ERICA SECCOMBE

Relocating the real: experiencing nature in the fifth dimension

Abstract

To address the theme of the panel, *Art, Environment, Interdisciplinarity: New Perspectives in Australian Art Practice*, this paper looks at the potential in my work to create an opportunity for a subjective experience of the virtual representation of a natural phenomenon, as a way perhaps, to consider deeper questions about life and the future of our planet. I will discuss various aspects of my interdisciplinary practice-led research project *Grow: visualising nature at nanoscale*, to show how my investigation into the visualisation of virtual datasets of germinating seeds is leading to the creation and resolution of a major body of work for examination. I will describe how the virtual data from 4D Micro-CT enables an audience to experience seed propagation at a scale enlarged well beyond the natural proportion of the original process. Because I do not want to create purely didactic or illustrative works with this science and technology, I will also discuss how I intend to engage the viewer by using phenomenological methods in order to create sensation, meaning and affect in my work. Therefore I will elucidate why I am proposing that an individual's subjective experience of virtual nature in this work can be considered as an additional fifth dimension.

Relocating the real: experiencing nature in the fifth dimension

My practice-led research project *Grow: visualising nature at nanoscale* investigates the aesthetic possibilities of computational extension of vision with 4D X-ray Microcomputed Tomography (4D Micro-CT). 3D Micro-CT is a non-invasive process that uses X-rays to capture cross-sections of a static object that can then computationally simulated as a high-resolution virtual model. 4D Micro CT is the same process that includes an additional dimension of time, capturing dynamic phenomena of and around an object while it is subject to change. With this science I have attempted to capture the transformation of edible plant seeds as they germinate, from embryo to first leaf stage. I am visualising this data in a custom-designed scientific volume exploration and presentation tool known as *Drishti* (meaning insight in *Sanskrit*), producing virtual time-lapse datasets that are exhibited as immersive stereoscopic projection installations.

As I am exploring frontier research into 4D Micro-CT visualisation the results of my project are shaped by the possibilities and limitations of the science and technology I am utilising. However, the rationale for propagating seeds with 4D Micro-CT is not just to test the capabilities of this modern science and technology. I also want to consider questions surrounding a cultural relationship with the natural environment through a contemporary visual art practice. I am investigating the potential for my own work to meaningfully engage an audience with the concept of nature, even though the materiality of the 'real-life' phenomenon of a germinating seed has been relocated to exist in a digital platform. So in consideration of the third and fourth dimensionality of the data I am exploring, I am proposing that an individual's experience of nature in my work can be understood as an additional fifth dimension.

My understanding of the fifth dimension in this context is based on the artist Olafur Eliasson's concept of the sensory properties in his own installations, which are often about the transposition of 'nature' into a constructed environment. He describes the dimension of engagement as an additional fifth dimension, 'because it allows for a greater relativity in our understanding of the other three or four dimensions.'[1] Eliasson's practice is based on the principle that sensation as a quality is as important as the object its self. He views the fourth dimension as time or temporality, the third as being the object/subject, and the fifth dimension as a necessary component of the perceptual process which works to destabilise the truth, or objectivity of the work, and transform it into an individual experience.

I am interested in the ways the augmented lenses of contemporary scientific imaging can also engage us with the natural world through both a process of rational observation and subjective experience. Yet, I am also curious about a possible disjuncture between the physical experiences of living in a natural world and our becoming more dependent on technology and science to mediate our experience and knowledge of nature to us. This questioning has lead me to look at recent research that reviews the phenomenological practices of artists such as Olafur Eliasson, whose work is now being considered a more effective model for engaging individuals with scientific concepts such as environmental change. Further on I will discuss a selection of contemporary readings on virtual data and phenomenological practices in contemporary art to reflect on my own practice-led research.

However, to begin it is important to clarify the idea of 'virtual data' in my work. The datasets I am visualising of germinating seeds are not derived from fragmentary evidence or rendered through mesh framing techniques used in conventional computer generated imagery, CGI. These volumetric datasets are instead the algorithmic recreation of the actual real-life seed, each volumetric (3D) pixel representing its real-life counterpart at five microns [see *fig.* 1.].With this science I am capturing the most precise virtual model possible of the seeds in the process of germination, simulating the texture and material density of both the internal and exterior structure as the seed begins to sprout. It would be impossible to recreate the ambiguous textures and translucent effects of these germinating seeds using mesh frames.

My premise for germinating seeds is to capture a moment that life comes into being and it is motivated by my concern for the future of our planet's natural resources and biodiversity. Rather than using native or endangered species I chose seeds that have short germination periods and are familiar edible varieties that are grown in crops, in domestic gardens or on windowsills. Historically seeds are a symbol of life, of fertility, abundance, good luck and were also a very early form of currency. Harvesting seeds continues to be essential to the survival of nomadic and settled communities, and our modern civilization is founded on the ability to cultivate crops. We are now living in an era that is experiencing the rise of mega-farms with maximum crop and stock production quotas relying on innovative agricultural production technologies and genetic engineering.

