Cover: Renata Buziak Sesuvium portulacastrum... antioxidant... from Core Energy series, 2012, archival pigment on paper, 61.2 x 50cm
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The contributions to this issue of Studio Research were selected by peer review for their original content and quality of material without any consideration of thematic coherence. Because of this, the coherence that does exist across the pieces is of special interest. In the opening essay, Sara Manser unwittingly forecasts these linkages when, in comparing her approach to urban ecologists, she proposes that “art and urban ecology share a multidisciplinary way of seeing and analysing the world”. Reading the subsequent contributions, it appears that multidisciplinary practice is indeed a dominant contemporary mode for artists. For example, Lynden Stone works across traditional painting, time-based, and computer-generated work, usually in sculptural or interactive form. More dauntingly, she delves into the world of quantum mechanics. What elevates Stone’s analysis is the way she investigates metaphor as mechanism, a strategy that, it might be argued, belongs to art, and takes this into the quantum physicist’s lab. Perhaps only an artist could develop an eccentric Esperanto that could decipher the failure of the metaphor of the complex Klein Bottle to represent “the way things are” and explain a work of art such as My father’s girlfriends, parallel alternatives, where the artist takes her “father’s relationships with various women over his life as the starting point for a series of ‘what if’ scenarios”. Her eighty-six-year-old father interacts in the work to conjure alternatives to her life. After reading her sources, one cannot easily dismiss Stone’s art as foolish science since the scientific thinking she engages with does not have ‘preposterous’, ‘impossible’, or ‘illogical’ included in its vocabulary.

Laura Woodward also uses the artist’s studio as a privileged site of investigation to understand human agency and systems in a post-humanist era, although she emphasises the role of site or exhibition contexts in understanding through the work. Woodward argues that her own and other kinetic sculptures represent a new materialist approach where the medium of the work holds a central place in a self-generating system.

Renata Buziak gives significant credence to Woodward’s reinvigoration of the concept of autopoetics, first imagined for scientific systems, in that she has developed a ‘biochrome’ system that visually and metaphorically translates complex biochemical processes. Significantly, Buziak undermines the traditional conception of photography as capturing an existing subject or image, for, in her biochromes, the process becomes the subject. Here biochemistry replaces or at least complements sensimetry. In so doing, Buziak explores the aesthetic tension that always existed between the photogram and the traditional photograph. She has researched the medicinal properties of plants in European and Australian Aboriginal traditions and, in choosing such medicinal chemistry, she gives gravitas to the metaphoric translation of the microbial action of decay that activates the pigment on a bed of photographic paper.

When Fiona Fell first took her ceramic figures to be scanned in the X-ray or CAT/CT machines at her local hospital, it was, as she notes, an aesthetic exercise to discover new forms or variations. The unexpected outcomes led to a more open-ended investigation that encompassed not only the visual outcomes of radiography but also a new linguistic vocabulary that evokes as much as it describes the spectral images found within any solid form.

If this is a representative sample of contemporary studio-based research practice in academe, as I implied above, then there is a clear and refreshing tendency among them. This is not their multidisciplinary approach, since this has been the standard, and perhaps a necessary strategy for artists to survive in academe, for two
decades. What is new here is the departure from a humanities-based rationale for their investigation, usually in the form of social science or, more typically, post-structuralist philosophy. Instead, this issue presents artists who are drawing conceptual frameworks for their investigations from environmental science, quantum physics, neocybernetics, biochemistry, and radiography. The emphasis on material transformation through process is no doubt what links the artist’s studio to the science lab, as it always has, but it may be premature to claim that contemporary art is coming home to its origins with science.

Ross Woodrow  
Executive Editor  
Studio Research
Nature’s relentless ability to adapt and prevail despite human activity—leaving its trace on concrete, steel, and glass—has inspired me, as an artist, to investigate and develop a creative understanding of the interconnectedness of human and non-human relationships in the urban environment.

From the outset, my studio-based research has investigated and attempted to define an aesthetic of the overlooked and unseen elements of nature within the city. The marks and stains found on manmade objects are a significant visual resource for my art practice. In addition, I find the persistent weedy, overgrown areas in and around the built environment just as interesting. My curiosity for these ‘natural’ marks and neglected places prompted an investigation of the ideas of urban nature, and led me to incorporate elements of urban ecological thinking into my research.

This essay specifically discusses how I developed more informed ways of identifying and defining an aesthetic of nature in the city. It has become clear to me that similarities exist between my studio-based research and the relatively young science of urban ecology. This is not a comparative study of art and science, but an explanation of how I have adopted some elements of ecological thinking as a method for analysing both the theoretical and artistic aspects of the city.

The cross-fertilisation of urban ecology and my studio practice has been invaluable to this art-based research. Not only has urban ecology informed my research, but it has also inspired alternative ways to visually interpret the evidence of nature within the city, and provided me with a framework through which to examine nature, and argue that the city is natural.

**STUDIO**

My studio is a place in which experiments take over table tops, floors, and walls—often spilling beyond the confines of those walls. My artworks are generally in various stages of flux and evolution, since my method of working involves bursts of activity and long periods of reflection. I am aware that many of my trials, maquettes, and experiments may never leave the studio as fully resolved works; some will morph into unexpected resolved pieces and some may come to signify pivotal moments of creative breakthrough.

Since 2009 I have made work in response to what I observe on walls, footpaths, and human-made structures of the built environment. Rusted steel, corrosion, cracking cement, and weathered surfaces are signs of decay, or change, and signify nature’s presence to me. I compare nature in the ‘marginal’ (Anderson 2009), suburban, and rural areas to what can be found in the city by exploring protected urban bushland reserves and the dark mangrove forests of the bayside. *Works of Another Nature* (2011–12, figure 1), which consists of a series of six large, connected drawings and hundreds of rusty spikes, suggestive of the aerating mangrove roots (pneumatophores), reflect these quiet ‘natural’ places and their lack of human inhabitants.

While studying these marginal places, I realised that the marks and stains with which I am so intrigued, and the weedy clumps of grasses juxtaposed with glass, concrete, and steel, are characteristics specific to the city. By reassessing my experiences of the ‘marginal’, ‘natural’ world, I began to notice and appreciate the unexpected interface between the built and what most people call the ‘natural realm’. The city provides the contrast and tension of human and non-human.

In January 2012, I met with urban ecologist Associate Professor Darryl Jones of the Environment Centre, Griffith University. I introduced him to my research topic and explained my interest in nature’s presence on the manmade environment. We compared our ideas of visual representations of urban nature and how urban ecology studies the same environment. To be clear, my research is not engaged in scientific fieldwork. Any collecting of data from urban environments is done through walking, sketching, photographing, imagining, reading and, note-taking, which I then reflect upon in my studio and reinterpret through art-making.
The cross-fertilisation of my studio research and urban ecology extended the scope of my research and inspired new studio experiments. I began to think differently about the city, and about what my practice has to offer in extending knowledge of the diversity of life in the city—urban nature—and its aesthetic appeal.

From early 2012, the delicate papers and subtle layering of inks (figure 2) were replaced with marine ply, aluminium, cement render, and sharp edges (figures 3–5). I departed from earlier methods that formally referenced earth colours, and textures, as my focus gravitated towards the aesthetic of the materials and structures in and of the city. I made a series of small intimate works to entice close inspection, a shift from my earlier panoramic work. Each piece comprised two different surface treatments. A crack, like a drawn line, separated smooth, high-key colour surfaces from texture and contrasting colour. By incorporating materials suggestive of construction, manmade, and architectural forms, I aimed to draw attention to the overlooked, vacant, and void areas within our cities, which, according to urban ecologists, may well be the link between people and nature.

‘Nature’ remains a theme for many artists, and a place where many urban residents choose to go to escape from the city. Art about nature, and artists who engage in environmental, ecological, or nature-based themes can enable ways of connecting audiences with urban ecological ideas. I have found a vast difference among artists engaged in art about nature. Some artists take a political stand and make work for a specific environmental cause, highlighting areas under threat from industry and economic growth. Others make work out of materials collected from forests or beaches. For the purpose of my research, it is those artists engaged with urban nature, and not the broader, global, environmental issues, that interest me most.

Theories on ecology and art (Gablik 1992; Grande 2004), environmental aesthetics (Saito 1983; Carlson 1995), and the environment-and-art became popular during the 1990s and early 2000s. These theorists questioned whether one can in fact aesthetically appreciate nature having little or no sound scientific knowledge of it. Although their environmental thinking helped inform their readers of the devastation of the planet, and questioned our attitudes to environment, I believe the view of humans being separate from the natural world still dominates everyday thinking. However, I have come to understand that there is much to discover about the ecosystems of which we are a part. It seems today that urban ecology, geography, biology, anthropology, and many social sciences can rigorously explain the evidence of the human and non-human coexistence. A contemporary philosophy of an aesthetic of urban ecology, however, remains elusive. Perhaps this...
Figure 2 Untitled 2012, ink, charcoal, and monoprinted layers of Kozo paper, dimensions variable

Figure 3 Fissure 2013, acrylic, wax, and cement render on board, 20 x 15cm

Figure 4 Fissure No.2 (detail) 2013, wax, graphite, acrylic, and ardidboard on board, 30 x 30cm
is because urban nature is still not as enticing or as attractive as bushland, wilderness, or countryside—areas we are accustomed to perceiving as ‘real’ nature.

COEXISTENCE AND CHANGE

Urban ecology studies the coexistence and interdependence of humans and non-humans at the physical point of connection, and how nature, which includes humans, adapts to environmental changes. It seems that much of the change is due to human action.

In an online discussion recorded for Orion Magazine in May 2013, titled “The Wide World of Urban Nature”, one panellist, ecologist Liam Heneghan, posed several ‘provocations’ regarding urban nature and ecology, and stated that “we live on an urban planet”. Urban living is becoming the dominant human experience. It is now apparent that with a greater understanding of the human influence and impact on the non-human, there are profound changes occurring in our definitions of nature, how nature challenges and confronts the humanistic perspective, and how it is appreciated aesthetically.

Cities are places of human and non-human diversity. On the human scale, a city can include a mix of cultures, beliefs, experiences, knowledge, and different attitudes towards nature. Importantly, cities’ native and non-native flora and fauna also include great biodiversity. This synthesis is not only a global mix of humanity, but, in ecological terms, it defines a diverse and changing nature; it gives us urban nature.

It is possible that our current urban existence influences how we relate to nature and what our ideas of nature at this point in time, compared with how our ancestors conceived of it. In 1980, Raymond Williams wrote that,

> We need and are perhaps beginning to find different ideas, different feelings, if we are to know nature as varied and variable nature, as the changing conditions of a human world.

(Williams 1980, 85)

Much of human history has legitimately been portrayed as a continuous battle against the risks and dangers inherent within nature. It could be said that today’s urban inhabitants appear to live...
beyond all that is natural; the risks and dangers of nature are reduced to localised catastrophes reported on the nightly news. Our cities—for the first time in history, the home of most people—are seemingly places where the only signs of nature are utterly tamed and domesticated: pet cats, potted palms, and piped water. Darryl Jones suggests that we seem to have imagined that ‘nature’ had somehow retreated in the face of the relentless march of human progress.

Perhaps we equate ‘nature’ with wilderness, or places where the presence of humanity is not evident. . . . the unavoidable reality is that nature cannot be excluded from anywhere. We are as much a part of nature as soil is of the Earth. (Jones, e-mail to the author, May 2013)

UNOFFICIALLY URBAN HISTORY
Since 1854, when Henry David Thoreau wrote of his intimate relationship with nature in the woods of Concord, Massachusetts, there has been a tradition of nature writers, mainly from Britain, Europe, and America, who have encapsulated the beauty, the sublime, and the often spiritual qualities of nature. Contemporary authors still write about similar themes. Today’s nature writers, however, are as diverse as the types of issues surrounding human and non-human nature. Indeed, subjects such as the loss of nature, the beauty in urban nature, ecology restoration, and preservation are currently being discussed by contemporary philosophers, scientists, sociologists, psychologists, and artists. I have gleaned much from these writers; some of their work is poetic, some nostalgic, some provocative, and much of it takes a political and environmental stance. All of it, however, supports my argument for an aesthetic of urban nature.

Contemporary nature writers such as Robert Michael Pyle (The Thunder Tree, 2011), Richard Mabey (The Unofficial Countryside, 1999), and Paul Farley and Michael Symmons Roberts (Edgelands, 2011) highlight ideas about the loss of nature since the Industrial Revolution and propose that wilderness is closer than we think. In keeping with the rest of the planet, as Australian cities grow, so too will diverse ecosystems. Scientists like Jones, whose interest is in urban wildlife, and writer Tim Low, are part of the new generation of researchers emphasising the changes, good and bad, of the ‘New Nature’ (Low 2002) of urban Australia. Furthermore, the cross-fertilisation of literature and visual art with the fields of ecology, geography, biology, and psychology is exciting and can only lead to a better understanding of our relationships with nature.

Some artistic and scientific observers dwell on the nature of the past, the pastoral and the wilderness, urging a move to return, reinstate, restore, or resurrect a state of nature that is not necessarily a reality for most urban inhabitants. Current thinking elevates the marginalised, abandoned, urban scraps that I find fascinating to a status of wonder at the coexistence and adaptability of nature. These scraps of nature are thriving in and around our cities, from the visible—vacant lots, laneways, and overgrown gardens—to the less-visible cracks in walls and footpaths that are home to many species of grasses, weeds, and micro-organisms. It is my understanding that these places are host to greater biodiversity than many forests.

Urban ecologists are not alone in finding these places full of life and full of clues as to how interconnected all life is. Geographer and philosopher Kevin Michael Anderson wrote his PhD dissertation on what he calls ‘marginal nature’, which is based on his research of a stretch of river called Hornsby Bend, located near a sewage plant in Austin, Texas. Although Anderson’s research is specific to wastelands and abandoned places, his broader and multidisciplinary approach to the human and non-human coexistence is extensive, and inspired my early research of similar places close to my home in Brisbane. He argues that to comprehend the “lifeworld of the wastelands requires a reassessment of the concept of place as a coproduction of humans and nonhumans”. In the introduction to his dissertation, Anderson writes,

Marginal nature is neither pristine nor pastoral, but rather a nature whose ecological and cultural significance requires a reassessment of our narratives of nature. The wastelands are unique sounding boards for measuring perceptions of nature, since
these places provoke ambiguous responses of attraction and repulsion. (Anderson 2009, xiii)

I relate Anderson’s idea of the ambiguous responses of attraction and repulsion to my interest in what may be classified as the messy, disparate, mix of materials and plants that are a part of urban ecosystems.

Timothy Morton’s book *Ecology without Nature* (Morton 2007) presents another perspective of nature in the city. Morton, an ecological theorist, challenges existing environmental thinking, and argues for a new idea of ‘nature’ if we are to understand and engage with ecology. Morton’s often radical theories have introduced to me a more realistic view of what nature is not. His ideas are developed without a sentimental view of nature, and provide a fresh analysis of connectedness. Morton writes,

> Strange as it may sound, the idea of nature is getting in the way of properly ecological forms of culture, philosophy, politics, and art . . . for it is in art that the fantasies we have about nature take shape—and dissolve. (Morton 2007, 1)

This way of thinking about what nature in the future could be like is powerful and practical; it encourages me to rigorously critique my methods and challenges my pragmatic perspective.

**ART AND SCIENCE**

. . . artists working in nature clearly come to quickly appreciate the more synthetic concepts: energy, environment, community, and ecosystem . . . without relying on indices, mathematics, or jargon. This approach to interpreting nature is accessible to many, and it deserves more attention from ecologists striving to expand public understanding of complex ecological issues. (Luken 2013, 219)

Science deals with predictions and the extension of existing ideas through empirical research, measurement, and the discovery of patterns. It is highly effective at testing ideas, analysing evidence, and formulating explanations. When I first described my interest in the marks on footpaths left by leaf litter to Jones, he explained that a scientist could determine the chemical origins of the traces left by leaves lying on rain-dampened concrete, and predict which conditions would lead to certain colours or the longevity of the stains. Jones pondered whether a scientist would attempt to assess why some patterns left by the same leaves were more attractive or had a greater aesthetic appeal. Jones decided that many scientists would probably not want to ask such non-scientific questions, although they may possibly appreciate that beauty and aesthetics are important notions.

Jones explained that the emergence of urban ecology as a sub-field of ecology, once treated with disdain from establishment ecologists, bases its interest in the way the real world functions in nature, and the reality of the infinite number of relationships and connections that exist between the myriad of species that make up ecosystems. It is these connections that define urban ecology, yet these connections appear to most people to be absent in human-dominated landscapes.

So, what contribution does my art have in this cross-fertilisation with urban ecology, and how can urban ecology and art effect a new way of thinking about our connection to nature in cities and the aesthetic value of such nature?

Artists and scientists walk on the same ground, view the same objects, and yet see them quite differently. The aim of my art and urban ecology is to draw attention to the unavoidable reality of the human and non-human connections. Jones is convinced that people need to ‘see’ these connections if we are to manage our influence. I believe art and urban ecology share a multidisciplinary way of seeing and analysing the world. Jones suggests that to think of a city as an ecosystem, as urban wildlife, as having ‘natural’ lives, was once too radical for traditional science to contemplate. One problem with this contemporary perspective is that it somehow assumes that humans are separate from the view.

I believe there is an underlying philosophy of urban ecology, separate from the measuring, counting, and recording of biodiversity, that encompasses an alternative aesthetic. This is where my research traverses art and urban ecology, albeit with a different frame of analysis.
Furthermore, my hope is that through this studio-based research I can convince my audience that urban ecologists proceed with a degree of aesthetic judgement and creative thinking in order to yield some of their scientific results.

**URBAN AESTHETIC**

Most people now live in large cities, a trend set to accelerate. This intensification of urban living has a multitude of implications including the possibility of a significant alteration of human relationships with, and perceptions of, nature. (Jones 2011, 76)

Environmental philosophers, aestheticians, and writers, such as Ronald Hepburn, Allen Carlson, Arnold Berleant, Yi-Fu Tuan, Noel Carroll, and Emily Brady, have argued over the aesthetic appreciation of nature and art. Simply put, this group argue that aesthetics is no longer purely a measure by which we judge and value a work of art; it is now applied when we come to appreciate objects of nature like trees and rocks, and the whole natural environment. For visual artists, this idea may not seem so difficult to grasp.

Richard Mabey has made extensive observations of the interactions and relationships between people and plants. Mabey writes in praise of weeds, of those plants in the wrong place, self-cultivating and successful survivors. He, like others, questions whether weeds are a cultural creation, and writes, “... weeds are trespassers of a kind, but across boundaries which are as often cultural as topographical” (Mabey 2013, 65).

