aur Bhi Hain*

Translation: Do not let mere day and night ensnare you,
 Other times and places belong to you.

In his another poem of Bal-e-Jibrel (160 -Khushal_Khan_Ki_Wasiyat)³ he says:

محبت مجھے ان جوانوں سے ہے ستاروں پر جو دلتے ہیں کہتے
*Mohhabbat Mujhe Un Jawanon Se Hai
 Sitaron Pe Jo Dalte Hain Kumand*

Translation: The youth to whom the stars are not out of bounds
 Are the ones I love indeed—

Dr. Iqbal in his messages motivates the youngsters for space exploration and strongly believes that youngsters of the nation possess the energy to gear-up the nation and can set the stage for next generations to play their role. As he is the national poet of Pakistan and his poetic work is regarded with great respect by the youths and children, his messages about exploration of outer space and science are also vital.

³Allama Iqbal Poetry, (Bal-e-Jibril-160) Khushal Khan Ki Wasiyat, <http://iqbalurdu.blogspot.com/2011/04/bal-e-jibril-160-khushal-khan-ki.html>, Accessed [08-Dec-2018].

7.2 Children Songs (Cradlesongs) and Stories

One of the most popular Urdu cradlesong the mothers and grandmothers sing to make children asleep is “*Chand Pe Peryan*”.⁴ English translation of this poem is presented below:

Chand pe Peryan Daadi Amman kehti hain Chand pe peryan rehti hain Roz utar ker aati hain Apnay per phelati hain Aaj main raat nahin soon ga Chand ke peryan dekhonga	Fairies of The Moon Grandmother Says Fairies live on the moon They come down daily Extend their wings I will not sleep tonight Will see fairies of the Moon
--	--

A beautiful poem—that is basically about life on the moon. Although it is about an imaginary creature (the fairies) and also human life on the moon has not become a reality till today, this poem raises question in the mind of almost every child that if human could also go and live on the moon?, and thus is a source of motivation to think about the option to travel to the moon and life in space.

Also there are some famous stories about an old women on the moon. One example of such stories is *daadi amman kehti hain, chand pe buriyah rehti hai*.⁵ In which the author explores the life on the moon to the children as their grandmother is telling the story to her grandchildren. The story revolves around the imaginative scenes with the major theme of teaching the children the importance of good values and obedience.

7.3 Poster Making at World Space Week

It has been observed that whenever children are given opportunity to express their thoughts and dreams, there is always a large number of children who show their wish for space exploration or space travel.

World Space Week is celebrated in Pakistan⁶ every year. The specialty of celebrating WSW in Pakistan is that it offers an exciting opportunity for children to explore new avenues for their future and the organizers (Space and Upper Research Commission of Pakistan—SUPARCO) hope to make children “go where no Pakistani has gone before”. Its aim is to excite students about science and provide an impetus for the development of space technology in the country. It is a platform that

⁴Dadi Amma Kehti Hain Chand Pe Pariyan Rehti Hain, Rhymes Collection for Kids, <https://www.youtube.com/watch?v=0pjmSQvV1-Q>, Accessed [08-Dec-2018].

⁵UrduFox, daadi amman kehti hain, chand pe buriyah rehti hai, <https://urdufox.com/stories/dadi-amma-kehti-hain-chand-pe/>, Accessed [29-Dec-2018].

⁶The Express Tribune, “Space Week hopes to make children go where no Pakistani has gone before”, <https://tribune.com.pk/story/967908/eyes-turned-skyward-space-week-hopes-to-make-children-go-where-no-pakistani-has-gone-before/>, Accessed [08-Dec-2018].



Fig. 7.1 Poster making at WSW-2014 “Space is the Future” [Courtesy: SUPARCO, National Poster Making Competition—2014, <http://www.suparco.gov.pk/pages/wsw-npmc.asp>, Accessed: 08-Dec-2018]

provides academia, students and decision-makers harness a generation that will seek careers in space science and applications.

One of the important event in the space week is the poster making competition. Many schools with a large number of students' poster present their imaginations about space travel, space exploration, and other space related activities, participate in this event. An example of students' work on “Future of Space” is given in the following Fig. 7.1.

In the above paintings, children portrayed their imagination about space life in future. Although the life in space has not become a reality till today but perhaps we will see our best efforts directed into outer-space with wonderful ideas of these school children. In a country like Pakistan where a large part of population has very little knowledge outer space exploration and its benefits, this kind of work is like making minds of young generation to perform their role in outer space in future.

7.4 Cartoons

Everywhere in the world, watching cartoons is a part of every kid's life. The same is true for Pakistani children also. Cartoons are a source of information and entertainment for children. Studies proved that the brain of a child is ever wandering, trying to pick up new things from what they see and absorb quickly. There are many cartoons that have space related contents that make children to think about space.



Fig. 7.2 Tom and Jerry—“Mouse into Space” [Courtesy: Tom and Jerry Wiki, https://tomandjerry.fandom.com/wiki/Mouse_into_Space, Accessed 06-Jun-2019]

For e.g. in an episode of Tom and Jerry cartoons titled “Mouse into Space”^{7,8} Jerry, the mouse, decides to have a space journey. This episode is about how Jerry becomes an astronaut and goes into space for peace and entertainment (Fig. 7.2).

A very funny stuff indeed—that is far from reality in many ways, for e.g. no earth based living being can survive in space without oxygen and yet Tom, the cat, did in this episode. But this episode highlights various aspects of outer space like astronauts’ training, space flight, space objects, rocket stages, space debris, and more important the idea of space journey, which are definitely thought provoking for children.

As another example, in one of the most famous drama serial amongst the children “Ainak Wala Jin”,⁹ the concept of space travelling, space suit, aliens and experimentation in outer space is presented beside other funny stuff.

⁷Tom and Jerry Episode 119 Mouse into Space Part 1, https://www.youtube.com/watch?v=wWtbaU7MDwk&list=PLSkVSA_qRNQF241AXiKSbIpEajgZeOZQ, Accessed [08-Oct-2018].

⁸Tom and Jerry Episode 119 Mouse into Space Part 2, https://www.youtube.com/watch?v=w4yP-WvhnP0&list=PLSkVSA_qRNQF241AXiKSbIpEajgZeOZQ&index=2, Accessed [08-Oct-2018].

⁹Ainak wala jin episode 16, <https://www.youtube.com/watch?v=TQDhHhvFEY>, Accessed [08-Dec-2018].

The screenshot shows the homepage of 'mysteries in time' with a focus on 'Space History for Kids'. At the top right are 'LOGIN' and 'VIEW CART' buttons. Below them is a navigation bar with links to 'Home', 'Login', 'Subscribe', 'Reviews', 'Topics +', and 'FAQ'. To the left of the main content area is a vertical column of social sharing icons for Twitter, Facebook, Google+, LinkedIn, and Email. The main title 'Space History for Kids' is displayed in large orange letters. Below it is a brief description: 'Learn about Space History for Kids in the eleventh adventure which transports you back to the Mir Space Station. You will learn about the solar system, the Space Race, gravity and more.' Another section below it says: 'Place the sticker on the timeline and find the USA and Russia on the world map. Find a cosy place to read the illustrated time-travelling Space story with the matching bookmark, then learn some Space facts in the history booklet.' A third section at the bottom discusses a 'Space Shuttle fridge magnet' activity.

Fig. 7.3 Screenshot of the website for space history for kids [Courtesy: mysteries in time an adventure through history, space history for kids, <https://www.mysteriesintime.co.uk/space-for-kids>, Accessed 08-Dec-2018]

7.5 Internet Resources for Reading

There is very interesting stuff available for kids who love books reading online for subscription from anywhere in the world. A good online resource is available as “Space History for Kids”¹⁰ that has information on Space race, constellation, space stations, solar system, and space journey for kids. It also presents and space facts for kids and space related imaginary stories for kids (like “Max and Katie’s Space Adventure”) (Fig. 7.3).

It is believed that a love of reading is a stepping stone to becoming an enthusiastic learner and a confident reader, writer and speaker. With confidence and enthusiasm, children can enjoy a wonderful world of learning and exploration. The same is true for reading online resources about space facts and stories. All this material on this site is of elementary-to-intermediate level and in my opinion it is a very good resource for kids that provide awareness about different areas of space studies and cultivate their minds to think Space. Simply great!

7.6 Conclusion

All the examples described above demonstrate how the ideas about space are planted in the minds of children and how some organizations (government and non-government) and individual resources play their role for increasing public awareness about the Space. However, it still requires some serious planning and

¹⁰Mysteries in time An adventure through History, Space History For Kids, <https://www.mysteriesintime.co.uk/space-for-kids>, Accessed [08-Dec-2018].

sincere efforts, from top level on a larger scale, to motivate youngsters to come in and play their role in space sector and to harness a generation that will seek careers in space for widespread benefits to the society.

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Clowns in Space: An Introduction to Circus Aliens and Spaced-Out Comic Performers

8

Anna-Sophie Jürgens

Abstract

This chapter is a guided tour of fiction and film on circus in space, since the mid-20th century. Through the analysis of selected case studies, it clarifies how ‘traditional’ circus can be defined in space narratives, and how space narratives expand on and transcend the cultural imaginary of the circus. Exploring the affinities between space and circus, the article focuses on the comic archetype of the Big Top, i.e. the clown, and on what defines a clown in space narratives—with particular reference to psychedelic and murderous clowns, and to clowns playing human(s). This chapter carves out their pervasive but surprisingly understudied cultural presence and the cultural work they do in different media.

8.1 Send in the Clowns

The future of manned space travel has a distinctive look: “crazy wig, oversized boots and a big red nose”—at least, if we turn into reality the latest research findings uncovering that on-board clowns, as part of the crew, may provide ways to enhance team dynamics and cohesion on long space missions and in stressful situations.¹ However, as exotic as it sounds, our cultural record demonstrates that clowns—those miraculous and unearthly creatures embodying bold extremes, the

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¹Sample, Ian: “Jokers please: first human Mars mission may need onboard comedians”, *The Guardian*, 16 February 2019, <https://www.theguardian.com/science/2019/feb/15/jokers-please-first-human-mars-mission-may-need-onboard-comedians> (accessed 12 April 2019). Cf. Blakely, Rhys: “Class clowns find their calling on eight-month journey to Mars”, *The Times*, 16 February 2019, <https://www.thetimes.co.uk/article/class-clowns-find-their-calling-on-eight-month-journey-to-mars-ws3dm5f9h> (accessed 11 April 2019).

garishly overstretched and the ambiguously unconventional²—have been in space for a long time. As this chapter elucidates, they have been around as ‘aliens’ of their own kind. The following pages thus explore how the comic archetype of the circus, cultural imaginaries of the circus world and space intertwine, and what such intertwining has come to mean. What are the narratives emerging at the interface of outer space, clowns and circus? What cultural work do they do? Do clowns in cultural fantasies of space missions contribute to cohesion? And how does space affect circus and clowning?

By addressing these questions, this chapter examines phenomena, and their pervasive cultural presence, that have barely been discussed before. It seeks to address that significant gap in our understanding through a study of the explosive and intriguing mixture of familiarity, semantic stability and cultural versatility that makes outer space circus and clown narratives so distinctive. As the first investigation of clowns in space, this paper explores semantic relations in particular: themes, recurrent motifs, reiterative stereotypical patterns (tropes) and storylines that accompany clowns in space contexts. This approach borrows from, and builds on, structuralist analyses of popular culture.³ The aim is to map facets of a discourse in a wider popular cultural context as it stands in the present by shedding light on its historical foundations. Considering a range of examples woven together to form an illuminating set of ideas offering new insights into mid-20th century space narratives on the one hand, and late-20th century stories and their recent revival on the other, this chapter presents a mosaic of characters, storylines and ideas that offers a colourful, suggestive picture of both transmedial circus voices and the delicious art of clowning in space contexts. Rather than delivering a comprehensive taxonomy of circus and clown phenomena in space fantasies, this study zooms in on some of the spectra of their cultural halo, based on case studies chosen for their inherent ability to ‘narrate’ the diversification and dynamics in the genre and their relevance for our present time.

²At least this is the type of clown examined in this chapter. For a more differentiated definition of the clown character, see Weihe, Richard (Ed.): *Über den Clown: Künstlerische und theoretische Perspektiven*. Bielefeld: transcript 2016.

³Particularly Christen, Matthias: *Der Zirkusfilm: Exotismus, Konformität, Transgression*, Marburg: Schüren 2010; Stoddart, Helen: *Rings of Desire: Circus History and Representation*, Manchester: Manchester UP 2000 and Jürgens, Anna-Sophie: *Poetik des Zirkus: Die Ästhetik des Hyperbolischen im Roman*, Bielefeld: transcript 2016. In his monograph, Christen undertakes an in-depth analysis of the relationship between cinema and ‘real world’ circus: circus films refer to the metacultural code that the circus provides in its double capacity as a sensuous spectacle and a highly complex mode of cultural (self-)reflexivity. Cf. also Stoddart’s latest book chapter on circus, in which she not only discusses the distinction between historical, romantic and realistic circus novels, and literary texts that approach circus allegorically and metaphorically, but also explores how circus—as a post-structuralist allegory for writing—challenges conventional classification and writing modes. (Stoddart, Helen: “Contemporary Circus Literature: Authenticity and Illusion in Sara Gruen’s *Water for Elephants* and Erin Morgenstern’s *The Night Circus*”, *Manegenkünste: Zirkus als ästhetisches Modell*, ed. by Margarete Fuchs, Anna-Sophie Jürgens, Jörg Schuster, Bielefeld: transcript 2019 (in press)).

8.2 Circus and Space

8.2.1 Preparing the Stage: Defining Circus

Several delegations from Mars visited Earth in the 1920s and 1930s. Purportedly discovered near the remains of their spaceship in the Mojave Desert, they soon performed in American sideshows, where the staging of cultural difference was easily pushed into the fantastic. These Ambassadors from Mars were famously staged by Eko and Iko, two African-American albino brothers with dreadlocks (who also wrote circus history as “members of a colony of ‘sheep-headed cannibals’”).⁴ Although freakshows and other genres of popular entertainment such as American carnival are not synonymous with the circus,⁵ freak performers and circus tend to fuse in our cultural imaginaries of the Big Top—and the same applies to space narratives, as we will see in the following.

As an institution, the historical circus was founded in 1768 in London by the cavalryman Philip Astley. In his shows he combined acts of horse dressage with many other forms of entertainment (e.g., juggling, clowning) that were already well-known from fairgrounds, travelling artists, and ‘old-style’ carnivals. Aspects of carnival have been preserved in circus. As the influential philosopher, literary critic and semiotician Mikhail Bakhtin observed, “[a]ll these jugglers, acrobats, vendors of panaceas, magicians, clowns, [and] trainers of monkeys, had a sharply expressed grotesque bodily character. Even today this character has been most fully preserved in marketplace shows and in the circus.”⁶ Nevertheless, in contrast to the Bakhtinian carnival (defined as a kind of festive season with specific rituals of Rabelaisian frenzy and utopian excess), circus and freakshows offer performances for profit, and as such are structured by hierarchies and discipline. Also, unlike the carnival, which deliberately merges performers and spectators, the circus retains physical and functional barriers separating them. Even clowns dying and resurrecting in the sawdust ring are not the expression of a popular, festive attitude

⁴Bogdan, Robert: *Freak Show: Presenting Human Oddities for Amusement and Profit*, Chicago/London: UCP 1988, 105. The brothers’ life story has recently been published; see Macy, Beth: *Truevine: Two Brothers, a Kidnapping, and a Mother’s Quest—A True Story of the Jim Crow South*, New York: Back Bay Books 2016.

⁵For a detailed analysis, see Jürgens 2016, 53–59. Examples of this amalgamation include *The Circus of Dr Lao* by Charles F. Finney, a 1935 novel in which a circus presents mythological creatures (a Medusa, a Mermaid, a Chimera and others) in a similar manner to how historical freakshows did, but it also features them performing in the Big Top (where freak performers did not appear). On stage, circus *Flic Flac* and the (in)famous *Zirkus des Horrors* (Circus of Horror) regularly present updated versions of historical freak performances in the circus arena. The 2017 box office film *The Greatest Showman* featuring the life of P. T. Barnum also amalgamates freakshow and circus—with a very liberal approach to historical records.

⁶Bakhtin, Mikhail M.: *Rabelais and His World*, Bloomington: Indiana UP 1984, 353. For a distinction between Bakhtin’s definition of carnival and American (capitalist) Carnival, see Janet Davis, *The Circus Age: Culture and Society under the American Big Top*, Chapel Hill: University of North Carolina Press 2002, 240.

towards life, as they are in the context of Bakhtin's carnival. Instead, they perform a show. To summarise: "The circus and circus texts may *perform* or represent some of the inversions and *mésalliances* which Bakhtin identifies as features of carnival processions, but they do so as carnivalesque art rather than as (temporarily) socially subversive carnival."⁷ Elements of both carnival and freakshows surface in outer space circus stories that, as we will see in the following, iterate (clichéd and stereotyped) patterns, in keeping with the traditional circus, but also renegotiate these pre-existing fictional and cultural traditions, and thus inform the patterns of future texts.

8.2.2 Future Past: Circus in Space

The circus theme and the science fiction genre both promise the *extra-ordinary*: "science fiction consistently explores utopian ideals for the future and engages possibilities of alternative worlds",⁸ and circus aesthetics insists on representing and accentuating the extreme, overstretched and (apparently) impossible. Historically, this is epitomised by size 90 clown shoes, somatic hyperboles (e.g. 'Human Cannonballs'), tools for sawing up spouses without harming them, and the typical verbal and visual bombshell-rhetoric of circus advertisements. For example, the latter manifests itself in promotional posters featuring a pig the size of a hippopotamus,⁹ verbal pyrotechnics promising "a once-in-a-life experience" that will "astound you, surprise you and exceed all of your expectations",¹⁰ and virtuoso heroic skills (including "death-defying dexterity" and "superhuman strength") presented by performers who are "doing the impossible" and inspiring the fantastic.¹¹ In many respects, the aesthetics of the circus are the aesthetics of the hyperbole: of exaggeration, of overstepping the mark in terms of what appears probable and credible.

Space circus strongly builds on, and explores, these aesthetics and the matrix and tropes of 'traditional' circus. Although 'traditional circus' is a poor and unsatisfactory term that does not come close to covering the magnitude of what it designates, it serves to denote the broad picture of circus at the time of its heyday (around the year 1900) and its cultural imaginary. A 'traditional' circus thus consists of at least one main tent; it follows an unsedentary, nomadic lifestyle;

⁷Stoddart 2000, 38.

⁸Hamilton, Mark D.: "Poli Sci-Fi 101: lessons from science fiction television for global and outer space politics", *Securing outer space*, ed. by Natalie Bormann and Michael Sheehan, New York: Routledge 2009, 205.

⁹Cf. Ortlieb, Cornelia: "Kafkas Tiere", *Tiere, Texte, Spuren: Zeitschrift für Deutsche Philologie* 126 (2007), 339–366, 346.

¹⁰Ringling Bros. and Barnum & Bailey Circus/The Greatest Show on Earth: *Legends*, 2014. Program booklet, without pages.

¹¹Ibid.

it presents acts by human and animal performers; and it may involve freak performers and other side show attractions.¹² By referring to historical circus life, protagonists and circumstances, and by deploying historically plausible settings and language, the imaginary of traditional circus is reiterated by circus narratives—also circuses-in-space-narratives—and passed into the imagination of the 21st-(plus-n)-century. By reiterating stereotypical kernels of meaning and repeating important storylines and tropes, space circus exhibits historical awareness, and (thus) affirms the historical and cultural meaning and significance of traditional circus. In so doing, it provides an essential contribution, through orientation and stabilisation, to the cultural memory of circus.

“Marvello’s Extravaganza!” may serve as an example. It is “The Greatest Show in Space!” in the 1966 “Space Circus” episode of *Lost in Space*, an American science fiction television series that aired between 1965 and 1968 and details the adventures encountered by a family of space colonists. The Greatest Show in Space is emceed by Andreas Marvello, “the professor extraordinaire galactic entrepreneur, and bringer of joy—to the crowned heads of the universe”, and features performances by: Vicho, “the strongest man in any universe”; Nubu the Magnificent, a “juggler of cosmic forces which would destroy any other creature”; Fenestra, the “clairvoyant supreme mistress of the lost arts of psychokinetology and extrasensory materialization”; and the Cosmic Monster, “one of the wonders of the universe” and “fiercest specimen from Supernova 12”.¹³ Although billed as “the most incredible assortment of alien creatures ever assembled on one planet”, the crew looks rather shabby and their performances do not go beyond the effects and tricks presented in traditional shows; their equipment, indeed, is thoroughly conventional in terms of traditional circus. In fact, visually, Marvello’s show draws on non-filmic¹⁴ circus history with its paraphernalia referring to the experiential reality and the way of living of historical circus- and carnival-members as they are recorded in non-fictional documentaries, ephemera, (auto)biographies, newspaper articles and archival records. The Greatest Show in Space has an ambulant, old-caravan-like stage decorated with 19th-century-style advertising material. Life and work of the troupe, their routines and performance practice are modelled on historical circus’s everyday daily tasks.¹⁵ Fitting all too well, the name of the show evokes the ultimate showman P. T. Barnum, who is remembered for founding “The Greatest Show on Earth” (1872), which was to become the largest circus in history. The sense of authenticity is not only transported through name and outfit, but also

¹²For a much more comprehensive discussion of this term, embedded in research literature on circus, see Jürgens 2016, 35–37.

¹³All the following quotes are from the episode’s text, see https://www.springfieldspringfield.co.uk/view_episode_scripts.php?tv-show=lost-in-space-1965&episode=s02e05. Available online at <https://www.dailymotion.com/video/x55c0xr> (accessed 9 April 2019).

¹⁴For the very close relationship between early cinema and the circus, see Stoddart, Helen: “The Circus and Early Cinema: Gravity, Narrative, and Machines”, *Studies in Popular Culture* 38/1 (2015), 1–17 and Gunning, Tom: “The Cinema of Attractions: Early Cinema, Its Spectator and the Avant-Garde”, *Early Cinema: Space Frame Narrative*, ed. by T. Elsaesser, London: BFI 1990, 56–62.

¹⁵Cf. Jürgens 2016, 134–141.

through the episode's plot, which is equally conventional: it features an impresario trying to abduct for profit a child who can materialise objects from his mind, a storyline that follows the 'insidious circus' trope.

Tropes are recurring literary, thematic or rhetorical devices, networks of meaning, motifs or clichés. In circus contexts they have many sources (including historical records) but tend to convey an anachronistic, and thus ambivalent, mode of recovering the (fictionalised) past. Circus tropes, which I discuss elsewhere in detail,¹⁶ include the depiction of the circus as a perpetually preindustrial, bucolic adventure world (although, particularly at its heyday, circus featured unequalled cutting-edge technology), and the portrayal of the circus as an abusive inhumane machine exploiting human and non-human performers alike.¹⁷ Another trope is 'running away with the circus':

The act of 'running away' involved breaking away from one's community for the imagined economic opportunities and unfettered life with the circus. [...] 'Running away' also represented a potential escape from the shackles of gendered and racial conformity that limited ordinary community life. Despite the lure of mobility at the circus, proprietors used these same normative stereotypes to market their shows.¹⁸

Circus tropes are powerful and complex tools, used and fostered by different agents for telling the circus's story, that transport the cultural imaginary of the circus world to other media.

As the insidious or criminal circus trope is a particularly popular narrative device, it is not surprising that it has also conquered space. Another apt example, besides Marvello's Extravaganza, is "Coby and the Starhunters". This episode of the 1985 animated television series *Star Wars: Droids—The Adventures of R2-D2 and C-3PO* (a spin-off from the original Star Wars trilogy) presents us with a travelling circus and rarity show, named the "Starhunter's Intergalactic Menagerie", that is specialised in capturing strange and valuable creatures from outer galaxies for profit. Members of the perfidious crew steal the protagonist's pet, a Tessellated Arboreal binjinphant (a feline life-form), which leads to substantial havoc.¹⁹

The 'running-away-with-the-circus' trope—and the role of the circus in providing refuge, i.e. a place to hide (albeit in plain sight) and from which evil can be fought—is explored in the 1999 sci-fi novel *The Stainless Steel Rat Joins the Circus* by American writer Harry Harrison (whose 1966 story *Make Room! Make Room!* was used as a basis for the famous 1973 film *Soylent Green*). Among other acts, the novel's circus (Bolshoi's Big Top) presents Gar Goyle's Freak Show and its intergalactic monstrosities in the circus arena accompanied by traditional circus and

¹⁶Ibid.

¹⁷This trope, too, goes beyond/exaggerates historical facts (cf. Jürgens 2016, 129–159). Other tropes include the 'happy elephant' and the 'elephant running amok'; cf. Nance, Susan: *Entertaining Elephants—Animal Agency and the Business of the American Circus*, Baltimore: Johns Hopkins UP 2013.

¹⁸Davis 2002, 30, 31.

¹⁹This episode is online: <https://www.youtube.com/watch?v=TIbnHT-JuFY> (accessed 9 April 2019).

freakshow rhetoric.²⁰ As it turns out, the freakshow impresario is a member of the “Galactic Union Union” striving to undermine a police-state planet. There are other agents acting under cover: Puissanto, billed as the Strongest Man in the Galaxy (who is actually a tax officer), and the protagonist, a great thief and con artist called the Stainless Steel Rat who (under the guise of the magician Mighty Marvell) chases a criminal, the richest man in the universe. Here again, the depiction of circus life, performance routines and aesthetics follows conventional patterns described above. Even in “Cost of Living”, the 120th episode of *Star Trek: The Next Generation*, in which (*although detached* from the ‘classical’ circus tent) circus elements appear in a holodeck simulation of the Parallax colony (a colony of ‘free spirits’), only the regular circus staff are around: a fire sculptor, an unimaginative juggler and a clown whose head flies in a bubble, but who nonetheless does look ordinary.²¹

Faced with this material and its bond to the historical-conventional, it seems that circus in science fiction space contexts does not conquer the brave new worlds or creative possibilities lurking in the genre, nor does it employ (outer) space for “the use of imagination, and the application of novel developments to create new possibilities”.²² Rather, it seems that space has no influence at all, and that the circus only acts as a versatile frame for interpreting our nostalgic (if not anachronistic) relationship with the history of popular entertainment and performance traditions. *Nothing new in space?*

Perhaps not quite. There is another set of cultural artefacts that playfully goes beyond a historicising perspective on circus. “The Greatest Show in the Galaxy”, the fourth and final serial of the 25th season of the British sci-fi television series *Doctor Who* (1988/89), provides an interesting example. The episode revolves around the Psychic Circus, which operates in a dreamlike atmosphere according to the trope of the criminal circus (a trap): the circus crew kidnaps and cages its visitors before forcing them to perform in the Ring, and those who fail are annihilated. However, this circus is not just another hideous tent enterprise employing shady methods for profit. The Psychic Circus itself has been trapped. The audience (a single family who considers the violent display of a werewolf killing the intergalactic explorer Captain Cook good entertainment) turns out to be the Gods of Ragnarok (stone statue-like creatures from before the creation of the universe), who subjugated and enslaved the Psychic Circus’s employees. The Gods, disguised as a zombie-like human family, make sentient beings suffer to entertain them, feeding on entertainment (as they used to feed on gladiators, in ancient times in their

²⁰That is: “a gaggle of ghastliness, a haemorrhage of horror, a dribble of disgust. Gathered from all corners of the galaxy for your edification and repulsion are the freaks of nature heretofore concealed from the eyes of the public. The misborn misfits, the monstrous mutations that you may have heard about, perhaps dreamed about. But if you dreamed, ladies and gentlemen, your dreams were nightmares.” (Harrison, Harry: *The Stainless Steel Rat Joins the Circus*, Londin: Gollancz 1999, 71.) Freak performers are “icon[s] of generalized embodied deviance” (Garland-Thomson, Rosemarie (Ed.): *Freakery: Cultural Spectacles of the Extraordinary Body*, New York: NYUP 1996, 10). Historically, they did not perform in the Big Top.

²¹See <https://www.dailymotion.com/video/x6n6g2w> (accessed 9 April 2019).

²²Bormann, Natalie and Michael Sheehan (Eds.): *Securing outer space*, New York: Routledge 2009, 3 (introduction).

Dark Circus). They can be read as a parody, both on sensation-predatory audiences who want something bigger and better with each act, and (as a corollary) on hyperbolic circus aesthetics.

Another, more recent example of a space circus expanding traditional circus-narrative patterns and settings is the eponymous show in Deva Fagan's 2011 novel *Circus Galacticus*. This is the story of a teenage girl with a pubertal complex of being (not) special, who becomes a circus recruit (a clown; another circus-as-refuge-narration). Subsequently she has to fight dangerous space powers. She aptly summarises the non-spectacularity of the circus's personnel: "The Galactic crew all look about my age or a few years older and oddly normal, for aliens."²³ Her appraisal should not detract from the fact that the Big Top itself is highly unusual because it is "older than some planets"—and actually a spaceship able to compact itself (during space jump, it squashes half of itself down).²⁴ In addition, the tent is partly organic, which is why hiding in its grooves and crevices can be an unpleasant experience: "Ewww. Spaceship walls are not supposed to be damp. Or warm. Or *spongy*. Gah."²⁵

These two examples—the Psychic Circus and the Circus Galacticus—present historically undocumented circus dimensions. In these cultural texts, historical circus imaginary is transformed into something that is still circus but different. The unearthly is juxtaposed with established understandings of circus aesthetics and history, and this juxtaposition does not seek to overwrite circus aesthetics but augments our understanding of it: by exploring a more amplified vision of what circus is, these circuses serve the reinterpretation of the historical circus matrix.