This year the total world human population is estimated to have reached a record 7.2 billion, and a recent United Nations report projects that this population will grow to 9.6 billion by 2050. Over these next four decades it is forecast that there will be at least a 70 per cent increase in food demand that will see, for example, current crop yields being doubled to feed a global population. Arable land, water and fuel will

[1] Grynsztejn, 2007, p. 53.

be far more prized and hard fought over than it is now. A majority of us will have to rely on food grown or grazed and transported from outside of our highly urbanized societies. Our carbon footprint is extensive. Without even calculating other potential threats such as global warming, this significant surge in human industry, consumption and waste is already having a major impact on the world's natural resources and it is modifying the landscape at a considerable rate.

It is estimated that that at least one quarter of the world's species of plants today is already threatened with imminent extinction, this being primarily due to human activity. Scientists have long argued that the sixth major mass extinction of life on Earth is well underway, but unlike the previous five this one is predominantly due to the impact of human population and it is happening faster than any other mass extinction in our planet's history. As writer Caspar Henderson comments on the mounting scientific evidence, 'the extinction crisis is so vast and complex that it almost repels thought.'[2] The paradox is that in our culture that relies predominantly on the authority of scientific evidence, our politicians, stakeholders and the broader community are pulling scientific directives on these critical environmental issues into question, creating a culture of inaction instead.

To understand more about seed conservation and scientific imaging of seeds, in context of my research project, I stayed at the Millennium Seed Bank in the UK as a resident on a research field trip for two weeks in 2012. Established by Kew Royal Botanic Gardens, the Millennium Seed Bank facility is based at Wakehurst Place on 565 acres of natural reserve in a relatively remote corner of West Sussex. It is a working research laboratory and seed storage facility that aims by 2020 to contain over 25% of the world's plant species identified to be from regions where plant life is under threat of extinction. These seeds are collected through conservation programs in as many countries as possible, including Australia, and the seeds are kept and maintained in the hope of preserving the world's plant biodiversity in the face of potential catastrophes.

In a secure vault embedded deep beneath the building there is more diversity of plant species in this one location than anywhere else in the world [see *fig.* 2.] The vault is accessed down a narrow descending spiral staircase onto a shiny metal platform. A huge steel bolted door leads to a massive underground room lined with reinforced concrete. Inside scientists in white lab coats work around a central bench, patiently sorting, weighing, measuring and counting seeds, peering through microscopes and tagging bottles. Along the walls other doors with round porthole windows give views through to cold rooms where thousands of labelled bottles full of collected seeds are shelved in -20 degrees centigrade. Many seeds can stay dormant in these dry and freezing conditions for decades or centuries, but other species such as tropical varieties have shorter preservation times or are impossible to store.

Dr Wolfgang Stuppy is an internationally renown and leading seed morphologist at the Millennium Seed Bank and I was privileged to spend some time with him during my residency. Stuppy is a specialist in the field of botanical evolution and conservation, which includes the understanding of the dispersal, anatomy and structure of seeds and fruits. His full colour publications, such as *Seeds – Time Capsules of Life* (Firefly Books, 2009), are based on his research and aimed at

[2] Henderson, http://www.theguardian.com/books/2014/feb/14/sixth-extinction-unnatural-history-kolbert-review, accessed, Friday 14 February, 2014

bringing to the attention of the general public the unique and unseen beauty of seeds and pollen as seen under the powerful electron microscope. Stuppy's electron microscopic images of seeds and pollen are exquisite. Blown up in a scale that is well beyond the proportion of the original microscopic object, these delicately coloured forms are revealed to have intricate mathematical surfaces and hyperbolic structures. Unless we are involved in the sciences, very few of us will ever have first hand experience of imaging material in this way.

However, Stuppy's images are visual constructions. As he explained to me, the electron microscope focus is so powerful it only captures a fraction of the surface of the seed or pollen at any one time. To create the whole image, Stuppy stitches the fragments together in a graphics program, cleaning, fixing and contrasting the object to give the layperson a better visual understanding of the complete object. The raw images are in grey scale so the final colouring effect is a later addition by the artist Rob Kesseler. While the image exaggerates the truth of the original data, the super-realism of these final images adds to the dramatic visual experience. Scientific microscopy seeks evidence to support a hypothesis, reducing the object down to its very elements for examination. Yet by bringing these seeds to our attention in this highly aesthetic form, Stuppy's intention is to draw the viewer in and ignite our imagination, engaging us in an awareness of plant life and science and, hopefully, furthering our passion for plant conservation research.

Stuppy's images would most likely be defined as belonging to a particular field of scientific visualisation, but looking at them always reminds me of an idea of Susan Sontag's in her book, *On photography*. She writes that, 'photographs really are experience captured, and the camera is the ideal arm of consciousness in its acquisitive mood.'[3] I propose this notion can also be applied to the electronic microscopic lens that Dr Wolfgang Stuppy gazes down. Even if these images are a reconstruction of the truth, they work to reflect the experience of the image-maker in the process of consciously acquiring scientific knowledge. These images also highlight our continuing fascination with the invisible and our confidence in the visual data produced by scientific imaging technologies.

