By emphasising enhancement, and implying that all humans are "disabled", the transhumanist form of posthuman can be critiqued using contemporary models of disability. The transhumanist proposal to negate intrinsic "defects" and "enhance" humans is based upon a medical-model of disability; however by focusing solely on enhancing the body, transhumanists overlook the disabling influence of extrinsic factors, such as an inaccessible physical environment; i.e. a social-model of disability.

While transhumanists may be able to negate physiological or psychological defects, an assumption that the posthuman-condition is always a better "enhanced" condition, and an emphasis on "perpetual self-improvement" overlooks the potential for posthumans from the different environments inherent to space-colonization to have different and conflicting concepts of "normal" physiology. When inhabiting the same space, there is the potential for otherwise "normal" and "able" post humans to become disabled "other" posthumans, because of architecture designed to an alternative concept of normal physiology. This understanding of disability as a combination of both intrinsic and extrinsic factors is demonstrated in the combined-model of disability.

A Science Fiction Parable

Set on Earth after attempts to settle on Mars have failed, a posthuman form of humanity has been adapted for life in space, and sent to build an artificial planet around Jupiter. After Earth suddenly enters a glacial-age, the "Jovians" decide to return and assist any survivors. Having landed on the surface, Ghan – the main protagonist – is sent on a mission to recover examples of advanced equipment. To do so, he must travel through an abandoned laboratory-ship called Dreadnought. Whilst Ghan – and the crew of The Jupiter – have specialist devices nick-named "chairs", designed to support the body in macro-gravity, his journey through the Dreadnought is complicated by an architecture designed for a different physiology.
THE HUMAN SPECTRUM

‘Other’ Physiologies in a Posthuman Era

ALAN J POTTINGER
THE HUMAN SPECTRUM: A SCIENCE FICTION PARABLE

The Human Spectrum (2016) is a work of fiction. Names, characters, businesses, places, events and incidents are either the products of the author's imagination or used in a fictitious manner. Any resemblance to actual persons, living or dead, or actual events is purely coincidental.

Cover art, maps and graphics by Alan J Pottinger
DEDICATION

For my nephew
Jack Pottinger
CONTENTS

RESEARCH METHOD STATEMENT 9

Breakdown of Thesis Title I Abstract-Thesis I A Brief History of Disability Models Research Sources & Methods I The Transhumanist Posthuman I Wider Relevance & Intent Presentation: A Science Fiction Parable I Pro-or-Anti Transhuman(ism) / Posthuman(ism)? Development of the RMS

INTRODUCTION: The Human Spectrum 15


THE HUMAN SPECTRUM
A Science Fiction Parable

Part 1 Home 23
Part 2 Dreadnought 26
Part 3 The Warlord and the King 30
Part 4 Sun Chamber 35
Part 5 The Pioneer Corp 38
Part 6 Breakthrough 43
Part 7 Eject-Reject 46
Part 8 Dawn 49

THE SHIP, THE SPHERE AND THE ARRAY:
A Conclusion in Three Parts 55

Transhumanism, Disability and The Human Spectrum
The Ship I New Bodies - New Morals I New Normals - New ‘Others’
The Sphere I New Bodies - New Architecture I A New World - For Some
The Array I When Worlds Collide I Egalitarian Space I Posthuman Architecture: A Proposal I An Ending or a Beginning?

BIBLIOGRAPHY 63
RESEARCH METHOD STATEMENT

BREAKDOWN OF THESIS TITLE

The Human Spectrum
‘Other’ Physiologies in a Posthuman Era

Human Spectrum: References the potential development of a ‘spectrum’ of divergent human and posthuman physiologies; ‘posthumans’ rather than ‘the posthuman’. The Human Spectrum is also the title of the short science fiction (SF) ‘parable’ used to illustrate and evaluate the thesis.

‘Other’ Physiologies: References the potential for individual/group physiologies to be identified as ‘other’ when compared to the ‘majority’ or ‘new-normal’ physiologies of any posthuman era. Whilst ‘other’ is a term with multiple possible connotations, in the context of this thesis it refers to disabled people.

A Posthuman Era: References one possible posthuman-era rather than the posthuman-era.

ABSTRACT-THESIS

By emphasising enhancement, and implying that all humans are ‘disabled’, the transhumanist form of posthuman can be critiqued using contemporary models of disability. The transhumanist proposal to negate intrinsic ‘defects’ and ‘enhance’ humans is based upon a medical-model of disability; however, by focusing solely on enhancing the body, transhumanists overlook the disabling influence of extrinsic factors, such as an inaccessible physical environment; i.e. a social-model of disability.

While transhumanists may be able to negate physiological or psychological defects, an assumption that the posthuman-condition is always a better ‘enhanced’ condition, and an emphasis on ‘perpetual self-improvement’ overlooks the potential for posthumans from the different environments inherent to space-colonization to have different and conflicting concepts of ‘normal’ physiology. When inhabiting the same space, there is the potential for otherwise ‘normal’ and ‘able’ posthumans to become disabled ‘other’ posthumans, because of architecture designed to an alternative concept of normal physiology. This understanding of disability as a combination of both intrinsic and extrinsic factors is demonstrated in the combined-model of disability.
A BRIEF HISTORY OF DISABILITY ‘MODELS’

Whilst disability-theory is wide-ranging in scope, my initial research focused on the social-model because of its connection to architecture. Although the social-model was not intended explicitly for architects, it posits the physical-environment as the major cause of disability. First developed in the USA the model was adapted by UK academics in the early 1980’s, and in 1983 Prof Mike Oliver created the term ‘social-model of disability’.

The Social-Model of Disability

The social-model posits ‘disability’ as resulting from an inaccessible environment – physical and social – and is intended to counter-act the medical-model of disability that focuses on the individual (Shakespeare, n.d.). While a simple concept, critics – most notably Prof Tom Shakespeare of the WHO (World Health Organisation) – note that any model that identifies social or environmental factors as the major cause of disability overlooks the influence of a physical condition. Conversely any model based solely on ‘missing’ or ‘deficient’ capabilities – a medical-model of disability—overlooks the influence of environmental and socio-cultural factors (Franssen, 2014; Shakespeare, 2014).

A Combined-Model of Disability

While the social-model is still considered the disability-paradigm, an ongoing ‘paradigm-shift’ recognises disability as a composite of both intrinsic physiological characteristics (medical-model) and extrinsic factors including the design of the built environment (social-model). Whilst this model has no formal designation it forms the basis of my thesis, and will be referred to as the combined-model.

RESEARCH SOURCES & METHODS

My research combines two broadly defined categories: posthumanism and disability-theory. For both categories I have relied primarily on academic sources – online journals and research papers; e-books and .pdf’s; essay-collections and books (see bibliography pp.63-71) – but have supplemented this research with subjective and practical experience and relevant or illustrative examples from Science-Fiction literature.
THE TRANSHUMANIST POSTHUMAN

My preliminary research into the posthuman and posthumanism identified the transhumanist concept of posthumanism as placing particular emphasis on ‘enhancement’ to negate perceived ‘deficiencies’. In my interpretation this posits un-enhanced humans as ‘disabled’. Transhumanism also emphasises space-exploration as a way of transitioning to a posthuman-condition, and I have researched historical and contemporary speculations on space exploration as a means of deliberately or indirectly achieving a ‘posthuman-condition’. Parallel research into terraforming has been used to place these proposals in context; a major source is Terraforming: The Creating of Habitable Worlds (Beech, 2009).

Research into texts that are pro-transhumanism, posthumanism and human-enhancement has been countered by researching arguments against human-enhancement, especially from a disability-rights perspective; a major source is The Human Enhancement Debate and Disability: New Bodies for a Better Life. (Eilers, Grüber & Rehman-Sutter, 2014).

WIDER RELEVANCE & INTENT

Challenge Contemporary Attitudes & Assumptions

The thesis aims to challenge assumptions about accessible-design, and general attitudes towards disability and disabled people, whilst also demonstrating the potential for otherwise able physiologies to be disabled by architecture. The Human Spectrum uses the composite-model of disability and a speculative scenario to demonstrate the thesis, while also demonstrating that architecture/architects in a posthuman-era may directly or indirectly discriminate – even though ‘posthumanism’ and ‘posthuman’ societies are invariably presented as ‘egalitarian’.

PRESENTATION: A SCIENCE-FICTION PARABLE

The thesis is presented in the form of a Science Fiction (SF) parable – The Human Spectrum (2016) – contained by an introduction and conclusion. As a precedent Vic Finklestein’s Revolution! (1981) (Shakespeare, n.d; Ashton 1992) demonstrated the effects of disability in a short parable. I have combined this format with SF’s ability to criticise preconceptions; the genre is replete with descriptions of alternative physiologies – however authors generally use a
medical-model representing disabilities as something that needs to be ‘cured’, as documented in Kathryn Allan’s Disability in Science Fiction: Representations of Technology as Cure.

The Human Spectrum illustrates the composite-model as described earlier. The narrative draws on my background research, presented as side-notes to the text, and a subjective and professional understanding of disability and architectural practice based on my own disability and practical experience gained by working as an accessibility assessor/auditor.

PRO OR ANTI TRANSHUMAN(ISM) / POSTHUMAN(ISM)?

It would be hypocritical to deny or ignore the beneficial role technology plays in supporting ‘other’ physiological conditions. However while I support the concept of technologically ‘altered’ or supported bodies this does not undermine my thesis, as my aim is to challenge the emphasis given to a single medical or social-model, rather than a combined approach.

