Science as Means for Making in Contemporary Art

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Abstract: The conceptual underpinnings of twentieth century modern and contemporary art established new directions for art making that led to a widespread use of non-traditional media in art making. This mindset paved the way for current artists to explore and integrate other disciplines and methodologies. The paper will offer evidence of visual artists who have used scientific methods in conceptually driven projects that blur the line between Art and Science. Nathalie Miebach, Berndnaut Smilde, Luke Jerram, Roger Hiorns, Peta Clancy, Hubert Duprat, Hilary Berseth, Aganetha Dyck, and Tomas Saraceno are contemporary artists utilizing microbiology, geology, apiology, arachnology, meteorology, chemistry, and physics as method for creating sculptural objects, installations and images. Through their interdisciplinary investigations, these artists have also made unique scientific discoveries and unprecedented contributions. Appreciating the close link between creativity and scientific experimentation, several science-based laboratories are now offering artist residencies, collaborative opportunities, or commissioning artists to assist with research and data visualization.

Keywords: art, science, collaboration, interdisciplinary, creativity

The interweaving of art & science that was commonplace in Greek culture and in the European Renaissance has once again been embraced as a source for enlightening collaboration. According to scientists Sallie Marston and Deborah Dixon, who lead an International project research team, Art-Science: Collaborations, Bodies, Environment at the University of Arizona, there is a loosely-held movement of 'new Leonardos' emerging:

> Despite a modern-day institutional compartmentalization that seeks to distance the arts from the natural sciences, these revolve within a shared history characterized as much by negotiation, mutual learning, and symbiosis as by the search for fundamental difference. And, it is the

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> recognition of this shared history, as well as a desire to draw upon it as both intellectual resource and source material, that helps drive the emergence of present-day art-science collaborations. (Dixon & Marston)

The practices of art and science have numerous commonalities including the use of experimentation, creativity, visual thinking, and the interpretation of the natural world. Scientist Eugene Garfield states, "Artists in various media still go about observing, interpreting, and rendering nature-activities not at all dissimilar to those performed by scientists." (54-55)

In turn, the conceptual underpinnings of twentieth century modern and contemporary art established new directions for art making that led to a widespread use of non-traditional media in art making. This mindset paved the way for current artists to explore and integrate other disciplines and methodologies. This paper will provide evidence of a sampling of the numerous conceptually driven projects by recent visual artists that blur the distinction between Art and Science. Methods include the visual interpretation of scientific data, harnessing nature's processes of creation, and collaboration with scientists. These projects have integrated the fields of microbiology, geology, apiology, arachnology, meteorology, chemistry, and physics to create sculptural objects, installations and images.

There is a long history of using visual art to document scientific phenomenon. Charles Darwin is an example of a scientist who saw a connection between the study of data and the visualization of it. His book, Power of Movement in Plants examines how individual plants respond to external stimuli to gain understanding of some general principles governing their growth and life; and more specifically, how plants have adapted to differing environments. The discovery of circumnutation, a process that creates the spiraling movement of the stem and tips of plants when they search for light, was identified as a significant one in enabling plants to evolve and adapt to almost any environment on the planet ("The Power of Movement in Plants"). He made his discoveries by tracing the movements of each plant's growth with a line drawing.

Whereas Darwin used creative thinking and a simple drawing technique to visually document natural processes, an artist can combine the same creative experimentation with their training in aesthetics to make the object or imagery more complex. The British

aesthetician Harold Osborne drew parallels between artists, scientists, and their relationship to nature, noting that while an aesthetic response may be elicited by "the diverse kinds of order in nature discovered and described by scientists," it is artworks made by artists that are "the most powerfully effective objects for the evocation and expansion of aesthetic experience." (qtd. in Garfield, 55).

Nathalie Miebach is an example of a contemporary sculptor that focuses on the intersection of art and science and the visual articulation of scientific observations. She translates scientific data from meteorology, astronomy, and ecology into complex sculptures using basket weaving, a method which provides her with a simple, yet highly effective grid through which to interpret data into a three-dimensional space (Miebach).

