
Déjà vu
Presque vu
Jamais vu
Selected essays by DrSonique

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62 Macgibbon Parade, Old Erowal Bay, NSW 2540, Australia.
Email: sonique1@icloud.com
Phone: +61(0)4 19 49 34 95
URL: http://www.sonicobjects.com

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Introduction

This small collection of essays is drawn from multiple published sources and spans many years of my critical writings on the topic of sound-art and sound-sculpture. The majority of the texts are reflections upon my own creative practice in its attempts to embrace of the biological and environmental sciences and reflect upon our ever changing relationship to the ‘natural’ world.

I hope the reader will find these texts of some interest and will forgive me for the inevitable overlaps between one essay and another — also for the variations in style and layout which I have decided to leave in the original format(s).

Finally it is important to acknowledge that many of the creative processes and methodologies that underpin the development of the works mentioned are collaborative. Whilst several texts directly identify the principal collaborating scientists, technicians and artists, there are many others unannounced, who have lent their energy and enthusiasm toward the realisation of these projects.

The Essays

A Different Engine (2014)

AudioNomad (2006)

Genes; Memes and Dots (2020)

Heavy Metal and Oratorio for a Million Souls (2019)

Walking; Thinking and Memory (2019)

Prometheus Bound; Art, Science, Creativity and the Imagination (2003)

Sounds of Place; Environmental Artworks at Bundanon (2017)

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A Different Engine

Abstract
A Different Engine is a kaleidoscopic look at the origins of the digital, driven by pattern making in textiles and music. The paper examines the historical exchange of concepts, images and technologies between East and West via the overland and maritime Silk Trade routes. The paper will reference the importance of the Arabic traditions of Astronomy, Mathematics and Navigation showing how these facilitated this trade, as well as prompting the Renaissance in Europe.

By employing the metaphor of pattern making and the weave of fabrics traded along the silk route the paper will examine the provenance of computer control which can be traced to the early industrial practices in textile production, where loom operating instructions were encoded as a series of punch cards, in essence ‘digitising’ weaving patterns in Jacquard looms.

The virtues of this novel punch card system were not lost on Charles Babbage who adopted them to drive his Difference Engine, from where they were rapidly adapted to automate mechanical music devices, the punch patterns becoming, in effect a form of graphical score capable of sequencing music boxes’ barrel organs and later Pianolas.

The Pianola (or Player Piano) was the most sophisticated manifestation of this development and in terms of reproduction quality was far superior to the nascent technologies of audio recording and transcription, such as the Edison Wax Cylinder or disc based Phonography, by virtue of being able to not simply encode musical pitch but also performance characteristics.

Ironically it was the punch card and subsequent punch tape technology that enabled the birth of the modern computer and its entwined history with music.

The first public performance of computer generated music was demonstrated at the Australian Computer Conference in 1951 by a team from CSIRAC (council for Scientific and Industrial Research Automatic Computer) who fed their massive computer with spools of punched paper

Three Thoughts about Code.

Signal and Noise
Disambiguation — Echo's cries rehearse the utterance of others, departing as counterfeits without significance, returning diminished and disembodied ~ orphaned sounds.

Narcissus swoons as he reaches out to caress the face that has him bewitched. As his fingers glance the perfect image it transforms into an animated mandala, formed of concentric algorithms far more complex than his melancholia.

Smoke curls up from the Beacon Hill, answered in the distance by another and yet still another. A King has died, an Armada has breached the horizon. In every case a presaged message is unleashed ~ only the timing is significant.

Stepping forward through the logic and logistics of the Enlightenment, writing ousts memory and unlike the transient voice, it has the ability to transpose and transport itself ~ it flies and it endures. But like everything it is subject to the 3rd law of thermodynamics, its clarion voice fading with distance. Poured

into channels of copper or sparked into the Æther language swims in an Ocean of Noise in constant fear of corruption, desperate for disambiguation.

The message is quantised, fundamental particles taking the form of semaphore flags, dots and dashes, the texture of Braille. Speech and spelling are rehabilitated as military jingo-jargon, Alpha, Bravo, Charlies.

Distance and Truth
Compression — It is one thing to speak with clarity and be heard over distance (or perhaps even time) but it is another to say a lot and say it fast. The goal of Telematics is to be coherent and robust, economical and fast. Our thoughts, already expressed as serial icons or codes, are now to be compressed into a form that is both necessary and sufficient for the purpose.

Lacking a written language and acknowledging the frailty of memory the ancient Peruvians developed the Quipos, delicate arrays of twisted and knotted threads encoding vital communal information. Marconi abbreviated standard business procedures to save bandwidth and Mawson, who established the first radio communication from Antarctica compressed the limited range of explorer narratives into a code-book, “R-776” meaning I have grown a beard for example.