Developing methods of interpreting the overlooked, unsightly, and mostly unseen traces of the human and non-human connections within the built environment has been crucial to my research over the last year. These are the places where we live, and they have a fragility and diversity that is very much natural. The dialogue between my art practice and urban ecology further informs my proposition of a change in perceptions of the natural, non-human environment. This shift in my aesthetic appreciation, attitudes, and interactions with nature or, more precisely, with the ecosystems in urban environments, stems from my observation that people prefer to have ‘nature’ in their lives, but most often they don’t realise that it is immediately around them.

The traces of organisms and evidence of contact can be scientifically understood, but to me, the traces and marks have an aesthetic appeal that signifies nature is everywhere. To me, asphalt, steel, and glass are the skin of urban ecosystems; they are the surface, the canvas, as it were—a background on which natural processes will mark and stain over time. Marks become surfaces themselves, subject to successive layers or gouges. The amalgam of surfaces and materials may be the initial attraction, but it is what lies between, beneath, in the cracks, and in the vacant spaces of the city surface that remains the platform for me to emphasise a nature of extreme diversity, and aesthetic value, in spite of and in conjunction with the hubris of humanity.

Apart from aesthetics, art, and the science of urban ecology, there is also a great deal of research regarding the psychological effects and benefits of connecting with nature. However, I believe there still remains a propensity to separate humans from nature.

Peter H. Kahn, a research professor at the University of Washington, studies the psychology of nature in human experience, which reveals that more frequent and positive experiences with nature reduces a fear of nature, or ‘biophobia’. Kahn has researched the implications of environmental generational amnesia, the result of less contact with what is traditionally regarded as nature, over successive generations. He studies the effects of a lack of intimacy with nature, and questions the importance of our relationship with nature, which he believes is established during our first encounters in childhood (2002). According to Kahn, our early experiences with nature effect how we relate to the natural world later in life, and help us define what is normal in nature.

For Kahn, this ‘extinction of experience’—a state of disengagement from the natural environment—is what many people experience in the city. Most city inhabitants may be unaware of their indifference to nature. From Kahn’s research, it would seem that many people rarely experience intimacy with nature. Environmental anxiety over the depleted state of pristine natural places is cause enough for nature-oriented artists to make art in protest, highlighting the demise of the natural environment and the irreversible damage caused by human disturbances. I am suggesting
that art has the potential to stimulate new ways to look at nature; as my research has discovered, there are natural places within the city, places not as history has recorded, not sanctioned parklands, or as seen in travel brochures, but places of natural wonder nonetheless. If appreciated, these places can provide time to escape, time to imagine, and reconnect.

My artworks and philosophy challenges the common belief that the urban/human environment is not natural. The methods and processes I have adopted constantly urge me to question my perceptions of an intimate aesthetic appreciation of what is natural. My art finds this intimacy by allowing time to think slowly, to imagine and contemplate, and hopefully incite a desire for people living in the city to seek out even the tiniest scrap of nature to engage with and to know they are connected.

How we aesthetically experience nature remains a question for philosophers, environmental aestheticians, sociologists, anthropologists, and artists alike. Environmental aesthetician, collaborator, and author Arnold Berleant explains that how we interpret nature and art depends on our knowledge, beliefs, and attitudes, as these are some of the influences through which we experience it. These influences determine aesthetic experiences, which Berleant believes are not purely personal but also social.

In engaging aesthetically with environment as with art, the knowledge, beliefs, opinions and attitudes we have that are an inseparable part of the experience are largely social, cultural and historical in origin. (Berleant 2002, 11)

Aesthetics was advanced as a branch of Western philosophy at the end of the eighteenth century by those such as Immanuel Kant and David Hume. Much of the discourse during this period involved how we define aesthetic experience and how we can best understand the relation between aesthetic value and aesthetic experience. Western aestheticians of the eighteenth century were primarily concerned with the judgment of beauty and what value system could be used, through empirical investigation, to assess beauty. In his Critique of Aesthetic Judgement, Kant suggests beauty is a matter of a judgement of taste and not reason (Kant [1790] 2014). I believe that many of the principles we still associate with the aesthetics of nature in the Western philosophical tradition are a product of the history of representing nature through art. As Berleant wrote “It is not a purely personal experience, ‘subjective’, as it is often mistakenly called, but a social one” (2002, 11).

It seems the principles and history of Western aesthetics in art continues to profoundly influence how we view and represent nature today. Casper David Friedrich’s sublime landscapes, J. M. W. Turner’s dramatic interplay of light on the elements of nature, and the romanticisation of the rural idyll depicted by painters such as John Constable are appreciated by art lovers not only for their technique but also for their representations of nature, and, importantly, our relationship to nature. Ideologies of nature and its representation permeate Western thought, including scientific assessments of nature.

MULTIDISCIPLINARY PRACTICE

As I have explained, urban ecologists study the relationships of humans and non-humans as a diverse urban ecosystem. This supports my personal philosophy that humans are not separate entities to nature. Humans are part of the ecosystems that make up life on Earth. Currently, this idea manifests in my studio research through tracing concepts of the physical, metaphysical, cultural, ideological, and ephemeral.

I am not an environmental artist, nor am I an overtly ‘green’ artist, and I cannot claim to have a totally ecologically sustainable practice. These are often concerns for nature-based artists. Reusing materials cast off from manufacturing industries or repurposing discarded objects is a practice employed by artists who choose to promote more sustainable ways of working and who are actively environmentally considerate. My most recent studio experiments with a selection of building materials were conducted to satisfy my interest in how those materials age and succumb to the natural process of change. My interest lies in the fact that these are the materials upon which micro-organisms will flourish, and plant life will grow and assist with sustaining diversity. More importantly, my intent is to evoke a different view
of the city by seeing these materials in a positive and creative context.

As I see nature everywhere in the city, I have become aware that it can be viewed as new and old, natural or unnatural—or as ‘semi-natural’, which describes plants that seem to exist “somewhere between totally natural and totally artificial” (Niemelä 2012, 149). In my research, the dichotomies of natural/artificial, human/non-human, and even old/new are not so much challenged as ignored. In other words, I accept that every variation of nature is valid nature.

There is a long history of art that encases the ‘wilderness’ and ‘countryside’ in a constrained and separate space—predominately, the picture frame—which further reinforces the notion of man as separate from nature. People are, however, according to urban ecology, one of the connections; the evidence of human activity in nature is ubiquitous. The evidence of ‘natural’ processes on the human world is similarly everywhere, but often somewhat more subtle—traces rather than tracts. Jones believes that to portray something this interesting, highly dynamic, and possibly unexpected provides an ideal opportunity for exploring the urban realm and the realm of nature through art. Therefore, ecologists, Jones suggests, should be more open to views, expressions, and interpretations of nature that are outside the ambit of science. Nonetheless, it takes conscious retraining to be able to see rather than observe, to experience rather than measure, to learn rather than know. Visual works may enable wholly new ways of comprehending nature that do not require habitual objectification and quantification. Above all, Jones believes, such works may have a role in allowing the scientific mind the opportunity to “step outside the hubris of modernity back into the natural realm from which it never actually left” (e-mail to the author, 7 May 2013).

I have looked to many other artists whose practices cross into areas outside the art realm. For example, Seattle-based artist Vaughn Bell incorporates performance, drawing, and sculpture. She uses materials such as acrylic, aluminium, and small plants to create personal biospheres. With humour and pathos, Bell questions our relationships with the places in which we live, and asks,

How is the landscape observed, divided and apportioned? What are the extents of our notions of connection and responsibility? How are we affected and how do we affect the places and spaces we inhabit and imagine? (Bell 2012)

Multidisciplinary UK-based artist Tania Kovats addresses similar themes, and writes,

you have to make people excited about your work. It’s a good idea to get other people involved, form collaborations, the more people you have willing a project to happen, the more likely it is to succeed. (Kovats 2009)

Kovats has always regarded talking to people as an important part of her practice. Collaborations and connections with people external to her practice provide a wealth of resources. Kovats views the crossover points between her work and those outside of her practice as opportunities to contribute to a broader cultural dialogue. Her work ethic and philosophy as well as her genuine concern for life on Earth are a constant encouragement to me. Artists such as Kovats have very realistic, positive, and well-informed perspectives of the relationships we make within the nature in which we live.

BUILDING NATURE

Building materials and the detritus of humanity are everywhere, and so too is nature. Finding an escape to nature, a place of serenity and contemplation in the middle of the concrete, glass, and busy city streets is a challenge. I believe it does exist, but not as we have always imagined.

In the documentary film Examined Life (Taylor 2008), philosopher Slavoj Žižek claims, “there is no nature”, suggesting that we need to work with the reality of what we have now within the urban, where he believes we can “find the poetry, spirituality . . . to recreate, if not beauty then aesthetic dimension in things like this, in trash itself. . . to seek perfection in imperfection”.

When Žižek claims there is no nature, he is referring to the idea of nature that people still hold on to—as wilderness, out there, away from the city, mysterious, and non-human. Žižek’s philosophy supports my proposition that there
is something aesthetically pleasing in the urban environment that rivals, and may well surpass, historical notions of the aesthetic of nature. Seeking perfection in imperfection resonates with my attitude to most things in my life and practice, including the materials I choose to work with in producing works of art about urban ecology.

CONCLUSION
My studio remains the primary site of investigation and experimentation into the surfaces, textures, marks, and objects, both naturally occurring and caused by human disturbance. I continue to reflect on the disparate and complex combinations of materials that provide the perfect environment for biodiversity and visual clues of urban ecosystems. As a result, my practice intimately explores the fabric of the built environment, reinterpreting the diversity and aesthetic found in the materiality of urban locations and the interplay of human and non-human elements.

My research has also drawn on ideas from ecological thinkers, writers, and artists about notions of the tenuous relationships and cross-sections of these elements within the city. Therefore, through creating a dialogue outside of my zone of knowledge, and analysing my topic through an alternative and unexpected framework, I have exposed a wholly new understanding of what originally inspired my studio research—nature.

ENDNOTES
1 There is a great deal of literature on the historical, social, cultural, architectural, political, psychological, and ecological aspects of cities. For the purpose of this essay, ‘city’ is a general term that refers to any urban centre located across the world with high rise buildings and high-density living.

2 It is not uncommon to hear the phrase ‘getting back to nature’. The term ‘nature’ has been used to describe most things that are not human and usually separate from humans. ‘Nature’, as an idea, is considered by many to signify pristine wilderness, away from cities. I acknowledge the various existing literature that defines ‘nature’, but, for the purpose of this essay, I use ‘nature’ broadly (whereas my exegesis expands on the complexities of the term and its meanings).

3 Professor of environmental science and ecosystem ecology at DePaul University in Chicago, Liam Heneghan has written extensively on restoration ecology. In his blog “fixing things wrong with the environment”, though he questions the importance of ‘fixing things wrong with the environment’, he questions the importance of ‘fixing things wrong with the environment’ and the use of words that suggest retrograde thinking, such as recycle, repeat, reclaim, and restore.

REFERENCES
INTRODUCTION

The metaphor is an essential instrument of conceptual engagement between visual art and viewer. Metaphors are critical to aid new understanding. Karol Berger, Professor of Fine Arts at Stanford University, asserts, “If we want to interpret things, metaphors and metonymies are all we have got” (Berger 2000, 223). Unlike a simile or analogy (where a thing is compared as being like or similar to something else), a successful metaphor requires greater intellectual rigour by the creator and the interpreter. The metaphor makes no simple comparison; it asserts that something stands in place of, or is, something else. A metaphor, as Aristotle said, gives something a name that belongs to something else (Berger 2000, 219 n10, 11, and 12). However, Aristotle warned that metaphors “must be fitting, which means they must fairly correspond with the thing, and yet not obviously so related” (Berger 2000, 219). If this is correct, can metaphors help us understand intangible, abstract concepts that have no correspondence to our physical world? Can a thing from our physical world metaphorically stand in place of such a concept?

The history of visual art shows innumerable examples of artists using metaphor to link the physical world to intangible concepts.1 However, if a metaphor “must fairly correspond with the thing”, then the use of the metaphor in these circumstances will not effectively assist the viewer in interpreting concepts beyond the physical world we ordinarily experience. I use metaphors to suggest the intangible concepts of quantum mechanics. For me, and other artists using metaphors to suggest abstract concepts, the authority and success of these metaphors depends on being able to demonstrate that metaphors can create new knowledge and understanding.

The theoretical discourse on the authority and limits of the metaphor for expressing intangible, abstract concepts identifies two contrary views. Aristotle’s idea of ‘correspondence’), is that the metaphor is based on the objective existence of material things that correspond to fixed and precise terms and meanings in language. Under this view, a metaphor is incapable of expressing a concept that has no physical equivalence. The other, the ‘intellectualist model’ (that has been further developed into an ‘experiential model’, which I will discuss below), accepts that the metaphor can create new relationships and understandings without the need for an immediate literal equivalent. As such, this second view supports the authority of the metaphor to incite new knowledge (both in the creator and the viewer) concerning intangible concepts.

Explicitly missing from both models is a psychological explanation of how metaphors work to create new meaning and understanding. Communications theorist Thomas Frentz (2011) observes this lack of explanation and proposes a psychological model of the metaphor that is, while controversial, particularly attractive for the artist engaged in making art concerning quantum mechanics. Frentz suggests that quantum mechanical processes in the brain may be involved in both the creation and understanding of metaphors.

THE METAPHOR: FUNDAMENTAL TO DEFINING CONVENTIONAL REALITY

Metaphor theorists George Lakoff and Mark Johnson (1980, 3) argue that metaphors are central to our conceptual system of how we perceive, think, and act; as such, metaphors are fundamental to defining reality. They support their claims though demonstrating how language carries metaphorical concepts, linking a thing to a whole structure of another (for example, argument as war, time as money, or time as a moving entity). They use a language-based approach to prove their claims since, they argue, language is a system of communication based on the same conceptual system used for thinking and acting. Visual artists,
however, mostly use metaphors through imagery (although text can be present in the image itself, in the title, and in supporting didactical statements). Even though I am interested in the image-based metaphor, the discourse on language-based metaphors, as will be referred to in this paper, is still relevant, since I posit that both language and visual imagery are sources of and feed into thinking and cognition, which is the ultimate seat of metaphorical interpretation.2

Since 2009, I have been making mixed media artworks that are based on concepts of quantum mechanics. Quantum mechanics demands a re-evaluation of the commonly accepted understanding of ‘conventional reality’ as a reality that is knowable, mind-independent, and objective (d’Espagnet 2011, 1712–13), a definition I adopt for the purpose of this paper. Quantum mechanics describes not only the basic components of matter but also the superposed immaterial or pre-material states of possibility (‘superposition’) in which those components exist prior to material form. Quantum theory suggests the possibility that human observation, or consciousness, might be the agent for collapse of quantum superposition into singular material reality (Heisenberg [1958] 1962, 54–55), or the alternate proposition that all possibilities manifest into multiple, branching universes (the ‘many worlds’ theory) (Everett 1957). Quantum mechanics also describes a relationship of entanglement where distantly separated parts demonstrate instant connectivity that cannot be explained by local causes. The intangible and non-material nature of quantum superposition and quantum entanglement has no equivalence to the physical world. In this sense, they are not able to be visualised in terms of the physical universe we experience. Quantum mechanics thus demands a re-evaluation of conventional reality (Bohr 1935, 697; Heisenberg [1958] 1962, 54–55; Deutsch 1997, 327; Barad 2007, 24; d’Espagnet 2011, 1712–13), because it suggests an unknowable, metaphysical world that might be more subjective and mind-dependent that we understand (Rosenblum and Kutter 2002; Wigner [1961] 1983, 168; Hameroff and Penrose 1996, 453–80; Goswami 2001; Wheeler 1983; Stapp 1999; 2001; 2006a; 2006b; von Neumann [1936] 1955; Walker 2000; Radin 2006). My artworks present an alternative to and a facility for doubting ‘conventional reality’.

According to Lakoff and Johnson (1980, 3), our ordinary conceptual system arises from what we perceive, how we get around in the world, and how we relate to other people. This in turn, they say, provides a central role in defining everyday reality. Those authors identify metaphors as ‘conventional’, where they associate something to another within the structure of our ordinary conceptual system. The imperceptible aspects of the quantum world, such as superposition, entanglement and multiple universes are thus outside our ordinary conceptual system. Therefore, a ‘conventional metaphor’ will be of limited use to me in making work about the intangible, abstract features of quantum mechanics and to other artists dealing with imperceptible ideas that are outside everyday, conventional reality. In order for metaphors to perform their function in artworks dealing with such abstract concepts, they must be able to associate something to ideas that go beyond conventional reality. Metaphors’ ability to do this has been the subject of intense philosophical debate.

THE EMPIRICIST VIEW

Johnson and Glenn Erickson (1980, 289–99) succinctly and clearly define the ambit of the discourse on the authority and limitation of metaphor in terms of the empiricist versus the intellectualist view. Empiricism holds that the only knowledge we can have is gained solely through our experience of the physical world (Godfrey-Smith 2003, 8). Johnson and Erickson (1980, 290) say that for empiricists, “Objects, it is claimed, have a determinative structure and stand in determinative relation to one another prior to the subject’s attempt to speak truly of them.” Therefore, to have any ability to convey meaning, a metaphor must have strict literal correspondence to objects and the relations between objects. Thus, in the empiricist view, a metaphor is grounded on the objective existence of physical objects.

Prior to measuring a quantum system, however, we cannot know anything for certain about the system or the state of its individual components. The objective reality of any particles does not exist. We can only know something specific about a quantum system after measurement. As physicist...
Werner Heisenberg (1958) said, the idea of an objectively existing quantum realm,

has thus evaporated in a curious way, not into the fog of some new, obscure, or not yet understood reality concept, but into the transparent clarity of a mathematics that represents no longer the behavior of the elementary particles but rather our knowledge of this behavior. (99–100)

Our knowledge of the system replaces any concept of an objective reality.

If a metaphor requires the objective existence of physical objects, then it is wholly unsuited to the expression of aspects of quantum mechanics, such as superposition, multiple universes, and quantum entanglement, as well as other abstract concepts that have no correspondence to objective, material reality. Accordingly, my installation, My father’s girlfriends, parallel alternatives (2012–13, figures 1–3), which I will describe below, is incapable of suggesting the multiple universes that make up the many-worlds theory of quantum mechanics. The metaphoric success of the work depends on challenging the empiricist view of the metaphor that is based on an objective singular and knowable reality. The ‘many-worlds’ theory does challenge this view of conventional reality by proposing many possible alternatives that are continually branching out and expanding in number at each point that an observation or measurement is made.3

In My father’s girlfriends, parallel alternatives, I take my father’s relationships with various women as the starting point for a series of ‘what if’ scenarios. For instance, what if my father had stayed with my mother; what would they look like as a couple later in life? After my parents split up, what if my father had stayed with Henrietta, who was partial to smoking marijuana; what might their wedding day look like? What if my father had stayed with Nora, a fat girlfriend who had severe alopecia and consequently no body hair? What if my father had stayed with Frances, the woman whom he did marry briefly, who seemed to me, through my fourteen-year-old eyes, to be sex-crazed. All these alternatives, and more, are painted on twenty-centimetre square tiles. These tiles are designed to interlock and move around in a frame as a large puzzle-tile work.