Corey Keller, Curator of Photography at the San Franscisco Museum of Modern Art, has researched a particular specialized subset of scientific photography as a way to understand the historical distinctions between scientific visualization and photography as an art form. Looking at the development of this field from earlier precedents of microscopy visualization techniques in late 19th Century photography and X-ray imaging, Keller identifies that, 'it is important not to read the powerful impulse toward photographing the invisible world as merely an exercise of the medium's improved capacities.'[4] Instead, the drive to make pictures of imperceptible phenomena was propelled by a changing cultural understanding that the world contained much more information than ordinary human sight could perceive. Keller explains that the capacity for the instruments to alter the experience of looking is through the subsequent development of visual documentation, and it is these images that have had the power to transform, 'ordinary sight into hallucinatory spectacle'[5].

[3] Sontag, 1977, p. 3.
[4] Keller, 2008, p. 29.
[5] Keller, 2008, p. 25.

Lenses enable us to observe things that are undetectable to the human eye and combined with computer technologies our vision is extended even further into the sub-atomic structures of life on Earth. The comparative scale of microscopy offers a unique perspective from which to reflect as observers, creating new meanings across time and circumstance. However, as Jonathon Crary explains in the introduction to *Techniques of the Observer* (published in 1990), the established cultural relationship and meanings between *observer* and *representation* have been irrevocably changed by the burgeoning industries of computer graphics and information technologies. For Crary emergent scientific technologies and computational visualisation, 'are relocating vision to a plane severed from a human observer.' [6] In a simulated environment, the human eye is no longer located in the real space of an optically perceived world, and Crary predicted that the future of visuality would exist mainly in cybernetic or electromagnetic terrains, with images referring mainly to 'millions of bits of mathematical or electronic data.' [7]

Today the awesome leverage of super-computational power has further enabled computer-simulated objects or environments to become essential tools within scientific and technological disciplines. Virtual modelling technology and software, such as Micro-CT and *Drishti*, aim to present objects or phenomena in a manner identical to their natural counterpart and follows in the tradition of scientific modelling to provide a rational and objective way to represent objects and processes while communicating theories and concepts. But the additional capability to view data in three or four dimensions has radically repositioned the viewpoint of the observer within the virtual space, whether in real-time or as animated sequences. Perhaps then, these new modelling functions that visualise, manipulate and simulate virtually represented objects *in silico* have extended the opportunity for both an objective and a subjective experience by creating an 'hallucinatory spectacle'.

In the laboratory I am not looking down a conventional lens with 4D Micro-CT [see *fig.* 3.]. The initial CT scans can only be monitored through two-dimensional black and white radiographs. It is only when I can finally visualize these volumetric datasets in *Drishti* that I can start to see the potential for the virtual objects to create a transformative experience for an observer. *Drishti* enables me to visualize the volumetric data of the germinating seeds by controlling the colour and level of opacity of the object's material density through transfer functions. Movement and animation can be executed in real time, but for finished animations, the trajectories and effects are manually set along a key frame editor. 4D Micro-CT data also provides an additional capacity so that the subject can be observed from a multitude of angles, depths of field and positions in time. It is unlike the powerful lens of an electron microscope that focuses so close to the subject that it provides a single fixed viewpoint abstracted from the rest of the object. In my project the seed is the object in focus but the catalytic forces of germination, the changing interfaces between the shooting seed and its immediate environment, and the inclusion of time are the constituent parts of the whole subject.

Acquiring this data through 4D Micro-CT experiments is not a straightforward procedure as capturing the full process of seed germination over an extended period of time has presented many unforeseen challenges. Eventually I hope to use

[6] Crary, 1990, p. 1.
[7] Crary, 1990, p. 2.

a wider range of seeds but for the moment mungbeans and alfalfa are the fastest and the hardiest to use for this purpose. The majority of my seeds have failed just before the first leaf develops, due mainly due to environment of the Micro-CT lab being uncongenial to plant life [see *fig.* 4.]. However, though the process of trailling these experiments, I realise that the failure of the seeds to grow to leaf stage should also be considered an equally vital component of this project. These disappointments, the death or failing of the seeds are equally relevant and add to that operatic narrative of life and death. Our emotions are deeply embedded in the hope for new life, a new dawn, a future. If our natural environments become inhospitable then there is a little chance for life to flourish.

In 2013 I completed an animation of virtual seeds germinating entitled *Grow*. The data is from a tightly sown pack of mungbeans and alfalfa seeds. Comprising of 40 volumetric datasets that were acquired over a four-day capture, each set is interpolated so that one discrete moment merges smoothly into the next. The resulting time-lapse animation is just six minutes in duration and it reveals not only the external growth patterns, such as root length and case swelling but the delicate internal structures of the first leaf, the cotyledon as it begins to grow. The mungbeans grew promisingly for the majority of this capture, but their development stalls, whereas the alfalfa shoot quickly from seed to leaf.