The compression of meaning and emotion is recirculating today in the form of emoticons, happiness a single condition reduced to a smiling PacMan.

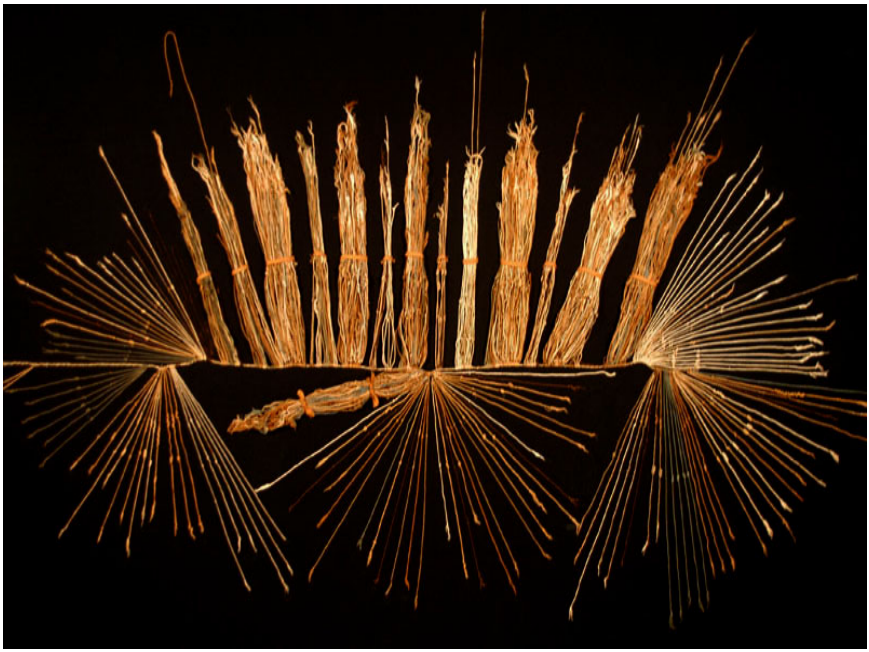

Fig.1 South American Quipos, Anon.

Knowledge is Power

Encryption — Sensitive messages have always been jealously guarded to ensure their privacy and security, never more so than in times of conflict. However, the air, airtime and airspace are open and permeable, available and exposed, as are the transmission technologies which propagate them. The solution to such vulnerability is encryption, the rendering of the unambiguous and compressed into a cryptic form, publicly flaunting itself but impenetrable without a key.

The Romeo Alpha Foxtrot (Royal Air Force) held back whilst the Luftwaffe destroyed the city of Coventry in order not to give the Enigma Machine code breaker's game away, a sacrifice that subsequently sealed the demise of the Afrika Korps through

intercepted intelligence, and which also initiated horrific reprisal raids on Dresden.

Across the Atlantic, US army communications were conducted in the unique and modern alphabet of the Cherokee Nation ~ a tongue difficult for the enemy to acquire. In London, at the outbreak of hostilities, the BBC panicked over the real possibility of Oxbridge trained upper-class Germans broadcasting ersatz programmes in perfect King's English.

Their solution was to install Wilfred Pickles as the voice of London Calling. Pickles, a Yorkshireman broke the mould of BBC voice types, with his broad northern accent, impossible even for a Home Counties resident to copy or perhaps understand, in this instance encrypting not the message per se but the vector of delivery.

Figure 2. Wilfred Pickles.

A Different Engine_Vignettes of the Ur_digital

The Switch — Arabia played a fundamental role in connecting the Orient and the Occident via the braided routes of the Silk Route

Caravans. These physical pathways also created circuits of transmission of ideas, of technologies and product between East and West. Arabia was also the focal point of trade sea routes, plying between China, India and Europa where the mathematical and astronomical skills of Islamic navigators took pride of place on Chinese Treasure fleets.

Viewed in this context Arabia played the role of a gatekeeper of knowledge, rekindling the fires of inventiveness and philosophy in Europa after the deep sleep of the Middle Ages.

The Silk Route becomes a resonant metaphor, a vast entwined network of dusty desert road and sparkling blue sea-ways, the careful and laborious haulage of precious of commodities, all manifestation of luxury embodied as Silk. But what in essence is silk? - a flow of pattern, a flow of intertwined fibres carrying symbolic memories, technological memories and the physical traces of intensive human labour and skill.

Texto

Silk is text and text is the keeper of memory and knowledge. The Latin to weave is texo, more broadly to twine together, to plait, to construct and to build. Textere is to compose whilst textus is texture. We carry on spinning yarns, knitting our brows, sowing things up and weaving tales. We weave webs of lies and fabrications. The text is a fabric and fabric is a text that travels on the back of a camel across the dunes, and rides the swells in the South China Sea.