I filmed my eighty-six-year-old father interacting with the work and moving the tiles around, rearranging my alternate histories of his life. I used two cameras, running at the same time, recording images from either side of his interaction with the work. In editing the video, I split the screen and ran both films together (figure 2). On the left side image, however, I again split and mirrored the vision from a centre point. My father and his body parts move in and out from the centre of the mirrored image, disappearing and reappearing like movement through a central portal, possibly accessing multiple alternative universes. This metaphor of the portal, through which to access other worlds, has been exploited in science fiction but is generally not supported by the many-worlds theory. However, in 1997, German physicist Rainer Plaga speculated that parallel worlds are weakly linked, thereby permitting communication between branches of the multiverse. He proposed “a procedure for ‘interworld’ exchange of information and energy” (Plaga 1997).

The final installation comprises the video projected in large format (figure 1) and the tiles, partially stacked in the frame with some also lying on the floor (figure 3). If the metaphor is limited in scope to invoking concepts with literal equivalence in our physical world, then the interlocking ‘alternate view’ images on the separate tiles, the split Rorschach-like screen mimicking a portal, and my father’s decision-making in manoeuvring the tiles in the video cannot metaphorically suggest multiple possibilities and alternate versions of my father’s life that exist in different universes, since these concepts have no empirical basis. In this sense, the work fails in its metaphorical and cognitive content. Thus, through these techniques, I have failed to enable the viewer to doubt conventional reality and entertain the possibility of multiple universes. However, I do not accept the limitations of the empiricist view of the metaphor. I believe metaphors can be used to express imperceptible, abstract concepts to create new knowledge and understanding in the viewer.
Figure 1 My father’s girlfriends, parallel alternatives 2012–13, acrylic and oil on board, digital video (9:11 min), dimensions variable

Figure 2 My father’s girlfriends, parallel alternatives (detail) 2012–13, video still
THE INTELLECTUALIST VIEW

The alternative, intellectualist position that Johnson and Erickson outline (1980, 291) is that the metaphor has a direct role in the possibility of conveying new knowledge. This is based on the view that objects are determined relative to and fashioned by the activity of the subject. However, this is not a purely solipsistic view and there is a more fundamental concept behind this. In the intellectualist view, “objects are relative not to particular subjects, who can thus be in error, but rather to generalized subjective viewpoints, which are the intersubjective ground of objectivity”.

According to this view, there are no objects that are independent of group conceptualisation.

In the intellectualist view, conceptual systems have the capacity to change because of the infinite ways the subject may conceptualise experience. In this event, metaphors are indispensable and are capable of replacing the dominant conceptual paradigm with new or altered concepts. This idea of group formations of dominant conceptual paradigms that are nevertheless subject to change recalls Thomas Kuhn’s (1996, 130) radical idea that strikes at the objectivity of material things and the relationship of thought to matter (that is, when paradigms of thinking change, it is possible that the physical world changes too). It also evokes a Jungian notion of a collective unconscious that I will discuss later as a way of explaining the psychological process behind the creation and interpretation of a metaphor. Critically, for the intellectualist, metaphors have a creative capacity in “bringing together what was not yet associated” or, of “inducing alterations within a conceptual system or even a shift to a new system” (Johnson and Erickson 1980, 292, original emphasis).

The intellectualist account of the metaphor (as opposed to the empiricist account) gives authority to artists’ endeavours to convey new concepts, including quantum reality. The intellectualist view does not require a metaphor to be linked to the objective existence of material things. Accordingly, metaphors can suggest realities outside conventional reality. Quantum theory itself challenges the notion of an objective reality...
beyond observation and measurement. Therefore, if viewed through the intellectualist authority of the metaphor, the separate tiles of My father’s girlfriends, painted with alternate versions of my father’s possible history and rearranged by his agency, are the different versions of his life that branch into many, alternate worlds at every decision he makes. The split screen showing the two, simultaneous camera angles and the further Rorschach-like splitting of the left-side of the screen metaphorically suggest alternate, parallel realities not only of my father’s past but also as a continuing occurrence with every choice my father makes in moving the tiles.

THE EXPERIENTIALIST MODEL
Johnson and Erickson and others have extended the intellectualist model of the metaphor into the ‘experientialist’ model. This model gives the artist an even stronger foundation than the intellectualist account for a justified use of metaphor when representing abstract, imperceptible concepts. Johnson and Erickson propose that metaphors work because of the way humans use the objective world to construct meaning. In line with a phenomenal approach, Johnson and Erickson (1980, 294) propose that the subject (say, the viewer) is viewed as a “pre-objective being” who is in the process of gaining a more objective understanding of themselves and the world. Within a conceptual system, “some beings are more fully objectified than others”. Through a dynamic relationship between the subject and object (say, the thing or image viewed), the pre-objective being continues to construct meaning and understanding. This pre-objectification level is also pre-conceptual, where ideas are yet to solidify into firm concepts. It is at this point that the metaphor can be used to solicit, support, anticipate, and bear conceptual meaning in the ongoing, dynamic process of determining both objects and the subject herself or himself.

Johnson and Erickson’s assertion of the subject (in the process of defining oneself and becoming more objective and determinate) as being the “pre-objective being” has some resonance with the quantum theory that proposes a fundamental interrelationship between observation, consciousness, and material result. In particular, it bears analogy to physicist John Archibald Wheeler’s view of a “participatory universe” that emphasises the role of the observer in creating observed phenomena. “The dependence of what is observed upon the choice of experimental arrangement”, he says, “conflicts with the view that the universe exists ‘out there’ independent of all acts of observation” (Wheeler 1983, 184). No phenomenon is a phenomenon until observed, and in this sense it is a “participatory universe” (Wheeler 1978, 41).

The idea of the participatory universe and the assertion of the role of the observer in quantum collapse and, possibly, in creating material reality, is what I seek to metaphorically evoke in many of my artworks. For instance, in The superposition of Neville’s brain, also known as Wigner’s friend (2010–13, figures 4 and 5), the metaphor ‘observation equates to matter’ is evoked through Neville’s looking into the microscope and the viewer’s observation through the peephole. The viewer, in peeping through the hole, has the unnerving experience of feeling linked to the workings of Neville’s brain through the system relayed metaphorically via the structure of the painted image and actual wires. This unexpected experience conveyed by the metaphor facilitates creation of new knowledge in the mind of the viewer. It acts as a challenge to the viewer’s notion of conventional reality where we do not ordinarily have a role to play in collapsing quantum superposition or sharing the conscious occurrences of others.

MEDITATIONS ON KLEIN BOTTLES
The dynamic association between subject, object, and the pre-objective being through which the subject constructs meaning in the experientialist model of the metaphor is redolent of the mutually enfolded, participatory relationship that quantum theory suggests between us as observers and objects. I have used the Klein bottle as a metaphor for the creative relationship between subject and object in my series of paintings Meditations on Klein bottles (2013, figures 6–9), The dynamic relationship between observation and creation # 1 (Space Invaders) (2013, figure 10) and The dynamic relationship between observation and creation # 2 (QIX) (2013, figure 11). A metaphor of this kind was suggested by Steven Rosen (2008),
writer, philosopher, and Emeritus Professor of Psychology at City University New York.

Rosen adopted communication theorist Paul Ryan's graphic linear schemata for the Klein bottle (Ryan in Rosen 2008) (figure 12). This scheme suggests that the Klein bottle in three-dimensional space contains three parts: the uncontained area of the neck of the torus when it emerges, cylindrical fashion, to double back on itself (analogous, Rosen says, to us as the subject or observer); the contained area surrounded by the torus (analogous to the object observed); and the internal area inside the torus (analogous to space). In three dimensions, the Klein bottle pierces itself to demonstrate its continuous, non-orientational surface. Rosen says that by being represented in three-dimensional space, the Klein bottle is misrepresented. Rather, it is a creature of four spatial dimensions where it is both open and closed and continuously one-sided without the need for self-penetration.

I understand the three-dimensional Klein bottle to be self-referential; at once describing the continual creative dynamic and interplay of subject, object, and space similar to our own possible creative role as participants in the dynamic relationship between observation and creation of matter at the quantum (and possibly macroscopic) level. Like the inhabitants in Edwin Abbott’s novel Flatland ([1884] 2006) who can only comprehend two dimensions, the Klein bottle’s world of four dimensions is incomprehensible to me. I am apparently stuck in three physical dimensions, reduced to metaphorical devices.

My Meditations on Klein bottles series is a careful, sustained look at the Klein bottle’s materiality in three dimensions and, ultimately, an act of material creation through this observation. The deliberate obfuscation of boundary between bottle and background forces the viewer, if desired, to complete, in their own mind, the objective delineation between space and physical object. In The dynamic relationship between observation and creation #1 (Space Invaders) and The dynamic relationship between observation and creation #2 (QIX), the object of the Klein bottle itself is described only in terms of how light (photons) is refracted through it.

The metaphorical use of the Klein bottle in all these works brings together two ideas (the Klein bottle and the interdependent relationship between subject and object in quantum theory) that were not yet associated (in the visual form presented by me) and may result in “inducing alterations within a conceptual system or even a shift to a new system” (Johnson and Erickson 1980, 292, original emphasis). Arguably, the simple visual perception of these paintings may not have this effect. However, Johnson and Erickson argue that metaphors are helpful at the pre-conceptual level to assist the pre-objective being to solicit and discern conceptual meaning. When these paintings are exhibited, I supplement them with the following didactic statement, which aims to help the viewer comprehend the metaphor:

As suggested by Steven Rosen, the Klein bottle is a useful tool in re-considering our subjective relationship with quantum (and macroscopic) phenomena. In three dimensions, the Klein bottle pierces itself to demonstrate its continuous, non-orientational surface. But represented in three-dimensional space, the Klein bottle is misrepresented. Rather, it is a creature of four spatial dimensions where it is both open and closed and continuously one-sided without the need for self-penetration. I understand the four-dimensional Klein bottle to be self-referential, at once, describing the continual creative dynamic and interplay of subject, object and space similar to our own creative role as participants in the dynamic relationship between observation and creation of matter at the quantum (and possibly macroscopic) level.

The intellectualist and experientialist accounts of the metaphor are subject to the empiricists’ criticism that metaphors fail if they do not correspond to the way things are (Johnson and Erickson 1980, 293). The objects we experience, such as glass bottles, have defined edges and we do not seem to have a creative role in manifesting them or any other physical objects; therefore, arguably, the Klein bottle metaphor does not represent the way things are. The
Figure 4 The superposition of Neville’s brain, also known as Wigner’s Friend 2010–13, oil on canvas and board, electrical wires, metal box (11 x 20 x 16cm), media player, digital video (8.35 min); installed dimensions approx 89 x 120 x 16cm

Figure 5 The superposition of Neville’s brain, also known as Wigner’s Friend (detail) 2010–13
Figure 6 Klein bottle meditation – pencil #1 (red)  
(from the Meditations on Klein bottles series) 2013,  
oil on board, 30 x 30cm

Figure 7 Klein bottle meditation – pencil #2 (yellow)  
(from the Meditations on Klein bottles series) 2013,  
oil on board, 30 x 30cm

Figure 8 Klein bottle meditation – mirror #1 (yellow)  
(from the Meditations on Klein bottles series) 2013,  
oil on board, 30 x 30cm

Figure 9 Klein bottle meditation – mirror #2 (pink)  
(from the Meditations on Klein bottles series) 2013,  
oil on board, 30 x 30cm
Figure 10 The dynamic relationship between observation and creation # 1 (space invaders) 2013, oil on canvas, 150 x 110cm

Figure 11 The dynamic relationship between observation and creation # 2 (QIX) 2013, oil on canvas, 96 x 120cm

Figure 12 Parts of the Klein bottle, from theorist Paul Ryan’s graphic linear schemata for the Klein bottle © Paul Ryan Estate
empiricists and the intellectualists (together with the experientialists) disagree because of a philosophical divide concerning objectivity and subjectivity. This philosophical divide, however, is precisely what the artist who engages in making work about concepts of quantum mechanics attempts to address. Such an artist seeks to shake the empiricist foundation of the belief in objective, knowable, mind-independent reality.

Both the intellectualist approach and Johnson and Erickson’s experiential approach to metaphor posit the fundamental role of the metaphor in creating new knowledge without some immediate literal equivalent (see also Lakoff and Johnson 1980, 139 and 144). The artist who uses metaphor to convey quantum mechanical and other abstract concepts through the authority of the intellectualist and experiential models is capable of creating new understandings and relationships where none previously existed in the mind of the viewer. For example, the peephole devices in The superposition of Neville’s brain, also known as Wigner’s friend (figures 4 and 5) and Dribblejuice (figures 13–15) indicate the subjective, participatory role of the observer in quantum theory. The separate tiles rearranged by my father and the split, alternate views of the video projection in My father’s girlfriends, a parallel alternative suggest the multitude of possibilities that are manifesting into different universes according to the decisions made by him. The self-piercing, non-orientational surface of the Klein bottle represents the subject/object interplay of material creation suggested by quantum theory.

A PSYCHOLOGICAL MODEL: THOMAS FRENTZ
Explicitly missing from the intellectualist and experientialist accounts is a psychological explanation of how metaphors work to create new meaning and understanding. Thomas Frentz observes this lack of explanation and proposes a psychological method by which this might happen (2011). While until now I have discussed and analysed the perception of a metaphor and the effect on the viewer, Frentz’s model hypothesises how a metaphor might be created by the author (in my case, the artist) at a psychological level.

While supporting the claim that the metaphor is capable of evoking new understanding concerning quantum mechanics, Frentz’s model also suggests that the psychological process of creating or interpreting a metaphor involves...
is based on Carl Jung’s formulation of depth psychology to explain how this process might work. In particular, Frentz accepts Jung’s concepts of the collective unconscious, the psychic instincts of the universal archetypes, and the principle of synchronicity.

Frentz’s alliance to the metaphysics of Jungian psychology could be the main point of criticism against and rejection of his model, particularly by the proponents of conventional reality. However, quantum mechanical concepts give reasons to doubt conventional reality. They propose that the extent of reality is beyond a materialist or empiricist account. Quantum theory suggests that consciousness may be an active agent in quantum mechanical processes. For these reasons, I persevere with Frentz’s model since it may provide insight into creative metaphors that generate new knowledge without some immediate literal equivalent.

For Frentz, Jungian synchronicity, or “meaningful coincidences”, could provide the prototype for his psychological account of how the creative metaphor is shaped by the author/artist (Frentz 2011, 114). An example of synchronicity that Frentz mentions is Jung’s story of the scarabaeoid beetle, whose gold-green colour resembles that of a golden scarab that is tapping at his window at the same moment his patient is telling him about her dream of being handed a piece of gold jewellery in the shape of a scarab beetle. Another example is the story of the wife of one of Jung’s patients for whom a flock of birds had been a harbinger of death and who foresaw her husband’s death when a flock descended on her house (Jung in Frentz 2011, 115–6). Synchronicity defies causality in the material world. Jung explains it as an image arising from universal archetypes in the collective unconscious that comes into the consciousness of a person either literally (such as the flock of birds) or is symbolised or suggested. This coincides with an objective situation. Jung believed that synchronistic experiences tap into archetypes of the collective unconscious because there is always a heightened effect on the people who experience them. This effect or “specific charge” on people is the power of synchronicities to change, sometimes in a radical way, the people experiencing them.
In Frentz’s view, metaphors are similar to synchronistic experiences. Both are accompanied by a heightened effect; both contain two parts (for synchronicities it is a conscious and unconscious occurrence and for creative metaphors, arguably, there is a literal and figurative tension); and in both, insight is gained for those who experience or produce them. Accordingly, Frentz proposes that if creative metaphors are language (and, by my assertions, visual) forms of synchronicities, “then perhaps metaphors, like synchronicities, are somehow related to the collective unconscious before they are expressed”. (Perhaps the collective unconscious is the undefined source of the “pre-objective being” in an extrapolated Johnson and Erickson account?) At this point, Frentz departs from Jung, unable to find any definitive structure of the collective unconscious further than Jung’s assertion that it is the archetypes (composed of psychic instincts) that constitute the structure of the collective unconscious. Frentz therefore proposes that quantum physics might provide an explanation of how the collective unconscious might be accessed by the mind. Not surprisingly, he focuses on the theory propounded by physicist David Bohm “that the ultimate foundation of physical reality [is] an undivided whole” and that the universe is holistic and interconnected (Bohm in Frentz 2011, 119).

Frentz acknowledges that Bohm’s quantum theory involving a unified metaphysical and objective world is controversial. Physicists who follow the orthodoxy of quantum mechanics regard it as marginal and radical (Cushing 1996; Myrvold 2003). Frentz, nevertheless, invokes it because he believes it can explain how Jung’s collective unconscious and archetypes are accessed and, ultimately, explain creative metaphors. In Bohm’s theory of quantum ontology, the physical universe of discrete matter (the explicate order) unfolds from the underlying connected metaphysical implicate order that contains all potentials. But matter can also revert back by an enfolding process from the explicate order into the implicate order as a potential, and so on, back and forth. Highlighting one of the main attacks that quantum mechanics makes on conventional reality, Bohm’s theory indicates that reality does not stop at what we think of as conventional reality and is more than merely physical matter. In Frentz’s analysis, Bohm’s theory of the implicate order equates to Jung’s collective unconscious.

Jung asserted that archetypes had properties of both matter and mind and Frentz draws on physicist David Peat’s earlier link between Bohm’s implicate and explicate orders and Jungian psyche and synchronicity. Peat (in Frentz 2011, 121–22) said,

If mind and matter can be understood as emerging out of a common order, then it will no longer be helpful to think of them both as distinct substances but rather as inseparable manifestations of the one undivided whole . . .

Our thoughts are the explicate forms thrown up by the underlying movements of the implicate orders of the mind.