I tinted this seed ball with a light-blue hue so as to not to try to imitate the green of plants, but to situate the work with a colour also found in nature, such as in blue sky or water. I then rendered density of the starchy shoots to be as translucent as glass through which incremental stages of growth can be seen to transition slowly as the data rotates clockwise on a vertical axis. I have then divided the black frame up with three panels that provide multiple viewpoints of the one time-sequence in the single projection. The right frame provides a more traditional view of observation from a distance, whereas the other two are more abstracted because the eye is placed in the centre of the data looking out [see *fig.* 5.].

Grow is interesting to watch when viewed on the screen of a computer but it definitely works better as a work of art when it is projected to proportionally enlarge the germinating seeds [see fig. 6.]. Playing with comparative scale in the installation process helps to enhance the experience of the work by shifting the position of the observer; the viewer is placed within the work. To maximise this sensory experience of looking at virtual data I am also experimenting with various formats for immersive stereoscopic projection installations. This year I have had the opportunity exhibit *Grow* in an exhibition, 'Synapse: a selection,' at the Powerhouse Museum in Sydney. For this exhibition I trialled a new stereoscopic modulator that projects a 3D image onto a circular preserving polarized silver screen. With this technology the audience is required to wear polarized paper glasses to experience the projection in high definition cinematic 3D. In a dark space the stereoscopic illusion appears to float in front of the screen, far more so than in a public cinema.

The feedback I received about this installation relayed to me that the format of both the animation and the technology worked well to create a meditative and self-reflective space. Some individual accounts described the sensory experience as both mesmerizing and moving and connected the work with the idea of life as being both exquisite and fragile. There were differing opinions about the multiple viewpoints and people had their own interpretations of what they were watching. Many visitors remained for the full duration of the animation to watch the virtual seeds germinating, or stayed for much longer periods of time. Some people preferred to sit transfixed while others played with the optical illusion by moving their body from side to side or sweeping their hands to try and catch the illusionary image. I like watching people interact with the work, and it is an interesting image in itself to watch groups of people with black glasses on collectively looking at the same spectacle.

The severance or distance from the subject through the use of virtual data would seem to negate any 'real' or meaningful experience of nature, or that additional fifth dimension that I am proposing in my work. However Sue Thomas writes, 'there is increasing evidence that we respond very similarly to a 'natural' environment, whether it's real or virtual.'[8] Encounters with 'real' nature have long proven already to be psychologically beneficial, and Thomas explores this concept in her recent book *Technobiophilia: nature and cyberspace* (2013). She looks at how the experience of nature in a 'virtual' situation can be just as profound, and how our technologies are named and evolve in reference to nature. But our definition of virtual just depends on what we understand as being 'virtual reality' and this can be confusing.

Marianne Krogh Jensen explains in her essay, 'Mapping virtual materiality', that this confusion lies in the notion of virtual reality as being a highly abstracted concept, 'in part because it implies total intangibility, and in part because it is most often associated with computers and cyberspace.'[9] For Krogh Jensen, the potential for relocating the real through an imaginative process is linked inextricably with the location of the body. Krogh Jensen suggests by being grounded in a continuous reflective sensation of experience, and that physically locating your own body within the imaginative and sensory state can, 'become something highly material.'[10]

Susan Best proposes that a phenomenological approach to contemporary installation art can be understood through Maurice Merleau-Ponty's 'notion of the flesh of the world, which is continuous with and yet makes possible sensation and the sensate body.'[11] Best explains that the concept of the 'flesh' is about the gaining of true meaning through an individual's sensory experience of an object; an experience that can not be, 'reducible to a narrowly conceived linguistic account.'[12] Best compares this phenomenological practice at the end of the Twentieth Century with earlier minimalist approaches to art. Minimalism sought to reduce the engagement of the viewer as a way of creating a controlled, self-conscious experience through alienation. The move away from considering 'affect' as a mode of distraction or disorganization began when contemporary installation artists began to adopt this phenomenological approach. These artists intentionally engage the viewer by expanding the sensory properties and affect in the work, as Best writes, to, 'amplify, intensify and motivate aesthetic experience.'[13]

The philosophy of phenomenology has been a major source of inspiration to the artist Olafur Eliasson who first became interested in the subject as an art student in the 1980s as it offered him a means for understanding subjectivity and a tool for

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8 Thomas, http://www.aeonmagazine.com/nature-and-cosmos/can-we-get-all-the-nature-we-need-from-the-digital-world/ accessed, 28 September 2013
9 Krogh Jenson, 2000, p. 302.
10 Krogh Jenson, 2000, p. 302.
11 Best, 2001, p. 219.
12 Best, 2001, p. 219.
13 Best, 2001, p. 222.

negotiating his surroundings. Eliasson notes that for previous generations phenomenology was used more as a formula for categorizing experience, and he warns that phenomenology should not be justified as a kind of truth but, 'an inquisitive, explorative approach to the world that allows for multiple perspectives on artworks, subjectivity, and experience.'[14] As object and subject are conjoined, the capacity of Eliasson's work to embody a range of complex ideas about time, space, virtuality, landscape, science, ecology and culture, exists mostly in our mind's eye. The passing of the physical experience, which is momentary, lingers in our memory as the transformative virtual experience.