Memory Machines

Her hands moves, slowly but inexorably to hover above the keyboard, then gently release to work the keys and the first notes

rise from the Organ. She does this perfectly and always with an inscrutable expression. Of course this is the only thing she can do, she is a memory machine, an early automat built between 1768 and 1774 by the Jaquet-Droz family in Neufchâtel. She is remarkable in that she does not mime to an encoded music (i.e., a hidden music box) but she holds in her 'memory' the actions of performance, the movements of head, eyes thorax, arms and digits on the fully functional keyboard, she is a true android performer.

Figure 3. Jaquet-Droz mechanical musician.

Basil Bouchon

Basil Bouchon was as fascinated by these early clockwork musical automata as he was worried by the fierce competition in the Silk trade, where the genuine article (silk from China) was still cheaper than his Lyon based silk factory could produce. Indeed his looms were based on the Chinese two person draw bar system which demanded a skilled (but often fallible) "draw-boy" to set the complex patterns.

Bouchon, determined to modernise and eliminate his overheads, began to experiment with a mechanism that employed punched paper rolls to control the loom patterns. Bouchon only ever managed a proof of concept, but his experiments were not in vain. His paper roll system was taken back into the world of music to eventually become the pianola (Player Piano). More importantly they sparked the imagination of another master silk weaver from Lyon, Jean-Marie Jacqard.

Jean-Marie Jacqard

Jean-Marie Jaquard developed Bouchon's concept into a robust system that employed chains of perforated cards (one card for each operation of the shuttle - with up to 30,000 individual cards for a single design). This eliminated the second person on the loom (the 'draw boy who's task it was to laboriously select the warp threads) making European looms more competitive with Chinese hand operated machines.

This technology revolutionised weaving but at the same time caused massive social labour disruption (akin to the more recent digital revolution in news and publishing) but most importantly the technological system for encoding information diffused into other areas. It was not long before the idea of encoding pattern and/or

numerical data was taken up by Babbage [1] in England (1822) and later by Hollerith [2] in the USA (1889 onwards).

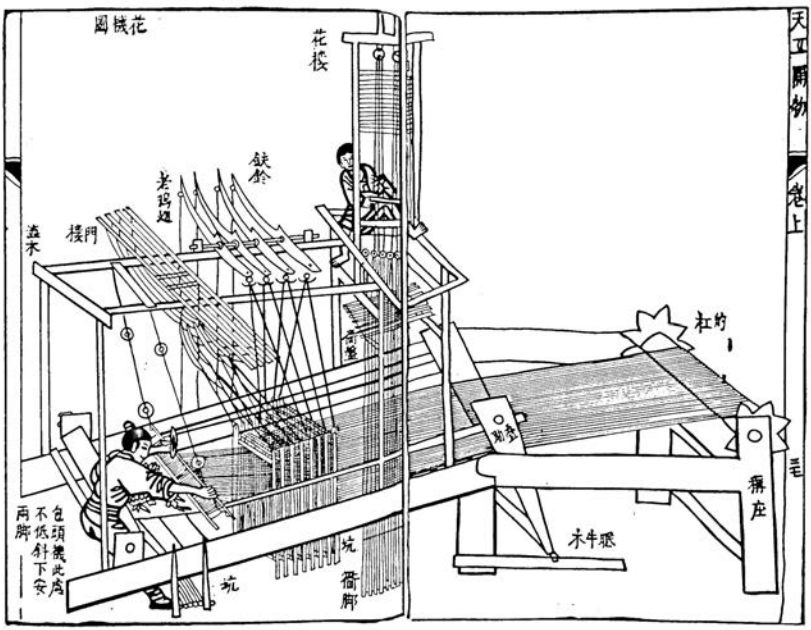

Figure 4. Traditional Chinese drawbar silk loom.

Player pianos, Microphones and Glenn Gould

But let us not loose the musical thread so quickly. The Player Piano (Pianola) differs from the Piano, from sheet music notation and from a recorded performance in that the smooth rolls of punched paper and the associated pneumatic vascular system, not only encode the music but also the performance values (the precursor of MIDI). Such encoding of content and delivery is reminiscent of Glen Gould, that irascible Canadian virtuoso, who held rehearsal in distain and wasn't too keen on performing in public. Gould much preferred the recording studio and could be said to have a love affair with the microphone (and of course the

subsequent editing process) the technically manipulated results of which, made his recorded performances for the CBS quite outstanding but possibly impossible to match in a live context.

The Dark Side

Like Nature, digitisation is indifferent - it can be applied anywhere and anyhow. Hermann Hollerith submitted his PhD thesis "An Electric Tabulating System" to Columbia University in1889. He was subsequently employed by the US Census Department at the end of the C19th to develop an efficient census evaluation system. In 1896 he founded the 'Tabulating Machine Company' which later merged to become IBM in 1924.