From these bases, Frentz gives his account of what might happen, psychologically, to an author in the process of producing a creative metaphor. He considers that before production, an impasse will be experienced; for my purposes, this describes the artist being troubled by an inability to find a metaphor for the many-worlds theory and the suggestion that our viewpoint of the world is entirely subjective. Frentz says that, in such a case, re-ordering pre-existing knowledge will not work, as something genuinely new is required. In trying to find an appropriate metaphor, the artist will become anxious:

Then, in a self-stoking cycle, heightened anxieties trigger escalated efforts, escalated efforts further intensify the anxieties, which in turn redouble the efforts, and so on. I think this anxiety/effort spiral is the psychological precursor of a creative metaphor. (Frentz 2011, 123)

If the impasse is unresolved, the impasse itself enfolds back into the wholeness of the collective unconscious “where the energy concentrations of the archetypes represent unrealized semantic knowledge potentials”. Here, the impasse, enfolded within the collective, is “reconfigured in some novel way as an energy concentration” to unfold back, finally, into consciousness.
Frentz’s scheme is controversial, and reliant on unverifiable theories of the psyche and quantum ontology. However, specific contemporary theorists of the mind entertain the possibility that consciousness and quantum processes have a direct interrelationship (Keutzer 1984; Atmanspacher and Frach 2013; Jahn and Dunne 2001; Chalmers 1996). In addition, Frentz’s model has some support from Jung and Pauli. In Jung’s supplement to *On the Nature of the Psyche*, and relying on correspondence that he cited from Pauli, he states:

> The application of statistical laws to processes of atomic dimensions in physics has a remarkable correspondence in psychology insofar as it pursues the foundations of consciousness to the point where they dim out into the inconceivable and where only effects of ordering influences on to conscious contents can be detected. (Jung in Atmanspacher and Frach 2013, 226)

Jung and Pauli made an analogy between, on the one hand, the process of measurement in physics to distill the holistic reality of the quantum realm into a local reality, and on the other, the process in psychology of becoming consciously aware of subjective reality arising from holistic unconscious contents. They saw parallels between the transition from mental and material holistic realities to mental and material local realities in both quantum observation and conscious awareness (Atmanspacher and Frach 2013, 225). And, as in Frentz’s model where there is a two-way interaction of the enfolding and unfolding, for Jung and Pauli, the transition between holistic and local realms is bi-directional (Atmanspacher and Frach 2013, 225).

Frentz’s model holds attraction for the artist who is aware of the tussle that the creative act can entail. This can be a process of trial, error, frustration, the passing of time, and an eventual moment of revelation and solution. In my case, I grappled for some time to find a way of metaphorically suggesting the subjectively relative view of the universe that the many-worlds theory proposes. The final version of *Dribblejuice* was preceded by many iterations: first, a large-format square painting; then a large rectangular painting; and then additions and subtractions of various elements. At each stage, I felt frustrated and wished to bring some unconventional element to the work. At some point, I bought a small, novelty viewing device, without any ulterior purpose, that sat on a shelf in my studio for many months. Randomly, and in one moment, the fully formed idea came to me to incorporate the viewing device into the work and to mount a much smaller version of the painting horizontally above. This satisfied my requirement to present the work in a way that would upset viewing conventions and require the viewer to observe the work through irregular means to gain an understanding of the work. The method for viewing *Dribblejuice* forces a discrete and initially confusing observation of an image through a small peephole and metaphorically relates to the notion that, in the many-worlds theory, one person’s version of the world is entirely relative to their view.

Frentz’s model addresses how creative metaphors might be shaped in the mind of the author. However, can his model be applied to assess the effectiveness of the metaphor from the viewer’s, rather than the creator’s, experience? In an e-mail to me in 2013, Frentz briefly addressed this question; he assumes (perhaps naïvely, he admits) that the processes by which metaphors are created would be reversed for perception. I understand Frentz to mean that a viewer of an artwork who perceives its metaphorical image might be confused by it and wrestle to understand it, and their increasing perplexity and anxiety leads to an impasse. Through the viewer’s consciousness, the conceptual impasse might become enfolded, through quantum processes, into the collective unconscious and then unfolded back, finally, into consciousness with new insight.

Additionally, the Frentz model focuses on how language-based creative metaphors are invented. However, there do not seem to be any constraints within the model to an application to metaphors perceived directly by the viewer as opposed to mental images that arise in the mind, and Frentz, in his e-mail, indicated no objections to my doing so.

**Conclusion**

Thus, I have demonstrated that the empiricist theory of the metaphor does not support the use of metaphors in artworks to aid interpretation.
of abstract concepts, such as aspects of quantum mechanics. The intellectualist and experientialist models of the metaphor, however, accept that the metaphor can create new relationships and understandings without the need for an immediate literal equivalent. These latter models provide authority for the proposition that metaphors can draw on real-world material perceptions to suggest abstract, imperceptible concepts and so create new knowledge and understanding. Frentz’s psychological model of how a metaphor is created and interpreted in the mind of the artist and viewer respectively, while highly controversial, nevertheless provides authority for the psychological creation and reception of a metaphor dealing with abstract concepts. It has particular appeal to the artist making work concerning quantum mechanical concepts. This is due to Frentz’s evocation of Bohm’s quantum theory of the implicate and explicate order that gives a subjective and creative role to the observer through consciousness in relation to his or her experience of the world.

Please note: Studio Research has modified its house style to preserve the author’s preference to lowercase her artwork titles.

ENDNOTES

1 Some examples are as follows: premodern religious images, such as Byzantine icons, where divine beings were thought to be present in the image and could intervene into the world through the image (see Belting in Berger 2006, 214–16); Gombrich 1959, 220; Coreggio’s depiction of the Roman god Jupiter as a cloud seducing Io, Jupiter and Io, ca. 1530; the Renaissance painters’ inclusion of cupids, angels, saints and other unearthly beings in their works; Hieronymus Bosch’s fantastic alternative worlds; Pablo Picasso’s and Georges Braque’s paintings and collages that suggest a multiplicity of objects in space that transcend ordinary human perception; the Surrealists’ renderings of the workings of the mind and, according to art historian Gavin Parkinson, the post-1930 Surrealists assimilated concepts of quantum mechanics into their paintings [2006, 357–77]; Wassily Kandinsky’s attempts to paint sounds; and M. C. Escher’s experiments with the logic of space. More recent examples include the contemporary artists duos Ms&Mr and Veronica Kent and Sean Peoples. The former create interventionist videos by adding contemporary film to old footage. By doing so, they create retrospective narratives about time and space, multiple possibilities and entangled states (Ms&Mr n.d.). The latter’s The Telepathy Project questions metaphorical communication boundaries (Kent 2012, 28).

2 Whether thinking occurs in words or images, or, as some cognitive scientists would argue, in abstract symbols according to mathematical logic, is unresolved. Mathematician Henri Poincare thought that scientific research of the highest order required thinking in images (Miller 1986, 222). Arguing against Edward Sapir’s assertion that speech was the only road to thought, Rudolf Arnheim considered words were aids to the more appropriate visual imagery in scientific thought (Arnheim 1969, 228, 231–32). Arthur Miller (1986, 223–26) gives a good account of cognitive science’s information-processing paradigm of thinking of the mind as a symbol-manipulating machine as well as the division in cognitive science between those who regard imagery fundamental in thinking and those who consider it that mental images have no causal role in thought processes.

3 The ‘many worlds’ idea, proposed by Hugh Everett (1957), postulates that multiple quantum states never collapse into a single state of material reality, rather that the reality we perceive is merely one part of vast network of all possibilities that continue to exist in their own parts of a super-space of alternate physical.

4 See also Mark Johnson’s formulation of the experientialist model with George Lakoff (1980).

5 Johnson and Erickson note that this idea is not new or exotic, and indeed their system draws its basis from the phenomenological approach promoted by Edmund Husserl, Martin Heidegger, and Maurice Merleau-Ponty.

6 A Klein bottle is a non-Euclidean mathematical form with a one-sided surface. It has no inside or outside.

7 Thomas Frentz is Professor of Communication at the University of Arkansas.

8 Frentz identifies for his purposes the relevant key thinkers and their texts on the metaphor as: Ivor Armstrong Richards (1936), Max Black (1962), and Paul Ricoeur (1977).

9 Carl Jung and Wolfgang Pauli met in 1923 but commenced “intense” discussions and communication between 1946 and 1958 over the relationship between the psychological and quantum physics; see Atmanspacher and Frach (2013, 221).


INTRODUCTION
This paper focuses on connections between neocybernetic discourse and new materialism in the arts using work developed in my PhD project “The Introverted Kinetic Sculpture”. I propose that drawing these discourses together informs and enforces particular contemporary approaches to kinetic sculptural practice that involve an active engagement between artist, material, and emergent systems as each work develops in the studio and exhibition space. Using two works from my PhD project, Underwing (2010) and Web (2012–13), as case studies, I argue that this engagement functions within and contributes to a new materialist approach to sculptural practice. The language and descriptions provided by particular strands of neocybernetic discourse (exampled in this paper by Niklas Luhmann’s “The Medium of Art”, 1987) allow one to understand and articulate the complex interactions enacted as each work develops through these contemporary approaches to sculptural practice. The approaches used in the two introverted kinetic sculptures reveal these works as sites in which to explore posthumanist considerations of agency, medium, and systems (all of which will be defined) in the kinetic work of art.

Kinetic sculpture entails a particular immediacy between material and artist: the movement inherent in kinetic sculpture foregrounds its material qualities, potentials, and limitations. For example, acetal plastic’s self-lubricating surface is evident when two acetal faces run against each other; the reaction of polycarbonate plastic to thread-locking adhesive (which causes damaging crazing) becomes apparent when it is applied to stop vibrations from loosening bolts; a silicone vessel’s elasticity is challenged by several thousand expansions; the volume of water necessary to pull a rope through a pulley indicates the pulley’s friction, and so on.

However, few contemporary kinetic sculptors discuss these material agencies at length. Theo Jansen is a notable exception; he creates Strandbeests—“beach creatures”—from plastic conduit pipe, cable ties, and plastic drink bottles. His book The Great Pretender (2009) details the works’ development over two decades. Jansen discusses materials thoroughly—their use, manipulation, limitations, and cultural readings—highlighting the importance of material engagement and process developments within his work. He states:

Given the restrictions of this material I was forced to seek out escape routes that were neither logical nor obvious . . . It was the beach animals themselves that let me make them. And the plastic tubing that showed me how. (Jansen 2009, 35–37)

In contrast, interviews and writings from other contemporary kinetic sculptors primarily focus upon end-product and artist intentionality. Therefore, rather than offering a survey of artists working with new materialist approaches to kinetic sculpture, this paper’s contribution to discussions surrounding new materialism and sculptural practice focuses upon my select works as case studies.

In this paper, I identify correlations between these new materialist considerations of agency and matter—where all matter asserts itself as active and agential (Coole and Frost 2010, 7)—and cyberneticist Luhmann’s articulations of “medium” and “form” as discussed in “The Medium of Art” (Luhmann 1987). To Luhmann, ‘medium’ is the combination of elements from which a work (a ‘form’) emerges—essentially, the
work’s environment. In this sense, material is an element in that work’s medium, as are factors such as the artist’s skills and the exhibition space. ‘Form’ is the work of art (in other words, the system) that emerges from this medium. Forms arise “through selection from the possibilities offered by a medium” (Luhmann 1987, 102). To Luhmann, a medium “holds its elements ready for coordination through form” (Luhmann 1987, 103).

Considering the emergence of *Underwing* and *Web* through Luhmann’s neocybernetic language resonates with particular aspects of new materialist discourse. A posthumanist approach to sculptural practice informed by new materialism recognises the inherent agency of each work of art distributed among various materials, relations, and elements, including the artist. Imagery evoked by Luhmann’s explanations of medium and form provides means to visualise and understand the complexities and agencies at play when kinetic sculptural practice is approached from a posthuman, new materialist perspective.

‘Agency’ as discussed in this paper draws from a conception of materiality in which material materialises (Coole and Frost 2010, 9); where matter is not considered passive or inert but instead possesses its own modes of self-transformation, self-organisation, and directedness (Coole and Frost 2010, 10). As Coole and Frost eloquently conclude, “‘matter becomes’ rather than . . . ‘matter is’” (Coole and Frost 2010, 10). Agency here is a generative force through which all matter (including the human being) asserts itself as active, self-creative, productive, and unpredictable (Coole and Frost 2010, 8–9).

I begin the paper by introducing “The Introverted Kinetic Sculpture” project. I then discuss the shift from cybernetics to neocybernetics, an emergence reflective of the movement towards posthumanist thinking about systems. I then focus upon Luhmann’s understanding of ‘medium’ and ‘form’, elucidating how this resonates with those understandings emerging in new materialist discourses, particularly in relation to agency. Finally, I discuss *Underwing* and *Web* in light of Luhmann’s essay.

**INTROVERSION IN THE KINETIC SCULPTURE**

As evidenced by its title, my PhD project investigates the notion of ‘introversion’ in kinetic sculpture. I use the term ‘introverted kinetic sculpture’ to describe kinetic sculptures that are defined by specific qualities of their systems (circularly causal, autopoietic systems with analogue manifestations) and the environmental conditions (the ‘medium’ of the sculpture, following Luhmann) through which these systems emerge.

Through this project, an understanding of systems developed that drew together in-studio experimentation, neocybernetic discourse, and in-exhibition testing. In taking select introverted kinetic sculptures as case studies, this paper considers a particular aspect of the research: the correlations apparent through these in-studio and in-exhibition explorations between new materialist and neocybernetic discourses; and how, by exploring specific works’ emergences, these discourses may inform approaches to both kinetic sculptural practice and sculptural practice more generally.

‘Introversion’ here denotes a kinetic sculpture oriented around inner factors; the sculpture’s ‘logic’—the system underpinning its emergence—is shaped as the work emerges from its medium. To be clear, I do not seek to anthropomorphise the kinetic sculpture through the concept of introversion. Though our understanding of ‘introversion’ is derived from Jungian psychology based on the aware human mind (see, for example, Craighead and Nemeroff 2004, 353; Sharp 1987, 65), the application of the term to something that, as far as we can perceive, has no ‘sense of self’ perhaps allows space to consider ways of being that are different to our human-centric experiences. Therefore, I use ‘introversion’ as an evocative term to frame concerns exploring circular-causality and material agency within the kinetic sculpture. In no way do I suggest that the introverted kinetic sculpture is introspective—that it has thoughts or feelings or that it examines itself ([*Oxford Dictionary of English* 2005, s.v. “introspect”]). Instead, the term ‘introversion’ is used in a posthumanist framework in which agency is not specifically linked to humanism.

The introverted kinetic sculpture’s logic both produces and is generated by the sculpture itself,
emerging directly through qualities of the system’s materials and other elements of its medium. This logic impacts upon the work’s motive qualities (the characteristics of that work’s movements) as the work grows around the system’s motive potentials. The logic moulds the work’s form, influenced firstly by the form’s capacity to support and contribute to the motive qualities and subsequently by aesthetic considerations. Each work’s logic is additionally framed by requirements that derive from it being a work of art, including exhibition length, maintenance, safety considerations, and installation limitations.

The factors above literally form and move the work, so that once manifest, the work has emerged through this logic. Additionally, the logic that has formed the work (and that exists only within that specific work) has itself been generated through the work’s coming into being. As this proposition specifically speaks to both the emergence and existence of the introverted kinetic sculpture, it is particularly relevant to investigating systems that emerged within the project.

Thus, the term ‘introversion’ is used beyond its Jungian roots, instead being applied in a posthumanist framework in which agency is not specifically linked to humanism, consciousness, or intention (Coole and Frost 2010, 8). This approach follows theorists dealing primarily with the material turn, including political theorists Jane Bennett, Diana Coole, and Samantha Frost, and theorists more directly dealing with the material turn in the arts, such as Estelle Barrett and Barbara Bolt. These new materialist accounts of agency resonate with in-studio and in-exhibition experiences within the project between myself-as-artist and the work of art’s coming-into-being.

**FIRST-ORDER CYBERNETICS AND SECOND-ORDER CYBERNETICS (NEOCYBERNETICS)**

The term ‘cybernetics’, coined in 1950 by Norbert Wiener (a cyberneticist), names the field of study that considers the control of systems through messages and communication (Clarke and Hansen 2009, 2). Cybernetics specifically relates to circularly causal systems, which are those that involve feedback (in other words, communication) that impacts, through a closed signalling loop, on the system’s ongoing functioning. Cybernetics became relevant to “The Introverted Kinetic Sculpture” when circular causality emerged as a fundamental condition of introverted kinetic sculptures.

The terms ‘first-order’ and ‘second-order cybernetics’ define two branches of the field. Heinz von Foerster, an important figure in the history of cybernetics, provides a distinction between the two: “first-order cybernetics is the cybernetics of observed systems, while second-order cybernetics is the cybernetics of observing systems” (von Foerster 2003, 303). He expands on these positions as fundamentally different, both ethically and epistemologically, in regards to how one considers oneself: “on the one hand [in relation to first-order cybernetics], as an independent observer who watches the world go by; or on the other hand [in relation to second-order cybernetics], as a participant actor in the circularity of human relations” (von Foerster 2003, 303). It is clear that von Foerster’s is a distinction between a humanist and a posthumanist cybernetics. First-order cybernetic thinking was seated in humanist considerations, where the observer is separate from the system being observed. In second-order cybernetics, the observer is inherently part of the system, observing (and in doing so, affecting) from within—the system is thus an ‘observing system’. Subsequently, second-order cybernetics functions in a posthumanist consideration of the world, where the observer cannot be meaningfully decoupled from the system.

In *Emergence and Embodiment: New Essays on Second-Order Systems Theory*, Bruce Clarke (a professor of literature and science), and Mark B. Hansen (a professor of English, visual arts, cinema, and media studies) prefer the term “neocybernetics” in place of “second order cybernetics” (Clarke and Hansen 2009, 4). Following Clarke and Hansen, I use the term ‘neocybernetics’ hereafter.

Where first-order cybernetics was marked by an ontological theory of form (which inherently focused upon matter), neocybernetics overcame classical ontology’s impasses by “de-ontologising” the question of the form/matter dichotomy (Clarke and Hansen 2009, 4). Neocybernetics saw a shift from an ontological (how systems come into being) to an autological (how observing systems bring themselves into being) theory of form.
Neocybernetics thus superseded the form/matter dichotomy by studying the distinction between form and medium (Clarke and Hansen 2009, 4). With this shift, neocybernetic discourse promoted new levels of attention to the “environments and the embodiments of systems” (Clarke and Hansen 2009, 5, original emphasis).

NIKLAS LUHMANN’S "THE MEDIUM OF ART"

Luhmann considers two major areas in “The Medium of Art”. The first is the role of the environment-as-medium (the ‘medium’) in the work of art’s emergence (the ‘form’), and how form constitutes its own medium. The second considers the art world as a medium from which works of art coalesce. The first is relevant in considering correlations between neocybernetic and new materialist discourses.

