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SPACE SCIENCE IS ALIVE WITH ART

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ABSTRACT

The history of human space flight and analogue and ground-based space science is alive with art. Artists, scientists and engineers working together build upon diverse frameworks of understanding, but also share tools and processes of investigation. By jointly stepping into new worlds and territories – with common purpose and mutual respect for curiosity – there emerge opportunities for encounters that offer an alternative viewpoint on things. Artists can introduce a *meta*-perspective (taking a step back and inquiring into the practice of research), a historical, conceptual or aesthetic view, all of which can invite those who are researchers, engineers and inventors toward new insight and discovery. Scientist's methods of inquiry and their particular ways of dealing with natural phenomena and technology can also be a great source of inspiration for artists. Often with technical curiosity, artists can also contribute to concrete R&D just as science can directly impact art and inform aesthetics. So combined, the different philosophies, the experiments and the field work can lead to collaborative outcomes that are positively contributing to research, exploration and advancement.

Artist and biologist Angelo Vermeulen has been working together with the European Space Agency (ESA) MELiSSA research program since 2009. In response to the ESA invitation to reflect on the development of future space habitats, Vermeulen set up SEAD (Space Ecologies Art & Design), a platform for artistic research on the transfer of terrestrial ecosystems to space to facilitate space settlement. Artist and diver Sarah Jane Pell has been working with the underwater technology and biotechnology community since 2003. She joined NASA's Luna Gaia team and the League of New World Explorers analogue space subsea habitat exploration mission Atlantica in 2006.

Current and future work by these, and similar partnerships, illustrates a dynamic culture of fieldwork, lab protocols/studio practice, research and development, experimentation, demonstration/exhibition, publication and dissemination made possible by including artists in the fields of science and engineering. As 'real' collaborators, artists can truly move science and engineering forward; and by co-creating art works, they can improve science and technology communication. Collaboration between the arts and science should therefore be encouraged and fostered.

1. INTRODUCING A METAPERSPECTIVE

The following work of Vermeulen and Pell demonstrate that an arts approach alters the research perspective in the fields of science, technology and engineering and, in doing so identifies uncharacteristic pathways for the transfer of knowledge which can stimulate new questions, pose new challenges, and often new insights.

2. SEAD (SPACE ECOLOGIES ART DESIGN)

It is clear that Vermeulen's original PhD training in ecology, environmental pollution and teratology plays a crucial role in his art. Vermeulen creates art installations that are often open, experimental setups that incorporate ecological processes and living organisms. In 2009 he launched 'Space Ecologies Art and Design (SEAD)', which will be discussed herein as a platform for artistic research on the architectures and bio-politics of space colonization, and that which led him to start a new PhD at Delft University of Technology in 2011.

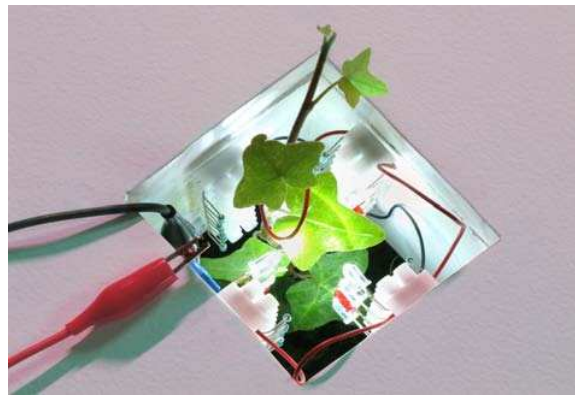


Figure 1. First Room for MELiSSA, 2010.

2.1 First Room for MELiSSA, 2010

First Room for MELiSSA [Figure 1] is the first art project presented by the independent research platform Space Ecologies Art and Design (SEAD), and was realized for the international art exhibition Coup de Ville in Sint-Niklaas, Belgium in 2010. The work is a text-based architectural integration that offers a multi-layered reflection on the issue of human space colonization and biopolitics. It was specifically conceived for the attic of the oldest building in town, the 16th century Walburg Castle. [Figure 2-3] As such, past and future, historical architecture and space habitation are brought together into an unusual dialog.



