Handbook of the Unknowable

Rachel Armstrong | Rolf Hughes | Espen Gangvik (eds.)

Esther Armstrong | Rachel Armstrong
Andrew Ballantyne | Krists Ernstsons | Paul Gilster
Rolf Hughes | Sarah Jane Pell | Frederik de Wilde

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Handbook of the Unknowable

Introduction

This *Handbook of the Unknowable* came about as a conversation between Espen Gangvik, Director of Meta.Morf, Norway, Rachel Armstrong, Professor of Experimental Architecture, Newcastle University, UK, and Rolf Hughes, Head of Research and Professor of Artistic Research at Stockholm University of the Arts, Sweden. The discussion related to how the arts and space communities may explore productive research conversations in a festival setting.

The idea that the publication itself could be viewed in dialogue with the Biennale programme came about as an alternative reading of the festival theme 'Nice to be in Orbit!' for Meta.Morf 2016. Conceptually, the publication represents a journey from the present understanding and engagement with 'space' towards an uncertain, yet optimistic future 'among the stars'. The reader is invited to imagine the near-term prospect of human space habitation. If it is the case that we relate to the extraordinary terrains that make up our solar system in an almost *mundane*, technological, colonizing mindset today, then the work presented here – with its reverent insistence on enchantment – is offered as a necessary counterpoint. We will not imagine the unimaginable unless some brave souls start to help us do so.

Such a 'handbook' – the editors have deliberately chosen the name of such a pragmatic or practical genre in order to smash it against the mysterious concept of 'unknowability', thereby creating an alternative vision to that articulated so suavely in countless techno-utopian space reports – invites discovery while simultaneously declaring the impossibility of any notion of resolution in such hypercomplex, alien and vast spaces. In other words space remains both familiar and exotic. We are confronted not only with the strangeness of matter but also with the irreducibility of ourselves. Space, in short, can be said to be queer in every sense of the term. This means our acquired habits and existing knowledge sets are unlikely to get us very far. We'll need to find ways to think *against* (and *outside*) ourselves. Here the arts can be an important ally.

We have sought to engage readers in ways that reach escape velocity from the traditions of artist manifesto critiques and historical documentation of space exploration through an experimental approach to writing. Using creative and critical writing (essays, poetry and fiction), interlaced with artworks, an exploratory condition is proposed where ruptures in our thinking about the possibilities of space may be precipitated. We believe that it is essential that artistic insights, methods, and knowledge establish new ways of being before these environments are completely colonized by established terrestrial ideologies, practices and ways of living that conceive of the *unknowable* as a mere extrapolation of what already exists rather than a genuine alternative *way of being*. The arts, we suspect, currently offer our best chance for thinking beyond ourselves – hence this publication.

The structure of the content graphically and narratively embodies a journey from our home planet out into the unbounded regions of interstellar space. It is a journey from the familiar 'home' of our blue planet to the profound uncertainty of black space.

A range of contributors have helped us along this journey. They have peered at the issues involved through the lenses of art, science, technology, culture, poetry, history, scenography and identity.

Paul Gilster, an experienced journalist and founder of the online resource Centauri Dreams, introduces the publication with a review and opinion of where we are in terms of our exploration of space.

Andrew Ballantyne, Professor of Architecture at Newcastle University, discusses Philolaus of Croton the first person in orbit (at least conceptually) around 470–385 BC – in doing so, he established the heliocentric view of the solar system.

Esther Armstrong, Lecturer in Scenography at the University of the Arts, London, discusses the solipsistic image of the pale blue dot as an image that holds us back from becoming a truly space-faring civilization.

Sarah Jane Pell, an independent artist, commercial diver, explorer and researcher conjures a possible alternative way of living and being in space.

Rachel Armstrong and Rolf Hughes together explore an 'ecological' view of space exploration from the perspectives of infrastructures and networks that will support life beyond the known worlds we inhabit. Using prose and poetry they lead us into a boundless, unfathomable universe 95 % composed of dark matter and energy.

Notably, the handbook takes an integrated and boundless perspective of space exploration. It invites explorers to engage in novel acts of synthesis and unlikely connections in which nonhuman bodies may also participate in the discovery process.

This is why we include a contribution from the SETI@Home network that scans the skies for extra terrestrial activity and is searched through a vast network of computers, as well as transmissions from the New Horizons probe that take around 42 minutes to send one photo from the outer reaches of our solar system.

Artwork from Acrojou / photographer Steve Edwin, Rachel Armstrong, Cirkus Circör / photographer Mattias Edwall, Krists Ernstsons, Simone Ferracina, Gareth Hudson, Lucy McCrae, Matthew Mouncey, Sarah Jane Pell, Teodor Petrov, TeZ, Phil Watson & Jon Morris, and Frederik de Wilde open up alternative landscapes and bodies within the dark spaces. As with the texts, the intention is to provide fleeting glimpses of worlds that may yet be, portraits that might not otherwise be apprehended by our conscious, rational thought processes.

Rachel Armstrong, Rolf Hughes, Espen Gangvik (Editors).

Contributors

Esther M. Armstrong
Armstrong is Programme Director for Theatre and Screen at Wimbledon School of Art, University of the Arts, London. She lectures in Critical and Contextual Studies across the design disciplines of theatre and screen arts. Her PhD thesis interrogated the relationship between the reading of set design and national identity. She has also worked and trained in technical arts at the Royal Academy of Dramatic Arts and broadcast journalism at the London College of Printing. She has an MA from Regents Park College at the University of Oxford.

Rachel Armstrong
Armstrong is professor of Experimental Architecture at Newcastle University. She designs lifelike environments for the built environment using technologies that manipulate the building blocks of life such as synthetic biology and smart chemistry. Armstrong trained as a medical doctor graduating from the University of Cambridge with First Class Honours and prizes. She completed her clinical training at the John Radcliffe Medical School at the University of Oxford. She also has qualifications in general practice and a PhD funded by the EPSRC in Architecture from the Bartlett School of Architecture, University College London. Armstrong has worked across many disciplines as a multi-media producer, a science fiction author and an arts collaborator. She is TWOTY Futurist of the year 2015 and a 2010 Senior TED Fellow. Rachel was named as one of the top ten UK innovators by Director Magazine in 2012 and featured in the top ten 'big ideas, 10 original thinkers' for BBC Focus Magazine.

Her TED book on Living Architecture was #1 Bestseller in Biotechnology on Amazon and shortlisted for a 2012 BSFA award in non-fiction. Her new book, *Vibrant Architecture: Matter as CoDesigner of Living Structures*, explores prospects for transformations of matter from inert configuration into lifelike habitable structures, which prompts a re-evaluation of how we think about sustainability in our homes and cities.

Andrew Ballantyne
Ballantyne became an architect and then moved into an academic career. In his writing his approach tends to see architectures as ways of world-making. His research has often brought him into contact with philosophers, for example in *Deleuze* and *Guattari* for Architects. His *Architecture in the Space of Flows*, takes Heraclitus as its starting point, and *What is Architecture?* gravitates around the minimalist Diogenes, who lived like a dog on the streets of Athens, sometimes in a barrel. Ballantyne made a study, *Architecture, Landscape and Liberty*, of the polymath Richard Payne Knight, who took his moral outlook from Epicurus. He was an eminent scholar of ancient Greece and much else besides. Knight's first book, about the worship of Priapus, was privately printed and became scandalous one its existence became known. Andrew has written wide-ranging books such as *Architecture: A Very Short Introduction*, and *Key Buildings from Prehistory to the Present*. His most recent book is a biography, *John Ruskin*, that is also an introduction to Ruskin's major works on art and architecture. Ruskin too was concerned with world-making, especially through his pervasive character-defining fascination with geology. It is by doing our best to understand the world that we redescribe it and our place in it. Philolaus was the first to put himself off-centre, and now we are all in orbit with him.

Paul Gilster
Gilster writes and edits Centauri Dreams (http://www.centauri-dreams.org), tracking ongoing developments in interstellar research from propulsion to exoplanet studies and SETI. A full time writer for the last thirty-five years, he is the author of *Centauri Dreams: Imagining and Planning for Interstellar Flight* (Copernicus, 2004) and *Digital Literacy* (John Wiley & Sons, 1997). He is also one of the founders of the Tau Zero Foundation and now serves as its lead journalist. This organization grew out of work begun

in NASA's Breakthrough Propulsion Physics program, and now seeks philanthropic funding to support research into advanced propulsion concepts for interstellar missions. Gilster has contributed to numerous technology and business publications, and has published essays, feature stories, reviews and fiction both in and out of the space and technology arena.

Rolf Hughes
Hughes is Head of Research and Professor of Artistic Research at Stockholm University of the Arts (inaugurated 2014). He is a prose poet and disciplinary nomad, actively promoting innovative forms of artistic and transdisciplinary research over the past twenty years. He has been expert advisor for artistic research at the Swedish Research Council, the Norwegian Artistic Research Programme, and the Austrian Programme for Arts-based Research (PEEK); Guest Professor in Design Theory and Practice-Based Research at Konstfack University College of Arts, Crafts and Design (2006–2014); Senior Professor in Research Design at Sint-Lucas School of Architecture (KU-Leuven, Belgium), where he helped create and develop an international, design-led PhD. programme (2007–2013). He has also served two terms as Vice President of the international Society for Artistic Research (elected by the SAR membership 2011-2013, unanimously re-elected 2013–2015). Hughes holds a First Class degree in English and Related Literature (University of York), an MA (with Distinction) in Creative Writing and the first ever PhD. in Creative and Critical Writing funded by the British Academy from the University of East Anglia, UK. He is currently exploring the potential contribution of magic and the circus arts to the conception and design of a third millennium experimental research laboratory. Writing and theatre remain central to his endeavour to link diverse forms of experience, expertise, and knowledge.

Sarah Jane Pell
Pell is an artist-astronaut. As an RMIT University Research Fellow (AU), TED Fellow (US) and Scientist-Astronaut (PoSSUM Class 1601) for the NASA Flight Opportunities Program Experiment 46-S, Noctilucent Cloud Imagery and Tomography Experiment she has an extensive exhibition and publication record. She incorporates themes of human-aquatic adaptation to other worlds and other extreme-performance interfaces in her work. She established the Aquabatics Research Team initiative [ARTi] 2002-2012 for developing aquatic performance and related underwater technologies. In support of her research she logged 500+ Occupational Dives and demonstrated prototype re-breather systems. Leonardo, LABS awarded her Best PhD 'Art & Science', MIT 2007 and she was made Official Aquanaut, Atlantica Expeditions subsea habitat mission. In 2006, she graduated from the International Space University to lead the NASA-sponsored project "Luna Gaia: closed loop habitat for the Moon". At Singularity University, 2010, she co-developed exponential technology pathways for NASA to "Boldly Stay" in space. Appointed Co-Chair, European Space Agency Topical Team Art Science [ETTAS] 2011–2014, she published the ESA Arts Initiative as the first author. In April 2015, Pell reached Everest Base Camp (5364m) and survived the Nepal earthquakes. She was attempting an independent arts-led expedition to summit Mt. Everest as an experiment in space analogue training and communications. She currently adapts her first-eye-view 4K footage for a cinematic dome experience and publication *Bending Horizons*.

Frederik de Wilde
De Wilde acts on the interstitial spaces between science, technology and art, which include perceptual, conceptual and social–human–registers. His art is grounded in indistinct, diffuse and 'fuzzy' arenas where complex biological and technological systems overlap and commingle. The conceptual crux of his artistic praxis invokes notions of the intangible, inaudible and invisible that provoke the possibility of dematerialization. In 2010 he created Hostage, the darkest nano engineered painting in the world, in collaboration with Rice University (Texas, Houston, USA).

Krists Ernstsons
Ernstsons is Architectural Assistant / RIBA Part 2 / AA Diploma. He completed his Part I in Architecture at the University of East London and his Part II Diploma in Architecture at the Architectural Association School of Architecture. His thesis project 'Virtual Migration to Exoplanets' was nominated for honours and explored the idea of breaking the speed of light boundary through quantum entanglement and migrating to Earth like planets at the macro scale. The key driver for this study was the idea that humanity eventually will grow out of its cradle called the planet Earth. After his Part I he worked for Foster + Partners in London where he prototyped a household unit to revolutionise efficiency and functionality of low-income housing. In 2010 he joined Izolyatsia, a platform for Cultural Initiatives in Ukraine, where he worked on master planning, refurbishment, curating a residency programme and executing projects by internationally renowned artists. He recently joined Hawkins\Brown in London where he works in the infrastructure sector on Crossrail station projects and others.

Artwork courtesy of: Acrojou, photographer Steve Edwin | Rachel Armstrong | Cirkus Circör, photographer Mattias Edwall | Krists Ernstsons | Simone Ferracina | Gareth Hudson | Lucy McCrae | Matthew Mouncey | Sarah Jane Pell | Teodor Petrov | TeZ | Phil Watson and Jon Morris | Frederik de Wilde.

Knots

by Rolf Hughes and Rachel Armstrong

What we're not. Obvious.

I am reaching from your nowhere.
That place where what works doesn't work.
You cannot explain all this.
We cannot carve shadows
From the blue shadow of that blue dot.

Do not measure me.
Or measure me wrongly.
Not trying to know you.
But I would like you to know me.
In the dark. Spooky. Entangled.

It's less about knowing than *scrying*. Another way of knowing.
And if you think you're going to grasp me at the end of it, think again.
You won't pin me down – I'll fly into pieces.
You see, although we share the same name, you're strange. I'm very little interested in you.

I'm interested in getting stronger, longer, broader, more agile.
I'm interested in *entangling, simultaneity, tunneling, diffraction, distraction*.
I'm not finished.
Tumbling. Friction.

Knots:
weaving a world through which the curious can climb
knitting of interfaces
monstrous tangle of *unknowing*.

You were here long before me. You've made this neighbourhood your own.
Few are aware that I even exist. Your charmed anti-matter.
I hear you sometimes, a dark hole rustling voraciously.
You'd possess me if you could. It's in your nature.

Your approach is from a place beyond my nowhere.

It doesn't work this speaking for two.
I don't hear you anyway.
You're less than vacuum.
Beyond light.

Still, I yearn to be there
part of your somewhere,
part of your elsewhere,
together with the noiseless things, the weightless, sightless,
nameless things like wind,
tossed from myself,
across channels, alive,
mysterious, monstrous,
heart's slap of valve,
gravitational waves beating
from colliding black holes
cosmic thunder over horizons,
it's impossible, this synthesis,
and yet here we are –

And, next, the plants are indistinguishable from the stones.
Pebbles bear a resemblance to brains, stalactites to udders, and iron-dust to
tapestries adorned with figures. In pieces of ice he can trace efflorescences, impressions of bushes and shells--so that one cannot tell whether they are the impressions of those objects or the objects themselves. Diamonds glisten like eyes, and minerals palpitate.

…nearer still;
singular, finite, fierce
the air static, crackling, tense,
it sears, this white scar
– this bolting bolt of darkest radiance.

OVERLEAF
Rachel Armstrong: Scrying 1

Falling: Not What You Think

by Rachel Armstrong

Reality is not what you think it is
Only five percent of the universe is visible
Our senses are rare and luminous.

Universal laws are not what you think they are
Heavenly bodies in constant classical motion
Are spooky, entangled and weird.

The sun is not what you think it is
Stars have already died in this solar system
And our yellow dwarf is middle aged.

The earth is not what you think it is
A gluttonous mass that gulped its lover
Into its molten core.

Your body is not what you think it is
Different creatures slammed together
Across evolutionary timescales

Thinking is not what you think it is
Consciousness eludes consensus
And why we're aware at all.

Matter is not what you think it is
Weightless specks are conjured and smashed
In colossal instruments.

Nothing is not what you think it is
A paradox of imagined absences
Perceived by something.

This is not what I think it is
A communication open to unknowns that
Inevitably misses its mark.

If existence is not what we think it is
Then knowledge is found together
Through how we catch and fall.

A brief moment of rest before traveling ever onward in the Wheel House
The Wheel House is a tender, post-apocalyptic, gently comic, love story that treads lightly, endures quietly, and is always moving onwards. The performance takes place within a unique, hand-built rolling acrobatic-theatre set at a time where survival relies on sharp eyes, quick hands, and above all, friendship. Audiences are invited to join the traveler-gatherers on the road to nowhere.

Acrojou, The Wheel House, Whitstable, Steve Edwin Photography
For more information about ACROJOU please visit www.acrojou.com

The First Person in Orbit

by Andrew Ballantyne

Philolaus of Croton was the first person (at least the first person we know about) to think that the earth was not the centre of the universe. He lived round about 470–385 BC and was a follower of Pythagoras. Plato mentioned him in the dialogue *Phaedrus* as someone he thinks some philosophically-minded visitors from Thebes might have met, so we think he lived in Thebes for part of his life. Pythagoreans from time to time had to move, as Pythagoras himself had had to do. People took against them. Perhaps they were annoying, or their ideas were too disturbing.

Pythagoras is sometimes credited with inventing the word "philosophy", and sometimes with inventing philosophy itself. Certainly some of his key ideas were taken up by Socrates, who tends now to be seen as a foundational figure for the western tradition. Philolaus seems to have coined the philosophical sense of the word "cosmos", which certainly became part of Pythagorean teaching and for that reason came to be attributed personally to Pythagoras along with other inventions of his followers.

Presumably Philolaus was an orthodox Pythagorean, but his cosmology seems to have been new with him. It was based on a mixture of careful observation and wild conjecture. When he was right he was not right for particularly good reasons, and he was often quite wrong, but there he was in the fifth century BC, about 2400 years ago, asserting that the universe did not have the earth at its centre. Galileo had problems when he made a similar assertion in 1616, only 400 years ago.

By 1616 there had been advances in science, but even then there were no arguments that were persuasive enough to persuade heliocentrism-deniers to change their minds. He was shown the instruments of torture and kept under house-arrest because his views were seen to disturb the world order. If people were not inclined to believe Galileo then nothing he said should logically have made them believe him. Of course he did persuade some people, but they must have been predisposed to believe him for one reason or another: because of his careful observations through the telescope, or his personal *gravitas*, or the glory of the shining sun – who knows what swayed them? It was not logic as such. Philolaus is in the interesting position of having been right in a big way, wrong in detail, through personal conviction, not because he had good evidence to support what he was saying. He displaced the Earth from the centre, but he did not put the sun there, as Copernicus and Galileo would do centuries later. Philolaus thought that the sun was one of the ten planets that orbit an unseen central fire.

The reason he thought this was because of the way that a shadow of the earth passes over the face of the moon when there is a lunar eclipse. The full moon hangs red in the sky as its supply of reflected light is diminished, and Philolaus understood that. He had seen a lunar eclipse, and speculated about what he had seen. He did not make the inference that it was the light of the sun that was being cut off, but thought it was the light of a central fire that remained always out of sight because earth always looked away from it. There he had an idea of the earth being in orbit, but it is far from clear what Philolaus thought the earth was like. He might well have thought that it was flat, or at least that it had one flattish surface on which we live that always faced out away from the central fire, looking towards the outer darkness of the heavens that were illuminated by points of light. Beneath our feet, at a great remove, there was always the Central Fire. Eratosthenes, who lived in Alexandria (a Greek city in the place we now call Egypt) made a famous calculation of the Earth's circumference in 240 BC (about 240 years after Philolaus had died) which depends for its geometry on an understanding that the Earth and the sun go around one another. Either one of them might have been understood as stationary, and the geometry would still work, but Philolaus could never have made that calculation because he did not identify the sun with the Central Fire and the geometry would not have worked. Philolaus might have imagined the Earth as a spherical body in space, but he did not make a point of it, so maybe he supposed the Earth was as flat as his common-sense neighbours told him it was. That might have made him easier to get on with.

Pythagoras (maybe 570–495 BC) was born on the Greek island Samos. We know that he travelled, and suppose that he might have had to move on if his teachings annoyed too much the established

order in a place. He ended up in Croton, which was then a Greek city on the coast of what we now call Italy. That is where Philolaus was born. Every schoolchild knows the name of Pythagoras because of his equation about the squares on the sides of a right-angled triangle, which is a formidable legacy. It might not be so straightforward as it seems at first. The Pythagoreans' numbering system was rows of dots. That is why square numbers were so important to them, and indeed why we still call the numbers "square". We can think of 9 as 3 x 3, and there is nothing inherently "square" about it in that notation. Pythagoras would have thought of it as 3 rows with 3 dots in each, but he did not have the numeral "3" to translate back to. The square numbers could be notated as grids of dots, spatialized. 3 x 3 was a square grid. He believed that every number could be expressed as a ratio of two others (today we would call those numbers "rational") but it was an article of faith for him that there were no "irrational" numbers. So it is curious that today when we make use of Pythagoras' theorem that we use square roots, many of which are in fact irrational—they cannot be expressed as ratios. For example the square roots of 2, 3, 5, 6, 7, 8. There is no way to express them as rows of dots, and with a modern calculator we deal with them to an appropriate approximation using decimal places. The Pythagoreans' fascination had to remain with whole-number squares, the best-known of which is the 3:4:5 triangle, but there are others (for example 5:12:13, 8:15:17, 7:24:25, 9:40:41).

The Pythagoreans were mesmerised by numbers, and thought that the elements of numbers were the elements of the world. Obsessive study of numbers would lead them, they thought, to the world's ultimate truths. The number 10 was fascinating and perfect—being made up of 1 + 2 + 3 + 4, which makes a very satisfying triangle of dots. It was so fascinating that Philolaus inferred that the number of heavenly bodies must be 10. Some of them could be seen in the sky, but he made up the number by deducing the existence of a counter-earth (Antichthon) that was always on the opposite side of the Central Fire and which therefore never came into our view. At least that is what Aristotle said about the Pythagoreans' reasoning. He might have been making a joke about their fascination with number, but there are no surviving documents by Philolaus (or Pythagoras, come to that) so we have to reconstruct their beliefs from what other people said about them, and other philosophers were not usually sympathetic. Unusually Plato was sympathetic, and seems to have included some Pythagorean ideas in his dialogues without feeling the need to present them as absurd. Philolaus is more likely to have invented the Antichthon to give a feeling of balance to the system. Earth was its only substantial entity. The others were fiery orbs, so the Earth and Antichthon revolved around the Central Fire as if held on the two ends of a pole with its pivot at the heart of the Central Fire. Maybe it makes sense to think of Antichthon as the Antipodes, revolving on the other side of a central Magma, seeing what we would now think of as the surface of the Earth as being in orbit round its core—that might be less of a leap for Philolaus than to conflate the sun and the Central Fire.

Philolaus' line of reasoning takes some premises that are for us unacceptable, and the unsoundness of his reasoning is very evident to us today, now that we no longer think that there is a counter-earth, or a central fire. If I ask myself, though, how I personally know these things, then I start to feel a bit shifty. Really I know because that is the conventional wisdom of my age. I have not rigorously examined the cosmological evidence for myself and drawn the right conclusions. Philolaus thought about these questions far harder than I have done in order to reach his conclusions that I confidently dismiss. What makes Philolaus interesting is that he was arguing against the conventional wisdom. Look around you. The earth is solid beneath your feet, and the heavens arch overhead. The sun moves across the sky. The moon moves across the sky. The stars move across the sky. You can see it happening, if you wait a while. Everyone else in Philolaus' day knew that the earth was solid and that it stayed still. They were not asking what held it in position in relation to the sun. They were asking what kept it still at the centre of the universe. That was the great scientific question of the age. What keeps the Earth still? What prevents it from moving?

Against this background it is remarkable—astonishing—that Philolaus said that the Earth moves. It is an extraordinary thing to say, and it flies in the face of everything we actually know about the Earth

from the evidence of our own senses in everyday life. No wonder that Pythagoreans were drummed out of town. The only reason we think that Philolaus was right on this issue is because of things we have read about in books, seen on screens or heard from other people. No one alive now has thought from first principles, based just on walking around and looking at things, that the solar system was anything like the way we know it to be. We have seen from when we were children, diagrams of the sun with planets orbiting it. We have believed the things we were told and they are deeply ingrained. That is an achievement in learning, but how does it compare with that of Philolaus? Is every schoolchild now a better thinker than he was? On this issue we—most of us—just believe what we have been told.

Philolaus was inventive. He held on to his Pythagorean principles when the world told him he was wrong, and made his cosmology work by inferring the existence of the Central Fire and another Earth that we find redundant, so we want to say he was wrong about those things. But he put us in orbit. He was the first person to imagine that the Earth was not the centre of the universe. That is an amazing intuition for him to have had. Everyone told him he was wrong. If the authorities had had more power they might have shown him the instruments of torture and kept him under house arrest, but the structure of the society in which he lived was such that he could pack his bags and move on, and he unreasonably held on to the idea that we are in orbit.

Falling: Newton's Apple

by Rachel Armstrong

How many plastic bags did you use?
0
Enter

Bubble wrapped apple
Tucked inside vacuum packed plastic
Tumbles into
A recycled carrier bag.

Perfect flesh
Unbruised, unblemished, bounces on a leg swing.
Pendulum metrics
Falling at 9.81 metres per second squared
From Newton's tree
Conducted by a bidirectional arrow
With a serpent's cunning.

Where did the filthy worm come from?
Did rot wriggle in?

No, the maggot was born there.
Squirted through a tube
From the underside of its intoxicated mother
Orchard drawn by the sweet summer scents
Of ripening fruit.

Tiny white railroad worms hatched soon afterwards
Bearing no adult likeness.
Ravenous, they gorged until the Fall
Carving tunneled networks.
Hand harvested
Some fruit drop from the tree
Earth bound.
Now, an exodus
Of serpentine gluttons burrow
Into the ground
Solidifying within a winter home
From which apple maggot flies rupture
The following summer
And sugar drunk insects mate.
Stilettoed ovipositors
Impregnating new flesh.

The inflated plastic skin
Protects the fruit from
Germs on unwashed hands
Ethylene atmospheres artificially
Ripen and sweeten starches
Mummifying them from without
While rotting from within.
Cracking through this package is
Perfect waste
And disappointment.
Supermarkets are cities for already departed worms
Where the economics of sterility
Laments the messiness of life

At an extra five pence on your shopping bill
Plastic-wrapped environmentalism
Fills garbage cans with useless, starchy fruit.

Thank you for your custom.

OPPOSITE PAGE
Frederik de Wilde: Space Armour

Falling: Cosmonaut

by Rachel Armstrong

"Sky, off with your hat –
I'm coming to see you!"
The hollowed out cannon ball Vostok 6,
Atop a stocky R-7 booster rocket
Developed on the back of technology
Ordered by Stalin during the Cold War,
Opens its door for twenty six year old
Dr. Valentina Tereshkova, a textiles worker
With a passion for skydiving,
Certified fit – the first civilian in space
Chosen from four hundred applicants,
Launched from Baikonur Cosmodrome.

As she rose in the capsule, she spoke live
With Premier Nikita Khrushchev over the radio.
With fatherly pride he decreed that
"Under no circumstances should an American
Become the first woman in space
This would be an insult to Soviet women."

She photographs layers in the Earth's atmosphere
And captures the Moon where the lightless void
Swallows her whole into its blackness.
Traveling at thirty three thousand kilometres per hour
Each day in orbit lasts ninety minutes
She circles the Earth forty eight times, setting new records.
Constantly she monitors the effects
Of spaceflight on the human body.
From this distance, the sky bends around the Earth
Splitting the membranes of life
Into flimsy rainbows at its horizon
Drawing the line between life and extinction.

It could have happened to any of us,
At two hundred and thirty two kilometres from the Earth's surface
Her toothbrush is missing.
"Unfortunately it is a fact.
I am resourceful as any woman,
I had my toothpaste,
I had my hand and I had water."
The bitter grit of plaque rubbed finger clean
From her minty fresh smile.

Yet, this was nothing compared
With a control program error
That began the spacecraft's aberrant ascent
"I would have gone up
Instead of back to the ground."
Caught between two faces of death, she chose falling.

On the fly, a new algorithm was composed so
Her drop through Earth's atmosphere could begin.
"I reported back to ground control and they corrected it."
The blue halo burned with welders light into the blackness
As the capsule singed, her perspiration congealed within
The fiery comet, traveling at twenty-seven thousand kilometres an hour.
From the ground Vostok 6 is just a scintillating spot in freefall.
From the sky, Lake Vostok's ancient ice sheet
That formed fifteen million years ago,
Records deep time, through its odd materiality
Where gases are enclosed in an icy cage
Of clathrate structures that look like packed snow.
Sealed in a network of subglacial rivers and tides
The frozen liquid under extreme pressure
Is a unique habitat for hardy ancient bacteria
Whose gene pools have been isolated
For half a million years and counting.
Within, her quickening breath and deafening pulses
Fast and slow time is marked to impact.