DEVELOPMENT OF THE RMS

Notable Changes

Previous versions of the RMS, and my initial research, focused on posthuman physiology, potentially re-enforcing transhumanisms medical-model of disability. Emphasis has now shifted to the composite-model, and what was previously supporting research has now become an essential part of the thesis as it allows for a detailed analysis of architecture and better illustrates the role of architecture in disability.

Potential Weaknesses

Early drafts of the thesis were in a more ‘technical’ format rather than the narrative format presented here. Whilst allowing a more ‘raw’ presentation of disability – based loosely on my subjective experience – the narration of The Human Spectrum, the composite-model, and the inaccessible environment it presents may be dismissed as a ‘disability-biased’.

Moreover although speculative, transhumanism’s ‘core’ technologies have a basis in contemporary NBIC technologies which give posthuman physiologies – as proposed by transhumanists – technical credibility. However neither my research nor thesis has challenged the practicality of transitioning from a
human to posthuman-condition. As my criticism of posthumanism depends on evaluating contrasting posthuman physiology, it assumes that the transition has occurred. I have therefore limited my criticism of posthuman physiology to its role in the combined-model.
INTRODUCTION

THE HUMAN SPECTRUM
‘Other’ Physiologies in a Posthuman Era

“Who we are is but a stepping stone to what we can become”


TOWARDS A POSTHUMAN ERA

The development of new ‘NBIC’ (Nanotechnology, Biotechnology, Information technology and Cognitive science) technologies – has the potential to fundamentally change human ontology, and led to speculative forms of ‘future’ human called ‘posthumans’. Of the various posthuman-ontologies, the transhumanist form of posthuman is notable as it emphasises the use of technology to ‘enhance’ the human condition — suggesting humanity as a whole is disabled and needs to be ‘cured’; transhumanists aspire to accelerate evolution, by developing and applying technologies that enhance intellectual, physical, and psychological capabilities, enabling ‘trans-ition’ to a posthuman condition.

A FUTURE IN SPACE

As a means of transitioning to a posthuman-era, transhumanists link colonisation of space with the development of ‘enhanced’ physiologies. Space-adapted bodies also fulfill transhumanisms commitment to physiological ‘plurality’ (More & Vita-More, 2013) and support the philosophies’ emphasis on ‘perpetual self-improvement’ (More & Vita-More, 2013). While transhumanism has no ‘core’ technologies (More & Vita-More, 2013), the technological-posthuman has its origins in historical and contemporary speculations on life in space. For example: J.D Bernal’s concept of a ‘Mechanised Man’ in The World, The Flesh and the Devil, (1929); Julian Huxley’s Transhumanism (1957); Manfred Clynes and Nathan Klines concept of the Cyborg (1963); and recent examples such as William Bainbridge and Steven Dick’s ‘post-biological’ universe (Bainbridge, 2002; Dick, 2009); Hans Moravec’s ‘artificial-progeny’ (Moravec, 1988) or Ray Kurzweil’s ‘merging’ of human beings with computers (Kurzweil, 2000; Kurzweil, 2005).
POSTHUMANISM IN SCIENCE FICTION

The speculative nature of posthumanism limits contemporary examples of ‘enhanced’ physiologies to treatment of specific disabilities; for example, redesigned military ‘exo-skeletons’ are being utilised by severely disabled people. However, while there has been no transition to a fully-fledged posthuman society – yet – alternative ‘posthuman’ physiologies and societies are a staple of Science Fiction (SF). Olaf Stapledon’s *The First and Last Men* (1930) is one of the earliest SF examples of a space-adapted humanity. However it is James Blish’s *The Seedling Stars* (1957) that first suggested altering humanity specifically for space settlement. The idea has continued with notable examples including Frederik Pohl’s *Man Plus* (1976), Bruce Sterling’s *Schismatrix* (1985) and collections such as *Supermen: Tales of the Posthuman Future* (2002) (Dozois, 2002).

MODELS OF DISABILTY

Whilst contemporary disability-models start with the body, any model based solely on ‘missing’ or ‘deficient’ capabilities – a medical-model of disability – overlooks the influence of environmental and socio-cultural factors (Franssen, 2014; Shakespeare, 2014). Conversely any model that identifies social or environmental factors as the major cause of disability – a social-model of disability – overlooks the significance of a physical-disability. While the social model is still considered the model of disability, an ongoing ‘paradigm-shift’ recognises disability as a composite of both intrinsic physiological characteristics (medical-model) and extrinsic factors including the design of the built environment (social-model). Whilst this model has no formal designation it forms the basis of my thesis, and will be referred to as the combined-model.

NORMALITY AND ‘OTHERS’

Although a combined-model recognises the disabling effects of architecture, it still depends on some definition of a disabled-body; ‘other’ physiologies can only be identified by comparison with ‘normal’ physiologies (Nayer, 2014), and there is no universal definition of a ‘normal’ body. Normal-functioning or normal-physiology can be a species-average; the capabilities of the ‘best’ member of a society, compared with the least capable; or an individual’s understanding of what the ‘majority’ considers normal. (Rehmann-Sutter, Eilers & Gruber, 2014).
However ‘normal’ and ‘other’ physiologies are defined, they have an influence on architecture, as priority is normally given to whatever is considered ‘normal’ physiology. This does not necessarily create an inaccessible environment, but any compromise in design or accessibility is normally at the expense of the minority or ‘other’ physiology.

**THESIS: ‘OTHER’ PHYSIOLOGIES IN A POSTHUMAN ERA**

By emphasising enhancement, and implying that all humans are ‘disabled’, the transhumanist form of posthuman can be critiqued using contemporary models of disability. The transhumanist proposal to negate intrinsic ‘defects’ and ‘enhance’ humans is based upon a medical-model of disability; however by focusing solely on enhancing the body, transhumanists overlook the disabling influence of extrinsic factors, such as an inaccessible physical environment; i.e. a social-model of disability.

While transhumanists may be able to negate physiological or psychological ‘defects’, an assumption that the posthuman-condition is always a better ‘enhanced’ condition, and an emphasis on perpetual self-improvement overlooks the potential for posthumans from the different environments inherent to space-colonization to have different and conflicting concepts of ‘normal’ physiology. When inhabiting the same space, there is the potential for otherwise ‘normal’ and ‘able’ posthumans to become disabled, ‘other’ posthumans because of architecture designed to an alternative concept of normal physiology. This understanding of disability as a combination of both intrinsic and extrinsic factors is demonstrated in the combined-model of disability.

**THE HUMAN SPECTRUM: A SCIENCE FICTION PARABLE**

Compared to the overwhelmingly positive representations of space-adapted posthumans described earlier, SF is more willing to challenge assumptions, and examines both the positive and negative aspects of posthumanism. Combined with contemporary disability-studies, SF also challenges concepts of ‘normal’ corporeality (Allen, 2013).

However whilst SF is willing to challenge certain assumptions, authors generally refer to a medical-model and consider disabilities as something that needs to be ‘cured’ using technology (Allen, 2013) – but what if a character is disabled by posthuman-physiology? Rather than focus on still-further use of technology to ‘correct’ a post-human form of disability, The Human Spectrum demonstrates the combined-model in the form of a short SF ‘parable’.
SYNOPSIS

The Human Spectrum (2016) is presented as an example of ‘hard’ SF. The narrative is supported throughout with side-notes that document my research into posthumanism and human-enhancement; space-exploration; terraforming; and the different models of disability. The story is also based — loosely — upon my personal experience of ‘disabling’ architecture, whilst also drawing on my professional experience of designing accessible architecture.

Set on Earth after attempts to settle on Mars have failed, a posthuman form of humanity has been adapted for life in space, and sent to build an artificial planet around Jupiter. After Earth suddenly enters a glacial-age, the ‘Jovians’ decide to return and assist any survivors. Having landed on the surface, Ghan — the main protagonist — is sent on a mission to recover examples of advanced equipment. To do so, he must travel through an abandoned laboratory-ship called Dreadnought. Whilst Ghan — and the crew of The Jupiter — have specialist devices nick-named ‘chairs’, designed to support the body in macro-gravity, his journey through the Dreadnought is complicated by an architecture designed for a different physiology.

February 2016

Alan J Pottinger
BA Hons Arch, PG DipArch
Introduction: The Human Spectrum: ‘Other’ Physiologies in a Posthuman Era
THE
HUMAN
SPECTRUM

A Science Fiction Parable

“In regione caecorum rex est luscus”
“In the land of the blind the one-eyed man is King”

Desiderius Erasmus’s Adagia, 1500
An hour after landing, the first human appeared; at least it seemed human. A light snow shower was rapidly turning into a blizzard, obscuring Khali's² vision. Simulated landings hadn’t modelled such extreme conditions, but she wasn’t worried. Khali’s quad-suit could survive in even the most severe storms, and the body of the lander³ provided some protection. It still glowed cherry-red from its passage through the atmosphere; heat from its belly was melting the ice, and a cloud of steam threatened to engulf both ship and crew.

The landing had been timed to maximise daylight hours – but the blood-red sunrise, a glowing spaceship, and three mechanised creatures⁴ moving in the mist must have seemed like an alien invasion! Undeterred, it pressed forward with its slow shuffling gait. Brave, she thought. A head blended into hunched shoulders and a body wrapped from head to foot in furs and what looked to be synthetic materials – speckled shades of brown, black and grey mixed with stripes of a garish red-orange; from the moment she saw it, the colours started to fade under a thickening layer of snow.