Figure 2 – 3. First Room for MELiSSA, 2010

First Room for MELiSSA is the first collaboration between Angelo Vermeulen and Tine Holvoet. Production: WARP. Production assistance: Helix. Graphic design: Raf Vancampenhoudt.

2.2 BODYREACTOR, 2011

BODYREACTOR is a workshop, installation, and social network by Angelo Vermeulen and Tine Holvoet. Vermeulen and Holvoet introduce theatre and performance students to the complexity of human corporeality in outer space, and invite them to explore the ideas within their personal creative practices. A collaboration with the MELiSSA research unit of the European Space Agency (ESA) lies at the basis of the project. MELiSSA is the European model for a regenerative life support system for astronauts, and allows the production of oxygen, water and food, and the recycling of organic wastes and carbon dioxide. A bioreactor with a bacterial culture of *Rhodospirillum rubrum* is on loan from MELiSSA, and forms the heart of the installation. [Figure 5-6] BODYREACTOR was created for (Exhibiting) Baroque Bodies at the Beursschouwburg in Brussels, Belgium. This event ran from November 21, 2011 till December 3, 2011.



Figure 4. BODYREACTOR, 2011 Workshop participants taking the bioreactor apart.

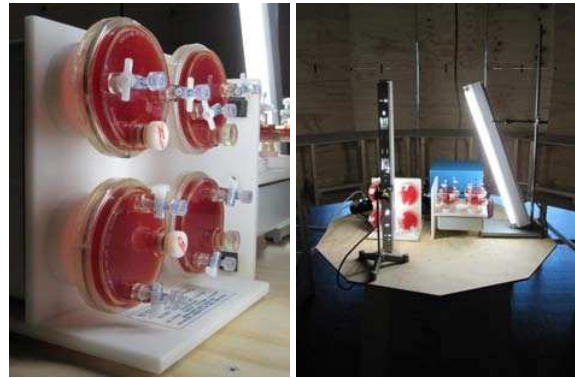


Figure 5 – 6. BODYREACTOR, 2011 The rotating wall vessel bioreactor in the center of the sculpture.

The final installation of BODYREACTOR exists as modular social sculpture built around a rotating wall vessel bioreactor from ESA's MELiSSA team. [Figure 7] The entire structure is drawn upon space exploration structures such as the Apollo Lunar Lander. It consists of an ingenious combination of floor panels, chairs and tables that can be taken apart at will. Design by Dik Scheepers & Marco Iannicelli, with Angelo Vermeulen & Tine Holvoet.



Figure 7. BODYREACTOR, 2011 Installation view.
Photo: Mikael Falke

2.3 H4aC (Habitat for a Commensal), 2012

H4aC (Habitat for a Commensal) is currently being developed for the KANAL contemporary art festival in Belgium, curated by Christa Vyvey and Michel Dewilde. Eight artists have been invited to create public art works in collaboration with local companies along the 19th century Roeselare-Leie canal. Angelo Vermeulen has designed a space habitat sculpture together with the engineers and workers of the A&S green energy plant in Oostrozebeke. [Figure 8-9] The art work refers to the global energy crisis and the world's technological future. Its outer structure is inspired by space exploration and planetary settlement. [Figure 10] The interior will be inhabited by alternative life forms 'feeding' on the energy plant. [Figure 11]



Figure 8 - 9. Building the outer framework of H4aC - A crane truck is lowering the dome for the main module. A similar dome is attached at the underside creating a symmetric volume. Photos: Steven Vandenbulcke



Figure 10. Umbilical that physically connects the art work H4aC with the power plant. It is used to transport energy, and data for the artificial life form inside H4aC. Photo: Steven Vandenbulcke

3. SPACE ANALOGUES & FIELD TRANSFER

The fields of arts and sciences are not in opposition. They are parallel and they twist and intersect at multiple junctions as if an intertwining of the very building blocks of life itself. The history of human space flight and analogue and ground-based space science reveals many types of relationships with artists and scientists, engineers, and technicians co-creating across fields of expertise and inquiry. [1]

Studio practice – much like experimental lab work or blue sky research – embraces concepts and strategies of imagination, intuition, play, improvisation, emotion and being indicative of the organic or biological processes integral to the SEAD projects of Vermeulen: but equally all key ingredients atypical of the activities and practices of both artists and scientists in pursuit of new research, discovery and innovation.