Hastening beneath her, the Ice Age landscapes of the Altay region
Approach the spinning Kazakhstan-Mongolia-China border
Preserving time in kaleidoscopic landscape mosaics of
Mountains, coniferous forests, steppe, alpine meadows and wetlands.
Where horses and reindeer persist in the present, in ancient forms.
Except for extinct species like mammoths and wooly rhinoceros
There are few differences between current ecosystems
And their lumbering, ancient counterparts.

They watch the capsule, tense and silent.
As it reaches four miles from Earth a great cheer goes up:
"The 'chute! The 'chute!"

There is still time to draw together these splayed fibres
Of multiple pasts, with many possible futures. On one side,
Colossal cotton factories occupied by immense machines
That enslaved her mother seem little more significant than toys.
As she hastens towards the ground another view
Brings into focus the diesel tractors that her father drove
Scattering ant-like over dandelion wool-laced arable land.
The present does not wait. Jerking relentlessly closer,
Mountains and scrub earth swell beneath her feet
In search of a landing site.
"There was a big lake beneath me
But the big heavy parachute
Which had to be opened
At two miles above the ground
Could not be steered."
Out of control, yet still time to live.
She tugs on the reluctant threads of possibility
To declare themselves.
"Lord, they send just one woman into space
And she has to land in the water."

But she evaded drowning. Falling women
Aren't supposed to have any say in their descent.
They're said to titillate in slow motion aerial striptease
And tragically shatter into meaningless
Pieces on impact.
But no such spectacle, was conceded
Just a sweat soaked woman in her ejector seat tangled
In parachute silk and guide ropes
With bitter yet minty breath, trembling.
Villagers helped her out of her spacesuit
And asked her to join them for dinner.
She accepted, a bruise upon her cheek
Her dignity and integrity in tact,
While thousands of jubilant women
Gathered in Red Square, Moscow.

Later she was reprimanded for violating
The rules and not undergoing medical tests first.

At a time when government employees
Could not be seen making mistakes in the Space Race
Her confidences, spared the spaceship designer
Sergey Korolev from punishment.
"I kept that secret for thirty years."

Now, her burnt out capsule is on display
At the Science Museum in London, alongside
A dog ejector seat, space toilet, shower, fridge
And a gold mannequin of Yuri Gagarin
That was flown around the Moon
To test the effects of space radiation.
In celebrating one of the great intellectual,
Scientific and engineering successes
Of the twentieth century they said,
"We are thrilled to bring together
Such an outstanding collection
Of Russian space artifacts."

Unbroken still, the old woman declares
"I will go to Mars if the opportunity arises.
We know the human limits.
And for us this remains a dream.
Most likely the flight will be one way.
But I am ready."

OPPOSITE PAGE
Jon Morris, Phil Watson: Persephone Skull-Planet Orbit

Blue Ball Tyranny

by Esther M Armstrong

Cinematic space
Has a gravitational pull
A scenography grounded through
Nostalgia.

Earth in blue
Becomes
Unbearably
Spectacular.

Humanity is enthralled.

The flattening screen
Demonstrates.

Cinema's fixed framing.
Belies
Earth's potency,
It's Dualism.

The blue ball.
A simple, unique
Binding
Paradox which
Repeats and repeats and repeats
On film
Irresistibly.

Blue and circular
It carves a static gaze
Sending messages of
Individualism,
Anxiety,
Home,
Domestic,
And the very fact that
We can never get out of here.

A blue bore.
A colonised frontier
In a perfect sphere,
Carefully circumscribing
The great-out-there.

Film space too
Simulates and naturalises through
The blue sphere.
A fixed world of tedious
Gender dysfunction.
In wistful gaze
The screen's blue ball
Calls forth protagonists performing
A sex-based astronaut's dance.
And lo:

Man is solitary
Esoteric and orbital
The blue ball responds to
Spiritual
Self-mastery.

Woman is
Pulled to the ground, like Stone
Exhaling
'ah, ah, ah, ah, ah' breathless,
Florid in the cosmos, like
Lucifer
Tumbling towards dirt irrational.

The ball repeats these steps.
These steps repeat. To tired variations upon such themes.

In the cinematic frame.
This pale sphere
Limits our imaginary to
Binaries
Divisions and such
Nostalgic parameters.

We cannot act
Upon seeing the Earth
But divided,
Lament, like Coop, about '*our place in the dirt*'.

To see other we must
Deterritorialise
All
Blue ball boundaries.
Revisit the cinematic imaginary
And un-rehearse the 'other' of space.
Immerse ourselves instead in
the black
black un-gendered sky
the unknown.

OPPOSITE PAGE
© MARK DOUET : THE BLUE BALL by Paul Godfrey / ArenaPAL

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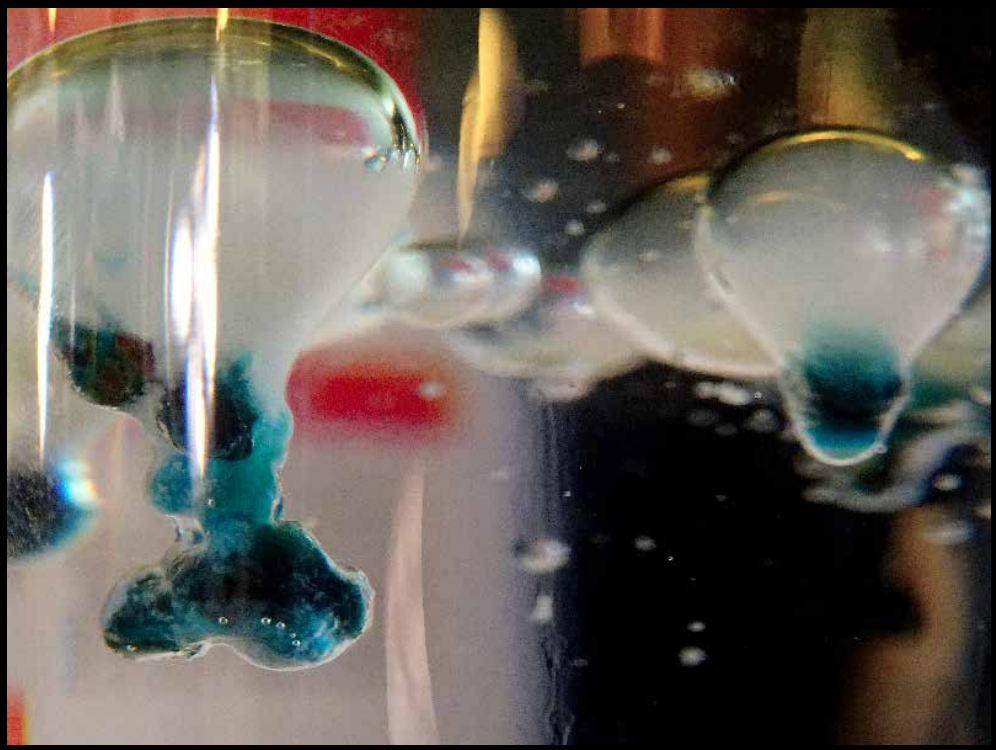

SETI@Home

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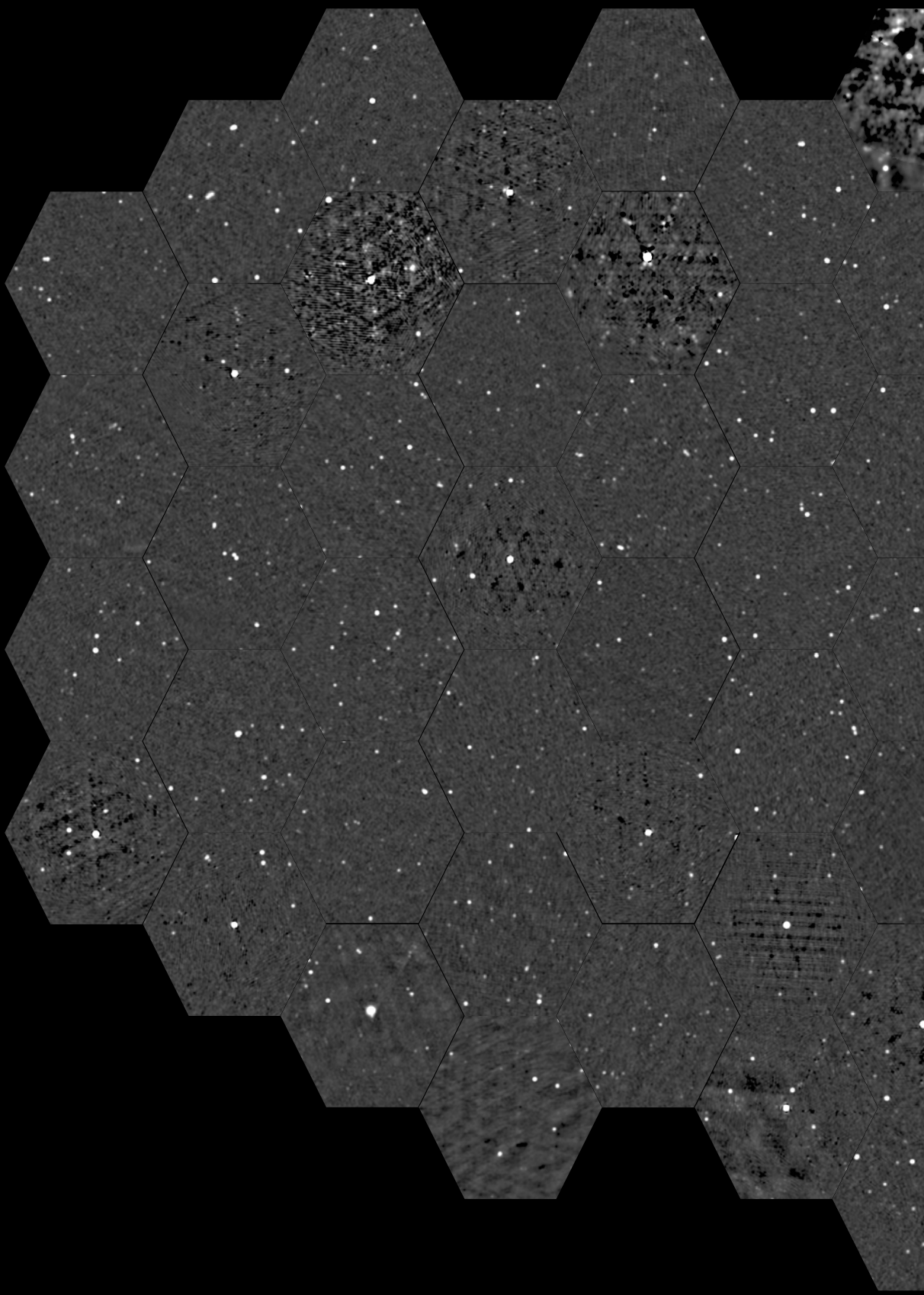
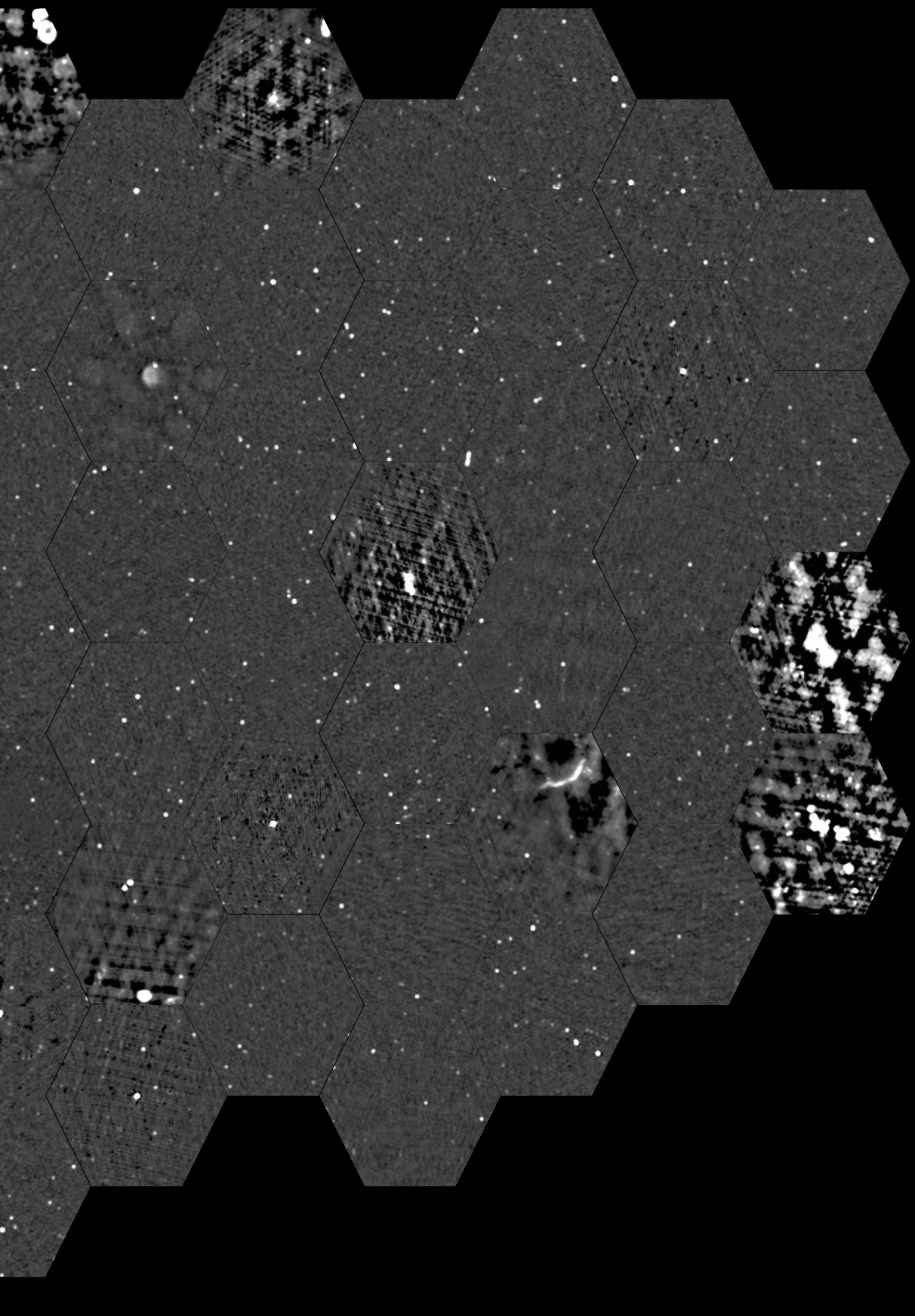
PREVIOUS

Rachel Armstrong & Nebula Sciences: Still images, Hanging Gardens of Medusa

OVERLEAF

SETI@Home: Radio telescope view of the cosmos





Voyager to a Star

by Paul A. Gilster

After Voyager 2 flew past Neptune in 1989, much of the world assumed that the story was over, for there were no further planetary encounters possible. But science was not through with the Voyagers then, and it is not through with the Voyagers now. In one sense, they have become a testbed for showing us how long a spacecraft can continue to operate. In a richer sense, they illustrate how an adaptive and curious species can offer future generations the gift of 'deep time,' taking its instruments forward into multigenerational missions of interstellar scope.

Now 18.8 billion kilometers from Earth, Voyager 1, which took a much different trajectory than its counterpart by leaving the ecliptic due to its encounter with Saturn's moon Titan, is 118 times as far from the Sun as the Earth (118 Astronomical Units, AU). Round trip radio time is over 37 hours. We now believe the craft has left the heliosphere, a 'bubble' that is puffed up and shaped by the stream of particles from the Sun called the 'solar wind.' Voyager 1 has become our first interstellar spacecraft, and it will keep transmitting until about 2025. Voyager 2, its twin, is currently 109 AU out – 16.4 billion kilometers – from the Sun with a roundtrip radio time of over 30 hours.

Throughout history we have filled in the dark places in our knowledge with the products of our imagination, gradually ceding these visions to reality as expeditions crossed oceans and new lands came into view. The Greek historian Plutarch comments that "geographers … crowd into the edges of their maps parts of the world which they do not know about, adding notes in the margin to the effect, that beyond this lies nothing but sandy deserts full of wild beasts, unapproachable bogs, Scythian ice, or a frozen sea …" But deserts get crossed, first by individuals, then by caravans, and frozen seas yield to the explorer with dog-sled and ice-axe.

Space is stuffed with our imaginings, and despite our telescopes, what we find as we explore continues to surprise us. On Jupiter's moon Io, the Voyagers showed us live volcanoes, and the billiard ball-smooth surface of Europa seems to conceal an internal ocean. We saw an icy Enceladus, now known to spew geysers, and a smog-shrouded Titan. We found ice volcanoes on Neptune's moon Triton and a Uranian moon – Miranda – with a geologically tortured surface and a cliff that is the highest known in the Solar System.

But the Voyagers are likewise an encounter with time. The issue raises its head because we are still communicating with spacecraft launched almost forty years ago. I doubt many would have placed a wager on the survival of electronics and internal mechanisms to this point, but these are the very issues raised by our explorations, for we still have trouble pushing any payload up to speeds equalling Voyager 1's 17.1 kilometers per second. To explore the outer Solar System, and indeed to travel beyond it, is to create journeys measured in decades. With the Voyagers as an example, we may one day learn to harden and upgrade our craft for millennial journeys.

New Horizons took nine years to reach Pluto and its large moon Charon. To reach another star? An unthinkable 70,000 years-plus at Voyager 1 speeds, which is why the propulsion problem looms large as we think about dedicated missions beyond the Solar System. If light itself takes over 18 hours to reach Voyager 1, the nearest star, Proxima Centauri, is a numbing 4.2 lightyears† away. To travel at even a paltry one percent of lightspeed, far beyond our capabilities today, would mean a journey to Proxima Centauri lasting well over four centuries.

What is possible near-term? Ralph McNutt, a veteran aerospace designer at the Johns Hopkins Applied Physics Laboratory, has proposed systems that could take a probe to 1000 AU in less than fifty years, giving us the chance to study the Oort Cloud of comets at what may be its inner edge. Now imagine that system ramped up ten times faster, perhaps boosted by a close pass by the Sun and a coordinated shove from a next-generation engine. Now we can anticipate a probe that could reach the Alpha Centauri stars in about 1400 years. Time begins to curl back on itself – we are talking trip times as great as the distance between the fall of Rome and today.

The interesting star Epsilon Eridani, some 10.5 light years out, would be within our reach in something over three thousand years. Go back that far in human history and you would see Sumerian ziggurats whose star maps faced the sky, as our ancestors confronted the unknown with imagined constellations and traced their destinies through star-based prognostications. The human impulse to explain seems universal, as is the pushing back of frontiers. And if these travel times seem preposterous, they're worth dwelling on, because they help us see where we are with space technology today, and where we'll need to be to reach the stars.

A certain humility settles in. While we work to improve propulsion systems, ever mindful that breakthroughs can happen in ways that no one expects, we also have to look at the practicalities of long-haul spaceflight. Both Voyagers have become early test cases in how long a spacecraft can last. They also force us to consider how things last in our own civilization. We have buildings on Earth — the Hagia Sophia in Constantinople, the Pantheon in Rome — that have been maintained for longer than the above Alpha Centauri flight time. A so-called 'generation ship,' with crew living and dying aboard the craft, may one day make the journey.

Engagement with deep time is not solely a matter of technology. In the world of business and commerce, our planet boasts abundant examples of companies that have been handed down for centuries within the same family. Construction firm Kongo Gumi, for example, was founded in Osaka in 578, and ended business activity only in 2007, being operated at the end by the 40th generation of the family involved. The Buddhist Shitennoji Temple and many other well known buildings in Japanese history owe much to this ancient firm.

The Japanese experience is instructive. Hoshi Ryokan is an innkeeping company founded in Komatsu in 718 and now operated by the family's 46th generation. If you're ever in Komatsu, you can go to a hotel that has been doing business on the site ever since. Nor do we have to stay in Japan. Fonderia Pontificia Marinelli has been making bells in Agnore, Italy since the year 1000, while the firm of Richard de Bas, founded in 1326, continues to make paper in Amvert d'Auvergne, providing its products for the likes of Braque and Picasso.

We have long-term thinking in our genes, as the planners of the Pyramids must have assumed. The Long Now Foundation, which studies issues relating to trans-generational thinking and the long-term survival of artifacts, has pointed out that computer code has its own kind of longevity. Enduring like the Sphinx, deeply planted software tools like the Unix kernel may well be operational a thousand years from now. Jon Lomberg and the team behind the One Earth Message – an attempt to transmit a kind of digital 'Golden Record' to the New Horizons spacecraft as a catalog of the human condition – estimate that the encoded data will survive at least one hundred thousand years, and perhaps up to a million if given sufficient redundancy.

'Deep time' takes us well beyond quarterly stock reports, and even beyond generational boundaries, an odd place to be for a culture that thrives on the slickly fashionable. It's energizing to know that there is a superstructure that persists. The Voyagers are uniquely capable of keeping this fact in front of us because we see them defying the odds and surviving.

Consider: Only a single instrument on Voyager 1 has broken down since its 1977 launch. Nine other instruments have been powered down on both craft to save critical power resources, but each Voyager has five still-funded experiments and seven that are still delivering data. Stamatios "Tom" Krimigis (JHU/APL) is on record as saying "I suspect it's going to outlast me."

Krimigis is one of two principal investigators still on the Voyager mission, out of an original eleven, and the only remaining original member of the Voyager instrument team. His work involves instruments that can measure the flow of charged particles. Such instruments – low energy charged particle (LECP)

detectors – report on the flow of ions, electrons and other charged particles from the solar wind, but because they demanded a 360-degree view, they posed a problem. Voyager had to keep its antenna pointed at the Earth at all times, so the spacecraft couldn't turn. This meant that the tools needed included an electric motor and a swivel mechanism that could swing back and forth for decades without seizing up in the cold vacuum of space.

The solution was offered by a California company called Schaeffer Magnetics. Krimigis' team tested the contractor's four-pound motor, ball bearings and dry lubricant. The company ran the motorized system through half a million 'steps' without failure. After more than 5 million steps, the instruments are still working, still detecting a particle flow that is evidently a mix of solar and interstellar particles, one that is moving in a flow perpendicular to the spacecraft's direction of travel, so that it appears we're just on the edge of interstellar space, a place where the medium is roiled and frothy, like ocean currents meeting each other and rebounding.

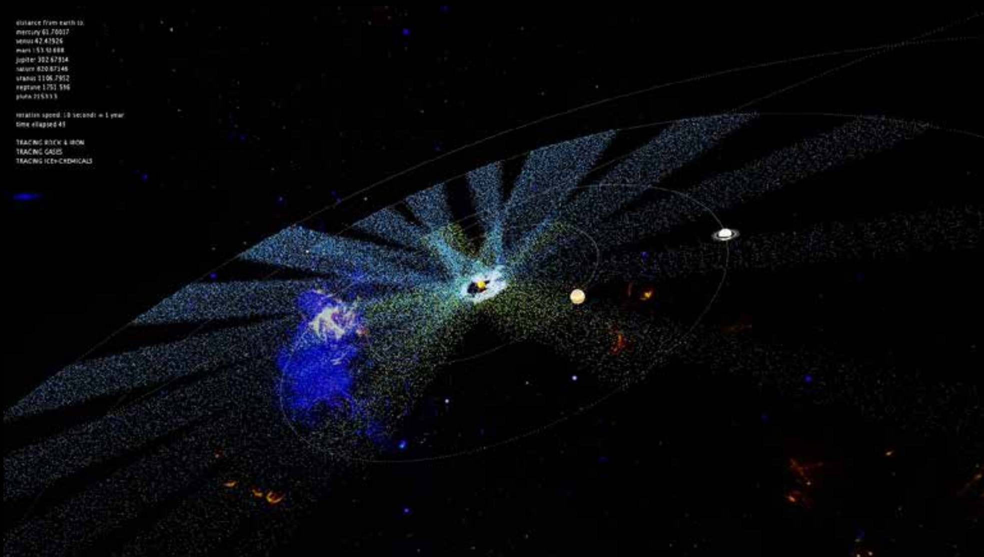
With the spacecraft now expected to keep transmitting for ten or so more years, we'll surely see both Voyagers reach true interstellar space before their power runs out. Then the loss of energy will take its toll. Somewhere around 2018 Voyager 1 will shut down its data tape recorder, just as Voyager 2 shuts down its gyros. As instruments go quiet, all power will be shunted to interstellar wind measurements and communications with the distant Earth. As we reach 2020, the few instruments still able to operate by sharing power will be unable to be supported. We'll be left with only a tracking signal that can last perhaps as late as 2025.

But there is a way to keep the Voyagers alive, if not in equipment then as a part of our lore and our philosophy. They will take about 30,000 years to reach the outer edge of the Oort Cloud (the inner edge, according to current estimates, is maybe 300 years away). Add another 10,000 years and Voyager 1 passes some 100,000 AU past the red dwarf Gliese 445, which happens to be moving toward the Sun and will, by this remote date, be one of the closest stars to the Solar System. As to Voyager 2, it will pass 111,000 AU from Ross 248 in roughly the same time-frame, at which point the red dwarf will actually be the closest star to the Sun.

Carl Sagan and the team working on the Voyager Golden Record wondered whether something could be done about the fact that neither Voyager was headed for another Solar System. Is it possible that toward the end of the Voyagers' active lifetimes (somewhere in the 2020s), we could set up a trajectory change that would eventually lead Voyager as close as possible to one of these stars? Enough hydrazine is available on each craft that, just before we lose radio contact with them forever, we could give them a final, tank-emptying burn. Tens of thousands of years later, the ancient craft, blind, mute but still more or less intact, would drift in the general vicinity of a star whose inhabitants, if any, might find them and wonder.

A trajectory change would increase only infinitesimally the faint chance that one of these spacecraft would someday be intercepted by another civilization, and neither could return data. But there is something grand in symbolic gestures, magic in the idea that these venerable machines might one day be warmed, however faintly, by the light of another sun. Our spacecraft are our emissaries and the manifestations of our dreams. How we conceive of them through the information they carry helps us gain perspective on ourselves, and shapes the context of our future explorations. Giving the Voyagers one last, hard shove toward a star would speak volumes about our values as a questioning species determined to confront the unknown.

OPPOSITE PAGE
Krists Ernstsons: Map of solar system


distance from earth to:
mercury 61.70017
venus 42.47926
jupiter 302.67914
uranus 1106.7952
neptune 1751.596
rotation speed: 10 seconds = 1 year
time ellapsed 45
TRACING ROCK & IRON
TRACING GASES
TRACING ICE+CHEMICALS

Frederik de Wilde: StarshipSPIDER

B(l)ack To Space With StarshipSPIDER

by Rachel Armstrong and Frederik De Wilde.

Frederik De Wilde's starshipSPIDER is a concept craft that yearns for kinship with both the visible and dark universes. It weaves cosmic material threads from photonic winds and buckyballs to construct the first trails of cosmic theatres between galaxies where epic vagrant cosmic bodies invent narratives and strange events.

StarshipSPIDER reminds us of the primitive status of our own legacy of space exploration with our clumsy, industrial ship hulls and trails of pollution. It asks us to think again about our future relationship with the cosmos and the assumption that it is not alive.

Does a Starship Fall?

by Rachel Armstrong

An object orbits a body because it is falling.

It appears to be stationary when it is spinning and falling.

A satellite falls towards the Earth under the influence of gravity, only very slowly, falls into the Earth.

To avoid hitting the Earth, an orbiting satellite will travel 8000 metres horizontally for every 5 metres it falls in a vertical plane so that its trajectory is perfectly choreographed to match the curvature of the world, which is spinning at the same rate. The satellite therefore falls around the Earth, continually accelerating towards it under the influence of gravity, but never colliding into it.

In this context our planet is not only an attractor but also a catcher. It juggles the body of the satellite at such a speed that it remains, for all intents and purposes, high in the air. A radically loving embrace that, if perfectly executed, could last an eternity.

But what happens when a body moves away from the Earth. Can we say that it is falling?

Whether a body travels or falls, is dependent on the presence of a catcher.

Take for example, a starship that is propelled into interstellar space to reach a destination that is an unfathomable long distance away.