Luhmann's application of the terms 'medium' and 'form' arises from neocybernetic discourse rather than the standard application of these terms in art. Reconsidering the neocybernetic use of these terms in artistic contexts highlights particular correlations between neocybernetic and new materialist considerations.

Luhmann clarifies that his concept of medium is distinct from the 'matter' often referred to in first-order cybernetics: “We speak neither of matter nor mind but confine ourselves to the concepts of medium and form” (Luhmann 1987, 102). In order to “stress relativity and evolutionary capacity”, medium should be considered to “consist of elements or events in the time dimension” (Luhmann 1987, 102). Luhmann further clarifies his vision of medium by using air as an example:

air is only a medium because it is loosely coupled in this way. It can transmit noises because it does not itself condense to noises. We only hear the clock ticking because the air does not tick. (Luhmann 1987, 102)

This “loose coupling” of elements constituting a medium is contrasted to forms, which:

arise through the concentration of relations of dependence between elements, i.e. through selection from the possibilities offered by a medium. The loose coupling and easy separation of the elements of the medium explains why the medium is not perceived but the form which coordinates the elements of the medium. We do not see the cause of light, the sun, we see things in the light. (Luhmann 1987, 102, my emphasis)

To Luhmann, a medium “holds its elements ready for coordination through form” (Luhmann 1987, 103). In neocybernetics, systems (Luhmann’s ‘forms’) coalesce through difference between form and medium: through a simplification of the environment into the form—which Luhmann calls “decomplexification” (Clarke and Hansen 2009, 11). To Luhmann, works of art, like anything else, emerge from medium.

Works of art . . . must not fix their medium invariantly . . . the difference between medium and form remains decisive as difference. There is neither a medium without form nor a form without medium. (Luhmann 1987, 103, original emphasis)

He then distinguishes medium and form: medium consists of many elements while form reduces the magnitude of these elements to what they can order: “form can only shape itself if a medium is available and its elements are suitable” (Luhmann 1987, 103). This interdependence of form and medium provides a crucial means of envisioning the way in which the introverted kinetic sculpture develops and emerges both in-studio and in-exhibition.

Luhmann then asserts his essay’s primary theme—that “form first constitutes the medium in which it expresses itself” (Luhmann 1987, 104)—using music as an example. Music, as distinct from noise, relies on a selection from the medium of noise: “in this medium . . . any tone can follow any or be combined with any, unless the form of the musical work decides otherwise” (Luhmann 1987, 105). In other words, the form constitutes (by way of selection, simplification, and difference from medium) the way in which that medium is expressed. Just as in music, explains Luhmann, “art establishes . . . its own rules of inclusion... served by the difference of medium and form as medium” (Luhmann 1987, 105).

I found that Luhmann’s co-constitution of form and medium resonated with particular
observations I had made early on in my PhD project—that it seemed that the work of art was ‘making itself’. To Luhmann, the work of art

... organises for itself a medium in the natural world in order to separate itself from the world’s conspicuous events and play with its own. Through art, new possibilities of the acoustical and optical world are discovered and made available and the result is this: strategies of dissolution permit more possibilities of ordering the world than would otherwise appear. (Luhmann 1987, 105)

Therefore, through Luhmann, the work of art self-generates via the artist’s hands (which are an element of medium). Thus, my experience as an artist of the work ‘making itself’ can be reconsidered as a responsive awareness of the systematic and material agency enacted in the emerging introverted kinetic sculpture.

This conception echoes articulations in new materialist discourses regarding the relationship between artist, material, and artwork. In discussing Martin Heidegger’s silver chalice analogy, Bolt states:

In his attribution of responsibility and indebtedness to the silver and to the chalice, Heidegger grants agency to both the silver and the chalice. In doing so, he opens the possibility for theorising a very different relation between humans, materials and tools... [He] provides us with quite a different way to think about artistic practice. Thought this way, humans no longer set the world before them... They activate a mode of being that lets something come into appearance. (Bolt 2004, 74–76)

Luhmann’s concept of the work of art “organis[ing] for itself a medium” (which includes the artist) and Bolt’s discussion of Heidegger’s silver chalice (which she contrasts with the accepted view that “the artist and crafts-person is the one who obtains results and consequently the one who is assigned authorship and ownership for the work” [Bolt 2004, 73–74]) both support the way in which new materialist approaches to artistic practice decentralise the artist. The artist is a necessary element within the work of art’s medium, but their agency is one of a host of interacting agencies that simplify the complexity of the work’s medium into the work itself. It is in this entanglement of agencies (to borrow the term from Rick Dolphijn and Iris van der Tuin (2012, 15)) that the work of art materialises.

The embracing of agency as a generative force through which all matter is active and productive inherently entails understanding the artist’s position—their agency—as decentralised and levelled. It is within the levelling and decentralisation of agency encountered in neocybernetic and new materialist discourses that a co-consideration of each offers exciting potentials for the articulation of the way in which specific works come into being.

EXPLORING MEDIUM THROUGH INTROVERTED KINETIC SCULPTURE

Luhmann’s articulation of form and medium provides a means to articulate the way in which kinetic sculptures conform to medium. The materialisation of the introverted kinetic sculpture as form through medium embodies what Luhmann foresaw as the emergence of “more possibilities of ordering the world than would otherwise appear” (Luhmann 1987, 105). In this section, I hope to show the potential of Luhmann’s ‘medium’ and ‘form’ as a model for thinking and articulating the emergence of works in sculptural practices informed by new materialism and posthumanist approaches to agency.

I begin by considering the elements that comprised the medium of Underwing. Considering Underwing through Luhmann’s medium shows how new materialist approaches to kinetic sculptural practice can be supported by neocybernetic conceptions of medium. This consideration emphasises the complexity of the medium from which any work of art emerges—and how the work, in taking form through its medium, emerges as a “manageably complex” manifestation from its “chaotically complex” medium (Clarke and Hansen 2009, 11).

I then investigate Web to explore how medium functions when work is exhibited in several exhibition spaces. I propose that as the work moves from site to site, its medium absorbs additional elements that interact with those...
already inherent in the work. The neocybernetic concept of ‘decomplexification’ is applied to contextualise this proposition and to articulate the shifts apparent in Web over several exhibition iterations. By doing so, I elucidate how kinetic sculptures comply to neocybernetic considerations of systematic emergences.

*Underwing* developed early in my PhD project (figures 1–4). The action in *Underwing* involves a moving equilibrium enacted through the weight of water. It followed an earlier work, *Shallows* (2010), in which I first identified a kinetic work asserting material agency. The potency of this experience led to active attempts for *Underwing* to provide an openness towards material agency. As Luhmann puts it, this approach resulted in discoveries and emergences in the work that allowed “more possibilities . . . than would otherwise appear” (Luhmann 1987, 105), showing the benefit of a new materialist approach in the creation of kinetic sculptures.

*Shallows* also hinted towards systematic potentials, and led to the shifting equilibrium in *Underwing* being responsive and causal—thus creating a circularly causal system. Each of the seven vessel pairs connects to its own peristaltic pump. This pump moves water from one vessel in the pair to the other. This shifting weight creates a smooth movement from one positional extreme to the other. As the vessel pair reaches its arc’s half-way point, it engages a switch that powers the pump connected to the next vessel pair. This shifting equilibrium, responsive and causal, creates a continuous looping system.

*Underwing*’s medium comprises many elements. Among them are the exhibition proposal; my wish to integrate the work’s motive input (the pumps) more systematically than in earlier works such as *Shallows*; and my skills, physicality, and experience in making kinetic work. The studio also contributes elements; in *Underwing*, these included the materials at hand during experimentation and the equipment available, such as heat guns for forming vessels, and the computerised router used to cut polycarbonate for the peristaltic pumps and the vessels.

Time is another influential element: the time in the studio, as serial experiments produce
particular sequences of events through which the work emerges; the time of a pump’s rotational speed; the time that a viewer spends with the work; the time required for the water to shift equilibrium; the length of time that an exhibition runs for, and so on. The medium also contains elements from the context of my practice; one that is primarily non-commercial, based in Melbourne, Australia, influenced by academic study and particular discourses in the art world (at that point in time), and impacted by access to art outside Melbourne through travel and the Internet.

The exhibition space also contributes to the work’s medium. Underwing was developed for Linden Centre for Contemporary Arts in St Kilda. This site embodies influential elements: the gallery’s size; its bay windows and a false wall; domestic architectural features remaining from its life as a nineteenth-century mansion, including fireplaces, architraves, skirting boards, paint colours, and floorboards; the condition of aged plaster walls, which are difficult to affix to; sound transmission between spaces; and a plaster ceiling that cannot support fixtures.

This list of elements is not exhaustive. Rather, it indicates their complexities and interconnections, interactions, and influences within the emergence and ongoing existence of a single work of art. Underwing emerged not symptomatically from these elements, but within a neocybernetic framework; it emerged as a simplification of these elements.

The work therefore supports the neocybernetic assertion that autopoietic systems emerge from mediums that are infinitely more complex than the systems themselves (Clarke and Hansen 2009, 11). The system, the form, is a simplification—or, as Luhmann puts it, a “decomplexification”—of that complexity, from “the chaotically complex to the manageably complex” (Clarke and Hansen 2009, 11). Thus, as a decomplexification of the significantly more complex medium, this consideration of the medium of Underwing posits the work of art as a small lens through which to see some of the complexities and agencies from which it emerges. These complexities and their intricately interwoven effects upon the work may or may not be perceivable nor fathomable, but
they are nonetheless there, present in the work of art’s existence. As Luhmann states, “we do not see the cause of light, the sun, we see things in the light” (Luhmann 1987, 102, my emphasis). In this understanding, Underwing is a concrete example through which to explore the expanded neocybernetic understanding of medium.

The exploration of medium in Underwing shows how a neocybernetic concept of medium allows consideration of the work beyond its in-studio production by encompassing its site’s elements. In sculpture of this nature, which resolves during installation and relies upon the site’s qualities to ‘hold’ its form in space, the gallery’s elements have significant impact. However, rather than considering this work as ‘site-specific’, a neocybernetic approach shows that medium includes elements of site, which constitute an influential role in the work’s emergence. In combining a new materialist approach to practice with the neocybernetic conception of medium, the way in which the work’s emergence is understood can be expanded beyond the studio, encompassing all aspects of the work’s development as well as its ongoing interactions with its environment and its audience.

How then does one practically apply these considerations to sculptural practice? As the work’s medium becomes apparent through its coming-into-being, it is counter to attempt to map a ‘process’ that will accommodate these variabilities between works. Instead, I propose an ‘approach’. Approach is taken in its many meanings: a moving towards; a way of interacting with; a proposition (Oxford Dictionary of English 2005, s.v. “approach”). This approach, drawn from a co-consideration of new materialism and neocybernetics’ medium, asks the artist for an openness towards medium: its elements, their potentials, their uncertainties, and the processes through which these elements take form in the work of art. In this approach, the artist’s role is to offer, as the other elements do, their material qualities as an agent among the many that assist the work to develop; and to be aware of their decentralised role and
the levelled ontological plane from which these agents function. In such an approach, manifest opportunities will arise—“more possibilities . . . than would otherwise appear” (Luhmann 1987, 105)—in which the work can form from its medium.

Web emerged through such an approach and developed through four exhibition iterations. Each iteration saw Web alter in response to these new contexts. It emphasised the role of decomplexification in medium-becoming-form, and the way in which this forming occurs when an installation-focused work is re-exhibited.

The first iteration of Web (figure 5) involved little in-studio development. Various pre-made components were collected—the circuitry from Underwing, hose clamps, pulleys, a stainless steel rod, and plastic vessels—and brought together within the gallery over three days. Thus, the work did not emerge until installation, forming directly in response to the gallery and the behavioural qualities of various materials and elements in the work.

While the system used the circuitry and pumps from Underwing, mechanical and formal differences impacted upon its behaviour. In Underwing, steel structures join each vessel pair, while in Web, they are connected with stainless steel wire rope running through pulleys. Another significant difference involves the cam-triggered micro-switches of Underwing, which were replaced with mercury tilt-switches in Web. Tilt-switches do not require cam-triggering, and can therefore be placed in any position so long as they can be thrown from one orientation to another. Combined with the vessel pair’s flexibility, these tilt-switches saw Web display substantial behavioural differences despite embodying similar circuitry to Underwing.

The way in which equilibrium affected Web both causally and in its motion marked a significant shift from the systems apparent in Underwing. Embracing the gallery’s unusual spatial qualities—five metres wide by seven metres long by eight metres high—this iteration of Web involved vessels dropping up to four metres. This sudden
plunging of water-laden vessels was violent, distinct from the gentle motion of Underwing.

Web was then reconfigured for the group exhibition Entertaining the Environment at LaTrobe Visual Arts Centre, Bendigo, shrinking into a clearer, distinguishable form. This second iteration, Web (Retrial) (figure 6), functioned similarly to its predecessor, yet differed in two main respects: the ceiling’s structural limitations meant both avoiding the violent action of the previous vessels and arranging the vessels in a line. These variations elicited a substantial shift in the work’s behaviour (and thus the sensory experience); with the smaller scale, the vessels moved more regularly, highlighting variabilities of time and volume that emerge within the limiting parameters of a system’s context.

The group exhibition was re-exhibited at Bus Projects in the Donkey Wheel House, Melbourne. In this third iteration, Web (Recur) (figure 7) shrank to one-fortieth of its original volume, its form resolving into a column, which reduced fixtures and simplified installation. With less water

than the previous iterations, the actions became smoother and gentler.

The fourth iteration, Web (Encore) (figures 8–10), exhibited in Introverted at the Margaret Lawrence Gallery, Southbank, saw new components replace the previous off-the-shelf components. After the third iteration’s columnal configuration, this final iteration refined many of the material and formal qualities of the first three iterations into a contained and delicate work. In particular, the minimal water required increased the transitional speed and emphasised the gentle motion with which the vessels moved.

The impact of these multiple iterations in the work’s development gave rise to questions about how medium can be considered when new sites are encountered. While Underwing shows how a neocybernetic consideration of medium includes the exhibition space, Web goes further by illustrating how additional exhibition contexts necessarily impact upon a work’s manifestation. The shifts visible across the four iterations of Web—its spatial shrinking and reductions in its motive distance and force—evidence a system

Figure 6 Web (Retrial) 2012, stainless steel, water, pulleys, fasteners, polyethylene, stainless steel wire rope, tilt switches, santoprene hose, nylon hose, electronic components, motors, dimensions variable
Figure 7 Web (Recur) 2012, stainless steel, water, pulleys, fasteners, polyethylene, stainless steel wire rope, tilt switches, santoprene hose, nylon hose, electronic components, motors, dimensions variable

Figure 8 Web (Encore) 2013, stainless steel, water, pulleys, fasteners, polyethylene, stainless steel wire rope, tilt switches, santoprene hose, nylon hose, electronic components, motors, dimensions variable. Photographer: Jem Selig Freeman.

Figure 9 Web (Encore) [detail showing peristaltic pump] 2013, stainless steel, water, pulleys, fasteners, polyethylene, stainless steel wire rope, tilt switches, santoprene hose, nylon hose, electronic components, motors, dimensions variable. Photographer: Jem Selig Freeman.
working towards efficiency, towards the simplest actions necessary for its continuation. Web exhibits those qualities fundamental to Maturana and Varela’s conception of autopoiesis (Maturana and Varela 1980) and to later developments, such as those of Luhmann (Luhmann 1987), where the system strives towards ever-greater simplification of its environmental complexity. In each new context, the work must, to continue its ongoing circular-causality, accommodate new elements brought to it by the new site. The work’s medium now includes several sites across multiple temporal instances in addition to those elements previously involved. These new elements do not override the effect of those already apparent in the work. Rather, they are absorbed into the work’s medium, impacting upon its ongoing existence and interacting with the elements already at play.

Exploring Underwing here has shown the complexity inherent to a work’s medium, while Web shows how form emerges from medium through decomplexification. Together, Underwing and Web provide useful case studies through which to envisage approaches that combine neocybernetic and new materialist discourses. These explorations underscore the relevance and value of such an approach to understanding and articulating contemporary sculptural practice and to visualising the complexities at play as a kinetic sculpture comes into being.

CONCLUSION
Thus, drawing from Luhmann, and as explored through Underwing and Web, the work of art’s ontology develops through agencies distributed between multiple elements. This conception of agency resonates with that discussed in new materialist discourse, in which material materialises, and where matter possesses its own modes of self-transformation, self-organisation, and directedness (Coole and Frost 2010, 9–10). In this posthumanist, new materialist framework, agency is a generative force through which all matter (including the human) asserts itself as active, self-creative, productive, and unpredictable (Coole and Frost 2010, 9). In
considering Luhmann's 'medium' and 'form' through the emergence of two of my introverted kinetic sculptures, this paper has elucidated these considerations of agency in both neocybernetic and new materialist discourse as they are relevant to contemporary sculptural practices.

The imagery Luhmann enables provides a means of visualising the relationship between the work of art and the artist that is explored in new materialism. The decentralisation of the means of visualising the relationship between the work of art and the artist that is explored in contemporary sculptural practices.

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Laura Woodward

4  'Autopoiesis' describes a system that is autonomous, operationally closed, interpretation of Luhmann's medium and form and particular aspects of new materialist discourse as it relates to artistic production shows how these terms are useful to comprehend, visualise, and articulate these complexities. More specifically, as exampled in exploring the mediums of Underwing and Web, a co-consideration of these discourses highlights the ways in which they can inform the artist's approaches to, and understandings of, those multifarious agencies at play in their own sculptural practice as each work comes into being.

ENDNOTES

1 Artists working with kinetic sculpture in the contemporary era—specifically those whose works are embedded in the work's sculptural form—include Korean artist U-Ram Choe, British artist Conrad Shawcross, American artist Arthur Ganson, Canadian artist and architect Philip Breeley, and Dutch artist Theo Jansen.

2 Precedents for studies of the relationship between Luhmann's approach to systems and art include Pamela Lee's Chronophosis: On Time in the Art of the 1960s (Lee 2004) and Francis Halsall's Systems of Art: Art, History and Systems Theory (Halsall 2008). However, little work has been undertaken that correlates neocybernetic considerations with the in situ and in exhibition experiences of the works' emergences, and the concrete manifestations of systems within kinetic sculpture. My project contributes to the field by addressing this gap.