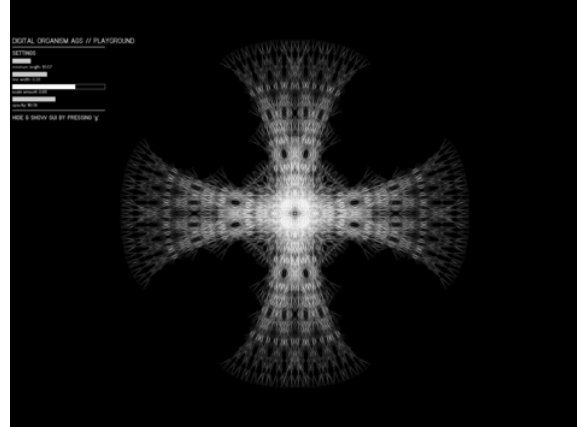


Figure 11. Preparatory study for the artificial life form inhabiting the sculpture: H4aC, 2012. The structure feeds on data from the energy plant's internal processes. Coding by Pieter Steyaert

Like many artists, Vermeulen and Pell share broad technical curiosity. Working with/in science, artists can contribute a novel technicity – recombining, mashing or patching tools, processes, and languages, philosophies.

3.1 Aquabatics Research Team initiative (ARTi)

From inner space to outer space, ocean space to deep space...artist and occupational diver Sarah Jane Pell is inspired by the space analogue environment of the ocean. The development of her live-laboratory-style performances and ongoing research into the aesthetics of life support depends on deepening her intimate understanding of, and relationship with, the protocols, technologies and investigative strategies used by explorers and researchers of these fields. Pell established the Aquabatics Research Team initiative (ARTi) to explore human performance, behaviours and limits underwater and the liminal state of being occupied through which the performer becomes and she calls: aqueous. She must therefore literally dive in. She is a fully qualified occupational diver and crew member.



Figure 12. Hydrophilia, 2006 Tract Live Art Festival Newlyn South Quay, Penzance UK by Sarah Jane Pell

By contrast to Vermeulen, Sarah Jane Pell's original PhD training in visual arts and human performance plays a critical role in her engagement with human space flight, analogue and ground-based space science. By transferring a performance-as-practice-in-research approach to apply to scientific methods of inquiry and entrepreneurship, Pell delves into the architectures and biopolitics, (or the aesthetics of C.A.R.E. Cultural Awareness Responsible Ethics) of extreme environment habitation – usually underwater – as both researcher and research subject. Her autobiographical or philosophy-in-action approach to both art-making and civilian in-situ space analogue research is deeply seeded across many arts and cultural traditions and discourses, yet within the context of a lab; an analogue or space architecture, or during field work, is considered highly experimental – even unethical.

Therein in lies some of her critique – the more sophisticated the technological and scientific advanced life support systems, the greater the protective architectures and more efficient the counter-measures, the greater separation from the human: bios, logos and pathos, and greater the dependency on the environment.

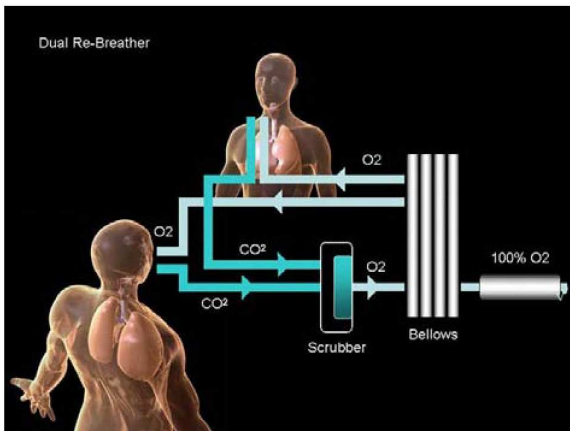


Figure 13. Dual Rebreather Study by Sarah Jane Pell



Figure 14. Dual Rebreather MKI - designed, constructed and demonstrated by Sarah Jane Pell & Martyn Couatts. Photo: Poets of the Machine



Figure 15. Self-Contained Emergency Re-breather Pack – designed, constructed and demonstrated during a performance titled 'Odyssey' by Sarah Jane Pell.