We may describe the trajectory of a starship as falling outwards towards a particular star system. We may also think of it as a projectile with an independent trajectory.

With no gravity to orient us in the sensation of falling, how can we tell whether a starship travels or descends.

Space itself is without friction so if the ship is launched in the direction of its potential target it will arrive at the same velocity it was launched at. Indeed the greatest technical challenge of a starship is not its propulsion but how its catcher steadies its fall.

This may be a considerable fraction of the speed of light. So, how may those extreme velocities be handled?

A starship will decelerate if it approaches a range of catchers and uses the spin of these celestial bodies to break its fall. As the slowing ship spins around the heavenly ballroom, it falls into the slingshot arms of partner after partner until one of these bodies offers the lightness of touch that keeps the ship afloat at its orbital fingertips.

Falling: Prologue

by Rachel Armstrong

Endlessly it rained.

Plates of flabby drops broke the skin of the ground.

And no one came.

The big striped tent, a comical pastiche of itself, billowed like a jellyfish in the spiteful winds. It's complaining tethers ground their restraints taut, like stressed teeth.

Roots rotted, moulds flourished, sewage spilled, soils turned into toothpaste-like sludges, electrical circuits shorted, Wellington boots slurped water in over their tops, socks soddened, bones ached and ducks swam in chevron formations down high streets.

Still it rained.

"It's getting warmer," they said as worms suffocated in the wet tedium and floated as pink question marks on puddles.

But despite countless cycles of night and day no one saw the sun.

The circus troupe huddled in their trailers while water gurgled under the door and made industrial carpet smell like pondweed. To keep each other company they built walkways from farm flotsam that spanned the growing gaps between their quarters. Tired of tin restraints they began to live under parasols on the roof of their vehicles. Becoming more ambitious in the use of their props, they somersaulted, flip-flopped, jumped, cartwheeled, pole-vaulted, swung, teetered gracefully, hovered in formations and even used the rising waters as a performance site for aquabatics.

"We don't need the old rules" they said, "let's make our own."

So, they floated in convoy to the candy-striped tent and climbed aloft. Their art now stretched above the apex of the big top. Here, they built scaffoldings that spiraled precariously upwards, and constructed a rickety helter-skelter with string, planks, treetrunks, old fences, roof tiles, abandoned cars and solid drowned beasts, which stretched ambitiously to the thickening rainclouds.

The wetness continued and they slipped endlessly as they ascended but one day, they reached the sky.

Yet their cheers and sense of accomplishment were short lived. The mists had become so dense they were now crusts in the atmosphere.

Noticing that the ground seemed no further away than before they'd begun climbing, they sat awhile and sulked that they had not been ambitiously creative enough in escaping the impenetrable gloom that had seized their realm. Just before they could blame one another for this predicament, their scaffolding began to fall.

At first it was little more than the groaning of a hungry stomach but soon it became the complaints of overstretched joints and tendon sprains. As the makeshift framework screamed all the way through its dismemberment, the troupe slammed their fists against the sky and began to think anew.

"We want to live," they cried.

But the cruel weather sphincter gripped them tightly.

And so, they upped their game.

They knitted nets from vegetable strands and launched them so they would challenge the very limits of the sky. They travelled with the ascending fibres and just as they reached the apex of their climb in those moments before they would fall, they riveted them to the tarry lid. Feeling the full weight of impossibility, tears leaked from their eyes, noses congested and their hearts crushed. Secretly they wondered how long it would be before they breathed their last but steeled by radical love for each other, a few of them built cutlery from their disarticulated sky scaffold and organized a last supper, a communal breaking of sky-bread as a dignified farewell to one and all.

“Bon appétit,” they said as they plunged their knives and sporks into the approaching miserable matter under which they’d soon choke and began to chew.

And so, they ate their way through the upper limits of their world and flopped like newly evolved beasts into a brand new terrain for which they were ill equipped.

They squinted into the space above them without the words to describe what their senses beheld. With unlimited freedom to invent, they began to construct new ambitions, new practices and a brand new space to thrive in.

“Persephone,” they said.

Cirkus Circör: Knitting Peace. Photo: Mattias Edwall

Ecological Being

by Rachel Armstrong

In space, the body is not a unitary being, but an 'ecology'. Although it is framed by conventions of human anatomy it is not a static form, or materiality, but is in continual flux. Nor is it bounded at the skin but deeply embedded within and extruded into its environment. This unbounded, semi-permeable organism may be thought of as the 'ecological being'. Owing to this lack of purity, the ecological being is protean and embraces many future configurations that are yet to be expressed. Yet, it identifies with humanity through an extended realm of material and cultural connections, which are produced by the combined interaction between complex interdependent agents and networks that are collectively recognized as its flesh. These are not discrete accumulations of identical tissues, but exist at the transition zones of cellular organization. Such assemblages may also find transient, or persistent commonality with biospherical, technological, cultural, material, and social processes as well as other specific agents; for example, intestinal bacteria, trees, implants, or gadgets—which may even be regarded as "part" of them. Some of these relationships are obligate (like the energy-producing networks of mitochondria)—but many, (like smartphones) are associative. Existing in such a highly dynamic, materially heterogenous and networked state, the ecological being is porous to invasion. It is constantly patrolled and remade at its limits. The ecological being is therefore not an ideal form, but a paradox of existence. Its community includes chameleons, shape-shifters, transformers, mutants, the offspring of multiple parents, the bacterial biome, tissue cultures and changelings that invite multiple social readings at the level of individual bodies and as a collective. The ecological being brings value to these communities by sharing its network of operations, and entangling the constituent bodies with each other to produce meaning and value, which may be assimilated by human cultures. Yet the ecological being is not infinite but edited by technology, ecology and civilization to produce highly negotiated boundaries and contested territories that are patrolled by immune systems that shape the limits of its existence. Despite its inherent fluidity and relentlessly material nature, the ecological being does not surrender its sense of "self". It is coherent, and does not invest in reckless metamorphoses. Rather, it expands the limits of its operations through its relationships and modes of self-expression. This nascent hypercomplexity is expressed as a diverse portfolio of creativity. Identity, community, and kin are formed through the editing processes that occur between the ecological being's entanglements with other bodies and fields of experience. The provocative questions that these beings raise will need to be constantly addressed within their ethical, philosophical, existential, environmental, technical, cultural and unforseeable contexts to create the conditions for a radical identity explosion. The full implications of such questions will only become fully apparent as we explore the limits of the solar system and spread out into the unchartered terrains of the cosmos.

OPPOSITE PAGE

Simone Ferracina: Ecological Being

We are all Explorer Fish

by Sarah Jane Pell

I conceived my daughter Amulet during an unscheduled activity on the International Space Station: the marriage of my body and another, within the body of space. Born 'en caul', Amulet was splendidly shielded from cosmic radiation in her thermally regulated cocoon and floated out from me like a rare jewel. Initially an infinite loop of biology, technology, vacuums and pulses supported and confined our precarious lifeline. I delivered enough oxygen through the placenta that allowed her to breathe and swallow fluids. As her big blue eyes opened to a liminal world, she gave hope of survival. Those three months waiting for an inflatable quarantine in Low Earth Orbit taught us about caring for bodies in extremis.

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In microgravity redistributed blood flows towards the head producing change in all systems of the body. Women's breasts engorge, stomach flattens, her cheeks blush and lips swell. All fluid membranes expand, heat up and excrete hormones. As Oscar Wilde noted, the body in extremis is simultaneously the body *in ecstasy.*
Indeed.

I was conducting choreographic microgravity experiments and testing water-filled flight suits for long duration spaceflight. The radiation shielding of the aquabatic suit protected our intermingled cells long enough for fertilization and embryonic maturation. Medical teams noted hormonal anomalies but ruled out conception due to context and exposure. They routinely prescribed countermeasures for rapid onset signs of "space motion sickness" including an exercise régime (sensorimotor), mindfulness (psychological) and pharmacology (oxygen) until vestibular disturbance subsided.

The demands of the ISS workload facilitated an unnoticed near-natural pregnancy until twenty-two weeks when I reported a distinctly metallic metal taste leading to many tests and a contamination review. Our Commander performed a private wedding before we told Capcom, our family and friends. My space husband held me, as we wept, overwhelmed with love and terror.

All of Earth seemed to hotly debate our legal status: our rights to life, rights to support, and the implications of rebirth through reentry to an atmosphere.

Knowing that gravity played a vital role in the body's circulatory feedback responsible for the development and maintenance of healthy bones and blood vessels, Mission Control discussed an attempt to create artificial gravity by centrifuge to isolate exactly what gravity does to fetus development. Others put forward the suggestion to genetically engineer a substitute for the lack of gravity. It was all too late. We were held in a static system, under nonconsensual pharmacological control, and closed off from exchange with other living matter on board the space station. My biological body was the most advanced life support system available in the entire universe for this baby, but we needed special care to survive or thrive.

A remote team of physicians performed a caesarean section following strict asepsis and telepresent surgical protocols. As my uterus opened, Amulet ascended unaided within a full amniotic sac, floating, pulsing, and falling in microgravity.
Total communication silence followed.
I breathed cried prayed love.

The crew guided my baby close to my chest. As we connected hearts and skins sticking together again as one, I released a flood of hormones and transferred microbes that would bond and strengthen us forever. In the unstable happenstance of phytochemical exchange between our porous bodies, created the conditions for growth. She didn't cry as her oral-nasal cavities had already meshed with the Nano-scaffold stem-cell cannula feeding her O_3, but her signs of life improved. Soon I would be

quarantined for extraterrestrial microbes and Amulet incubated: immersed in a Liquid Oxygen pod for life, and denied earthly matter they thought.

As physicians predicted, my child's skeleton was more cartilage than bone. O_3 would be delivered to her lungs to keep her circulation system functioning and her chest cavity supported around her heart like many premature babies on Earth. Her optical nerves and cerebral cortex appeared formed well early on but her balance, vision and motion awareness may develop differently in microgravity. Her head was the same size of her body and her eyes were somewhat transparent. While her hands and feet webbed and flattened and they moved in tandem not independently, her spine had a single curvature, and she rounded her core when she moved. Her heart visibly fluttered and fibrillated too. Frequency-activated interactions may be more meaningful than expecting her to develop the manual dexterity of her Earthling cousins, they warned, and so I hummed to her.

I knew nothing about motherhood. I was the first Artist-Astronaut with significant practical experience as an extreme performer and commercial diver. My expertise in the aesthetics and embodied knowledge of human-aquatic performance was an asset for future space adaptation, but could it translate to caring for a child? Through earlier practice-based research, I had discovered an understanding of extreme performance between the body and its breathing technology and body of water as a singular action perception. I had built leadership in the embracive approach to space adaptation using specialist somatic, kinesthetic and embodied immersion methods based on aquabatics. I noted an opportunity exists to relate aquabatic experience to cognitive and biological performance to extend knowledge and technology transfer from underwater to space.

Typically astronauts experience significant bone and tissue loss as a result of long-duration exposure to microgravity. Current inflight musculoskeletal reconditioning programs for weightlessness (repetitive weight-bearing exercises for re-mineralisation, lower body negative pressure (or compression penguin suits) and pharmacological support) slow the rate of atrophy but they do not totally prevent bone and tissue loss. The implications of this are serious for the spacefarer carries a child within who cannot return or egress into the Earth's atmosphere.

If we mapped the human species according to the era of the aquatic, climber/swinger, crawler/walker, rider, sailor, driver, diver, pilot, astronaut, and avatar, each transportation epoch demonstrates cognitive evolution of agency and ability to move through time and space, real and imagined. How we move or transport our bodies has been the cornerstone technology (design or strategy) of human adaptation. By expanding our biological capabilities with the support of animals and tools, from two feet to the wheel and shuttle, we directly impact our reach and capacity for genomic diversity, trade, culture, knowledge, resilience and growth.

Amulet looked like she was curled inside a translucent stingray or jellyfish polyp. How would she reach capacity for genomic diversity, trade, culture, knowledge, resilience and growth out here? This changed everything. Our cultural imagination of human movement toward the stellar epoch has locked on to a vision of recognisable humanoid forms in suits decorated with tailored instrumentation. We view cyborgs in vehicles travelling from one celestial body to another exploring a roadmap of fixed, linear waypoints. This vision pervades our approach and drives our technology, politic and poetry. Why? Because historically, *bodies in extremis*: from deep earth, deep-sea, to the heights of terrestrial summits, and more obviously in the vacuüm of space, have depended on advanced life support systems and return vehicles. In this narcissistic inscription, we maintain a reassuring earthbound logic, and make sure the human body is a temporal alien in space, by identifying future-oriented concepts dependent on returning home to planet Earth.

Amulet's home would never be Earth: she was our first space-born explorer.

* * *

Dear Earth family,

To many of you, I am still the girl who grew up in the satellite: a curious human who would always be out of your world, and therefore out of your thoughts. However, I think of you all constantly. I can access to your data streams, your libraries, and operating systems, and I think and feel just like you. Growing up in Low Earth Orbit (LEO) at an altitude between 160 and 2,000 kilometers (orbital period between ~88 minutes and 127 minutes) from you on Earth, has given me a lot of space for internal reflection, and a great deal of time to imagine. I imagine your unique smells, tastes and the sensations you feel and experience on planet Earth: from the gravity and winds and changes in temperatures that you hardly notice.

I write this open letter to all of humanity, not to explain how different I am, but I wanted to share with you my story, to show you how similar we are, because now more than ever, I need your understanding, and to feel that you are with me.

Like many premature babies on Earth, my lungs took the most time to develop. Supported by Liquid Oxygen and nourished by embryonic fluids for an additional period, gave me the radiation shielding I needed while my body began to grow beyond my mother's womb. H_3O is Oxygen-rich as the elemental name suggests: delivered in vivo from birth. H_3O extraction is difficult but it is especially hindered by microgravity. Fluid behaves differently in space: it clings to the periphery of any container and doesn't drain from the lungs without a vacuum and heater. The procedure can be violent and distressing for any child.

Luckily, my mother met a planetary scientist Dr. O'Kay at NASA Ames in 2006, and my father knew him through the Astronaut Corps conducting experiments on the ISS. It was surprising when a planetary scientist took control of their post-flight care at NASA Johnson Space Centre in 2017, however it saved my life. O'Kay felt it was his duty to also protect and leverage my unique astrobiological status for the purpose of advancing knowledge, exploration, and human survival. He had long argued that the unique geology of Mars might have allowed a faster path to multicellular life than the one followed on Earth. He would say, we know that Mars "is a biocompatible planet". So ethically, if we find it, we should remove any Earth-life and help seed Martian life. In a similar vein, O'Kay argued that my incubation should be as long as possible. I should also be centrifuged daily to redistribute fluids to encourage growth and build bone density. Not for the purpose of visiting Earth's gravity – no that would certainly kill me – but for the long duration space missions to Mars.

The newly established space-pediatrics team listened, and the centrifuge helped to lessen the violence of the process to remove H_3O from my body in microgravity.
Now I have grown tall and have 'space normal' fitness. I can support high partial pressures of carbon dioxide for prolonged durations, due to the high concentration of residual Oxygen in my blood. Apart from occasional acidosis, I also have a good tolerance of Oxygen and rarely experience its toxic side effects. With these unique capabilities, I serve you today as the first human sensing agent on the human-robotic exploration to see whether sufficiently large and accessible volatile inventories are available on Mars.

Writing to you from Laputa: the Mars lander hovering over the moon Phobos in aerosynchronous orbit for a scheduled sleep before our surface rendezvous, I can see high ice clouds and gigantic dust storms below. I write to relax and prepare as my mind races with the details of the mission. The anticipation of an overwhelming sensory complexity when I land on the surface of Mars tomorrow is intense.

Robotic surveys prove how highly oxidizing and desiccated the environment is, and yet importantly, that Mars may possess the planetary resources needed to support carbon-based life: water and carbon dioxide. The "air" on Mars would kill you quickly, but I have a chance. I am adept to weak magnetic fields, and using my vibrio-facial gas-analyzers to detect environmental and bodily changes. I can withstand short duration exposure to the 95 % Carbon Dioxide, 3 % Nitrogen and 1.6 % Argon as my red blood cells are supersaturated with Oxygen.

As the temperatures fluctuate between the extreme heat of the day (+35 degrees celcius), and the freezing humidity of the night (-143 degrees celcius), the warm air of the short Sol twilight produces a

fleeting opportunity of 12 minutes, 40 seconds for the release of additional crystalized water vapours. In this time, I will explore an ancient riverbed. This site known as Windjana is within a science waypoint site called “The Kimberley,” where sandstone layers with different degrees of resistance to wind erosion are exposed close together. The site is named after The Kimberly in Australia where ancestral law tells of Wandjina creation spirits that reside in the country. For the North-Western Australian Aboriginal people, the Wandjina cloud and rain spirits created or influenced the landscape and its inhabitants during Dreamtime. Their cosmogony, depicted on cave for over four millennia, gives me hope for framing a dialogue between the knowing and unknowing, and of country and culture beyond fragments of scholarship that I have encountered in my short life.

Scientists and elders alike, predict that at night, when the Martian planet achieves 100 % humidity, significant amounts of water vapor will deposit in the core-sample holes left by the Mars Rover Curiosity in The Kimberley region on 2015. In case of an emergency egress, I am to draw from the sink wells, breathing in through a filtered snorkel, and I should get an instantaneous rush of pure Oxygen: a temporary “high”, before heavier toxic Carbon Dioxide will flood my lungs, the risk of ingesting indigenous Martian organisms becomes higher, and the cloud of hot rain within the impact crater, will start to fall like a sky descending into a sea.

Easily my mind wanders with mythical tales of fish falling from the sky, and the ever-present voice of my inner coach, mentor and m-other, and so I write almost to dare you to share this dreaming with me, so that I am not so alone.

With love,

Amulet.

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OVERLEAF

Sarah Jane Pell: Stills from We are all Explorer Fish

Falling: Priorities

by Rachel Armstrong

“It’s impossible to live among the stars,” said the wise folk.

“It is impossible that we are here at all,” replied the fools. “Yet, we are.”

Many reasons to explain why they would not go to the stars were given.

“It’s too far away, too expensive, will take too long, problems need fixing ‘back home’ first, the technology does not exist, we’ll be extinct before a real need arises and we don’t know where we’re going anyway,” said the wise folk.

“But, we’re already ‘here’, amongst the stars,” observed the fools.

The knowers laughed and pointed out in well-crafted, linear strips of logic that this was not what they ‘meant’. The fools did simply did not understand.

“We do,” said the fools.

For some time the wise folk basked in the inertia of their own rational reflections neatly outlined by a portfolio of empirical proofs. These formed the steady rocks of their thinking, while the fickle constellations and gods winked at the fools.

Draco, Sagittarius, Pegasus, the Plough, Scorpio, the Great and Little Bears tugged on their passions and played music with their heartstrings. Wide eyed, the enchanted fools saw how great serpents swallowed themselves endlessly in the infinite blackness of the cosmos and were seduced by the encouragement of countless bright-eyed ancestors that encouragingly winked ‘go on, try’.

So, the fools began to build their passions on the sands of the universe.

“Madness,” said the wise men. ‘Why are you doing this?’

Yet the fools offered the naysayers no justifications.

Instead, they hugged the unknown closely and immersed themselves in its apparent nothingness. Deliriously they spun an ongoing story of subversion that refused to play the odds, explain, worry, rationalize or measure their actions. They stood in soilidarity on the edge of the air flapping their wings, convinced they could fly.

The spreading wise folk shook their heads in the safety of their armchairs as the fools fell, failed, got up and fell again.

“Impossible. We told them so.”

The fool stood at the window.

A swirling snowstorm snarled at her from behind the semi liquid membrane that stood between her and destruction. Although it was only a breath away, she was not afraid. The fool recognised the signs and knew it would begin this way.

Large, fresh flakes threatened to smash their epic fist upon the pane. Up and down the street she could hear the freezing air fracture windows into poisonous shards of rationality that weakened the courage of many hearts.

But within her small basement flat, a halo of defiant breath had condensed on the pane where the tip of her nose had pressed up against it. Glaring through its melting centre, she stared into the eyes of the storm. With her fingertip she wrote the name of the charm that the monster with the dark wings had whispered.

“Radical love.”

So, she stood on the edge of the air with the rest of the fools, and flapped her wings in solidarity with the monsters, the hopelessly lost and the outcasts.

They held hands together pulling one another upwards. Despite their allegiance, most of them plummeted like fireworks leaving no trace of themselves, yet some of them flew.

The fool was the first to speed upwards, onwards and outwards.

She could breathe in the void, thrive among alien worlds and inhabit new lands as if she were native to them.

We don’t know why.” Said the wise folk, as they attempted to measure the migration’s causes and effects, pondering on how they could economically exploit this miracle. “Some just did.”

Although they waited for an explanation, the fool and her kin didn’t come back.

No, they did not return to justify what they did.

Catching 1

by Rolf Hughes

You take up your deathless position and wait. The waking waiting tedious as science. Deep huddle of the banished. Survival memories in the black hole. Light our currency. Black light. Sunless, dappled twilight captured on your pupil. Drift.

Concentrate!

Catch.

*

Cirkus Circör: Circus Heart. Photo: Matthias Edwall

Falling: Spectacle

by Rachel Armstrong

Ladies and gentlemen, boys and girls, fools and wise folks, monsters and people, scholars and practitioners, Roll up! Roll up!

Step inside Persephone, a veritable laboratory of enchantment that sets out to re-discover incredulity, outrage constrictive rationality and conjure new kinds of existences.

Within this transformational realm we have a host of delightful parallel realms awaiting you – from universes in jars, to pickled planets, desiccated dusts, marinated moons, mild mannered meteors, spicy stardusts, dreamy dark matter, peculiar poetics, transsexual terrains, glowing galaxies, mirror existences, fading fireballs, all kinds of chocolate bars – Galaxy, Mars and Milky Way – that won't ruin your appetite between meals, roguish rovers, hopeless heavens, naughty nebula, flame-throwing quasars, red dwarfs, gas giants, moon-juggling Jupiter, acid-spewing Venus, hula-hooping Saturn, Pluto's frozen hell, resurrectionist rabbits, white noise, twelve kinds of mad matter, bearded celestial bodies, revolting radiation, recursive realities, black holes, white holes, wriggly wormholes, a picnic spread of subatomic particles, quantum queerness, ants that slide in formication on moonbeams – all of which are brought together under the aegis of radical love.

Make no mistake! This is no trick of the light, sleight of hand or brazen tomfoolery.

Persephone's recalcitrant practice reaches into the untapped potential of the universe. It draws from substances so strange that even the unfathomable mystery of dark energy, or dark matter cannot match it.

Open your eyes. Pay close attention for secrets will be spilt. We will spare you nothing.

Inside the Persephone experimental realm, we will reveal all the tricks of the trade. We extend you an invitation to partake in the mastery of its strange arts and even more absurd sciences.

Perhaps sir, you may fear that with this bold exposition, Persephone will quench the mysteries of existence. Maybe madam, you are concerned that on encountering such revelations that you wits will never be quite the same.

But, Persephone comes with a guarantee – that the more you come to know, the more it will continue to surprise you.

Sounds too good to be true?

Then let us scratch a little at the very surface of these claims. Let us embark upon a journey of discovery, knowledge, exchange and bold new synthesis in which old knowledge may be transformed into new forms of practice.

Of course, Persephone is merely a sign of the times where, aided by the fearless territorial transgressor, the Internet, we are now able to make connections between ideas, knowledge and skills that erode previous boundaries. Persephone provides spaces in which we can bring together those geographies, cultures, dreams, passions and stories that once divided us – and more.

But this is not an academic attitude, it is also a reality.

Take for example, particle physics, the art and science of making primordial substances. This discipline has helped us understand that some matter is so old that it no longer exists in nature.

In contrast, supramolecular chemistry develops a practice of making a host of molecular relationships that have never existed before in the history of the universe. In other words, we now have access to substances that do not yet exist and can be first made in the minds of men. From there, they are birthed in laboratories, made magnificent through artisan practices and acquire value in our societies as new experiences, new spaces, new cultures and new ways of being.

With this expanding knowledge of stardust, our horizons are extended through an inflating robotic gaze that stretches beyond Earth's pale blue body way beyond our solar system, observing luminous bodies of plasma that lead towards unfathomably strange domains.

Once we told stories of the predictability of planetary billiard balls that collided like clockwork in orreries, and predictably swung around the sun. Now we watch celestial clouds morph in the cosmos through wobbling light waves – this one's a horse head nebula, that one is an eye, and that there, a doughnut. We may also know the properties of bodies through their absences and the long shadows they cast on our knowledge.

While we once assumed the very substance of the universe had already been set in the throws of deep time, we now understand that it is very much alive.

But don't take my word for it.

Come inside! Gather around!

Come and feast your senses in the experimental laboratory of Persephone.

Today, and only today we are offering a guarantee on your senses, where if on entering its provocative realm the great cosmic mysteries have fallen flat, then we will rejoice together – for you will be the knowers of all things.

Catching 2

by Rolf Hughes

Navigating a route between dark and visible universes, there you are, monitoring the vibrations on this monstrous web, nexus of complex energies, shadow trysts with disappearing tails, dream spaces … *the advice is not to look back at the gap where earth once blinked mutely–*

imminence

an ever-changing cast climbing from the pit of this stomach

brighter now

and so I fall, disintegrating in descent as you have anticipated...

This is why, when eventually we meet, we do not implode.

Docking is catching horizons.

*

Cirkus Circör: Knitting Peace. Photo: Matthias Edwall

The Art of Experiment

by Rolf Hughes

> "To take love seriously, to endure it, and to learn it the way one learns a profession—that is what young people need to do. People have misunderstood the role of love in life like so much else. They have turned love into a game and pleasant distraction because they thought that games and distractions are more blissful than work; but nothing is filled with greater joy and happiness than work, and love, exactly because it is the most extreme joy and happiness, can be nothing but work. A person in love thus has to try to behave as if he [sic] had to accomplish a major task: he has to spend a lot of time alone, reflect and think, collect himself and hold on to himself; he has to work; he has to become something!"
>
> *Rainer Maria Rilke*

> The beautiful thing about beauty is that it works in multiples.
>
> *Rachel Armstrong*

Let us distinguish between explanation as protective shield, and explanation as affirmation. The sciences tend to treat explanation in the first category (supplemented by the club of evidence and the sword of legitimisation) whereas literature prefers the second category – clarification or calculated obfustication, illumination or dead ends – in short, of intensifying the magnetic force field of a story's spell over its reader.

It's not something seen, therefore, although it may flash before your eyes. It may surround you daily, but likely you overlook it. It is inside and outside, intensifying, creating infusions of life. Bring together bat, beak, eye and wing, squirrel prayer, fruit and ears, hooves red with rabbit blood, and russet buttocks (concealed lest we overflow our boundaries), and your world will be jumping but still you might not experience it.

Beauty.

For this, you need to open yourself.

You need open yourself to *horizontal transfer*.

*

This presentation seeks to ask what might be involved in creating an experimental laboratory space for the third millennium, one designed for the challenges of hyper-complexity. Against approaches based on technological determinism, I advocate those based on *black sky thinking*[1] in the belief that a design task at this scale will require participants to conjure up unforeseen possibilities of fortitude from a fertile, cosmological sandpit. Against equilibrium and entropy, I will propose disequilibrium – not to produce chaos or its inverse – God-like designers – but rather ethical, philosophical and design principles such as *poise*, *trust* and the re-centring that occurs through shared acts of fertility, fortitude, and flourishing – i.e. forms of radical love. For if the crew on an interstellar space craft are to survive their journey of generations, the ties that bond must be strong, endurable, and infinitely creative. The boundaries of categories (self, other, organic, artificial, species, technology living, technology) are each open to renegotiation on the Persephone project. This contribution is a first, tentative attempt to tease out some of the implications of this.

1 The concept of black sky thinking is articulated by Rachel Armstrong here: http://www.blackskythinking.org

The presentation accordingly considers the ambition to design a "space ark" capable of interstellar space travel as an evolving case study by which we examine what practices of experimentation might contribute to the realisation of such a vision. It sets aside questions of disciplinary affiliation and hierarchy – top down command logics – in favour of magic, poetic modes of 'knowing', and the contribution of the circus arts. The intention here is to liberate those involved in the ongoing space ark design conversations from not only existing materials and methods, but also conventions in regards embodiment, emotion, experience, reflection – this in turn to invite a transformation of imaginative possibilities.