Recent research proposes that these same phenomenological practices in immersive installation art, such as Eliasson's, can also be used as models for engaging audiences more effectively with urgent environmental concerns such as global warming, population control, conservation and carbon emissions. Lesley Duxbury's research is concerned with this social complexity in understanding climate change and potentially cataclysmic events in context of artistic practice. Where scientific evidence is working against encouraging any social and political change in society to effectively address the problems, Duxbury proposes that certain art practices, such as Eliasson's, have the potential to engage society with nature emotionally and experientially

> *engaging populations on a personal level to address the ways we perceive our surroundings opens up the possibility that individuals are capable of contributing to the changes required to stem the rapid deterioration of the climate.*[15]

Duxbury discusses an example of this methodology in Eliasson's installation *The Weather Project*[16] as not just an imaginative or aesthetic activity but 'integral to meaningful communication between humans and the changing world.'[17] Exhibited in the great Turbine Hall of the Tate Modern in London in 2003, this massive atmospheric installation immersed an audience in an all encompassing aesthetic and sensory experience. With a massive panel lights and mirrors Eliasson created a huge artificial sun that neither rose nor set, lighting the dark hall in a yellow haze of sugar smoke. Duxbury explains that the artist's intention for this work, 'is to encourage his viewers to reflect upon their understanding and perception of the physical world around them through works that capture fleeting aspects of the natural world, evoking the spiritual and emotional.'[18] Regrettably I missed this installation, but I have heard first hand accounts of the powerful meditative experience *The Weather Project* created. Visitors lingered for hours in the ominous perpetual twilight, lying on the cold concrete floor observing themselves in the mirrored ceiling above.

Sasha Engelmann also sees the potential in Eliasson's methodology to inform modern environmental protest, proposing that this phenomenological approach to engage the individual in immersive installation art can lead to way to set new 'global paradigms, leaning toward sustainability and long-term interaction between

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[14] Grynsztejn, 2007, p. 52.
[15] Duxbury, 2010, p. 295.
[16] Eliasson, *The Weather Project*, 2003, http://www.olafureliasson.net/works/the_weather_project.html, accessed 15 July, 2011.
[17] Duxbury, 2010, p. 294.
[18] Duxbury, 2010, p. 297

society and ecosystems.'[19] As the rhetoric of eco-activism is often embedded in the same rationalistic view that nature and culture are separate, activism also works against itself by perpetuating these social hierarchies. For Englemann, to reconnect with nature we need to find new ways of shifting our perception of this divided relationship. She proposes that Eliasson's work breaks down traditionalist views and provides a multitude of perspectives from which to reflect on our relationship with the physical world, reminding us that we are bound to nature as we are bound to life.

Englemann highlights the importance of understanding Eliasson's oeuvre as, 'more than just a body of aesthetic phenomena,'[20] but to recognize the artist's ability to combine the spectacle, phenomena and individual perception as an interface between humans and nature. Eliasson's work evokes phenomena derived from what are referred to as classical elements and forces of nature: light, space, rivers, ice, steam, fog, waves, erosion, atmosphere, solidified lava, moss, mountains, gravity, rainbows, waterfalls, ripples and reflections. His installations are often temporal and atmospheric, accessible and engaging. The audience is invited to become part of the work, as part of the experience, and this individual experience is the added fifth dimension. As Eliasson suggests, our experience of nature is a product of culture and as we carry with us our experiences of life, socialization and civilization are embodied within each of us. Therefore regardless of what circumstance we happen to find ourselves in, our view of nature is changed the moment we look at it.[21]

Reflecting on the work of artists such as Eliasson in the context of my own work has helped me clarify the processes of testing out theoretical propositions embodied in the practice of thinking, making and exhibiting. An audience will draw their own conclusions about a work of art and, ultimately it is not the role of the artist to solve the world's problems. Yet the nature of art can reveal things about our time and culture in ways that work beyond a literal translation, mechanical objectivity or knowledge based evidence. Therefore I have found it useful to consider an individual's experience of my work as an integral component of the whole. Included in the third and fourth dimension, subject, object, time and temporality, experience and sensory perception is an additional fifth dimension.

Personally I really do care about what the future holds for our natural environment and what it might be like to live in 2050 and beyond. In particular I feel a mixture of sadness and fear for the imperilled wildernesses, oceans, Polar Regions, and the myriad plant species, animals and creatures with which we co-inhabit this planet. Extinction is forever so it would be an unfathomable tragedy if most of the species alive today should exist only in the minds of future generations. I feel complicit yet powerless to change the course of this predicted trajectory but I am motivated to address these anxieties through my practice. By asking an audience to be engaged in a moment of multidimensional reflection, I hope my work can evoke a sensation of wonderment as a reminder of what it is to be conscious in the world; knowing that life, society, culture, art, science, technology and nature are all connected.