3.2 Luna Gaia: a closed loop habitat for the Moon

In 2006, Pell joined an international team of scientists, engineers and graduate students, to architect Luna Gaia: a closed loop habitat for the Moon designed to provide up to 12 astronauts with fresh vegetables, fish, spacious rooms and clean drinking water (albeit recycled from their own urine). The group designed a self-sustaining habitat [Figure 16], which harvests solar energy and reuses all of its waste, while attending the International Space University in Strasbourg, France. Now, with interest in the moon accelerating thanks to NASA's focus and Google's new Lunar X Prize, Luna Gaia is proving to be more than just an academic exercise. The Luna Gaia design solution focuses on optimizing the synergy between all regenerative processes of a network of closed loop life support systems. It also details the ethical and philosophical considerations of a lunar settlement and the wider implications for international law, policy and future interplanetary governance. It highlights the advancement of earth-based application of these processes and recommends strategies for effective information transfer and handling through education, media communication, outreach and advancement of futures research.



Figure 16 – 17. Luna Gaia: closed loop Lunar habitat design 2006. NASA Inflatable Habitat Model 2012

In the past few years, the team has presented the plan to several space programs, including NASA, which may incorporate ideas from Luna Gaia into its own lunar outpost, planned for post 2020. [Figure 16] This is a great result for science, technology and engineering, but equally, from an artists' perspective, the very nature of the international, interdisciplinary and intercultural space project continues to build on the key themes that under-pin both art and space science: discovery, experimentation, visualisation, invention and insight.

3.3 LNW Undersea Habitat Mission – Atlantica I

Also in 2006, Pell was invited as official crew of The League of New World Explorers undersea habitat mission. [Figure 18] The mission architecture is in two phases: Atlantica Expedition I & II – to be carried out in unique, purpose-built habitats in Florida: The first phase includes a 90 day expedition designed to develop, refine and demonstrate an array of technologies, philosophies and zero-waste strategies – commencing July 2013 (all things going to plan). The second phase will see invited 'colonists' time-share their occupation of the Challenger underwater habitat as a longer-term space analogue.

"These efforts do not represent an underwater hotel, an outpost or a way-station, or a laboratory. They will establish a human community: The first humans who will relocate there and stay with no intention of ever calling dry land our home again. They represent the first generation of a people who will live out their lives beneath the sea." – *Aquanaut Dennis Chamberland: Sci-fi Author NASA Bioengineer Atlantica Expedition Commander*

The League of New World Explorers Atlantica Expeditions – much like the phased Luna Gaia missions – are an ongoing opportunity to look at new designs, new material, and new technologies that will transform how we live, thrive and survive in future underwater and outer space environment. This is an opportunity to design, prototype, and establish a principal real human performance laboratory with careful architecture and execution according to a shared vision: to enable future generations' the opportunity for continuous, viable, ethical and sustainable human undersea habitation.

While responsible ocean stewardship and diving take priority on this mission, Pell is mindful of making contributions to biological enhancement space technologies (theoretical and actual) and to broader human performance investigations. In parallel to, and in support of the pursuit of responsible environmental stewardship, and in-situ, live ocean diagnostics, Pell and her fellow crew are each preparing their own art and science proposals. As 'real' collaborators, explorers, inventors and artists can truly move science and engineering forward; and by co-creating art works, they can improve science and technology communication.