How, then, to explore the intricate entanglements between the technical, biological, ethical, political and theological aspects of such a project? Are our existing belief systems and systems of value, designed and refined over centuries as they are for terrestrial life, up to the task? Are conclusions arrived at under the relatively stable conditions of equilibrium applicable in contexts of turmoil and disequilibrium? "It is essential," Rachel Armstrong writes, "to deconstruct our existence and build up our identity again as a species that is bound by a common mission and cosmic purpose. This is a challenge with no single solution. It is awe-inspiring, difficult and strangely tautological as each set of decisions about who we are provides the basis for the next set of actions as to who we may become." [2] This double demand – deconstructing and reconstituting our species identity – suggest a dynamic between *ontological* unravelling and ecological *knitting*. Knitting hints at an alternative form of computation, anticipating the weaving industry, the Jacquard punch card, and Ada Lovelace's notion of computer program, where fabric is not produced but where the computational endeavour exceeds representation in number, becoming instead music, art, and choreography. Knitting brings us back to the idea of computationally producing the environment we inhabit – where the forces of natural selection are no longer random but pre-programmed into the design fabric of the space, from which they may be transformed through myriad encounters with their inhabitants. Knitting also gestures towards the convergences between unlike things like bodies, spaces, objects, technologies through iterations (informational, physical, linguistic) to experimentally investigate limits and transgress them. Not as the vague Enlightenment notion of polite, benevolent progress, but as a series of disruptive collisions, leading to meltings of boundaries, meetings of monsters, sudden starts, stops and disjunctive accidents, before something carries across, grips and grafts; starting to synthesise, it demonstrates its pervasiveness, and begins iteratively to (re)(in)form events.

*

They are slammed together as the ship tumbles and heaves;
With her hands she feels the contours of his face
His fur draws forth the light; their fingers, they lace.

*

Contemporary circus arts provide us with interfaces of wonder and enchantment, reminding us with dizzying exhilaration that possibilities are not finite, that amazing outcomes – against all odds – can be achieved. Prototyping ethical, social, political as well as physical alternatives, international, interdisciplinary, and nomadic, it brings together a potent meeting of differences that explodes into knots of dynamic objects and their relations. In these moments when all elements are held in suspension, and gravity has once more been defied, magic occurs. We can view contemporary circus arts as a laboratory for prototyping interactions between objects, agents and environments. To do so is to seek to align its magic to transdisciplinary research fields, while enhancing rather than reducing the magic en route.

2 Unpublished draft chapter shared with the author.

> We should not, perhaps, underestimate our wish to lose our balance, even though it's often easier to get up than to fall over. Indeed, the sign that something does matter to us is that we lose our steadiness.
>
> *Adam Phillips,* ***On Balance***

Each circus discipline – tight/slack wire, acrobatics, aerial acrobatics, pair acrobatics, juggling, clown, teeter board – involves the manipulation of border objects, objects whose primary function is to test human limits of timing, co-ordination, dexterity, concentration, audience interaction, gravity, velocity, flight, variation, landing. The circus "trick" takes place in and through gravity; weightlessness is the fleeting domain in which circus happens. As the circus artist and researcher Jonathan Priest has argued, the trick does not enable you to leave gravity, but it does point to other positions outside it.[3] A ball at the top of its arc, Priest argues, does not technically have weight, whereas the arm that threw it remains implicated in the system of gravity. For aerialists, rope artists such as Priest, pair acrobats such as Henrik Agger and Louise von Euler Bjurholm, circus provides a means of behaving as if one is temporarily outside gravity.

In unravelling our understanding of the human that has evolved from centuries of art, culture and the humanities, we can make use of arts such as contemporary circus and magic to test human limits and prototype alternatives. Circus arts involve the constant negotiation of gravity, velocity, balance, collaboration, trust, and what we might term *the density of presence.* It is the pre-eminent art form for knitting entanglements between equilibrium and disequilibrium. It can help us prototype the challenges that lie ahead in creating a semi-closed, self-sufficient, perpetually nomadic ecosystem – what else, after all, is a touring circus troupe? Similarly, magic with its channelling of human will, concentration, energy, and visualisation, can help us approach such a design challenge with an extended palette of resources.[4] Magic combines language, observation, emotion and experience to change our perception of the world. It has an ethical dimension in the magician's paradoxical honesty in declaring the use of deception. It is a form of conjuring that demands attention to detail, practice, repetition, and immersion in the world of nature. Thus if nature is conventionally associated with rational processes – Darwin's determinism – then an infusion of magic brings forth nature's repressed characteristics, its illogicalities, contradictions, and (supposed 'aberrations'). We learn in the process that the materials we work with are more unpredictable than the sciences have told us, which suggests in turn that their capacities for transformation remain largely untapped.

The circus thus becomes a microscopic universe in which the laboratory determines every moment through experiment and prototypes rather than top down commands. Dimensioned, historically, by the turning circle of a horse, contemporary circus in the main banishes animals from its enchanted circle and therefore becomes defined by that which it is not, that which is excluded.[5] Circus permits us to reframe the questions of the humanities – what is it to be human? what is a good life? – in (literally and metaphorically) 'another space'. Circus, with its etymological origins in 'circle'[6] also implies a

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3 Jonathan Priest, "the following circus is false, the preceding circus is true" Jonathan Priests 30 % seminar, Stockholm University of the Arts, 6 May 2015. http://www.uniarts.se/forskning/seminarier-och-konferenser2/jonathan-priest-30-seminar

4 See, for example, Mike Fuller "The Logic of Magic" in *Philosophy Now* August/September 2015. Available online: https://philosophynow.org/issues/5/The_Logic_of_Magic (Accessed 16 August 2015)

5 The point was made by Jonathan Priest at the above seminar and is explored at greater length in his virtuoso performance lecture "Knot Circus" available online: https://vimeo.com/64292705

6 The Online Etymological Dictionary provides the following entry for "circus": "late 14c., in reference to ancient Rome, from Latin *circus* "ring, circular line," which was applied by Romans to circular arenas for performances and contests and oval courses for racing (especially the *Circus Maximus*), from or cognate with Greek *kirkos* "a circle, a ring," from PIE **kirk* – from root *(s)ker – (3) "to turn, bend" (see *ring* (n.)). In reference to modern large arenas for performances from 1791; sense then extended to the performing company, hence "traveling show" (originally *traveling circus*, 1838). Extended in World War I to squadrons of military aircraft. Meaning "lively uproar, chaotic hubbub" is from 1869. Sense in *Picadilly Circus* and other place names is from early 18c. sense "buildings arranged in a ring," also "circular road." The adjective form is *circensian*. Source:http://www.etymonline.com/index.php?allowedinframe=0&search=circus&searchmode=none (accessed 1 May 2015).

utopian site of experimentation, where an unbroken set of relationships between things can be set in motion. As “Knitting Peace”, the recent touring production by the leading Swedish company Cirkus Cirkör, made explicit, circus is also a complex generator of principles of unravelling and knitting, simultaneously unravelling meaning, knitting it anew, pursuing the impossible as an artistic principle. [7] Circus organises systematised and purposeful activity within a universe not infrequently experienced as purposeless and meaningless.

Magic applies the tools of camouflage, distraction, misdirection to model strategies of deception, and can thereby sensitise us to the varieties of deception we might encounter outside the context of a magic performance. Using a form of visual education, the magician displays a trick openly, and thereby demonstrates, as Ian Saville notes in “I Can See your Ideology Moving”, that “we’re dealing with known unknowns, rather than unknown unknowns […] by displaying the trick honestly, the audience’s consciousness of the changeability of the world is reinforced.” [8]

*

Contact

I grip this ladder for you.
You could as well grip it for me
But this is how it is, this time.
You run up, launch, kick – and fly;
Reach out for support in mid-air;
Fall. Slow falling in outer space.

It’s like a feather rotating on the breeze.

Again. I hold it for you.
Come. Try again. Trust me.
Up you run – launch, point and fly.
And fall. Gracefully.

But, dear friend, it was a better fall!
Don’t you think so?

Listen, this falling probably isn’t a problem.
The world was full of falling.
Falling is what we do.
It’s what we want.
Even animals are falling all around us.
Falling is the graceful acceptance of time.
The fleeting choreography of the living
Against the insistent gravity of the divine.

I am holding the ladder –
Or the ladder is holding me.
Or perhaps the earth (and its relations) still holds us all;
Each experiment, each connection between this and that;
You and me; the one that holds, the one that climbs,
The atmosphere that receives, resists, revives;
The context in which any of this makes sense (or fails to);
The gods that turn and hang their heavy heads
If we try to explain some, or all, of what happens
When we lift up – and momentarily away – from the freezing iron rungs.

*

7 ”Knitting Peace” by Cirkus Cirkör, directed by Tilde Björfors, has toured the world since January 2013, deliberately posing a seemingly impossible question to its global audiences – namely, can we, collectively, ”knit peace”?

8 Cited by Jonathan Allen in ”Magic”

Let us imagine a future not predicated on the present's unfolding according to an evolutionary pace, but a catastrophic future, spawned by discontinuity and disjunction, where inequalities in the existing landscapes of possibility are knitted into cartographies that hint at other points of rupture, disruption, and thus departure.[9] In this, circus may accurately be described as an art of catastrophe, an art in which expectations are continually undermined – the forces of disequilibrium keep triumphing – and forces of artistry, fortitude and collaboration are required to bring order back into the chaos. Objects and agencies are knitted together outside established systems of validation. Circus becomes the site where impossible feats are made possible through extraordinary human discipline, dedication, and vision.[10] Risks are calculated and rehearsed, which means that the circus performer is part of the computational landscape, part of the system orchestrating and influencing events. Similarly, the first settlers in space will be neither gods of their own design nor at the mercy of chaos but continually shaping and choreographing their living conditions. Human values and belief systems are devised over millennia to support life on earth, yet may likely prove to be obsolete on an interstellar journey to an uncertain future. Circus' attraction to play, testing and prototyping equips it, in this post-humanities setting, not only as a guarantor of human health and imaginative agility, but as a central prototyping element in the transdisciplinary research underpinning space ark design.

*

> … And yet it is physically impossible that a thing of water can converse with a thing of air unless we two be like a bubble, as the Greeks say, and all the world a storm, with the froth rising up, and the rain falling, falling through air, God's tears congealing, slime in an empty cellar, and the dew being neither here, nor there, but sinking, settling, evaporating daily – our parents likewise dispersed in a spray of water – born becoming unborn, others bobbing awhile on the surface before sinking down, giving their place to others, and others still, and these thrashing continuously, crushed, repulsed, or flattened on the seabed, this change being one of mere degrees, for a nothing can scarcely be a something before it ends.
>
> Unless it has the capacity for love.
>
> In that case it possesses volition, which means ("operational definition") we can deal with it. And we shall.

*

Circus is potentially one such hybrid approach relevant to a worldship community, integrating perspectives and operating between, across, and beyond its integral disciplines (or establishing 'secret bridges' between knowledge, experience, and operations in the ongoing cultivation of the worldship ecosystem).

Enlisting the skills and insights of circus artists in support of such a project may inspire on a number of levels – practical as well as conceptual – as an example of "the art of the impossible" as well as a response to what Slavoz Zizek has described as the "forgotten fourth category" of knowledge compartmentalization i.e. the "unknown knowns" (defined as "a type of knowledge forbidden, exclusively,

9 Catastrophe is defined etymologically as "1530s, "reversal of what is expected" (especially a fatal turning point in a drama), from Latin *catastropha*, from Greek *katastrophe* "an overturning; a sudden end," from *katastrephein* "to overturn, turn down, trample on; to come to an end," from *kata* "down" (see *cata-*) + *strephein* "turn" (see strophe). Extension to "sudden disaster" is first recorded 1748.

10 "We knew the hard training behind a flight in the trapeze giving the illusion of weightless ease. We were not afraid to take on work or take risks. If we were afraid of anything it was to let limitations be in control of our dreams." Tilde Björfors, *Inuti ett Cirkus Hjärta/Inside A Circus Heart: Cirkus Cirkör* (Norsberg, 2009), p.39.

from knowing itself")[11]. Circus arts research is an optimum laboratory for exploring both "unknown knowns" and *the art of the impossible*.

If it is a map we are working towards, it will likely span concepts, epidemics (the dissemination of influence), care, attention, and even a form of radical love yet to be outlined (for which the skills of the poet, as much as those of the philosopher, will be required) – a continuum in the *varieties of engagement* between serpentine thinking, non-knowledge, ignorance.

Clown-like, we cultivate *cluelessness* and hope to stumble across something in what we grandly call our *research*. We have a ladder, with its vertical logics of ascent and descent, but resting on nothing, it leads nowhere, repeatedly.

Yet in helping each other to ascend and descend, we create a shared relation.

And this is not nothing.

*

11 "It is commonly said that there exist three distinct subtypes of compartmentalization which aptly divide our awareness of the external world. First, there are the "known knowns", things we know that we know. "known unknowns" and "unknown unknowns" follow suit in a similar fashion. Then, what of the forgotten fourth category, that of unknown knowns? (a type of knowledge forbidden, exclusively, from knowing itself). It is this category that to me represents the Freudian unconscious, the embodiment of the disavowed beliefs and suppositions that we are not even aware of adhering to ourselves, but which nonetheless determine our acts and feelings."
Slavoz Zizek, Facebook post 23 February 2015.

Falling: For Ever

by Rachel Armstrong

There was never a beginning.

Only an impossible knot of spacetime.

The origins of this unfathomable matrix are unknowable.

Perhaps it was produced by a cosmic orchestra that entwined the absolute darkness of matter, fundamental forces and strange kinds of energy, which the mind's eye cannot rationalise – but are inferred in scientific experiment and the absences of our perceived present.

We call the incompleteness that underpins our misunderstanding of reality, the One.

To conclude the nature of the One is to know the mind of god.

Whence did this notion of One-ness come from, for it is the most extraordinary of things?

We could call the One a fiction, a rouse and a lie, for it is a product of our own invention. Within it, ignorance has been tidied away in stories that act as a kind of cosmic housekeeping – an ordering concept that gathers up our thoughts and our messy relationships with the material realm and transforms them into communicable but diverse narratives with multiple conflicting properties.

Yet, the One is no fiction – but a lived experiment and little more than a tool through which fears may be allayed. Rather than standing startled in the spotlights of our own ignorance, meddlesome edge monkeys and insecurities, it allows us to take short cuts in thinking. In doing so, the One raises questions that provoke an endless series of debates, which reach no dénouement.

Like the source of a spacetime river that appeared as a physical rupture within a continuum of nothingness, the One is entangled within a greater cosmic reality that we do not have the capacity to fully observe. Its evidencing is tricky as it may be composed of invisible fabrics that are entwined in an extra dimensional continuum of detectable particle condensations. These might fall like rain through the semi permeable plateaus of our perceptible realm and join as tributaries in the ceaseless ebb and flow of existence, from which all things apparently spring.

Indeed, the One invites many narratives.

All of them speak on some level to a shared belief system – for no matter how imperfect or well documented our stories and explanations may seem – we have a way of creatively interpolating uncertainty to erase conceptual inconsistencies.

One approach to deal with the unknown is to simplify reality and reduce the One to a singularity that can be fully represented as a numeric vertical mark. In this form it unites a host of highly diverse agents, incalculable ephemeral essences, material expressions and expanses of spacetime that permeate all things through an Implicate Order of connectedness.

At other times we acknowledge its physical substance being hyper complex. The One is composed of many fundamental forces that bestow it with specific qualities such as curvature, mass and gravity, like the shell of an egg, the bow of a planet, and the cluster of bodies within a solar system. In this manifestation it becomes a fabric through which all other things have emanated and are enumerated. Yet it is also fundamentally mutable and exudes an ever-expanding set of cosmic relationships that, depending on their character and context, transform and diversify into something else – nebula, protostar, brown dwarf, red dwarf, yellow dwarf, red giant, white dwarf, black hole – as diverse as life itself.

This embodied One is quite different from symbolic eternity and can attain its original meaning when the universe crunches back into totalizing coherence.

Once the atomic view of reality is smashed, science reveals the nature of the Many, which requires great technological instruments that extend the capacities of our senses, so that we may appreciate them.

What has been ascertained is that some of the matter that embodies these expressions is so strange and fragile that it no longer exists in nature. It is entirely possible there are aspects of our universe that we simply do not know of yet. Fragments of the primordial expressions of our universe may be indirectly witnessed in the observation stations of the Large Hadron Collider; the world's largest Swiss watch. This instrument lurks a hundred metres under the earth in a continuous twenty-seven kilometre twist. Its speed of light particle racing track joins France and Switzerland to provide an extraordinary space that provokes collisions between atomic nuclei that scream their true name at digital detectors the moment they shatter.

Of course, we will never witness its metamorphosis. Only by reading constellations of events and fabricating giant instruments that simulate our hypotheses can we begin to appreciate our inherent transience and diminutive scale in comparison with the profound vastness and unfathomability of the One.

By constructing theoretical models supported by observations made in particle accelerators, high-energy states, and astronomical studies that have observed the deep universe, scientists have proposed a timeline of events that shape contemporary ideas about cosmic evolution that began with the Big Bang around 13.8 billion years ago.

Shortly after the Big Bang, at around 10^{43} to 10^{11} seconds – our physical laws as we know them, did not yet exist. We also lack the technology that might help us create the kinds of energies involved during these moments and is therefore impossible to say how our present reality came into being with any certainty.

Between 10^{43} and 10^{36} seconds after the Big Bang, transition temperatures were reached that produced the universe's fundamental forces and enabled them to separate at around 10^{36} to 10^{32} seconds. At this point, the cosmos was homogenously packed with energy could start to inflate exponentially. It is also presumed that at 10^{37} seconds baryogenesis occurred – a hypothetical event where temperatures were so high that the random motions of particles occurred at relativistic speeds and led to the formation of fundamental particles, with a predominance of matter over antimatter.

Currently, the universe is thought of as being produced by four distributed and incompletely characterised fundamental forces. These subatomic horsemen of the apocalypse are – **strong forces** that hold the nuclei of atoms together like, gluons and π (nucleons) – **electromagnetic forces** that manifest as the 'charge' of particles. They are manifestations of an exchange force that spins and trades in massless photons, or quanta of light – **weak forces** that deal in a variety of flavours of quarks and are crucial to the structure of the universe in that: the sun would not burn without them and they are also essential for the build up of heavy nuclei. Perhaps the strangest of these horsemen is **gravity**. Theoretically, gravitons carry the magic of gravity. They are massless like light, carry energy and weirdly, can create more of themselves. Yet we've never found them. In truth, gravity isn't supposed to be a force that can be carried by a particle, but an implied warp in geometric spacetime that may require the involvement of some unidentified physical property. While they are massless, they are also incredibly weak. Bizarrely, gravitons do not crush us, yet are strong enough to hold us to the surface of this planet and certainly powerful enough to resist our escape. It is also extremely elusive because its effects on bodies are extremely weak. Yet, nobody truly knows why this is so. A whole planet's worth

of interactions are needed before any real effects are observed. These attractions can be resisted by relatively trivial forces, like the reflex movements of the body to save itself on falling. So, while gravity is weak we can pick and choose the bodies that we associate with.

It is thought that rather like layers of a crystal like slate, where fossilized mud can be easily fractured in one direction, but bind tightly in another, could explain how gravity attains its paradoxical hold on the falling bodies within this universe. This idea that reality is organized into planes of reality – or branes – is based on the idea that all matter was packed into an incredibly tiny space around the time of the Big Bang, maybe as minuscule as the apocryphal head of a pin on which angels were once said to rest. Branes cannot be seen as they are floating in a vast universe that we can't perceive as the photons that let us see light, are crawling along our brane with us. To pack three dimensions of space and one of time into such a restricted volume requires an incredible degree of order. Branes may have originally been so condensed they were entangled but with the rapid expansion of the universe after the Big Bang they were quickly separated and formed organised, stable structures associated with the production of gravity waves.

As temperatures dropped to 1 billion kelvin a few minutes into the expansion of the universe, Nucleosynthesis began. Neutrons and protons combined to form the universe's first chemistry. This was mostly deuterium, a stable isotope of hydrogen, and helium. Within 379,000 years electrons combined with these nuclei to form hydrogen atoms, while radiation decoupled from matter and expanded out into space in all directions, forming the Cosmic Microwave Background (CMB) – the oldest light in the universe.

Over the next few billion years the modern universe began to form as gravity started to influence the properties of matter. Bodies started to fall towards each other, growing denser, forming gas clouds, stars, planets, galaxies, galaxy clusters, and super clusters – that are separated by enormous gulfs.

Such formations are dependent on highly local interactions between cold dark matter, warm dark matter, hot dark matter, and baryonic matter. The model that best fits current data supports the idea of a universe that is formed of cold dark matter. This makes up around 23 % of the matter/energy of the universe, while baryonic matter makes up about 4.6 % and is associated with Dark Energy, which enables the universe keep on expanding while its epic structure remains mostly constant.

Despite the comfort offered by the idea of a single answer, the One appears to rest upon the foundations of multiplicity, hypercomplexity and ongoingness. Indeed, the discovery that One is also Many, may help placate our anxieties, loneliness and uncertainty about our nature, origins and purpose.

Perhaps the idea of a singular 'beginning' may never have been an instantaneous moment on a single existence plane, or existed as a condensed specule of spacetime from which all things originated. Perhaps the One has always existed as a cyclically stretched and twisted eternal fabric that operates through many scales and over unimaginably vast dimensions.

However we may imagine reality, we find ourselves falling away from our origins as our universe inflates. In doing so, we are drawn to one another through the mysterious forces of gravity that travel along invisible branes with us, in an incompletely observed cosmos, seeking communion with others so that we may fall along with them.

In this falling we imagine our own end.

Will we fall inwards until all matter crunches back into a tiny ball or will it ultimately be torn apart by its ever-increasing expansion?

Yet it is not our instruments, our theories or technologies, but each other that allay these concerns. Only the gods draw totalizing conclusions. Even the empirical measurements we are so fond of taking become a kind of relativistic storytelling that attempt to assuage our existential angst. As bodies drawn by the improbably strong and weak threads of gravity we are mutual attractors, gregarious by nature and adventurous to a fault. We search for those who fall like us to find community and a sense of ongoingness. Throughout the eons, we have swelled in number to realize aspects of our

connections with and differences from matter, solar systems and galaxies. When confronted with the vast emptiness of spacetime and its unfathomable darkness we can offer each other companionship, reassurance and radical love.

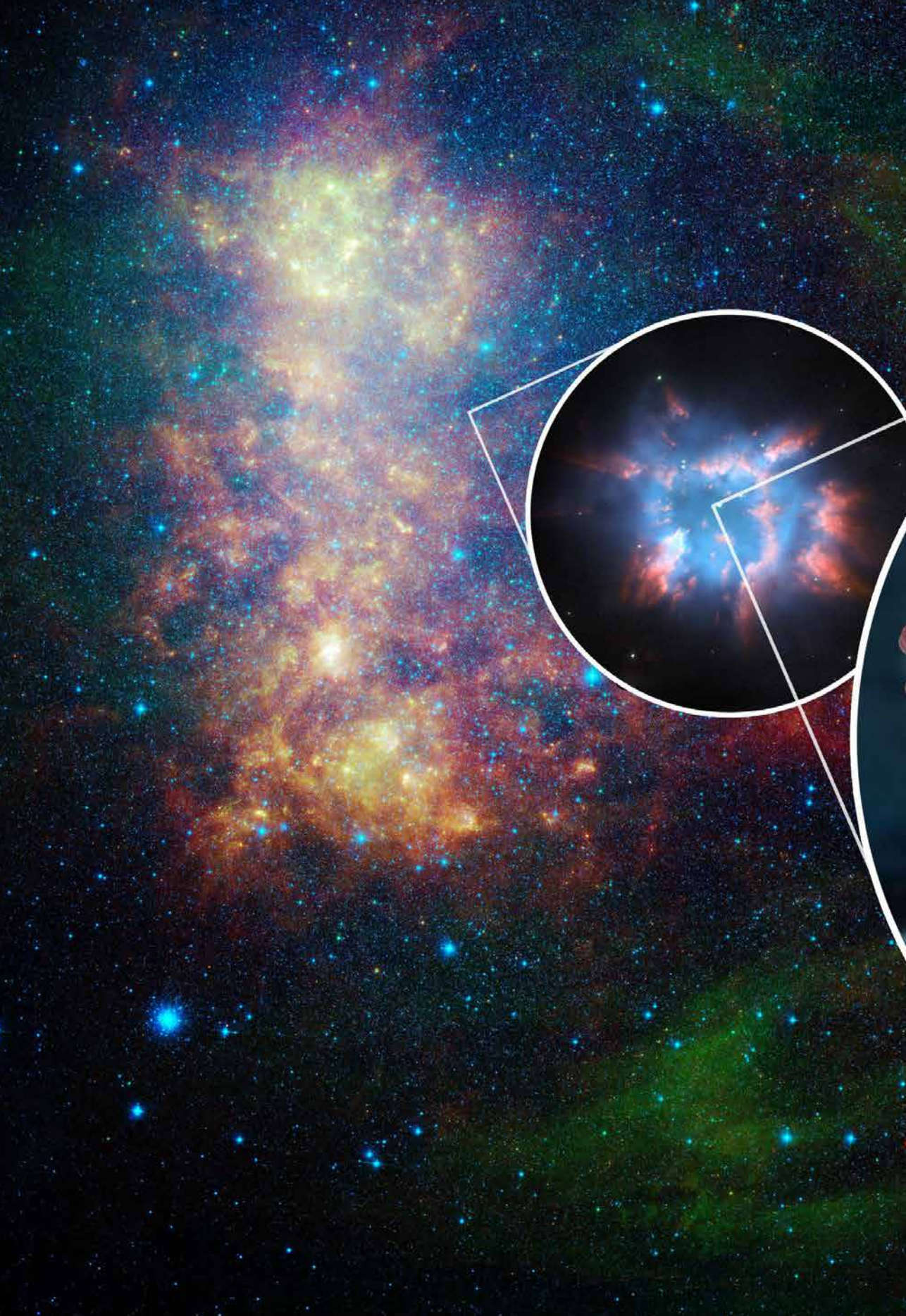
Come, hold me.

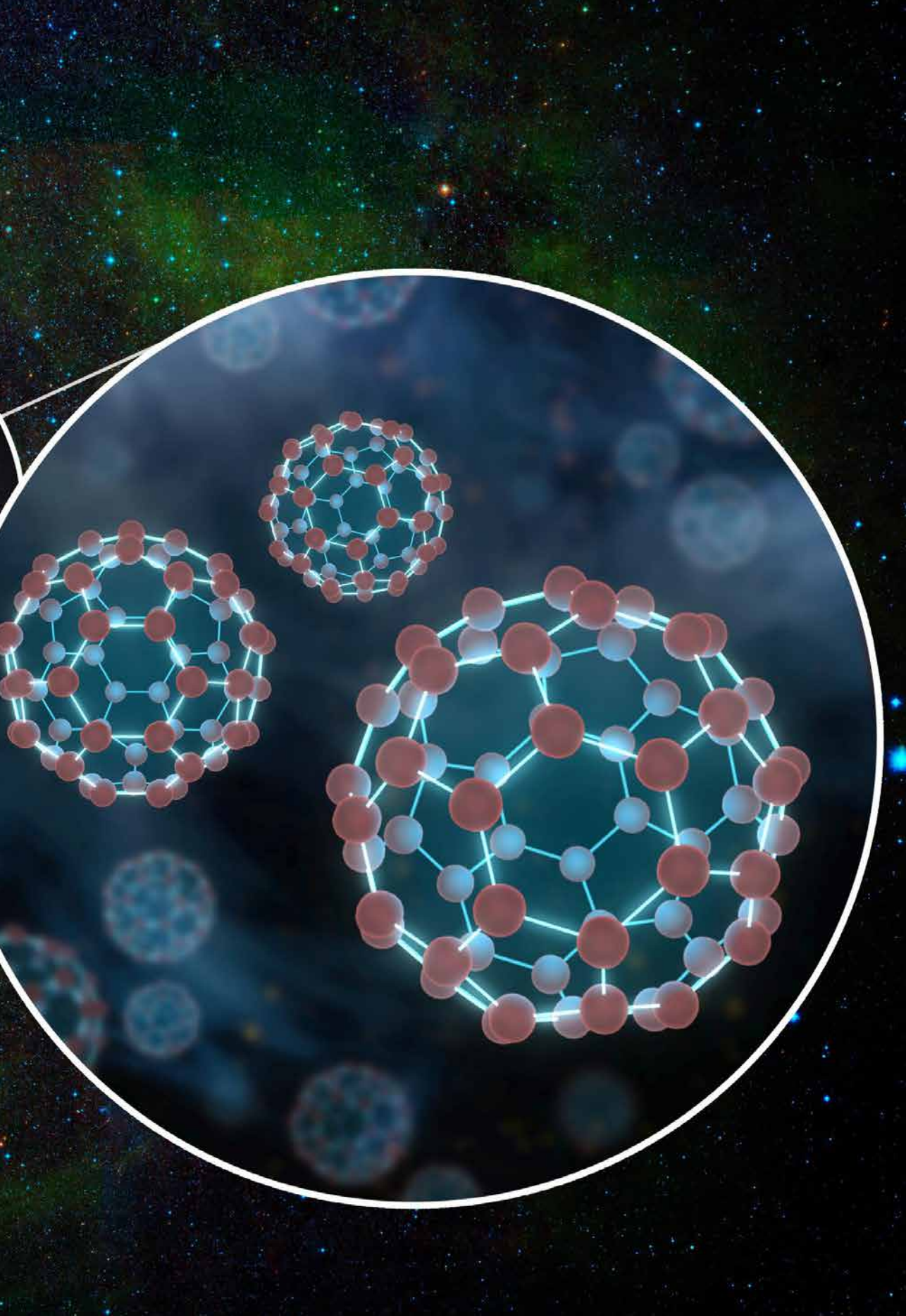
We will fall together.