The (offstage) machinations of the Psychic Circus and the Circus Galacticus are not governed by logical (our-worldly) connections but by an alternative ('alien') type of causality. Similarly, an alternative type of causality traditionally drives the comic protagonist of the circus and cultural archetype of the comic performer, the clown. Hammering leaking water back into a tube, inflating balloons with a leaf blower or unrolling toilet paper with a hairdryer, the clown in contemporary Western culture participates in a dense web of cross-fertilisation between fiction and reality, and is one of the most durable personifications of human experience. How do clowns manifest in space?

8.3 Clowns and Space

In circus contexts, clown actions generally lack common sense (which makes them funny); their social interactions are clumsy, and they seem unaware of their repetitive behaviour. Alternatively, they express 'superhuman' qualities by

²³Fagan, Deva: *Circus Galacticus*, New York, Houghton Mifflin Harcourt 2011, 61.

²⁴Fagan 2011, 54.

²⁵Fagan 2011, 168.

(apparently) defying gravity, body size, and expectations—which is exactly how humans comically imitate robots on stage.²⁶ It is thus hardly surprising that in sci-fi space contexts, clowns, circus, robots and human(oid)s also mingle in various ways: clown robots chase Earth teenagers (“The Greatest Show in the Galaxy”); pseudoflesh robots perform on the circus stage (*The Stainless Steel Rat Joins the Circus*); and human clowns pretend to be robots (Woody Allen as Miles Monroe, “the alien” in the 1973 movie *Sleeper*).²⁷ There are also escaped clowns in space, and space conquerors in clown disguise.²⁸ Additionally, there are the familiar (slapstick) clowns Abbott & Costello on the planet Venus (where they ended up after having accidentally hijacked a rocketship).²⁹ There is no space here to review all these fascinating clown characters who, within their fictional narratives, with their doings and non-doings, entertain their audiences (and us) by addressing the senses, not by appealing to reason. Two extreme interpretations of this phenomenon in outer space contexts will be examined in the following—they involve clown characters that either force others to undergo psychic trips or that experience such phantasmatic journeys themselves.

8.3.1 Psychedelic Clowns in Outer Space

8.3.1.1 In-Brain Clown

Produced in 1996, “The Thaw” is the 39th episode of *Star Trek Voyager*, yet another American science fiction television series emerging from the Star Trek mould in the 1990s. It takes us into a surreally designed and costumed world beamed into the Voyager spaceship from a deserted planet, Lt. Tuvok. This world is

²⁶Cf. Nijholt 2019, 231.

²⁷*Sleeper* is a fascinating example. Cryogenically frozen in aluminium foil in 1973, unbeknownst to himself, the protagonist wakes up 200 years later in a world run by machines and governed by a technocratic regime from which he has to hide, in the guise of a robot, to escape capture. Miles explains the background as follows: “To me, a miracle of science is I go into the hospital for a minor operation, I come out the next day, and my rent isn’t 2000 months overdue... This is what I call a cosmic screwing!” (cf. Jacobs, Diane: *But we need the eggs: the magic of Woody Allen*, New York: St. Martin’s Press 1982, 84) A human in robot disguise already appeared in *Devil Girl from Mars*, a 1954 British film production. Due to the cardboard boxes he wears, the main character is much of a camp robot, at least from today’s perspective. The film plot is appropriately summarised by Rabkin: “Atomic sex war on Mars has left the women winners in need of male ‘seed’, so the title character, Nyah, invades Earth to snatch some studs.” (2005, 154–55).

²⁸This includes Magnifico Giganticus, a former clown of Asimov’s Mule, who disguises himself as a clown to better manipulate his environment; see Asimov, Isaac: *Foundation and empire*, Garden City/New York: Doubleday 1952. And there are more clowns buried in sci-fi, like Trurl and Klapaucius, Stanislaw Lem’s rogue inventor-engineers in *The Cyberiad* who have been compared to slapstick comedians Laurel and Hardy (“the Laurel-like Trurl causes the snafu and the Hardy-like Klapaucius has to rescue him”); see Rothfork in Ziegfeld, Richard E.: Stanislaw Lem, New York: F. Ungar Pub. Co. 1985, 90.

²⁹Before their interplanetary adventure, they land in New Orleans during Mardi Gras and mistake outlandishly costumed celebrants for aliens. Cf. Rabkin, Eric S.: *Mars: A Tour of the Human Imagination*, Westport: Praeger 2005, 156. *Abbott and Costello Go to Mars* (1953) is online at <https://www.youtube.com/watch?v=5ymBvIJZ2wA> (accessed 9 April 2019).

created by five aliens (three alive, two dead) who are attached to a super computer. Their attachment is involuntarily: their brains are held prisoner by the machine. The Voyager crew makes the rescue of those aliens their mission, and sends two of their crew members into the virtual reality the aliens live in. *Welcome to the circus*.

The dreamlike virtual reality generated by the alien super computer is tinged with the otherworldliness of Alejandro Jodorowsky's 1973 cult film *The Holy Mountain*. It is sparsely furnished (a pink guillotine, cleaned with a duster by a short, chubby person in a tutu, is the only feature) and it is populated by circus-evoking, quaintly abstract creatures that dance and bounce in gaudy leotards without rhyme or reason. They are contortionists, rhythmic sports gymnasts (with different apparatus, including yoga balls), mimes and equilibrists (many of those walking on their hands) jollificating and moving around erratically, excitedly and affectedly.³⁰ In the course of events, they change from individually made up 'poetic' figures into a uniformly clown-masked mob. Their role is reminiscent of the Transylvanians from the planet Transsexual in the galaxy of Transylvania in the *Rocky Horror Picture Show* (see below): they act as garish entourage, flamboyant background dancers and weird chorus in the shadow of their supreme leader, who is a clown. Like Heath Ledger's Joker in *The Dark Knight* twelve years later, that clown is introduced the moment he removes a clown mask from his face, uncovering yet another, painted clown face, in grey. The grey clown face reflects the similarities between the clown's role and grey matter: to control all the functions of the brains connected to the system, as well as all functions of his colourful groupie court, his central 'nervous system'.

The grey clown in his fluffy, hoodied onesie is a concoction of five aliens who chose to sit out a major ecological disaster on their planet in physical stasis, while their brains live on in the computer. They did not foresee that the virtual reality generated by that computer would manifest their fears in the form of a clown. Thus, the clown is a collectively, computer-generated virtual *brain clown*, who is able to read thoughts and to induce death in the living. He is an emotion—described as “unstable, unpredictable, everything you expect from fear”³¹—and holds hostages to ensure his existence. For his bemusement, he tortures one of the Voyager's crew members (a Human Starfleet officer) sent into the system to better understand the situation, playing on his most secret and terrible fears: he transforms the crew member into a geriatric and then into a newborn (states of total helplessness), to the delights of his delirious gang. Hysterically laughing himself, the clown also threatens the crew member with physical violence (through insane surgery and appropriate props: face mask, scalpel) and death, before randomly guillotining one of the aliens. What the crew member ultimately survives is the experience of a temporarily altered state of consciousness induced by a clown, including visual alteration and psychedelic personal development—in sum, a very bad trip. But that does not stop the space explorer(s), who finally manage to disable the computer, thus tricking the sadistic clown. ‘Brain dead’, the clown dissolves into darkness.

³⁰The episode is online at <https://www.dailymotion.com/video/x6rgrgh> (accessed 9 April 2019).

³¹Ibid.

A product of outer-space technology, the clown in “The Thaw” does not embody a desire for the circus itself, as we have examined in the first set of space circus narratives. The grey clown does not represent the pleasures and excitements of circus life and its routines, and the absorption in that life and all its lived and irrecoverable moments that makes circus so attractive for other media.³² Rather, the grey clown draws on the cultural imaginary of the violent clown, who threatens (more or less comically) the life of others, and whose cultural (performance) background can be traced back to (at least) 19th-century pantomimes, in which clownesque manslaughter and acts of violent immorality were regularly presented on stage.³³ But the grey clown is not only violent, he also embodies what Simon Cooper calls a “paranoid sensibility” in popular culture: “Our fears of the increased capacity of technology to affect our lives, whether through more pervasive surveillance mechanisms or through the manufacture of powerful technological illusions.”³⁴ Through this lens, the grey clown can be read as a sign of how technology and the effects of ever-increasing technological mediation of our lives work subtly, “and behind our backs, to reconstruct the mode of our being human”.³⁵

8.3.1.2 Superclown, Far Out—and yet so Close

In contrast to “The Thaw”, Vincent King’s 1976 science fiction novel *Time Snake and Superclown* does not explore the technology of enchantment in clown form,³⁶ ‘casting a spell’ over passers-by from space. Instead, according to the back of the book, it “explores, through the eyes of a mysterious central figure, the concept of who or what is the alien among us and how do we know we all see the same thing”.³⁷ In fact, the novel masterfully obfuscates what we see by fleshing out a synesthetic world that only a reader with a LSD gland might fully fathom.

The mysterious protagonist of the text wears a lightskin, which seems to be a Harlequin leotard of unearthly qualities: “The skin wrapped itself onto me and fitted perfectly. Each triangle facet moulded to me exactly, it all flexed to match the flesh it covered, there were smaller shapes where the forms were more complicated... the tiniest in and around my ears. It was a perfect thing and it worked well too, there

³²In a study on circus in early movies Helen Stoddart explains the circus appeal for cinema: “circus performance stands for the lost (live) kernel at the heart of all the technologies and industries of representation” (2015, 2).

³³Jürgens, Anna-Sophie: “The Joker, a Neo-Modern Clown of Violence”, *Journal of Graphic Novels and Comics* 5/4 (2014), 441–454. In contrast to many recent examples, 19th-century clown violence, according to contemporary reviews, was terribly funny.

³⁴Cooper, Simon: *Technoculture and critical theory: in the service of the machine?*, London/New York: Routledge 2002, 1.

³⁵Cooper 2002, 1.

³⁶Gell, Alfred: “The Technology of Enchantment and the Enchantment of Technology”, *Anthropology, art, and aesthetics*, ed. by Jeremy Coote and Anthony Shelton, Oxford: Clarendon Press 1992, 40–66.

³⁷King, Vincent: *Time Snake and Superclown*, London: Futura Publications 1976.

was enough lubricant for several wearings.”³⁸ In addition, his attire consists of a face plate. This character is a Watcher. He has to watch out for

*Something... the Something... the enemy... Something bad... different... obscene... unspeakable, so dangerous it had no name and there was no image for it. We did not think of it, we veiled it from our minds and did not speak.... But I was the Watcher and I was prepared for it, whatever it might be.*³⁹

However, the protagonist is distracted from his task by a human “whore wraith”, later metamorphosing into the “Girl Queen”, who transforms him into a clown. Discovering the transformation, he describes it as follows: “I looked through the side of the bridge to where I was reflected and I was a clown. Not dressed like one, but my face was sure painted. It was disgusting... low... low *comedy*, animal.” But not enough: “As I watched my red nose blew up like a balloon and then went down with a wail and a whistle [...] inflated again with a noise like breaking wind.”⁴⁰ This clown face is rub-resistant, and the nose cannot be shifted.⁴¹ Forty pages into the book, the protagonist suddenly realises the girl has taken his pants, too:

There were little screams and laughter squeals all around me. The people wraiths were moving, pointing at me... little boys stared and girls giggled. I must have appeared there, like a thunder clap, suddenly... that anger... I was angry and shaking with it. I didn't care about the pants. But the clown face was something else... that and the wraiths laughing... jeering... pointing. I broke and ran. All through the trees that seemed to sway with the laughter across the grass and through the deckchairs and the people sitting up in them to see me go by. All the time my nose was going like a klaxon.⁴²

In both examples—the Superclown novel and “The Thaw”—the setting defies definition: outer and inner space overlap. The boundaries collapse between human and non-human. While the grey clown in “The Thaw” tells us much about our attitudes to technology, technological power over the body and the ambivalence about technology as a notion of manipulating life by artificial (computer) means, the Superclown is a compelling symbol of the ambiguous nature of both outer and inner space. If “science fiction shows the transformation into the posthuman”,⁴³ as stated by Daniel Dinello, the posthuman in clown narratives is characterised by the loss of control over bodies; it discards the body. Even clown bodies are made up.

Clowns in space narratives, it seems, can thus be placed somewhere between the benevolent extraterrestrial of the E.T.-type—the hairless, “macrocephalic,

³⁸King 1976, 14. (punctuation as in the original, also in the following quotes).

³⁹King 1976, 17. (italics in original).

⁴⁰Both quotes are from King 1976, 41.

⁴¹King 1976, 45–6, 64.

⁴²King 1976, 41. In the rest of the novel, the whore-girl keeps mocking the Superclown for being a clown, while he keeps trying to get back to a Zone; outside reality he travels through time and space, for instance into “what the man called the ‘Paleolithic’” (128), and finally fights an alien entity, the Time Snake.

⁴³Cf. Dinello, Daniel: *Technophobia!: Science Fiction Visions of Posthuman Technology*, Austin: University of Texas Press 2005, 2. For Dinello, the posthuman is “the horrific harbinger of the long twilight and decline of the human species” (*ibid.*).

bug-eyed, and gray alien⁴⁴—and its opposite, the murderous giant space homunculus of the *Alien*-type. But, as we have seen, the cheery smile from clowns in space is no less dangerous and apocryphal—and clowns *from* outer space in particular teach us a lesson about funny tastes.

8.3.2 Clowns from Outer Space

8.3.2.1 Feed Me!—Cannibal Clowns

A signature characteristic of extraterrestrial clown creatures visiting earth in films from the few last decades—when the circus film had entered its post-classical era⁴⁵—is their exorbitant hunger for human flesh. We earthlings are terribly tasty for clowns from outer space. We know this from the *Little Shop of Horrors*, a 1986 American rock musical comedy horror film in which a comic extraterrestrial plant sustains enormous growth into limitless voracity. The plant is dubbed “Audrey II”, can talk and, among other misdeeds, successfully proposes murder. We also know it from the ultimate lascivious superalien: Frank-N-Furter in *The Rocky Horror Picture Show* (1975), whose manner is evoked in Audrey II and whose legacy obviously continues in the grey sadist clown mentioned above, albeit in a visually prissy and rather puritan way (grey onesie vs. suspenders, etc.).

Frankie, the sweet transvestite extraterrestrial, seduces two science-course sweethearts, creates a carnal athlete named Rocky and slays a delivery boy with an ice pick (whose corpse is later served as dinner) before being killed in an insurrection by his servants. He is a hybrid of two types of comic entertainers: violent clowns and panto dames. As I clarify elsewhere in detail based on original research undertaken in the Jim Sharman Collection of the National Library of Australia (Jim Sharman is the director of both the *Rocky* musical and film),⁴⁶ Frankie engages in axe-wielding cannibalesque antics reminiscent of comic madcaps from the (saw-dust) stage, where (in the late-19th century) the imaginary of the ‘wild’ cannibal and violent clown fused. Famous French author Théophile Gautier, for example, among many other writers working in the years before 1900, describes the clown as embodied on stage by the world-renowned performance troupe Hanlon Lees as follows: “Two spots of blood mottle his powdered cheeks; red gashes lengthen his mouth to a maw and give him an air of cannibalistic voraciousness: you would

⁴⁴Moffitt, John F.: *Picturing Extraterrestrials: Alien images in modern culture*, Amherst: Prometheus Books 2003, 17.

⁴⁵Cf. “While up to the 1950s, circus films used to conjure up a seemingly regular circus experience by providing a certain range of actual performances as well as additional insights into the private world of the performers, circus films later on often limit their scope to individual traits of the circus that nevertheless invoke the full richness of its semantic reserve.” (Christen, Matthias: “Alien Invaders: Clowning as Metacultural Performance in Stephen Chiodo’s *Killer Klowns From Outer Space*”, *Comedy Studies* 2019 (currently under review; written for a special themed issue of *Comedy Studies* on violent clowns, expected publication September/October 2019).

⁴⁶Jürgens, Anna-Sophie: “Comic in Suspenders: Jim Sharman’s circus worlds in *The Rocky Horror (Picture) Show*”, *Journal of Australian Studies* 42/4 (2018), 507–523.

think he was a man-eater who had just bitten into a morsel of human flesh.”⁴⁷ Thus, already in the 19th century, the imaginary of the cannibal is linked with the clown through laughter, and a cannibalistic smile.

While the encounter of the libidinous third kind in the *Rocky Horror Picture Show* takes place in Frankie’s secluded castle-spaceship, another alien clown recurrently dwells among earthlings in a less alluring manner: Stephen King’s It, the eponymous anti-hero of the 1986 horror novel. King’s It is an ancient cosmic evil and shapeshifter from the Macroverse whose most common appearance is the extra-dimensionally beastly Pennywise. Pennywise the Dancing Clown loves to bite into human children (armpits in particular),⁴⁸ and is yet another popular incarnation of the cannibal clown and his staged *s/laughter*.⁴⁹

S/laughter, finally, is the pastime of a whole group of clown cannibals from outer space. Having landed on Planet Earth in their circus tent spaceship, these clowns engage in destructive absurdity: they violently envelop townspeople in cotton candy-like cocoons for liquefaction and drag them into their Big Top. In their spaceship they feed off their human victims by drinking them through crazy straws. Yet again space circus is *not* a bucolic place. The murderous clowns’ tent is in fact literally electrifying: it gives electric shocks when touched.⁵⁰ And it is not only these voracious clowns’ domicile and eating habits that are peculiar, but also their gait: their curious ‘standard’ walk is “a slow-motion gait with an eerie underwater quality as if the gravity on Earth was greater than on their home planet.”⁵¹ This comes as no surprise since the director of the 1988 American science fiction horror comedy film *Killer Klowns from Outer Space*, Stephen Chiodo, was at the time “an avid fan of sci-fi and monster movies of the 50s and 60s”, in which monsters do move slowly (compared to contemporary standards).⁵² Chiodo adds: “Films like *Forbidden Planet*, *This Island Earth*, *King Kong*, [and] *Godzilla* were major

⁴⁷Gautier in Storey, R.: *Pierrots on the Stage of Desire: Nineteenth-Century French Literary Artists and the Comic Pantomime*. Princeton: Princeton University Press 1985, 32.

⁴⁸Cf. King, S.: *It*. St. Louis: Penguin 1987, 33, 36. Cf. the iconic red squeaking beach ball alien with claws in the 1974 American science fiction comedy *Dark Star* (itself a kind of gigantic clown nose) who attempts to bite a space crew member in the neck. The film is online at <https://www.dailymotion.com/video/x39408j> (accessed 21 April 2019).

⁴⁹Christen uses this word in his discussion of the Joker’s humour and horror in *The Dark Knight* (Christen, M.: “Düstere Clowns: Figuren des Schreckens im Kino der Transgression”, *Über den Clown*, ed. by Richard Weihe, Bielefeld: transcript 2016, 203–242, here 234).

⁵⁰Cf. a forthcoming book chapter on electricity and engineering in circus contexts: Jürgens, Anna-Sophie and Robert C. Williamson: “Engineering Circus Enchantment: Automagic Technology and Electrifying Performances in Fiction”, *Circus, Science & Technology: Dramatising Innovation*, ed. by Anna-Sophie Jürgens, Cham: Palgrave Macmillan, expected to be published in 2020.

⁵¹For more details, see Anna-Sophie Jürgens and Stephen Chiodo: “Greatest Klown on Earth” — and the *Killer Klowns from Outer Space*. Stephen Chiodo in conversation with Anna-Sophie Jürgens”, *Comedy Studies* 2019 (currently under review; written for a special themed issue of *Comedy Studies* on violent clowns, expected publication September/October 2019).

⁵²Ibid. (“Greatest Klown on Earth”) Cf. Gozilla’s gait in Ishirō Honda’s 1954 movie.

influences on everything in our klown universe. The designs were inspired by these films but reimagined through our own visual style.”⁵³ Drawing on these examples using practical effects (such as puppetry and creature suits), it is only logical that the Killer Klowns look like giant puppets. What is particularly interesting is that these cannibal clown puppets from outer space ‘play’ human(s).

8.3.2.2 *Calypsis and Ekstasis*—Extraterrestrial Clowns Playing Human(s)

Among all the clowns introduced here, only the puppet-like Killer Klowns (and, more vaguely so, the 19th-century stage characters) resemble the ‘traditional’ clown iconography: “over-sized feet, poorly-fitting clothing (that either causes the body to bulge at the seams or that is far too large and falls slack), a bulbous red nose, a gruesomely exaggerated grimace”.⁵⁴ Their noses are the most interesting part of their bodies, although they do not blow up or make weird noises, as does the Superclown’s nose (see above). Instead, Killer Klown noses explode like fireworks when hit or shot: they are the only vulnerable spot of the Klowns, their ‘Achilles’ noses’ so to speak. The fact that the red clown nose is “the smallest mask in the world”, according to theatre scholar Richard Weihe,⁵⁵ adds to their interest. However, in the case and face of Killer Klowns, that mask does not conceal a person or alien. This phenomenon—the relationship between human clown and alien as effected through (un)masking—is explored in two particularly fascinating scenes in the movie.

In a scene at the beginning of the film, the extraterrestrial puppet-like Boss Klown seeks to avoid being recognised as an alien by impersonating a non-human version of himself modeled on a human in a clown costume, that is, a storefront display figure of a clown. A puppet-like clown mimicking a clown-puppet is a funny form of camouflage, with the clown apparel being simultaneously encoded as the symbol of a human ‘in disguise’ and the symbol of circus identity. A clown costume is a non-verbal means of communicating affirmation, if not ‘membership’, of the circus and the human world. But this clown is not only ‘incorporated’ in, but he actually ‘becomes’, his costume—a ‘costume-cum-body’,⁵⁶ thus ‘fictionalising’ himself. His ‘costume’ is reminiscent of a mourning veil, which perfectly

⁵³Ibid. (“Greatest Klown on Earth”) For more details see “Killer Klowns from Outer Space: Behind-the-Scenes” at <https://www.youtube.com/watch?v=qZ0u9UK5leA> (accessed 21 April 2019).

⁵⁴Kerner, Aaron Michael and Jonathan L. Knapp: “Laughter: Belly-aching Laughter”, *Extreme Cinema*, ed. by Kerner and Knapp, Edinburgh: Edinburgh University Press 2016, 72–100, 86.

⁵⁵Weihe 2016, 15.

⁵⁶This has been studied in other circus contexts; see Jürgens, Anna-Sophie (2019): “Costumes of Belonging: ‘Fitting in’ circus fabrics in the novels *The Unusual Life of Tristan Smith* by Peter Carey and *The Pilo Family Circus* by Will Elliott, and the costume-cum-body art of Leigh Bowery”, *Social Beings, Future Belongings: Reimagining the Social*, ed. by D. Bissell, M. Bruce, H. Keane, A. Tsalapatanis, London: Routledge, 98–104.

illustrates the concept of *calypsis*: it simultaneously exposes what it hides.⁵⁷ The clown's disguise thus serves as a schizophrenic *mask*, *subversum* and *interface* of the protagonist's belonging to *another* world while he acts (apparently) as an integral piece of the fabric that constitutes human (popular) culture.

In another scene from *Killer Klowns from Outer Space*, the same Klown operates a dead police officer's nervous system by inserting his hand into the dead man's spine. Sitting behind the lifeless human, who wears two clownesque red spots on his cheeks like the Hanlon clowns (see above), the Klown 'plays' the officer like a hand-puppet, making his corpse mimic, smile and talk. This version of the sci-fi trope of the alien infesting or bursting out of the human body⁵⁸ is as original as it is comic, because it takes ad absurdum both the circus's hunger to establish and put on show the mastery of and power over human bodies, and Henri Bergson's theory of the comic.

According to French philosopher Bergson, humour and laughter emerge from the degradation of the living to the lifeless, from "something mechanical encrusted upon the living".⁵⁹ Bergson's seminal thesis is that laughter primarily occurs when the human body demonstrates the "inelasticity of a machine", when flexibility and agility are turned into rigidity, manifesting a lack of human dignity. According to this theory, we laugh at someone imitating someone else because such an imitation reproduces the person's most mechanical, unconscious movements and gestures. Surely, what Bergson did not have in mind is an extraterrestrial clown-puppet operating or 'playing' a dead human through a form of alien galvanism—resulting in a zombie performance of a parody-human.

Another, rather domesticated version of the clown from outer space 'playing' a parody-human is Mork (aka Robin Williams) in the American sitcom *Mork & Mindy* (1978–1982). An extraterrestrial from the planet Ork, he is sent to Earth ("an insignificant planet on the far side of the galaxy"⁶⁰) in an egg-shaped spaceship to study human behaviour. Mork only partially succeeds in adapting to American customs, manner and dress, his misfortunes becoming a source for endless comic situations. Originating from a planet where humor is forbidden, the human disguise allows him to act out at once what he is "denied in the socio-historical world" out of which he has come, and what seems impossible in the "realm of artifice" that he has penetrated, which is how Wolfgang Iser describes the cultural power and function of the mask.⁶¹ Mork's human disguise is at the same time concealment (hiding the

⁵⁷Hansen-Löve, Aage A.: "Der Schein trägt: Kunstlügen und Lügenkünste: Dissimulationen", *Blickwechsel: Perspektiven der slawischen Moderne*, ed. by Gun-Britt Kohler, Vienna: Otto Sagner 2010, 109–134, here 110.

⁵⁸See the iconic Chestbuster from the *Alien*—film saga (e.g. *Alien* from 1979 or *Aliens* from 1986).

⁵⁹Bergson, Henri: *Laughter: An Essay on the Meaning of the Comic*, translated from *Le Rire: Essai sur la signification du comique* (1900) by Cloutesley Brereton and Fred Rothwell, Gutenberg project 2003, online at <http://www.gutenberg.org/files/4352/4352-h/4352-h.htm> (accessed 21 April 2019).

⁶⁰Cf. the first episode of the series, which is online at <https://www.dailymotion.com/video/x6k9f3n> (accessed 22 April 2019).

⁶¹Iser, Wolfgang: *The Fictive and the Imaginary: Charting Literary Anthropology*, Baltimore/London: Johns Hopkins UP 1993, XV.

alien) and discovery (revealing the alien). It works in similar ways to the clown veil of the first killer Klown discussed above. In contrast, however, Mork's human dress creates social relationships that could not be created without that mask or its mediating function. Moreover, his disguise has a double effect: its outside surface effects Mork's surroundings; its inside surface effects himself.⁶² In human disguise he can leave his usual form of existence (being an Orkian) and experience the state of being out of himself (being perceived as human). His disguise does not only cover his identity but also acts as a medium for externalisation of his personality and humour, that is, for *ekstasis*—a state of being beside one's self, which is how the word 'ecstasy' is originally defined.⁶³ In sum: "Because it facilitates an ecstatic condition of being himself and standing outside himself, [his] mask is a paradigm of fictionality which discloses itself as a deception in order to show that such deceptions are always modes of revelation."⁶⁴

Clowns from outer space do not only feed on humans, but also 'play' human(s) in various ways: by camouflaging themselves *as* humans with comic consequences, by impersonating the human clown—the cross-cultural epitome of human experience—and by changing humans in comic clown-puppets. In so doing they explore the rich spectrum between mimicry and deception, turning humans into 'human curiosities'.

8.4 Spaced-Out. Conclusion

Circuses never belong firmly to the everyday life of their patrons. They are by design extraterritorial venues. Only as an itinerant enterprise does the circus access the "ordinary" world and only in this capacity is it able to engage with and temporarily upend the structure of norms and beliefs that underpin the perfectly normal.⁶⁵

Circus always comes from somewhere else and features unconventional people, extraordinary bodies and feats that overcome pedestrian standards and are incommensurate with common human ability, such as juggling a dozen remarkably unrelated objects on a high wire while wearing pointed shoes and turning somersaults. Across different media, circus-in-space stories prove to include (standard) iconographic fixtures, conventions and narratives from the history of the historical circus—established understandings of the cultural circus phenomenon. In so doing, space stories recognise the circus's role as a cultural agent.

However, space narratives also transcend the 'traditional' motive and story reservoir of the circus, for instance through familiar storylines that end differently than expected, and by depicting the circus world as a trapdoor leading to a

⁶²Cf. Weihe, Richard: *Die Paradoxie der Maske: Geschichte einer Form*, München: Fink 2004, 50.

⁶³Cf. Weihe 2004, 110.

⁶⁴Iser 1993, 76.

⁶⁵Christen 2019.

supernatural or fictional insanatorium. Space circuses can thus be electrifying, super-powered and ‘spongy-gah’ (see above; the Big Top of the Circus Galacticus is described as “*spongy. Gah.*”). They can also emerge as a collectively created virtual reality (“The Thaw”). The juxtaposition of the ‘historical’ circus imaginary with such historically undocumented circus facets does not lead to a redrawing of the past, but enlarges our understanding of the circus’s narrative and cultural potential. The cultural insistence on formula and repetition implies that something is at stake, that the narrative patterns of circus stories enact long-standing debates, fantasies, or desires. It also suggests that film makers and writers had an eye on the considerable audiences that, in the mid- and late-20th century, and since, still enjoy ‘traditional’ circuses, the life of which captured the public’s imagination. Space circus routine is thus rooted in long-standing traditions of representation and performance, which it reactivates in the present, and from which it draws allegorical power. Space circus is a worm and rabbit hole, and invokes the image of a preserving jar, as in Salman Rushdie’s novel *Midnight’s Children*: “To pickle is to give immortality [...]. The art is to change the flavor in degree, but not in kind; and above all [...] to give it shape and form—that is to say, meaning.”⁶⁶

In space narratives, the comic archetype of the circus, i.e. the clown, turns out not to be an isolated instance of a modern literary or cinematic fascination with the comic extraordinary. Instead, he participates in a transhistorical discursive continuum that both informs the modern sensibility and predates it. Without being themselves the ‘evolved’ human of the future, space clowns embody the ways in which space narratives deal with the problem areas of representation, personal and cultural identity, the effect of technology on the human body, and of what is human in outer space. In accordance with their cultural background, space clowns do not engage in role play (in the way actors do when interpreting and realising dramatic texts or literarily fixed characters), nor do they appear as ‘private persons’. Instead, they play their own role, which is a real tour de force. They question the boundaries between self and surface, subject and object, control and loss of control, interior and exterior, masking and unmasking—and thus embody the impossibility of corporeal integrity in space contexts, symbolising in the process what posthuman clowning might be.