3 A panel presentation at the Art Association of Australia and New Zealand's 'Inter-discipline' Conference (2013) comprising Dr. Bianca Hester, Dr. Sarah Crowest, Benjamin Woods and myself (in which I presented a version of this paper) explored new materialism in light of sculptural practice. Convener, Associate Professor Barbara Bolt, explains: "with its intimate engagement with objects, materiality and spatial and social relations, Sculpture and Spatial practice provide the exemplary conditions of possibility for examining the ethical, aesthetic, epistemological and ontological claims of the new materialism through the arts... in order to take stock of the opportunities and limits offered by a new materialist perspective" (Bolt 2013, 18).

4 'Autopoiesis' describes a system that is autonomous, operationally closed, and self-referring (Lee 2004, 312). The term emerged early in neocybernetic discourse and remains a key consideration in discussing neocybernetics. The neocybernetic system is open in its structure (the material nature of the various components affected by their inherent nature and the surrounding environment), but closed in its organisation (the self-referential logic that the system uses to filter its environment) (Wolfe 2010, 60).

5 In Autopoiesis: A Theory of Living Organizations, Zeleny clarifies this consideration: 'it should be recalled here that organizational closure of autopoietic systems is meant in the sense of circularity and has nothing to do with the openness of such systems with respect to environmental inputs or perturbations. Structure refers to the realization of the organization in a particular space of components. Thus structure is not only a result of a system's interaction with its environment, but, more fundamentally, of the underlying organization' (Zeleny 1979, 1:155). Within this project, circularly causal systems have emerged displaying characteristics that reflect those of autopoietic systems.

6 Of course, the human is always an element within the work of art's medium. The human elements with most agential influence are the artist and the viewer, and all that they embody, that impacts upon the work's development, reception, and its existence as a work of art.

7 In discussing the new materialism, Coole and Frost discern an "insistence on describing active processes of materialisation in which embodied humans are an integral part, rather than the monotonous repetitions of dead matter from which human subjects are apart" (Coole and Frost 2010, 8).

8 'Motive' is used in the sense of either pertaining to motion, or as "producing physical or mechanical motion" (Oxford Dictionary of English 2005, s.v. "motive").

9 This is not a binary distinction between the work's motive and aesthetic qualities. In fact, the work's motion is fundamental to aesthetic experiences of it. However, while the motive and aesthetic qualities are intertwined, aesthetic qualities in the introverted kinetic sculpture develop chronologically subsequent to the functional and motive qualities that emerge through the systematic relationships between components. To further consider the relationship between systems and aesthetics, I recommend Jack Burnham's text Great Western Salt Works: Essays on the Meaning of Post-Formalist Art (Burnham 1976), where Burnham speculates that a systems aesthetic "resists functioning as an applied esthetic, but is revealed in the principles underlying the progressive reorganization of the natural environment... the idea of process takes precedence over end results" (Burnham 1974, 18–19).

10 Particularly relevant to this research in relation to agency and new materialism in artistic practice are Cornell Knowledge: Towards a 'New Materialism' through the Arts, by art theorist Estelle Barrett and artist and art theorist Barbara Bolt (2013), and New Materialism: Interviews and Cartographies, by cultural theorist Iris van der Tuin and art theorist and philosopher Rick Dolphijn (2012).

11 Von Foerster was one of the first participants in the Macy Conferences, a series of interdisciplinary conferences exploring the then-emerging cybernetics in various fields.

12 Luhmann appears to be speaking of everyday experiences, when the medium is sufficiently diffuse to avoid attention. It is, of course, possible to experience medium (such as seeing the sun) but much more likely in daily life to experience forms in the medium (such as seeing forms in the sun's light).

13 See Bryant's conception of a "flat ontology" (2011, 19).

14 A 'cam' is a rotating mechanical part with projections along its edge. When the cam slides against another part, these projections transfer the cam's rotational motion to a variable linear or reciprocal motion based on the pattern of projections.

REFERENCES


BIOCHROMES AND HEALING PLANTS: TRANSDISCIPLINARY STUDIO RESEARCH

Renata Buziak

For thousands of years, humans have used plants for their medicinal properties. However, as many sources have noted, such knowledge of plants is not always retained. In Australia, the decreased use of plants for their medicinal purposes is due to the impacts of colonisation, the introduction of modern medicines, limited written records, some issues over secrecy and confidentiality, and also a lack of appreciation for local natural resources (Lassak & McCarthy 1997; Chevallier 2001; Gurib-Fakim 2006; Clarke 2007; Williams 2010; Ningthoujam et al. 2012; Tan et al. 2012). Nevertheless, Michael Christie notes that Indigenous knowledge systems are “alive and well”, “responsive, active, and constantly renewed and reconfigured” (Christie 2006, 78 and 79), and Karen Martin argues that Aboriginal people “never relinquished, nor lost the essence of, our Ways of Knowing and Ways of being, and this is reflected in our Ways of Doing” (Martin 2003, 211). While it is beyond the scope of this paper to discuss research concerning Indigenous knowledges, my research promotes respectful treatment of cultural property and engages sharing of knowledge and learning from the Quandamoooka Peoples. As Christie states, “Aboriginal knowledge everywhere comes out of the routine of practices of life and makes those practices possible” (Christie 2006, 79). My doctoral research project sets out to generate cultural material, intended for exhibition in galleries and other public venues, through a visual exploration of local Australian plants with medicinal properties. By creating works of art that encapsulate the complex physical properties—as well as the embedded history and mythology—of these plants, the project aims to contribute to recording history and advancing contemporary understanding of Australia’s natural history. This focus has necessitated a transdisciplinary approach that includes research of available records and collection of data, visually and orally, in dialogues with the Quandamoooka Peoples of Minjerrribah (Aboriginal name for North Stradbroke Island). The Island is located in Quandamoooka country, twenty-seven kilometres west of Brisbane. As Martin writes, “Quandamoooka is the land, waterways, skies, spiritual and law systems of the Quandamoooka people of Minjerrribah (North Stradbroke Island), Moorgumpin (Moreton Island), Moreton Bay, and part of the mainland. There are three clans who have traditional rights to this country: Noonuccal, Koenpul, and Ngugi” (Martin 2003, 206).

I concur with Gary Iseminger, who writes that “The function of the artworks and practice of art is to promote aesthetic communication” (Iseminger 2004, 128). According to Michael Kelly, “aesthetics is clearly a necessary part of art’s enactment of its substance” and “is deeply embedded in artistic practices, making it a partner in the production of contemporary art” (Kelly 2013, 11, 25). This aesthetic exploration is conducted using experimental photographic processes; I transform chemical properties into aesthetic dimensions, providing visual representation of the healing qualities of flora. This paper will focus on transdisciplinary and experimental aspects of my studio research methodology and will provide underpinnings of the research project, which includes plants and natural processes in visual art.

DEFINITIONS

For the purpose of my research, I accept the definition of healing or medicinal plants offered by Andrew Chevallier as those that contain “active constituents that have an action on the body” (Chevallier 2001, 10). Traditionally, medicinal plants are used to “treat symptoms such as fever, congestion, headache, skin sores, tired or swollen aching limbs and digestive problems” (Clarke 2007, 99).

For the last several years, I have been developing an experimental photographic process I call the biochrome, which results
from amalgamating plant matter and analogue photographic materials that are subjected to organic decomposition, scanned, and presented as digital prints or videos. These works document traces of chemical and biological reactions and micro-organic activities that occur over a period of weeks during a plant’s decay. ‘Bio’ means “of or relating to life”, and ‘chrome’ originates from the Greek word ἱχρόμα, meaning ‘colour’ (Hawker et al. 2001, 107, 213). Therefore, in my biochromes, I record the ‘colour of life’ left by the microbes that are feasting on or decomposing the plant material in the pigmented gelatious surface of the C type print. The biochrome process provides an alternative, unconventional method to visually represent plant specimens and natural processes, and, by highlighting aesthetic dimensions, it reveals additional details of the plants’ characteristics. My collaboration with organic processes in image making furthers our perception of medicinal chemistry by translating it to another metaphoric dimension, while the works, layered with bioscience, botany, and history, highlight the interconnection of all living organisms’ microbes’ significance in the universe, and their transformative power in the cycle of life.

My interest in natural remedies draws on my early life. I come from a small town, Janów Lubelski, in South East Poland, surrounded by the Janowski Forests and farming fields, where there is a strong connection to the land and its history. Like most residents there, my family had a garden with fruit, vegetables, herbs, and flowers; a seasonal family activity was to make preserves and store various vegetables for winter, as well as collect fruits of the forest and make medicinal remedies. As a child, I was given herbal teas and remedies by my grandmother, and accompanied my mother regularly on visits to local herbalists and healers. As a result of my immersion in nature and its healing qualities in those early days, in recent years, I have actively fostered an interest (or obsession) in knowing and making sense of my adopted Australian home and my relationship to this beautiful, harsh (and, to me, unfamiliar) environment. My personal background, my fascination with natural processes, and my growing understanding of the necessity to preserve biodiversity provide the impetus for this visual art research project.

**SCIENCE BACKGROUND**

My practice operates within an environment already defined by botany and ethnography, and my research includes investigations of resources that provide background understanding of the First People’s use of land and plants, as well as scientific data of plants’ medicinal properties. In *Bush Medicine* (1990), Tim Low laments the loss of knowledge, practices, and significant changes within the Aboriginal ways of healing since white settlement. He argues this is due to three influences: new diseases that Aborigines had no experience of; adoption of introduced plants as food sources; and the introduction of the billycan that allowed for boiling herbs instead of soaking them in water. Pre-settlement medicinal practices, Low asserts, “will always remain a mystery” (Low 1990, 5, 20, 25). The Aboriginal medicine man’s practices included magic, spirits, and chants, but herbal and other remedies for various complaints “were used by all Aborigines, although older women were usually the experts” (Low 1990, 3, 25). Ethnographer and anthropologist Philip Clarke studies Aboriginal peoples’ relations to plants in order to “discover much about a people”, as plants are “fundamental parts of the landscape that cultures occupy and transform” (Clarke 2007, 6). Ethnobotanical studies of Aboriginal cultures help to recognise that these cultures “had complex relationships with the flora and fauna” and that “there is a great depth in the Aboriginal understanding of ecosystems in which they lived” (Clarke 2007, 7). Clarke states:

> From a contemporary Western European perspective, ‘bush medicine’ in Aboriginal English embraces a continuum: from substances that are demonstrably effective due to pharmacological properties, to others that work solely on a psychological basis. (Clarke 2007, 99)

Clarke, similarly to Low, notes that “in pre-European times, all adults in the community would know about basic medicines” (Clarke 2007, 97). He discusses Aboriginal rituals and beliefs in connection to the use of plants for healing (their physical and symbolic properties), as well as rituals performed out of the responsibility of looking after the land and “maintaining the
fertility of their country”. He writes that “many Aboriginal groups performed ‘increase’ rituals and held ceremonies that they believed would continue the cycle of renewing the species of their country” (Clarke 2007, 23, 96). Martin Nakata reminds us that “Aboriginal Knowledge now surfaces in academic and scientific circles” (Nakata 2002, 282) and Christie stresses the current use of Aboriginal knowledge in “the ongoing work of caring for country” (Christie 2006, 84). In The Biggest Estate on Earth: How Aborigines Made Australia (2012), Bill Gammage describes Aboriginal peoples’ connection to their country:

The people felt intensely for their country. It was alive. It could talk, listen, suffer, be refreshed, rejoice. They were on it and others were not because they knew it and it knew them. (Gammage 2012, 142)

Aborigines “possessed a spiritual connection with their natural resources, placing immense significance on this relationship” (Tan et al. 2010, 331). Gammage describes the care for the land that was part of life:

The Dreaming taught why the world must be maintained; the land taught how. One made land care compulsory, the other made it rewarding. One was spiritual and universal, the other practical and local. (Gammage 2012, 139)

In recent years, there has been increased interest in testing Australian native plants for active compounds potentially beneficial as new remedies and as part of “a chronic disease prevention strategy” , and an increasing number of data sources are available (Gurib-Fakim 2006, 7; Tan et al. 2012, 332). As part of my research, I drafted a table listing selected medicinal plants of North Stradbroke Island. The table is composed of a thumbnail photograph of the plant, its botanical, common, and Aboriginal names, and its various uses for healing. Sources used to compile the table include Bush Medicine (1991), Australian Medicinal Plants (1997), Aboriginal People and Their Plants (2007), and The Flora of North Stradbroke Island (2009), as well as data of plant properties or active compounds from scientific journals. It is important to note that in Aboriginal culture, different communities would use the same plant species for different ailments in a distinctive way. Lassak and McCarthy assert that “The method of preparation of the remedy is extremely important”, and some older reports do not provide precise details in describing preparation stages, and the levels of chemicals they contain may differ within the same species (Lassak and McCarthy 1997, 12, 13; Clarke 2007, 100). Sanjoy Singh Ningthoujam and others (Ningthoujam et al. 2012, 22, 24), in a review of medicinal plants databases, assert that “culturally specific plants in one community may not be significant in another” and “plants of the same species collected from different locations are known to possess different chemical compositions”. Often, there is a notable inseparability of the function of specific plants in their medicinal, spiritual, and dietary uses.

PLANTS AND NATURAL PROCESSES IN ART PRACTICE

The use of plants for their healing properties is as old as human history, and, in the past, anyone studying and practicing medicine also studied plants; the now separate disciplines of medicine and botany were once undivided (Pavord 2005, 16). Illustrations of plants can be traced to some of the earliest available records, even bone carvings from the Paleolithic period. Records of the use of medicinal plants in China date from 5000BC. The oldest illustrated manuscript dates from AD512—Dinocrates’s medicinal plants codex (Blunt et al. 1994; Lack 2001). During European explorations, illustrators drew from life to record unfamiliar spices in exotic lands (Lack 2001).

In 1839, William Henry Fox Talbot produced his first photographic images of plants by placing plant samples directly onto light-sensitive materials and exposing them to light. Anna Atkins, Talbot’s contemporary, took this idea further, documenting botanical specimens of “flowers of the sea” (Atkins et al. 1985, 30), using a cyanotype photogram technique (by placing an object on paper prepared with cyanotype chemistry and exposing it to light), which resulted in cyan colour images. For the first time, a botanical book of British algae was illustrated photographically. Since then, advances in science and optics have allowed for precise illustrations and photographic documentation of botanical specimens for the purposes of art and science.
By utilising the processes of decomposition, biochrome photography offers another means of representation and documentation of plant species, and can reveal, in visual form, additional details and layers of the plants’ characteristic features as well as suggest the idea of decomposition as integral to plant life cycles.

A number of contemporary artists work with natural processes to create their work, seemingly allowing nature to image itself, letting chance and organic processes to take over. The works mostly depict organic forms and these materials become the medium and process as well as the subject. My work can be situated within this bio-art context. Contemporary artists embracing natural processes in their work include Daro Montag, Mario Reis, and Jenifer Wightman, whose work I will examine later in this paper.

As part of my research, I conduct surveys of selected native plants traditionally used by the Quandamooka People of Minjerribah for their medicinal qualities, and document them using the biochrome process, which transfers and translates them into an aesthetic dimension. This research methodology encourages intercultural and transdisciplinary exchanges, promoting dialogues between Aboriginal community, visual art, and bioscience. I have limited the scope of this project to Minjerribah in order to produce comprehensive records within defined parameters. The Island provides an ideal location for this initial investigation. Its diverse habitats contain over 500 of Queensland’s native plant species and over fifty native medicinal and/or food plants, as specified in The Flora of North Stradbroke Island (Stephens and Sharp 2009).

The following methods outline my procedures:

I review available data on selected medicinal plants in literature; I draw on appropriate protocols to develop formal and informal consultations with the Minjerribah Moorgumpin1 Elders-in-Council, members of the Combined Quandamooka Aboriginal Organisations Forum, Quandamooka Yoolooburrabee Aboriginal Corporation (QYAC), and the North Stradbroke Island community members;2 and I reside on the Island to identify, select, and locate relevant plants in their natural environment. Field trip and studio activities include photographing, filming on location, gathering plant samples, biochrome making and evaluating, collecting and analysis, time-lapse photography of the biochrome process (see figures 1–6). In addition, I visit Bush Care, the local nursery, to acquire selected plants for planting and use in the project.

FIELDWORK: NORTH STRADBROKE ISLAND
Prior to my field trips, I met with Queensland Herbarium Director Dr Gordon Guymer3 and Kathy Stephens, both of whom contributed to The Flora of North Stradbroke Island (2009), a publication that was produced by a collaboration between the Queensland Herbarium, the Minjerribah Moorgumpin Elders-in-Council of North Stradbroke Island, and the mining company Consolidated Rutile Ltd. Guymer and Stephens were very helpful in the defining stages of the project; we discussed access to and collection of some plants that I selected from the publication, the processes to gain collection permits, and they recommended a couple of their contacts on the Island, whom I was able to meet during my first field trip.

I also made contacts at the North Stradbroke Historical Museum where I can access research resources, and have met community members and Elders through meetings and by attending a few Island events.4 Since 2011, I have progressively built relationships with the Quandamooka Peoples, and my engagement with the community has been educational and inspiring. I believe that getting to know some of the Island’s Elders and community members has already enriched this project and my understanding of Australia’s First Peoples’ connection to their land and community. It has also confirmed the importance of educational and cultural opportunities that engage and educate current and future generations on topics regarding medicinal plants. That the local Island community is informed of, and where possible, engaged in this research is important for the viability of this research.

METHODOLOGY OF THE BIOCHROME PROCESS
The Flora of North Stradbroke Island (Stephens and Sharp 2009), which lists the Island’s entire flora, including medicinal plants, has provided a solid foundation for this project. It lists over twenty plants used by the Quandamooka Peoples...
for medicinal purposes, and I have noted some of these in my initial research. After selecting certain flora, I locate these plants during field trips, and document the sites and plants through written, photographic, video, and audio recordings. I remember the feelings I experienced as I headed out on my first bushwalk, overloaded with all my equipment (photo/video/audio recording, tripod, plant images and information, maps, notebook, etc.). My diary entry from this experience, dated 12 October 2011, records my initial doubts about my ability to recognise the plants from the photographs in the reference book:

I feel like I stepped into a different world; in fact, getting to the Island gives me this kind of feeling too. But this is much stronger. Being surrounded by this beauty, and, at the same time, harshness of the bush makes me feel at peace, not just peaceful. I can breathe as in trying to take it all in. Smell of the trees and soil, sound of insects, gentle breeze and nothing else.

After walking for some time, I thought to myself that it is going to be much harder to find the specific plants than I expected. Massive trees... thick bush... how can I recognise them from these little photos in the book, without seeing the plants live ever before, or at least not knowing that that’s what they were? It seemed hopeless for a while, but didn’t stop me from embracing this vastness and beauty of nature... I found 3 plants on my list on this walk.