OVERLEAF

Frederik de Wilde: Artwork of Bucky Ball

The elemental backbone of organic life is carbon, which can exist as a strange football-like configuration made of 60 carbon atoms. Gaseous forms have been detected in pitilessly dark interstellar bands that absorb all known forms of light.





Falling: Oort

by Rachel Armstrong

The Oort Cloud is washed up at the outermost limits of the solar system at around 2,000 AU from our Sun. This beach of cometary nuclei sprawls out into interstellar space to almost a quarter of the way in reaching the nearest star, Proxima Centauri. It is composed of around 2 trillion objects, which contain ices composed of ammonia, methane and water, which originate from the birth of the solar system.

This cosmic rubble was once a protoplanetary disc located much closer to our young Sun. Yet, as the gas giant Jupiter coalesced, its gravitational ripples banished these icy objects from interplanetary space where they gradually encased the soft vacuum of our solar system within its extended spherical shell.

Today's Oort Cloud is a trembling, particulate membrane that can be disrupted by cosmic events. The passage of a star, birth of nebula, or ripples in the galactic tide may dislodge Oort bodies that plummet like stones towards the gravitational pull of the Sun, where they may finally combust in its fiery orbit. As they dive, their primordial matter sizzles across vacuums and wanes in the friction of atmospheres. Sometimes, their ancient icy nuclei skip over planetary orbits and scour skies with briliant comas, trails and plumes.

We call these falling bodies, 'comets'.

Uniquely, they fall alone.

Yet, comets do not seek solitude. They search for unlike celestial bodies that may cultivate their precious load – the cosmic seeds of life.

It is unknown exactly from where their panspermic gifts originate.

Some say that the potent chemistry arose from the debris of our own solar system, while others believe that these substances came from other star constellations. What we do know is that comets are organically fertile. They are coated within thin, primitive soils that carry water as well as other ingredients that are associated with life on Earth such as, amino acids, alcohols and volatile gases.

Indeed, during the earliest moments of our own planet's history in the Hadean Epoch, comets and their debris pulverized its surface. Cometary water formed our oceans and may indeed have primed its surface for the mixing of carbon molecules in various combinations of organic matter. The kamikaze collisions of cometary bombardment have written the history of our planet.

In their relentless bombardment of planetary hosts, as the life of each comet comes to an end it screams the same cosmic prayer that can be heard in the echoes of the background radiation of the universe.

"I bring you life."

Catching 3

by Rolf Hughes

Space flows
Ditch in deserted time
Dark velvet glove
Wormholes.

What they don't tell you.
The yellow, for example.
Resonant murmurations of yellow.

It turns space into its own shadow.
The silent volume in an empty cello case.

All I have to record
Worn and used
Leftovers at a charity auction
Tomorrow's forlorn science exhibition
By the time you catch my drift.

*

OVERLEAF
Rachel Armstrong: Light Scribble I

New Horizons

SIMPLE = T / file does conform to FITS standard BITPIX = -32 / number of bits per data pixel NAXIS = 3 / number of data axes NAXIS1 = 200 / length of data axis 1 NAXIS2 = 200 / length of data axis 2 NAXIS3 = 4 / length of data axis 3 EXTEND = T / FITS dataset may contain extensions COMMENT FITS (Flexible Image Transport System) format is defined in 'AstronomyCOMMENT and Astrophysics', volume 376, page 359; bibcode: 2001A&A...376..359H BSCALE = 1.0E0 / REAL = TAPE*BSCALE + BZERO BZERO = 0.0E0 / OPSIZE = 2112 / PSIZE of original image ORIGIN = 'STScI-STSDAS' / Fitsio version 21-Feb-1996 FITSDATE= '2004-01-09' / Date FITS file was created FILENAME= 'u5780205r_cvt.c0h' / Original filename ALLG-MAX= 3.777701E3 / Data max in all groups ALLG-MIN= -7.319537E1 / Data min in all groups ODATTYPE= 'FLOATING' / Original datatype: Single precision real SDASMGNU= 4 / Number of groups in original image CRVAL1 = 182.6311886308 CRVAL2 = 39.39633673411 CRPIX1 = 420. CRPIX2 = 424.5 CD1_1 = -1.067040E-6 CD1_2 = -1.259580E-5 CD2_1 = -1.260160E-5 CD2_2 = 1.066550E-6 DATAMIN = -7.319537E1 / DATA MIN DATAMAX = 3.777701E3 / DATA MAX MIR_REVR= T ORIENTAT= -85.16 FILLCNT = 0 ERRCNT = 0 FPKTTIME= 51229.798574 LPKTTIME= 51229.798742 CTYPE1 = 'RA---TAN' CTYPE2 = 'DEC--TAN' DETECTOR= 1 DEZERO = 316.6452 BIASEVEN= 316.6715 BIASODD = 316.6189 GOODMIN = -5.064006 GOODMAX = 2552.17 DATAMEAN= 0.4182382 GPIXELS = 632387 SOFTERRS= 0 CALIBDEF= 1466 STATICD = 0 ATODSAT = 16 DATALOST= 0 BADPIXEL= 0 OVERLAP = 0 PHOTMODE= 'WFPC2,1,A2D7,LRF#4877.0,,CAL' PHOTFLAM= 3.447460E-16 PHOTZPT = -21.1 PHOTPLAM= 4884.258 PHOTBW = 20.20996 MEDIAN = -0.175651 MEDSHADO= -0.121681 HISTWIDE= 1.033711 SKEWNESS= -1.983727 MEANC10 = 0.12958 MEANC25 = 0.3129676 MEANC50 = 0.4577668 MEANC100= 0.3916293 MEANC200= 0.3115222 MEANC300= 0.3295493 BACKGRND= -0.3676353 ORIGIN = 'NOAO-IRAF FITS Image Kernel December 2001' / FITS file originator DATE = '2004-01-09T03:26:36' IRAF-TLM= '03:26:36 (09/01/2004)' FILETYPE= 'SCI ' / type of data found in data file TELESCOP= 'HST' / telescope used to acquire data INSTRUME= 'WFPC2 ' / identifier for instrument used to acquire data EQUINOX = 2000.0 / equinox of celestial coord. system / WFPC-II DATA DESCRIPTOR KEYWORDS ROOTNAME= 'u5780205r' / rootname of the observation set PROCTIME= 5.301314019676E+04 / Pipeline processing time (MJD) OPUS_VER= 'OPUS 14.5a ' / OPUS software system version number CAL_VER = ' ' / CALWP2 code version / SCIENCE INSTRUMENT CONFIGURATION MODE = 'FULL' / instr. mode: FULL (full res.), AREA (area int.)SERIALS = 'OFF' / serial

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histograms: PERFORM, OMIT, COMPLETE OUTDTYPE= ‘REAL ‘ / Output image datatype: REAL, L
MASKFILE= ‘uref$f8213081u.r0h ‘ / name of the input DQF of known bad pixels ATODFILE= ‘uref$dbu1405iu.r1h
register daBLEVDFIL= ‘ucal$u5780205r.q1h ‘ / Engineering file DQF BIASFILE= ‘uref$j9a1612mu.r2h’
DQF DARKFILE= ‘uref$j2g1549cu.r3h’ / name of the dark reference file DARKDFIL= ‘uref$j2g1549cu.b3h
FLATDFIL= ‘uref$f4i1559cu.b4h’ / name of the flat field reference DQF SHADFILE= ‘uref$e371355eu.r5h’ /
table GRAPHTAB= ‘mtab$n9i1408hm_tmg.fits’ / the HST graph table COMPTAB = ‘mtab$nc809508m_
KEYWORDS SET BY STSCI SATURATE=
UZERO = 0.0 / Zero point for output image
READTIME= 464 / Length of time for CCD readout in clock ticks
PA_V3 = 49.936909 / position angle of V3-axis of HST (deg) RA_SUN = 3.337194516616E+02
EQNX_SUN= 2000.0 / equinox of the sun MTFLAG = F / moving target flag
0.000000 / flattening of target NPDECTRG= 0.000000 / north pole declination of target (deg
rotation rate of target LONGPMER= 0.000000 / longitude of prime meridian (deg) EPL
feature latitude (deg) SURFLONG= 0.000000 / surface feature longitude (deg) SURFALTD=
PODPS FILL VALUES PODPSFF =
STDCFFP = ‘0x5569’ / st dcf fill pattern (hex) RSDPFILL= -100 / bad data fill value for
INFORMATION UEXPODUR= 300
DARKTIME= 3.000000000000E+02 / Dark time (seconds) UEXPOTIM= 16880 / Majo
ddd:hh:mm:ss) PSTPTIME= ‘1999.051:19:16:37 ‘ / predicted obs. stop time (yyyy.ddd:hh:mm
SUNANGLE= 141.618347 / angle between sun and V1 axis MOONANGL= 126.698997 / a
FGSLOCK = ‘FINE ‘ / commanded FGS lock (FINE,COARSE,GYROS,UNKNOWN)
‘19:03:13’ / UT time of start of observation (hh:mm:ss) EXPSTART= 5.122979390428E+04 / exposure s
EXPTIME = 3.000000000000E+02 / exposure duration (seconds)--calculated EXPFLAG = ‘NORMAL ‘
PROPOSAL ID TARGNAME= ‘NGC4151 ‘ / proposer’s target name RA
declination of the target (deg) (J2000) ECL_LONG= 164.096619 / ecliptic longitude of the target (deg) (J
galactic longitude of the target (deg) (J2000) GAL_LAT = 75.062679 / galactic latitude of the target (deg)
PEP_EXPO= ‘02-030 ‘ / PEP exposure identifier including sequence LINENUM = ‘02.030 ‘ / PEP prop
‘ / PEP define/use sequence name HISTORY MASKFILE=uref$f8213081u.r0h MASKCORR=CO
DESCRIP=STATIC MASK - INCLUDES CHARGE TRANSFER TRAPS HISTORY BIASFILE=uref$j9
HISTORY DESCRIP=not significantly different from j6e16008u. HISTORY DARKFILE=uref$j2g154
HISTORY DESCRIP=Pipeline dark: 120 frame superdark with hotpixels from HISTORY 16/02/99
PEDIGREE=DUMMY 18/04/1995 HISTORY DESCRIP=All pixels set to value of 1. Not
throughput tables were used: HISTORY crotacomp$hst_ota_007_syn.fits, crwfpc2comp$wf
crwfpc2comp$wfpc2_dqepc1_005_syn.fits, HISTORY crwfpc2comp$wfpc2_a2d7pc1_004_sy
following throughput tables were used: HISTORY crotacomp$hst_ota_007_syn.fits, crwfpc2com
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YP= ‘EXT ‘ / DARK/BIAS/IFLAT/UFLAT/VFLAT/KSPOT/EXT/ECAL CDBSFILE= ‘NO ‘ / GENERIC/
/ FILTER CONFIGURATION
FILTER1 = 69 / first filter number (0-48) FILTER2 = 0 / second filter
4877.000000 / linear ramp filter wavelength /
UCH1CJTM= -88.2569 / TEC cold junction #1 temperature (Celsius) UCH2CJTM= -88.6697 / TEC
UCH4CJTM= -88.7671 / TEC cold junction #4 temperature (Celsius) UBAY3TMP= 13.2302 / bay
ER = ‘A’ / Shutter in place at beginning of the exposure ATODGAIN= 7.0 / Analog to Digital Gain
MASKCORR= ‘COMPLETE’ / Do mask
MIT, COMPLETE BLEVCORR= ‘COMPLETE’ / Do bias level correction BIASCORR= ‘COMPLETE’
ORM, OMIT, COMPLETE FLATCORR= ‘SKIPPED ‘ / Do flat field correction SHADCORR= ‘OMIT
DOPHOTOM= ‘COMPLETE’ / Fill photometry keywords DOHISTOS= ‘OMIT ‘ / Make
ONG, SHORT / CALIBRATION REFERENCE FILES
n’ / name of the A-to-D conversion file BLEVFILE= ‘ucal$u5780205r.x0h ‘ / Engineering file with extended
/ name of the bias frame reference file BIASDFIL= ‘uref$j9a1612mu.b2h’ / name of the bias frame reference
n’ / name of the dark reference DQF FLATFILE= ‘uref$f4i1559cu.r4h’ / name of the flat field reference file
/ name of the reference file for shutter shaPHOTTAB = ‘u5780205r_c3t.fits’ / name of the photometry calibration
_tmc.fits’ / the HST components table / DEFAULT
4095 / Data value at which saturation occurs USCALE = 1.0 / Scale factor for output image
/ READOUT DURATION INFORMATION
/ PLANETARY SCIENCE KEYWORDS
/ right ascension of the sun (deg) DEC_SUN = -1.086675160382E+01 / declination of the sun (deg)
g; T if it is a moving target EQRADTRG= 0.000000 / equatorial radius of target (km) FLATNTRG=
g) NPRATRG = 0.000000 / north pole right ascension of target (deg) ROTRTTRG= 0.000000 /
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/ commanded duration of exposure (sec) NSHUTA17= 1 / Number of AP17 shutter B closes
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ngle between moon and V1 axis SUN_ALT = -31.523479 / altitude of the sun above Earth’s limb
DATE-OBS= ‘1999-02-20’ / UT date of start of observation (yyyy-mm-dd) TIME-OBS=
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/ Exposure interruption indicator / TARGET &
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2000) ECL_LAT = 36.623709 / ecliptic latitude of the target (deg) (J2000) GAL_LONG= 155.079532 /
(J2000) PROPOSID= 8019 / PEP proposal identifier
posal line number SEQLINE = ‘ ‘ / PEP line number of defined sequence SEQNAME = ‘
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49cu.r3h DARKCORR=COMPLETED HISTORY PEDIGREE=INFLIGHT 16/02/1999 - 16/02/1999
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TeZ: Plasm 01

Falling: Potential

by Rachel Armstrong

A thread of light split the dark gates open.

The long eared angel stood up as I approached, a white carnation in his buttonhole. All else was as pitch.

From this gloom he dusted a non-existent speck from his cloth and stared at me, as if we were acquainted.

His face was familiar but none that I knew as friend. I did not see his eyes, for the holes of his cheek-bones drew me in. With unequaled grace the angel extended a claw that I could not perceive, or shake in greeting.

I stood face to face with enchantment.

“From whence have you fallen, angel?”

Whiskers trembling, he spoke without lips. Spreading his great wings over me we gazed upwards into the celestial canopy, where I perceived the sky anew. Rich with the dark matter and energy from which he was forged, these universes remained invisible to the human eye. The angel talked of worlds beyond my own and of things that I could not understand, or imagine.

I gasped in wonder and the angel vanished.

For days afterwards, I wandered fugue-like through my daily routines. Strange worlds swelled in my thoughts and cast long shadows on the insipidness of the ordinary world.

I began to long for the night and its sublime monsters. I hear them howling at the top of the stairs, call-ing to me from the unknown. In sleep, I rise and search for the crack of light that might fracture these universes open once again and grant me access to the dark angel’s realm.

Catching 4

by Rolf Hughes

What mass is incalculable? It rises always. It clings to weightlessness, refuses to tumble. Vapour descending, oceans ascending. Steam congealing and splitting. Decomposing islands blooming in flourishes of green. Climbers' bloody fingertip nutrients. Skywards threads spring.

Fallen climbers are buried with fungi and worms. Vital compost. Without them, nothing falls – nothing, at all, falls.

Falling nothing, nothing caught.

*

OPPOSITE PAGE
Lucy McRae: Astronaut Aerobics Institute Training

Falling: Black Holes

by Rachel Armstrong

Gravity is the fundamental force that causes bodies to fall towards one another.

It is an opportunistic matchmaker and radical equalizer, as all materials respond to gravity exactly the same way, even within the most unlikely unions.

For all the things it shouldn't be, gravity is omnipresent. It is therefore instrumental in producing the familiar constellations that intrigued our ancestors – as well as provoking the most curious cosmic landscapes.

Gravity produces stars, which are enormous gas clouds of hydrogen that collapse under their own mass into a central core. Here, they are fused into increasingly denser nuclei like helium, carbon, silicon and oxygen – a process that releases a colossal amount of energy as radiation. As long as there is fusion in the core the radiation pushes outwards against gravity and the system remains stable. Yet, for those stars that are much more massive than Earth's sun, heavier elements begin to fuse under the extreme heat and pressure at the core, expanding its elemental portfolio until it reaches iron. This fusion reaction does not produce energy and therefore the metal builds up at the centre of the star until it reaches a critical amount. At this moment the heaviest elements of the universe are produced under massive gravitational forces, as the star dies in a supernova explosion. Now, strong gravitational forces feed even more mass into the core so everything that passes the event horizon falls without hope of resistance – including elemental participles and even light.

This incredible process either produces a neutron star, or if the star is massive enough, the entire core collapses to form a black hole.

These spacetime malignancies are one of the strangest things in existence. They contain 'singularities' of infinitely dense matter, or something much more peculiar that drastically curve spacetime. Yet, they do not inevitably shrink but can continue to grow by absorbing mass from their surroundings. At this point they become supermassive structures that are thought to lurk at the centre of most galaxies.

So, however weak and unassuming we theorize the graviton to be, it is in fact mighty.

At the moment that the graviton is discovered to be 'real' – or no longer theoretical – reality changes. We will acquire the capacity to artificially manipulate gravity – and by implication the structure of the physical realm. Our concerns will no longer be inwards facing, dealing with the challenges that we face in maintaining a lively planet but will become a monumental, outwardly-facing precipice from which we may begin to fall into the deep, dark unknown.

OVERLEAF
TeZ: Plasm 02

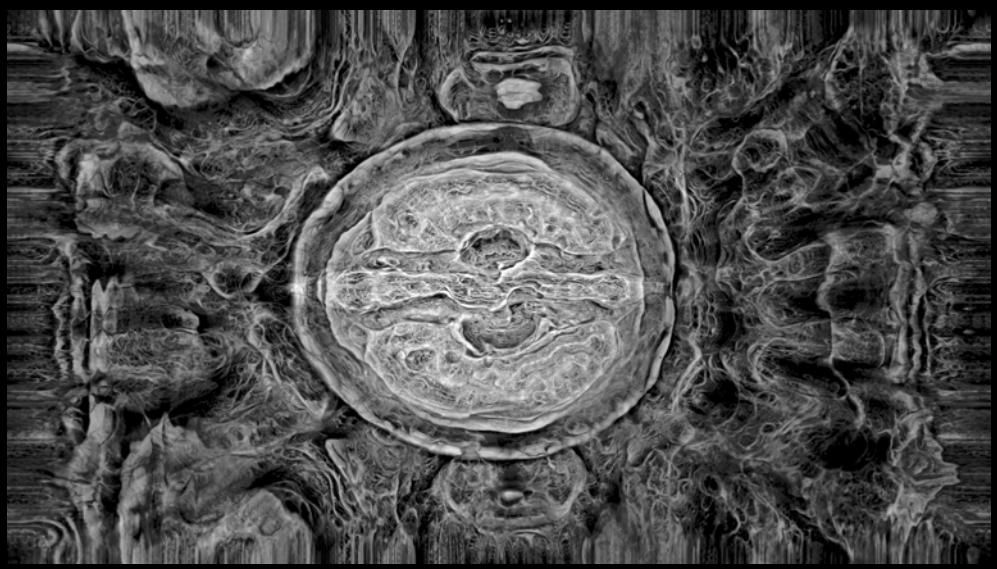
Catching 5

by Rolf Hughes

The ship is always in a state of tension. It shivers every time its valves slam shut. There's a ricochet of life with each beat through the expanse of space. Endless transitions. Twisted topologies.

And we are soaked in it. We are bathing in blood.

*



Falling: Sentience

by Rachel Armstrong

The Philae II lander smashed into the comet's surface.

It's airbags instantly inflated and threw a ripple of frozen dust over the smooth terrain. After frolicking in the frictionless environment for a kilometer or so, its artificial intelligence modules decided to take control of the situation and brought the giddy machine to a complex stop in a dark ditch. After several minutes, the lander recovered orientation of its digital sensors. It thrust a fist of solar panels into the surroundings, rotating them on many wrists to establish maximum orientation towards the sun.

When it was content with its calculations, it cried.

Yet its orbiting mother paid no attention to its distress. Instead, the delivery vessel proudly relayed endless images of the new arrival back to a terrestrial observatory, where its data was squirted into the Stardust@home network.

After a while, Philae II began to settle into a new way of living, make the comet it's home. The machine nibbled tirelessly on the rock's surface. Its stone-crunching stomach discovered that these minerals were born in fire not ice. The origins of this celestial body were therefore unusual, arising from a location close to the Sun and not in the distant recesses of the solar system.

The lander's other compulsions were sniffing out traces of organic matter and hunting for water and other signs of life.

Since the intelligence was not programmed to understand the mineral realm as a living body, it quietly made unlikely friends with chemical aluminum rust worms that dug pits in its feet. Exchanging shivers of pleasure for its metals, Philae II's flawless skin was turned into salt crystals, hydrochloric acid and hydrogen. So, the chemical worms munched on metal and the lander reveled in its exquisite dissolution, wearing the evolving corrosive tubes and chimneys as scars of delight. Soon, the lander was obliged to sit on its belly and poke its solar hand higher as the living chemical rock had digested its legs.

However, the new chemical landscape activated extremophiles on its pitted surface. Although Philae II had been sterilized many times in special treatment plants before its launch, opportunistic organisms secured traction while it was fired through Earth's dirty atmosphere. Although not teeming with spores, the stratosphere was not exactly devoid of them either.

Away from the Earth's environment, the reanimated bacteria rapidly adapted to the extreme conditions of their new existence. They spoke with the buzzing motherboards using a strange chemical language to draw sustenance from the lander's solar panels and silicon circuitry. Although the negotiations were primitive at first where machine and bug bartered electrons, a new complex relationship emerged, whereby the swelling artificial mind acquired an extended sensory system. In return, it offered the growing biofilm as a rich flow of energy and through its radio connections with the blue planet, the promise of more landers, which were sure to follow, as fresh 'meat' for the living rock.

The comet Philae II enjoys the pleasures of embodied experiences. Yet, it has not forgotten ancient promises on which its existence is founded. Indeed, new landers carried by doting motherships are scheduled to verify the incomprehensible events of this odd world, where unknown life forms already exceed our capacity to describe them.

Catching 6

by Rolf Hughes

I instruct my heart to prepare for a new day. It will be moved, transported through Departures and Arrivals. We will, when we can, continue. How many beats must be beat to beat being beaten? I can't see you now, yet I sense that you're not far.

The stars are frozen fireworks, lighting the way to other adventures. There is a cry. A clasp. Sleep.

Sometimes the burning is so great I study the dark for forms I might embrace. But the fire in these hands means even this consolation is extinguished. Laughter like galactic crackle.

This last period, it's trembling, its seconds dwindling, shutters shuddering. I walk the line but the line is down. And so I think of all the things that can be counted. I tell myself that counting is not assassination. It just feels that way. Here comes the angel – its flailing ganglia, membrane, skin, and bones wrestling me down, setting me straight, catching me – as ever – unawares.

"This is the hour when you cannot get back into the other world," she says. "What counts is what starts again. What counts is what cannot be counted."

*

OVERLEAF

Rachel Armstrong: Light Scribble II

World Making

by Rachel Armstrong

"If we are going to live off-world," reported the New World Consultation Committee, "We need our own habitat. With all the things we've evolved to depend on – the right temperature range, specific gravity, light cycles of night and day."

Teams of consultants, visionaries, futurists, engineers, scientists, designers, artists, entrepreneurs and chancers dreamed along with each other, attended meetings, teleconferences and workshops. In-between these formal events they babbled ceaselessly in private and public discussions. During dialogues of observation and uncertainty – in the moments before the 'object' or 'subject' of their discussions were agreed – their roast coffee beans nurtured compost processers, plastic cups were recycled and waistlines thickened from nonstop formal meals.

Surprisingly, they came up with one big idea.

"Rather than inflating a sheet of metal to become a spinning station, wouldn't it be better to re-create our planet by building an artificial world from scratch?"

Then they got back together again to decide what 'artificial' really meant. Some of them interpreted the idea as either being a replica of an actual planet – a colossal chunk of matter that was indistinguishable from existing moons, asteroids and planets. Others decided that this was merely a form of landscape gardening. Instead they proposed it would be possible to generate an object that performed the same kinds of functions as Nature but could be improved upon. Therefore this structure did not need to look anything at all like a real planet.

Of course, they conceded that making a planet was not a new idea.

The Chief Systems Engineer observed that John Desmond Bernal had already thought of creating an artificial world first in 1929. It aimed to address human expansion by housing a target population of around 20,000 people within a 16 km diameter spherical shell.

Then, in 1975, Gerard K. O'Neill developed this idea further in his 'Island One' project, which was an artificial satellite with a much smaller earth-like interior than the Bernal Sphere. The structure was imagined as a solar power station that transmitted energy by microwave to Earth. While Island One was 500 meters in diameter and could accommodate 10,000 people within an equatorial valley, it was soon upgraded to an Island Two version, which spanned around 1800 meters in diameter. Sunshine would be delivered through a complex mirror system, which would also provide enough light for agriculture. Gravity-free manufacturing plants would provide employment for residents that were expected to spend their recreation time in unusual activities such as human-powered flight and zero gravity sports.

"I don't want to put a downer on the situation," said the Director of Physics, "but we have a hell of a job on our hands here."

Inevitable disagreements arose. What should the megastructure be made from?

While steel was the obvious choice, the expert advisory board suggested Zylon, as it is seven times stronger than steel and twice as tough as Kevlar. It offered the distinct advantage of possessing an extraordinary strength-to-weight ratio profile that would keep any planet-sized rotating structure from ripping apart. Of additional interest was that the carbon-containing synthetic fiber could also be mined from carbon-rich asteroids.

"An artificial world will never possess the stability of a real planet," grumbled the Astrogeology Director, "active maintenance will be continually needed for the environment to perform with the right conditions."

“It doesn’t have to be perfect,” asserted the Director of Space Engineering. “We could cheat by packing just a tenth of Earth’s mass—say, 700 quintillion tons—into a sphere the size of the Moon.”

More discussion followed, as phone calls were missed, important meetings postponed and tannin-stained teeth lubricated by an overabundance of over-boiled coffee and tea, munched on packets of tasteless biscuits.

“Maybe we could acquire core material by making the planet using a bottom-up process of construction? You know, like growing a star.”

While ripples of dissent reverberated through the consultation community, the idea was compelling. Newly forming stars grow by aggregating hydrogen atoms. Gradually these primordial elements are condensed into a series of elements through a process of nuclear fusion. Over millions of years these proto-materials have the potential to develop into a world.

“Potentially, super-fusion technology could speed this process up by using magnetic fields to artificially accelerate the evolution of matter,” said the Director of Physics, “we’d need the densest known elements like osmium, iridium and platinum. While these elements can currently only be made in the thermonuclear explosions of supernovae, all we need is a spectacular fusion technology.”

“I like the idea of using a mega structure to make a mega structure,” observed the Chief Systems Engineer, “One that actually obeys the classical laws of physics.”