The director of *Killer Klowns from Outer Space* recently wrote: “The current reaction to modern clowns as objects to fear I believe is a cycle like any other cycle. In time, society’s view will change and clowns will change again. But clowns will always be part of our world as they have been for centuries.”⁶⁷ We can now add: they have been, and are, part of other worlds, too. And even when shot in the nose, space clowns will come back—and invite us to do the *clown warp* again.

⁶⁶Rushdie, Salman: *Midnight’s Children*, London: Jonathan Cape 1981, 444.

⁶⁷Chioldo in “Greatest Klown on Earth” 2019.

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Keeping the Torch Burning for ‘Good Science’ in Popular Culture: Video Games, Space, and Education

9

André Siebrits

Our passion for learning ... is the tool for our survival.
Carl Sagan (*Cosmos* (New York: Ballantine Books Trade Paperbacks, 2013), 294).

Abstract

Exploring ways in which space has become embedded in popular culture and consciousness is an essential endeavour since billions of people around the world rely on space systems in their daily lives. One of the challenges faced by the space community is raising awareness of this fact among the public and political decision makers, at a time when the more glamorous aspects of space are commonplace in modern culture such as the visual and performing arts. The purpose of this chapter is to illustrate and argue that popular culture, including video games, can also be a potent and valuable tool to educate the public and evoke their interest in space. I argue by way of six examples that video games as popular culture artefacts are (at least to some extent) enablers of the next wave of space exploration, and their educational value is worthy of more serious scholarly attention. The six examples are analysed in the context of a triangular model of popular culture, outer space, and video games, and illustrate the interest of the public in engaging with more challenging, technical, and practical aspects of space via a highly relevant and contemporary medium. This chapter is thus dedicated to a discussion of the six video games and highlights the part they are playing in a broader historical trend, especially in keeping the torch burning for ‘good science’ in popular culture, reflecting public interest in ‘unglamorous’ space, and in turn in promoting such interest and education around space.

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9.1 Introduction

This chapter seeks to explore the intersection between outer space and popular culture by way of a highly contemporary medium—video games. It is well known that outer space has, since long before the launch of Sputnik in 1957, had a profound impact on several areas of popular culture. These include fashion, art, television and films, architecture, toys, comic books, and others.¹ The ideas and excitement generated within popular culture, in turn, had an impact on the scientific explorations of outer space (as, for example, succinctly illustrated by Miller²). It is clear that outer space has figured heavily in the popular consciousness, especially prominent in the two decades after World War II, and at that time there “were references to rockets and space travel everywhere one looked, from television and movies to the pages of the Sunday comics to the hood ornaments of the latest-model Oldsmobile Rocket 88”.³ While in many ways this era represented the peak of public excitement around space, space continues to feature in a plethora of media.

Following this, it is reasonable to argue that the conceptions of space in popular culture continue to centre around its more ‘glamorous’ aspects, as was the case in the 1930s and 1940s when *Buck Rogers* and *Flash Gordon* promoted an “emphasis on swashbuckling romance and utter disregard for anything resembling science”.⁴ However, in this chapter, I posit that the idea of the more glamorous aspects of space being used within popular culture, for instance, to sell everything imaginable,⁵ is only one side of a more complex reality. Rather, I argue that via the contemporary popular culture medium of video games the ‘unglamorous’⁶ aspects of space are also being marketed to the public, and serve an important educational function. This also counters the idea that space and its impact on daily life are going unappreciated or unrecognised within the popular sphere, especially among the youth. Granted, the balance remains mostly in favour of the public only encountering ‘glamorous space’, for instance in films, and remaining unaware of the full impact of space on their daily lives, but the arena of video games does represent an

¹R. Kennedy, “When the Space Age Blasted Off, Pop Culture Followed,” *The New York Times*, September 25, 2007, <http://www.nytimes.com/2007/09/25/science/space/25pop.html> (accessed February 27, 2017).

²R. Miller, “Spaceflight and Popular Culture,” in *Societal Impact of Spaceflight*, ed. S. J. Dick and R. D. Launius, (Washington: National Aeronautics and Space Administration, 2007), 501–512, <https://history.nasa.gov/sp4801-part1.pdf> (accessed February 27, 2017).

³Ibid., 509.

⁴Ibid.

⁵A good example is a relatively recent television advert in South Africa promoting the products of a popular fast food outlet in a space-based setting, see: The Citizen, “WATCH: This has to be the best Chicken Licken ad ever,” December 6, 2016, <http://citizen.co.za/your-life/your-life-entertainment-your-life/1367259/watch-this-has-to-be-the-best-chicken-licken-ad-ever/> (accessed February 27, 2017).

⁶I refer here to ‘unglamorous’ as the more difficult, technical, and practical aspects of space, in contrast to ‘glamorous’ depictions glossing over these and presenting a more fictionalised vision of space, such as space opera.

avenue of ‘selling space’ to a public which is, in Sagan’s words, “starving for knowledge”.⁷

The following section will discuss and define some of the core concepts used in this chapter, and proffer a brief word on methodology. Following this, section three will deliberate the educational value of video games, before section four will delve into six examples that illustrate my argument. These are *Kerbal Space Program*, *Buzz Aldrin’s Space Program Manager*, *Take on Mars*, *Lunar Flight*, *Universe Sandbox*, and *Surviving Mars*. Each of these will touch on a different aspect of outer space, which will also be discussed, along with the accuracy of the portrayal. Together, these six video games have reached an audience of over seven million players.⁸

9.2 The Coming Together of Popular Culture, Video Games, and Outer Space: A Brief Review

A brief word on methodology will suffice before delving into the key concepts used in this chapter. Similar to the study conducted by Jones⁹ on the impact of ideas of space on popular culture through the medium of British films from the 1950s and 1960s, this chapter represents brief exploratory research with some descriptive aspects relating to the six examples listed above. It also incorporates cross-sectional research in the sense that the changing nature of space in popular culture, or in video games, will be beyond the scope of this chapter. Nevertheless, I argue that this particular locus represents an under-researched area within the broader space discipline, although the learning value of games is well known within e-learning circles, as discussed shortly. Purposive sampling was used vis-a-vis the video games, which Neuman¹⁰ argues is appropriate in the selection of cases that are “especially informative” or “trend setting”. While such a sample is not generalisable, purposive sampling is aimed “less to generalize to a larger population than it is to gain a deeper understanding of types”.¹¹

This chapter will explore the interrelationship between popular culture, video games, and outer space, as illustrated in Fig. 9.1, via the six examples. This model relates directly to the discussion that follows below. First, popular culture, as the ‘landscape’ for the bringing together of space and video games, will be explored as it forms the cornerstone concept. Second, a word will follow on video games as a medium of popular culture. Third, the interplay of space and popular culture will be

⁷Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Ballantine Books, 1994), 53.

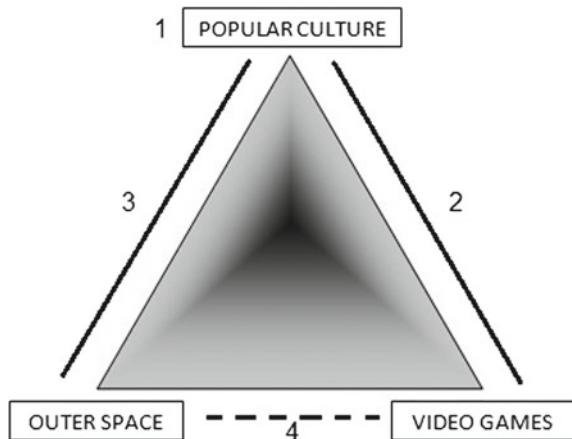
⁸Only includes ownership estimates for the Steam online gaming store, as reported by: Steamspy, Sergey Galyonkin, 2018, <https://steamspy.com/> (accessed December 4, 2018).

⁹R. A. Jones, “They came in peace for all mankind: popular culture as a reflection of public attitudes to space,” *Space Policy* 20, (2004):45–48.

¹⁰W. L. Neuman, *Social Research Methods: Qualitative and Quantitative Approaches* (Boston: Allyn and Bacon, 2003, fifth edition), 213.

¹¹Ibid.

Fig. 9.1 Conceptual space and interrelationships



considered. Fourth, the ‘triangle’ is then closed by considering the video game examples and their representations of space.

The first concept that requires clarification is necessarily that of popular culture. Storey¹² discusses the concept of popular culture in relation to that of material culture, and considers various questions, including popular versus ‘real’ culture, popular culture as commercial culture, who the people are in ‘popular’, and the ideological aspect of popular culture as a terrain in which class struggle is played out. Thus, Storey¹³ makes the point that “however we define popular culture, we are defining a social practice that entangles meaning and materiality”, and consequently, the material objects of popular culture “are never things in themselves, but always objects that are articulated in relation to a particular regime of realized signification, enabling and constraining particular types of social practice”. The point here is to impart a recognition of the complexities embedded within a concept such as popular culture, and later I will return to the aspect of enablement and constraint. For this study, however, a far more rudimentary conceptualisation shall suffice, namely that of Reid,¹⁴ who arrives at the following working definition of popular culture: “*a piece of media transmitted via the mass media that is popular and enjoyed by a majority population*”. Through this definition, it is possible to situate video games, and the broader video game industry, firmly within the realm of popular culture.

Thus we arrive at the second concept, video games, and more specifically video games as a medium of popular culture. The size of the video game industry is staggering. In 2017 in the United States alone, total consumer spending on video

¹²J. Storey, “Culture: The ‘Popular’ and the ‘Material’,” in *Materiality and Popular Culture: The Popular Life of Things*, ed. A. Malinowska and K. Lebek (New York: Routledge, 2017).

¹³Ibid., no pagination.

¹⁴A. J. Reid, “Video Games as Popular Culture,” *Medium*, January 29, 2014, <https://medium.com/@ajreid93/video-games-as-popular-culture-49d22adbd091#.v1uy0dqp> (accessed February 27, 2017). Emphasis in original.

games reached \$36 billion, with the value added by the gaming industry to US GDP reaching more than \$11.7 billion.¹⁵ The average age of the most frequent game purchaser is 36, with 61% being male and 39% being female.¹⁶ Additionally, the age of the average gamer is 34, with 45% of US gamers being women, and with 11% of male and 12% of female gamers being over 50 years of age.¹⁷ Devices used for gaming are Personal Computer (41%), smartphone (36%), wireless device (24%), dedicated game console (36%), dedicated handheld system (14%), and virtual reality devices (8%).¹⁸ In this chapter, I will focus on the PC segment. According to estimates, the global video games market is expected to reach \$137.9 Billion in 2018 with 2.3 billion gamers.¹⁹

The figures reveal the highly dynamic and broad-ranging nature of video games, as well as their pervasive nature and widespread appeal to all ages. Given the sheer number of gamers and the economic importance of the gaming industry and market, news reports have emerged in recent times recognising and exploring the impact of video games on the broader popular culture. Examples of these include Alderman,²⁰ who explores how video game “culture and ideas” have begun to influence other art forms, such as theatre. Similarly, Keogh,²¹ writing for Australian ABC News, argues that video games “are now reaching a cultural legitimacy previously reserved for things like film, music and literature”, but that until recently they were confined to the “cultural margins” for two reasons. First, they need to be learned as opposed to merely observed, and second, they have historically been regarded as “simply a thing young men do”, i.e. they were seen as part of a specific subculture. Of course, given the reality revealed by the figures above, these perceptions have shifted. However, despite these perceptions of video games only belonging to a subculture, Keogh²² posits that video games “have been significant and influential popular culture artefacts since their inception” and one has merely to regard “the past 50 years and you see the influence of video games on electronic music, on the special effects on movies, on the military, on increasing the popularity of personal computers”.

¹⁵Entertainment Software Association (ESA), “Essential Facts about the Computer and Video Game Industry: 2018 Sales, Demographic, and Usage Data,” April 2018, 10–14, http://www.thesa.com/wp-content/uploads/2018/05/EF2018_FINAL.pdf (accessed December 4, 2018).

¹⁶Ibid., 13.

¹⁷Ibid., 6.

¹⁸Ibid., 5.

¹⁹Tom Wijman, “Mobile Revenues Account for More Than 50% of the Global Games Market as It Reaches \$137.9 Billion in 2018,” newzoo, April 30, 2018, <https://newzoo.com/insights/articles/global-games-market-reaches-137-9-billion-in-2018-mobile-games-take-half/> (accessed December 4, 2018).

²⁰N. Alderman, “Videogames have had an amazing influence on popular culture,” *The Guardian*, April 14, 2015, <https://www.theguardian.com/technology/2015/apr/14/naomi-alderman-gaming-culture-interactive-culture> (accessed February 27, 2017).

²¹B. Keogh, “You can’t ignore the cultural power of video games any longer,” *ABC News*, April 6, 2016, <http://www.abc.net.au/news/2016-04-06/keogh-why-you-should-care-about-video-games/7303744> (accessed February 27, 2017).

²²Ibid.

The third concept is that of outer space, specifically as it figures in the popular realm. Miller's consideration of this relationship is excellent as it highlights clearly how "Astronautics is unique among all the sciences in that it owes its origins to an art form".²³ This is because art and literature were the only means for the general public to explore or engage with outer space for centuries until technology made a more direct exploration possible. Miller discusses several examples of this, but here the underlying trend is of greater interest. Firstly, Miller points out that the arts "kept the torch of interest [in space] burning".²⁴ This, I argue, remains true today. Second, Miller notes a clear historical trend in public interest in space. Initially, coinciding with the discovery and settlement of the New World, there emerged a spate of "space travel stories", but these were, for obvious reasons, devoid of sound scientific basis.²⁵ Next, as the reading public became more scientifically aware in the nineteenth century, they demanded better (i.e. more scientifically based) content. This made it "*necessary to provide an interplanetary story with the trappings of real science*".²⁶ In turn, these works impacted the "seminal founders of astronautics", who were "directly inspired by the space novels of Jules Verne and others".²⁷ These founding figures finally impacted popular culture (thus closing the circle), such as the work of von Braun and Bonestell, which appeared in a magazine series²⁸ in the 1950s and had a significant influence on public conceptions of space travel.²⁹

Two concluding remarks will suffice here. First, Miller identifies two basic features of space in popular culture—"it ... *reflected* contemporary fascination with space travel", and "it *helped fan* it into a blaze".³⁰ Second, by space flight becoming common, it greatly reduced public interest (especially in works displaying "good science and positive images about the future of space flight" as opposed to the space opera 'abyss'), and now "there appears to be less interest in space travel than there was in 1957, or even 1947", such that one can claim that "the Golden Age of space travel occurred before space travel became a reality".³¹ The discussion of the six video games will highlight the part they are playing in the broader historical trend, especially in keeping the torch burning for 'good science' in popular culture, reflecting public interest in 'unglamorous' space, and in turn in promoting such interest and education around space. It is to this education that we turn in the next section.

²³Miller, "Spaceflight and Popular Culture," 501.

²⁴Ibid.

²⁵Ibid., 502.

²⁶Ibid., 504. Emphasis in original.

²⁷Ibid., 505–507.

²⁸Ibid., 510.

²⁹Ibid., 511. Emphasis added.

³⁰Ibid., 512, 508.

9.3 The Educational Value of Video Games

The video game examples in this chapter were not selected because they are classified as ‘educational’ or ‘serious’ games at their core. While it is true that one of the examples has been specifically adapted for use in the classroom as a serious teaching and learning tool, this is not true for the others. Moreover, I posit that by precisely *not* selecting games that are used in an educational niche environment, they can better illustrate the use of space in a broader popular context. Nevertheless, in order to make the point that the general gaming public is indeed learning about space from video games, and especially about the less ‘glamorous’ aspects, it is necessary to—briefly—consider a few points on how games can serve as a learning tool.

Since the turn of the century, authors such as Prensky³¹ have argued that “today’s learners are different from their parents and from all previous generations” as a result of having grown up in a digitally connected world. This argument has been taken so far as to suggest that the brains of this digital generation have changed as a result of their constant interaction with technology.³² While there have been critics to this argument,³³ it cannot be denied that the ‘millennial’ generation as a whole is spending more time engaging with technology—and especially video games—than ever before. In fact, in the US, 63% of households have at least one person who spends three hours or more per week gaming.³⁴ Critically, three-quarters of gamers report that gaming “provides mental stimulation or education”.³⁵ Moreover, as was seen earlier, the impact of gaming also extends beyond the youth (recall the average age of a gamer is 34), and 62% of parents whose children play games join them in this activity at least on a weekly basis.³⁶

Video games, when well developed, offer a powerful combination of principles that promote learning. This, as I will argue in the next section, is true for all six examples used in this chapter. These principles, outlined by Trybus³⁷ are: (i) use of a simplified version of a real-world domain; (ii) the encouragement of critical and active engagement and learning; (iii) the promotion of a cycle through which the player can probe the game world, reflect on the outcome, form a hypothesis based on the outcome, and then re-probe the game world; and finally (iv) the

³¹M. Prensky, “Digital Game-Based Learning,” *ACM Computers in Entertainment* 1, no. 1 (2003): 2.

³²Ibid.

³³For such a critique in the South African context see L. Leonard, T. Mokwele, A. Siebrits and J. Stoltenkamp, “‘Digital Natives’ Require Basic Digital Literacy Skills,” in *The IAFOR International Conference on Technology in the Classroom—Hawaii 2016, USA: Official Conference Proceedings* (Naka Ward, Nagoya, Aichi, Japan: The International Academic Forum (IAFOR), 2016), 19–35, https://www.uwc.ac.za/elearning/Documents/IICTCHawaii2016_proceedings.pdf.

³⁴Entertainment Software Association (ESA), “Essential Facts about the Computer and Video Game Industry,” April, 2016, 2, <http://www.thesa.com/wp-content/uploads/2016/04/Essential-Facts-2016.pdf> (accessed February 27, 2017).

³⁵Ibid., 6.

³⁶Ibid., 9.

³⁷J. Trybus, “Game-Based Learning: What it is, Why it Works, and Where it’s Going,” *New Media Institute*, 2014, <http://www.newmedia.org/game-based-learning-what-it-is-why-it-works-and-where-its-going.html> (accessed February 27, 2017).

encouragement of practice on learners' own terms. As Trybus³⁸ argues, "to progress in a game is to learn; when we are actively engaged with a game, our minds are experiencing the pleasure of grappling with (and continuing to understand) a new system ... [which] is true whether the game is considered 'entertainment' ... or 'serious'...".

The following section will discuss the six video game examples, along with their use of space.

9.4 Six Video Game Examples of the Use of Space in Popular Culture

Very few examples exist in the scholarly literature of authors considering the educational value of space-themed video games, and even fewer (if any) about *Kerbal Space Program*, *Buzz Aldrin's Space Program Manager*, *Take on Mars*, *Lunar Flight*, *Universe Sandbox*, and *Surviving Mars*. In terms of what value video games offer for educating the public on space matters, practically no research has been done, signifying a gap in the literature. While this study constitutes only a tiny step in this direction, this gap is worthy of consideration given the impact of video games on popular culture. The games elected here all fall predominantly within the 'simulation' category, and to various extents, encapsulate the "good science and positive images" lauded by Miller.³⁹ Some cursory statistics for each game will also be discussed, although reliable figures are hard to establish.

9.4.1 Kerbal Space Program (KSP)—Rocket Propulsion, Orbital Mechanics, and Spaceflight

Developed by Mexican gaming studio Squad, KSP represents by far the most popular and widely known of the six examples. Steamspy, which produces estimates of sales based on the most popular video game marketplace, Steam, which has over 100 million users and an average of 10–14 million active users per day, indicates that between 2 million and 5 million copies of KSP have been sold to date via the Steam store.⁴⁰ While the reliability of these figures is uncertain, and they do not take into account sales from Squad's own online store (or other retailers), they are at least suggestive of the game's popularity.

In KSP, players must use a variety of parts and components to construct functioning spacecraft and launch vehicles, with which they can then send the Kerbal

³⁸Ibid.

³⁹Miller, "Spaceflight and Popular Culture," 511.

⁴⁰Steamspy, "Kerbal Space Program," Sergey Galyonkin, 2018, <http://steamspy.com/app/220200> (accessed December 4, 2018); J.L. Wilson, "Steam (for PC)," PCMag Digital Group, December 9, 2016, <http://www.pc当地/2017/2392198.00.asp> (accessed February 27, 2017).

occupants to various destinations within the Kerbol solar system.⁴¹ This solar system, while much smaller in mass and scale than our own (to simplify the experience), is nevertheless modelled on it, providing familiar analogues to astronomical bodies such as the Moon, Mars, Mercury, and Jupiter. Underneath its colourful appearance, KSP manages, according to a study conducted to assess its impact in a first-year Engineering course (one of very few such studies), to produce “a somewhat realistic depiction of the physics of rocket propulsion and spaceflight, providing students an environment to explore these concepts as they played”.⁴² Arguably, while only ‘somewhat’ realistic from an academic professional’s viewpoint, KSP represents the first direct experience of an average member of the gaming public with orbital mechanics and rocket propulsion, not to mention concepts such as Hohmann and bi-elliptic transfers, Delta V, specific impulse, orbital apoapsis and periapsis, and aerobraking—concepts usually omitted in space films such as *Gravity*.

While it is true that players can enjoy the game without delving deeper into these mechanics, KSP players have formed a large and active community, and some of the members produce content, such as Youtube videos, that expand on these concepts. One of these is Scott Manley, who, with a background in astronomy and physics, markets himself as an “astronogamer”, and maintains a popular Youtube channel with over three-quarters of a million subscribers in which he explores concepts used in KSP.⁴³ Some of these include: *Why do Ion Thrusters use Xenon?*, *Rocket Engine Plumbing*, and *Can Kerbal Space Program Really Teach Rocket Science?* (the answer is yes, especially for the general gaming public). Beyond this, the KSP community on Reddit (with 435,000 members) and on the Squad official forums (with hundreds of thousands of posts) host regular challenges (such as recreating the Apollo lunar landing) and discussions of ideas around various spacecraft designs and concepts.⁴⁴

Beyond this gaming community, KSP has also received recognition within the scientific community. The National Aeronautics and Space Administration (NASA) reached out to Squad in 2013 via Twitter, and after collaborating with the developers, an asteroid redirect mission was introduced into the game.⁴⁵ This was part of a concerted effort by NASA to promote public interest in space, and represents a recognition that “[g]ames are, after all, becoming the primary medium for a new

⁴¹Squad, “About Kerbal Space Program,” *Take-Two Interactive, Inc.*, 2018, https://kerbalspaceprogram.com/en/?page_id=7 (accessed December 4, 2018).

⁴²J. Ranalli and J. Ritzko, “Assessing the Impact of Video Game Based Design Projects in a First Year Engineering Design Course,” *2013 IEEE Frontiers in Education Conference (FIE)*, October, 2013, no pagination, <http://ieeexplore.ieee.org/document/6684880/?reload=true> (accessed February 27, 2018).

⁴³See <https://www.youtube.com/user/szyzyg/videos>.

⁴⁴Reddit. “Kerbal Space Program,” *reddit inc.*, 2018. <https://www.reddit.com/r/KerbalSpaceProgram/> (accessed Decemver 4, 2018); Squad, “Kerbal Space Program: Forums,” *Take-Two Interactive, Inc.*, 2018, <http://forum.kerbalspaceprogram.com/> (accessed December 4, 2018).

⁴⁵S. White, “Minecraft in space: why NASA is embracing Kerbal Space Program,” *The Guardian*, May 22, 2014, <https://www.theguardian.com/technology/2014/may/22/kerbal-space-program-why-nasa-minecraft> (accessed December 4, 2018).

generation of digital natives”.⁴⁶ Beyond this, many within NASA had become followers of KSP, and by 2013, “half of JPL [Jet Propulsion Laboratory] was playing KSP”.⁴⁷ Even Elon Musk has publicly expressed his admiration of KSP.⁴⁸ While KSP has thus achieved high levels of fame and success in spreading awareness of space (with formal recognition of this from NASA) and could be considered an outlier in the video game world, it nevertheless serves to illustrate that video games can market more technical (and less space opera) aspects of space in a way that can reach, and appeal to, the public at large (the asteroid redirect mission is a good example). A further development of this was the release of KerbalEdu, an “official school-ready standalone remix” of KSP for use in classrooms.⁴⁹

9.4.2 Buzz Aldrin’s Space Program Manager (BASPM)—Space Flight History and Management, Space Race

Developed by Polar Motion in collaboration with Buzz Aldrin, and published by Slitherine, BASPM gives players an insight into the dynamics of the Space Race between the US and the Soviet Union, as well as the historic space missions undertaken by both sides.⁵⁰ It was officially released in October 2014. The player assumes control of either the US or Soviet space program with the goal of landing humans on the Moon first. Along the way, the game requires players to “[c]arefully manage [their] budget by opening programs, spending R&D funds on improving the hardware, recruiting personnel and launching space missions in this realistic turn based strategy game”.⁵¹ The game takes place entirely during the Space Race era and covers the years 1956–1973. The player is responsible for hiring personnel (astronauts, researchers, flight controllers), opening programs (such as Project Mercury), researching the various components (such as the Redstone booster and Mercury capsule), and then launching the missions, which have a success chance based on how well the player prepared the personnel and components. Throughout, players can access the “Buzz-opedia” which “gives background information on the real programs, missions and hardware throughout the game”.⁵²

⁴⁶Ibid.

⁴⁷M. Emanuelli, “Kerbal Space Program: The Spaceflight Simulator that Conquered JPL,” *Space Safety Magazine*, August 12, 2013, <http://www.spacesafetymagazine.com/aerospace-engineering/rocketry/kerbal-space-program-space-flight-simulator-captured-jpl/> (accessed February 27, 2017).

⁴⁸J. Grubb, “SpaceX, Tesla founder Elon Musk loves Kerbal Space Program, Mass Effect, and Civilization,” *VentureBeat*, January 6, 2015, <http://venturebeat.com/2015/01/06/spacex-tesla-founder-elon-musk-loves-kerbal-space-program-mass-effect-and-civilization/> (accessed February 27, 2017).

⁴⁹Squad, “KerbalEdu,” *Take-Two Interactive, Inc.*, 2018, <http://www.kerbaledu.com/> (accessed December 4, 2018).

⁵⁰Slitherine Ltd., “Buzz Aldrin’s Space Program Manager,” 2018, <http://slitherine.com/products/product.asp?gid=462&PlatformID=1> (accessed December 4, 2018).

⁵¹Ibid.

⁵²Ibid.

In contrast to KSP, BASPM has a much smaller community (primarily on the Steam Community Hub, with 300 active topics, and the Slitherine forums with over 5000 posts), and Steamspy estimates up to 20,000 copies were sold via the Steam platform (though more could be purchased directly from the publisher).⁵³ BASPM has also not received the same hype as KSP from the space community. Nevertheless, while presenting a simplified version of the history of the Space Race, it allows players to gain an insight into the dynamics of the time, and to explore alternative avenues for reaching the Moon. This includes the possibility of developing a Gemini lunar lander instead of Project Apollo or developing a direct ascent strategy, which sheds light on some of the less well-known options that were considered by the superpowers at the time. Although the reach of BASPM is quite small, and its slower-paced strategic nature might limit interest from the gaming public—for instance on mobile devices only 6% of gamers play strategy games⁵⁴—it is nevertheless encouraging to consider that thousands of people have been exposed to the history of space flight during the Cold. This can again be argued as representing an instance of marketing the ‘unglamorous’ aspects of space (personnel and programme management, research and development, and spaceflight history) successfully to the public.

9.4.3 Take on Mars (ToM)—Robotic and Human Exploration of Mars

Only officially released in February 2017, but with an extended early access period, ToM was developed and published by Bohemia Interactive, and allows players to “[p]ioneer the exploration, and colonization, of the Red Planet”.⁵⁵ Simultaneously capitalising on, and promoting, public interest in the exploration of Mars, ToM allows players to conduct their own robotic missions, including rovers and landers—mirroring historic real-life efforts. However, ToM then goes further, allowing players to engage in manned missions in which they can experience walking around on the Red Planet, building outposts, and dealing with the harsh environmental challenges. The level of simulation is quite advanced, and players can “[e]xperience motion in locations with different gravity strength, including Zero-G. Break off cameras, robotic arms, or even individual struts and wheels - all affecting the way your vehicle handles. Each object, system, and instrument in Take On Mars is

⁵³Valve Corporation, “Buzz Aldrin’s Space Program Manager: Discussions,” 2018, <http://steamcommunity.com/app/308270/discussions/> (accessed December 4, 2018); Slitherine Ltd., “Buzz Aldrin’s Space Program Manager: Forum,” 2018, <http://www.slitherine.com/forum/viewforum.php?f=226&sid=f6b78bf7feb7c44201b2c54fa956a974> (accessed December 4, 2018); Steamspy, “Buzz Aldrin’s Space Program Manager,” Sergey Galyonkin, 2018, <http://steamspy.com/app/308270> (accessed December 4, 2018).