A scan confirmed it: human, male, and very old. A bi-centenarian⁵ at least. He was an Elite⁶; only they were permitted enhanced healthspans⁷. For him to be so close to the excavation site was not unexpected; The Cartel⁸ only operated from the largest cities. Those who had survived the cataclysm⁹ clung to remnants of their old lives, and most of the larger ruins – including London – were occupied, if only by the hardier survivors.

Note: Side-notes are numbered by part. References without a prefix refer to notes within the same part; e.g. [ref 9] refers to note 9 in this chapter. References prefixed by a number refer to another part of *The Human Spectrum*; for example [ref 2.14] refers to the fourteenth note in Part Two: Dreadnought.
The old man stopped, before crouching down on the ice – less than a meter from a freshly cut opening. Had he seen it? Khali didn’t know how long he’d been watching them. With luck the storm had hidden Ghan as he dropped into the ship below. Her two remaining crew members, Owan¹⁰, and Yu¹¹ were puzzled by his behaviour. Yu flash-transmitted a message through her surface emitters – her aura a deep shade of purple¹². [What is he doing?]¹³

Khali wasn’t sure. They’d been briefed on common cultural practices, but she couldn’t recall anything like this. The old man had shielded his eyes from Yu’s message, but now just sat there patiently. About to connect with the database on the lander, something made Khali pause – his lips were moving. He was speaking to her! The quad-suits had audio-receivers for this situation; the Elites still used a written and spoken language, but Jovians¹⁴ rarely spoke. Sound doesn’t travel in a vacuum, and what started as a language used by work-crews had become the norm: a form of communication¹⁵ based on signs, the emission of light and exchange of written words via a HUD¹⁶.

Since landing, snow had hammered against her suit, sending an arrhythmic pattern of vibrations through her head; sound added another layer of annoyance, so they’d all muted their receivers. By chance Khali’s had still recorded the old man. Within seconds the message was translated. It was simple, so the chance it had been miss-translated was pretty low, but it still came as a shock. [What did he say?]¹⁷ asked Yu.

Confused, Khali’s aura changed to purple. [He said: ‘Welcome back’]

The old man needed to be careful. He’d worn his old Cartel pin for years. Even now, his Elite status gave him the respect of the other survivors. The

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¹⁰Chief Engineer Owan-M33, Male, Representative of the Ionian Territories

¹¹Communication Officer: Yu-91, Female, Representative of the Europa Collective.

¹²To differentiate communication sent via surface-emitters from speech or text-messages, it is in italics and enclosed in square brackets [denoting a ‘flashed’ message].

¹³This refers to surface-emitters. Different colours indicate different mental states, e.g. red means anger.

¹⁴The second posthuman in the narrative. Ref the Jovian System – Jupiter and Galilean moons; Io, Europa, Ganymede, Calisto.

¹⁵Conflicting communication methods are another intrinsic - extrinsic factor, but has not been examined in detail.

¹⁶Head Up Display. Military displays designed for pilots to read information with ‘heads-up’ and facing forward.

¹⁷Term used by Elites to describe Jovians.
Pioneers¹⁷ were clearly interested in his ship – one had already dropped through the ice – but why were they here?
Dreadnought

<Alright – power and fuel are green. Let’s get this over with>

-Lt-Cmdr Ghan-K81 (Ganymedean Union),
‘The Jupiter’ flight-logs

[Ladies and gentlemen – the MKIV-A200 quad-suit...] The instructor lifted herself to full height. Pacing back and forth, she demonstrated its controls. Each suit included a sophisticated life-support suite, tied directly to the user through a tailor-made seat.

The instructor grinned, as she halted in front of the group. [As you can see, ‘suit’ is a misnomer. So we just call them chairs!].

Falling, arrestor-rockets\(^2\) fired but Ghan\(^3\) still crashed onto the deck. The chair-legs bowed to cushion his fall, but it still hurt. The hull was only five meters deep, but with the ice-sheet the drop was closer to ten. While he seemed to be listening to the old man, Owan also monitored Ghans progress through com-exchange.

<Ghan, are you alright?>\(^4\). The Chair dulled or eliminated pain, but it also reduced performance. Commands choice of painkiller was far too powerful, and at only half the dose he was already finding it difficult to concentrate; hopefully it was enough for him to complete his mission. Ghan took a moment to gather his thoughts <I’m fine. Are you picking up my vid-feed?>.

They’d trained with plans of the ship, but the ice-sheet prevented detailed scans. <Yes. Look around – Let’s figure out where you are>. Even the smallest movement was exhausting, and Ghan now considered his chair an essential part of him, and his

---

[1] The quad-suits quadrupedal design makes the designation chair appropriate; ‘chair’ is also used by manual and electric wheelchair users as short/slang for a wheelchair.

[2] Small rockets usually fitted to space-vehicles to help slow a descent. Used here to counter unexpected falls or drops.


[4] To differentiate communication sent via text-messages from speech or surface-emitters, it is in italics and enclosed in more than/less than symbols <denoting a ‘message’>.

[5] Long-term exposure to micro-gravity causes the “space-adapted state.” (Sandler, 1995), but effects can be categorised as life or non-life threatening. As most changes are only detrimental on earth, one solution is to accept and enhance the space-adapted state: the original justification for developing the Cyborg (Clynes, 1963) [Ref 12].

[6] Bernal speculated that ‘mechanizing man’ would result in numerous specialized forms (Bernal, 1929) optimized for different environments.

[7] References Micro-gravity. Also known as zero-gravity - a misnomer, as all objects are subject to gravity to some extent; opposite of Macro-gravity.

identity. In space the Jovians were unsurpassed\(^5\); everything optimised\(^6\) for a life in micro-gee\(^7\). With minds and bodies unencumbered, their orbital-habitats\(^8\) had expanded in every direction. But their limited experience of gravity had not prepared them for the impediment\(^9\) of earth’s gravity-well, becoming weak and fragile\(^10\) when compared to the Elites. Able to move freely in the null-gravity of their ship\(^11\) – The Jupiter – since planet-fall Ghan’s chair had ceased to be an extension of his body but a part of it; the interdependency\(^12\) of flesh and machine making it pointless to differentiate between his abilities and the quad-suit’s. To Ghan they were one and the same – he didn’t know where he ended and the chair began. Designed to move like a quadruped, each chair-leg also had a retracted manoeuvring wheel; he’d already raised himself above the deck with ‘wheels-down’. Ghan was in a narrow corridor, and turning on the spot proved difficult. Light from the opening spot-lit walls and floors with a rough metallic finish. Suddenly, light-fixtures flicked on, casting everything in a harsh green light and crisp shadows. The hull was obscured by a rack of large metallic-tanks.

‘The automated lights are still working’ messaged Owan. The tanks were storage tubes for finished probes, held here before pick-up. ‘You’re in the bow. Vibration-readings suggest the main generators are on, but the lab is powered by a separate generator in the engine room...>.

That was the other end of the ship! He thought. ‘You’ll need to go through the prep and launch areas. Shouldn’t take long, but watch your energy-levels’.

He’d barely even moved, but still checked his HUD: 75% fuel and 95% power.

[14] High-gee environs favour individuals resistant to higher force (Dole, 1964, p.210). Limbs shorten, bones become compact, muscles more developed – more “slow-twitch”, red-fibre muscle (Hall, 1999); less external fatty tissue – average height decreases, average baby size increases, and reaction times increase to counter gravity (Dole, 1964, p.21).

[15] Open space/low-gee environs either lack or have a limited breathable atmosphere, favouring individuals with better respiratory systems, larger rib-cages (Dole, 1964, p.212); Limbs lengthen; weight-bearing bones weaken; muscle reactions change – more “fast-twitch” white-fibre muscles (Hall, 1999) and reduction of heavier red-fibre muscle – average height increases, babies become fragile, and reaction times no longer counteract gravity (Dole, 194, p.212).

[16] ‘Mechanization’ & space-settlement are linked: the former pre-dating the latter. The World, The Flesh and the Devil (1929) presented ‘mechanical man’ as another stage in evolution. By interfering in an ‘unnatural manner’, ‘useless’ body-parts are given modern functions, removed or replaced. (Bernal, 1929).

[17] Disparity between space and earth environments would cause biological changes that balance the body – the homeostatic mechanism – but ultimately favor mechanization (Bernal, 1929). Bernal’s mechanized-man, predicts Manfred E. Clynes and Nathan S. Klines Cyborg – a portmanteau of Cybernetic - (referencing Norbert Wiener’s Control and Communication in the Animal and Machines (1948) and organism – a body altered for survival in extra-terrestrial environments. Rather than a spacecraft, ‘terrestrial’ or terra-
formed world, exogenous devices compliment the inherent homeostatic mechanisms for survival in space ‘qua natura’ (Clynes, 1963; p.30).

[13] A mini ice-age could occur within a year or ten years; however a rapid-onset ice age is essential to the plot.

[14] An unforeseeable environmental change, one of two motivations for expansion [Ref 15]

[15] Despite asserting humans are ‘natural explorers’ (Howerton, 1996), and expansion a natural continuation of that drive, past migrations were normally a response to unpredictable and uncontrollable events – e.g. climate change (Westfahl, 1997) Moreover ‘human destiny’, ‘utopian societies’ and ‘maximising human potential’ are insufficient justifications on their own for committing resources. Space remains dangerous, within exploration revealing an almost universally cold, barren and uninhabitable frontier (Westfahl, 1997) while investment in life-supporting infrastructure – space habitats, terraforming etc. – is expensive and presents extreme technological problems (Westfahl, 1997; Harrison, 2007). Space programs are symbols of progress (Dickens, 2010) but ultimately motivated by political – or economic – advantage (Lanius, 2008). 