I collect samples using the scientific methods of botanical sample collection, labelling and recording available information about the species, their location, and date of collection. I place each sample in a zip-lock plastic bag with their label affixed. Subsequently, some of the samples are usually steamed to encourage the decay process, and arranged on a piece of photographic paper or film. The arrangement is placed in a zip-lock bag and stored in a press for three to six weeks. After about three weeks, the samples are viewed and either kept in the state of decay for a longer period of time or the process is stopped. Once dated and photographed, all the samples are placed in trays to dry in the sun, which also kills the bacteria, making the works safe to handle. After several days, the samples are pressed between pieces of paper to keep flat. Following a further couple of weeks, the samples are examined and selected for scanning and printing.

At this stage, the plants have undergone many visual changes, since they lose a lot of their details and colour during the drying stage. Drying, as well as the decomposition process, is usually not recorded and is difficult to observe, as every time the fragile samples are handled, they are easily destroyed or altered. Trials of placing ‘fresh’ samples in plastic or glass containers with lids provide some possibilities for observation.

Photographic materials containing colour dyes, gelatine, and protective layers provide the perfect breeding ground for microbes, especially when some organic matter is added. Biochrome photography is a camera-less, physical, and biological process, where the natural object and the emulsion are in direct contact, allowing nature to ‘imprint’ itself through its own decay. A Winogradsky Column, a laboratory experiment designed by Russian microbiologist Sergius Winogradsky, uses colour to demonstrate bacterial ability to thrive within a created environment. These activities can be examined and utilised within an artificial setting, such as photographic film or paper for biochrome image making. This experiment demonstrates bacterial self-sufficient ecosystems, where colour is used as an indicator of change. The column’s ecosystem is driven only by energy from light, and the biological by-products derived from aerobic (oxygen-rich) and anaerobic (oxygen-depleted) environmental processes. It illustrates micro-organic functions and how the biological activities of one organism enable another to grow and reproduce, while the chemicals produced through metabolism allow the system to be self-sustaining (Rogan 2005, 349). It presents a multitude of colours and textures.

Brooklyn-based artist Jenifer Wightman, a former biologist, based her work on the Winogradsky Column. Inspired by Mark Rothko, Wightman’s work Winogradsky Rothko: Bacterial Ecosystem as Pastoral Landscape (2004) uses mud and water to prompt bacterial growth in sealed glass cases or frames. These were installed for three months outdoors on a brick wall of Cornell University in Ithaca, New York.
Figure 1 North Stradbroke Island

Figure 2 North Stradbroke Island field trip

Figure 3 Sesuvium portulacastrum, North Stradbroke Island

Figure 4 Sesuvium portulacastrum, biochrome in progress

Figure 5 Sesuvium portulacastrum, biochrome in progress (detail)

Figure 6 Brisbane backyard studio, biochrome in progress
Wightman's work is a live display of “biological transitions—an infinite evolving color-field of living pigments” (Wightman 2008, 312). Wightman says that “de/composition represents beginnings, change, contingencies of causes and effect, interconnectedness, possibility” (2008, 310) and that “the beauty in this ‘living distraction’ is that one organism’s waste product is another organism’s food resource” (2008, 316). Through her work, Wightman reinforces the significance of bacteria in lifecycles on Earth and presents a visual representation of otherwise invisible “exponential growth by a successful community . . . by the surplus color” (2008, 317). In 2012, Whitman produced ‘bacteria paint’ from the New York City mud and waters. Enclosed inside steel and glass frames in which “the change in pigmentation allows the viewer to witness an evolving landscape of a particular place” created by microbes (Whitman 2012).

Not only are microbes the most diverse organisms, but lifecycles on Earth also depend on them. John Williams states that subsystems that comprise the Earth, including all ecosystems “and the complex interactions within and between them, are built on the activity of microbes” (Williams in White 2003). Bacteria and fungi are responsible for producing oxygen and nitrogen, and breaking down and recycling all organic matter:

If there were no bacteria and archaea, there would be no plants—and consequently no animals . . . Without these organisms, Earth would long ago become a garbage heap of dead, organic matter. (Krogh 2009, 393)

In addition to the essential microbial activities, photosynthesis (powered by energy from the sun) is one of the life-giving processes that “gives life to the Biosphere” that humans are part of (White 2003, 32). During his experiments, Talbot reasoned that light “can exert an action . . . [and] cause changes in material bodies”, which could be made visible on paper (Talbot in Trachtenberg 1980, 29). Just as photography is based on the action of light producing an image, so “all life depends on photosynthesis” (White 2003, 32).

The evolution of Life-as-we-know-it would not have been possible without photosynthesis that first created and now maintains the oxygenated atmosphere and provided carbon for the skeletons that built all living things. (White 2003, 32)

Daro Montag is an English artist who collaborates with nature’s events to make ‘bioglyphs’—traces of nature. Montag makes works with micro-organisms and photographic materials; in his PhD thesis, Montag states: “a bioglyph is the resulting artefact created when the activities of living matter have been encouraged to ingest the gelatine emulsion of specially prepared films” (Montag 2001, 2). In creating his images using natural systems over time, “the images are primarily generated by activities of living matter, such as fungi, bacteria and nematode worms” (Montag 2001, 2). Montag explains further:

The trace left both on and under the surface of the bioglyph is the result of what would generally be classified as ‘natural processes’. This phrase describes a series of interlinked activities through which the living organisms carry out their existence. Such activities include eating, growing, defecating and breeding. Bioglyphs denote the proximity of microorganisms, causing an abrasion on the film through direct, physical contact. (Montag 2001, 78)

Montag has been involved in several ecological projects and exhibitions. His work and methodology parallel my own in regards to fieldwork, collection, connection to science, and collaboration with nature. In his publication, This Earth, Montag focuses on “the symbolic and essential life-sustaining properties of soil” (Montag 2007, 8). The artist locates, collects, tests (in a collaboration with a scientist), and makes works using soil. He extends his bioglyphs with a project that increases awareness of the importance of knowing and looking after our immediate environment, presenting work made on photographic film by the microbial activities in the collected soil.

Both Whitman’s and Montag’s works are concerned with the importance of microbial
activities within living systems. Indeed, this interaction and collaboration with nature is at the core of their practices.

German artist Mario Reis is another artist who collaborates with nature. Reis lets the currents of various rivers in the world ‘paint’ his canvases with sediment and vegetation, resulting in what he calls ‘nature watercolours’ or ‘river paintings’, each providing “an expression of nature in its own voice” (Grande 2004, 106). Reis has some control of his work by placing the canvases in particular locations tied up or weighted down with rocks, letting nature take over and make marks over a period of time.

In their diverse art practices, all three artists select locations and natural materials, and let nature take over; they also have a common thread of the objects becoming the subjects and the medium, and the recording of traces created by natural events on various materials. Further, it seems audiences react similarly to Reis’s and my work (and that of the other two artists, one can surmise). At first, viewers are drawn in by the “colours and patterns” of the works; then their curiosity prompts them to examine the works more closely, and perhaps read the inscription or didactics; realising what they are looking at leads them to ask questions about the work, its underpinnings, and the process; this increases their appreciation of nature and its processes (Grande 2004, 106–107). Grande says that in Reis’s work, “the results are infinitely variable, revealing the patterns, colours, texture and residue of each site in microcosm. The nature watercolours give a sense of the specific microecology of a place” (Grande 2004, 105). Similarly, my work provides a ‘specific microecology’ for each selected plant.
TIME-LAPSES

Central to my studio methodology is the documentation of the progression of decay to reveal its stages, to make visible the process of decomposition that usually goes unnoticed. This led to several tests and options for documenting the process. In the end, the best was to place a heavy piece of glass over a developing biochrome in controlled conditions, and photographing it in regular time increments over period of a few weeks. This resulted in an experimental two-minute time-lapse documentation of the biochrome development that reveals the transition of organic processes and metaphorically links to the active healing properties of the plant (figure 7).

My time-lapse video of the biochrome process contextualises my work; it aesthetically engages the viewer, displays action, and traces the duration of time and organic transformations to reinforce the cycle of life, as presented in a loop of decay and renewal. As Anna Pavord says in referring to Pliny’s commentary, it is “difficult to represent a plant in a single image when the plant itself changed all the time” (Pavord 2005, 76). Time-lapse references the early chronophotography by Étienne-Jules Marley, who revealed details of movement invisible to the naked eye, as opposed to a decisive, frozen moment, and unfolding processes as opposed to objects of contemplation (Van Gelder and Westgeest 2011, 64).

Video artist Bill Viola explores techniques that manipulate time; he expands and contracts time using various techniques, such as speeding up, slowing down, or reversing his captures, which result in revealing what cannot be perceived otherwise, engaging the audience emotionally, and encouraging contemplations on birth, death, and natural cycles. Keith Moxey argues that works of art “are capable of affecting those that experience them” and it is that “power of that aesthetic experience” that allows art to touch the audience and provoke responses (Moxey 2014, 174). Natural cycles play an important role for Viola; he states . . . that his work Catherine’s Room (2001) relates to “the cycles of nature, which are eternal because they are cyclical” (Kindel 2007), and Townsend stresses “temporal cycles—whether daily, annual or whole life cycles—are a crucial aspect of Viola’s work” (Townsend 2004, 67). I strongly relate to
As illustrated by the time-lapse video, the chance aspects of decay during these few weeks form the composition, as transformation occurs. In her introduction to Chance: Documents of Contemporary Art, Margaret Iversen states “it is this gap between intention and outcome that seems crucial to the meaning of chance in art” (Iversen 2012, 12). Chance plays a large role in the biochrome process; even though certain changes, colours, and patterns are expected to occur, the results are often a surprise. Letting nature take over the creative process allows for a unique collaboration with natural processes. Alan Kaprow writes that when working with nature as a co-creator, “long-term chances, only approximately foreseeable, can be brought about by insects, rotting, heat and cold”, which result in unpredictable effects of time as well as “physical constitution and appearance” (Kaprow in Iversen 2010, 54). I continue to embrace chance in creating my work, which allows for ‘discovery or risk’. As Kaprow states:

Hence, as a point of view and a technique, Chance methodology is not only refreshing in the best sense of the word, it is extremely useful in dispersing and breaking up knots of ‘knowables’, of groupings, relationships and larger structures which have become obsolete and habitual through over-use... If old values are destroyed, new experiences are revealed. Chance, therefore, is a dramatic affair involving both our need for security and our need for discovery or risk. (Kaprow in Iversen 2010, 57)

In my studio research, I have conducted various tests with plant samples, allowing for natural processes in diverse conditions, various durations of time, and a number of photographic materials, which will be used as references for further work. For example, I use the same plants on a variety of recycled photographic materials, manufactured by Kodak, Agfa, and Fuji—paper and film, colour and black-and-white—and photographs of the selected plants are taken on field trips as backgrounds for new biochromes. Also, I experiment with allowing the decay process to continue for various durations of time, and photograph some samples before, during, and after the process, which can be useful in further studio research.

WORKS OF ART 2012
My Core Energy series 2012 (figures 8–10) presents a variation of plant arrangements when compared with my previous work; the circular composition refers to a concept of belonging to a community, a country, and an island—to the circle of life, holistic relationships with nature, and Aboriginal culture’s approach to healing. This also visually represents the circular structure of interconnected ecosystems with its roots in Indigenous histories. In addition, the titles of the artworks include the botanical name and one of the properties of the plant, providing an insight to the metaphoric visible transformation of the image and allowing further understanding and an increase of awareness of the local Australian plants.

One of the works from this series, Sesuvium portulacastrum... antibacterial... (figure 9), depicts the species Sesuvium portulacastrum, the common name of which is sea purslane. Native to
Australia, it was used by Quandamooka Peoples for its healing qualities (Stephens et al. 2009); its juice was applied directly onto the skin for relief of marine and insect stings. This coastal plant grows on sand dunes that protect the coastline and exhibits antibacterial properties, among its other attributes. Layers of thick leaves overlap and appear three-dimensional. The leaves’ surface reveals specks of sand and crystallised salt from the beach, as well as some fungi. The outer part of the work, around the mass of leaves, displays light, pastel colours—from almost white in the top left side corner to reds and yellows in the bottom right. As the colours transition into the middle of the work, they intensify and become more dramatic to the point where strong splashes emerge on a black backdrop. The work of art focuses on the plant’s thick, juicy, and flexible succulent qualities and form, and presents the plant’s leaves curved into a circular composition. This shape references a nest or a protective dome, suggesting warmth and nurture—a sense of community.

The centre of the image appears as if you are able to look through and beyond the dome into the distant universe. The strong yellow and red colours, and small particles of light, suggest an experience of looking at a night sky filled with stars, nebulae, and cosmic activity. The work’s aesthetic dimensions allow for audience engagement and numerous interpretations, depending on the viewer’s experience and interests, and, even though created on one plane, it offers multiple views of the environment through the intricate details of the leaves, branches that are covered with bacteria, and fungi.

When the work has been exhibited at 1.2 metres, the viewer is immersed, and the scale allows for a closer examination of each section. The leaves appear real, causing the viewer to question whether they are attached or printed onto the surface of the paper. The work is inkjet printed onto thick, textured, 100% cotton paper that reinforces the already highly textured organic appearance of the image. The physicality of the paper and its association of pressing, embossing,
and morphing of the plant with the material suggest a printmaking process (or a plant press).

I feel it is a liberating experience working in the natural environment as opposed to the man-made gardens that produced the confined structure of my previous projects; it encourages more freedom and space in my artwork, just as these plants, growing widely in the bush, are wild and uncontrollable. For example, the biochromes of eucalypts show leaves freely extending past the edges of the photographic paper, the image spreading beyond the conventional rectangle into the white borders (figures 11 and 12). Previously, I would have neatly cropped the image to comply with the space of the rectangle.

In summary, this paper presents the transdisciplinary nature of my doctoral studio research. My research aims to produce cultural materials, reach diverse audiences, and extend appreciation and understanding of Australia’s natural history by providing an aesthetic experience and metaphoric linkage to healing. By means of visually exploring the plants with medicinal properties specific to the Minjerribah Peoples, this project aims to expand contemporary understanding of Australian medicinal plants. Further, it examines the conceptual and technical possibilities of the biochrome process as an unconventional way to aesthetically document flora.

Please note: Studio Research has modified its house style to preserve the author’s preference to lowercase her artwork titles.

ENDNOTES:
1 The Aboriginal name for North Stradbroke Island is Minjerribah (Island in the Sun), and Moorgumpin (Place of Sand Hills) is the name for Moreton Island.
2 This project was granted ethical clearance from the Griffith University Ethics Committee.
3 Guymer contributed the book’s Foreword.
4 These include Lines in the Sand Art Festival, exhibitions by the Quandamooka artists in Brisbane, the North Stradbroke Historical Museum’s exhibition at the State Library, NAIDOC Day, a Blessing Ceremony, and the Sun Gardens: A Celebration of Indigenous Plants and Nature event at Dunwich.

REFERENCES
STRETCHING MY PRACTICE’S LIMITS
For the last two decades, my artistic training has been firmly grounded in the traditional practice of pottery and ceramic sculpture. During that period, my creative activity has been based in academe and has therefore increasingly developed within a research paradigm with the usual interplay of practice, experiment, investigation, and reflection. Using a collaborative and interdisciplinary approach has allowed me to explore venues in my art conception and practice in an often uncanny process that has replaced familiar spaces with new, unexplored territory, leading to unexpected outcomes and results that question my definition of art and body. Realms that once seemed extraneous to my art have densified, taken shape, and materialised as new, exciting spaces of exploration; eccentric to known venues in ceramics but highly ground-breaking and productive in their cross-fertilisation. Interdisciplinary initiative has recast my notion of creativity, materiality, embodiment, and authorship in innovating ways, and has similarly affected my partners in collaboration.

Conversely, what seems to be an incongruous relationship between new mediums and the hand-made has reignited my interest in the material of clay and the making of forms. This relationship adds a further risk when co-opting the application of tacit knowledge and the alternative logic of studio practice in real time. All these collaborative interventions so far have forged new connections and relationships between traditional modes of practice and emergent interdisciplinary engagement, in which exciting new work flows from the hybridised shadows of old, trodden artistic paths. While my research originates in the platform of an autonomous art practice, it has expanded into a multidisciplinary study of performative practices that are constitutive of new identities (see Butler 1990). In order to ask questions relevant to my current genre and industry, I have forged new directions and links with other research fields, breaking through the confining skin of ceramic sculpture in multiple, expansive ways.

An important stage in the process of engaging with new techniques and mediums has been to explore the spectral inner landscapes of my clay pieces by means of hospital X-ray scans, so as to reveal their quasi-human interiors in a process that has uncanny resonance with the living body. These scan photographies trace the creative tension between work of art and artist in ways that blur and question the self-evidence of their mutual embodiment within the creative environment. The hospital constitutes an adequate space of existential dis-ease in which such tensions can be uncovered. I attempt to go beyond the mere surface of my body of work and my body as an artist to reveal new spaces that I see and experience as foreign to traditional art forms in clay. In this paper, I will address the importance that scanning technology has acquired in my current artistic output, taking the appearance of the uncanny in this process as a productive agent of meaning in my work.

SPECTRAL INTERIORS AND THE UNCANNY
The revelation of disturbing inner worlds has always been present in my sculptural output and has informed my process of artistic creation. Thus Freud’s investigation of the uncanny, or das Unheimliche, as existential dis-ease expressed in modern art is relevant to my artistic project. Essentially, Freud’s study of the uncanny was an analysis of the interface of psychology and aesthetics, fuelled by the existential despair and loss that surfaced in art after the Great War in the wake of Late Empire. He defined the uncanny as
a disturbing space of experience where what is homely and known becomes unhomely and so discomforting by the revelation of knowledge that has been hidden and repressed (1919) (1953, 219–52).