⁵⁴Entertainment Software Association (ESA), “Essential Facts about the Computer and Video Game Industry,” 2016, 5.

⁵⁵Bohemia Interactive, “Take on Mars,” 2018, <http://mars.takeonthegame.com/> (accessed December 4, 2018).

accurately simulated to offer a truly authentic experience”.⁵⁶ ToM also allows players to “[d]iscover interesting facts about the Red Planet with the in-game Mars Encyclopedia”, to “extract raw materials from Martian soil and build [their] own habitat panel by panel”, and “utilize botany to grow crops, and operate various vehicles to keep you and your crew alive”.⁵⁷

As could be expected with such a contemporary topic, ToM has sold between 50,000 and 100,000 copies, and hosts quite active communities on Steam (277 active topics) and the official Bohemia Interactive forum (over 2900 posts).⁵⁸ ToM in particular can be presented as an excellent example of fanning public interest in an area of space that, in order to reach the currently much-publicised goal of sending humans to Mars, will require very high levels of public interest in order to motivate politicians to divert sufficient funds to support such an effort at the political level. For instance, recall the argument that spaceflight in popular culture also serves to fan public interest, which in turn in the 20th century “was instrumental in raising public awareness of the reality of imminent spaceflight, and it also informed a government that was about to spend many billions of dollars on a space program that it had the *enthusiastic support of its taxpayers*”.⁵⁹ While these video game examples constitute only a tiny part of the use and manifestation of space in popular culture, they nevertheless (a) reflect by their sales that the gaming public is interested in the often more ‘unglamorous’ side of space, and (b) in turn educate and promote further enthusiasm.

9.4.4 Lunar Flight—Lunar Module Flight

Officially released by Australian developer Shovsoft in January 2012, and featuring full Virtual Reality mode, Lunar Flight offers players the opportunity to pilot a lunar lander across the Moon’s surface, in order to complete several objectives such as “Transporting Cargo, Acquiring Data at Survey locations and locating Lost Cargo”.⁶⁰ Taking place in a fictional alternative future in which humanity continued to venture to the Moon after Apollo, eventually setting up bases there, Lunar Flight offers a simulated environment which “features correct Newtonian physics behaviour and will provide one of the most authentic and dynamic space based, low gravity flight experiences”.⁶¹ In essence a Lunar Module pilot simulator, Lunar

⁵⁶Bohemia Interactive, “Take on Mars: About,” 2018, <http://mars.takeonthegame.com/about> (accessed December 4, 2018).

⁵⁷Ibid.

⁵⁸Steamspy, “Take on Mars,” Sergey Galyonkin, 2018, <http://steamspy.com/app/244030> (accessed December 4, 2018); Valve Corporation, “Take on Mars: Discussions,” 2018, <http://steamcommunity.com/app/244030/discussions/> (accessed December 4, 2018); Bohemia Interactive, “Bohemia Interactive Forums: Take on Mars,” 2018, <https://forums.bistudio.com/forum/173-take-on-mars/> (accessed December 4, 2018).

⁵⁹Miller, “Spaceflight and Popular Culture,” 511. Emphasis added.

⁶⁰Shovsoft, “About: Lunar Flight,” 2018, http://www.shovsoft.com/lunarflight/?page_id=2 (accessed December 4, 2018).

⁶¹Ibid.

Flight requires that players cope with the difficulties of fuel management, cancelling out momentum, and weight restrictions.

Perhaps surprisingly for such a technical game, between 50,000 and 100,000 copies have been sold, and the Steam community hosts 250 active topic discussions, while the Shovsoft forum has over 3000 posts.⁶² The level of simulation, while simplified like all the previous examples, provides a high level of realism, especially when combined with a VR experience. Indeed, while it can be argued that flying a spacecraft over the lunar surface is a glamorous depiction of space, the game nevertheless requires players to progress along a ‘career’ path by performing what could be considered mundane but challenging tasks such as ferrying cargo around, before they can unlock new upgrades. That one hundred thousand people are prepared to engage in such an activity indicates once again that members of the public are willing and interested to learn about the intricacies of piloting a spacecraft, and are prepared to invest many hours towards that goal. This, I argue, is again proof that space can be successfully marketed to the public in an educational manner.

9.4.5 Universe Sandbox—Physics and Astronomy Simulation

This discussion relates to the more recent (August 2015) Universe Sandbox 2, which like its predecessor, was developed and published by Giant Army. Perhaps the most scientifically realistic of the six, Universe Sandbox 2 constitutes a “scientifically accurate space and gravity simulator” that “merges real-time gravity, climate, collision, and physical interactions”.⁶³ While not able to account for general relativity, the simulation that players can interact with does offer a gravity model based on the n-body problem, with “[g]ravity in Universe Sandbox² ... simulated as an n-body problem. An n-body simulation takes small steps forward in time and looks at how each body affects each other body in the system, then moves them accordingly”.⁶⁴ Again, the developers admit that many aspects of simulating space are simplified in order to speed up performance on desktop computers and to still make it engaging for the general public.

However, perhaps more than any of the other games discussed in this chapter, Universe Sandbox 2 typifies the marketing of ‘unglamorous’ space to the public. Players can either interact with a highly realistic simulation of our solar system, or create their own, with the ability to create collisions between space objects, model the climate of Earth, deform planet surfaces or terraform them entirely, and even

⁶²Steamspy, “Lunar Flight,” Sergey Galyonkin, 2018, <http://steamspy.com/app/208600> (accessed December 4, 2018); Valve Corporation, “Lunar Flight: Discussions,” 2018, <https://steamcommunity.com/app/208600/discussions/> (accessed December 4, 2018); Shovsoft, “Lunar Flight: Forum,” 2017, <http://www.shovsoft.com/forum/> (accessed March 1, 2017).

⁶³Giant Army, “Universe Sandbox 2: Frequently Asked Questions,” 2015, <http://universesandbox.com/faq/> (accessed December 4, 2018).

⁶⁴Ibid.

create supernovae.⁶⁵ Players can alter mass, density, radius, age, surface temperature, velocity, rotational period, surface gravity and escape velocity, among many other variables to see the results on the body in question. The fact that this simulation program is sold to the public as a game in many ways belies the perception that the public is either only exposed to ‘glamorous’ space, or not interested in the more technical or scientifically-based aspects. It may seem most surprising of all that combined, Universe Sandbox 1 and 2 have sold over a million copies.⁶⁶

9.4.6 Surviving Mars—Mars Settlement and Colony Management

The most recent of the six examples, Surviving Mars was released in March 2018 by Swedish developer and game publisher Paradox Interactive.⁶⁷ Surviving Mars simulates the near future scenario of establishing the first colony on the Red Planet and takes a broader view than ToM discussed above. Instead, it allows players to “[c]choose a space agency for resources and financial support before determining a location for [their] colony”, including American, European, Chinese, Russian, and other agencies, with ‘SpaceY’ also available, while then allowing players to “[b]uild domes and infrastructure, research new possibilities and utilize drones to unlock more elaborate ways to shape and expand [their] settlement”.⁶⁸ Players are challenged to build a sustainable colony with food production, medical facilities, housing, mining, factories, exploration, and an array of other aspects, with “[i]ndividually simulated colonists”.⁶⁹ In more recent updates, Surviving Mars also contains aspects of competition with rival Martian colonies. Steamspy reports sales between 200,000 and 500,000 copies, while the Steam forum has over 400 active topics, with the Paradox Interactive forum having over 7500 messages.⁷⁰ As with ToM, Surviving Mars provides insights into some of the challenges and discoveries that humanity will face in the future, including the provision of basic services and support to human colonists, and the consequences of failure, although it takes a wider colony-based perspective. Supplying fresh water and coping with cold waves which freeze water reserves and pipes, supplying power while dealing with long-lasting dust storms coating solar panels, supplying oxygen from the Martian

⁶⁵Giant Army, “What is Universe Sandbox 2?,” 2015, <http://universesandbox.com/> (accessed December 4, 2018).

⁶⁶Steamspy, “Universe Sandbox,” Sergey Galyonkin, 2018, <http://steamspy.com/search.php?s=universe+sandbox> (accessed December 4, 2018).

⁶⁷Paradox Interactive, “Surviving Mars,” 2018, <https://www.paradoxplaza.com/surviving-mars/SUSM01GSK-MASTER.html> (accessed December 4, 2018).

⁶⁸Ibid.

⁶⁹Ibid.

⁷⁰Steamspy, “Surviving Mars,” Sergey Galyonkin, 2018, <http://steamspy.com/app/464920> (accessed December 4, 2018); Valve Corporation, “Surviving Mars: Discussions,” 2018, <https://steamcommunity.com/app/464920/discussions/> (accessed December 4, 2018); Paradox Interactive, “Forums: Surviving Mars,” 2018, <https://forum.paradoxplaza.com/forum/index.php?forums/surviving-mars.983/> (accessed December 4, 2018).

atmosphere while repairing damage caused by micro meteoroids, and organising resupply vessels from Earth while generating and supplying them with fuel produced from Martian resources are all realistic aspects of the game that will be an inescapable feature of Martian exploration in the future. Surviving Mars allows players to safely explore, engage with, and gain an understanding of the aspects mentioned above that would not be easily possible otherwise (including the forthcoming addition of Martian terraforming to the game). Once again it also fans support for, and interest in, human space exploration.

9.5 Conclusion

This chapter, while providing only an initial and cursory step towards understanding the interplay between space, popular culture, and video games, has nevertheless sought to illustrate that the public engages with space, including its less glamorous aspects, *for its own sake*, rather as a mere tool in the hand of smart product advertisers. The success of the video game examples discussed above in ‘selling’ space to the public in an entertaining format, is illustrated by the many hundreds of thousands of buyers willing to pay for the experience. While I fully acknowledge that the primary motive of the game developers is to make a profit and to provide entertainment, the fact that they successfully engage space in a rather sophisticated way to do so is suggestive. It is precisely this that piqued my interest in these examples and this popular medium—that thousands, even millions, of ordinary members of the public are hungry to engage with more challenging aspects of space, and will readily do so if the means of engagement is entertaining and enjoyable. I believe that in this, interactivity is key.

This is possible because those principles highlighted earlier by Trybus⁷¹ are all present in each of the six video games I have discussed. Thus, while these remain video games rather than formal educational tools (with the exception of KerbalEdu) there is a reason to suspect that their players do engage in learning about space. Of course, it will be up to future research to investigate whether this suspicion has a basis in fact, by taking a much more in-depth look at the experiences and obtaining reliable survey data from the players.

Earlier, I mentioned the enablements and constraints of popular culture. By not only satisfying public interest in space but in *fuelling* it, video games as popular culture artefacts are (at least to some extent) enablers of the next wave of space exploration. Moreover, they are part of the trend identified by Miller⁷²—that a more scientifically sophisticated public will demand more scientifically accurate ‘space

⁷¹Trybus, “Game-Based Learning: What it is, Why it Works, and Where it’s Going.”

⁷²Miller, “Spaceflight and Popular Culture.”

stories'. That this potential of video games has been recognised at the highest levels of the space community, such as NASA, prompts us to devote more serious scholarly attention to them. It is, after all, quite likely that upcoming space professionals will be (or will have been) gamers who learnt something of space through a video game. In fact, one of them authored this chapter.

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Regarding Influences of Space on Popular Culture via the Medium of Science Fiction

10

Neal Prins

Fiction is a kind of fact, although it takes some people centuries to get used to it. To point out that its substance is imaginary, or fantastic, is no criticism of it, for that is the kind of fact it is: a thing man has thought or imagined, rather than observed or made.

Raymond Williams

Abstract

In the last 60 years or so, more and more science fiction authors have included space in their stories. The effects of space in the stories have increased dramatically as well. To a certain extent, science fiction (SF) is now mostly about space related subjects, or makes use of science that would not have been possible without space exploration. The five examples discussed in this chapter are just a small selection but serve to illustrate this point well. Most of the authors mentioned use real science (practical or theory) and interweave it in their stories in a way most laymen would be able to understand fairly easily. This makes the narrative vastly more enjoyable, as it gives the reader hope that such occurrences may one day be our reality, instead of just being ideas on pages in a dusty old book. To support the discussion, a model is presented of the constructive dialogue of SF elements, and the use of the space element is analysed through relevant literature.

Raymond Williams, “Science Fiction”, *Science Fiction Studies* 15, no. 3 (1988): 356.

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10.1 Introduction

In this chapter we will be exploring the ways in which ideas of space have been used in the genre of science fiction (SF) for a variety of purposes and in a myriad of ways, sometimes unforeseen to the authors themselves. By now it is fairly obvious that space has become the de facto ruler of the SF genre, and is particularly employed as a means of affecting the people and their situations in a narrative, in a similar manner to how old tales would use the environment that the characters are into emphasise their travails. All of the examples used in this chapter follow this trend to a greater or lesser degree. First, there is David Weber, with the *Honor Harrington* series (I say series as there are more than 30 books related to the series in some way or form). Second, there is John Ringo with the *Looking Glass* series. Third, there is Steve White with the *Starfire*-series (some of these are co-authored by David Weber and other authors as well). Fourth, John Ringo is considered again with the *Troy Rising* series. Fifth and finally, Lois McMaster Bujold is considered with the *Vorkosigan* series. There are other examples worth mentioning as well: John Ringo again, with *The Legacy of the Aldenata Series*, David Drake's *RCN* Series, CJ Cherryh with the *Foreigner* series, Travis S. Taylor with his *The Tau Ceti Agenda* series, *Bolos* created by Keith Laumer, and many others. However, first it is necessary to sketch out the background in terms of theoretical model to be used in the analysis, and considerations on SF as a medium in general.

10.2 Possibility Space

This section will provide a brief consideration of the approach undertaken in the analysis of the abovementioned examples, as well as a model to guide this. Firstly, to define SF it is useful to consider the definition of Moskowitz (cited in Steinmüller¹) that SF is a “branch of fantasy identifiable by the fact that it eases the ‘willing suspense of disbelief’ on the part of its readers by utilizing an atmosphere of scientific credibility for its imaginative speculations in physical science, space, time, social science and philosophy”. However, as depicted in Fig. 10.1, to this definition it is possible to add that the SF genre is also defined by a creative juxtaposition of science, fiction, past, and future, and fruitful SF is a product of a constructive dialogue between these elements. The fertile ground on which they meet is where these elements become fused into a possibility space that directly influences our understanding of the past, our expectations of the future, and reflections on ourselves and how we will navigate the challenges ahead. If you look at SF another way, it is a way of predicting what can be reality in the future, but the medium can also act as a warning of the future if we are ill prepared to meet the inevitable challenges of space travel for example. This ‘translation’ of science/past into fiction/future (or even ultimately science/future) requires the creative interpretation of the author to re-imagine the future in ways so that challenges become

¹Karlheinz Steinmüller, “The uses and abuses of science fiction”, *Interdisciplinary Science Reviews* 28, no. 3 (2003): 175.

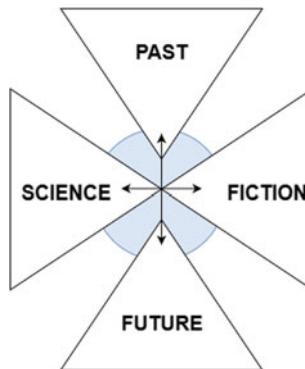


Fig. 10.1 Constructive dialogue of SF elements

apparent within our present frame of reference. This is also expressed by the observation of Pohl (cited in Steinmüller²) that “[a] good science fiction story should be able to predict not the automobile but the traffic jam”.

Before delving into the examples listed, it can be noted, as Williams has argued, that

SF has been put to service in almost every kind of traditional story. There are the stories of war and banditry, like *War of the Worlds* or Mr E.F. Russell's *A Present from Joe*. There are stories of adventure and exploration, beginning perhaps with Poe's story of a flight to the Moon, *The Unparalleled Adventure of one Hans Pfaal*, and continuing through nearly all the stories of Jules Verne to a recent example like Mr Arthur Porges' *The Ruum*. There is at least one ordinary murder story, Mr John Wyndham's *Dumb Martian*, which is also a common kind of love story. Men from flying saucers have been used as a contemporary *deus ex machina* in an otherwise realistic story, such as Mr Henry Kuttner's *Or Else*. There are humorous stories, like Mr H. Nearing's *The Cerebrative Psittacoid*, and trick stories like Katherine MacLean's interesting *Pictures Don't Lie*. Poe wrote a *Thousand-and-Second Tale of Scheherazade* using 19th-century scientific and technological wonders as a continuation of Sinbad: Scheherazade is strangled, for although the king believes in a sky-blue cow with 400 horns he will not believe in photography or the steamship. Earlier, Mary Shelley, in *Frankenstein*, had added SF to the Gothic novel, and this horrific strain has been very widely exploited. Mr C.L. Moore's *No Woman Born* is a recent “Frankenstein” type, and in the general field there is such a profusion of monsters from outer space or the ocean depths as to constitute an entire 20th-Century Bestiary.³

This review is useful in that it provides an overview of the reach and scope of SF in modern literature. Moreover, it is beneficial to reflect on the more specific seminal SF typology as presented by Williams. Williams classifies SF according to three types of thematic characteristics, namely Putropia, Doomsday, and Space Anthropology. Putropia is defined as the “characteristic 20th-century corruption of the Utopian romances” and contains elements of presenting “not so much an observation, but a current form of feeling, related primarily to contemporary

²Ibid., 176.

³Raymond Williams, “Science Fiction”, *Science Fiction Studies* 15, no. 3 (1988): 356–357.

society”, or put another way, “defended as an extension of obvious contemporary tendencies”.⁴ Doomsday “disposes of life altogether” in the sense that the narrative setting “used to have a God; it has none now”, in other words it presents the bleakest vision of the future.⁵ Space Anthropology presents a conscious use of “the SF formula to find what are essentially new tribes, and new patterns of living”.⁶ These typologies are still relevant to the SF medium in the sense that elements of the thematic characteristics are present to various degrees in all the examples mentioned previously. In some case, one typology will dominate, whereas in others, typologies are morphed to support the central theme of the narrative. For example, in the case of John Ringo’s *The Legacy of the Aldenata*, the Doomsday type is predominant. In the case of *Bolos* (Keith Laumer), all types are visible—for instance, Putropia is evident in the discussion of self-aware Artificial Intelligence (a highly contemporary topic), Doomsday is evident in the collapse of human civilization and an apocalyptic war, whereas Space Anthropology is evident in the ‘new patterns of living’ of the Bolos themselves where they assume human characteristics. In the examples below, these types will also be explored.

The science element in SF is also used in a variety of ways. For instance, Steinmüller argues that “[s]cience fiction writers use science in many ways, as foreground, background, context, or subject for their stories”.⁷ This framework of Steinmüller is also argued here as being applicable to the use of *space* in SF. This will be addressed in the following examples. Steinmüller also highlights the classifications of SF as ‘soft’ or ‘hard’/‘hard core’ in their treatment of science, in that the latter “tries to follow as closely as possible the established facts of hard science and technology” whereas the former is more of a background use of science in general terms.⁸ Again, the same applies to space. In this way I propose an analytical framework using the former concepts to create an analysis spectrum of the uses of space across ‘hard’ and ‘soft’ SF. All the books listed fall into the space opera category to a lesser or greater degree (space opera is a “subgenre of speculative fiction or science fiction that emphasizes romantic, often melodramatic adventure, set mainly or entirely in space, generally involving conflict between opponents possessing powerful (and sometimes quite fanciful) technologies and abilities”).⁹

These examples will now be discussed in greater detail.

⁴Ibid., 357–358.

⁵Ibid., 358–359.

⁶Ibid., 359.

⁷Steinmüller, “The uses and abuses of science fiction”, 176.

⁸Ibid.

⁹Goodreads, Inc., “Space Opera”, 2019, <https://www.goodreads.com/genres/space-opera> (accessed April 14, 2019).

10.3 Five Book Examples of the Use of Space in Popular Culture

The examples below are discussed by way of an initial summary of each relevant book/series, with an emphasis on how space features therein. This is then followed by an analysis in the Conclusion in relation to the model and framework discussed in the previous section.

10.3.1 Honor Harrington Series by David Weber¹⁰

The main focus of this series following the adventures or misadventures of the woman named Honor Harrington, and her companions. She begins her story with her assumption of command of the HMS Fearless (CL-56), a Light Cruiser class spaceship of the Royal Manticoran Navy which after an incident of them proving an admiral wrong, gets posted to a far away outpost of the kingdom, in a ‘show the flag’ exercise, where she has inadequate staff and equipment to do the job properly, but does it anyway. The first book ends with how she uses her old outdated ship to outmanoeuvre and outfight a superior foe. What makes this particularly interesting is the author’s description of the battles, the technologies used, and the clear rules of said technologies (hard SF). The ships use two different drives in this universe, one to move in a solar system, and one to go faster than light either through wormholes, or travelling through hyperspace.

The drive ‘tamed’ gravity waves to be used in normal space, and is called the impeller drive. The impeller drive created a pair of stressed gravity bands above and below a ship, known as the impeller wedge. Both sides of this wedge (above and below), were impenetrable by any known weapon in the universe. The missiles they used in space combat used the same drive, the only difference being, the speeds involved (a ship, even a warship, could only reach a maximum of about 500–800 gravities acceleration depending largely on the size of the warship in question and how advanced the drive and compensator were, while a missile could reach 60,000–80,000 gravities) which made this a one-use drive. This was because there was less of a need to provide as much safety for the components of the missile as there was a clear need to provide it for the crew of a ship, as ships used a gravity compensator. Basically, if the limit of the compensator is exceeded, it would fail catastrophically, and the crew would not survive. The other drive is what they used to travel faster than light, and is called the Warshawski sail. The sail was an adaptation of the usual gravitic node used in the impeller drive. It was an extended force field at the bow and stern of a starship perpendicular to the axis of the ship. It served as a way to control the forces which gravity waves produced in hyperspace. What follows in the subsequent stories is the long tale of how she and her kingdom tries to survive in a series of small skirmishes to very large space battles and wars against their aggressively natured neighbours, Haven, Solarian League and finally, the

¹⁰David Weber, *On Basilisk Station* (Riverdale, NY: Baen Publishing Enterprises, 1993).

Manpower Incorporated on the planet Mesa (and the people that actually ran them from a distance).

The way this universe worked, is almost like it used to work for empires and kingdoms that used sail powered ships, with no communication between continents or countries for months on end, because here there are very large distances involved between the solar systems, so most communications would come through the use of ships (specifically, specialised couriers), which would take weeks or months to reach their intended target. This clearly indicated the need for the officers or administrators of the kingdoms (or countries) to have a much higher degree of self-sufficiency and self-reliance, as they could not wait months for orders or decisions to be made by their superiors. Even in solar systems, there was a large communication lag, for instance, a missile would be fired, and by the time it reached its target about 6–8 million km away (and even more later on in the series when missiles would become more advanced and longer ranged), the firing ship would only know what the result was quite a few minutes later, as they used light speed sensors. While this is an oversimplification, as later on they did have Faster than Light (FTL) communications, for the most part the civilisations in this universe had to make do with STL (Slower than Light) communications for centuries.

10.3.2 John Ringo with the *Looking Glass* Series¹¹

In this book a scientist on earth experiments at a university, and inadvertently opens a porthole to another part of the galaxy. As a consequence, a race of beings that convert any and all organic matter, sentient or otherwise, and use this material to make more of themselves, discovers Earth. What follows is a long struggle in closing this portal, as more and more invaders flood the planet and humanity is sadly outclassed. The invaders in this case use genetically engineered beings, each designed with a specific purpose, and each ranked in a specific way, stronger and stronger the further up the chain one goes. There are also two different types, one land related, and one space related. In the first book, the human race narrowly succeeds in closing the portal, only to discover that the invaders also have FTL space travel, and if they cannot find allies or new technology to help them they would be doomed in a few years. Luckily another entity gives them a device at the end of the first book, which the humans figure out how to use as a hyperdrive. They then venture out in a converted submarine, to find said allies. Here, because the only part of the ship's technology that was advanced was the drive, they suffer numerous mishaps. Finally meeting a race that has also met the invaders (and almost lost), they then, with the newcomers help, create a new ship and have a chance of surviving. In this book, the level of science was very thorough, especially in the first book. Travis S. Taylor is the co-author and it is evident that the subject was thoroughly researched. They used real theories, and this made it particularly interesting in that it prompted further research into the terms used. What is also

¹¹John Ringo, *Into the Looking Glass* (Riverdale, NY: Baen Publishing Enterprises, 2005).

striking, is that if we go out into the unknown with our current technology, we will suffer casualties. But as has always been the case, exploration in any form has always had high risk. It is in a particularly poignant sense the human race's gift that we are willing to push the boundaries despite this.

10.3.3 Steve White with the *Starfire*-Series¹²

In this book, there are multiple different civilisations, with different species that largely co-exist with each other (some from the start, some after wars against each other). The book begins with two of the races (Human and a race called the Orions, a cat like species), having a small squadron of starships in an outlying system, where they meet another unknown race that immediately sets out to attack them. To have some context, the Orions and Humans were at war about 50 years before this incident took place, and the system they were posted in was the same system where a group of human refugees travelled through a dangerous wormhole to escape the Orions. These humans came across a race on the other side of the wormhole, that was still in the early Steam Age with regards to their technology. They gave all their knowledge to this new race, but also told them about the danger of the Orions and how bad the war was going. The last of the refugee humans died out, but the race created a religion and then used this religion as a Jihad, preparing for 50 years to fight the enemies of the human race. They come out of the wormhole and promptly opened fire when they see their Orion ships. What follows is a long war, with the humans having to fight there 'saviours' on their own. What is striking about this book is the way that misconceptions and misunderstandings can be disastrous for any discussions or interactions between civilisations. On a side note, in this universe the starships used reactionless drives for normal space, but could only travel faster than light through wormholes. Later on they could enlarge said wormholes, or even create their own, but until then they were limited to the known wormholes that were in this universe. There were also two different types of wormholes, open-ended, and closed-ended—in the case of the former sensors could easily see this, but for the latter, this would only be detectable by accident or if ships came out from the other side of the wormhole.

10.3.4 John Ringo with the *Troy Rising* Series¹³

In this series, the human race received peaceful alien visitors, that create a hyper-gate for them, then invites other races to trade with the humans. They very quickly realise they have basically nothing the advanced alien races want for trade. They also learn that there are two very warlike races that want to take over and subjugate and enslave the humans for their 'own good'. The first of these warlike races starts

¹²Steve White, *Crusade* (Riverdale, NY: Baen Publishing Enterprises, 1992).

¹³John Ringo, *Live Free or Die* (Riverdale, NY: Baen Books Publishing Enterprises, 2010).

to bomb some of the cities on Earth, to ‘prove’ to the humans that they must submit. Naturally, there were of course quite a few of them that refused to be slaves, while some acquiesced. The price for ‘protection’ was for the humans to provide the invaders with copious amounts of heavy metal (gold, platinum, etc.), basically everything that can be mined, so there were no metals for use by the humans themselves. What follows is the main character of the book discovering something other peaceful races actually want to trade for (In this case maple syrup of all things), and then using this to get better technology, finally ending up using the sun as a power source, to melt asteroids first for the metal. This is used later on to make huge fortress-like globes, 400 km across, to fight the enemies using the sun’s power as a weapon. They finally win against the first race, but this just invites the stronger second warlike race to target them. This race was also getting ready to make war on all the other civilisations at the same time. To summarise, humanity finally prevails, after the foremost peaceful race gives them all their technology out of desperation.

The drive that the battle stations used for propulsion is called an Orion drive, Project Orion (nuclear propulsion). What it boils down to is having a very large plate of metal on one side of the ship, and then producing thrust through nuclear detonations.

10.3.5 Lois McMaster Bujold with the *Vorkosigan Series*¹⁴

This last series provides more of an emphasis on the people in the book and how different cultures affect them and how they deal with them. Also, cultures in isolation develop in different ways than cultures that are in contact with other cultures. The main character of this series, Miles Vorkosigan, is the heir of his house, and is crippled by an attack when his mother was still pregnant with him. Subsequently, he fights against his fate despite this setback. Put another way, he goes above and beyond to prove to others that his disability will not cause him to be held back. Despite this disability, he goes on to prove that he is a master strategist, out-thinking his adversaries almost always, using the people around him not as tools but almost as extensions of himself. Space in this series is part and parcel of the environment they deal with. He eventually becomes an agent of the crown, and have two personas—one not a secret, he is a junior lieutenant in the intelligence service, and the other (Undercover) he is an Admiral of a space mercenary group that solves problems for his employers (in this case, the crown). While there are battles in space, it is not the main focus of the series, and more focus is placed on how space challenges humans and how they overcome it.

In this series, they also use wormholes to travel from system to system. The science is not explained in as much detail as some of the examples above (soft SF), but still enough to make it believable. This series inspires hope that as long as we have enough perseverance and work hard, we can overcome most obstacles.

¹⁴Lois McMaster Bujold, *The Warrior’s Apprentice* (Riverdale, NY: Baen Books Publishing Enterprises, 1986).