[16] Rather than limbs – designed to operate against gravity – I imagine a society that lives in micro-gravity would uses ‘fields’ to move objects using attracting or repelling forces, as there a minimal forces to impede momentum.

Jovian probes uncovered a frozen planet, they hadn’t discovered the cause. He explained how a solar-flare disrupted the planets weather; in eighteen months¹³ almost the entire surface had been covered by an ice-sheet, in what became known as the cataclysm¹⁴. But it seemed unlikely they’d make the journey out of curiosity¹⁵. And what did they want with his ship?

On the surface Dreadnought appeared as a simple screening-lab, floating on the river. But hidden – below the waterline – was a factory. As Ghan moved forward, the corridor opened into a larger compartment. Gantries ran along each side, with ladders set at regular intervals, but they were too narrow for a chair. Elites had never intended for their Pioneers to operate the ship, so he’d have to make his way through the factory.

In front of him, massive black-rubber bags filled the space from floor to ceiling. The last test before storage, finished probes were ‘fired’ using a rocket-sled – caught by a bag, a mechanism then loaded it into storage. A loading platform was recessed into the ceiling. Following a hanging cable back to the ground, he found a control-column sat on the deck, but the handle on top was beyond the reach of his manipulator-fields¹⁶. Ghan pushed his legs, servos whining in protest as he stretched towards it. As he pulled the control, the legs retracted back as if the strain had hurt them. Pushing the suit had been draining, and worse the platform was motionless. Until – suddenly – a noisy mechanism brought it slowly towards the deck.

He had to admit, he was impressed. He’d engineered them for space, but the suits they were
wearing let them move on the surface with no major difficulties. The old man had been providing the location of other survivors to Khali when he recognised the sound of a lift moving. He asked with a grin “What was that?” But Khali just continued to question him.
3

The Warrior and the King

<Of course I’m monitoring his life-signs! I’m more worried about his energy usage – >

-Engineer Owan-M33 (Ionian Territories), ‘The Jupiter’ flight-logs

Ghan used the platform to lift himself up to one of the bags. Crawling through a void in the middle, he found himself in a long compartment where he couldn’t see the other end. Some of the lights had been damaged, and those still working were melting ice coated walls and floors, filling the chamber with mist. A raised test-track ran into the darkened part of the ship. <It’s twenty meters to the end...> Owan said <Deploy your wheels again>. With the legs of his chair slotted into grooves on the track, Ghan pushed forward.

They knew nothing of earth’s recent history. It was the explosion in global population that led him to study medicine; state-sponsored programs bred long lived and productive citizens, while so-called ‘mortality-vaccines’ even promised immortality¹. The UN led calls for a global moratorium, but no one would agree a strategy. And as growth became unsustainable², attention shifted from Earth to attempts to colonise Mars. Aggressive terraforming³ tried to create a new Eden, and for a time proved a successful incentive to leave earth. The chance for a new-life on a new-world⁴ caused a global exodus⁵.

Racing along the track, something came into view. Pulling back on the power until he stopped, Ghan

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¹Unchecked population growth – due to arrested-mortality, an aim of transhumanism – is the second of two motivations for expansion. [ref 2:14, 2:15]

²Transhumanism advocates expansion as essential for posthuman evolution, but it is not inevitable. ‘Traditional’ motivators – economic, demographic and existential – are insufficient; the greatest barrier to expansion is a lack of compelling and achievable motivations (Bainbridge, 2009). In this narrative, combined ‘biological’ and environmental hazards present both the motivation and opportunity to expand and evolve. [ref 1, 2:14, 2:15]

³Without other ‘terrestrial’ planets in our solar-system two interrelated strategies have developed: colonising another star-system, or terraforming a planet. Barriers to extra-solar colonisation – the light-speed barrier and distance involved – are not insurmountable; theoretical ‘generation’ ships could ‘seed’ another star-system. Because habitable earth-sized planets are expected to be a rarity in the galaxy, terraforming of potential earths will be part of any overall expansion and depends entirely on skills developed in our solar-system. However, the narrative is limited to Mars – as the most common target for conventional ‘soft’ terraforming in reality and SF – and Jupiter, terraformed using ‘hard’ para-terraforming (Terraforming: The Creating of Habitable Worlds Beech, 2009) as interaction between posthumans is more viable within the same solar-system.
inched forward. The track had buckled but was still intact, dropping steeply before rising again. A rocket-sled, used to accelerate the probes, hung overhead. Designed around one large and multiple smaller engines, one had fallen onto the track. Slowly, Ghan descended and almost immediately started to slide. Leaning backwards in a panic, the suit responded but still slid towards the bottom, colliding with the other side. Ghan took a deep breath. That was the easy part he thought. Climbing the other side was going to be difficult. Chairs had been designed for flat surfaces, their power-pack fitted towards the back. On a slope there was a danger of tipping backwards. He’d barely started moving up the other side when the front legs lifted. A cold rush of adrenaline hit him, and he stopped. As the front legs dropped, he adjusted his posture, pushing his body as far forward as he could. Slowly he continued to ascend, eventually reaching the top⁶.

For reasons that remain unknown, the terraforming process went awry, and Mars mutated⁷ into a world plagued by violent storms. Hidden under a planet-wide tempest it became the sick man of the solar-system; the surface pockmarked with blisters of concrete and steel, heavy cupolas⁸ replacing elegant worldhouses⁹. With so little sunlight penetrating the clouds, it could be months between breaks in the storm front. Artificial illumination simulated a day-night cycle, but immigration all but stopped. The global population level rose, and nothing could convince people to move off-world. The colony became such a massive financial burden for the Cartel that when the cataclysm hit it became totally unsustainable, and colonists who couldn’t be evacuated were abandoned.

[4] [ref 1; 2:14, 2:15] In addition to traditional motivations, expansion may be motivated by the chance of a new live on distant world(s) (Bainbridge, 2002); any apathy stems from a lack of sufficient motivation (Westfahl, 1997) [ref 8:11]

[5] Critics of expansion argue that while nomadic hunter-gathers developed oral communication, clothing, tools, and mastered fire ‘everything else’ (Westfahl, 1997) developed during 10,000 years of settled existence. However whilst the majority ‘stayed put’ exploration and expansion still influenced world culture – positively and negatively.

[6] The ‘ramp’ in this part of the ship is the result of an accident rather than by design, but it helps to describe the difficulties associated with traversing a steep sloped surface.


[8] My own solution to maintain a colony-dome on a terraformed planet that has regressed.

[9] Early stages of a Mars colony could include domed settlements. Worldhouses would cover large sections – or the entire surface – with transparent domes several kilometres high, enclosing an atmosphere and biosphere (Beech, 2009).
The break in the track had been an unexpected, power-hungry delay; his energy had dropped to less than 75%. Ghan pressed forward onto a table raised in the middle of a long metal cylinder. All around him were racks designed to hold the probes. 

"It's a centrifuge"³⁰ said Owan "They span probes here before launch". Ghan didn’t answer him – he felt sick; a feeling of unease grew the closer he got to the engine room.

Without the Mars colony there was nowhere for humanity to escape to. As national borders collapsed, a surge in xenophobia led the UNPD¹¹ to enforce a treaty called the Reproductive Control Measure. What it lacked in authority it made up for in its ambiguity; The Cartel seized the opportunity to direct policy with its model of an Elite ‘³H’¹²: Healthy Happy Humans. Eventually, with Elites occupying all major government and corporate positions, what the UN failed to do with politics The Cartel achieved with genetics.

"It looks active to me" said Ghan. Once through the centrifuge, he’d moved onto another raised platform. Two circular elements on tracks wrapped around the compartment, each studded with scanning devices¹³. Most were still frozen, but the ice was melting rapidly; Ghan could see a faint blue-green glow coming from some of the panels. The device scanned completed probes, after they passed through the chamber in front of him. While Ghan knew that the scanner was harmless, the chamber could be dangerous.

Ghan crouched by a heavy circular door, built from a ceramic composite. According to the plans, it was an environmental test-chamber. If the journey from Earth to Jupiter wasn’t dangerous enough,
probes were exposed to extreme conditions; in shadow, temperatures could drop to absolute zero, whilst in sun they rose above boiling point. The chamber re-created those conditions on Earth.

<Are you reading any extreme temperatures?> said Owan. The composite was working perfectly — the only heat came from the scanning machine. If the chamber were running, wouldn’t a safety mechanism stop him from opening the door? He thought.

<Can you see any controls?> Ghan had already spotted a small control pad set into the door.

<Yes. There is a panel> He paused for a moment <I’m going to try it>. He didn’t wait for Owan to reply; he was losing power just sitting here, and couldn’t afford to waste any more time.

With access to data from over the whole world, the Elites learnt how ineffective the RCM had been, and became obsessed with the idea of founding another colony. Never short of ambition¹⁴, and without any suitable planets¹⁵, the Elites came to an extreme conclusion: they would build one! With Dreadnoughts in every major city no one was spared from the RCM, and as director of a Cartel subsidiary – the Pioneer Corp – He’d used the ‘extras’¹⁶ to create an endless supply of workers¹⁷ for the largest engineering project in history. The workers¹⁸ would make a new home for humanity and build the Jovian Supramundane Structure¹, encasing Jupiter in a cyclopean sarcophagus.