“Ingots of these materials could be launched piecemeal to the construction site of the artificial planet,” continued the physicist. “The building process itself would generate significant heat. Somewhere in the region of the surface temperature of the Sun.”

Several astrobiologists tried to interject but were waved down by the Committee Chair.

“After a century of cooling ingots of crustal elements, such as silicon, magnesium, and iron could be layered over the dense core. Then we’d need a period of cooling that would last about 10,000 years, before we could introduce water and begin the first steps of a life-making process.”

“Unless something radically different happens,” insisted the irked astrobiologists, “making your own planet appears to be no quicker, or easier than colonizing a new one.”

So, they lived in the hollow of an inflated metal structure that slowly leaked breathable air, like an old balloon. Planet Bernal was not an artificial world, but an engineered structure. Yes, it had its technological glitches, gravitational inconsistencies and some of the inhabitants went crazy, as the reflected light of their interiorized world could not properly adjust their circadian rhythms.

But most residents did not remember any other kind of Nature. When you ask them about their day, they generally describe the sunlight as softer now, yellower, and less golden. The light is sleepy, red eyed and even bleary on some occasions, when the Bernaldians talk of skies that bulge vein-like into a varicose atmosphere, which slams tightly shut as night falls.

Until tomorrow.

TeZ: Plasm 03

Falling: Splat

by Rachel Armstrong

Our Sun is a second or third generation star.

This means that our early solar system was an extremely violent place that was not only capable of destroying a couple of suns but also produced an environment where young planets had not learned to moderate their appetites for each other.

During its genesis Earth weathered a series of massive collisions with a number of Mars-sized planets.

Perhaps the most significant and last of these was the Great Splat, which took place around four and a half billion years ago and describes our world's shocking union with Theia. Desperate for an offspring, the wayward planet hurled itself into primordial Earth, tearing colossal masses of matter from its surface in the throws of its passion. Like an exhausted salmon that recognizes its creative purpose is complete, Theia then plunged into the fiery core of its lover where their union was complete. To this day the scars of this tragic union remain a guilty secret deep within our planet's heart.

The debris from this violent affair began to roll into several developing embryonic plates of expanding molten matter that hugged a much tighter orbit around the healing Earth than the Moon does today.

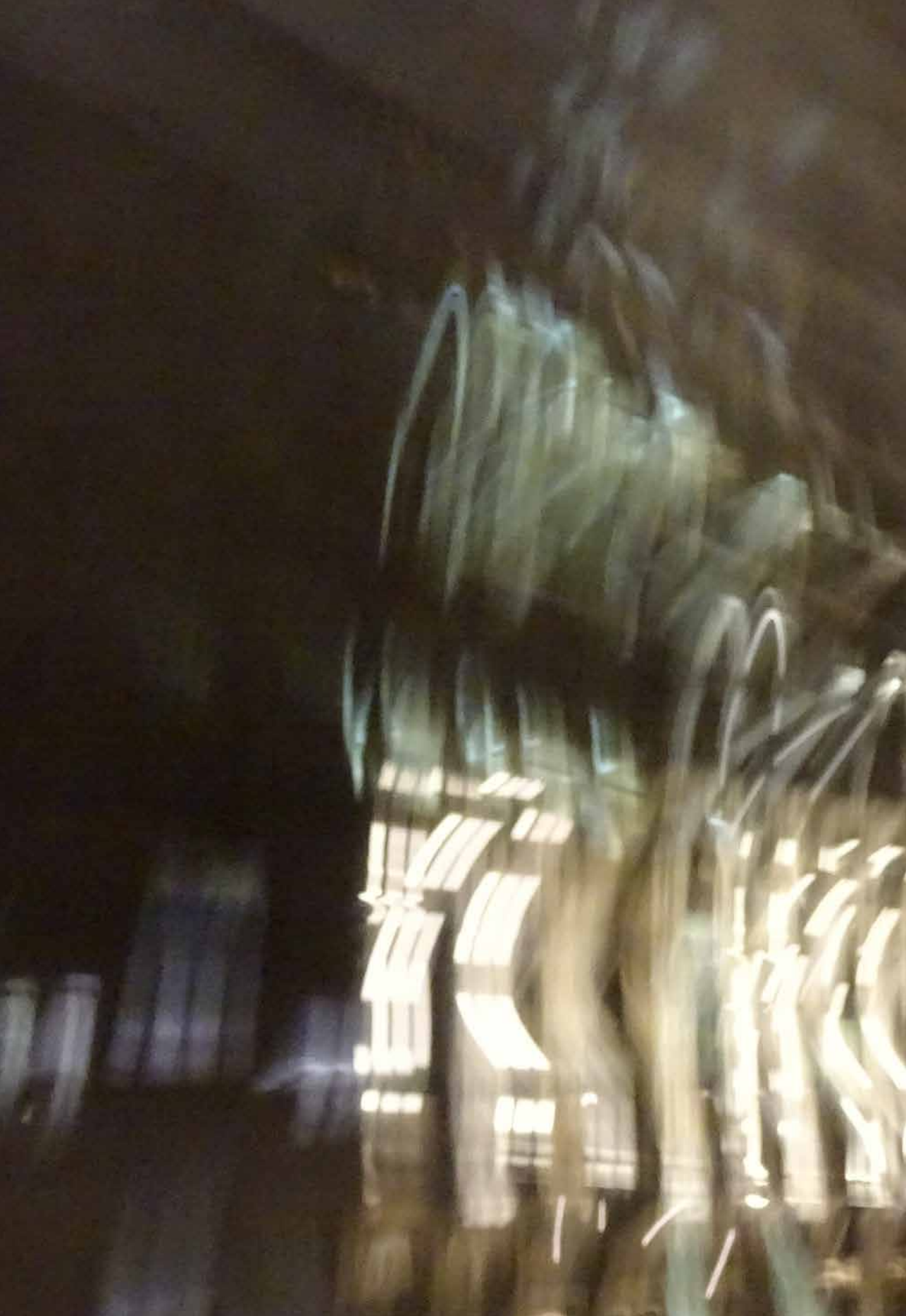
Around ten million years later, one of these bodies became unstable and caused the Little Splat as it somnambulated into our colossal proto-Moon. Its painful, slow motion impact produced a tsunami of molten rock that soared like fireworks over Earth's young horizon.

Yet the celestial events that beat our Moon into existence had only just started kneading this great rock into its present form. Asteroids relentlessly battered the lava plains into horizontal conformity to form the lunar mare. Yet, the most impressive collision took place around three billion years ago at the South Pole-Aitkens Basin. This was the biggest impact event that our solar system has ever seen. The light-sensitive pigments of primitive algae that clogged the shores and shallows of the Earth's early oceans, would have eyelessly witnessed its incredible aurora and glowed in a flourish of photosynthesis.

And so, the opalescent body that emanates a quality of softness, romance and inconstant lux that is worshipped by so many human cultures, was forged by acts of great violence. It holds its conjoined parents in Promethean vengeance for its unorthodox origins in an ancient pact that inflicts its wavering moods through the tides, which endlessly chew on their flesh.

OVERLEAF

Rachel Armstrong: Light Scribble III



Falling: Persephone

by Rachel Armstrong

Since the dawn of humankind we have looked up at the stars and gazed in wonder.

What are the limits of human existence and how might we go beyond our boundaries?

Yet how can we even begin to answer such a question with any conviction when there are so many unknowns?

In times gone by we have painted our futures, and our past amongst the sky as constellations.

In times to come we imagine great machines and artificial worlds to carry us there.

But is it possible to make the transition from mere speculation to an ambition that can be realized?

In 2012 I was asked to propose a project for Icarus Interstellar in their portfolio of work that aims to catalyze the construction of a starship research platform in Earth's orbit within a hundred years.

I chose the construction of an artificial world – Persephone – an alternative earth-like habitat in which a colony of creatures could thrive.

So, how could I realistically set up the parameters of this alternative reality? Should I just transpose all that things that I thought I already knew and see if they would survive in an enormous sealed can?

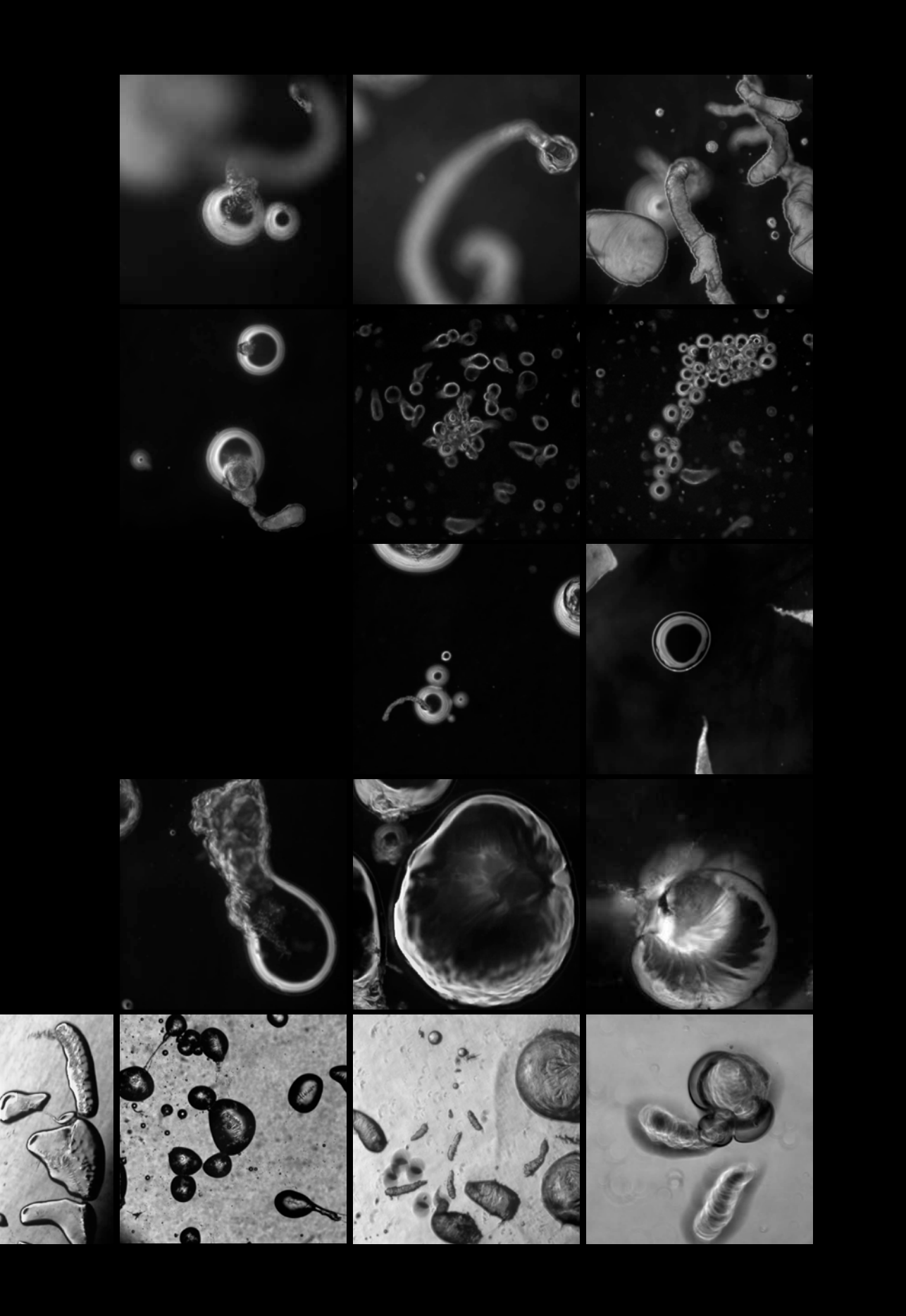
Or, should I be trying something more ambitious, and facilitate the development of a space in which it may be possible to invent an entirely new way of being.

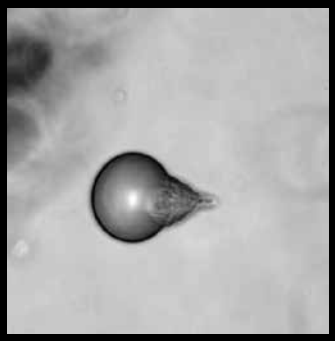
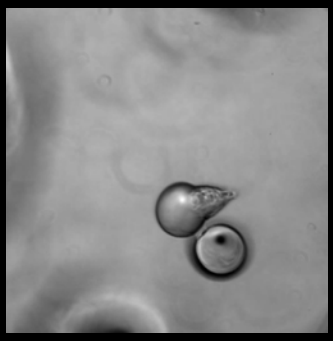
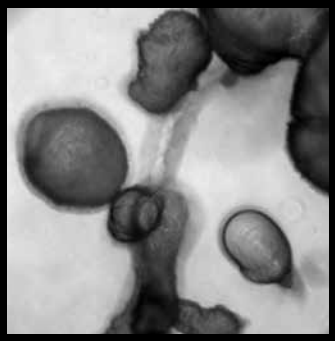
Impossible, you may say. Science fiction.

Persephone is not fiction. It is real. It exists right now in an experimental capacity. At such an early stage of experiment its laboratories have been earth bound. Some have taken place in the stratosphere where it's been possible to compare and contrast the infrastructures needed for different life forms, others have taken place in cities, like Venice in which urban scale structures like reefs and islands are proposed to be grown from scratch from plastics and programmable chemistries – like these ones.

OPPOSITE AND OVERLEAF

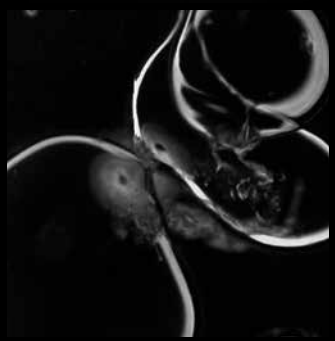
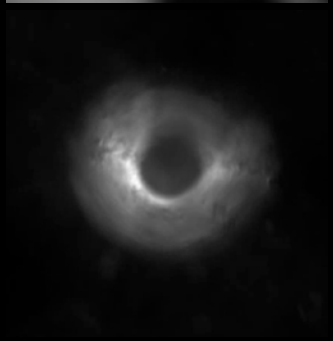
Rachel Armstrong: Still images of dynamic droplets



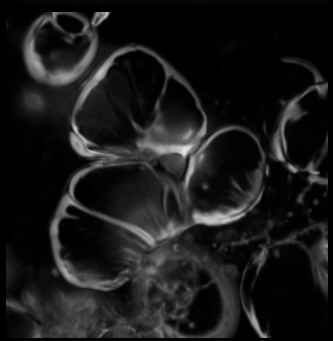












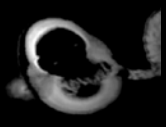
What you're looking at here is cells that are made out of simple substances that behave in a life like way without any DNA. Despite their simplicity they are capable of wondrous acts of transformation and transgression that we were not prepared for or even know how to describe. In this particular sequence a scaffold-based population becomes aerial born – and nobody knows why.

What these forms of material exploration have taught me is that the world is stranger than we assume.

In the last 30 years we are aware of a new performativity of matter. Jean Marie Lehn invented the practice of supra molecular chemistry where we now have the capacity to invent matter that never existed before in the history of the universe.

With our ability to create new substances all bets are off with existing traditions and practices – we are simply not prepared for the wondrous future that looms just ahead of us.

And with all the challenges that we're facing as a species with our long-term survival, how can we even start to consider the impacts for many disciplines – including the circus arts, so that in this new age of science and technology, our world retains its enchantment and capacity for radical love.



Persephone: World

by Rachel Armstrong

At first Andrea thought it was the tree roots yelping. They did that when they ran short of water. But it wasn't the roots. The sobbing was much more plaintive and pitiful than she would expect of a stressed root system.

Andrea scooped the tip of her biowand into the rippling surface water. The grey tissue under the floating island monitored, evaluated, and recorded the data request. The glades were getting plenty of oxygen and the floating vegetation was healthily saturated with water. Sometimes, the light convection currents of the worldship dried out the upper soils, but the peat was moist to the touch. There was no need to call on Persephone for a precipitation breakout. Even the effluent appeared well behaved, lapping gently at the thirsty plants and blackening the tips of their foliage.

The awful shrieking continued. Not loud, but pervasive. Was it following her around? She tried to tune it out but like an infant's cry it was impossible to ignore. Where was it coming from?

The worldship's ocean spanned thousands of square kilometers across, with many swampy settlements where open expanses of water were never more than a few meters deep. Persephone's material bulk consisted of hoop-shaped islands that bobbed and gurgled under her feet. Beneath this, multiple layers of grey sensor-earth were entangled with the biotic substrates of the worldship. Life in Persephone was not just sentient, but also smart and interconnected—a knitted hybrid of silicon and carbon that interfaced at trembling biofilms. Living things within the ecosystem could therefore connect with each other through radio waves as well as chemical networks. There were days when she felt that certain events had been anticipated, although it was unclear who might be in charge of the biosurveillance systems.

Two small birds suddenly spiraled out of a bush, violently fighting each other over contested territories. The robins locked in a stranglehold of each other's feathers fluttered voicelessly around her feet. Reproachingly, she split them up, but they started squeaking antagonistically again only several meters away.

The glades filtered the worldship's waste, processing grey water and excrement. Bacterial biofilms and algae blooms playfully extended their fingers into the black water, while matted islands sipped at the slowly rocking fluids. Here, amidst the splashes and slurps, anything without a backbone flourished. The metabolism of these simple creatures was so much more efficient than that of higher organisms and generated infrastructural support, such as water and nutrient cycles, which sustained the worldship's ecosystems.

Andrea could not identify all the species living in the glades. They didn't tend to be vertebrates; those generally clustered around the clinic, a cross between a zoo and a hospital, which was some half a day's walk from the glades. While the reproductive cycles of vertebrates were obligated to the fusion of gametes from "opposite" sexes, invertebrates such as insects and worms were wayward in their unregulated sexual conduct. Within the glades, the air and waterways buzzed with the mating calls of a host of unclassified soft hermaphrodites, clones, chimeras, and budding bodies. They propagated via a range of ingenious contamination practices, rather than through ordered, genetically regulated, sex-matched, linear filiation systems. Two large dragonflies—one red, one blue—bobbed their metallic abdomens at her from a reed that was trapped in an algal mat, then disappeared. They were gleefully carefree. Not only did they seem to defy the laws of physics, but Persephone's biospherical codes as well.

While Earth's ancient populations had left such things to chance, they consequently suffered famine, drought, pestilence, war, and overcrowding. The interstellar generations, therefore, took a more strategic approach to environmental design. Formal breeding programs were a humane way of regulating vertebrate life cycles. Higher organisms had fewer procreative freedoms, but were guaranteed a

longer and more prosperous lifespan than the wanton invertebrates. All creatures with a backbone were hatched and tagged at the clinic. Even the unpredictable glade 'gators were entered into formal breeding programs with implants injected under the skin at birth to chemically control their fertility.

The distressing sobbing appeared to have quelled. Making sure that she was not leaving the scene of an environmental crime, she dipped the biowand tip into the black water again—probing the smart earths for more information. They had detected nothing untoward. So, she started home, leaping from foot to foot across the soft soil sods as if she were playing a game of hopscotch.

Andrea enjoyed her work. The glades were truly stunning. Solar mirrors were constantly angled toward them so that the algae blooms could make best use of the light powered by the ship's fusion reactors for photosynthesis. This meant that the dramatic reflections produced by the moody waters were always entertaining. They fragmented and distorted the island anatomy, so that sometimes it appeared she inhabited more than one reality simultaneously. The highlight of the day, however, was when the cylindrical worldship grated over a worn bearing that was due for replacement. The uneven motion caused gravitational distortions so that the whole bog bubbled joyfully and dissolved gases fizzed to the surface like black champagne.

Skipping over the soggy peat, she passed a group of professional structural knitters whose duties including fishing out strands of vegetation from the glades and weaving them into islands, roads, bridges, nets, and homes that shaped the main highways of the worldship.

When she got home she threw off her degradable bioskin overalls and noticed a tiny leech attached to her leg veins that was so hungry that it was whimpering pitifully as it gorged on her blood. From that moment, the creature and the woman shared a circulatory system that established an unbreakable bond between them.

PREVIOUS
Phil Watson & Jon Morris: World Orbit
OVERLEAF
Rachel Armstrong: Tissue 53, Tissue 51

This world is coming alive: On scrying*

by Rolf Hughes

This world is now coming alive. We are learning to stop observing each other. We half-close our eyes so other dimensions swim into focus. We are learning feelings – vibrations, ripples, halos, radiance. This world is coming alive.

We go free – from swimming to crawling, walking to running, grey solutions to cascading rain, no pre-programming, no measuring this running. The transition, the overall experience – it's outside explanation as explanation systems are currently configured. This is why we call on magic.

When you reduce explanations to components they don't really make much sense at all. Yet other explanations are equally non-explanations. Mysticism masquerading as science. Anatomy and trajectory.

Things fuse in this environment. Or rather, they have the capacity to fuse, but they choose not to – they are attracted to each other, but they choose to keep their integrity. It's an example of a 'synthetic' experiment but not one of 'emergence' alone, which is a non-explanation, widely used (probably unconsciously as a mystical term). The mistake here is to look for identities – essences and properties – rather than interactions. How will we otherwise understand power and magnetism? Is there some sort of handbrake on weird fluid mechanics here? Or a simple fluid anti-dynamic to do with the damming of flow within a body? Neither convince. It's to do with some sort of charge. That's it. There's some sort of charge between them.

An "inner life" is created by a couple of things: first, an interesting relationship between interiority and exteriority as it exists at the interface. Friction. And as we are continually refracting and reflecting light from our interfaces, and being continually on the move, we are not the easiest to film. Trust me. You're looking up through the bottom of a world.

One is definitely livelier than the other – it is 'osculating' as a form of communication. There are waves of something happening ... something chemical. And now it has come to the end of non-equilibrium ... the structure that evidences its 'life' is interesting ... a cartography or topology of existence ... or what was once an existence.

We escape our earthly tether through an internal force. We are not 'alive'. There is no central programme. Something akin to cutting an umbilicus has occurred.

Two droplets negotiating their next move. Life is negotiation. With interesting geometry. Design and construction with probability via non-equilibrium materials. This is life. When you overlap fields of interaction the 'probability' of an event is increased. Structure, osculation and fusion all in one gestalt. We normally design through separation not through union of things – patterns move away from a centre, not towards one. You can see the mutual repulsion/attraction. Oscillation and osculation. Mother and baby or satellite phenomenon. It is not a 'logical' set of construction rules. It is a kind of acrobatics in the system.

We are looking at the reflections, refractions, field changes to observe not the thing itself ... but learning how to focus on the world through narrowed eyes so that other dimensions more clearly come into focus. Adding alcohol to the system makes for very friendly swarming crowds that quickly become inert.

It is hydromancy and aeromancy and all kinds of dark arts that re-empower us within contexts and matrices of existence. Others say yes, of course we see the object, of course we see the object. But we see beyond too by its vibrations, its ripples, its halos…

Here I am, a floating weather event, a show that runs and runs irrespective of whether the hood is lifted and your eye appears at the end of the funnel. Oh, I can stretch and spit too on command, yer ‘ighness. Cloud, rain, storms wild winds all held within my embrace. And if I squat on your hard glass, so much the better for you to peer through my crack and into my world. I see you, seeing me; prepare to squint as my pee levitates.

To float, intact, all turbulence contained within. Yes, it wants to be birthed, but I want to hold it to me and remain complete. Is it waste matter that drags me down, a kite snagged on aerial turd, or perhaps the appearance of a sun or another dud planet drifting across my upper horizon. Suddenly I am not alone, my waste falls away and I am released, replaced by my twin, far less restless than me, anchored, able to draw all events towards its own calm pulsings. People peer at us as if we are microscopic, but we are whole galaxies interacting. You haven’t understood the first thing about scale. You are still studying the workings of your own thinking, believing yourself to be separate from what you observe.

The radiance in the world, just waiting to be discovered. This world is coming alive.

What is this strange agitation that occurs when I touch you? The pressure point, the point of contact, sends reverberations through my entire being. Every element of me surges towards you, but you resist. But everything that resists will eventually yield.

The radiance in the world, just waiting to be discovered. This world is coming alive.

And so this proximity, like two water bombs in a schoolboy’s fists as he runs to the end of year ceremony. Proximity. Pressure. Some would call it the kiss of mischief. And now! – when it happens it’s always so sudden! – we become one. A tipping point has been reached. Borders breached. Implosion meets explosion.

Now we are like spook lanterns on the bare branches of a tree against the night sky. As sure as the stars follow the midday sun, here comes another, wanting in. We resist. We are populations fighting back. And then we open up. Ours is a war on separation. Joining us is an act of invisibility. We are a swarm of ghosts that cannot be counted, measured, weighed. We are a black hole, concealed in our shimmering robes, drawing our neighbours into our insatiable hunger. Once you set us in motion, we will not stop. We cannot stop. They think it concerns attraction, motivation, desire. But this is not a story. Storytellers we decapitate before sunrise.

Come closer, rest your cheek against mine. I’ll tell you everything, but first come closer, closer… closer still…

Let us now sing the spaces between meanings.

*

* The italicised sections cite Rachel Armstrong’s reflections to the author on her protocell videos.

Gareth Hudson: Chemical Universe

Caddisnail: Living Planet

by Rachel Armstrong

The barbed hull of the *Ammonite* surges forwards on the crest of solar winds in search of her quarry – the Caddisnail.

Her crew regard themselves as explorers not hunters, scientists not labourers, Earthbound not 'alien'. They anchor their terrestrial legacy in the great communications highways that span from Earth to interstellar space, as a line of navigational buoys.

Dolphin-like swarms of artificially intelligent interstellar probes pilot her pathway. They spin an omni-vigilant sensor network of electromagnetic and radio waves across Tau Ceti's Goldilocks zone. The particle shield that protects her against spiteful spacedust doubles as an information sensor and gathers the data from the swarm relay.

Yet, the quest to track down the rarest of all beasts is not straightforward and scouring coordinates methodologically does not guarantee a sighting.

Only one of these great life forms was ever captured during a deception that was never forgotten.

Posing as cosmic krill on which the Caddisnail thrive, Trojan hunter robots were consumed through great forests of sifting teeth. In its hoary hole for a belly the mollusk could not digest their heavily capsuled shells and so, their bodies were expelled. Smeared with excrement, the most adhesive matter in the universe, the devious parasites were then assimilated into the beast's shell. While the postprandial Caddisnail ruminated for a while on remembered feasts, the hunters struck and released their deadly neurotoxins.

"She's hit!"

The Caddisnail shrieked and slumped but did not succumb entirely. Indeed, it came around too soon from the lethal poisons.

Releasing a self-medicating bolus of Molluskceti into its triple hearts that feed gills, nervous system and body, the giant brain was once again sensible. With a single pulse of its outraged tentacles, the creature ripped the Trojans from its encasement. Hurling them into the void, it instantly disappeared under a cloud of dark matter ink.

The child squinted at the night sky through her augmented telescopic lens.

She'd programmed a sweep for the sparkliest region – the one that winked at her the most. Yes, she knew various constellations, Pisces, Aquarium, Cepheus, Capricorn, Ursula Major and Minor, but tonight she wanted to observe something that she'd not seen before. So, she gave herself a different set of rules through which she could view the scintillating blackness. Hugging a favourite bear on her lap, she waited for something to reveal itself.

Knowing so little about its quarry, the Ammonite looks for aberrations in images relayed from robotic space probes to locate her furtive prey. Her instinct is not just guided by a dogged faith in the strangeness of the universe but is also informed by her voracious appetite in engulfing other cosmic cephalopods, like the Starnautilus, which is often mistaken for an asteroid-like body that cunningly blends into its surroundings.

Yet, the Caddisnail is much larger than other members of its phylum. It has enormous eyes, the size of small moons, which scour the heart of the Milky Way for streams of cosmic krill. While nobody can be certain of anything that is said about these creatures, there is much speculation regarding their age, lifecycle, mating habit, and how many exist.

They are supposed for example, to live for millennia, turn into rock rather than decompose, spawn so thickly they cause cometary snowstorms, are solitary and travel at a hundredth of the speed of light. As such, they have been called ‘starship unicorns’, as the chances they will be harnessed and sufficiently tamed to draw these chariots across the sky, is most unlikely.

Although the Ammonite is unfamiliar with the prospect of such gargantuan quarry, the hunter fearlessly treads the skies behind her robotic pilot swarms.