One can understand the uncanny as a marginal or liminal concept that reveals a disturbance or gap in the discursive definition of reality as we believe to perceive it; it is, in fact, a grey zone where conceptual borders blur, definitions break down, and space for new meanings is created. Despite Freud’s socio-historic and geographical locatedness (see, for instance, Cixous 1976; Žižek 1994), his analysis of the uncanny as a fringe concept where discrete meaning dissipates remains valid; the appearance of the uncanny is a relevant indicator of shifts in perception, experience, power balances, discourse, and so on, which signals the unsettlement and resettlement of artistic truth and tradition in multiple ways. Thus, the antipodean site that I create sculpture in and from is postmodern in its postcolonial and gendered locatedness. What currently drives my artistic production is the female gaze, as it dares to stare back, scrutinise, and penetrate the bare surface, and chisel out her own embodiment against the Australian male Other. This gaze maps out the female as a force of artistic and bodily incorporation within a space of creation and display. The title of this paper emulates this female gaze; it points at a spectral shadow world of alternative embodied realities underneath the hard surface of the work of art. This ghostly quasi-existence dissipates the discrete distinction between the inside and outside, the virtual image and the object, man and woman. But ‘beyond my skin’ is not only a space inside but also outside discrete and contained surfaces. It also points at how my figurative images and my body are placed in non-traditional, unfamiliar environments, and extraneous, eccentric spaces as they perform in projects of collaboration across different art disciplines. I use ‘extraneous’ in the sense of “coming from the outside, foreign” (American Heritage Dictionary 2000) and thus as a way to defamiliarise and re-investigate known and trodden ground in my art practice. The uncanny, spectral spaces that are created in the process of X-ray scanning, which make the known and visible less known and less comfortable, contrast with the traditional, familiar domains of the studio and other places my work has occupied. They are marginal to them and thus eccentric, not central to what is commonly understood as informing a ceramics practice. ‘Eccentric’ in this context is to be understood not only as physically decentralised from known and accepted ceramics locations but also as “a departure from a recognized, conventional, or established norm or pattern” (American Heritage Dictionary 2000), or a novel, unexplored way of proceeding. The search for the extraneous and eccentric in my art practice has resulted in an emerging performance that deconstructs the sensorial field of clay. This medium is now so familiar to me that it has become an extension of my own flesh; yet, it also reveals new, hidden experiences and knowledges when put under closer scrutiny from unexpected vantage points. Scanning is the key to these inner worlds encapsulated in the medium of clay, both new and challenging and yet pre-existing. The hospital environment has been ‘hospitable’ as well as ‘hostile’, welcome as well as unfamiliar—a space that both embraces and alienates my artwork from its known, material parameters, a place on the mortal limits of health and well-being that allows me to investigate my material projections of existential dis-ease in the uncanny limits of death and life (see Cixous 1976).

SCANNING: A CLOSER LOOK

My X-ray investigations were inspired by a literal instance of border-crossing associated with the scrutiny of the male gaze—a security check at the airport when I travelled from one country to another, which is traditionally a policed and militarised site of patrol and defence. In order to cross the frontier, my hand luggage was scanned and the on-screen image revealed, in challenging ways, the presence of a sculpture I was carrying in my bag. Fascinated by the novel sight of the same ‘old’ object sitting as an unborn child in an externalised womb I decided that this inner vision deserved following up. At geographical border crossings, the male gaze penetrates the surface to reveal the hidden; people and objects are screened, turned inside out to release inner meaning, to detect possible danger, secrets. This process encapsulates a notion of the Freudian uncanny—the repressed, that which should not
come to light but is already and always there. Yet, it is also an attempt to fix reality according to a pre-established order, a safe discourse: the Self against the alien, wild Other. To what extent then is (my) artistic practice transgressive, a crossing of figurative borders representing the demise of the old and the advent of the new and different? What does (my) sculpture hide and reveal? Sculpture can acquire a life of its own when it is seen through another perspective and undergoes a new process of scrutiny. The mere fact of border crossing beckons towards different processes and tools and thus interdisciplinarity through the use of non-standard mediums in ceramic sculpture. It also requires different perceptions and thus the fluidity of borders and the penetrability of the subject—how we artificially keep subject–object, and the Self–Other antagonism in place.

What does X-ray scanning have to offer in such a conceptualisation of artistic embodiment? Traditionally, X-rays have been applied for analytic and diagnostic purposes. Yet, while it started out for use on live bodies, X-ray scanning has subsequently extended to inanimate matter. Radiography scanning is the process of making a radiograph, which produces an image on a radiosensitive surface by radiation beyond visible light to penetrate hidden, deeper layers of a body, animate or inanimate. It applies a non-standard form of energy, beyond visible light, to reveal and capture a different, transparent aspect of what we normally perceive as stable, opaque matter or bodies in the real.

W. C. Roentgen first discovered the existence of such radiation in 1895 and spoke of X-rays because its nature was as yet unknown. Its
Robert Rauschenberg *Booster* 1967, colour lithograph, screenprint printed from two stones, two aluminium plates and one screen, sheet 183 x 89cm; National Gallery of Australia, Canberra, purchased 1973 © Robert Rauschenberg/VAGA
penetrative, analytical possibilities appealed to different groups of professionals, who developed its application into a diagnostic technique. In hard science, X-ray line spectra were used by H. G. J. Moseley in 1913 to establish atomic numbers, and they also provided further confirmation of the quantum theory of atomic structure. Important for the development of the arts was the discovery of X-ray diffraction by Max von Laue in 1912, and its subsequent application by W. H. and W. L. Bragg (father and son) to the study of crystal structure. Not surprisingly, X-ray crystallography became a scientific focus at the time that Cubism was emerging as an exciting and innovative approach to modern art, the scientific and painterly technique pointing towards a common analytical framework and new way of seeing reality beyond its surface appearance.

In the arts, scanning techniques have long been applied by museums to determine the age of an artwork, and to identify the processes and materials by which it was made so as to enable its repair and conservation. Scanning's diagnostic capabilities expose the layers of materials, revealing a hidden world interacting with its external surface. Yet, scanning has also been used in more productive-creative ways too. Artists have long used X-ray technologies directly in the conception and making of their work, and as part of that work. The list includes famous artists such as Man Ray, who developed what is known as the 'photogram' or 'rayograph' in 1921; this was a cameraless picture formed by the action of light on an object in direct contact with light-sensitive material. The Metropolitan Museum of Art in New York highlights the importance of this random photographic technique in that:

The rayographs revealed a new way of seeing that delighted the Dadaist poets who celebrated his work, and that pointed the way to the dreamlike visions of the Surrealist writers and painters who followed. (Metropolitan Museum of Art 2011)

Thus, X-ray technology was seen to contribute to the alternative ways of perceiving material reality that modern art was developing.

Fifty years later, Robert Rauschenberg created his key work *Booster* (1967), which featured a six-foot-high X-ray image of his body. It was the largest hand-pulled, single-sheet print ever made at the time, and challenged painting’s dominance as a medium. Seemingly random images suffused *Booster*, including a chair, an astronomical calendar, two drills, and a photograph of a man in the midst of a long jump. This apparent randomness offered viewers an opportunity to bring their own interpretation to the work. As it is, “*Booster* remains one of the most significant prints of the twentieth century, a watershed that catapulted printmaking into a new era of experimentation” (Babington 2007). This way, X-ray technology was, again, forging novel ways of artistic representation.

In contemporary art, there are several examples of (male) artists using X-ray techniques to produce creative art work. Hugh Turvey has a background in design and art direction in film. Turvey has worked on many collaborative projects that combine fine art with his commercial ventures. In 1996, he started experimenting with X-ray shadows. As well as advertisements for cars and various products, he has created an X-ray application (app) for iPad and iPhone that was developed from his residency with the British Institute of Radiography in London. Recent research in collaboration with the institute enabled Turvey to work on innovative developments, focusing on the hospital experience of the patient. For this project, he produced large-scale panels around the radiography department of botanical imagery with subtle and soothing colouring. Workshops for the community and children were also held to show the process and history of X-ray technologies, working from the premise that:

The artist and medical staff share an interest in the semiotics of images and the way that the creative manipulation of images could be used to educate patients and demystify complex investigations. (Hugh Turvey website 2012)

Nick Veasey is another well-known artist who produces work of art through X-ray imaging. This British artist has developed a studio resembling a large radiography chamber lined with lead. The subject of Veasey’s work, which takes the form
of large-scale photographic prints, ranges from small, everyday objects, such as the humble pipe in his Homage to Magritte (2004), to a complete airplane hangar, robots, guns, buses, and motorcycles. He also uses skeletons to depict humans. The image taken is exactly the same size as the objects depicted. When an object is too large to fit on one film, multiple prints are produced to make up the one image. The X-ray plates are then scanned to create an image of higher resolution, retouched, and sometimes adjusted with colour.

Veasey claims that his art aims to reveal the superficial quality of our lived experience as well as to express a desire to see beyond the skin to the simple structure of objects. As he says:

To create these x-ray artworks [entails] serious risks, and procedural hurdles need to be managed. The results are worth the hassle. X-ray allows us to see what is normally hidden to the human eye. It reveals the subjects from the inside out and allows us to appreciate what the world around us is truly made of. In contemporary life, where so much of what we see has been embellished or has a level of artifice, the honesty and integrity the x-ray reveals has a simple, pure elegance. In a nutshell, the work is a statement against society’s obsession with superficiality. (Nick Veasey website n.d.)

Finally, Mark Penhale uses X-ray scanning to extract beauty out of destruction. He arrived at his art practice and explorations into X-ray imagery via his profession as a veterinarian. His work developed from taking X-rays of animals with broken or shattered bones, roadside accidents, and diseased and decaying animals. His interest in materiality and the photographic intricacies of darkness into light have expanded into large-scale, light-boxed X-ray images that have been digitally manipulated using repetitive design

Figure 3 Fiona Fell and Lyndall Adams One Night Stack 2008 (installation detail), acrylic, stoneware clay, glaze, digital print, timber, 220 x 180 x 56cm

Figure 4 CAT scanning machine in process with Fiona Fell’s ceramic sculpture, 2013
imaging devices. The original point of departure for Penhale’s enquiry was purely aesthetic: “the fragmentation of living tissue resulted in beautiful images of scattered light” (Mark Penhale website 2011). Penhale’s fixation on the transformation of destruction into beauty aligns with my own investigation of the uncanny in my work.

**BEYOND MY SCULPTURE’S SKIN...**

I first explored the implications of my recent work at the Positive Feedback Positive Loop Symposium, held from 21 to 23 November 2012, at the Queensland College of Art, Griffith University, Brisbane, where I emphasised the collaborative and cross-disciplinary aspects of my practice. I have since intensified the focus of the project towards making work that is more conducive to the scanning process, using body parts that slot into the ceramic figures, testing clay at different stages of vitrification, and identifying appropriate density settings. The material of clay has a similar density to bone so that, when X-rayed, an internal landscape is revealed and traces of fingerprints and imperfections exposed. These processes show a direct relationship between image and object, external and internal gestures, and this direct interplay informs my current practice and research. I use collaboration with practices, techniques, and disciplines alien to pure ceramics and ceramic sculpture-making to extend the possibilities of these new findings and explore the rich inner dialogue of the lived body in a state of flux.

The act of scanning became a familiar process while collaborating with the digital artist and painter Lyndall Adams. This was not by employing an X-ray but a simple flat-top scanner. My scanned work kept its sense of three-dimensionality as it retained a shadow describing the curvature of the coils.

Adams and I have worked together over five different creative outcomes. Each new show is an extension on the previous one, since we continue to gain valuable insights into how we arrive at a work of art, how we manipulate unfamiliar materials and tools, and how we deliberately aim to intervene in the density and space that configure the materiality and non-materiality of our work. The conversation between Adams and me deals primarily with the translation of processes and materials. Through collaboration, we explore the potential for a rethinking of Self and Other. Playing with the idea of collaboration between artists as an issue of interactions between bodies, performativity, and emergence or becoming, throughout three of the shared bodies of work, entitled *Pause/Play* (2006), *Save and Select* (2010), and *Reload* (2011), notions of foreign bodies, of the stranger, and possible estrangements unwrapped debates surrounding representation. Notions of embodiment-as-intercorporeality were evident in the work, with emphasis on reinterpreting the subject/object shadow in a conversation where the exterior and interior, Self and Other, were free to speak.
I continued this investigation by initialising the radiographic scanning of my work as part of a project with a group of ceramics artists in Fu-Ping, China, for a curated show called Nothing to Declare but Good Company proposed for 2015. After several experiences of taking works in hand luggage to shows in different countries, I was fascinated by the X-ray scans at the airport. As a trial, I took one of my figurative works to be X-rayed at my local hospital, and this is how I started using a CAT (or CT) scanning machine to explore my work. The CAT/CT scanner is a so-called tomographic device that employs narrow beams of X-rays in two planes at various angles and thus enables computerised cross-sectional images of the body to be produced beyond the bone and cartilage, and thus include soft tissue. Moreover, this technology creates images that show slices of the work in 3D as a moving image, which led me to video-recording exploits. To me, CAT scanning started out as a purely an aesthetic exercise, but, in reflection, it has exposed a hybrid myriad of connections and possibilities. By performing these actions and having to deal with unexpected outcomes and consequences, practice leads to research.

As well as gathering a platform of associated practices surrounding X-ray imaging-devices, my research aims to develop creative outcomes that once again challenge my relationship with objecthood. This also involves the terrain of language, as redefining my practice requires the development of an alternative vocabulary. The techniques involved in revealing the ‘bowels’ of my figurative ceramic sculptures feed back into my sculptural and conceptual language, and thus I have cross-examined some of the terminology used in the field of radiography in relation to the familiar territory of material terms used in working with clay. By acknowledging the internal landscapes of the form beyond the aesthetic-artistic surface and the way these suggest independent, alternative realities, my preconception of language was challenged. During the process of searching through radiographic sites in an attempt to familiarise myself with the terms, I became increasingly excited by how I could employ this new vocabulary for titles of work and how these terms could inform the process of making. I found the language emotive and poetic; the meeting of the corporeal and the metaphysical suggested parallels between the material and the immaterial. In my latest sculpture exhibition at Watters Gallery in Sydney (2013), I employed the following titles suggested by radiographic terms and descriptors: Fissured Physique, Radical Reassembly, Virtual Density, and Indefinite Distortion.

**THE SHADOW WORLD OF THE UNCANNY**

Scanning allows me to reveal the shadow world of my works’ interiors; what is not visible, what is hidden, comes to light under the penetrative gaze of the scanning device and acquires a life of its own. It makes the inanimate matter of my clay figures come alive in the vein of what Kenneth Gross terms “[t]he madness of the puppet … this creature that burrows out of shadows, into the light, a remnant of something …” that lives in a strange world and yet seems to “know about our world” (2011, 1) and so speaks back to us. His words take us back to the uncanny, which Freud conceptualised around the stories of the German Romantic author E. T. A. Hoffmann (1776–1822). His fiction, which combined the grotesque and the supernatural with psychological realism, was very influential on the German Romantic movement. Freud calls him “the unrivalled master of the uncanny in literature” (1953, 233), and uses his story of The Sandman, which features the scary female automaton Olympia, to theorise the uncanny. Hélène Cixous (1976) later re-interprets The Sandman in terms of its connections to the pro/creative principle in her effort to unpack the Freudian uncanny along the axis of gender. Scanning allows me to give Cixous’s take an artistic twist; scanning takes my sculptural figures out of their known spheres and inserts them into defamiliarising environments that question their very essence. Are we dealing with the familiar opposition of man and woman, mind and matter, or can we, in hybridised ways, move beyond such distinctions in artistic creation?

During the process of their making, my works have been in normal locations and processes of production, storage, exhibition, and distribution. They include the studio with its own situational logic, such as plastic coverings to keep the work...
wet and workable before its termination and display; means of transport and packaging to take pieces to their destination (kiln, storage, exhibitions, future owners); and the kiln, to fire pieces and fix their form. Yet, recently they have also occupied uncommon spaces, such as radiography tables, emergency departments, and freezers; and virtual spaces, such as in scanning, photography, and video, where they perform in eccentric ways, acquiring a different, alternative life and bringing what seems foreign as an uncanny innovative element into my art practice. Thus, cross-disciplinary collaboration has opened up a fertile field that reveals a dynamic of flow and rupture recalling those internal dialogues that have shaped us and our bodies; they focus on both intimate yet uncanny, too-close-for-comfort spaces that deliberately corrupt the habitual practices of the participant artists while investigating art, both domestic and industrial.

The virtual realities explored in scanning take my body and sculpture as the points of departure to investigate the continuities and discontinuities between both. Once again, I return to the skin's surface, the outer limit of my inner world that separates inside from outside, Self from Other, only to blur the distinction between the animate and inanimate by using the spectral shadow world of the scans as the grey in-between spaces where the human and sculptural body may meet and merge, cross over, and add that extra quality that distinguishes art from the ordinary. In his introduction to the English translation of Mario Perniola's *In Art and Its Shadow* (2004), Hugh Silverman argues that Perniola:

> . . . is providing an alternative reading of Benjamin's notion of the work of art in the age of mechanical reproduction, for instead of arguing for the democratization of art which has as one of its necessary consequences the destruction of the aura, he argues instead for a third regime of art ... Perniola offers the shadow of art as the place of this third regime. (Silverman in Perniola 2004, x)

Silverman adds that “The shadows are the feelings of differences”, relating to the “remainder”, which, according to Derrida, is:

> . . . a supplement, a left-over, a super-addition of sense, but not an alternative, not an opposite, not the other side of a binary pair. A remainder is like a shadow, it follows around what it adds on to. (Silverman in Perniola 2004, xi)

We can take the spectral in-between world of the scan as such an artistic remainder: a shadow that inscribes the act of creation in the uncanny crucible of life and death (see Cixous 1976).

**CONCLUSION**

What arises out of the shadow world of the scan is the artistic beauty of the new as the reinterpretation of what was yet already known and thus old. In the performance of the inanimate as animate and vice versa, the negotiation of life in the crucible of death, art is created. Sculpture is the human-body-become-corpse and yet a corpse-coming-alive-as-a-corpus-of-art. Through the footage that I have taken throughout all of my scanning procedures, I have become increasingly aware of the implication of my female, re/productive body in relation to the figures I give birth to and the clinical spaces that they occupy as they acquire a life of their own. It has called for an investigation of my own embodiment in relation to the work of art, engaging with Maurice Merleau-Ponty’s phenomenology of perception, which primes the body rather than the mind in the perception of the world (2005), while my concern with the male body in my sculpture practice is all-pervading and constant.

Is my practice a simple reversal of traditional gender patterns in artistic fixation and inspiration; one that dissects, isolates parts, and sexualises as the male gaze does, one that invades and usurps a terrain traditionally male? Or is a transgressive female gaze at work that has become hybrid? How dissociated is this gaze from my female body, and to what extent integrated to it? Do I gaze or feel my way into the male, Other body, or both? Do I simply investigate Otherness, or rather hidden parts of myself? Can scanning, so associated with scrutiny and the gaze, be an alternative means to penetrate the female Self and male Other, and go beyond the superficiality of the aestheticised skin? Can it help women artists trespass into
traditionally vetoed areas of experience? These remain questions to be answered, and require a deeper investigation into the use of my body in relation to my art work. This is an exploration that beckons to a further development of interdisciplinary projects, such as my current engagement with video-making.

REFERENCES


All articles published in Studio Research have been double-blind peer reviewed.
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