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19 Engelmann, http://www.artandeducation.net/paper/breaking-the-frame-olafur-eliasson's-art-merleau-ponty's-phenomenology-and-the-rhetoric-of-eco-activism/, accessed 10 May 2011.
20 Engelmann, http://www.artandeducation.net/paper/breaking-the-frame-olafur-eliasson's-art-merleau-ponty's-phenomenology-and-the-rhetoric-of-eco-activism/, accessed 10 May 2011.
21 Morais & Koerner von Gustorf, http://www.db-artmag.com/archiv/06/e/magazin-eliassoninterview.html, accessed 11 July 2011.

Biographical statement

Erica Seccombe is a visual artist based in Canberra. She has been a recipient of the 2011 Synapse residency through ANAT, and the 2012 Australia Council for the Arts London Studio. She is currently a PhD candidate in Photography and Digital Arts at the ANU School of Art, and her research project Grow: visualising nature at nanoscale is conducted at the ANU Micro-CT laboratory, and Vizlab, the ANU Supercomputer Facility, supported by NCI, the National Computational Infrastructure. This project is facilitated by Professor Tim Senden, Head of the Department of Applied Mathematics, and Dr Ajay Limaye, creator of Drishti. The increasing capacity of Drishti's ever evolving interface is driven by the demands of the emergent advancements in the Department of Applied Mathematics Micro-CT program, and through a growing network of international users.

Illustrations

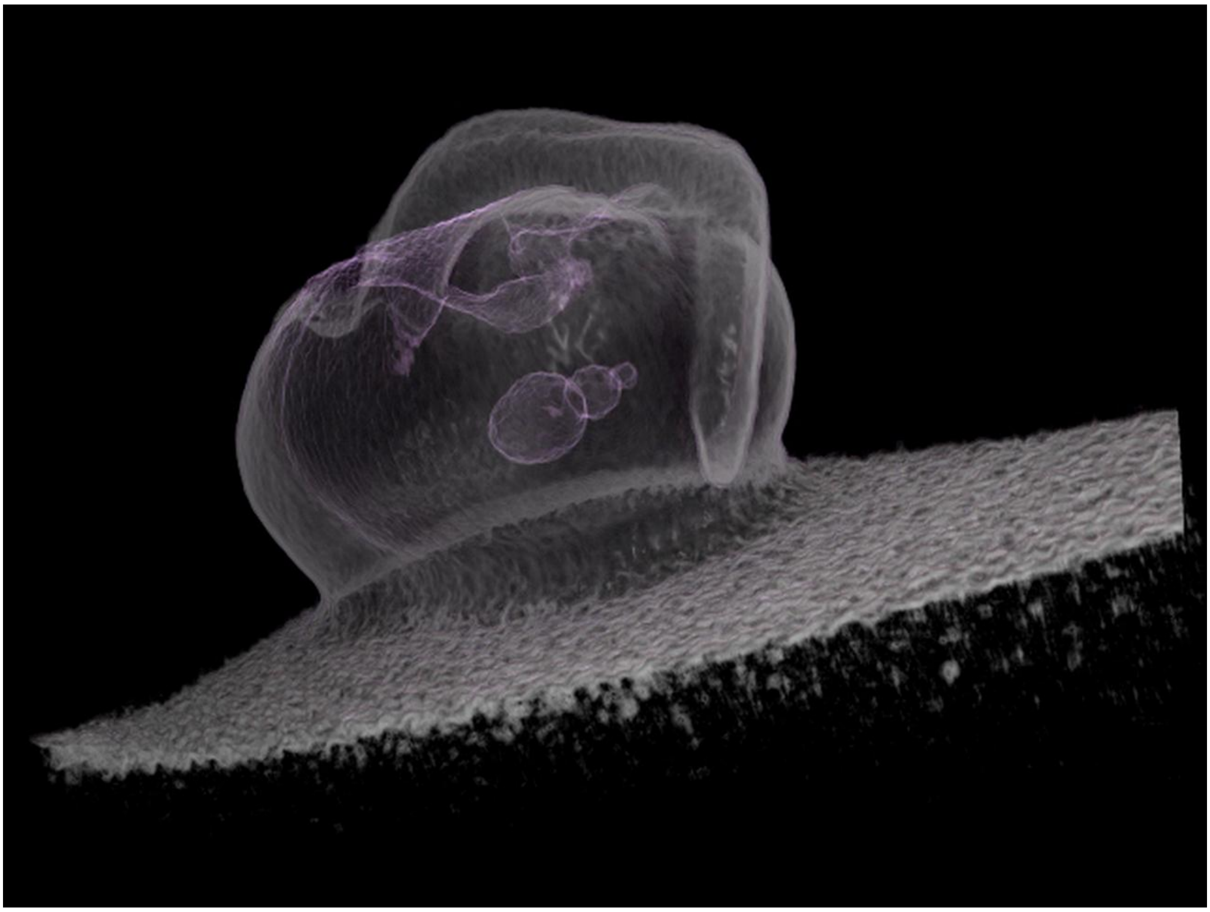

Fig. 1 Erica Seccombe, *dataset of mungbeans in Drishti window*, work in progress, 2011, digital image, data derived from 4D Micro-CT, imaged in *Drishti*, ANU Department of Applied Mathematics CT Lab. (Copyright Erica Seccombe.)