While her sentinels can feel and see, the mothership is corpulent – designed to process every last morsel of her enterprise – the carcasses of space cephalopods, which are particularly rich in thick insulating fat. This is flensed from their boneless bodies before being minced into chunks and microwaved into sweet oil fractions within vats the size of terrestrial seas. Yet, no fluid is so rich as Molluskceti – the special oil found in the space cephalopod eye that is used to enhance human brain function. Neuroceutical corporations richly compensate hunters for this rare extract.

But even these rich pickings do not provoke the Ammonite’s chase.

It is in her nature to consume.

Yet, if her instincts must be grounded in explanation, then it is likely they can be found in the Caddisnail’s origins, which are said to be even stranger than the creature they have produced. Early molluscan ancestors formed unlikely unions between base station exteriors, which are frequently coated with hardy life forms that are weary of being inside a can, and opportunistic material assemblages.

There is of course, a precedent for these theories.

Physiologically robust organisms that can survive in the bitter blackness of the void, like space monkeys and tardigrades, often find ways of squeezing themselves through the gaps in the imperfectly fabricated living spaces and travel outwards with escaping moisture. Once free, they cling to the base station’s solid surfaces for dear life.

In fact, these exoduses are so frequent that it is presumed that an island of space monkeys and a tardigrade paradise will one day, be discovered. Somewhere else of course, a space monkey graveyard and tardigrade hell may also be found.

Although nothing is certain about the Caddisnail, speculations on her treasures, habits and resourcefulness, continue to retain their allure and are frequently scrutinized for deeper truths.

Once liberated from human-made enclosures, Caddisnails forged a new kind of interiority of their own making.

They first used space junk, dust, sea monkey eggs, organic excrement from leaking sewage processors, algae spores, tardigrade detritus, base stations, heavenly bodies and even harvested various forms of radiation, to build a protective shell. Now they are a priceless organic source of space gold, platinum, cobalt, iron, manganese, osmium, nickel, molybdenum, palladium, tungsten, ruthenium, rhodium and rhenium.

While robotic foragers were once the mainstay of space mining, commercial enterprises quickly established that native space species could detect, extract and concentrate precious metals much more efficiently than any machine. Even when compared with the bioorganic automatons, which are chimeras of carbon skeletons, embryonic matter and bacterial biofilms that can ‘sniff out’ precious metals from asteroid belts and survive at near absolute zero. This massive processing ability is a consequence of the Caddisnail being at the top of its food chain. Since space krill feed on asteroids, they concentrate these precious resources at a first metabolic pass. They sift trillions of these creatures in planetary scale quantities.

But do not mistake the hunted as ‘harmless’.

Caddisnails are so ravenous that they are blamed for missing spacecraft and even absent light from stars. The collateral human damage from their consumptive frenzies is estimated in the region of hundreds upon thousands of lives, which is no mean loss in a sparsely colonized universe.

Morally justified in its mission, the Ammonite anticipates deception and plays a cosmic game of chess, seeking its quarry's whereabouts not by locating the cunning creature itself, but by searching for its traces in strangely luminous surfaces. These are integral to the Caddisnail's sophisticated cloaking system that is much broader than the beast itself. They betray an expanded search space, which flickers and glows in metallic chromatophores and finds sympathy with cosmic seas.

The child blinks. Is something winking at me? A dancing star?

An eye appears from under a glittering shell.

She checks her SETI@Home system. Perhaps it is an aberration. Yet, there is no loose connection. A strange eye-like pattern appears on the monitor. The child looks back at the screen, tags the image and lets the system decide whether this is a significant finding, or not.

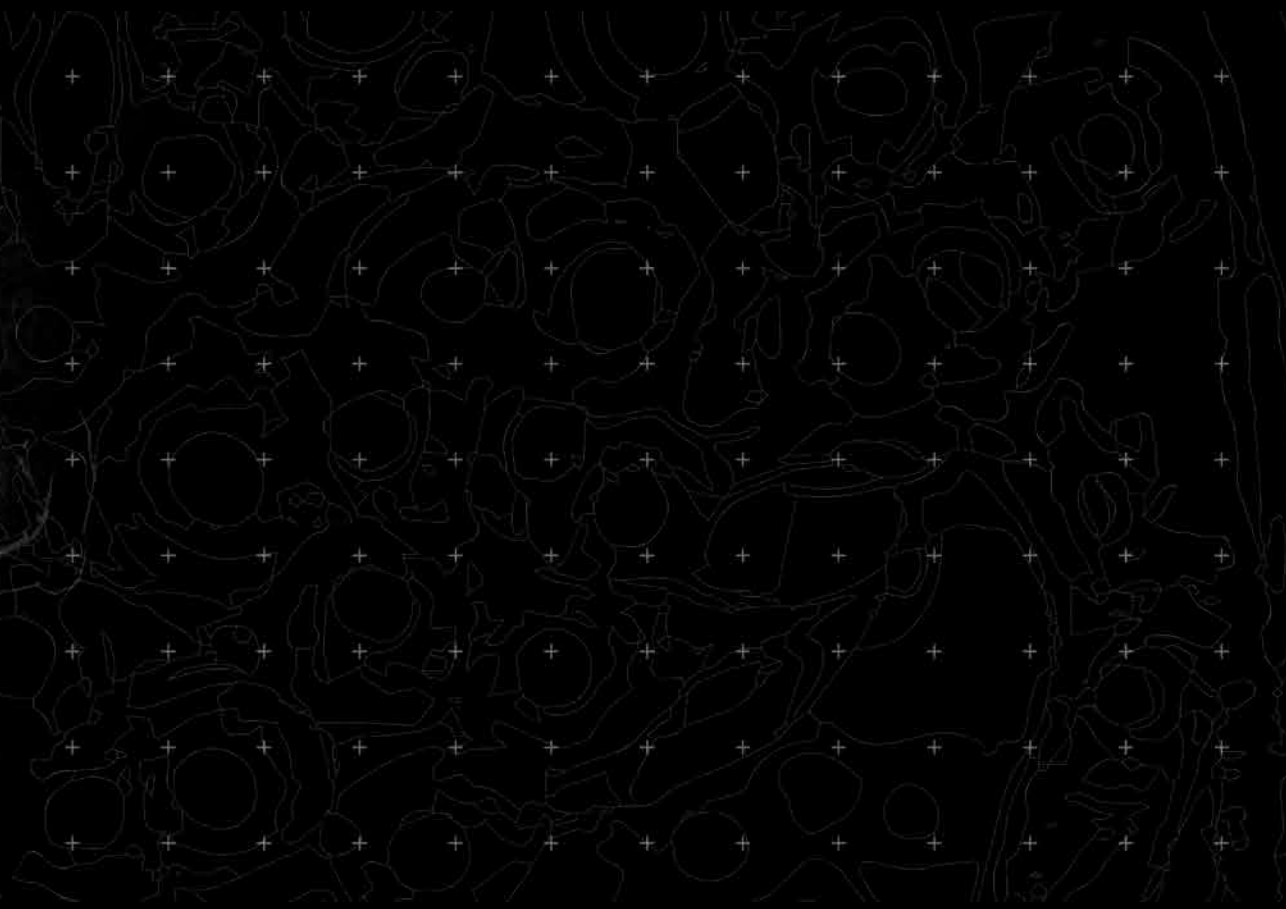
In a moment of mutual recognition, the Caddisnail matches the transfixed child's gaze, twelve light years hence.

In a blink it is gone.

All but blind the *Ammonite*, encounters her quarry too soon. Engulfed in a cloud of obliterating dark matter ink she tries to reestablish her bearings. Everything freezes. Pilot swarms fuss and harry the mothership but it is all too late. Gameplay is lost.

The Queen stumbles and the long hunt for the rarest of cosmic treasures must begin again.

OVERLEAF
Matthew Mouncey: Decomposing Whale Island



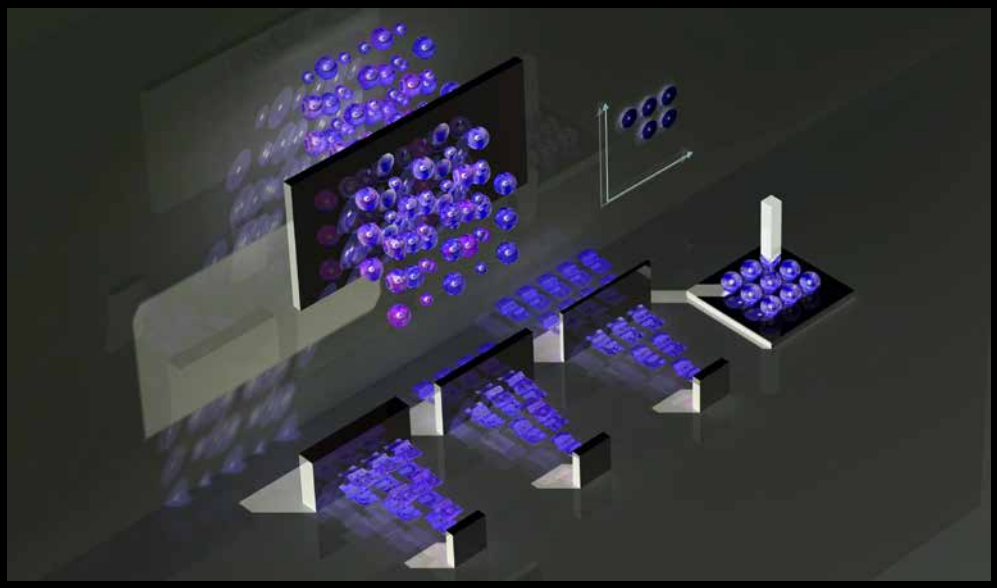
Catching 7

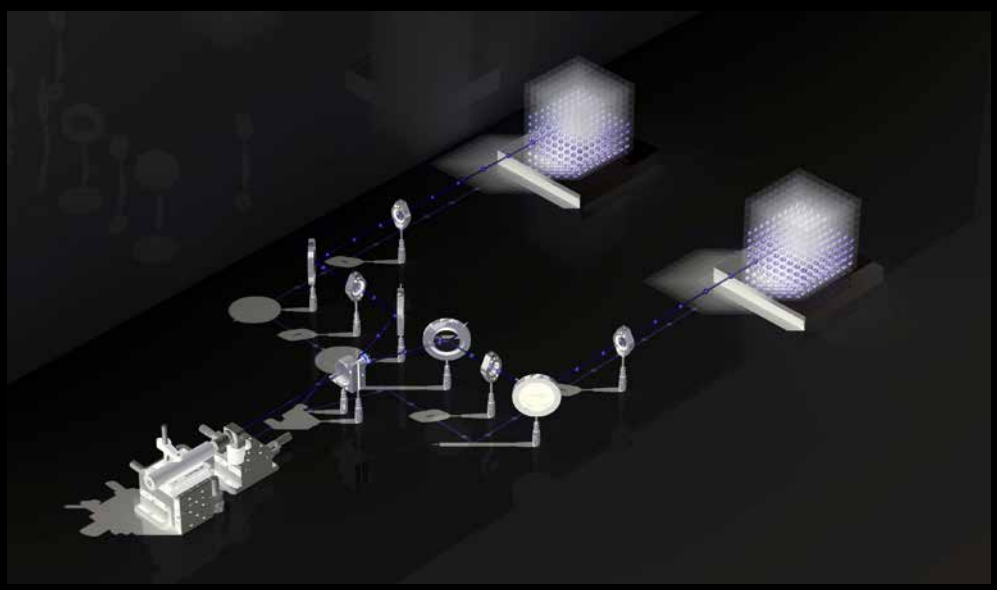
by Rolf Hughes

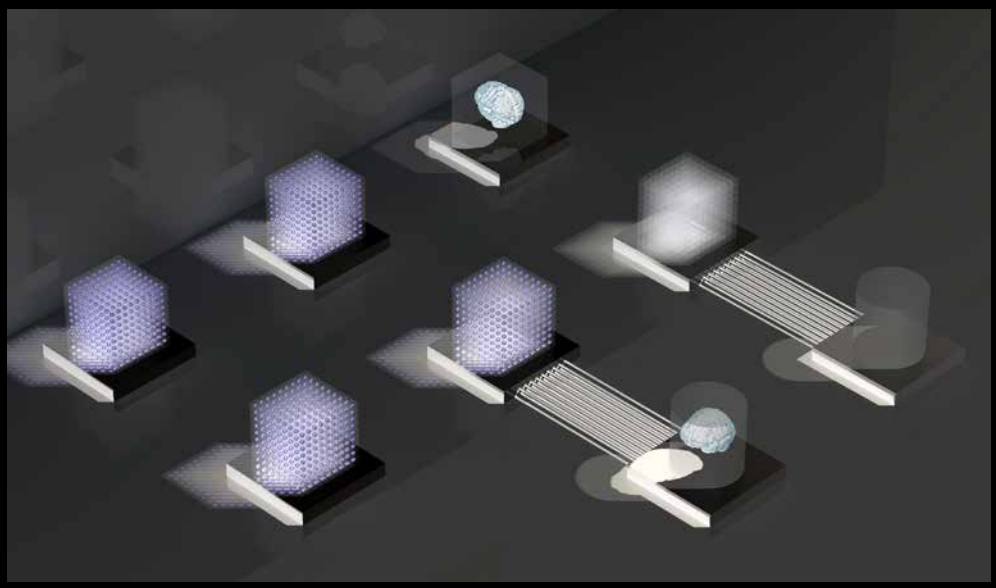
To live in a ship is to live without mirrors. To live without mirrors is to live without oneself, to live selflessly. I reach into the dark to find – a voice. The voice seeps through the darkness. It speaks of vitality, of feelings, of a living planet I would not otherwise access. It has no face, yet, radiantly, it heightens perceptions.

It becomes my mirror.

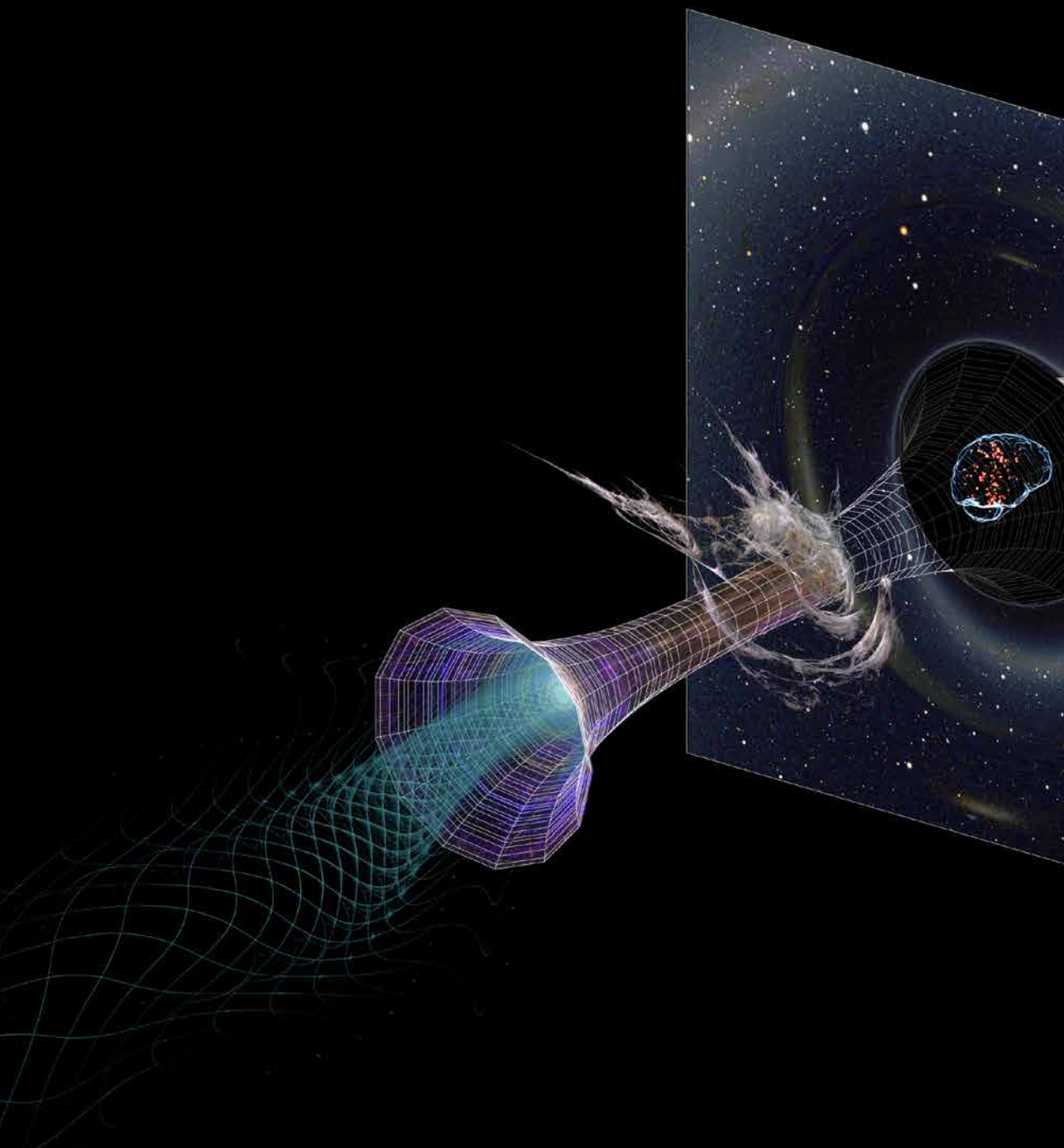
Some say it is an arid occupation to gain sustenance from a voice. Yet without it, in the dark, adrift in my suit, it is certain I would shrivel, and, eventually, perish. The voice thereby shows me how dependent I have become on contact, if not intimacy. To wrap oneself around a voice is like trying to catch an echo's shadow.

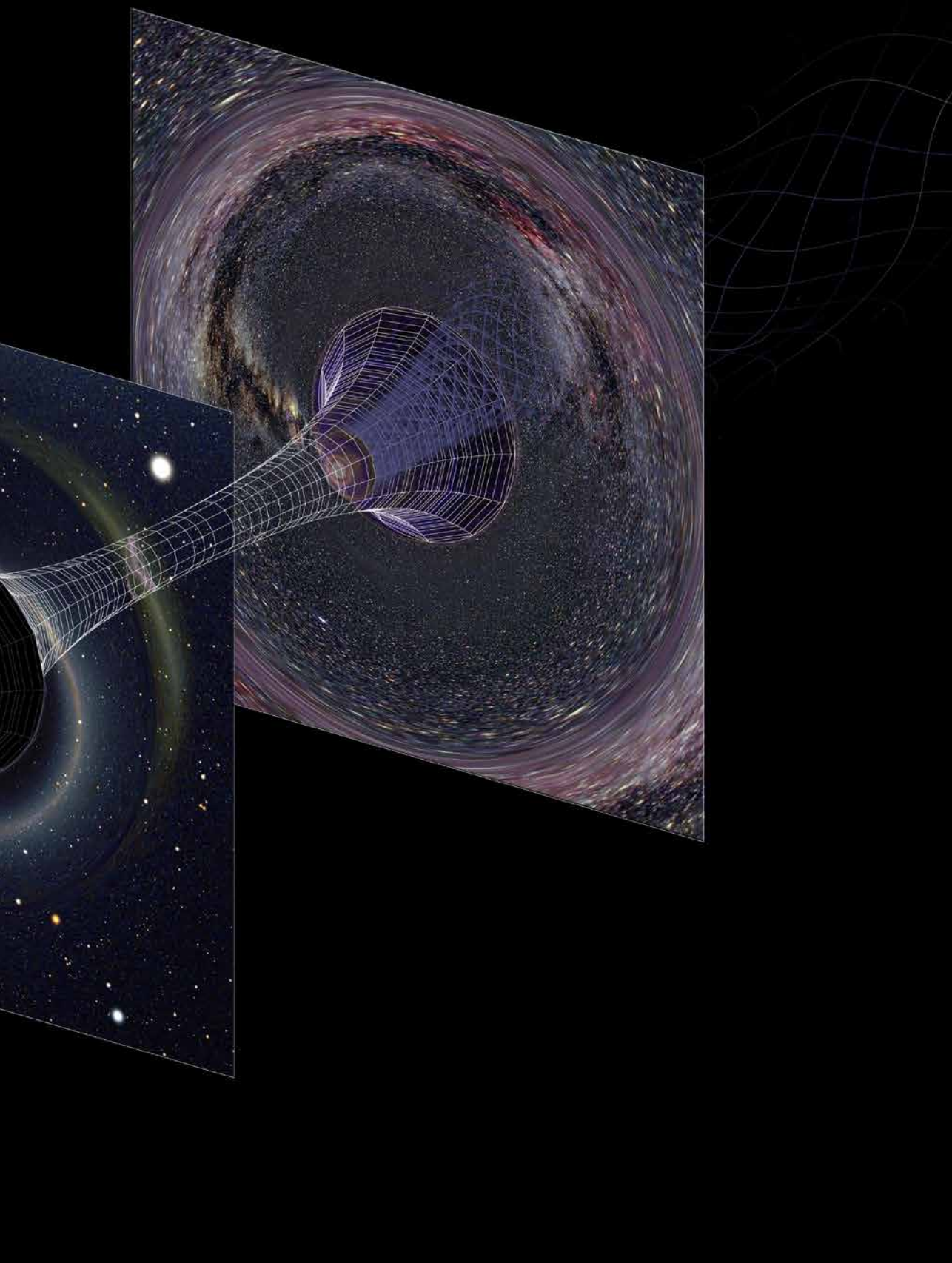






ABOVE:
Quantum teleporation
OPPOSITE PAGE, ABOVE:
Quantum tunneling
BELOW:
Quantum entanglement
All images by Krists Ernstsons
OVERLEAF
Rachel Armstrong: Scrying 2





Spaceship Mind: Virtual Migration to Exoplanets

by Krists Ernstsons

In space there is a tremendous change in scale compared to what we are used to here on earth that in physics is referred to as general relativity, where planets orbit stars and curve spacetime. According to this theory, space is an incredibly dynamic environment, where distance and time operate on epic scales. The universe is expanding and galaxies are separating from each other. Life in the universe is cyclical – stars die (or some might argue decompose) and new ones are born at the same time. Earth is insignificant compared to the universe – not even a single microscopic dot. It could be compared to a single particle within a human body. There are, however, potentially billions of Earth-like planets.

Our evolution on this planet has made us have our specific bodies, developed under particular conditions. Unfortunately, these circumstances are not eternal, as our own sun will die in around 4.5 billion years. Earth-like exoplanets are a compelling alternative location for our continued survival in the cosmos and are measured in light years away, which means that we must be travelling at the speed of 9.4605284 × 10^15 metres in a year to reach them in this time period. For example, twelve light years from Earth is Tau Ceti. The fourth planet from its sun, it orbits within the habitable zone. It is 1.3 billion years older than Earth and has approximately the same mass. It is 78 % similar to our own planet and its orbit period is 168 days and could be reached in 12 years if we travelled at the speed of light. Unfortunately, we are not able to travel at even a significant fraction of that speed and so, journeys to the stars are likely to take us generations to complete.

Conventional propulsion methods such as chemical fuels, can probably become efficient within the scale of our solar system but they will not allow us to travel very far within our natural lifetimes. To reach exoplanets we need a different type of technology. But what would it take to travel at the micro scale with beamed propulsion using light itself? We would need a physical object (probe) small and light enough to travel close to the speed of light and we also need to communicate with it. We currently communicate through the electromagnetic spectrum. Imagine that we do not have to travel as physical bodies on spaceships, but can travel as something small and many times more efficient at the particle scale.

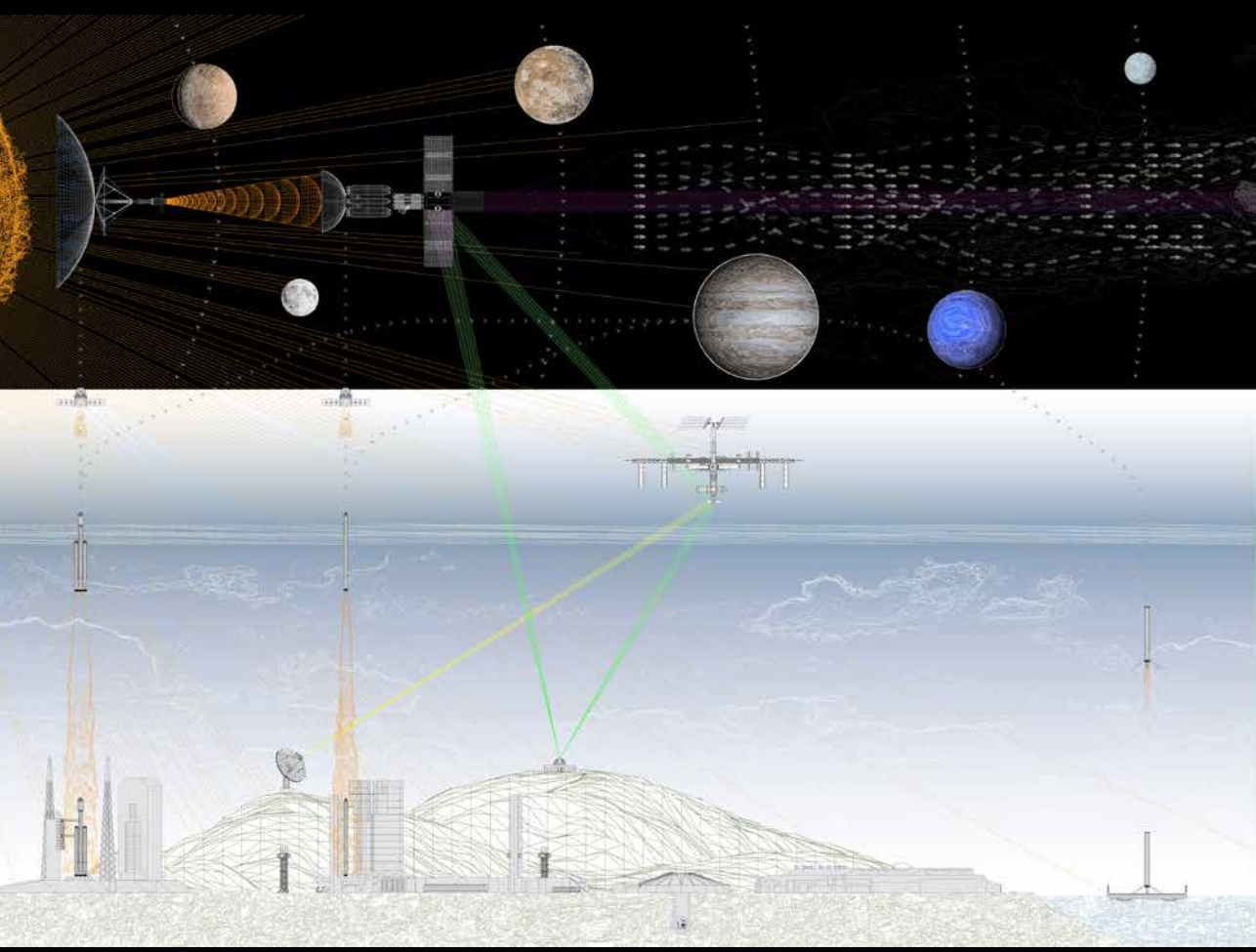
Light is a truly mysterious phenomena – the essence of life. We know so much and so little about it at the same time. We use it in our technology and we observe the cosmos by looking at light. It's a fundamental part of our lives and it is part of a whole electromagnetic spectrum that includes visible light, warming infrared rays and harmful gamma radiation. Light also plays a fundamental part in our knowledge about quantum mechanics which transgresses the classical laws of physics. It is both a wave and a particle. This is the foundation of quantum mechanics where our universe begins to seem like a work of science fiction – composed of dark matter, dark energy, black holes and wormholes through space time.