[15] The Elite colony needs to support and maintain their current physiology, requiring a 1G ‘Earth-normal’ gravity. Venus is the only rocky planet with an atmosphere, and has gravity comparable to Earth, 8.87 m/s² - or 90% of Earth normal. However terraforming is estimated to take 15,000-35,000 years to create an Earth-like environment (Beech, 2009). This presents a supra-mundane structure [ref 18] as the best immediate and ‘architectural’ option.

[16] Not all potential zygotes meet the requirements of the RCM. The narrative does not define Elite physiology, but those who don’t match their concept of ‘normal’ are repurposed for the Pioneer Corp.

[17] Stable, fair societies are not built by Elites alone; new worlds require populations working and living in space (Sommariva, 2014). In the narrative a divide has developed between a space-based working class and a terran ‘Elite’.

[18] Vast honeycombed shells built around any planet unsuited for terraforming. A sphere built around Jupiter at 42,000km above the upper-cloud level would have a macro-gravity of 1G and provide a surface area equivalent to 318 ‘earths’. Colonists would also have access to energy from the planets core or atmosphere (Beech, 2009).
Sun Chamber

<I’m amazed that anyone survived. His knowledge has been invaluable>

-ComOfficer Yu-91 (Europa Collective), ‘The Jupiter’ flight-logs

Ghan nearly jumped out of his chair. Doors at either end of the chamber slammed back and shook the entire ship; at the back of the next compartment he could see a row of tanks¹ hanging from the ceiling. The chambers surfaces had not been meant for driving on² – the walls and floor were polished and extremely slippery – but he had to keep moving. With so many of the ship-systems automated, would the door close behind him as soon as he got inside? He’d need to move quickly, and as he stepped into the chamber, re-deployed his wheels. They spun wildly, but eventually he started to gain traction. Passing quickly through the chamber, as he neared the end Ghan realised that the doors were staying open, but now he had a bigger problem – he couldn’t stop!

He remembered that noise! Whoever was searching the ship must be close to the maturation tanks. There had been so many. How would they react? The London Dreadnought³ operated for seventy-five years, launching almost three hundred thousand pioneers, but even at that rate it would be centuries⁴ before the JSS was finished.

More importantly, the exchange with Khali let him watch the Jovians communicate with each other. As she’d questioned him, the one called Owan had exchanged flash-messages with her. It’d been difficult to follow at first – undoubtedly effective in

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¹ Ghan’s first glimpse of the Dreadnoughts’ maturation tanks.
² Whether or not the chamber interior was designed for anyone to access it helps to describe the difficulties associated with traversing a polished or slippery surface ‘on wheels’.
³ Hospital-ships moored in the River Thames, from 1821 to 1870, were referred to as Dreadnought – the name is used here again.
⁴ Timescales vary by technique and planet, but would be multi-generational. ‘Optimistic’ projections expect Mars to become fully-habitable after 1000–2000 years of terraforming (Beech, 2009). No estimate is provided for construction of a supramundane structure, and ‘centuries’ may be too optimistic; [ref 3.3] Nevertheless, transhuman/posthuman ‘core’ NBIC technologies will inevitably influence other sciences, including terra/para-forming.
— but he’d found out why they were here, and what was happening to their forth crewman: someone called Ghan.

Ghan fell through the open air! The fall was short but still came as a shock; the suit-rockets fired automatically, braking his fall. With nervous laughter he checked the HUD: 52% fuel; 61% power. <Check the plans. Is this the last compartment before the engine room?> He panned his view across the compartment.

<Yes> said Owan, <Move towards the back. You’ll have to pass through the assembly area first>. Another track⁵ was recessed into the heavy deck plates. He’d ride the rails, but would have to move carefully. To either side, the deck sloped at a steep angle. During assembly, modular components — including highly corrosive and combustible fuel-pods — dropped from storage bins and rolled down to slot into pre-prepared shells⁶. A larger platform⁷ lifted finished probes into the environmental chamber. The dispensers were empty — hopefully — but he still moved cautiously. The compartment was split level, the rear section raised above the deck⁸. As the track disappeared under the deck, he had to find a way off; a short-ramp⁹ to his left was the only way out, and after climbing up the track and the slope, he continued towards the rear of the ship.

[5] The entire factory is designed to run automatically, with minimal supervision from human operators. Any reference to tracks refers to the automated production line.

[6] As with the modular components, the probes are designed to be constructed by machines. Pre-constructed monocoque ‘shells’ form two halves of the probes outer-casing.

[7] The platform was ‘down’ when Ghan came through the chamber, and is why he fell instead of moving onto another platform.

[8] The track ends here because the bottom-half of the probes casings are stored under the deck.

[9] This is used to ‘roll’ completed Pioneers in their maturation tanks from the upper level to the lower level of the deck.
Whilst the laboratory-tower provided the public face of the RCM, this compartment formed the real heart of the ship. Metal racks hung on either side of a central track. Some were empty, but there were still rows of blunt-nosed tanks. The ship’s maturation chamber — this was where he’d been ‘born’.

Ghan knew the program had been extensive, but was still shocked by the number of tanks. Hundreds of glistening, silver-white shells¹ pointed nose-down towards the deck; he just hoped they’d been empty when Dreadnought shut-down. He felt a sudden urge to shout, to scream as loud as he could. An unwelcome feeling of self-pity welled up inside him. What had they done here — and why — why any of them? His mind began to unfold: to see new pathways. He knew he had to stop. He was in danger of losing himself, swamped by his own sense of indignation. He had to remember the nature of the Dreadnought program. Nobody chose to be Jovian, it was entirely up to the Elites. Before they’d built The Jupiter, most workers had simply accepted there was no ‘before’, or what might have been, just the here and now — and that meant building the sphere. Only the cataclysm removed the last barrier to their complete independence; without direction from earth, they’d been free to choose their own path, and the fatalistic attitude held by so many Jovians simply vanished. What was it about this place — the ship and the planet — that made think this way?² He laughed to himself. It has to be the pain-killers. I told Command they were too strong! A message from Owan finally broke his
melancholy. <I’ve been trying to contact you for ten
minutes, are you ok?> He was about to respond, but
Owan continued <The door at the end of the track
leads into the engine room>. Good, thought Ghan,
lets get out of here.

As Ghan approached the engine room, vibrations
through the deck-plates grew stronger. The com-
partment was flanked by two massive generators.
Towering over him, they almost filled the compart-
ment. Between them sat a generator that didn’t fit
with the environment. Compared to the engines –
heavy industrial equipment – it was compact and
sleek. Encased in shiny black plastic it had a totemic
presence; a solid rectilinear mass, with no visible
seams or controls³. Ghan’s image reflected in its
surface.

<You need to jump>⁴ said Owan. <You’re too
short. A motion sensor near the top scans for body
heat>.

Ghan could extend the legs or give the rockets
a short burst. <My suit won’t register as biological>.

<Deploy your comm-surfaces and set them to
emit infrared> said Owan. The surfaces were pow-
ered by battery – using them with the legs would
drain his supply – so he’d have to use the rockets.
Arrayed around his torso⁵ the panels sprang out
from against his body. Once they’d generated suf-
ficient heat, and with a quick tap on his panel, Ghan
hopped from the deck, hovering⁶ in front of the gen-
erator while it scanned him. As he landed, its surface
lit-up and a stream of text flowed. <Good job. It’s
re-booting>. Owan paused, momentarily <Ok, that’s
it. Head back to the maturation chamber>.

Ghan’s HUD, showed his supplies were dangerous-
ly low. The jump used only a second of his fuel, but

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[3] ‘High-tech’ does not neces-
sarily mean accessible. Interfaces that depend upon
a particular physiology or capability can discriminate,
even thought they are ‘ad-
vanced’.

[4] [ref3]. The position of
controls/sensors that are
also set at heights based
on ‘average’ or ‘normal’
reach-ranges can also dis-
criminate.

[5] These are the same pan-
els used by Khali, Owan and
Yu to communicate with
each other in Part 1: Home.

[6] [ref 3 & 4] In addition to a
controls design an height,
interfaces that depend on
maintaining a fixed position/
posture assume certain
physiological capabilities.
heating the com-panels used a lot of energy. Ghan
looked at the ceiling; a small lift poked through the
hull, from the tower above. Even if he could reach
it, it was too small; it was designed for small supply
canisters containing prospective Pioneers. The
factory workers entered using an opening in the
hull, but without access to the gantry there was no
way for Ghan to reach it.

<Head back down to the preparation area>
said Owan. At the top of the short ramp another
control-column operated a goods platform, used
to receive replacement modules. Stretching again,
Ghan pulled the handle, and a section of the ceiling
moved towards the deck.

As he rose from the deck, Ghan realised the void
between lift and outer doors was going to be tight,
perhaps too tight. Approaching the ceiling he or-
dered the suit to crouch, and the lift stopped with a
few centimetres between him and the heavy out-
er doors. Inoperable since the cataclysm, as soon
as the platform stopped, the outer doors opened;
Command worried they would jam — several metres
of frozen ice sat on the hull — but they easily sliced
through the underside of the ice-sheet, showering
him with crushed ice. Protected in an ice-pocket,
the raised doors formed strong walls.<The tower
is about five meters in front of you. Time to make a
hole> said Owan. Using heat to activate the gener-
ator had been unexpected, but it had always been
intended to use the com-surfaces now. Hopefully
he’d have enough energy left to reach the con-
tral-room.