> Central to this work is my desire to explore the role visual aesthetics play in the translation and understanding of science information. By utilizing artistic processes and everyday materials, I am questioning and expanding boundaries through which science data has been traditionally visually translated (ex: graphs, diagrams), while at the same time provoking expectations of what kind of visual vocabulary is considered to be in the domain of 'science' or 'art'. (Miebach)

Miebach's series "Recording and Translating Climate Change" uses simple data-collecting devices to gather weather observations from specific ecosystems, and compares the numbers to the historical/global meteorological trends before translating the data into sculpture. Miebach acts as a researcher, with curiosity similar to that of a scientist, as this investigation reflects her "hope to gain a better understanding of complexity of systems and behaviors that make up weather and climate change." For her, the visualization of the data is not enough. After assessing her earlier artworks to be in want of emotionality, Meibach took her process of experimentation further by collaborating with musicians to adapt the data into musical scores, which she believes may present the data in a new light and reveal patterns that she had failed to see before.

In contrast, the Dutch artist Berndnaut Smilde recreates weather phenomena as an ephemeral "sculpture," the lifespan of which is 10 seconds on average—just long enough to be photographed. Smilde may spend days perfecting his formula of smoke and water vapor, until he arrives at the ideal miniature cloud. He finds locations that are cold, damp, and have a controlled lack of air circulation. "For one shoot, he

might create 100 clouds to get the image. The result is stunning, an ephemeral artwork caught just before it vanishes." (Slobig) Akin to a philosopher, the artist says "I see them as temporary sculptures of almost nothing—the edge of materiality…They can stand in for the divine, but also for misfortune." (qtd. in Slobig)

The artist Luke Jerram fuses his artistic sculptural practice with scientific and perceptual studies. His Glass Microbiology series, begun in 2004, was made to imagine the global impact of multiple diseases and designed in collaboration with virologists from the University of Bristol. Jerram wanted to depart from the common representations of viruses that use artificially colored imagery; because he contends "viruses have no color as they are smaller than the wavelength of light." (Jerram)

Assisted by the glassblowers Kim George, Brian Jones and Norman Veitch, a combination of scientific photographs and models were transformed into color-less translucent glass sculptures with an astounding physical presence. "By extracting the colour from the imagery and creating jewel-like sculptures in glass, a complex tension has arisen between the artworks' beauty and what they represent." (Jerram)

Jerram's glass artworks are seen as useful representations of virology within the scientific community, and photographs of his work have been used in medical journals, text books and media stories including the Lancet, the British Medical Journal and Nature Magazine. His sculptures have also been presented alongside the work of Leonardo da Vinci at the Art-science Museum, Singapore and the Mori Museum in Tokyo.

Rather than imitate nature, artists such as Roger Hiorns and Peta Clancy make art with nature itself. Peta Clancy developed the project Visible Human Bodies (VHB) during an artist's residency in a genetics laboratory, in which she made drawings of the human figure in petri dishes using live bacteria. Clancy chose bacteria in order to "create a metaphor for the fragile and mutable human body." (Clancy)

> Keen to see how 'the human body was viewed in the context of gene therapy,' Clancy produced her images by first drawing blind with pathogenic bacteria onto Petri dishes in order to create living likenesses. The dishes were incubated at 37C for several days, after which the images materialised, to be subsequently photographed, enlarged and transferred to lightboxes. Clancy wanted to duplicate the lab's

> aesthetics: 'I watched the scientists view bacteria colonies on lightboxes in the lab. Plus, I want to suggest the conditions of viewing cells through a microscope. The individual lightbox works are like large Petri dishes…' And the bacteria, luminescent blobs which make up the final form, are themselves metaphors for what she describes as the 'fragile, transient, mutable and constantly changing nature of the human body' itself. (Periz, 118-121)

For several years, the UK artist Roger Hiorns has also experimented with growth in his sculptures, via chemical experimentation. In 2008, he created his most pivotal work in chemistry, a monumental installation of crystal growth called "Seizure." Hiorns selected an abandoned residence in London that was slated for demolition, and undertook extensive preparations for the ambitious project.