10.4 Conclusion: Navigating the Currents of Science

This chapter set out to explore ways in which ideas of space have been used in SF, as well as the variety of purposes this served and the myriad of ways in which this has been done. Five main examples of book series were chosen for this purpose. The discussion in section two has provided a way in which to approach this task by presenting the model of the constructive dialogue of SF elements in Fig. 10.1, as well as a framework for classifying the use of space in SF (via the work of Steinmüller). The seminal SF typology presented by Williams presents an additional layer to the analysis. Here, having thus reviewed and summarised the five main examples of SF and their incorporation of space, it is now possible to return to these points.

First, by using the analytical framework derived from the work of Steinmüller, it is possible to create an analysis spectrum of the uses of space across ‘hard’ and ‘soft’ SF. In this way, it becomes evident that four of the five examples discussed above are instances of ‘hard’ SF, and that space is used in three of the four ways identified—foreground, background, and context (Table 10.1). None of the examples uses space as the core subject of the work, because making space itself the core subject would be much more difficult an undertaking for an entertaining story.

Second, the SF typology of Williams remains highly applicable, and elements of Putropia, Doomsday, and Space Anthropology are present in almost all the examples discussed (Table 10.2).

Third, by applying the model presented in Fig. 10.1, the creative juxtaposition of science, fiction, past, and future is evident in all five examples discussed. As mentioned, SF presents a fertile ground on which these elements meet and influence our understanding of the past, our expectations of the future, and reflections on ourselves and how we will navigate the challenges ahead. The dialogue between science, past, and future, for example, are exemplified by the discussion of gravity waves by Weber in 1993, which were recently discovered by the Laser

Table 10.1 Classifying the use of space in SF

	Soft SF	Hard SF
Foreground		<ul style="list-style-type: none"> • John Ringo with the <i>Looking Glass</i> series • John Ringo again with the <i>Troy Rising</i> series
Background	<ul style="list-style-type: none"> • Lois McMaster Bujold with the <i>Vorkosigan</i> series 	<ul style="list-style-type: none"> • John Ringo with the <i>Looking Glass</i> series • Steve White with the <i>Starfire</i>-series
Context		<ul style="list-style-type: none"> • <i>Honor Harrington</i> series by David Weber • Steve White with the <i>Starfire</i>-series • John Ringo again with the <i>Troy Rising</i> series
Subject		

Derived from the concepts of Steinmüller (Steinmüller, “The uses and abuses of science fiction”, 176)

Table 10.2 SF typology classifying types of thematic characteristics

	Putropia	Doomsday	Space Anthropology
Honor Harrington series by David Weber	✓	✓	✓
John Ringo with the <i>Looking Glass</i> series	✓	✓	✓
Steve White with the <i>Starfire</i> -series	✓	✓	✓
John Ringo with the <i>Troy Rising</i> series	✓	✓	✓
Lois McMaster Bujold with the <i>Vorkosigan</i> series	✓		✓

Derived from the work of Williams (Williams, “Science fiction”, 357–359)

Interferometer Gravitational-Wave Observatory (LIGO)¹⁵; asteroid mining by Ringo in 2010, as well the use of an Orion nuclear propulsion drive—a concept seriously studied and proposed in the 1950s and 1960s¹⁶; Bujold’s discussion of how space challenges humans and how we can overcome these; and the possibility of conflict, misconceptions, and misunderstandings in space as discussed by White. In this way, SF allows us to consider different combinations of past, future, science, and fiction, as in the model, to help us navigate possible challenges we may face in space and recognise dangers and warning signs (as the quote by Pohl aptly demonstrated). Thus, SF, through a consideration of scientific trends and historical experiences, presents us with a creative reimagining of our future. Moreover, as in the real world, the process of writing SF can sometimes unfold in ways unforeseen to, and unexpected by, the authors themselves, who may find the stories they write take them off on tangents which make their work richer and more interesting as a result. So too with life, we may find our future unfolding in unforeseen, yet richer, ways than we could have ever expected.

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¹⁵LIGO Caltech, “What are Gravitational Waves?”, n.d., <https://www.ligo.caltech.edu/page/what-are-gw> (accessed April 14, 2019).

¹⁶Mark Wade, “Orion Nuclear Pulse Vehicle”, *Astronautix*, 2019, <http://www.astronautix.com/o/orionnuclearpulsevehicle.html> (accessed April 14, 2019).



Unspoiled Space: The Use of Space in Popular Culture as a Caution Against Environmental Degradation on Earth

11

David Lindgren

Abstract

This article describes various cultural references that make the use of space in communicating a cautionary tale of environmental degradation. Space is frequently used as a cultural touchpoint in helping to emphasise important themes, and this appears throughout various mediums, including computer games, advocacy campaigns, books, and movies as described here. In addition to exploring the use of space for communicating an environmental message, it remains important to understand these messages in the context of current space realities and how, if these fictions were reality, they would follow existing space norms and policies. While popular culture often distorts the accuracy of real conditions of norms and policies to provide an entertainment value to audiences, this paper finds that for the examples described they are largely faithful in abiding by and accounting for current space law and policies.

11.1 Introduction

The concept of space as the ‘final frontier’ pervades popular culture, and has in fact earned this moniker through popular culture itself from the Star Trek series. Although the final frontier concept implies the last great unknown area for humankind and therefore boundless opportunities for the benefit of humanity, it also can represent an escape or departure from the failures witnessed on Earth. As much as settlers forming the American western expansion into what are now the Plains and Western states of the United States were seeking opportunities

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(ex. California gold rush and homestead allowances in the mid-nineteenth century), many were also leaving the Eastern states due to overcrowding and unsanitary cities and from further abroad in Europe to avoid famine and war (ex. Irish and Scandinavian crop failures, the Franco-Prussian War in the mid to late nineteenth century).

Popular culture often employs the final frontier idea as the next logical step in the evolution of humankind in a linear and onward march of social and technological progress; however, this contrasts greatly with depictions of space as humankind's only alternative for survival following disasters on Earth. While some view expansion into space as a result of positive human development and achievements, others see it as driven out of necessity and desperation.

Although not mutually exclusive, these visions of space do offer two competing narratives in the realm of popular culture for either humanity confidently striding into space or desperately seeking an alternative home.

In the latter interpretation of space, a variety of reasons factor into specific popular culture references for why Earth becomes uninhabitable, but largely present-day references feature severe climate and environmental changes that force humans to leave the Earth and venture into space. Some references feature a post-apocalyptic Earth wracked by nuclear war among other reasons, although many references from the current to those in the two decades past reflect on the theme of climate change given its prominence in the popular consciousness with the rising calls for action globally to address its causes and mitigate its effects.

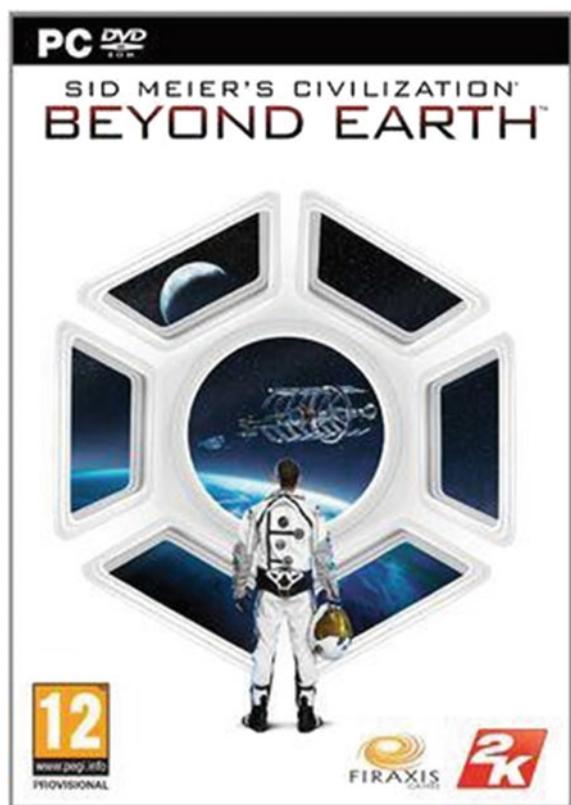
As such, this analysis will assess this negative use of space as a caution and reminder against environmental degradation on Earth in five popular culture examples. These include Civilization: Beyond Earth (a computer game), Earth Hour (a poster and advertising campaign), New Earth (a book), Interstellar (a movie) and Wall-E (a movie). Each of these popular culture references uses space in a negative manner so as to prompt reflection on the ongoing real challenges facing Earth with regards to climate change and the environment. The next sections of this report assess the use of space in each of these references and explores the accuracy and objective of using space in the particular context.

11.2 Civilization: Beyond Earth

Released on 24 October 2014, the game developers describe Civilization: Beyond Earth as "Set in the future, global events have destabilized the world leading to a collapse of modern society, a new world order and an uncertain future for humanity. As the human race struggles to recover, the re-developed nations focus their resources on deep space travel to chart a new beginning for mankind."¹ Apparent from the opening trailer of the game, as found here online, the Earth has undergone some environmental calamity as overcrowded refugee and internally displaced persons (IDP) camps develop around launch sites for spacecraft that will eventually

¹2k & Firaxis Games 2016. Civilization: Beyond Earth Game Description. Available: <http://www.civilization.com/en/games/civilization-beyond-earth/>.

Fig. 11.1 Cover of the video game “Sid Meier’s Civilization: Beyond Earth”.
Credit Firaxis Games



take carefully selected individuals (assumedly based on age, health and genetics) into space for settlement of a new world (Fig. 11.1).

As shown in the trailer, each major spacefaring region on Earth develops its own launch sites and launch systems in order to participate in the new settlement.

The major ‘civilisations’ that the player can select to play are arguably grouped around the world’s current major spacefaring countries with some exceptions, and which helps to lend the game some accuracy. These include eight civilisations that include the African Union, a corporation-like entity that represents North America, Brasilia, Franco-Iberia for Western Europe; Kavithan Protectorate, a South Asian regional bloc; Pan-Asian Cooperative, a grouping of East Asian countries; Polynesia, derived from present-day Australia and the Pacific Island nations; and the Slavic Federation, a regional group led by Russia.

Although the gameplay for Civilization: Beyond Earth centres on what happens after founding a settlement on a new world, the use of space remains key for understanding the game’s storyline. Resulting from an environmental disaster on Earth, humankind is forced to flee into space using advanced spacecraft launched from Earth and which are able to travel for decades or centuries. Although this technology does not yet exist, it remains accurate to a degree given its premise for

launching these spacecraft based on current launch systems essentially requiring a powerful rocket, launched from a secured launch site guided by ground-based mission control, to move the spacecraft into orbit and ultimately deep space. However, despite the quasi-accuracy of the rockets and launch systems, the game fails to accurately capture current international law as it relates to space, particularly with regard to the United Nations Outer Space Treaty of 1967.

Specifically, the Outer Space Treaty in Article II states “Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”² Moreover, the treaty continues in Article IV, “The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden...”³ As such, the establishment of settlements by each of the game’s spacefaring civilisations with clear and identifiable borders appears as an exercise in sovereignty, and thus violates Article II of the Outer Space Treaty.

Moreover, the game also features the potential for extensive warfare between the various civilisations through the development and production of military units and bases along with weapons of mass destruction, thus again violating the Outer Space Treaty and its clauses found in Article IV. Therefore, despite the somewhat accurate portrayal of the technological space systems used in the game, its premise based on the establishment of new settlements in the name of individual civilisations (or ‘States’ as used in the Outer Space Treaty) and with the potential for militarisation renders the game largely inaccurate as it pertains to current international law.

However, the entire motivation for using space in the game is predicated on the scenario whereby humankind has destroyed Earth’s environment to a point where the planet becomes uninhabitable and this becomes the driving force, or push factor, for settlement in space. Other popular culture references deploy the same or similar theme, and can be found in advertisements and posters forming part of environmental advocacy campaigns.

11.3 Earth Hour

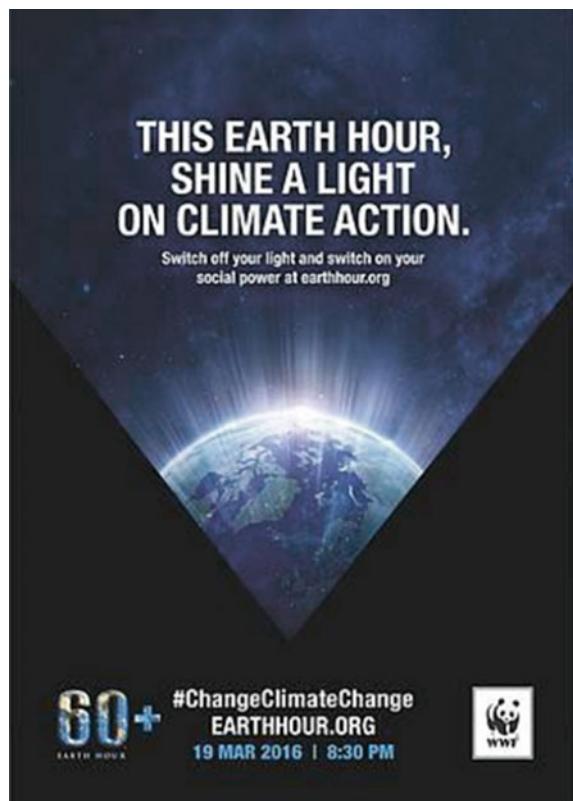
Organised by the World Wildlife Foundation (WWF), Earth Hour started in 2007 in Sydney, Australia as an environmental advocacy campaign to encourage energy conservation through the switching off of lights and electricity for one hour (Earth Hour, 2016). The campaign has now reached over 172 countries and territories.⁴ As an environmental campaign, the objective remains clear so to as encourage energy conservation, and thus reduce greenhouse gas emissions and the effects of climate

²United Nations. 1967. *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*.

³Ibid.

⁴Earth Hour 2016. *About Us*. Available: <https://www.earthhour.org/about-us>.

Fig. 11.2 Poster promoting Earth Hour, 2016. Credit World Wildlife Foundation



change. Earth Hour deploys space imagery to help achieve this objective, particularly through the use of Earth's image as taken from space and placed in context with stars as the background (Fig. 11.2).

The official video for the 2016 Earth Hour campaign, which can be found online here, features an elderly woman in the year 2090 or sometime soon after standing on what appears to be an orbiting space station. The woman proceeds to reflect on seeing Earth from an orbital perspective, or “way up there” as she says, and then reflects on the achievements of the past century (from 2090 and prior) as they relate to avoiding environmental degradation and climate change.

Although orbiting, habitable space stations that allow ordinary citizens to live in them do not yet exist and are currently limited more or less to trained astronauts, cosmonauts and researchers (with the exception of space tourists), the portrayal of space is not completely inaccurate. The view presented in the advertisement and poster campaign has been a view shared widely many times from those aboard the International Space Station, and relies on the same narrative promoted by Carl Sagan in his famous Pale Blue Dot reflection on a distant image taken of Earth by the Voyager 1 spacecraft. Sagan writes, “There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it

underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known.”⁵ The essential idea remains that Earth serves as humankind's only home, and therefore among the vastness and emptiness of space humankind should care for it and prove a good steward as it lacks an alternative home, at least for the time being.

In pursuing this narrative invoked by the use of space, Earth Hour also relies upon one of the mainstream ideas in space discourse, which is the use of space for Earth-based social, environmental and economic benefit rather than the exploration and use of space for purely scientific pursuits and the learning of new knowledge. Operating in the realm of national and international politics, it proves no surprise that Earth Hour taps into this idea given it remains popular with politicians and citizenries alike so as to justify vast expenditures for space for the benefit of humankind on Earth, and which is readily seen in the continuing use of Earth-observation satellites for climate and environmental monitoring, disaster management, wildlife conservation, urban management and treaty compliance.⁶

The Earth Hour campaign relies heavily on this narrative, and uses the space imagery to achieve its objective of sensitising people to the fact there is only one Earth among all the stars of the universe, and thus encourages people to take action (i.e. switching off the electricity for one hour) to help in preservation of the planet against climate change. This proves a counterpoint to the narrative relied upon in the Civilization: Beyond Earth game. While both popular culture references use space imagery to serve as a caution against the effects of environmental degradation, the game suggests the possibility for escape by humanity while the Earth Hour campaign implies there is no such alternative and therefore environmental degradation and climate change require immediate action so as to avoid future disasters.

11.4 New Earth

As the name suggests, New Earth focuses on a team of astronauts and researchers who set out on a decades-long space mission to investigate a planet that seems nearly identical to Earth. Authored by the well-known science fiction writer Ben Bova, the book explores the team's exploration of this planet and their subsequent interactions with a group of humanlike people who are found to already reside on the planet. Aside from the discovery of and interest in a relatively nearby Earth-like planet, one of the primary motivations for sending the mission is to discover a suitable alternative home for humankind as Earth suffers severe climate change, similar to the concept proposed in the Civilization: Beyond Earth game and the principal outreach message of the Earth Hour campaign described above (Fig. 11.3).

⁵The Planetary Society 2016. *A Pale Blue Dot*. Available: <http://www.planetary.org/explore/space-topics/earth/pale-blue-dot.html?referrer=https://www.google.co.za/>.

⁶Martinez, P. 2016. Africa in space. 3 March. Vula: 6.

Fig. 11.3 Book cover of “New Earth” novel by science fiction author Ben Bova.
Credit John Harris



This is made clear in the opening passages of the book: “‘Demons and devils!’ Chang burst. ‘All my life we’ve been fighting the sea-level rise. We’ve built dams and levees and pumping systems all over the world! We had things under control! And now this.’”⁷

Bova uses this strong imagery of environmental disaster to contrast it against the new planet and the potential it offers humankind as an alternative for Earth. However, despite the strong need to either stabilise the Earth’s environment or move to an alternative habitable planet, Bova also introduces an accurate portrayal of the complex political economy that factors into funding of space missions. In a scene after the mission loses contact with Earth and an aide lobbies the United States president for a backup mission to the new planet, Bova writes “The president shook his head. ‘Impossible. We can’t take money away from reconstruction and recovery projects to send another gaggle of scientists out there,’”⁸ serves as one excerpt among several where Bova accurately explores the dynamics affecting space

⁷Bova, B. 2013. *New Earth*. First ed. New York, NY, USA: Tom Doherty Associates, LLC.

⁸Ibid.

mission funding and the realities present-day missions continue to face, consistently needing to prove their social, environmental and economic benefit for Earth as resources could otherwise be used on other pressing social needs.

Bova's space mission also appears as an accurate portrayal when it comes to the use and exploration of space. The mission is focused exclusively on scientific purposes, and is demonstrated as such by the inclusion of various researchers in the fields of biology, climatology, geology and astrophysics. Moreover, the international character of the team proves the mission as exercise in international cooperation and peaceful use of space as envisioned by the Outer Space Treaty of 1967 and Articles 3, 4 and 5 of the Moon Agreement on the use of celestial bodies as the province of and for the benefit of all humankind.⁹ Throughout the book, there are also no attempts by the mission to appropriate or exercise sovereignty over the newly discovered planet, thus not violating the Outer Space Treaty.¹⁰

Given this, Bova's book presents an accurate portrayal of the medium-term future for space while incorporating a cautionary message against manmade environmental degradation and climate change which would force humankind to search for an alternative home. While it must be inferred that climate change caused the environmental disaster in Civilization: Beyond Earth, Bova makes his message clear, similar as the Earth Hour campaign, that without significant action to address climate change on Earth in the present humankind may need to flee to another habitable planet out of necessity.

11.5 Interstellar

In its cautionary message, Interstellar is perhaps the most poignant of the examples cited in this report that showcases the disastrous consequences of environmental degradation caused by humankind. Interstellar, released in 2014, features a team of astronauts and researchers who are commissioned by NASA to explore via a wormhole potential planets for humankind's new home. The Earth's environment proves so dire that massive crop failures affect the very existence of humanity, thereby placing the survival of humankind solely on the success or failure of the space mission. A trailer for the movie can be found online here (Fig. 11.4).

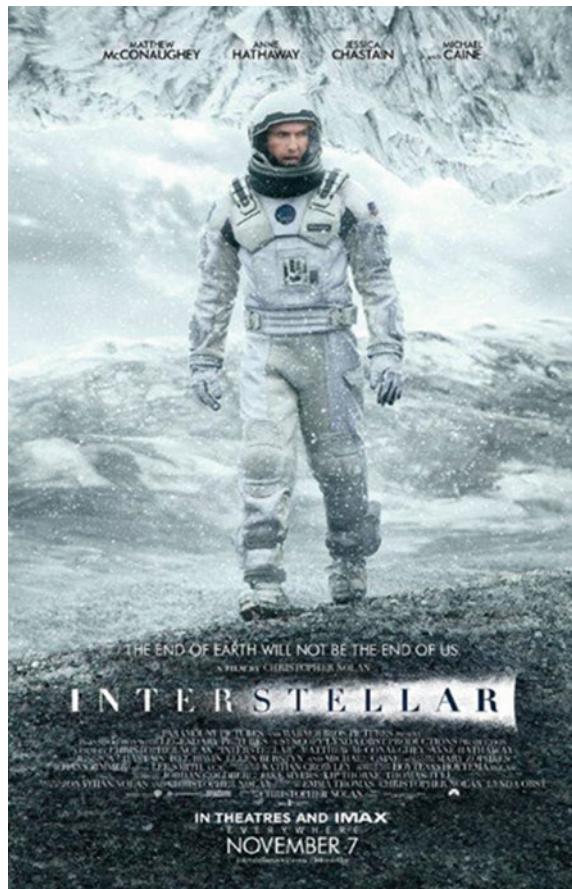
Although a wormhole nearby Saturn does not exist as portrayed in the movie, planets outside of the solar system do exist, called 'exoplanets,' and number in the thousands based upon discoveries made in the past two decades with many made via the Kepler space telescope.¹¹ Therefore, the film is partially accurate in its depiction of space and celestial bodies.

⁹United Nations. 1979. *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*.

¹⁰United Nations. 1967. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

¹¹Howell, E. 2015. *Exoplanets: World Beyond Our Solar System*. Available: <http://www.space.com/17738-exoplanets.html>.

Fig. 11.4 Movie poster for the film “Interstellar”. Credit Paramount Pictures



Similarly as found in Ben Bova's New Earth, *Interstellar* grapples with the question of limited resources and funding available to support such an intensive undertaking being the exploration of exoplanets via wormhole located nearby Saturn. It is made clear in the movie that although humankind faces an environmental threat unlike any other, resources are limited and the space mission remains the only hope for finding a habitable exoplanet necessary for the survival of humankind as there will be no future missions.

Although this dynamic reflects largely on a scenario where there is an actual global scarcity of resources rather than a political question of allocation in New Earth, it nonetheless proves accurate in showcasing the importance for mission's to demonstrate success given the significant investments that are made to support them.

As it pertains to the movie's interpretation of present-day international law, it does not appear to violate or contravene any of the provisions found in the major space treaties, including the Outer Space Treaty of 1967 and the Moon Agreement.

NASA, a governmental space agency, does commission the mission; however, the movie implies NASA may be working on behalf of the global community when sponsoring the mission given the severity of the environmental degradation and in the face of worldwide famine that carries the potential for causing humanity's extinction. Therefore, any appropriation that may result from the team's discovery and settlement of a habitable exoplanet would not assumedly be done in the name of national sovereignty, but rather in the spirit of international cooperation and for the benefit of all humankind in compliance with Articles I, II and III of the Outer Space Treaty.¹²

Therefore with a somewhat accurate portrayal of space and its governance, Interstellar provides another example whereby environmental degradation drives humanity from Earth in search of an alternative home planet. This proves to be a similar concept in another movie, Wall-E, albeit with some minor differences.

11.6 Wall-E

An animated film produced by Disney and Pixar in 2008, Wall-E features a high technology society 700 years in the future that abandons Earth in favour of a space cruise because of overwhelming toxic pollution that makes the Earth air unbreathable. As implied in the start of the movie, humankind had polluted Earth to the point that garbage piles as high as skyscrapers and vegetation had been completely decimated, thus leaving a toxic environment that resulted from the overly consumerist and high technology society. A trailer for the movie can be found online here (Fig. 11.5).

In many ways, Wall-E remains similar to the themes explored above as it cautions against environmental degradation and promotes a message of good environmental stewardship. Despite being an animated movie, the strength of the movie's message is nearly as prevalent and dire as that shown in Interstellar, and as an animated movie advocates for environmental stewardship among a younger audience in the effort to promote wise of Earth resources in the future.

However, where most of the above examples refer to an alternative planetary home for humankind, the society in Wall-E sits in a perpetual state of waiting on a space cruise in order to be able to one day return to Earth when the climate eventually stabilises. Indeed, as the movie demonstrates, humankind left Earth out of desperation and in a hurry because of ever increasing air toxicity levels, but intends to return one day eventually when the environment reaches a point for human habitation once again.

¹²United Nations. 1967. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

Fig. 11.5 Movie poster for the animated film “Wall-E”.
Credit Pixar Animation Studios



Moreover, the movie differs from the other examples in that it portrays the space debris in orbit around Earth as a major problem, lending support to its real-world accuracy. This is presumably as a result of the wasteful excesses and behaviours demonstrated by the society on Earth at the time.

Unlike the other references as well, Wall-E focuses on non-human characters (i.e. robots) that are used to convey the movie's message. A human society does exist in the movie and although the human-robot relationship in the movie is meant to be one of master-servant, the reality in the movie is in fact the opposite whereby the humans are subservient to their supposedly robot servants. This poses an interesting question for international law and space law, particularly with regards to future developments in artificial intelligence (AI) and the potential for sentience to eventually develop among high technology robots that may be used in future space activities, particularly the most dangerous or risky.

Since international and space laws have yet to develop such policies guiding the use of AI robots, or even sentient robots, it remains difficult to assess the accuracy of the relationships portrayed in the movie. However, if one were to apply space

law as it concerns responsibility of space objects, such as those provisions found within the Liability and Registration Conventions, the movie would prove accurate as the robots and space cruise are technically owned and registered as property with the quasi-corporation government (Buy n' Large) as described in the movie per Articles II and VII found in the Registration Convention.¹³

Since the movie does not portray any use of space except for the space cruise to travel within, the relevant provisions in the Outer Space Treaty or the Moon Agreement are not necessarily relevant to this particular example. Therefore, the movie, to the extent applicable, proves accurate on the space debris issue and use of space objects as being registered and owned by the launching party, in this case the Buy n' Large government.

11.7 Conclusion

As demonstrated above, the popular culture examples cited are used to promote a message cautioning against environmental degradation and climate change and promoting positive stewardship of Earth resources. To the extent it was possible to assess the accuracy and relevance of present-day space law and knowledge of space, the examples were also largely accurate with the exception of Civilization: Beyond Earth proving inaccurate on multiple fronts. This proves interesting given that for most of the examples they neither did not have to compromise or extrapolate too wildly from current space realities in order to prove successful in the realm of popular culture nor did they have to soften their environmental messages to accommodate these realities. This finally also demonstrates that despite the wide range of types of examples used, most were able to faithfully communicate their message while largely staying true to space realities and providing a further entertainment value.

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¹³United Nations. 1974. *Convention on Registration of Objects Launched into Outer Space*.



Predictions of Science Fiction That Came True

12

Mónica Estébanez Camarena

Abstract

The idea of other worlds and realities beyond what we can see in the sky has always stimulated the public imagination. In this way, space has had an important place in popular culture since early times, before the beginning of the space race. Representations of this can be found in many forms of arts, including cinema, plastic arts, music and literature. Whether popular culture inspires scientists in their work or technological developments expand the limits of writers and artists' imagination, there is an undeniable interplay between both fields. From the astonishingly correct predictions in Jules Verne's novel *From the Earth to the Moon*, to the early visions of space depicted in Stanley Kubrick's *2001: A Space Odyssey*, this chapter presents a compilation of "predictions" of science fiction that came true in the space industry.

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12.1 Introduction

Oxford dictionary defines *science fiction* as:

Fiction based on imagined future scientific or technological advances and major social or environmental changes, frequently portraying space or time travel and life on other planets.¹

The term “science fiction” is compound of the two words that describe this genre. On one side, the word “fiction” represents an imagined reality, such as the explained in the Oxford dictionary’s definition. Therefore, it is not surprising that this genre is often mistaken for fantasy. However, the difference between science fiction and fantasy lies in the first word of the term, “science”, that implies a rational and scientific background to the genre. Therefore, even if its narrated worlds may seem improbable, they can be somewhat possible.

Therefore, a necessary interplay between science fiction and the evolution of technology arises in which they inspire and boost one another. Science fiction inspires scientists to realise the visions that it expresses and to make the scientific developments in which the future science fiction will then be based.

This is the case of some visionaries that predicted with an astonishing accuracy some of the major advancements in space technology. Back in their days, their ideas were surely taken for impossible. However, they inspired science and became feasible only later, and a reality in today’s world.

Isaac Asimov, regarded by many as one of the best science fiction writers and one of the “Big Three” (together with Arthur C. Clarke and Robert Heinlein) for bringing science fiction into a *golden age* in the mid-twentieth century, put it this way during an interview on The Open Mind show hosted by Richard D. Heffner²:

Richard D. Heffner - “But isn’t science fiction itself such a function of imagination, such a function of futurism, that in its own way it does the same thing [as mysticism]?”