With the com-panels at full-power it still took
twenty minutes to melt the ice. At the base of the
tower, Ghan had another bulk-head door to open.
Stretching to full height, he pulled the latch and
wrenched it back. Stepping into a lift shaft the doors
ahead were open; in the room beyond sat rows
of pristine\textsuperscript{12} white incubators – It was here that the Elites were born. There were only about fifty\textsuperscript{13} units, a handful compared to the maturation chamber. There was also no way out. Looking up, Ghan saw a lift-car stuck at the top of the shaft. It was small, and ran on tracks recessed into the walls. Deploying his wheels, Ghan lodged one into each track. It was slow-going – and if he lost his grip he’d fall – but he started to climb. He ascended for two more decks, but as he neared the top realised that access to the control deck was blocked. Carefully using his manipulator fields, he opened the nearest set of doors. Slowly, inching forward, he spilt out of the lift-shaft and skidded across the floor.

As he slid forward Ghan came to a stop against a workstation. Regaining his balance, he looked around. The end of the room was dominated by a large zygote-screening\textsuperscript{14} station; he’d collided with one of several smaller\textsuperscript{15} units on either side of the show-lab. A glass ceiling above him allowed observation\textsuperscript{16} from the control deck overhead. Like the incubation rooms, the screening-room only had one exit: the lift shaft. \textit{There has to be another way up there} said Owan. They’d come too far to be stopped by a glass ceiling\textsuperscript{17}.

\textsuperscript{13} Elites are produced in much smaller numbers. Hardly any zygotes ‘pass’ the screening process.

\textsuperscript{14} This is where prospective zygotes are screened. Those who ‘pass’ become Elites; those who ‘fail’ are sent below decks to the factory-floor and become Pioneers.

\textsuperscript{15} Small stations that form part of the screening process; a ‘production’ chain from one station to the next, ending at the larger screening point.

\textsuperscript{16} The Tower-Labs have been designed to be ‘open’ allowing for staff and clients to see how the process works.

\textsuperscript{17} Glass ceiling: In this context a literal and metaphorical barrier. As well as describing the discriminatory business practices directed at women, Disabled people can also be constrained by a glass-ceiling.
Ghan smashed through the glazing on a jet of flame, showering the control-deck with shards of glass, before landing unceremoniously in front of the main console. The jump drained the last of his fuel and energy; exhausted\(^1\), the chair collapsed into a fail-safe\(^2\) position, its legs curled and locked underneath it. He was close, the control-panel sat less than a meter away. His HUD and auxiliary systems were still active. Running on the same supply as the suit legs, he must have some energy left; all he needed was a few seconds of mobility! He messaged Owan, *<I’m going to try something. You might lose my signal>.* If he shut everything down and reset the suit, it would direct power to each system in turn starting with the legs. It would work; it *had* to work.

Owan sent a message to Khali *<Commander. I’ve lost communication with Ghan>.* He tilted his body towards the old man. *<I could go down there, but what do we do about him?>.* Throughout the old man had made no effort to hide his feeling, seeming almost relaxed in their presence. He suddenly seemed uncomfortable. Could he understand Owan?

*<We’ll wait> she said. <Give him time>.*

After waiting for thirty seconds, he hit reset — and nothing happened. A cold sweat rippled up his ach-

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\(^1\) Can refer to Ghan’s feelings of exhaustion, the chair’s power being exhausted, or both of them together.

\(^2\) A position designed to protect both the chair and its ‘occupant’ until the occupant can be recovered or the chair ‘re-activated’.
Alan J. Pottinger

ing spine. He knew what he had to do next – it had been part of his training – but he wasn’t ready. Not yet. There had been few Jovians willing to expose themselves to heavy gravity; in a space-based society it had no positive influence. It was something to be avoided. The thought of landing on a planet where they’d be pinned to its surface was considered so ludicrous that any mention of a mission to earth was dismissed as fantasy; Jovian scientists even speculated that gravity would cause such severe spasms that they’d be unable to function. The cataclysm changed all that; as the last life-forms in the solar system, a mission to earth became essential. Of course, it would be uncomfortable, but the selection process favoured those with some existing resistance to gravity. Without military-pilots they’d tested workers, including Ghan. He’d been sent to Quadrant 81 – a training camp on the surface of the sphere. As a builder he’d already been exposed to short ‘bursts’ of macro-gravity and had a distinct advantage, but it had still been tough, living under earth-normal gravity for a month. It had also prepared him for this. Out of options, he had no other choice: he’d have to get out of the chair.

[3] Despite their space-based physiology, the Jovians are still descended from homo-sapiens, and have retained many of their physiological characteristics, including bone-structure.

[4] [ref 2:7], refers to macro-gravity.

[5] [ref 2:5&2:10] The Jovians culture has developed independent of earth and in the absence of gravity.

[6] An inversion of our own history. A mission to the moon or other planets remain an impossible fantasy until the late 1950’s saw the beginning of the Space Race between the United States of America and the Soviet Union.

[7] Similar arguments were made during the Mercury Program. It was suggested the astronauts would become disorientated in space. It was this speculation that was partly responsible for the development of the Cyborg concept (Clynes, 1963).

[8] This alludes to the Jovians beginning to develop a concept of their own ‘destiny’ lying beyond their home-system [ref 8:11]
Eject-Reject

<Ok, let’s have a look at this. ‘Remember: breathe normally’>

-Lt-Cmdr Ghan-K81 (Ganymedean Union), ‘The Jupiter’ flight-logs

[Earth’s air is perfectly breathable] the instructor was in front of an open chair, gesturing toward the seat. [In an emergency, pull the manual release switch and you’ll be ejected. However, without support from the suit you’ll be exposed to full-gravity].

Ghan grasped the locking mechanism. One strong pull and the suit would crack like an egg. He’d braced himself, but it happened quickly – a chain of explosive bolts rippled up the torso, splitting the suit in two. As the chair tipped him forward¹, cables disconnected and he grasped the arms² of his seat³. His body – dulled but still aching – trembled⁴, but he had to keep going. Slowly, pushing against the seat and the deck, he stood for the first time since landing. Muscles⁵ slipped and writhed as they adjusted to his change in posture; underneath his bones⁶ re-arranged themselves, pressing, popping and cracking in a chorus muted by his own flesh.

Any sane being would stop, but he pushed himself towards the console. And then he was falling. His blood froze as he tilted forward. Limbs locked⁷, and he thought he would sprawl over the deck, but he grasped the edge of the console. Pulling himself up, body screaming in protest he leant against the panel. It was a touch-sensitive screen, and completely inoperable with his manipulator fields. He’d have had no choice but to leave his chair. A black-glass⁸ work surface screen was clear, except for a

[1] Some wheelchairs/ergonomic chairs are fitted with a mechanism that assist the occupant when they stand.

[2] Each wheelchair-user will have his/her own methods for entering/exiting their wheelchair - although ‘normal’ techniques have been established for designers to refer to - based on their ability level. [ref 3-7] is based upon or describes the range of my own physical movements.

[3] After gripping the arms, and pulling forward, the arms are used to push-up from the seat into a standing positioning.

[4] After spending extended periods in the same position, any change in posture for people with musculo-skeletal conditions can result in ‘clonus’ more commonly referred to as spasms.

[5] [ref 4]. Muscles can re-arrange/slide into a new position after after spending extended periods sat-down.

[6] [ref 4 & 5]. Without continuous exposure to weight, bones ‘spread’ and have to ‘pop’ back when posture is changed.

[7] Certain musculo-skeletal conditions prevent rapid movement, causing a persons limbs to ‘Locked’. The Shock of falling causes limbs to tighten rather than extend to break the fall.

green icon flashing in the upper right-hand corner. Starting to slide, Ghan stretched his arm towards the top. Everything he’d done had led to this moment. Seconds away losing his grip, he struck the panel.

As the ground began to tremble, a web of fine cracks spread across the ice sheet. Khali, Owan and Yu exchanged a flurry of messages. Owan’s aura changed to a magnificent shade of blue."He did it!"

Yu looked at the old man’s face. Something behind them had caught his attention – he was horrified! As she spun around, Owan and Khali did too. From behind the lander, a brilliant-white slab of ice as big as their vessel soared through the air. As a shower of lumped ice started to fall, the old man scurried towards the lander, taking shelter underneath it.

“What have you done?” he screamed. Khali watched as a dark-grey monolith punched its way through the ice-sheet. The storm continued to pelt them with snow, but she was aghast at the sight before her. It was the control-tower!

As the tower came to a stop, Khali signalled and threw Owan a power-pack,"Get him back into his chair. Now!" As Owan sped forwards, the old man lunged out from his hiding place and grabbed Khali. Exaggerating his lip movements, he snarled “I said what have you done?”

Khali’s aura blazed a deep shade of red, before fading to blue. In a measured mechanical tone, she responded “Don’t you recognise your own ship?”

So, they’d known who he was all along.”I know what it is” snapped the old man. “You still haven’t answered my question, why are you here?”

Khali moved towards the tower, the old man scampering after her. “Our mission has two goals. We need the equipment: the factory and the laboratories. We’ll take it apart, learn how it works -"

“You can’t do that” He said. Khali stopped in her tracks. “It’s far too complicated” for you to un-
derstand” He continued, his tone patronising12 “Be-
sides, how will you move all this machinery when
you can barely stand?” he laughed13 “You’ve only
got one shuttle!”