> The work required some engineering chutzpah. It was created by pouring 75,000 litres of copper sulphate solution into the flat, and then draining it off to allow the crystals to grow. To do that safely, a watertight steel structure had been built around the flat, otherwise, according to Hiorns, London would have had its worst-ever chemical spill on its hands. (Higgins)

The chemical process resulted in an interior fully covered with gleaming blue crystal formations, transforming the walls, floor, ceiling and bath. The installation was open to the public, but to protect the installation, only five people were able to enter at a time, and they had to don rubber boots and gloves before entering. The site soon became a place of pilgrimage, with people lining up around the block. "You heard of people going in there to meditate," said Caroline Douglas, head of the Arts Council Collection. "There was a sense of absolute wonder. It was a thing of breathtaking beauty: it was the colour of the best Mediterranean sky but somehow unnatural, uncanny." (Higgins)

> Like a modern-day alchemist Hiorns transforms the objects and materials to give them a new function and meaning. [Seizure] is destined to be remembered as one of the truly worthwhile and significant moments of modern British art … The result is a mineral cavern inside a bereft flat, as if the inhabitant had magically created this beauty by force of will and dream. It invites you to make up a story about how this transformation occurred, to picture some strange life of tragedy and transcendence. (Jones)

Hiorns' process forced him to embrace the fact that he was not in complete control, and allow elements of chance to enter the work, letting nature do its work.

> The crystal growth is governed by a precise and yet uncontrolled logic and this ability to self-generate a sculptural form is why Hiorns chose to use it. Hiorns' use of copper sulphate as a transformative material in his work dates back several years. Other objects Hiorns has coated with the solution include BMW car engines, thistles and architectural models, all of which have emerged encrusted with a glittering layer of intense crystalline blue. Hiorns has also made sculpture with detergent, disinfectant, semen and fire. "I'm not somebody who's interested in a deliberate form, design or style. These materials - fire, foam or crystal growth - have their own behaviour and aesthetic, which takes me out of the equation. ("Roger Hiorns' Seizure")

The contemporary artists Hubert Duprat, Roger Hiorns, Peta Clancy, Hilary Berseth, Aganetha Dyck & Tomas Saraceno took the idea of collaboration with nature one step further, by harnessing the natural construction methods of living creatures to create lasting artworks.

After French artist Hubert Duprat learned about Trichoptera (caddis fly larvae), who excrete silk from their salivary glands and glue nearby substances in their environment into a sheaths or cases, like miniature architects, he asked the question, "What if a caddis fly had only gold and other precious stones or jewels to work with?" (Jobson) This hypothesis led him to an experiment in collaboration with a group of the larvae, taking advantage of their engineering skills to make miniature sculptures. Duprat removed them from their natural environment, "providing them small aquariums of gold, turquoise and pearls that the larvae readily used to construct their temporary homes" (Jobson). Duprat learned that "The larvae are remarkably adaptable: if other suitable materials are introduced into their environment, they will often incorporate those as well" (qtd. in "The Built Environment") and was able to create a series of works that deceivingly look as though they may have been designed by a jeweler.

The artists Hilary Berseth and Aganetha Dyck instead exploit the building skills of honeybees. Hilary Berseth realized after investigation that you can 'break the behavior' of the bees and "manipulate [their] instincts about proportion and form." He constructs frameworks to provoke a desired shape from the bees while working with the acclaimed beekeeper Jim Bobb. Berseth says "I knew they were

ordered and regimented. I had an intuition that I'd be able to organize that, architecturally…You can plan out a certain amount of the design, and it will sort of ripple through, and then they'll begin to draw out combs and riff off that design." (Bonanos)

Instead of more abstract formal shapes like those of Berseth, artist Aganetha Dyck asks the bees to mend and transform sentimental objects that she selects from second-hand shops. "I choose damaged objects because honeybees are meticulous beings, they continuously mend anything around them and they do pay attention to detail" ("Interview with Aganetha Dyck"). She describes her work as "interspecies communication;" a cooperative conversation or exchange she has with the bees. To encourage the honeybees to converse, she strategically adds wax, honey, propolis, or hand-made honeycomb patterns to the objects before placing them into the hives. "At times, the honeybees encourage me to add or delete honeycomb after they have worked on an object. As an example, by overextending their honeycomb, the honeybees encourage me to sculpt into this mass of waxed cell construction and return it to them for further consideration" (Ibid.). Dyck describes her collaboration with the scientist as an exchange in research that helps each of them think differently, leading to new discoveries.