Figure 18. *Atlantica Expeditions I & II Architectures & Outreach Images: The League of New World Explorers.*

Pell and Vermeulen are world-renowned for presenting new media, fine art and performance or living-mechanical artefacts for exhibition, public screening and outreach including space art payloads, field work – including remote or extreme installations from undersea to open desert – and the construction of public architectures and facilities. It is not the specific requirements, languages or expectations of each respective discipline or thesis they transverse, or the trajectory of professional development from the arts to sciences, the sciences to arts rather, it is their vision, curiosity and tenacity for inter-field-knowledge transfer.

Scientist's methods of inquiry and their particular ways of dealing with natural phenomena and technology can also be a great source of inspiration for artists. For example, consideration of the human rights of space farers and future colonists; the body-shocks and long-duration bio-stressors; the effects of exposure to the inhospitable environment of the protective architecture/suit/station/settlement/vehicle; the isolated extreme environment on human bio-feedback and body memory systems; the intersections between biology, ecology and technology and the implications this has for future genetic behaviours, desires and requirements is an open source of artistic and academic inspiration for artists like Pell and Vermeulen. The spin-off and spin-in potentials are enormous – while the results are often surprising and measurable in non-traditional science modes – they are often equally profitable and engaging and therefore should be harnessed to the fullest.

3.4 Biological Enhancement Space Technologies

With this focus and conviction, when Pell was invited to NASA Ames in 2010 to the Singularity University to co-author the NASA/SU report, 'To Boldly Stay' [3] she launched an interdisciplinary think-tank 'Biological Enhancement Space Technologies (BEST)'. BEST was imagined as a platform for attracting formal partnerships and joint activities with international space

enterprises – yet much of the research has grown from Pell’s pre-existing practice, networks and own artwork. Notably inspired by and her 5 year involvement with Atlantica Expeditions and various collaborative with human space flight and ground based space analogues, Pell saw the opportunity and need to align artist-directed movements such as Vermeulen’s SEAD group and Pell’s BEST think-tank within the public realm. The outreach helps to develop the global community, strengthen technological know-how and biopolitical sensitivity. It creates platforms for collaboration so that new hybrid work and approaches to art-making and cultural practice is applicable to global human spaceflight mission technology needs *and* contributes to commercial competitiveness in private global markets – *whilst* providing the cultural, poetic and aesthetic framework for wider public engagement and debate.



Figure 19. 3DPrintMe – Speculative Future Installation by Sarah Jane Pell for Biological Enhancement Space Technologies – Human+, Science Gallery, Dublin 2011

In 2011, Pell wrote a mission statement with Connor Dickie suggesting that BEST design transformative technology in conjunction with site-specific models and behaviours – then added the postscript in 2012 – to critique the trajectory of societal thinking and progress. The ethos proposes that, ‘what may seem experimental or speculative by the standards of today, will be common pathways of innovation tomorrow.’ With bold purpose to seek to visualize and define such pathways, BEST intends to contribute innovative design solutions to meet current global grand challenges and create the next generation of tools required for a sustainable future in extreme environments such as the extremes of Space, Polar and Ocean territories as artist-researchers *and* provocateurs of deep thought and critical discovery. Perhaps art could inspire human space flight & ground based science and analogues too one day.

4 RECOMMENDATIONS

There are many aspects of “art and science” that can contribute, inspire and support the advancement of space and space-related activities, with multiple positive spin-off technologies and creative strategies for enhancing quality of life on Earth. Rapidly accelerating advances at the intersection of biology, technology and computation indicate opportunities for new space-related design and engineering approaches. Collaboration between the arts and science therefore should be encouraged, supported and fostered.

The human space flight and analogue and ground-based space science community should be encouraged to embrace unique and innovative pathways enabled by exponential growth areas and creative and cultural practitioners. Artists, scientists and engineers working together build upon diverse frameworks of understanding, but also share tools and processes of investigation. By jointly stepping into new worlds and territories – with common purpose and mutual respect for curiosity – there emerge opportunities for encounters that offer an alternative viewpoint on things. Combined, the different philosophies, the experiments and the field work of cooperative arts and science can lead to collaborative outcomes that are positively contributing to research, exploration and advancement.

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6 PROJECT WEBSITES

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- <http://www.sarahjanepell.com>
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