[12][ref 10&11] Assumptions about physical ability can be
made based on compar-
son with the observers own
abilities and physiology.
The old man assumes that
the Jovians will not be able
to move the equipment
because of their 'limited'
mobility.

[13][ref 10&11]. The nature
of an action can be subject
to ridicule if it does not
meet with the observers
understanding of “normal”
movement(s).
Dawn

<Ok, Khali – I’ve got him>

-Engineer Owan-M33 (Ionian Territories), ‘The Jupiter’ flight-logs

Suit-power was limited, so Owan helped Ghan onto the Dreadnoughts hull. Snow had already started to settle on the tower, and in a few hours it would be hidden from view. During the landing, in the early morning light, Ghan had been reminded of their training on Ganymede¹. That moon with its frozen seas was the closest thing to a glacial-earth. Without an atmosphere, there’d been nothing between him and the emptiness of space. Though muted through polarising filters, the weak sunlight and orange tones of Jupiter reflected in the ice had still caused him to pause.

Now that the sun had risen, earth was unlike anything he’d seen before. Light dissipating through the atmosphere cast everything with warm-hues and soft-shadows, and a pale blue sky was speckled with snowflakes. Feeling the warmth against his suit, Ghan turned to face the sun. It was the dawn of a new day.

The old man was talking to Khali, when a rippling, booming-sequence caused them to stop. Streaking in and out of the clouds a formation of white-hot objects flamed across the sky. As their form became clear, he baulked. Oh no, he thought. More ships! As he struggled towards the tower, Ghan moved to block his way. The old man pushed against him, trying to fight his way past, but it was a futile gesture. Even in Ghan’s exhausted condition, the old man lacked the strength to move him. “You need to go back, to finish the JSS...”

Ghan modulated his emitters, softening his tone and aura to a pale-blue. “We’re not building

¹ One of the four Galilean Moons, Ganymede is covered in an ice-sheet estimated to be 20km thick. It is also a viable candidate for extra-terrestrial life, as a ‘world-ocean’ underneath the ice could harbor life. [ref1:14]
Distance from earth had always given the Jovians a degree of autonomy; sending enforcers to Jupiter would reveal the project to the public, so the Elites could never really force them to build the sphere. Nonetheless, most dutifully continued with the project. It was only after losing contact with Earth that the workers decided unanimously to stop construction; if the Elites were trapped it was ridiculous to devote their lives to building something they would never be able to call home.

The old man felt his mind begin to unravel. Without the new colony there was nowhere left to go! "You can’t do that!" Collapsing to the ground, he sobbed uncontrollably. He wanted to stop them, but knew there was nothing he could do. Optimised for space – deficient on earth, what did it matter now? He could try to deny it, but after everything he’d seen, everything they’d done to get here, he had no right to stop them. They were the Elite now.

What happened next still surprised him. Wrapped in a manipulator field, Ghan gently lifted the old man to his feet. Their language lacked the subtly of the Jovian system of signals, but he still tried to explain as best as he could. "We knew there were people here, that there were survivors. Our probes detected you from orbit, and we couldn’t just abandon you" The Jovians had every reason to hate the Elites, and there had been Jovian’s who’d argued for precisely that.

The old man stammered, confused. "Where will you take us? Without the colony —"

"I said we’d stopped building your colony" said Ghan, “Your sphere would have just been a second earth. We’d have survived there, but would have been struggled to make it our home”

“You could have dismantled it, built your own perfect world?”

Ghan wished he could transmit a smile. “But could you, or any other human live there?”

The old man imagined himself floating around in
null-gee, and grinned. “No, I suppose not”.

“This is your home, and ours is in space; we’re impaired here – you’re impaired there. Neither one of us is ‘right’ or ‘wrong’. We adapt, but we always remain human. Just – different. Our array represents that. It supports no Elites\(^7\), no dominant form. It is universal. As we change\(^8\), it changes with us – “

“It’s, alive?”

“In its own way. It’s a new beginning. Geological, biological and technological have merged\(^9\) to create a home for all living humans – and all those yet to come\(^6\). The Array will help us all to take the next step forward\(^11\). New worlds need new bodies\(^12\), and a new way of thinking. The array – coupled with your techniques – will let us work together\(^13\) and create a diverse human spectrum\(^14\).”

The old man still seemed uncertain, “It’s a worthy goal, but will you achieve it?”\(^15\)

Ghan didn’t know what more he could say to convince him. “It’s entirely up to you. I’ve done all I can – our part of the mission is over. Only you can decide to join us”

Ghan watched as they finished loading the last pieces of equipment into the Lander. Khali was helping Owun and Yu move some of the larger items while the old man stood next to him, gazing into the distance. Nothing in his expression or body language told him what he was thinking, but Ghan watched as he removed a small pin from his clothing. Despite everything that had happened, he wouldn’t press him for a response. He’d made his case and the decision was for the old man alone; he still held the pin between bony fingers. Gravity pulled against Ghan’s spine, the dull ache slowly sapping his energy, as the painkiller started to wear-off. Only this time he didn’t mind. He would wait.
Movement proposes colonisation using reanimated ‘archived’ personalities. The first interstellar expeditions would be conducted by digital crew and settlers. Rather than terraforming, settlers would be downloaded into ‘immortal’ robots, with subsequent ‘waves’ sent as data-files (Bainbridge, 2002). Humanity may eventually roam the galaxy as ‘smart’ probes (Dick, 2009), establishing an interstellar post-biological civilization (Bainbridge, 2009). As posited by transhumanists, Immortal machine bodies may become the ultimate motivation for space exploration (Bainbridge, 2002); humanity ‘usurped’ by its own artificial progeny (Dick, 2008; Moravec, 1988).

[13] Exploration will have to serve a ‘public good’ (Dickens, 2010), and cannot be achieved by a single ‘nation’—however that is defined—necessitating cooperation (Sommariva, 2014), whilst also preventing space from being owned or exploited by one group (Dickens, 2010).

[14] Expansion, allows new nations impossible on earth. Colonies will be free to develop new social forms and practices (Heppenheimer, 1977), to explore, settle and create, and to develop ‘perfect’ or ‘utopian’ societies (Lanius, 2008). Whilst individuals who value freedom and self-realization will embrace off-world colonisation (Sommariva, 2014) even perfect societies have flaws; a diverse humanity will have social and cultural practices—positive and negative—that become unrecognisable to contemporary humanity (Pass, 2011).

[15] Expansion needs suitable infrastructure and the development of a spacefaring society: a nation or species that travels regularly in space, where the entire culture is influenced by expansion (Pass, 2002, 2001; Harrison, 2007).
THE SHIP,
THE SPHERE AND THE ARRAY
A Conclusion in Three Parts

“It will be interesting to see how you manage to comport yourselves as a minority. I think you lack practice.”

Hoqueah (An adapted-man)
Watershed (1954) from The Seedling Stars (1957)

TRANSHUMANISM, DISABILITY AND THE HUMAN SPECTRUM

As noted in the introduction, the transhumanist concept of a technologically enhanced posthuman is predicated on a perception of humanity as physiologically and psychologically flawed or disabled, and corresponds with the medical-model of disability. However by focusing on the body transhumanism overlooks the disabling influence of an inaccessible built environment.

As a Science Fiction (SF) parable, The Human Spectrum challenges the transhumanist’s assumptions by demonstrating that disability is the result of both a ‘disabled’ body and a ‘disabling’ physical environment; the combined-model also described in the introduction.

Historically, disability-models have progressed from an intrinsic ‘medical-model’ that focuses on the body, to an extrinsic ‘social-model’ that focuses on the environment, and finally an emerging ‘combined’ intrinsic-extrinsic model of disability. This conclusion follows the same progression, and is split into three sections that broadly correspond to each disability-model, illustrated with examples from The Human Spectrum.

‘The Ship’ represents a ‘worse-case’ scenario and the medical-model of disability; ‘The Sphere’ represents conventional architectural thinking, and the social-model of disability; and ‘The Array’ represents a speculative form of architecture and the combined-model of disability. By presenting the disability-models and fictional representations together, the text demonstrates the relationship between disability and the environment, whilst also progressing towards my final conclusion.
THE SHIP

Ghans journey through the *Dreadnought*, and the challenges he encounters, are predicated on an understanding of ‘normal’ physiology that differs significantly from his. Consequently this part of the conclusion considers the influence of *intrinsic* (medical) models of disability.

NEW BODIES - NEW MORALS

Despite the transhumanist assertion that posthumans will be physically *and* morally enhanced (Nayer, 2014) the potential for posthumans to deliberately discriminate against ‘other’ physiologies cannot be dismissed. Posthuman morals – by definition – cannot be assessed by human standards (Rehmann-Sutter & Scully, 2014), however we can posit that a posthuman-condition will at least influence morals – either as part of a deliberate attempt to create morally ‘better’ posthumans, or as a consequence of physiological changes.

As different cultural, religious, or ethnic groups have different morals, posthuman physiologies may also generate different morals. How we perceive the environment also depends on our physiology, and each posthuman would perceive the world in different ways, with different ethics, different priorities, different values, and different judgments. (Rehmann-Sutter & Scully, 2014).

NEW NORMALS - NEW ‘OTHERS’

As with contemporary disability models, when a particular physiology becomes the ‘new-normal’ it is paralleled by the development of ‘new-others’. The transhumanist emphasis on ‘perpetual-enhancement’ positst that there is no ‘final’ or ‘perfect’ body, and posthumans will adapt their physiology as the situation dictates (More & Vita-More, 2013). However despite a commitment to plurality, when ‘mutability’ becomes the new normal, any posthumans who do not – or cannot – adapt to circumstances would be considered ‘other’ or disabled by comparison.