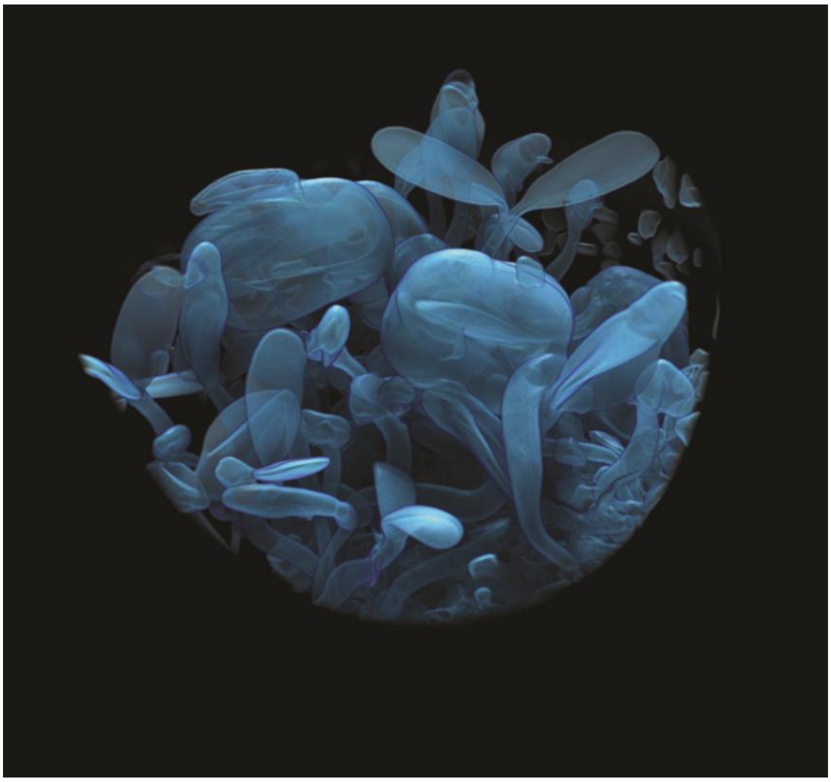

Fig. 2 Erica Seccombe, *Vault Door, Millennium Seed Bank, Kew Royal Botanic Gardens, Wakehurst Place, West Sussex, UK*, 2011, digital photograph. (Copyright Erica Seccombe.)

Fig. 3 Erica Seccombe, *View of the Mico-CT, ANU Department of Mathematics Micro-CT laboratory,* 2012, digital photograph. (Copyright Erica Seccombe.)

Fig. 4 Erica Seccombe, *Germinating seeds being grown in the ANU Department of Applied Mathematics Micro-CT laboratory,* 2012, digital photograph. (Copyright Erica Seccombe.)