Isaac Asimov - “It depends, as in everything else there is good and bad. There is good science fiction and there is bad science fiction. Good science fiction tries to invent a society which is different from our world, distinctly different, but which holds lessons from our world. In other words, you suppose that you have a society in which space travel is coming, let us say. Which problems arise? What special difficulties to people who are engaged in space travel? What are they facing, etcetera, etcetera? Now, this is no promise to you that life will be easy. As a matter of fact, I think that most science fiction stories tend to be on the grim side, that unfavourable futures make for better stories, and favourable ones. And a friend of mine says that science fiction writers are scouts sent out by mankind to survey the future and to come back and say, “that way like quicksand, this looks pretty good if we can get over a hill” and so on. We don’t predict, not deliberately, sometimes we hit something that actually comes to pass - I’ve done that myself - but that’s largely accidental. The main thing we do is just see if we can illuminate the human condition under a particular system

¹The Oxford dictionary is made available by Oxford University Press on the website <https://en.oxforddictionaries.com>.

²The whole interview is available in YouTube at the following link: <https://www.youtube.com/watch?v=5F4WvaiyQTw>.

of thinking that is supposed we lived in a society other than our own. Now, it's just another version of literature in other words. Good literature, all of it, it's supposed to illuminate the human condition."

This chapter will present some examples of predictions of science fiction that came true, related to space. Five examples from different areas of popular culture (Literature, Cinema and Plastic Arts) are included: The book *From the Earth to the Moon* by Jules Verne, the manuscript *The Space Station: Its Radio Applications* by Arthur C. Clarke, the movies *Woman in the Moon* by Fritz Lang and *2001: A Space Odyssey* by Stanley Kubrick and the illustrations made by Chesley Bonestell. The chapter will convey an analysis of their ideas, their current implementation and the repercussion they had in the space industry.

12.2 Space in Popular Culture

12.2.1 Space in Literature

12.2.1.1 From the Earth to the Moon—Jules Verne (1865)

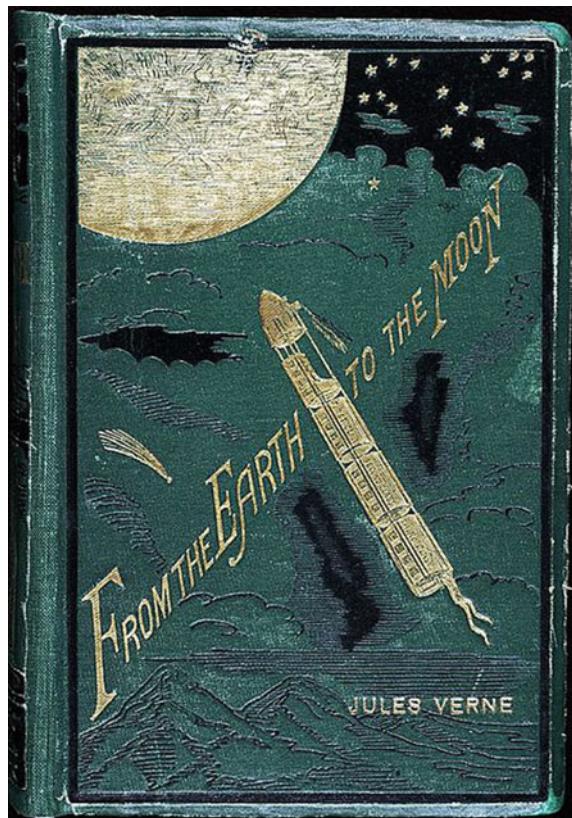
Verne (1828—1905) was one of those early futurists able to see ahead of their time and predict some of the technological advancements that were to come. His best-known right guess may be the electric submarine driven by Captain Nemo in his novel *Twenty Thousand Leagues Under the Sea* (1870). Verne is said to have come up with the idea of Nautilus based in his scientific knowledge about electricity and electric battery technology and inspired in models he would have seen at the 1867 world's fair in Paris (Fig. 12.1).

As for the theme treated in this chapter, the book *From the Earth to the Moon*³ (1865) presents many ideas that have been, up to a certain point, adopted in space missions. It narrates the story of the Baltimore Gun Club, an association of veterans of the American Civil War that, bored in a time of peace, plan to send a projectile, carrying three passengers to the moon. It must be highlighted that the novel was written 94 years before President John F. Kennedy's 1961 Speech before Congress, during which he announced that the US "should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth." Eight years after, NASA succeeded in landing a 2-men crew on the moon surface with the Apollo 11 mission. However, the resemblance between the book and this first manned NASA mission to the moon and posterior space missions is surprising.

The proposal in Verne's novel was to shoot the projectile using an enormous gun, called Columbiad, with an initial velocity of 12,000 yards per second (yd/s), equivalent to 10.97 km/s, and pointing to the local zenith, perpendicular to the local horizon, aimed at the moon. The vehicle weighed 9072 kg and had a 2.74 m

³Verne J. (2005). *From the Earth to the Moon*. Barnes & Nobles Books. New York: Barnes & Nobles Publishing, Inc.

Fig. 12.1 Cover of the book “From the Earth to the Moon” by Jules Verne



diameter. The spacecraft was built predominantly of aluminium. Because of the latitude and the proximity to the ocean, in the book the spaceship was launched from Florida.

Although some of the calculations the author made were imprecise, it is astonishing the degree of accuracy he had in others. For example, with the proposed initial velocity, having into account the deceleration due to the atmospheric drag, the spaceship would not have reached the Earth's escape velocity, around 11.2 km/s. However, it is true that Apollo 11 was built predominantly of aluminium and that the launch site was in Florida, only 213 km from Verne's site. Other characteristic that Verne's and NASA's missions to the moon had in common was a three-men crew (Ardan, Barbicane and Nicholl on Verne's projectile; Aldrin, Armstrong and Collins on Apollo 11). Furthermore, whether it was a prediction or maybe an inspiration to the later NASA mission, Verne named the gun that launched his projectile to the moon Columbiad. Many years later, Apollo 11's command module was called Columbia.

Another process still inexperienced at the time and that is present in the novel is microgravity, which he describes as:

When a body left to itself falls to the surface of the Earth, it falls five feet in the first second; and if the same body were removed 257,542 miles further off, in other words, to the distance of the moon, its fall would be reduced to about half a line in the first second. That is almost equivalent to a state of perfect rest.

When talking about the future of humankind's ways of transportation, being it the spacecraft, Verne wrote:

Is it not evident, then, I ask you, that there will someday appear velocities far greater than these [those of the planets], of which light or electricity will probably be the mechanical agent?

He was anticipating then the electrical propulsion for rockets and the solar sails. The former was not going to be reality until 1964 in an experiment carried out by the NASA's Glenn Centre. Jet Propulsion Laboratory developed the first solar sail in 1976, for a rendezvous with the Halley comet.

Finally, just as the Apollo mission did one hundred years later, in its return to Earth the Columbia splashed down in the Pacific Ocean to be recovered by a US Navy's corvette. Once again, he was right. Indeed, long time later landing a spacecraft in the sea became a common practice. Neil Armstrong realised this right prediction and made reference to it during a live television broadcast that the astronauts did during their return to Earth from the moon during which he said:

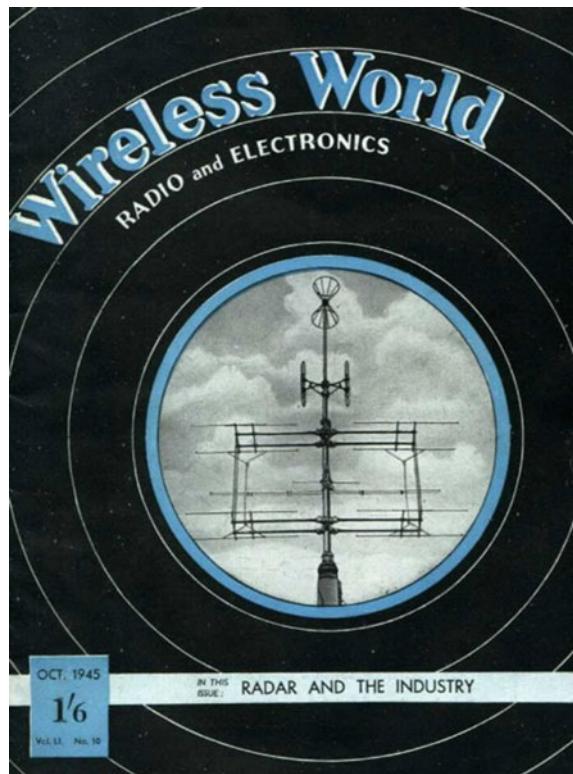
A hundred years ago, Jules Verne wrote a book about a voyage to the moon. His spaceship, Columbia took off from Florida and landed in the Pacific Ocean after completing a trip to the moon. It seems appropriate to us to share with you some of the reflections of the crew as the modern-day Columbia completes its rendezvous with the planet Earth in the same Pacific Ocean tomorrow.⁴

Probably the most relevant impact *From the Earth to the Moon* had was inspiring the so-called Father of Rocketry, Konstantin Tsiolkovsky. Although he refuted some of Verne's ideas, such as launching a projectile using a cannon, as it would cause acceleration unbearable for the passengers,⁵ he was encouraged by his stories. Tsiolkovsky's most impactful contribution to Rocket Science was the characterisation of the movement of a rocket by establishing a relationship between the initial rocket mass, the changing rocket mass due to fuel being burnt and the maximum increment in velocity that the burning of this fuel can produce. This relationship is expressed in the "Rocket equation" or "Tsiolkovsky equation", named after him, and that is the basis of Rocket Science. Other ideas proposed by him are multi-stage rockets, valves to regulate the pass of fuel from the storage tanks to the combustion chamber in a rocket and the use of propellant to cool down certain parts of a rocket, as well as pressurised suits for astronauts' extra-vehicular activities (EVAs) (see Footnote 4).

⁴Howell E. (2014). *Apollo 11 Flight Log, July 23, 1969: Preparing for Landing*. SPACE.com. [ONLINE] Available at: <https://www.space.com/26617-apollo-11-flight-log-july-23-1969.html>.

⁵Taylor Red N. (2013). *Konstantin Tsiolkovsky: Russian Father of Rocketry*. SPACE.com. [ONLINE] Available at: <https://www.space.com/19994-konstantin-tsiolkovsky.html>.

Fig. 12.2 Cover of a 1945 magazine “Wireless World”



12.2.1.2 The Space-Station: Its Radio Applications—Arthur C. Clarke (1945)

Sir Arthur C. Clarke (1917–2008) was a British scientist and science fiction writer whose most famous work may be *2001: A Space Odyssey*, which he wrote together with the director Stanley Kubrick, producing both a film and a book in 1968. The movie version will be analysed later in this chapter.

Although the manuscript *The Space-Station: Its Radio Applications* does not belong to the science fiction genre, the decision of including it here was based on the fact that Clarke was also a science fiction writer and on the originality of the idea: It had never been proposed and at the time it was not taken seriously.

Before this manuscript, Clarke had already made reference to his idea of a geostationary orbit in the letter *V2 for Ionosphere Research?* sent to the editor of the magazine *Wireless World*⁶ (Figs. 12.2 and 12.3), where it was first published

⁶Wireless World magazine was a British electronics journal that began in April 1911 under the name *Marconigraph*. It was renamed as *Wireless World* in 1913 and *Electronics & Wireless World* in 1984. Finally, the journal adopted its current name, *Electronics World*, in 1996. An archive of the 1911–1994 issues is available at: https://www.americanradiohistory.com/Wireless_World_Magazine.htm.

Letters to the Editor**Peacetime Uses for V2 · FM Protection Against High-Amplitude Interference Pulses · Bad Books****V2 for Ionosphere Research?**

ONE of the most important branches of radio physics is ionospheric research and until now all our knowledge of conditions in the ionosphere has been deduced from transmission and echo experiments. One of the more modest claims of the British Interplanetary Society was that rockets could be used for very high altitude investigations and it will not have escaped your readers' notice that the German long-range rocket projectile known as V2 passes through the E layer on its way from the Continent. If it were fired vertically without westward deviation it could reach the F₁ and probably the F₂ layer.

The implications of this are obvious: we can now send instruments of all kinds into the ionosphere and by transmitting their readings back to ground stations obtain information which could not possibly be learned in any other way. Since the weight of instruments would only be a few pounds—as compared with V2's payload of 2,000 pounds—the rocket required would be quite a small one. Its probable take-off weight would be one or two tons, most of this being relatively cheap alcohol and liquid oxygen. A parachute device (besides being appreciated by the public!) would enable the rocket to be re-used.

This is an immediate post-war research project, but an even more interesting one lies a little farther ahead. A rocket which can reach a speed of 8 km/sec parallel to the earth's surface would continue to circle it for ever in a closed orbit; it would become an "artificial satellite." V2 can only reach a third of this speed under the most favourable conditions, but if its payload consisted of a small one-ton rocket, this upper component could reach the required velocity with a payload of about 100 pounds. It would thus be possible to have a hundred-weight of instruments circling the earth perpetually outside the

limits of the atmosphere and broadcasting information as long as the batteries lasted. Since the rocket would be in brilliant sunlight for half the time, the operating period might be indefinitely prolonged by the use of thermocouples and photo-electric elements.

Both of these developments demand nothing new in the way of technical resources; the first and probably the second should come within the next five or ten years. However, I would like to close by mentioning a possibility of the more remote future—perhaps half a century ahead.

An "artificial satellite" at the correct distance from the earth would make one revolution every 24 hours; i.e., it would remain stationary above the same spot and would be within optical range of nearly half the earth's surface. Three repeater stations, 120 degrees apart in the correct orbit, could give television and microwave coverage to the entire planet. I'm afraid this isn't going to be of the slightest use to our post-war planners, but I think it is the *ultimate* solution to the problem.

ARTHUR C. CLARKE,
British Interplanetary
Society.

Frequency Modulation

WHILE post-war plans for television and UHF sound broadcasting are under discussion, it is important that the pros and cons of FM should be understood. Space will not permit a full discussion here; but I wish to correct a misconception, found even among responsible engineers, that FM can give no protection against ignition noise or other similar pulses which have an amplitude much greater than that of the signal carrier. The actual response of an FM receiver to very powerful impulsive interference can be summarised as follows:—

(1) In the absence of a signal,

the FM receiver gives no output from impulsive interference.

(2) In the presence of an unmodulated carrier to which the FM receiver is accurately tuned, the impulsive interference causes no audible output. If the receiver is not accurately tuned, there will be an audible output, but the amplitude of the pulses in the audio-frequency circuits of the receiver will correspond to a modulation of the carrier of less than 100 per cent., in fact to a modulation depth equal to the ratio of the frequency error in tuning to the frequency swing corresponding to full modulation of a frequency-modulated signal.

(3) In the presence of a frequency-modulated signal to which the receiver is accurately tuned, the audio-frequency noise pulses are limited to the *instantaneous* level of signal modulation. If the receiver is not accurately tuned, the amplitude of the audio-frequency pulses will be increased by the amount defined in (2) above.

If it is true, as sometimes suggested, that ignition noise is the chief trouble in UHF broadcasting, this summary provides a basis for the comparison of FM with other systems, such as wide-band AM with audio-frequency limiting.

D. A. BELL.

London, N.21.

"New Thoughts on Contrast Expansion"

EXPEDIENCY be damned. My condemnation of contrast expansion was not based upon noise and neighbour tolerances. John B. Rudkin (your January issue) says "condemn the Philadelphia Orchestra because it is too large to play in the village hall." The truth is that anyone who asks it to do so should be condemned, and those who try to get the B.B.C. Orchestra into their bedroom are committing a crime. If the room is small, acoustically small, then only a limited contrast is proper, and all music

Fig. 12.3 Letter written by Arthur C. Clarke to the editor of the magazine "Wireless Communications", published on page 58 of the February 1945 magazine's issue

publicly. The letter was published in the February 1945 magazine's issue, under the "Letters to the Editor" section called *Peacetime Uses for V2*.

In his letter, Clarke proposed a peaceful way to reuse the rockets that had been used for war during World War 2—ionosphere research by launching a V2 rocket to take measurements in the ionosphere and fall back to the surface using a parachute, and positioning satellites in orbit around the Earth by launching a small rocket as a payload on a V2 missile, so as to be able to reach the necessary velocity to maintain an orbit around Earth and that the V2 missile would not be able to achieve on its own. He ventured even further by proposing placing these artificial satellites at such a distance from the Earth so that their angular velocity around Earth would be the same as the planet's rotational velocity. In this situation, they would appear to be static over the same point on the Earth surface. He stated that a minimum of three stations in a circular equatorial orbit and at an 120 angular separation from each other would be enough to attain global coverage.

Later the same year, in May 1945, Clarke privately circulated the manuscript *The Space-Station: Its Radio Application*,⁷ which is currently kept by the National Air and Space Museum, Smithsonian Institution, Washington D.C. In this manuscript he gave more engineering detail into the geostationary concept he had proposed in his February letter. In particular, he identified the distance to Earth necessary to achieve the proposed geo-synchronicity to be 42,000 km and on the equatorial plane and connected between them by very-narrow-beam, low-power links (Fig. 12.4). Clarke also recognised that because from that position the "space stations" would appear to be static for an observer on the ground, this orbit would simplify the use of receivers on Earth. Furthermore, he established that these receivers should be "small parabolas perhaps a foot in diameter with dipole pickup", which would be just somewhat smaller than today's television antennae.

Figure 12.5 shows how Clarke conceptualised the signal relay that a "space station" could offer from the geostationary orbit.

Clarke suggested television and other UHF signal transmissions as the primary application of such a network. Other applications could include astrophysical, physical and electronic research, meteorological applications and monitoring of traffic of ships approaching and leaving the Earth, as well as being the first link in the solar communication system.

Yet another publication that he produced in the same year in which he continued exploring the possibilities of a geostationary network was *Extra-Terrestrial Relays: Can Rocket Stations Give World-Wide Radio Coverage?* published in October 1945 in the magazine *Wireless World*.⁸ However, in this manuscript he talked about manned geostationary space stations, which has not occurred to date.

⁷Clarke A. (1945). 'The Space-Station: Its Radio Applications' in *Exploring the Unknown. Selected Documents in the History of the U.S. Civil Space Program Volume III: Using Space*. Eds: Logsdon J M, Launius R D, Onkst D H and Garber S J, pp. 12–15.

⁸Clarke A. (1945). 'Extra-Terrestrial Relays: Can Rocket Stations Give World-Wide Radio Coverage?' in *Exploring the Unknown. Selected Documents in the History of the U.S. Civil Space Program Volume III: Using Space*. Eds: Logsdon J M, Launius R D, Onkst D H and Garber S J, pp. 16–22.

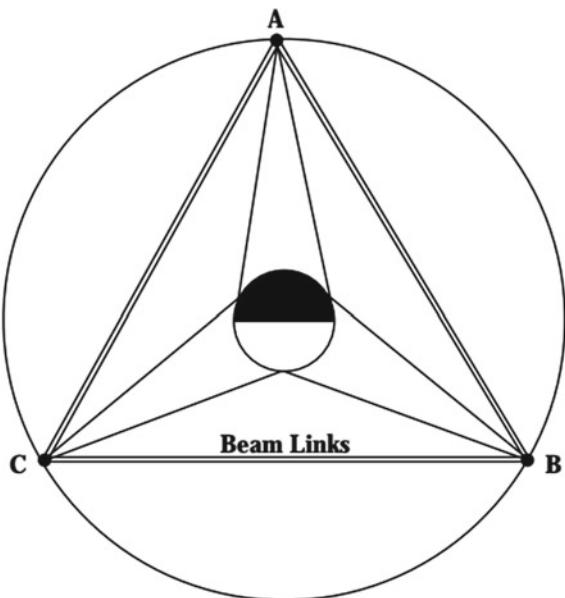


Fig. 12.4 Geostationary constellation proposed by Arthur C. Clarke

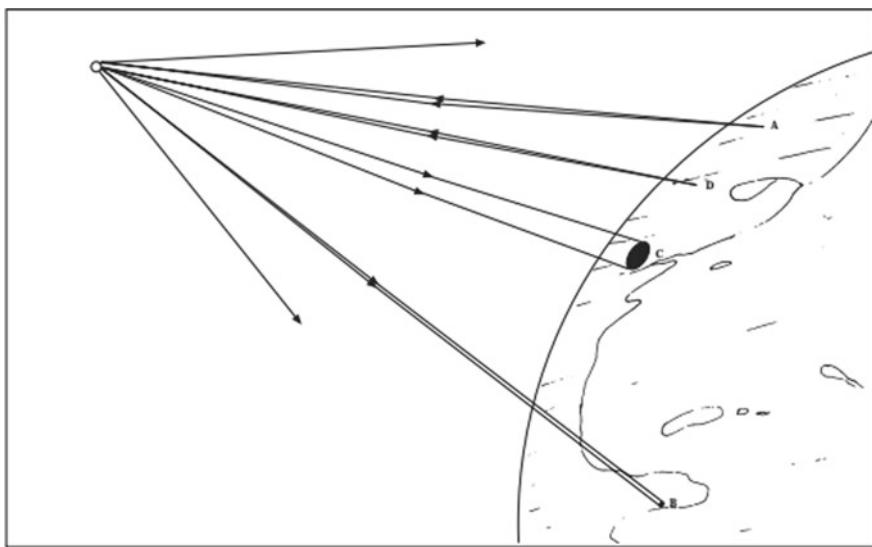


Fig. 12.5 Television relay from the geostationary orbit as proposed by Arthur C. Clarke: programme from A being relayed to point B and area C and programme from D being relayed to whole hemisphere. [Clarke A. (1945). 'The Space-Station: Its Radio Applications' in *Exploring the Unknown. Selected Documents in the History of the U.S. Civil Space Program Volume III: Using Space*. Eds: Logsdon J M, Launius R D, Onkst D H and Garber S J, pp. 12–15]

Even if it is not evident that he was the promotor of the telecommunication satellites, due to the fact that other scientists came up with the same idea independently, he was the first one to propose it and he fully characterised it in the manuscript *The Space-Station: Its Radio Application*. Indeed, the geostationary orbit is often referred to as the “Clarke orbit”.

With his work, Arthur C. Clarke predicted almost twenty years before of the launch of the first geosynchronous communication satellite, Syncom 2 (1963), and the first geostationary satellite, Syncom 3 (1964), what would be one of the main space applications, and the one with the greatest presence in modern daily life and the essential and unique orbit to accomplish it. He also predicted the use of this orbit for meteorological missions and research. It will be necessary to wait to see whether his vision of this orbit also being used for space traffic monitoring and manned missions will become true.

12.2.2 Space in Cinema

12.2.2.1 Woman in the Moon—Fritz Lang (1929)

*Woman in the Moon*⁹ is a silent melodrama directed and produced by the Austrian filmmaker, screenwriter, and occasional film producer and actor Fritz Lang. It tells the story of a group of characters that go to the moon following an announcement that there is gold in the satellite.

Here again one of the best-known names in the history of Rocketry makes appearance: After having been inspired by Hermann Oberth’s ideas about space flight present in his 1926 book *The Way to Spaceflight*, Lang hired him as his technical consultant for the realisation of the film. Among other contributions, Oberth designed an incredibly realistic spaceship for the movie. In fact, his designs were so realistic that after the establishment of the German space program, the German government destroyed his prototypes and censored the film, out of fear that the designs were too similar to those being developed by the German scientists.¹⁰

The launch sequence in the film¹¹ presents, with a thundering soundtrack, different aspects that were done later in the space race:

First of all, the spacecraft was launched from a pool filled with water. In the movie it is submerged in the water, which in a real case would prevent a proper lift-off. However, water is widely used in launch sites to absorb and dissipate the launch sound and the heat induced by the nozzles exhaust gases.

Later on, it comes what may be considered the main invention of this film: the countdown for split-off. In an attempt to create an atmosphere of suspense before the launch, Lang introduced a characteristic countdown, from six to zero, using “NOW!” as zero. This countdown was so powerful and effective that NASA decided

⁹Woman in the Moon/Frau im Mond. (1929). [Video] Germany: Fritz Lang.

¹⁰Otfinoski, S. (2006). Great Inventions. Rockets. Marshall Cavendish. New York: Benchmark, p. 18.

¹¹The film launch sequence referred to here can be watched on YouTube at: <https://www.youtube.com/watch?v=I8gu1p939a4>.



Fig. 12.6 Final moment of the countdown for launch introduced by Lang in the movie Woman in the Moon and later adopted by NASA (Source YouTube)

to adopt it and for every North-American launch ever since (see Footnote 10). Indeed, already in the first successful launch of the US space history, the launch of Explorer 1 in January 1958, just four months after the launch of Sputnik I by the Soviet 1, the commentators broadcasting the event said at the moment of lift-off “the moment is at hand, the countdown reaches... zero!”¹² (Figs. 12.6 and 12.7).

Flying, the screen displays the sentences:

Start rocket is depleted, middle rocket at full throttle!

Win – degger... dump-middle rocket!

It was the first apparition of multi-stage rockets: The first stage was ejected and the second one fired and ejected. The concept of multi-stage rockets has been attributed to the three fathers of Rocketry: Konstantin Tsiolkovsky,¹³ Robert Goddard¹⁴ and Hermann Oberth.¹⁵ Although the three of them developed may of their theories at the same time, there is no evidence that they relied on each other’s work (see Footnote 14).

Also, to bear the g-forces needed to escape the Earth, the crew lay horizontally on beds, tighten to them by straps instead of the velcro used nowadays. However, the acceleration is still too high, and every character faints as they are reaching the Earth’s escape velocity, 11.2 km/s, written correctly on the speedometer frequently shown.

¹²A video of the launch of Explorer 1 is available at: https://en.wikipedia.org/wiki/File:1958-02-03_First_US_Satellite_Launched.ogg. In the clip, the lift-off moment referred to in the text takes place in the minute 1:13.

¹³Taylor Red N. (2013). *Konstantin Tsiolkovsky: Russian Father of Rocketry*. SPACE.com. [ONLINE] Available at: <https://www.space.com/19994-konstantin-tsiolkovsky.html>.

¹⁴Hutchings Goddard R. (2017). Dr. Robert H. Goddard, American Rocketry Pioneer. [ONLINE] Available at: https://www.nasa.gov/centers/goddard/about/history/dr_goddard.html.

¹⁵Taylor Red N. (2013). *Hermann Oberth: German Father of Rocketry*. SPACE.com. [ONLINE] Available at: <https://www.space.com/20063-hermann-oberth.html>.



Fig. 12.7 Countdown clock switching into elapsed mode after the launch of Space Shuttle Discovery (Source NASA)

Because of the assistance of Hermann Oberth, it cannot be said that, except from the countdown, the rest of the ideas were born in this film. But it is undeniable the impact they had in the society and the space race and this constitutes another clear example of the symbiosis between science and science fiction. *Woman in the Moon* represented the first time that some of the basic scientific features of space travel were presented to the masses.

12.2.2.2 2001: A Space Odyssey—Stanley Kubrick (1968)

Produced by the American director Stanley Kubrick only one year before the landing on the moon, *2001: A Space Odyssey*¹⁶ is considered one of the main science fiction master pieces ever made. Its scientific accuracy and attention to detail made it stand out in its genre, winning multiple awards in different contests, such as the USA Academy Awards or the Academy of Science fiction, Fantasy and Horror Films.

However, it is necessary to remark that Kubrick produced this film in collaboration with Sir Arthur C. Clarke, whose books somehow inspired the director. In fact, Clarke wrote and published a book with the same title as the movie in the same year.

¹⁶2001: A Space Odyssey. (1968). [DVD] USA: Stanley Kubrick.



Fig. 12.8 Space station as depicted in 2001: A Space Odyssey (Source NASA)

The choice of including the film rather than the book in this chapter, even if some of the ideas it presents were originally thought of by Clarke, is based on the film bigger impact that the film had in the popular culture. *2001: A Space Odyssey* narrates the evolution of humankind in three phases: Prehistory, future and present. In the movie, Kubrick showed for first time in the screen technological advances such as videoconferences, tablets or a space station.

On the one hand, the space station, depicted as a rotational wheel in the movie,¹⁷ was far from reality: It was elegant, with pink coaches, a reception desk, rooms for different purposes such as videoconferencing or meetings and elevators. Also, inside it the crew and visitors were able to walk normally, since artificial gravity was created by centripetal motion. Although the idea of a rotating wheel to obtain artificial gravity has been considered by science fiction writers and scientists, in practice it has not been developed yet. On the other, it was the first time that a space station with a full-time crew on-board appeared in the cinema and so took form in the public imaginary. It was not until three years later, in April 1971, that the Soviet Union launched the first space station in space history: Salyut 1 (Fig. 12.8).

Other features in the movie that were non-existent at the time that it was produced and that are present today on-board the International Space Station (ISS) are flat-screen computer monitors and in-flight entertainment (astronauts on-board the ISS have DVDs, iPods and computers). Furthermore, Kubrick showed an astronaut jogging on-board the station, something that also happens today as exercise is part of the astronauts' daily routine. Lastly, the movie showed glass cockpits in the spacecraft, such as those on the flight deck of the space shuttle.¹⁸

¹⁷Clips of the space station depicted in 2001: A Space Odyssey are available on YouTube at: <https://www.youtube.com/watch?v=AEo9ZzT5Hos> (outer view of the station) and <https://www.youtube.com/watch?v=vG6CjOFl07A> (inner view of the station).

¹⁸NASA. (2014). 1968 *Science Fiction is Today's Reality*. [ONLINE] Available at: https://www.nasa.gov/mission_pages/station/main/2001_anniversary.html.

Because of the great impact that 2001: A Space Odyssey had in the public and as another example of the collaboration between space science and science fiction, NASA joined the 2008 40th anniversary celebrations of the film with a screening at the Academy of Motion Picture Arts and Sciences' Samuel Goldwyn Theater in Beverly Hills, California. During the screening, a message sent by astronauts on-board the ISS was played (see Footnote 18).