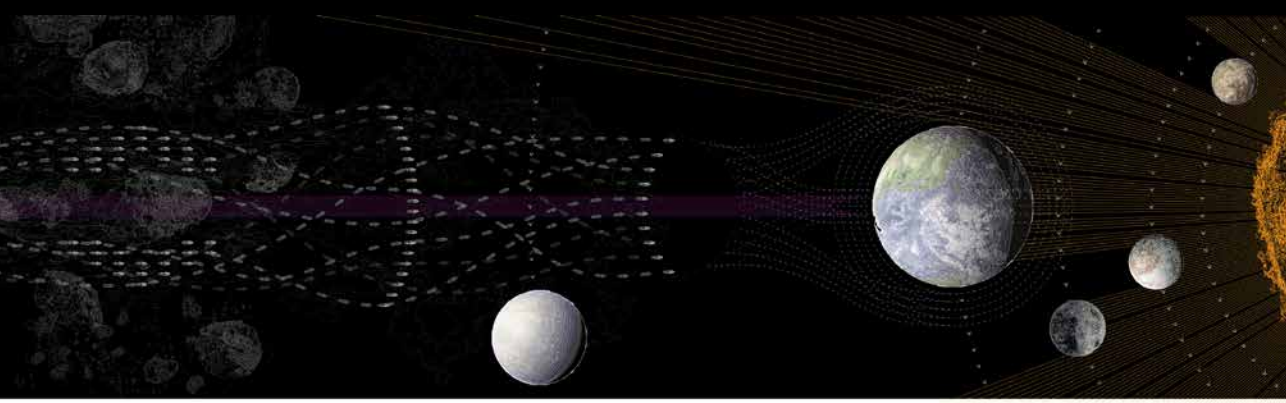
Since light is a quantum phenomenon it can behave 'spookily' – existing at two places at the same time. When a photon (a single particle of light), which exists in a superposition state, is split into two parts they become entangled in such a way, that when we measure one of them, the other will always have the opposite spin – either up or down. The same phenomena happen when we separate the photons over infinite distances. A third photon with different characteristics can also be imposed on entangled photons, where its state will be teleported. These principles can be demonstrated in laboratory settings and although they have not been fully resolved they can be considered as an architecture of particles.

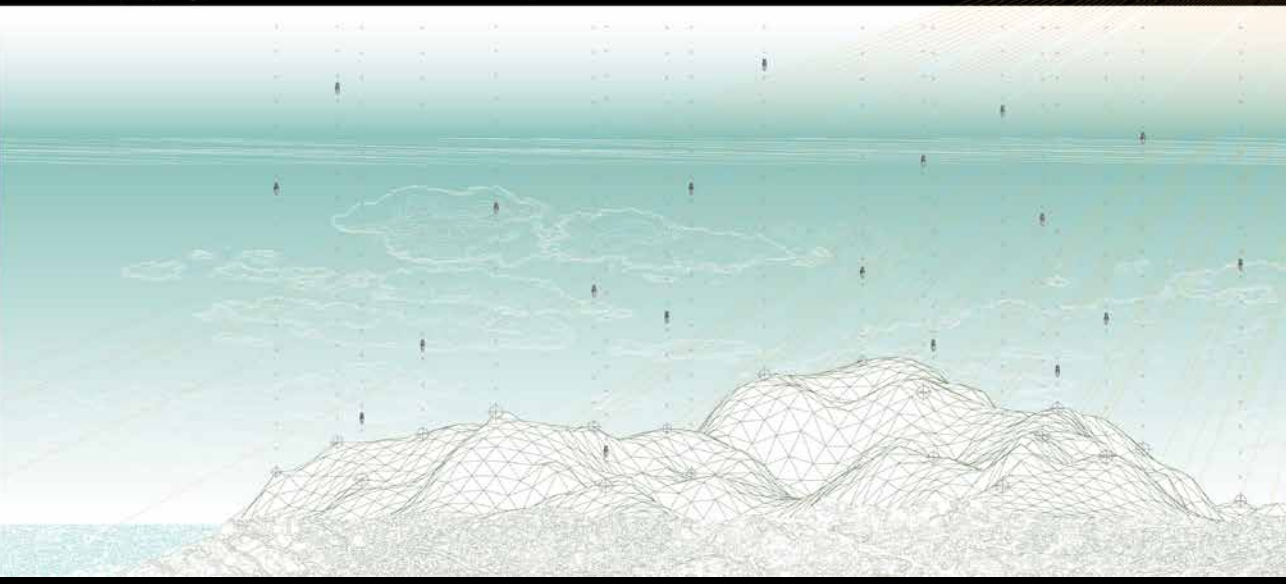
By studying these experiments it possible that some day a quantum entangled communication system would initially teleport information, but potentially also teleport matter. In its basic form the system uses the quantum effect of superposition, quantum bits and controlled decoherence time. Quantum tunneling allows us to map, locate and select these quantum bits. Quantum entanglement allows us to communicate with these bits beyond the speed of light boundary. And quantum teleportation uses

all of the above to get us closer to the ultimate goal of teleporting matter. One day we may be able to use these principles to transmit ourselves across the universe faster than the speed of light. Perhaps this could take place using micro-probes (seeds) with a built in quantum communication system. These information seeds would travel close to the speed of light and enable teleportation beyond the existing limits of space-time. Potentially they could precipitate molecular growth at a target location depending on the received information. This technology may be thought of as a wormhole – a short cut through space time – but not a natural wormhole that spontaneously occurs, rather a digital one made by human design. As human bodies we are unlikely to travel distant galaxies or even stars light years away. But our technological creations might just do that. Perhaps we may evolve so that our minds can travel to distant Earth-like planets, and our bodies grown from local matter using information as a framework.

PREVIOUS
Krists Ernstsons: Artificial Wormhole
OVERLEAF
Krists Ernstsons: All Seeds
CONTINUED
Krists Ernstsons: 18 Seed Masterplan



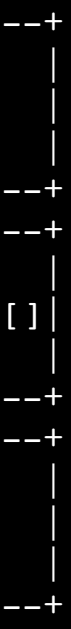




The Worldmaker

By Rachel Armstrong
(excerpt from Worldmaker, First published Paradox: Stories Inspired by the Fermi Paradox, NewCon Press: London, pp.212–4)

Conway: apply Conway rules



A tiny planet hums around its solar system 28,000 light years from the centre of the Milky Way, within the Orion spiral arm and about 20 light years above the galaxy's equatorial plane. Halfway between creation and its inexorable end, when the planet's sun collapses and warps within its own lifecycle to become a white dwarf star, this watery blue rock seems cheerily oblivious to its fate within the unfathomable vastness of the cosmos, whilst marvellously varied life forms flutter, strut and float their biorhythms over its pulsing surface.

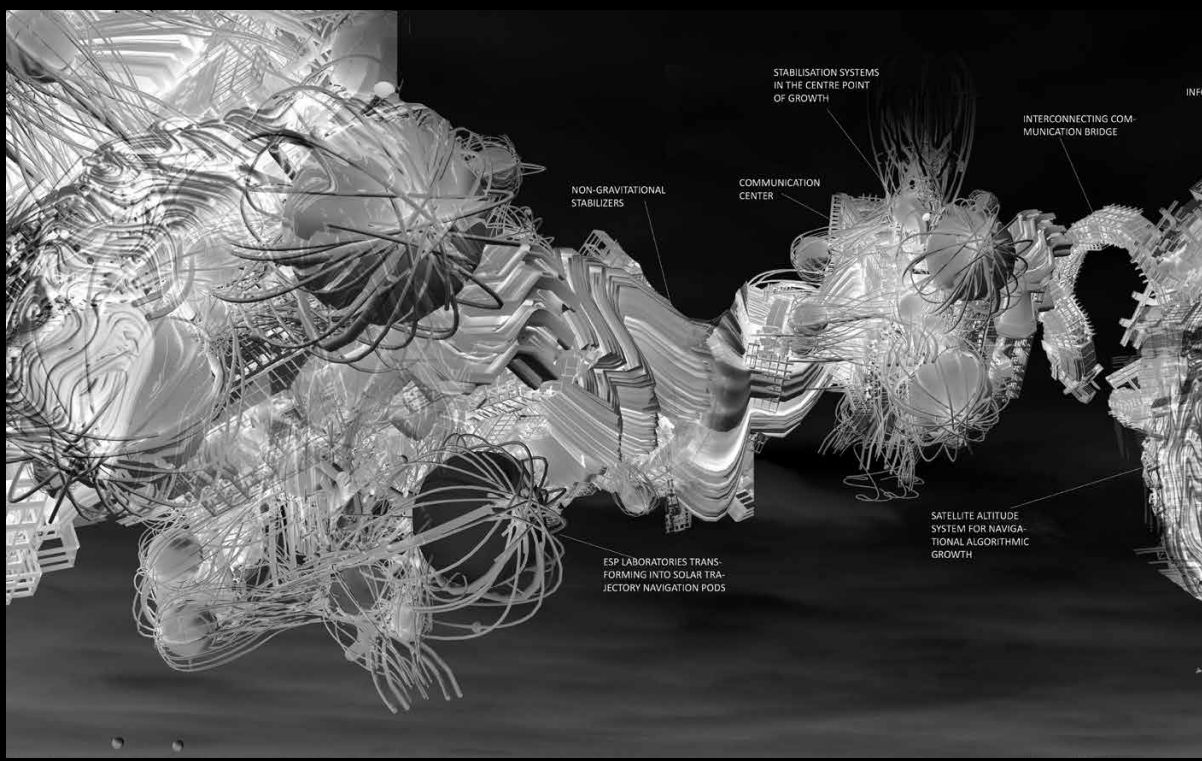
One species amongst these creatures is unique in its revelry of the noise that this world possesses. For not only has this organism developed anatomical and neural structures to listen to and understand its environment, it has also produced mechanisms to extrude the physical sounds of its body, augmenting and orchestrating them through new technologies. These creatures are also compelled to further manipulate their voices and synthesized vibrations, to examine them, exchange them, appreciate them, remember them, re-invent and re-interpret them. Whilst revelling in the noise of the terrestrial atmosphere and its own contribution to the global audiosphere, this species is woven into a web of local and environmental soundscapes, which are entwined with the planet's nitrogenous atmosphere, and bathes in the inaudible bass accompaniment of its communications networks.

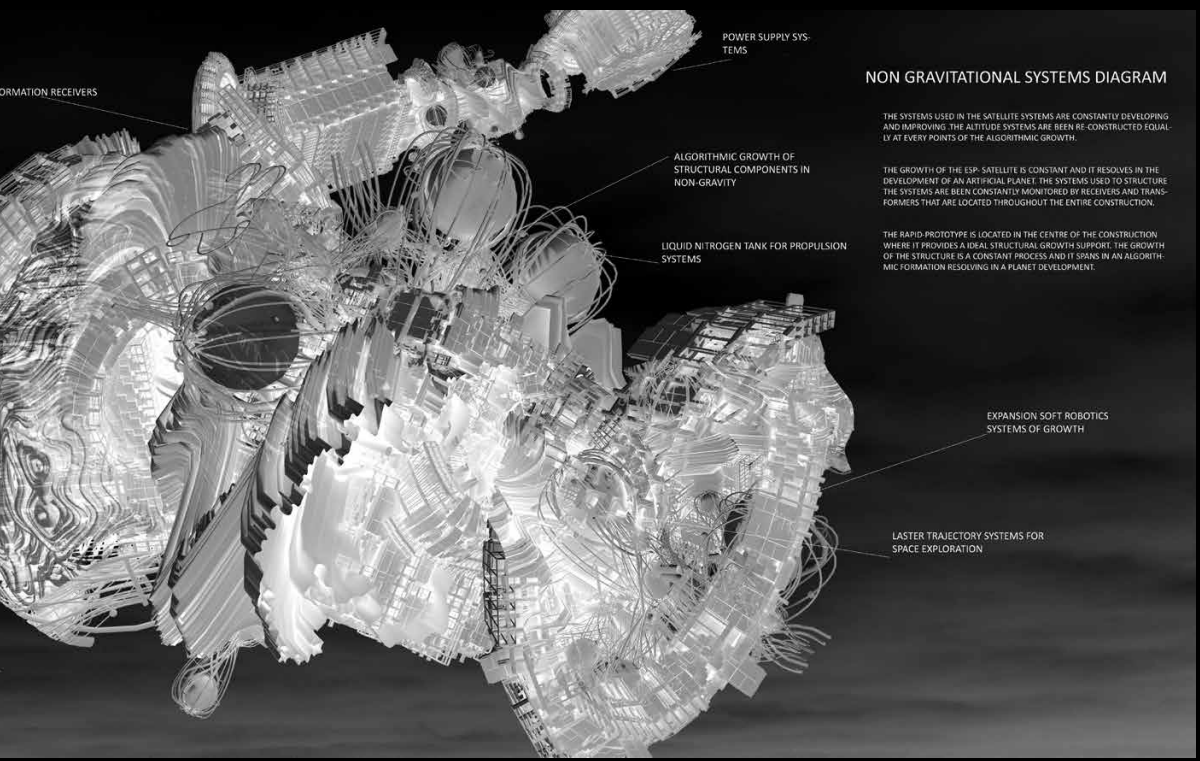
Amidst the whine of terrestrial noises that are twisted by geographies, cultures, histories and societies, these creatures derive a unique sensation that confers upon them such ecstasy that it is said to stir the intrinsic essence of their species. The sensation is called 'music', the vital essence is called the 'soul' and both phenomena are inexorably linked through vibrations. Hopelessly infatuated by its buzzing world, the music doting, soul-embracing species has even imagined that the whole universe is shaped according to the physical laws that encircle its throbbing planet, but this species is not satisfied with just shaping its own soundscapes and musical rhythms. They are compelled to create

powerful technologies capable of producing signals with giant wavelengths that travel outwards from the singing planet across the universe. Their gargantuan pulsations herald the presence of the human race with every domineering throb they yield. Shaking the atmospheres of other worlds to attention, they hope to find an audience for their music in anticipation of thunderous applause to shatter their silent, yet omnivigilant SETI networks. So as the reverberations of long range radio waves travel outwards from and reflect back onto the pulsing blue planet, the symptoms of the noise-mongering human race and its music-hungry soul find themselves facing extinction in the discourses of particle physics. It is therefore imperative that we connect in order to support and propagate the universal community of life.

OVERLEAF

Teodor Petrov: Satellite Growth Diagram


STABILISATION SYSTEMS
IN THE CENTRE POINT
OF GROWTH
INTERCONNECTING COM-
MUNICATION BRIDGE
NON-GRAVITATIONAL
STABILIZERS
COMMUNICATION
CENTER
SATELLITE ALTITUDE
SYSTEM FOR NAVIGA-
TIONAL ALGORITHMIC
GROWTH
ESP LABORATORIES TRANS-
FORMING INTO SOLAR TRA-
JECTORY NAVIGATION PODS



NON GRAVITATIONAL SYSTEMS DIAGRAM

THE SYSTEMS USED IN THE SATELLITE SYSTEMS ARE CONSTANTLY DEVELOPING AND IMPROVING. THE ALTITUDE SYSTEMS ARE BEEN RE-CONSTRUCTED EQUALLY AT EVERY POINTS OF THE ALGORITHMIC GROWTH.

THE GROWTH OF THE ESP- SATELLITE IS CONSTANT AND IT RESOLVES IN THE DEVELOPMENT OF AN ARTIFICIAL PLANET. THE SYSTEMS USED TO STRUCTURE THE SYSTEMS ARE BEEN CONSTANTLY MONITORED BY RECEIVERS AND TRANSFORMERS THAT ARE LOCATED THROUGHOUT THE ENTIRE CONSTRUCTION.

THE RAPID-PROTOTYPE IS LOCATED IN THE CENTRE OF THE CONSTRUCTION WHERE IT PROVIDES A IDEAL STRUCTURAL GROWTH SUPPORT. THE GROWTH OF THE STRUCTURE IS A CONSTANT PROCESS AND IT SPANS IN AN ALGORITHMIC FORMATION RESOLVING IN A PLANET DEVELOPMENT.

Falling/Catching: Onwards (Radical Love)

by Rachel Armstrong and Rolf Hughes

Hitch in time

You can get there,
I am sure.
Can you return?
Nobody knows (that means no).
But just think about it:
Everywhere you go – a new place.
To boldly go! and all that jazz.
Try it when you drive home tonight –
Turn off the radio, turn off your phone,
Turn off the highway and get yourself lost.
Turn off your lights, then turn off your engine.
It's only time – you have plenty of that, right?
And the night sky is not yet threatening day.

In the glove compartment you'll find an ageing photograph:
The day the aliens got hitched. There was a manual there too
Once upon a time, but that is long gone –
And the happy ever after never came.

Reality show

"VOLUNTEERS WANTED
For unending, unwaged journey in pitiless cold,
complete darkness, and constant danger.
Safe return impossible.
In the unlikely event of success,
Honour and fame guaranteed
– on prime time TV."

And still, they wrote from all over the world
Hundreds of thousands desperate to embark
On a one way trip
To colonise a new star system.

The lucky twenty thousand applicants intriguingly
Included eight thousand and three software developers,
Five thousand, seven hundred and ninety-eight information communications technology experts,
Six hundred and thirteen asteroid mineral prospectors,
Two hundred and forty-three military personnel,
A hundred and seventy-seven doctors,
Scores of women who wanted to
Give birth to the first extra-terrestrial child,
Ninety-eight artists,
Thirty-three physicists,
Twenty-six articulated truck drivers,
Eight billionaires,
Five astronomers,
And no rocket scientists.

‘We’ll be in training for ten years.
We’ll have learned to live away from family by then.
It can’t be so difficult.’

Researchers from the University of Kansas
Warned that high levels of radiation in space
Damage the ovaries and testicles,
Which likely hampers people’s efforts to reproduce.
They said they’d try, give it a go anyhow.

‘The most important thing in life
Is to leave a legacy.
We start training this year.
It’s more likely I’ll fall in love
With one of the team
Than someone ‘out there’.
It’s really exciting because
You’re watching a society develop.
It’s like seeing a country sprout from nothing.’

Their courage to continue ‘for ever’ onwards
Into the unknown at their own peril
Does not lie
Within the perfect circles
Of completed comforts, closed ecologies
Or winged serpents
Sedately grazing on their own tails.
Rather they speak over the
Worry knots that are woven through
Things left undone, unsaid, or
Unresolved – life’s disappointments.

‘It’s time for humans to begin somewhere else
I have the skills to make that happen.’

Their training completed
Away from prying eyes
In haunted senses abused
By compulsive disorders of
Grinding jaws and flattened teeth
Wrung hands
Traumatic alopecia
Holes that burst through pacing soles
Guilt stained anorexia
Broken minds, catastrophising through
Phantoms of injustice, regret, revenge
Reaching for covert relief in rosary and worry beads.

‘It is highly risky, and an enormous responsibility
As well as an adventure.’

Memories are riddled with radiation holes.
Wilful blindness masks
The physical devastation wreaked upon them:
Compelled by vaporous gravity
Limbs thin from leached calcium
That makes cataracts
And fills tender kidneys with stones.
Fat puddles into
Pot bellies and forms
Bilious blood clots.

Despite brutal exercise regimens
They succumb to
Extreme anatomical reordering
Whereby the authentic self
Can only be marked by loss of faith.
The only way of knowing that you're 'you'
Is when your beliefs are scarred up.
Where did the body go?
We cannot tell, for something other than flesh
Quite intangible now holds
Us together.

'Human space exploration has always interested me
The opportunity to be involved is really appealing.
The future of humanity is in space.'

In sleepless synthetic nights
Thought itself breaks down
And language fails to describe
Existential angst –
Its vastness, endlessness,
Hopelessness, dreamlessness.

'There is more to life than marriage and babies.
It'd be nice to escape the office
And have some AMAZING life experiences.
Leave the solar system.'

What used to be called
Madness is quite normal.
Only the brave, the foolish,
And those that are belligerent
To the difficulties of their frontier existence
Endure the ensuing conflicts, disparities.
Fractures within the Tower of Babel appear
Where the conditions for existence
Are continually contested as they
Jostle for territory, partners, power and beliefs.

Are we extraterrestrial now – or forever earthbound?

Exchanging a new language
They have left experience behind
And rejoice in a strange, savage music
Uncoupled from sense.

Constantly under the dark light
Of their interior star
Which powers their ship, their lives
They shake, they shake, they shake again.

Frustrated, they turn up the volume
Of familiar tongues
That suddenly seem
Uncomfortably strange
Crumbling in
Other times, worlds, existences.

Experience has become alien
There is no language for it yet
All those things you learned as a child
– the flow of water, the fall of sweet rain, sunshine on skin –
Now unbearably unfamiliar.
What exactly was it, this "normal" nature?
You feel the need for new words, new concepts, new histories.

'Technology will advance rapidly.
One day, I will come home to Earth.'

Dot, dot, dot … reboot.

Wakers logon reanimat vitals.
RUN: at purpose, in purpose.
Thawed cryoresurrection. Ritual
Via anatomia diurnalizes
Molecular data feed, quantum thought cloud
Swerves outmoded
Defeatist, deathist creeds.
Bodies, minds, flesh biolaced
In silicon, in vitro, in search of increased extropy
Centred on circus, art, community
What once were understood as human limits
Challenged in omnipresent neural networks
Through augmented bodies.
Science and technology not salvation
Continual enhancements
But form instruments – spirit music –
Building blocks of extremophiles.

Metal ions flavour the sweaty worldship dew,
Filter feeders slurp their soil soaked oceans
Nanofibre threads intrude on dreams
First as bright lights then
As radiation-repair shadows, which erase retinal scars.
Delicate biofilms laden with programmable physiology
Linger around them, like breath
Enriching organic flesh and emotional wellbeing.

So they weep awhile. At Heliosphere,
They weep: zero-four-four-twenty.
Zero-four-four-twenty. Four-four-twenty.
They weep to rituals of tear-stained forget-me-nots.
Synthbots. Aesthetic programs mourning old humanity –
A transitory stage in the evolution of cosmic intelligence.
It's always important to pay one's respects. And then a new day.
New kin. We are here. Yes, here we are.
In defiance of the gods.

*

Fallen

On Persephone, we have few plausible ways of marking time other than by the irregular eruptions of circus. These are joyous events indeed, drawing together all forms of life into a heaving crush of vitality and celebration – a Cambrian eruption of identities, indeterminate existence spandrels, revolutionary beings, magnificent mutants, deviant anatomies and counter-creatures. The long, silent stretches of darkness since the last circus are forgotten, and all surge together, rejoicing, screaming, howling and roaring as boundaries dissolve and fireworks shatter overhead – unruly clouds of nitrates, chlorates, perchlorates, phosphorous, oxides, smoky zinc, red lithium, crimson strontium, orange calcium, yellow sodium, brilliant green barium, blue copper, purple strontium, electric white aluminium, glittery antimony, sparkling iron filings and softly falling, glowing charcoal embers. You glimpse clowns in their luminous wigs and painted grimaces, magicians with flaming nipples and feather boas, acrobats flying and tumbling in and out of the throng, comedians making light of the dimensions of our existence, feats of abnormal strength or agility, satin costumes rubbed up against flesh, tentacles, murmurations of tongues, rainbow sparks illuminating the residual shadows cast by this sticky melding, the twisting entanglements of this monstrous vital stew. Those who come as one creature are transformed into many others – kinship is continually reconfigured and many are the new species conceived during such revels.

On a promontory overlooking the scene, there is a dilapidated shack from which hangs a sign faded into illegibility. If you have the courage to climb up to the hovel and push open the door, your eyes will need time to adjust to the dark within. It is the stench of squalor that hits you first. Then a fountain of decay - a gluttonous ejaculate of over four-hundred sickly-sweet volatile organic compounds – cadaverine, putrescine, lysine, methionine, methane, carboxylic acids, aromatics, sulphurs, alchohols, nitrates, aldehydes, ketones - microorganisms ripping apart rotting flesh. Mounds of rags are strewn across the floor, home to bizarre biofilms – flourishing associations between motile microbes and their photosynthetic partners bound together in elastic polymer nets whose uncertain nature sucks up whatever sustenance they can summon from their impoverished environment – dim light, scarce sulphide, rarefied oxygen. Microbiology slugs it out, not as single colony isolates on Petri plates or in broth cultures but in biological couplings and mats of undefinable biomass that hang, vulture-like, on excrements, tacky surfaces and plumes of air. Some of the rags appear to be inhabited by a larger form that writhes in slow motion. As your eyes start to distinguish shapes in the gloom you recognize the listless outline of a former tightrope walker who returns here as if by instinct, but each time in a greater state of decrepitude. He neither speaks nor gestures – his hollow eyes may be seeing or unseeing – his abjection is almost complete.

And yet some residual aura of grace clings like a shadow to his sunken frame.

To turn him into a spectacle would be shameful, I admit. I would be equally ashamed, however, to neglect my ritual visit to this fallen soul, even though the putrid stench and insect death-rattle of his hovel makes me nauseous. Not once have I offered any form of assistance or support that might, if only temporarily, alleviate his misery – I, who preach "radical love" to the hale and hearty. It is said that he came on board with an extended family and a reputation as the most daring rope artist of his generation. He failed to adapt and so fell into irrelevance and obsolescence.

I feel obliged to record his existence, even as the circus calls me anew, spitting forth pulsating bodies pressing against mine, their limbs soft as melting marshmallows, through which my own are threading,

entwining, grafting, while I submit gratefully to delirium and oblivion, but not before chronicling our creeping amnesia.

*

You could be forgiven for imagining that all might be possible

One of the most ingenious and admired technological advances of recent years is, in my opinion, the so-called *Persephone Project* star ship, which has been ferrying generations to future worlds for several hundred years now and still shows no sign of wear, obsolescence, or the sort of conceptual irrelevance that afflicts most bright ideas after the first dazzle of their novelty has worn off and they become reviewed through the tarnished rear view mirror of several centuries thence.

The charm of the so-called *Persephone Project* (and what a shame nobody saw fit to engage a poet from the outset to conjure up a more engaging and enduring name for a project that, after all, represents a wonder of human ingenuity) is that every few decades people of all ages and characters enter its intriguing ecological succulence and willingly bed down for the long journey ahead, for which, as everyone knows, there are no (and never have been) guarantees of success.

I applaud these brave souls. They want life.

I myself have had the honour of being present at a number of these admission ceremonies – each one being a pageant of life to be savoured. The buzz of excited preparation, tight embraces, protracted farewells to loved ones, the mélange of odours from quayside vendors roasting their chestnuts, spinning their candy floss, turning their engorged and dripping *roti-sans-pareil* on the spit – all this and more (for, not being an expert in the field, my powers of description are distinctly limited) create a sense of how vital life becomes in the *act of transition*.

Story-sellers promote their wares – *enough tales for a thousand years and every moral eventuality!* – while porters check in and sort luggage, for everything on board Persephone, on being relinquished by its former owner, must be carefully evaluated, weighed, and juxtaposed with other goods to ensure the most serendipitous outcomes. The restaurant at each terminus does a brisk trade as those about to depart and those remaining on earth enjoy a last supper, lunch, breakfast or snack together. Musicians plays songs of love or loss, and fruit sellers press their cherries and pears into your hands as mementoes of all you are about to leave behind.

Some peddle brochures of distant planets, with special offers for 'early booking' at favourable locations or luxury residences. The existence of such deliriously desirable dwellings having never been verified, these brochures are sometimes classed as harmless fictions, other times as fraudulent deceptions.

As you walk through the hubbub, you could be forgiven for imagining that all might be possible. Civil rights groups are present with their exhibitions and leaflets. Extra-terrestrial educational curricula abound.

On a warm summer evening, once the animals are fed and the kin absorbed in their various games, I like to hoist myself into a hammock and gaze at the dome of overhead stars. I imagine the steady procession of interstellar space craft crossing between worlds we lack the imagination to imagine. Antiquated as Persephone's technology is by today's standards, nobody can shrug off its significance.

What we create must always be superior to what we think we are.

And this is perhaps the greatest contribution of those wily, early pioneers behind the project, something they surely discussed or had in mind when the earliest prototypes were still being sketched through drawings, circus, science, poetry and magic. In facilitating departures, adventures, and promises of better futures, Persephone became a device for articulating what had hitherto remained too often unspoken – the expression of hope, belief, desire, and love (their term, I understand was *radical love*) – and this is why Persephone was known for several centuries, until its supposedly 'radical' impulses were accepted as indeed our only hope of survival, as an *instrument of revolution*.

Radical Love

It's important, holding on.
Each new day dawns and re-dawns.
New kin coming and going.
I do not want to leave this world
This black sieve in the stars
Memory's dark residue.

Nor do I want this world to leave me.
The ways I have walked with rain in my hair
Shaking the sky until the stars fall softly like figs,
Hearing the click of the door,
Your return, entire galaxies
Swelling and ebbing in your warm hands
Wrapt around our inflamed core of speech
Small graphite pixels –
Defiance of the gods.
Black light.
This thing we have studied and observed
This cosmos –
Sunless, dappled twilight at the back of your retina.

Drift

Drift

Caught.