> All my work with honeybees is overseen by a scientist and is always completed under the direction of a beekeeper. The beekeeper takes care of the bees. I am an artist interested in environmental issues and in inter-species communication, specifically interested in the power of the small. My ongoing research asks questions regarding the ramifications all living beings would experience should honeybees disappear from earth.
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> The scientists and beekeepers who have generously assisted my art work have indicated that my research methods and my art practice make them think outside their box. Observing scientists working in bee labs has blown my mind and made me think entirely outside my box.

Through their interdisciplinary investigations, these artists have made unique scientific discoveries and unprecedented contributions. Artist Tomás Saraceno is a superlative example of an artist who has successfully combined research and scientific experimentation with his artistic processes.

Saraceno is fascinated by the beauty and complexity of spider webs, and the best way for him to understand the spider's web was to

recreate it. "That no one has done this before might derive from the fact that for a biologist, for example, imitation is not an obvious route to knowledge. Here, the artist opens a door to new insights into the spider's web, but also into how we can build a model of it so as to experience with our senses something that we cannot yet weave ourselves." (Arrhenius, 2)

He has created monumental room-size installation artworks inspired by spider webs, handmade out of nylon thread, and some created with over 70,000 knots. It was a logical next step to investigate the unique sculpting power of the creatures themselves. His celebrated series working with spiders, 14 Billions (Working Title) started from his inquisitiveness: "Is it possible to measure and understand a spider's web, to depict it and re-create it in a three-dimensional model?" (Arrhenius, 2) As a result, in 2010, Saraceno was the first to create a three-dimensional digital replica of the spider web of the *Lactradectus mactans* (black widow). To prepare for creating the work, Saraceno spent two years researching and consulting with arachnologists, astrophysicists, engineers, and architects. "The three-dimensional model was developed with coordinate data collected by using Laser Supported Tomography combined with Photogrammetric analysis, a method and set-up devised by the artist Tomás Saraceno with Photogrammetric Institute at the Technische Universität in Darmstadt in consultation with leading arachnologists Peter Jäger and Samuel Zschokke." ("3D Spider Web Scan")

> First he and his team put a solitary spider into a transparent cube where it will spin a web. Then, they replace that spider with a colony of social spiders. As individuals build on top of the original spider's creation, Saraceno and his team rotate the boxes, inducing disoriented new patterns. ("The Cosmic Spiderwebs…")

Significant members of the scientific community have consistently praised Saraceno for his discoveries, which have informed scientists. Professor Joseph Koh of the Lee Kong Chian Natural History Museum and author of two encyclopedias on Spiders from Southeast Asia affirms "I would like to applaud Tomás for breaking new ground with his artistic creativity…with spider silk, he has spun a web that has connected the two separate domains of art and science." ("Arachnid Orchestra")

Peter Jäger, Head of Arachnology, Senckenberg Research Institute, and co-author of the World Spider Catalog, says "Saraceno has opened

our eyes to the intricate geometry of spider webs… Saraceno's technique has enabled much needed comparative studies in mathematics, engineering and arachnology." ("Hybrid Webs")

The art critic Sara Arrhenius praises his interdisciplinary proficiencies:

> The world that Saraceno moves through is a vast, open field where the boundaries between science and art are not set out in the usual ways. Here, there is no high fence between disciplines and fields of knowledge, but a world of possibilities that are driven forwards by a sense of wonder at how the world was created. This playfulness, the desire to test out the new and the apparently inexhaustible torrent of ideas, gives Tomas Saraceno's art an intensely visionary energy. An energy that I believe arises in the coming together of and interaction between different worlds, fields of knowledge and thought models. (Arrhenius, 3-4)

The artists just mentioned represent a mere sampling of the new partnerships and innovations developing, and the prevalent return to an interdisciplinary, enlightened collaborative philosophy. Appreciating the close link between creativity and scientific experimentation, several science-based laboratories are now offering artist residencies, cooperative opportunities, or commissioning artists to assist with research and data visualization.