There are a number of reasons for a posthuman to have an alternative physiology. Whilst transhumanists emphasise ‘rationalism’, what may seem at first to be an ‘irrational’ decision – retaining a comparatively disabled physiology – may be entirely rational according to a posthumans own ‘normal’ social, cultural (Franssen, 2014) and environmental circumstances.
Moreover, perpetual self-improvement may not only prove impractical, but being forced to regularly modify or replace bodies, or adhere to a set of ‘universal’ attributes, would contradict the transhumanist commitment to ‘morphological freedom’ (Sandberg, 2013) that by definition includes the right to alternative attributes or physiologies.

Nevertheless ‘Immutability’ could become a posthuman equivalent of the medical-model of disability, albeit a model which identifies ‘failure to adapt’ as a disability, rather than any definable medical condition.

The potential for some forms of posthuman to be designated as immutable or ‘other’ is demonstrated in The Human Spectrum. Rather than adapt their bodies to macro-gravity, the Jovians develop technologies that supports their space-adapted forms in Earths gravity (pp.26-27); any permanent physical alteration would not only change Jovian ontology, but would become a disability when returning to space, so a temporary adaptation is the best solution. However even though Jovian bodies are ‘unsurpassed’ and ‘optimised’ for life in space (p.27) it is assumptions about normal physiology – epitomised by Dreadnoughts ‘narrow’ gantry and ladder (p.28) – that initiates Ghan’s journey through the factory.

**THE SPHERE**

Whilst Ghans journey through the Dreadnought also demonstrates an inaccessible physical (social) environment, the ship was never designed for Jovians. However the Jovian Supramundane Structure – as a ‘work-in-progress’ – could be made fully-accessible to the Jovians. Consequently, this part of the conclusion considers the influence of extrinsic (social) models of disability.

**NEW BODIES – NEW ARCHITECTURE**

Any transition from a human to posthuman-condition will also influence the physical environment. Artificial, cultural, and social infrastructure – all common points of references – will change to accommodate the ‘new-normal’ (Schües, 2014). In the extreme, ‘de-mundanisation’ could cause the entire reference system to collapse, and the physical environment would become ‘unknowable’ (Schües, 2014) and unusable to anyone with ‘other’ physiologies.

In The Human Spectrum Jovian physiologies have diverged so far from the new normal – the Elite ‘3H’ – that their physiology is disabled by what could
be an accessible environment. However by prioritising *Elite* physiology, *The Sphere* becomes ‘unknowable’ and unusable to any Jovians who try to settle there.

**A NEW WORLD – FOR SOME**

In *The Human Spectrum*, *The Sphere* also represents a continuation of the thinking that created *Dreadnought*. Whilst *The Sphere* is never completed, we can still surmise from Ghan’s journey through the ship how difficult life would be in an environment designed for a different physiology. The Jovians were created to build *The Sphere*, so it is technically accessible to them, however the generation of artificial-gravity – intended for *Elite* physiology – still disables them; quad-suits support the Jovians, and they retain their space-adapted form and capabilities, but the suit exists only to counteract the effects of a disabled body interacting with a disabling environment.

By focusing on the ‘immutable’ individual, posthuman architects may overlook the influence of the physical environment. Although legal obligations can prevent deliberate discrimination, and ensure environments designed for all physiologies, *practical difficulties* can create an indirect form of disability. Designing for conflicting physiological requirements will present practical problems that may prove difficult – or in extreme cases impossible – to rectify without compromise; and where priority is given to a ‘normal’, ‘average’ or majority physiology, compromise is invariably at the expense of the ‘other’.

In part eight of *The Human Spectrum*, Ghan explains to the old man that the Jovians have stopped building *The Sphere*; its environment disables them, and with the Elites ‘frozen’ on earth what point was there in continuing to build an ‘inaccessible’ environment? (p.50, ref 4). Admitting defeat, the old man asks Ghan why they didn’t convert *The Sphere* to a ‘perfect world’ (p.50, ref 5) for the Jovians? Ghan’s response is intended to demonstrate his understanding of a social model of disability, and one of its potential flaws (*Shakespeare, n.d*): any world built for Jovian physiology would disable the Elites (p.50, ref 6).

**THE ARRAY**

Ghan’s description of *The Array* is intended to illustrate a society that recognises how definitions of ‘able’ physiology depend as much on the environment as physical abilities. The Jovians, preparing to adapt and expand beyond their home-system, recognise the benefit of developing environments accessible to all forms of posthuman; both *Elites* and *Jovians*. Consequently, this part of
the conclusion considers the influence of a combined *intrinsic* (medical) and *extrinsic* (social) model of disability: referred to as the *combined-model*.

**WHEN WORLDS COLLIDE**

Ghans description of *The Array* is the opposite of *The Sphere*. Whilst *The Sphere* represents a single fixed concept of posthuman physiology and architecture, *The Array* represents an aspiration to create an artificial-environment able to adapt and support a variety of posthuman physiologies. It is this shift in emphasis that provides the conclusion to *The Human Spectrum* and this thesis.

**EGALITARIAN SPACE**

The risk of using SF to illustrate a concept or moral position is that emphasis can be placed upon the word *fiction*. Nevertheless whilst the Jovians are fictional, *The Human Spectrum* uses speculative ‘posthuman’ physiology to demonstrate that disability is *not* exclusive to contemporary society; the technological-posthuman condition is *not* necessarily a better condition; and ‘compatible’ posthuman physiologies are *not* guaranteed.

Furthermore, whilst the Jovians represent a form of space-adapted posthuman, potentially ‘disabling’ environments are *not* exclusive to ‘alien’ physiologies; Earth’s variable-environment has generated diverse cultures and body-types, each with the potential to develop unique – and potentially conflicting – posthuman physiologies and architecture.

Whilst highlighting just one of the numerous flaws in transhumanist-posthumanism, *The Human Spectrum* also challenges the assumption that technology will eventually ‘cure’ disabled or deficient humans. Recognising disability as dependent on the interaction of body and environment, *The Human Spectrum* demonstrates that any physiology that diverges significantly from the ‘new-normal’ could become the ‘new-other’ or disabled. And by demonstrating that a model of disability will persist into a supposedly technologically advanced and egalitarian ‘posthuman-era’, *The Human Spectrum* challenges contemporary attitudes towards disability and accessible-design.

**POSTHUMAN ARCHITECTURE: A PROPOSAL**

The NBIC technologies needed to transition from a human to a posthuman condition will inevitably influence materials science. New construction technologies remain speculative, but as one of the ‘great transformations’ of posthu-
man architectural practice (Baofu, 2012) they will permit new, transformative and ‘posthuman’ types of architecture; supra-mundane structures and para-forming in general depends on the development of the advanced engineering skills and materials (Beech, 2009) proposed by Nanotechnology, whilst ‘conventional’ terraforming techniques depend on advances in biotechnology to create a habitable biosphere on Mars (Beech, 2009).

The Human Spectrum presents a deliberate, explicitly technological solution to the challenge posed by multiple posthuman physiologies. An appeal to a ‘technological future’ echoes the transhumanist assumption that everything can be ‘fixed’ with the right technology. However, as a piece of aspirational and speculative thinking The Array is designed to highlight the influence contemporary and speculative forms of architecture have on contemporary and speculative ‘posthuman’ forms of disability. Instead of persisting with ‘static’ architecture, the technologies used to create posthuman conditions could be used to design ‘dynamic’ architecture, able to accommodate any potential human and posthuman physiology.

Notwithstanding the potential for deliberate discrimination, the practical issues of designing for multiple physiologies cannot, at present, be resolved. However, as with contemporary efforts to develop a concept of ‘Universal Design’ (Lid, 2014) for both disabled and able-bodied people, The Human Spectrum presents design ‘challenges’ instead of ‘problems’; instead of something that needs to be ameliorated, disability in its contemporary and posthuman form presents an opportunity to develop architectural technologies and design conventions that reflect the pluralistic nature of human and eventually posthuman physiology.

However, speculative designs and technologies do not guarantee a pluralistic approach to design, and technological progression should corresponded with a reaffirmation that architecture is expected to support a range of physiologies, not just the architects own or the majority held understanding of ‘normal’ capabilities.

AN ENDING OR A BEGINNING?

The Human Spectrum ends with Ghan, the main protagonist, left standing on the ice-sheet waiting for the old man to make a decision. Ending the story without a decisive final-scene is deliberate, and poses a question – and a challenge – to the Jovians, the Elites and to contemporary society. Will they – will we – continue as ‘normal’, arbitrarily defining certain people as ‘other’ or disabled? Or will we work together to create a world fit for the entire Human Spectrum?


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JOURNAL ARTICLES


WEBSITES


Alan J Pottinger
BA (Hons) Arch, PG Diploma Architecture

Alan completed a BA in Architecture at the University of Greenwich (2000-2003), and a Post Graduate Diploma in Architecture at University College London’s Bartlett School of Architecture (2005-2007). He is Senior Access Auditor at David Bonnett Associates Ltd.

Alan is currently studying an MSc in Architectural Design, with the AVATAR (Advanced Virtual and Technological Architecture Research) group in UNIT 15 - tutored by Nic Clear and Mike Ailing - at the University of Greenwich.

*The Human Spectrum (2016)* is Alan’s MSc thesis, and also his first Science Fiction short story.