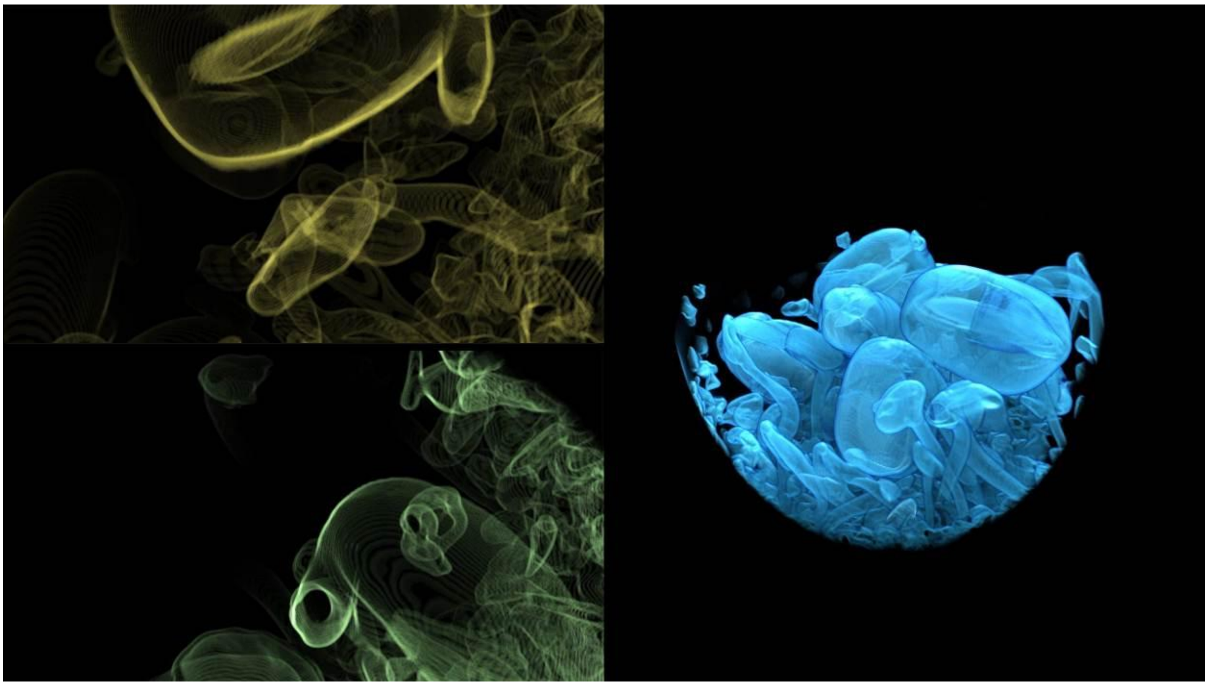

Fig. 5 Erica Seccombe, *Grow: work in progress,* 2013, (detail) Digital animation formatted for stereoscopic projection, 6 min duration. (Copyright Erica Seccombe.)

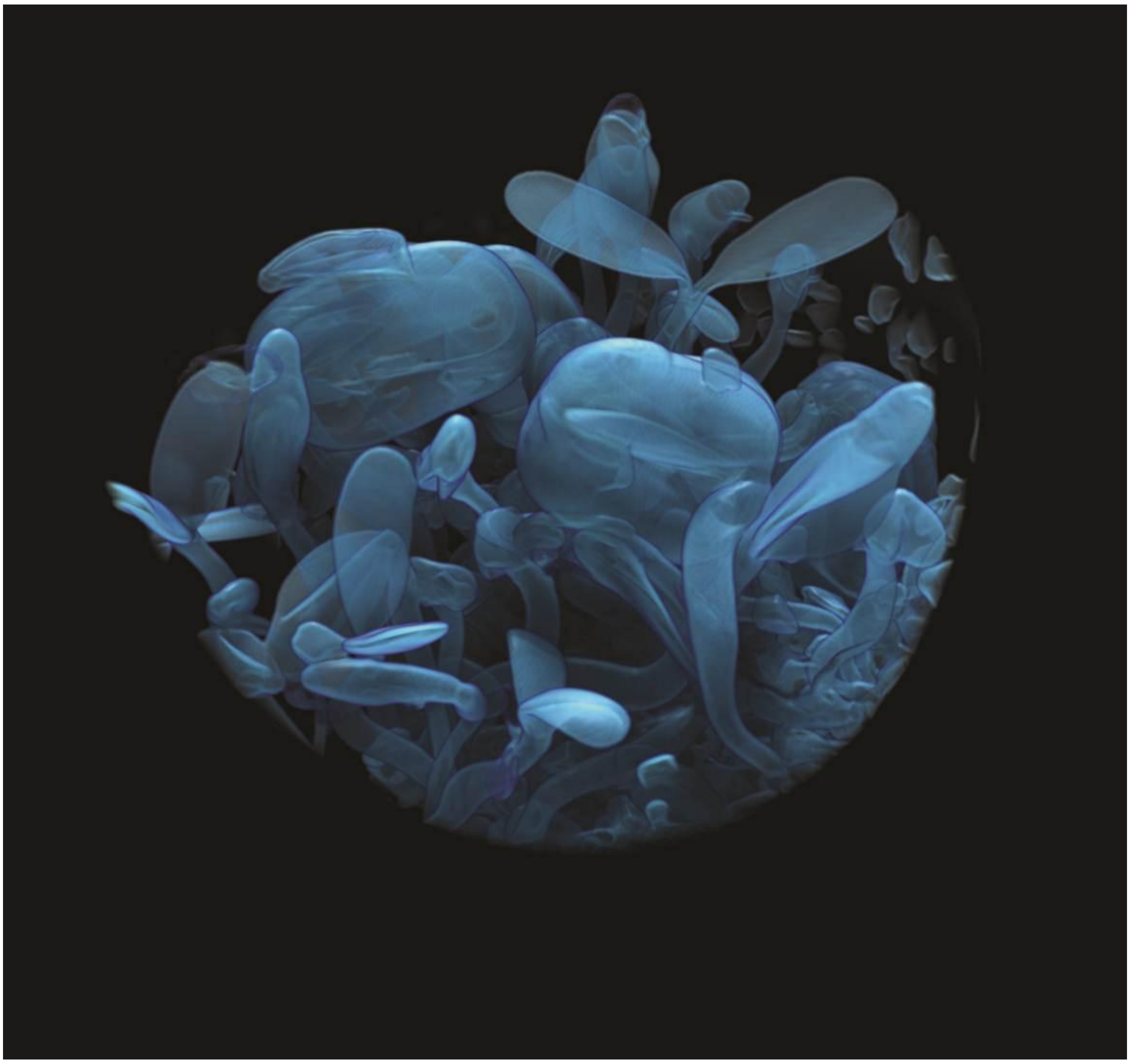

Fig. 6 Erica Seccombe, *Grow: work in progress,* 2013, (detail) Digital animation formatted for stereoscopic projection, 6 min duration. (Copyright Erica Seccombe.)

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