Jeff Stanford, vice president of marketing at the Orlando science center affirms, "Imagination and creativity are at the heart of both art and science. It is very important to use art to provide a new perspective on science. Artists and scientists use several of the same skills in pursuit of their goals, including critical thinking and problem solving, communication and collaboration, flexibility and adaptability, and social and cross-cultural skills. These skill sets are essential for success in both fields." ("Orlando Science Center…")

Max Planck, the father of quantum theory, felt that the pioneer scientist must have "a vivid intuitive imagination, for new ideas are not generated by deduction, but by artistically creative imagination." ("Full STEAM Ahead...")

REFERENCES:

"3D Spider Web Scan." Studio Tomas Saraceno, 2016. tomassaraceno.com/projects/3d-spider-web-scan/.

"Arachnid Orchestra. Jam Sessions." tomassaraceno.com/projects/arachnid-orchestra-jam-sessions/.

Arrhenius, Sara. “Intergalactic spiders, *in* 14 Billions (Working Title).” 2011. Exhibition Text, Esther Schipper gallery, pp 1-2.

Bonanos, Christopher. “The Hive Mind. How Hilary Berseth Makes His Buzzworthy Sculptures.” NYmag, 12 Oct. 2008, nymag.com/arts/art/features/51163/.

Clancy, Peta. petaclancy.com/vhb/ [accessed: 20.11. 2016].

Dixon, Deborah & Sallie Marston. “Art-Science: Collaborations, Bodies And Environments.” artscience.arizona.edu/project-description

“Full STEAM Ahead: Creativity in Excellent STEM Teaching Practices.” Accredited Tutor. accreditedtutor.org/full-steam-ahead-creativity-in-excellent-stem-teaching-practices/. [accessed: 26.11. 2016].

Garfield, Eugene. 1989. *Essays of an Information Scientist: Creativity, Delayed Recognition, and Other Essays*, Volume 12. *Art & Science*. Part 1. “The Art-Science Connection”. pp. 54–56.

Higgins, Charlotte. 2012. “Roger Hiorns' Turner Prize-Nominated Artwork, Seizure Escapes Demolition.” The Guardian, 6 July 2012. theguardian.com/artanddesign/2012/jul/06/roger-hiorns-seizure-demolition-yorkshire.

“Hybrid Webs.” tomassaraceno.com/. [accessed: 20.05.2016].

“Interview with Aganetha Dyck: Canadian Visual Artist.” Mason Journal, 24 Oct. 2011. mason-studio.com/journal/2011/10/interview-with-aganetha-dyck-canadian-visual-artist/.

Jerram, Luke. “About Glass Microbiology.” lukejerram.com/glass/about. [accessed: 25.11.2016].

Jobson, Christopher. “Artist Hubert Duprat Collaborates With Caddisfly Larvae as They Build Aquatic Cocoons from Gold and Pearls.” This is Colossal, 25 July 2014. thisiscolossal.com/2014/07/hubert-duprat-caddisflies/.

Jones, Jonathan. The Guardian, 151-189

Miebach, Nathalie. “Statement.” nathaliemiebach.com/statement.html. [accessed: 10.11.2016].

“Orlando Science Center Fuses Art with Science at New Gallery.” Highlights. 18 April 2016. svad.cah.ucf.edu/highlights.php?id=1625.

Periz, Ingrid. 2009. Skin doesn’t have roots, it peels away easy as paper. *Australian Art Collector*, Issue 42: 112–121.

Roger Hiorns’ Seizure. 2008. *Don’t Panic Magazine*. dontpaniconline.com/magazine/slow/roger-hiorns-seizure. [accessed: 27.11. 2016].

Slobig, Zachary. 2015. How This Artist Makes Perfect Clouds Indoors. Wired.Com/2015/06/Berdnaut-Smilde-Nimbus/.

“The Built Environment. ‘Trichopterae’ by Hubert Duprat (plus some caddis flies): A TBE SHORT.” 2 June 2011. tbecolumn.wordpress.com/2011/06/02/trichopterae-by-hubert-duprat-a-tbe-short/.

The Power of Movement in Plants. Wikipedia, en.wikipedia.org/wiki/The_Power_of_Movement_in_Plants. [accessed: 25.11. 2016].