12.2.3 Space in Plastic Arts

12.2.3.1 Illustrations by Chesley Bonestell

Chesley Bonestell (1888–1986) was an architect and astronomy amateur. After having participated in some famous projects such as the Chrysler Building or the Golden Gate Bridge, he started a career as a special effects painter in Hollywood.

In the meantime, he developed his skills as an astronomical artist. Applying the knowledge he had acquired as a special effects painter, he developed a personal technique that conferred his paintings an unprecedented realism: He used to build detailed models, photograph them and finally paint over the pictures.

Soon his paintings became famous and started to be published in various magazines. He then started to work in cooperation with Willy Ley, who had been a member of the German Spaceflight Society and who convinced him to add spacecrafts to his paintings. In 1946, the magazine *Life* published his first series of paintings depicting a manned space mission: a mission to the moon (Fig. 12.9).

Although in this painting the moon surface is quite different from what the Apollo mission would discover later, the most important effect Bonestell's work had was arousing interest about space among the general public (Fig. 12.10).

Such was his success, that he was hired by the Collier's magazine to illustrate a series of articles about spaceflight written by the well-known Wernher Von Braun, who described him as:

Chesley Bonestell's pictures... are far more than reproductions of beautiful ethereal paintings of Worlds Beyond. They present the most accurate portrayal of those faraway heavenly bodies that modern science can offer. I do not say this lightly. In my many years of association with Chesley I have learned to respect, nay fear, this wonderful artist's obsession with perfection. My file cabinet is filled with sketches of rocket ships I had prepared to help him in his art work—only to have them returned to me with penetrating detailed questions or blistering criticism of some inconsistency or oversight.

The Collier's series had a great impact in the American public that influenced the government to invest in space exploration. The impact Chesley Bonestell had in promoting the space industry development was so important, that even the Asteroid 3129 and a crater in Mars have been named after him.



Fig. 12.9 Assembling the ships for the Mars expedition, by Chesley Bonestell, 1956



Fig. 12.10 Space station, ferry rocket and space telescope 1075 miles above Central America, 1952 (Source Bonestell LLC)

12.3 Conclusions and Commentaries

This chapter has presented some examples of the symbiosis between science fiction and space science and technology that highlight the role that the former plays in the development of the latter and vice versa. They advance in parallel, boosting one another: science fiction bases its ideas in science and real-world technology and proposes new concepts, some of which are later implemented in technology.

It is also noticeable how science and science fiction co-work together. In the majority of the above examples, the writer/cinema director/illustrator worked in collaboration with some scientist. Most of them important scientists that changed the path of the space race, on the same level as the “futurists”, that were able to describe a technology they had never seen. In words of Sir Arthur C. Clarke:

If by some miracle, a prophet could describe the future exactly as it was going to take place, his predictions would so sound so far-fetched, so absurd, that everyone would laugh at him to scorn.

And even though they did it, because it needed to be done. Science cannot evolve if we do not try to go beyond what we already know. Only exploring new possibilities and breaking the barrier of “the impossible” can we go where we have never been.

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Seven Billion Deer in the Headlights

13

Humankind's reactions and solutions to a large impact event, according to Hollywood.



Bas Martens

Abstract

A large scale asteroid impact is inevitable! This is both a truth and the plot of the disaster films discussed here: When Worlds Collide (1951), Meteor (1979), Asteroid (1997), Armageddon (1998), and Deep Impact (1998). They may be a hit in Hollywood, but their physics and logic do not always adhere to the truth. Interestingly, they sometimes offer insight in the geopolitical relations, the deemed potential of the space industry, and the popular image of space at the time of release. The films show Hollywood's unrealistic mitigation efforts, but the truth is that real solutions are yet to be proven in practice.

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13.1 Introduction

Mankind has since long gazed to the sky in wonder.¹ Their view was occasionally glossed by an impressive *long-haired star*, or comet, confirming the divinity of the starry dome once more. People around the world attributed prognosticative value to these events, often in the form of an omen of impending doom.²

In the first century AD, the Roman Lucius Seneca wrote: “Men will some day be able to demonstrate in what regions comets have their paths, why they move so far from the planets, what is their size and constitution.”³ Statistically, it is no wonder that one of these prophecies actually materialized and not by chance, but by means of theories and telescopes people enabled themselves to predict the future. Instead of comets telling us where we were headed, we could now tell them where they were headed. It is also statistically sure that one will land on Earth.

Despite the demystification of comets, people rightfully wonder about what would happen if those or other far away chunks of rock come closer than we are comfortable with. This wonder is met by the genre of space disaster movies, which follows and extrapolates the current technological and strategic trends and sets them at the same time.⁴

Although their artistic value is disputable, their scientific, technological and strategic accuracy can be determined and compared to one another. This is the aim of this review. The scope only allows a few cases, but they are chosen to be an exemplar of the rest of the film. During this analysis, a few extraordinary features in the films will be pointed out and elaborated. The discussion of the films will be done in chronological order of release date: *When Worlds Collide* (1951), *Meteor* (1979), *Asteroid* (1997), *Armageddon* (1998) and *Deep Impact* (1998).

¹Image on cover retrieved from <http://doubtfulnews.com/2015/08/september-asteroid-impact-lies-results-in-nasa-statement/>.

²‘Comet’, *Online Etymology Dictionary* <http://www.etymonline.com/index.php?term=comet> [accessed 19 February 2019].

³Ian Ridpath, ‘A Brief History of Halley’s Comet—Comet Lore’, *Cambridge University Press*, 1985 <http://www.ianridpath.com/halley/halley1.htm> [accessed 19 February 2019].

⁴Patrick Purdy, ‘From Science Fiction to Science Fact: How Design Can Influence the Future’, *UX Magazine*, 2013 <http://uxpamagazine.org/science-fiction-to-science-fact/> [accessed 19 February 2019].

13.2 When Worlds Collide

Year of release	1951	Figure 13.1
IMDb rating	6.7	
Link to trailer	https://www.youtube.com/watch?v=KcLaMyc4ecE	
Summary	A rogue planet is on a collision course with Earth. A group of people race against the clock to build an ark that can carry them away from their doomed home	

13.2.1 Situation

At the time of discovery, the planet Bellus is three billion miles and eight months away from impact with the Earth. Around forty randomly chosen people and some animals are sent on a journey to continue Earthly life on Bellus' satellite planet Zyra, of which the habitability is unknown. The secretly built spaceship that carries them will be shot

Fig. 13.1 Front cover of *When Worlds Collide* (IMDb)

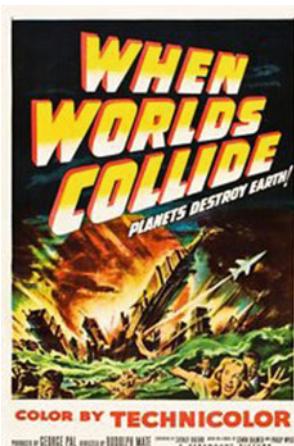
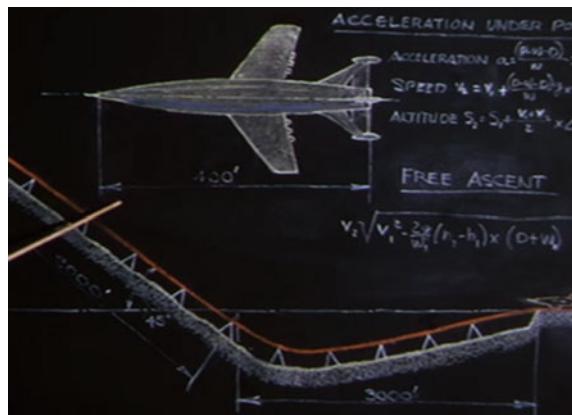


Fig. 13.2 The blackboard detailing the launch to Zyra's (Paramount Pictures)



to Zyra by means of a slingshot rail. In the novel, intelligent life is discovered on Zyra. In the film, non-natural structures appear on Zyra, confirming this.

13.2.2 Analysis: Spacecraft Launch

The rocket scientist explains that the spaceship will be fired to Zyra by a rocket propelled carriage, after which the rocket consumes no power until they reach Zyra. This means that they have to reach their final velocity on the rail. The plans for the rocket launch are briefly shown in the movie, allowing us to assess the feasibility of this plan.

For the sake of determining an order of magnitude, let us assume that the Ark to Zyra would at least need to reach low Earth orbit, which requires an increase in velocity of 9.4 km/s.⁵ From the blackboard shown in the film, a total rail length of 6000 ft can be read. It can be calculated that reaching the final velocity over this distance requires an acceleration of roughly 2500 g. Unfortunately, this would result in the spaceship and its passengers being completely obliterated, and with it life's last chance of survival beyond Earth (Fig. 13.2).

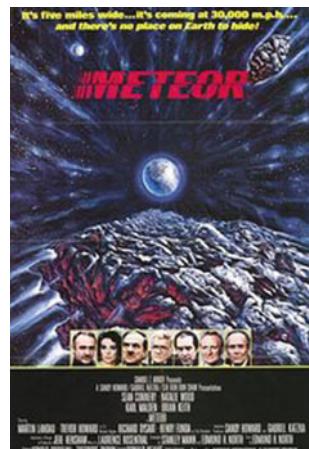
13.2.3 Analysis: Zyra

From the given distance and time to impact, the average speed of the two planets can be calculated: 233 km/s, or 0.077% of the light speed. The oldest rogue planets that have been discovered are approximately 130 million years old.⁶ This means that Zyra could have originated anywhere in the universe within approximately 100,000 light years from the Earth: roughly anywhere in the Milky Way galaxy.

⁵'Low Earth Orbit', Wikipedia, 2019 https://en.wikipedia.org/wiki/Low_Earth_orbit.

⁶'Rogue Planet', Wikipedia, 2019 https://en.wikipedia.org/wiki/Rogue_planet.

Fig. 13.3 Front cover of *Meteor* (IMDb)



There might be twice as many rogue planets as stars in our galaxy, so the chance of complex life is small, but present.⁷

The chance of people surviving there, however, is null. Apart from the impractical and life-inhibiting eternal darkness after leaving our Sun, the planet's atmosphere would never meet the requirements of the human lungs.⁸ In addition, to maintain a temperature above the freezing point, the atmospheric pressure would have to be two to three orders of magnitude higher than on Earth. The jolly manner in which the people left the spaceship on arrival would have undoubtedly resulted in some severely damaged eardrums.⁹

13.3 Meteor

Year of release	1979	Figure 13.3
IMDb rating	4.9	
Link to trailer	https://www.youtube.com/watch?v=DVQrq-TUZIw	
Summary	The USA and USSR must join forces in order to destroy a giant asteroid heading for Earth	

⁷Tony Phillips, 'Free-Floating Planets May Be More Common Than Stars', NASA, 2011 https://science.nasa.gov/science-news/science-at-nasa/2011/18may_orphanplanets [accessed 19 February 2019].

⁸Sean Raymond, 'Life in the Dark', *Aeon*, 2015 <https://aeon.co/essays/could-we-make-our-home-on-a-rogue-planet-without-a-sun> [accessed 19 February 2019].

⁹Viorel Badescu, 'Free-Floating Planets as Potential Seats for Aqueous and Non-Aqueous Life', *Icarus*, 216.2 (2011), 485–91 <http://www.sciencedirect.com/science/article/pii/S0019103511003654>.

13.3.1 Situation

A comet crashes into a large asteroid in the asteroid belt between Mars and Jupiter, releasing an Earth-bound chunk of five miles wide, travelling at 30,000 mph that will hit in six days. The plan is to fire Hercules (US) and Peter the Great (USSR), two secret nuclear attack systems in orbit around the Earth. The blast waves of their combined detonation at a small distance from the asteroid should redirect it past Earth. During the preparations, large splinters hit the Earth causing global destruction.

13.3.2 Analysis: Deflection

The film Meteor was inspired by a 1967 MIT school assignment (see Footnote 8). Although this is one of the earlier concepts and films about asteroid impact prevention, the strategy used is still one of the most efficient and effective, as shown in a 2007 NASA study. It delivers a high change in momentum without the need for thorough mapping, placing, or the risk of breaking it into many smaller but dangerous pieces.¹⁰

13.3.3 Analysis: Cold War Relations

The secretly built nuclear missile satellite Hercules was built to meet the threat of incoming celestial bodies. However, during the Cold War it was targeted at the USSR rather than outwards, to the dismay of the designer. The USA suspected the USSR to do the same, and vice versa, so they fulfilled their own prophecies.

The investigation of the large asteroid was done by a couple of American astronauts, casually making a detour to the asteroid belt on their way to Mars. Albeit a science-fiction film, this suggests that:

- The general public held the space industry and its technological growth trend in high regard;
- Manned space exploration was a hot topic;
- The Apollo missions were ahead of their time: fifty years later, nobody has even come near Mars;
- The film was shot for an American audience, promoting American manned spaceflight.

In order for the world to survive, the USA and the USSR had to cooperate to deliver the nuclear missiles to the asteroid at the same time. Understandably, cooperation did not go without struggle. To force collaboration, the president of the

¹⁰NASA, *Near-Earth Object Survey and Deflection Analysis of Alternatives*, 2007 https://www.nasa.gov/pdf/171331main_NEO_report_march07.pdf.

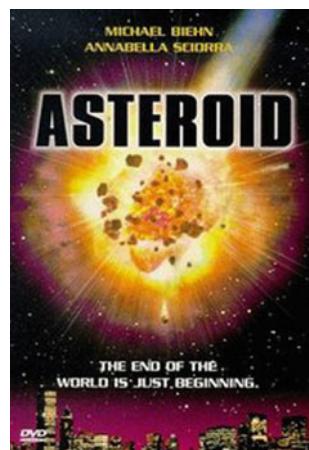
USA announced on television that they had built a system for fending off asteroids, giving the Russian president the chance to join him in his apparent altruistic endeavor. The Russian president reacted strikingly: “The Americans elected an alchemist for president... He can turn hypocrisy into diplomacy!”¹¹

Just like in real life, cooperation among scientists came before political agreement and just like in real life, the meeting ground was space. The two superpowers who thought each other to be their greatest enemies found a common cause. This notion of peace was thoroughly emphasized in the film by the long-winded attitude control move of the missile systems adjusting their aim from Earth to space. Coincidentally, or perhaps not, the period in which the film was shot coincided with the period in history of temporary alleviated Cold War tension and the first US-USSR space collaboration.¹¹

13.4 Asteroid

Year of release	1997	Figure 13.4
IMDb rating	4.8	
Link to trailer	https://www.youtube.com/watch?v=ZX5TRQOeWHw	
IMDb Summary	With the discovery of an incoming asteroid, the government of America formulates a plan to destroy it. When the plan fails, all the world can do is wait	

Fig. 13.4 Front cover of *Asteroid* (IMDb)



¹¹‘Space Race Time Line’, NOVA <https://www.pbs.org/wgbh/nova/astrospies/time-nf.html>.

13.4.1 Situation

The gravity of a comet carries a few large asteroids make their way towards the Earth. The largest one, Eros, is four miles across and will cause a global ecological disaster if it were to hit in two days. The American government adapts the secret Air Force's Airborne Laser for use at space and mounts three on fighter jets. The world rejoices as the plan appeared to work, but it only broke it into many smaller but dangerous pieces. Places around the world get hit and terror and rescues ensue.

13.4.2 Analysis: Lasers

The laser-inspired deflection strategy has some potential, but the execution in Asteroid was a laughably unrealistic one. First of all, the laser system fit to blow up a four mile rock would require an energy that is comparable to many weapons of mass destruction. There are some high energy and high power lasers, but any current system would not even come near these capabilities.^{12,13} Secondly, these systems, their subsystems and power supply are extremely large and heavy, so they could never be fitted on a fighter jet. Thirdly, the lasers in the fighter jets appear to be fixed in the flying direction. Hitting an asteroid in space that is moving at 16 miles per second with three moving jets simultaneously would require the most complex of targeting systems and coordination.

A more viable laser-based alternative for asteroid deflection is laser ablation. A high energy laser is pointed on the surface of the asteroid, resulting in material to vaporize which produces a small thrust. Over time, this will alter the asteroid's trajectory. However, application in the case of Asteroid would be impossible. The astronomers had two days to deflect a four mile asteroid. Depending on their power, laser ablation techniques are estimated to take five to fifteen years to deflect a 500 m asteroid.¹⁴

Although it is refreshing to see an asteroid film without nuclear missiles, especially in this film the Earth would have had a slightly bigger chance by giving the asteroid a momentum change as large as possible, by means of some good old nukes.¹⁵

¹²Josef Shwartz, 'Tactical High Energy Laser', *SPIE Proceedings on Laser and Beam Control Technologies*, 4632 (2002) http://www.northropgrumman.com/Capabilities/ChemicalHighEnergyLaser/TacticalHighEnergyLaser/Documents/pageDocuments/SPIE_Manuscript_Tactical_high.pdf.

¹³Gianluca Sarri, 'World's Most Power Laser Is 2,000 Trillion Watts—but What's It For?', *The Conversation*, 2015 <https://theconversation.com/worlds-most-powerful-laser-is-2-000-trillion-watts-but-whats-it-for-45891> [accessed 19 February 2019].

¹⁴Tomasz Nowakowski, 'Could a Laser Weapon Save Earth from Killer Asteroids?', 2016 <https://phys.org/news/2016-03-laser-weapon-earth-killer-asteroids.html> [accessed 19 February 2019].

¹⁵NASA.

13.5 Armageddon

Year of release	1998	Figure 13.5
IMDb rating	6.6	
Link to trailer	https://www.youtube.com/watch?v=kg_jH47u480	
IMDb Summary	After discovering that an asteroid the size of Texas is going to impact Earth in less than a month, NASA recruits a misfit team of deep core drillers to save the planet	

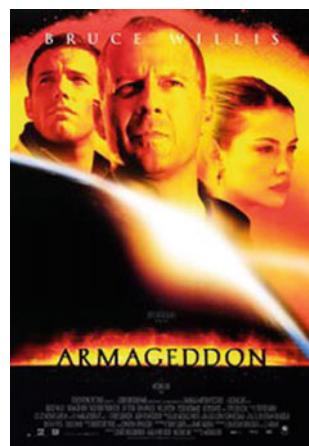
13.5.1 Situation

An asteroid the size of Texas will hit the Earth in 18 days. NASA recruits a team of oil drillers and quickly trains them to be astronauts. The team members will land two shuttles on the asteroid, where they will drill a nuclear bomb into the surface. The explosion should cause the asteroid to split in two pieces that will fly past either side of the Earth. After many struggles, they succeed and most return to Earth.

13.5.2 Analysis: Accuracy

Armageddon is a welcome, action and comedy packed change to the serious and bland films in the genre and has even been the most enjoyable asteroid impact film to watch. However, the space aspect only serves as an exciting environment in

Fig. 13.5 Front cover of *Armageddon* (IMDb)



which an infinite amount of impressive stunts can be performed. It is so filled with ridiculous and unrealistic details that analyzing its accuracy would be a trivial task. Examples are:

- A ten day astronaut training;
- A heavy Howitzer-like gun on the asteroid rover and a skull on its gear stick;
- The laws of gravity only apply when it adds a “cool” effect;
- Docking a space shuttle to a spinning space station;
- The bomb that is needed to achieve their goal requires a yield a billion times larger than the strongest bomb ever detonated on Earth.¹⁶

13.5.3 Analysis: Space Industry

The film does have a few striking comments that emphasize the nature of the space industry. During the launch, one of the team members says: “You know, we’re sitting on four million pounds of fuel, one nuclear weapon and a thing that has 270,000 moving parts built by the lowest bidder. Makes you feel good, doesn’t it?” And near the end of the film, the cosmonaut yells: “...American components, Russian components, all made in Taiwan!”.

Although most spacecraft are government-funded and constructed within the borders of a country, a lot of the aspects of the free market apply. Within the boundaries of technical norms, price has always played a decisive role in task allocation and feasibility. This is true to an extent that much equipment is bought from countries where quality is sufficient and prices are low, for instance Taiwan.

13.6 Deep Impact

Year of release	1998	Figure 13.6
IMDb rating	6.1	
Link to trailer	https://www.youtube.com/watch?v=9cqDWRIv7Mg	
Summary	A newly discovered comet will wipe out mankind, unless it can be destroyed or people will take refuge underground	

¹⁶‘Bruce Willis Couldn’t Save Us from Asteroid Doom’, *University of Leicester Press Releases*, 2012 <https://www2.le.ac.uk/offices/press/press-releases/2012/august/bruce-willis-couldn2019t-save-us-from-asteroid-doom> [accessed 19 February 2019].

Fig. 13.6 Front cover of *Deep Impact* (IMDb)



13.6.1 Situation

A newly discovered seven mile long comet will cause an “Extinction Level Event” when it crashes into the Earth one year from now. A team of astronauts plan to land on it, drill in nuclear warheads and mitigate the damage by reducing it to many smaller asteroids. This mission fails, dividing the comet into a six mile and a 1.5 mile comet. All hope appears to be lost. One million Americans are randomly chosen to stay in a huge underground complex for two years, which leads to desperation at the gates of the cave. The smaller comet hits first, causing a huge tsunami. The returning astronauts decide to give humanity one last chance by planting their leftover nukes into the comet with a kamikaze-strike, resulting in a meteor shower for the world to enjoy.

13.6.2 Analysis: A Harsher Reality

Although Deep Impact is one of the more accurate impact event movies, there are still many errors to be found.¹⁷ One of the more interesting ones is summarized in the line at the end of the movie: “We watched as the bombs shattered the second comet into a million pieces of iron and rock that burned harmlessly in our atmosphere and lit up the sky for an hour.”

Critique can be made against this scenario, starting with the logic aspect. The first attempt to destroy the seven mile comet with four sub-surface warheads resulted in it cracking into two pieces. The second try, a spaceship with the same

¹⁷Phil Plait, ‘Hollywood Does the Universe Wrong’, 2000 https://web.archive.org/web/20101012010422/www.space.com:80/opinionscolumns/opinions/plait_000217.html [accessed 19 February 2019].



Fig. 13.7 Sarah and Leo marvel at the harmless meteors (Paramount Pictures)

amount of warheads crashed into a similarly sized comet, suddenly shattering it into a million pieces. This would be highly unlikely.

But for the sake of argument, let us assume that half of the comet actually did explode into countless harmless pieces. If the 200 billion ton remainder were to break into exactly one million pieces like the film suggests (assumed spherical for simplicity), this would result in one million 86 m wide comets entering the atmosphere. Using typical velocity and density values for comets (51 km/s and 600 kg/m³, respectively), the Earth Impact Effects Program developed at Purdue University tell us that a single piece would cause a 60 megaton airburst explosion, in turn causing shattered windows, felled trees, and collapsed buildings and bridges.¹⁸ Now imagine a million of these explosions over a large area of the United States! The combined shock waves would be ear-deafening and create hurricane-like winds that would fling around all terrestrial debris, resulting in an hour-long Armageddon. Fortunately, however, the director decided to end the film happily with Sarah and Leo smiling towards the sunset, blessed and in awe by the magnificent lightshow (Fig. 13.7).

13.7 Conclusion

A few common characteristics can be found when considering the five impact event films in this review. Firstly, the incredible disregard for the laws of physics and statistics are shown in every film. Although often embarrassing to watch, it is justifiable when it provides for an exciting film for the public: not too gory, not too complicated, much romance and a happy end.

Secondly, the perspective from which the films are shot and the target public it is directed at play a large role. All films are made in Hollywood and not coincidentally, discovery of the asteroid, mitigation efforts and major impacts all take place in

¹⁸Marcus, Melosh, and Collins, ‘Earth Impact Effects Program’, 2004 https://impact.ese.ic.ac.uk/cgi-bin/crater.cgi?dist=0.1&diam=86&pdens=600&pdens_select=0&vel=51&theta=45&tdens=2500&tddens_select=0.

the United States of America. Some films do show international collaboration, but not by far enough when it comes to an Earth-threatening situation.

Finally, all films surprisingly accurately emphasize the message that a large impact event is inevitable. The world's first asteroid mitigation effort is the American Double Asteroid Redirection Test (DART) space mission, and has moved into the final design and assembly phase.¹⁹ It will attempt to redirect an asteroid by impacting it. Although rare, a global disaster is upon us, unless something can be done to prevent it. These films show Hollywood's unrealistic mitigation efforts, but the truth is that real solutions are yet to be proven in practice.

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¹⁹ Michael Buckley, 'Asteroid-Deflection Mission Passes Key Development Milestone', *Phys.Org*, 2018 <https://phys.org/news/2018-09-asteroid-deflection-mission-key-milestone.html> [accessed 19 February 2019].



Hope at the Frontier: *Firefly* and the Value of Space Exploration

14

Mehak Sarang

Abstract

Space is often defined as the final frontier. Historically, the development of the American frontier was an important pursuit that not only expanded the physical boundaries of the nascent nation, but led to the development of uniquely American values that came from overcoming the challenges associated with frontier life. As we begin to expand into the final frontier, it is likely that this pursuit will have a similar affect on the culture of a spacefaring humanity. *Firefly*, the 2002 television series created by Joss Whedon, draws out the analogy between space exploration and the frontier. Following the crew of a spaceship, Serenity, Whedon explores the kinds of values that are associated with life at the frontier, and reimagines them in a new context. This examination serves as a useful reminder of the consequences of exploration, and the possible effects it could have on defining a new culture.

14.1 Introduction

The frontier story is a symbol of American national identity. The decades-long quest of Manifest Destiny planted the seeds of democracy and defined the nascent nation. When the final settlers reached the last land to be incorporated into the United States, the physical frontier, and a chapter of history, came to a close. With the closing of one frontier, however, another opened. Science was deemed the next horizon to conquer—one that could promise endless exploration and an opportunity to expand and inspire. In time, space offered itself as a worthy contender for the

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next *physical* frontier to conquer. When President Kennedy charged Americans to lead mankind into space, he evoked this frontier spirit, “...the United States was not built by those who waited and rested and wished to look behind them. This country was conquered by those who moved forward, and so will space.” The frontier mentality, present in the earliest days of American expansion, was thus embedded in the new realm of American space exploration.

Joss Whedon’s beloved television program, *Firefly*, lays bare the obvious analogy between the early American frontier and the new age of space exploration. Set 500 years in the future, Earth has been “used-up”, forcing humanity to terraform new planets to sustain the human race. Life on the “core planets” is luxurious and futuristic, while poverty defines life away from the center on the outer planets and moons, where humanity scrapes by on limited resources. The collection of planets and moons inhabited by humans is called the ““Verse”, and the central government, the ‘Alliance’. *Firefly* is a bridge between the familiar form of the America Western and the space opera—aptly dubbed a ‘space western’. Whedon’s pioneers are the crew of a spaceship, Serenity, that careens through the “Verse”. He takes advantage of his medium, science fiction, which lends itself well to “tak[ing] familiar concepts and reinvent[ing] them; [placing] them in an unfamiliar or disturbing, futuristic or technological setting.”¹ But staying true to the Western, Whedon shows us just how rough life at the frontier can be, albeit in space.

By showing the struggles that come with exploring the unknown reaches of outer space, and drawing out the analogy to life at the frontier, Whedon offers a unique perspective on space exploration. In this article, I will first offer motivation for what makes the concept of a “frontier” so special, and how Whedon transports the defining characteristics of the frontier into space. Then, I will examine how *Firefly* could offer insight into what the consequences of transporting the frontier into space, and the values that emerge from life at the frontier.

14.2 The Frontier, Defined

The frontier, or where “civilization meets savagery”,² is a historical term fraught with tension. In the case of the American West, the frontier and the process of settlement marked an important chapter of American history. Lacking the infrastructure afforded by life at the center, the frontier is land—or space—waiting to be conquered. For Joss Whedon, this was to be the subject of *Firefly*. In an interview he explains, “I wanted to play with that classic notion of the frontier. Not the people who made history, but the people history stepped on—the people for whom every act is the creation of civilization.” Turner’s theory aligns with this notion of the process of settlement as creation,

¹Handlin, Oscar. “Science and Technology in Popular Culture.” *Daedalus*, vol. 94, no. 1, 1965, pp. 156–170. *JSTOR*, www.jstor.org/stable/20026900.

²Frederick Jackson Turner, “The Significance of the Frontier in American History,” in *The Frontier in American History* (New York, NY: Henry Holt, 1920), 1–38.

at the frontier the environments is at first too strong for the man. He must accept the conditions which it furnishes, or perish...little by little he transforms the wilderness, but the outcome is not the old Europe...the fact is, that here is a new product that is American.

Challenges faced at the frontier, as man transforms the environment, in turn, transforms the man, and thus defines a new culture that may be entirely new from the center. Importantly, there is an idea that life at the frontier influences the center,

From the conditions of frontier life came intellectual traits of profound importance...that coarseness and strength combined with acuteness and inquisitiveness; that practical, inventive turn of mind, quick to find expedients; that masterful grasp of material things, lacking in the artistic but powerful to effect great ends; that restless, nervous energy; that dominant individualism, working for good and for evil ... these are traits of the frontier, or traits called out elsewhere because of the existence of the frontier.

The conditions of relevance unique to the frontier are the physical environment, and the restrictions it imposes; the technology used to navigate and manipulate the environment; and how society is formed and governed at a distance from central authority. These conditions are found in *Firefly*, and are similar to those faced by early American pioneers; but space offers its own challenges. The environment is not just challenging, it is by definition inhabitable. Technology has advanced by leaps and bounds, and the government is now limited by the laws of physics from interfering with affairs at the fringes of their authority.

Even at the imagined frontier, these conditions and resulting traits are worth examining because, as Turner argues, the traits developed at frontier are “called out elsewhere.” Actions of a minority, acting at the frontier, can affect the majority culture at the center. We can imagine this being the case as space exploration becomes more of a reality. Historical precedent tells us so: the Space Race defined an era, and planting a man on the moon reigned a spirit of exploration that resonates until today. Using *Firefly* as a lens, examining frontier traits will serve as an exercise to highlight what values space exploration and pursuing life at the final frontier could hold, both good and bad.

14.3 Constructing Worlds, Creating Civilizations

Constructing a life on the frontier goes hand-in-hand with transforming the environment for human habitation. In Whedon’s ‘Verse’ planets and moons are terraformed with ease by the Alliance, making way for the seemingly endless expansion of humanity. The further away from the ‘core’ planets, however, the further away we find ourselves from ‘civilization’. As described in the beginning of *Serenity*, the film feature based on *Firefly*,

In the end we had more than enough room for everyone, and generations to come... The Central Planets were the first settled and the most advanced, embodying civilization at its peak. Life on the outer planets and the border moons is much more primitive, and difficult. That's why the Central planets formed the Alliance, so that everyone can enjoy the comfort and enlightenment of true civilization. That's why we're fighting the War for Unification.

The conflict between civilization and liberty is an important theme in *Firefly*. Although life at the edges is more difficult, and lacks the same infrastructure afforded in core planets, the crew of *Serenity* and inhabitants of these outer planets are drawn there hoping to evade the reach of the Alliance. Through the series, it becomes clear that in addition to representing the dangers of big government, the Alliance also serves as a metaphor for the double-sided nature of using technology to exert control over the environment. As Miller and Riper argue, Western steampunk follows the process of “creating a West where nature is conquered by civilization, and civilization is, in turn, conquered by technology.”³ The more Whedon depicts the outer planets, the more apparent it becomes that civilization is undergoing a process of being conquered by technology, usually brought on by the actions of the Alliance. When support is offered by the Alliance, it is often misguided. Terraforming gone awry means that clean air, water, and living environments at a planet-level become a privilege. For Wash, the pilot of *Serenity*, the pollution on his home planet—so thick that he couldn’t see the stars—served as a motivation for him to leave, “sometimes I think I entered flight school just to see what the hell everyone was talking about.” Planets at the periphery also become testing grounds for new technologies. The Reavers are a race of humans said to gone mad by staring into the “black” of space. Eventually, we discover that the Reavers were actually created as a result of a terraforming experiment on a planet named Miranda. Chemicals injected into the atmosphere intended to create a docile civilization by weeding out aggression and anger in the population. About 1% of the population had the opposite reaction, turning into cannibal pirates that roam the outer rim preying on humans. When the crew learns of the experiment gone awry, one member comments, “Amazing things they can do to a person’s brain nowadays. And they think they got the right to do it. No territory is off limits, right?” Technology affords the ability to civilize, and so, the Alliance takes advantage of it.

This begs the question, once we have control, what will stop us from exerting it? Who will receive the benefits, and who will suffer from the mistakes? Frontiers are often seen as “empty” space, waiting for us to imbue land, and even indigenous populations, with culture and civilization. As Whedon points out, however, the idea of planets as discardable playgrounds for human inventions seems reckless, and yet, entirely aligned with the historical frontier mentality. Wash’s planet, with pollution so thick it obscures the stars, reminds us of the pollution and irreversible damage we have wrought to the Earth as we continue to gain control over the environment. The case of the Reavers, although extreme, is a cautionary tale, calling back to efforts on the historical frontier to impose “culture” on indigenous civilizations. As technology advances, we are afforded more control over our environment, and ourselves than ever before. The Alliance’s use of technology reminds us that *control* is often an illusion, and the effects are generally unforeseeable.

³Cynthia J. Miller & A. Bowdoin Van Riper (2011) Blending Genres, Bending Time: Steampunk on the Western Frontier, *Journal of Popular Film and Television*, 39:2, 84–92, DOI: <https://doi.org/10.1080/01956051.2011.571109>.

14.4 The Pursuit of Liberty

The other double-edged sword of frontier life is the fierce independence that comes with pursuing a life without the safety nets afforded by “civilization”. American Westerns focused on the lives of outlaws. Many individuals in these films made a life for themselves outside legal means, far from the reach of the central government. In *Firefly* we follow a crew of bandits—eking out a living pursuing whatever jobs they can find, legal or not. Working outside of the law, however, brings all kinds of problems, and the crew often finds itself dealing with untrustworthy individuals. Mal justifies the work the crew does, even with the perils and struggle it brings, because life on the edge also grants the elusive promise of liberty.

The opening theme of the show evokes this idea of liberty, “Take my life, take my land, take me where I cannot stand. I don’t care, I’m still free, you can’t take the sky from me.” Even as Mal shows Zoe, the second member of the crew, around the ship for the first time, he encourages her to look past the rundown nature, “I’ll show you the rest. And try to see past what [Serenity] is, and on to what she can be.” Zoe questions, “What’s that, sir?” to which Mal responds, “Freedom, is what.” Mal, and the crew that he recruits are all in search of the liberty that Serenity promises.

Liberty in Whedon’s ‘Verse is found away from the reach of the Alliance, the seemingly supreme government. As the crew finds themselves further away from authority, however, they also find themselves further away from the protections afforded by government, another characteristic of frontier life. As Torres explains, the lack of government could lead to perpetual anxiety about potentially being attacked by the other individuals at the frontier,

...anarchy generates uncertainty about the present and future intentions of other actors; this leads to fear, resulting in the accumulation of weapons arsenals, etc. for “defensive” purposes; this increases the fear of other actors uncertain of one’s true intentions, ... two peaceable civilizations could end up warring due merely to a spiral of escalating militarization given a lack of mutual trust. A related concept is *Schelling’s dilemma*, also known as the “Hobbesian trap,” whereby one actor engages in a first strike against a second actor due to a fear of being immediately attacked by the first actor.⁴

This idea is played out countless times in the series. In the microcosm of the ship’s crew, the only thing valued above liberty is allegiance to the crew on Serenity. When Jayne, one of the members of the crew attempts to sell out two other members in order to profit, Mal threatens him by storing him an ajar airlock adding, “The next time you decide to stab me in the back, have the guts to do it to my face.” Even the hint of betrayal is met with a threat of death. In the context of the work they do, and the fact that each member plays a vital role in sustaining their life at the edge of the ‘Verse, the unity of the crew is tantamount. Although the crew seeks a life at the frontier to avoid the traditional structures of authority, Mal’s role as captain is generally understood to be the “law”.

⁴Torres, Phil. (2018). Space Colonization and Suffering Risks: Reassessing the “Maxipok Rule”. *Futures*. 100. <https://doi.org/10.1016/j.futures.2018.04.008>.

In the microcosm of the ship, this structure affords some level of security, but on the grander scale, it's almost impossible to trust other individuals on the frontier. For example, when forced to ask for help in finding a part to repair Serenity, Mal realizes they are far from the signal of the Alliance. As such, he is left to ask for assistance from a strange crew, likewise roaming around the edges of outer space. When they dock ships and meet face-to-face, it's clear there is an equal lack of trust. After making the request, the captain of the other ship questions Mal, "... how can I know for certain your story's true? Ambush could be waiting for me and my people on the other side." When the captain finally does dock, he attempts to steal the ship and cargo on Serenity. Mal strikes back, and when he finally gains the upper hand, the captain, in defeat, remarks, "You would have done the same." The lack of mutual trust and accountability breeds a constant existential threat of betrayal. In terms of the historical frontier, Turner warns, "democracy born of free land, strong in selfishness and individualism, intolerant of administrative experience and education, and pressing individual liberty beyond its proper bounds, has its dangers as well as benefits." At the frontier, distrust of authority must strike a balance between healthy skepticism of big government and a complete lack of accountability—something that could lead to a constant fear of an existential threat.

14.5 Ingenuity at the Frontier

The third trait drawn out in pursuit of life at the frontier is the need for ingenuity. Usually, science fiction serves as a commentary on the limits of technology, and laments the growing dependence between man and machine. In *Firefly*, the technology errs more towards the kinds of machines one would see in steampunk. In this way, the relationship between technology and man is important, and the inventor, or tinkerer, is highly valued. The main "technology" in *Firefly* is Serenity, the spaceship. It is clear from the beginning of the series, however, that the ship is not a static, passive piece of technology. Rather than an object, we frequently see efforts to personify Serenity, and in some ways, the ship feels like another member of the crew.

The episode "Out of Gas" explores this relationship between (wo)man and machine. Serenity experiences an explosion, which threatens the life of the ship and the life of one of the crew members, Zoe, who is hit by the blast. The action in the episode flits back and forth between Simon, the crew's doctor, and his efforts to save Zoe, and Kaylee, the ship's mechanic, saving Serenity. The parallel nature of the episode, doctor saving patient, and mechanic saving spaceship, draws out the analogy of Serenity as crew member.

The depiction of technology in this manner is important because it gives Whedon a way to play with one of the most important frontier traits: that of practical ingenuity. As the only shell between the crew and the vacuum of space, Serenity is a lifeline. When the technology is threatened, the crew must rely on human ingenuity, borne out of a lack of resources. Floating out in the outer reaches

of space, Kaylee laments that the ship needs a new catalyzer to which Mal responds, “There is no new one. You gotta make do with what you got.” This mentality of DIY, valuing human knowledge over the mysterious nature of machines, is another characteristic of the frontier. All individuals must meaningfully contribute skills to ensure the sustainability of their precarious lives.

14.6 Conclusion

Human habitation of space may still be relegated to the realm of science fiction, but the importance of these depictions should not be understated. As I’ve shown, Joss Whedon’s *Firefly*, imagines life at the final frontier, and highlights the challenges that would be faced by pioneers in space. Similar to the challenges faced by settlers of the American West, certain values would be selected for that are crucial to sustaining life in otherwise inhabitable conditions.

The three values analyzed here—the quest to imbue empty space with “civilization”, pursuing ultimate self-reliance, and cultivating practical ingenuity—are only a sampling of the kinds of characteristics that could be useful at the frontier. As I’ve shown, these values can be double-sided, a fact that our history of exploration verifies. This analysis serves only to highlight the usefulness of science fiction in its ability to imagine what values could emerge from the pursuit of space exploration, and whether it leads to the cultivation of a society that would be worth living in. As we continue to encourage space exploration in the same way we encouraged the expansion of the American frontier, it is worth examining the consequences to our collective value system and learn from the mistakes, and successes, of early exploration.

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The Space Activities of Animals in African Fairy Tales in Light of International Space Regulations

15

Annette Froehlich

Abstract

“The Baboon who went to the Moon” (John Bush/JC Phillips, Storytime Africa, South Africa) is a marvellous fairy tale that shows that determination leads far, even to the Moon and potentially beyond. However, it also invites analysis of the space activities of this genius baboon with respect to international space regulations. In this context, the space freedom rights conferred by the Outer Space Treaty will be discussed together with the constraints and further regulations that have to be respected in order to guarantee the sustainable and equitable use of outer space for all.

15.1 Setting the Scene

Stargazing has a longstanding tradition in Africa. Since the beginnings of humankind, humans have gathered during the evenings to tell stories to each other to spend the long dark nights together. It seems even stargazing socialized our ancestors. In addition, they looked at the stars to find answers for their own lives, and to understand their aspirations and existence within the universe. However, not only human beings look at stars, other living beings also use star constellations as a kind of navigation system to help safely guide them during long flights across continents and sea areas.

But is not only migratory animals that have to master long distance walks or flights that are in close relationship to the stars, more sedentary animals such as monkeys also seem to be inspired by the stars. This is the story of “The Baboon

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who went to the Moon".¹ It is a story about a baboon who was so enthused by the stars that he sat down in the evening on the sandy ground to look at them. He was so inspired by the stars that the desire grew in him to go to the Moon. Where other beings may have \$\$\$ signs in their eyes, it was the Moon that was reflected in his eyes. It is also the Moon that leads the baboon throughout the whole story; a story about how perseverance brings one to the highest, unreachable levels and fulfils desires. Indeed, the baboon undertook every possible effort to get to the Moon such as jumping as high as he could or by climbing the tallest tree. Since baboons are very smart living beings, he even undertook various unimaginable ventures to get there, just to fulfil his yearning desire to go to the Moon. He even constructed a super-sized kite and a hot-air balloon, which despite his enormous creativity and high technical skills could not bring him to the Moon. Nevertheless, his aspiration to get to the moon remained, and led him to construct a space rocket.

For the purpose of this essay, the space activities of the baboon are regarded as human space activities since he is acting in this story like a human, so the rules elaborated to regulate human space activities can be analysed and applied to his space activities also.²

15.2 The Freedom Rights for Space Activities

In general, Art. I Outer Space Treaty (OST)³ grants freedom rights for space activities, especially the freedom to explore and to use outer space. Therefore, Art. I-2 OST stipulates that "*outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.*"⁴ However, space endeavours "*shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.*" (Art. I-1 OST).⁵ Moreover, it provides that there "*shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation*" (Art. I-3 OST).

¹The Baboon who went to the Moon, John Bush/JC Phillips, Storytime Africa, Fish Hoek, South Africa, 2006.

²In the context of this fairy tale it will come as no surprise that not all living beings are mentioned in the international space related treaties since they were drafted by human beings who did not consider the possibility that one day other living beings might undertake space activities to fulfill their desire to go to the Moon.

³Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 27 January 1967 (Status of ratification as of 1.1.2019: 109 states).

⁴Art. I-2 OST.

⁵Art. I-1 OST.

Therefore, the question that must be asked is whether the envisaged space activities of the baboon fit into this mandated freedom. Even if the baboon has not clearly defined the purpose of his space activities, it can be concluded from the circumstances that he intends to undertake them for pure scientific purposes. This can be deduced from the fact that he attempted to reach the Moon by various means as a kind of scientific experiment (by jumping, by climbing on the top of the tallest tree, by firing himself on an arrow with a bow bent with a strong branch, by getting launched by an elephant etc.), but every time he experienced that gravity was stronger than his efforts. Once the natural possibilities to get to the Moon were exhausted, the baboon created further technical flying equipment to get there. However, neither the super-sized kite he constructed, nor the hot-air balloon brought him to the destination. They did however enable him to gain more technical knowledge that eventually led him to his next development, the construction of a space rocket. Therefore, it can be concluded that his space activities could be classified as scientific investigations.

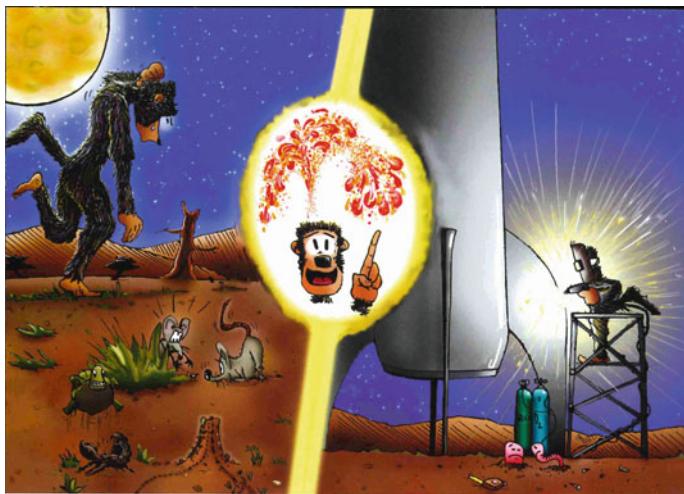
15.3 Building His Own Rocket

“Dejected and sad and out of pocket, he went back home and built his own rocket”. Indeed, the baboon can be seen in a wide sandy arid area where he is working long nights under the shining brilliant stars to build his rocket, ten times larger than himself. Once finished, the arc of the Milky Way frames the silhouette of the rocket and on the ground his African companions, a warthog, an elephant, a giraffe and a lion, looking from a distance at it. At that moment, the baboon announces his space mission: “An amazing machine, a massive missile. ‘I’ll get there now’, he said with a smile” (Figs. 15.1 and 15.2).

Even if the baboon had decided by himself to use his construction for his space activities, from an international space law perspective, several aspects arise and invite analysis.

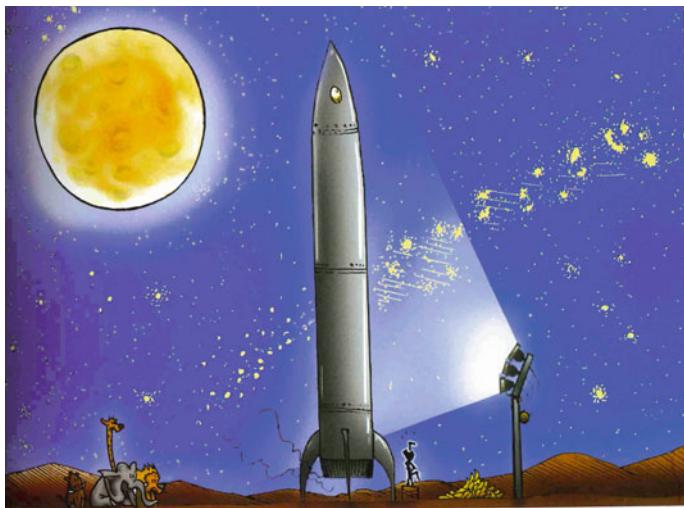
15.4 The Licensing, Control and Liability for Baboon’s Space Activities

The international space treaties comprise various provisions in order to ensure safe and secure space activities. First, Art. VII OST provides that *“each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space.”* This liability clause has a very wide scope to ensure that in case of damage, a state party to this



Dejected and sad and out of pocket,
He went back home and built his own rocket;

Fig. 15.1 The Baboon who went to the Moon, p. 26; *Credits John Bush/JC Phillips, Storytime Africa, South Africa*



An amazing machine, a massive missile.
'I'll get there now,' he said with a smile.

Fig. 15.2 The Baboon who went to the Moon, p. 27; *Credits John Bush/JC Phillips, Storytime Africa, South Africa*

treaty will compensate the victim. Therefore, the notion of “launching state” is defined in the OST and in the Liability Convention (LIAB)⁶ in a very broad way, comprising various possible scenarios. In fact, the launching state can be the state that launches or procures a launch of a space asset, but also the state from whose territory or facilities the space object was launched.⁷ This so-called launching state is then liable for the damage caused by the particular space object.

In the case of the baboon, the launching state of his rocket has to be determined according to the criteria mentioned above. However, the rocket of the baboon does not bear an official flag and the state on whose ground the rocket stands ready for lift off is not specified. Since the rocket can be seen in a wide sandy and arid area, surrounded by a lion, a giraffe, an elephant and a warthog that assist the launch in a safe location, it can be deduced that the launching site is probably on African territory. Also the star constellation, particularly the arrow of the Milky Way, is so clear and close to see, that this is a further indication that the launch site is in the southern hemisphere. Moreover, the imprint of this fairy tale book reveals that it was published and printed in South Africa. Therefore, it can be argued that this publishing or printing house somehow made the launch of baboon’s rocket possible, in the sense that it procured the launch. Consequently, South Africa could be considered as the launching state without excluding that other states may have been involved, for example, in financing these space activities.

Since the launching state would be internationally liable for any damage that is caused by space activities of its natural or juridical persons, the launching state has also an interest in reducing its risk of being held liable for any damage. Therefore, the state has the right to supervise these space activities and to demand authorization for them. Indeed, the relevant Art. VI OST stipulates: *“States Parties to the Treaty shall bear international responsibility for national activities in outer space (...). The activities of non-governmental entities in outer space (...) shall require authorization and continuing supervision by the appropriate State Party to the Treaty”*.⁸ However, in this concrete situation, it is doubtful that the baboon actually applied for and received the authorization of his state authorities, or that the state was even aware that one of its nationals was undertaking space activities such as building a rocket. Therefore, the aspect of continuing supervision is even more questionable. Even though the baboon’s friends were sitting around the launch site watching the scene, it is “iffy” that this can be considered as supervision. It is certainly not the “continuing supervision” required by Art. VI OST especially since on the previous book page, the baboon seems to have built his rocket alone in the desert during night-time.

Moreover, it is uncertain if the baboon’s rocket was registered as provided by Art. VIII OST. *“A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object,*

⁶Convention on International Liability for Damage Caused by Space Objects of 29 March 1972 (Status of ratification as of 1.1.2019: 96 states).

⁷See Art. VII OST; Art. I LIAB.

⁸Art. VI OST.

and over any personnel thereof, while in outer space or on a celestial body.”⁹ As for registration of space objects, the Registration Convention (REG)¹⁰ requires two registrations, one at the UN registry and another in the respective national registry (Art. II REG). Art. IV REG stipulates the elements that must be submitted to the UN Secretary-General. “*Each State of registry shall furnish to the Secretary-General of the United Nations, as soon as practicable, the following information concerning each space object carried on its registry: name of launching State or States; an appropriate designator of the space object or its registration number; date and territory or location of launch; basic orbital parameters, general function of the space object*”.¹¹ Lastly for UN registration, the baboon should have communicated the designation of his space activities, i.e. a journey to the Moon, through his national entities to the UN. This declaration to the UN Secretary-General must be done “to the greatest extent feasible and as soon as practicable”.¹² The baboon’s statement “I’ll get there now”, he said with a smile” is unlikely to be considered as detailed enough.

Incidentally, these supervision and control requirements also extend to all material and equipment intended to be brought into space. It is even more doubtful that the baboon and his respective authorities previously checked and licensed all his technical equipment (hammer, screwdriver, drill and all the material to build his hut on the Moon with a satellite dish) before being transferred to the Moon. This is also important in light of Art. IX OST that stipulates a non-contamination obligation for space activities, meaning that space exploration has to be conducted “*so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter*”.¹³

In this context, reference should also be made to the voluntary Space Debris Mitigation Guidelines that were established to avoid and reduce space debris. These guidelines were subsequently adopted by the Scientific and Technical Subcommittee of UNCOPUOS¹⁴ and its Main Committee in 2007 to ensure the long sustainable use of outer space.¹⁵ However, the reader of the baboon’s space trip gets any information on what happened to the baboon’s rocket, since only the baboon is depicted on the Moon.

⁹Art. VIII OST.

¹⁰Convention on Registration of Objects Launched into Outer Space of 14 January 1975 (Status of ratification as of 1.1.2019: 69 states).

¹¹Art. IV REG.

¹²Art. IV-3 REG.

¹³Art. IX OST.

¹⁴United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS).

¹⁵See further: United Nations Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, http://www.unoosa.org/pdf/publications/st_space_49E.pdf.

15.5 The Walk and Play on the Moon in View of Environment Protection Regulations

Once the baboon made it to the Moon, he was satisfied and happy that he had realized his dream that “He played in the moon dust for all he was worth”. Here again, Art. I OST confers on him the freedom right to use and explore outer space including the Moon. Nevertheless, he must respect Art. IX OST and the protection of the environment while playing with the moon dust. Since it is stated that “he jumped far higher than he could on Earth”, it may be concluded that this is covered by Art. I OST and its “freedom of scientific investigation in outer space”.¹⁶ Indeed, this activity can be considered as “scientific” (even if the baboon raises a lot of moon dust) since through his jumping exercises the baboon is becoming aware that gravity on the Moon is different than on Earth thus allowing higher jumps.

The baboon’s scientific investigations on the Moon are even enlarged since “he met a whole tribe of green, moon baboons; who had seven legs and fingers like spoons”. (Fig. 15.3) Hereby the baboon discovered that his species presents differently on the



He met a whole tribe of green, moon baboons,
Who had seven legs and fingers like spoons.
He built himself a little moon shack
And made up his mind he'd **never** come back.

Fig. 15.3 The Baboon who went to the Moon, p. 30; *Credits John Bush/JC Phillips, Storytime Africa, South Africa*

¹⁶Art. I-3 OST.

Moon. However, by greeting them with hand shaking, the non-contamination provisions of Art. IX OST should be respected to avoid any harm to those indigenous green baboons, but also reciprocally for the earthly creature. Moreover, it is interesting to see that the terrestrial baboon is wearing an air bell around his head, which the green moon baboons don't need. Apparently, they seem perfectly adapted to the Moon environment. Other smaller species on the Moon, such as the little moon mice, nevertheless seem to need such an air bell. All these findings underline once again the scientific character of the baboon's space mission.

Concerning the protection of environment and sites with special historical importance, two or three footprints can be detected on the sandy ground on the scene where the baboon builds his hut. They should stem from humans since they could not have emanated from the earthly baboon or from the moon baboons since they are all barefoot. Therefore, they have to have originated from previous first humans on the Moon, which make these footmarks so precious and worth being protected (Fig. 15.3).

15.6 The Constructions on the Moon and the Non-appropriation Principle

In addition, the baboon constructed a little hut. “*He built himself a little moon shack, and made up his mind he'd never come back*” (Fig. 15.3). This construction has to be analysed in light of Art. IV OST because even though this moon shack looks quite nice and comfortable, some legal issues arise, especially since Art. II OST stipulates the principle of non-appropriation. “*Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.*”¹⁷ Even if the baboon is not explicitly claiming suzerainty over the Moon or the part on which he constructed the shack, this cottage with dishes and antennas seems to be built in a solid manner. This fixed installation to settle on the Moon could be considered as an appropriation by means of occupation. The permanent, rather than temporary nature of this construction is underlined by the baboon's declaration that he “made up his mind he'd never come back”. Therefore, the fixed character of this shack may raise questions as it might infringe the non-appropriation principle since this fixed construction could be considered as a de facto appropriation. With reference to the Moon Agreement (MOON),¹⁸ which has been signed only by very few countries, Art. 11-2 MOON states that “*the Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by*

¹⁷Art. II OST.

¹⁸Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 18 December 1979 (Status of ratification as of 1.1.2019: 18 states, i.e. Armenia, Australia, Austria, Belgium, Chile, Kazakhstan, Kuwait, Lebanon, Mexico, Morocco, Netherlands, Pakistan, Peru, Philippines, Saudi-Arabia, Turkey, Uruguay and Venezuela. Four further states have signed, but not yet ratified: France, Guatemala, India, and Romania).

any other means".¹⁹ Moreover, Art. 11-3 MOON underlines that "*neither the surface nor the subsurface of the Moon, nor any part thereof or natural resources in place, shall become property of any State, (...) or of any natural person. The placement of personnel, (...), facilities, stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof*".²⁰ In addition, Art. 9-1 MOON foresees that "*States Parties may establish manned and unmanned stations on the Moon*". However "*a State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of that station*".²¹

From what is revealed in a picture in the book, the baboon has in fact only taken the space that is absolutely needed for his hut—other areas around the hut have not been staked out or fenced. Furthermore, no other actors seem to be interested in this place. The only other potential actors in this area are the green moon baboons, which seem to be extremely satisfied with their presented gift, a card game.

However it is questionable that the UN Secretary-General was informed of the location of the shack on the Moon, since "*subsequently, at annual intervals that State shall likewise inform the Secretary-General whether the station continues in use and whether its purposes have changed*" (Art. 9-1 MOON). This is of particular interest if the baboon changes his mind about the shack being his usual residence, and sees it as a kind of hub for a next journey to Mars. In this case, the change of purpose must be notified to the UN Secretary-General.

15.7 The Conclusion and Way Forward to Mars

By way of conclusion, it can be stated that this moon trip enhanced the baboon's scientific research and knowledge, as he wanted to get to the Moon. Consequently he deployed all his technical skills and means to successfully achieve his endeavour, summarized by the sentence "[The] Baboon was as happy as happy can be". Sitting on the Moon and looking at the stars (while his green co-residents were enjoying playing their card game) was the reward for all his efforts and his endless striving for knowledge. The baboon enjoyed being on the Moon "Till one fine night, he happened to see a twinkle of red amidst the stars. 'I wonder', he said ... 'what life's like on Mars?'" This declaration perfectly describes the desire to cross the actual frontier of knowledge and to continuously learn and discover. In this way, the baboon reflects our terrestrial human feelings and aspirations to better

¹⁹Art. 11-2 MOON.

²⁰Art. 11-3 MOON.

²¹Art. 9-1 MOON.



Baboon was as happy as happy can be,
Till one fine night, he happened to see
A twinkle of red amidst the stars.

Fig. 15.4 The Baboon who went to the Moon, p. 31; Credits John Bush/JC Phillips, Storytime Africa, South Africa

understand the universe, unlike the green moon baboons that seemed not to be attracted by the stars. They just sat on the dusty moon ground, their eyes and concentration focused on their card game, and seemed not to be inspired by the universe surrounding them. They will stay grounded where they are, further initiatives to go beyond (for example to go with the earthly baboon to Mars), are not to be expected from them (Fig. 15.4).

This reveals once more the importance of scientific education as it inspires and raises interest in our universe and environment. Scientific endeavour on Earth allowed the baboon to go so far, but his green moon baboon colleagues seem not to have been initiated in the pleasure of discovering the universe of knowledge.

On the back cover of this inspiring fairy tale book it is duly stated that: “Baboon soon realizes that the Moon is a lot further away than it seems. Undaunted, he remains steadfastly determined to get there. His antics make hilarious reading and portray just how far determination can take you”. Moreover, thanks to his perseverance the baboon will certainly get to Mars as well. It should be noted that this idea accurately reflects ongoing discussions and tentative plans for several Mars missions, which envisage using the Moon as a hub or landing platform for Mars missions, just like the baboon intends to do for his next trip to Mars. Since the baboon has already gotten from Earth to the Moon which was quite a tough

endeavour due to the stronger gravity on Earth than on the Moon, it can be expected that his determination and curiosity will also certainly get him to Mars.

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