Figure 5. poster for the Deutsche Hollerith Maschienen Gesellschaft.

In 1910 the Deutsche Hollerith Maschienen Gesellschaft began operation in Berlin under licence from Hollerith. We can picture Herr Doktor Korherr, loading a batch of census cards into the Hollerith Machine. The year1939 and the National Socialist Census Office has perfected a system to capture the biological make up of each family in the German Reich. We all know the outcome!

A Reprise

To recap — the provenance of computer control was originally devised as a sequence of punch cards, encoding weaving patterns to operate industrial revolution Jacquard looms.

The virtues of the punch card system were not lost on Charles Babbage who adopted them to drive his Difference Engine and they were rapidly adapted to automate mechanical music devices, punch patterns becoming, in effect, a form of graphical score capable of sequencing music boxes' barrel organs and later Pianolas.

The Pianola, or Player Piano, was the most sophisticated manifestation of this development and in terms of reproduction quality was far superior to the nascent technologies of audio recording and transcription, such as the Edison Wax Cylinder or disc based Phonography, by virtue of being able to encode, not simply musical pitch but also performance characteristics.

It was textile and musical patterns manifest as punch card sequences that enabled the birth of the modern computer and entwined it's history with music. The first public performance of computer generated music was demonstrated at the Australian Computer Conference in 1951 by a team from CSIRAC (council for Scientific and Industrial Research Automatic Computer). The

CSIRAC fed upon spools of paper punch tape. The world's first true computer, COLOSSUS was installed in 1944 at Bletchley Park for cryptanalysis of the German Geheimschreiber, an in-line cipher teletype machine. This was followed closely by ENIAC, a US military, numerical integrator and computer — used to calculate ballistics and the Atom Bomb.

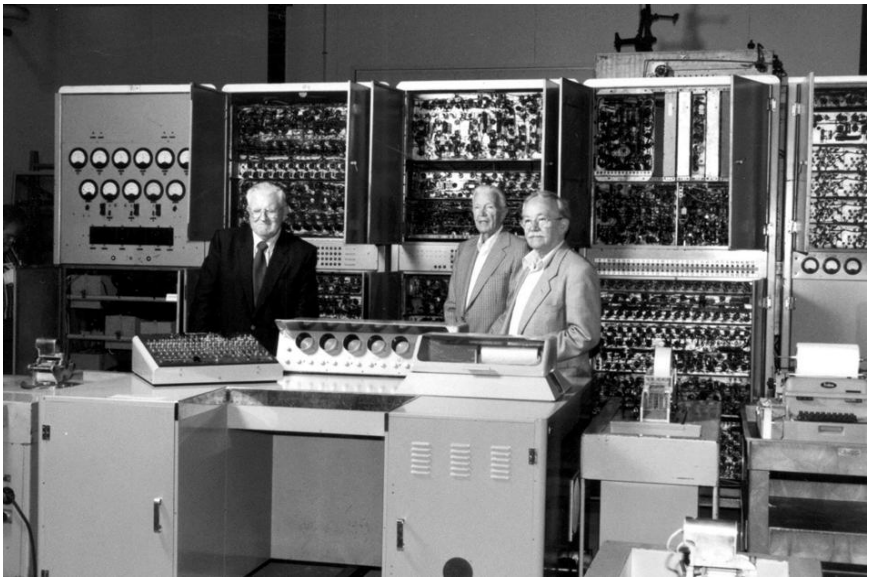

Figure 6. CSIRAC in Sydney 1951.

Some thoughts about Codes and Life - Joe Davis with Malus Ecclesia & Nigel Helyer with GeneMusiK.

As an end-piece let us consider that other revolution in encoding discovered during the twentieth century, DNA. In 2003 artists Joe Davis and Nigel Helyer exchanged a series of ideas for encrypting information in DNA. Davis pursuing textual codes and Helyer musical.

At that time Helyer, working under the aegis SymbioticA, collaborated with the School of Agricultural Science (University of Western Australia) to develop a proof of concept designed to translate music into DNA which when inserted into Bacteria was able to be re-mixed and subsequently extracted and de-coded into novel musical forms.

Fast-forward eleven years and Davis is en-train of realising his Malus Ecclesia project at the Harvard Medical School. Davis plans to transpose the fount of all human knowledge, Wikipedia (sic) within the junk DNA of an ancient strain of Apple. Malus in Latin represents both Apple and Evil (whereas Ecclesia refers to Church - and pays an Homage to George Church the Harvard Professor with whom Davis is working). This reprise of the Garden of Eden scenario, Davis will ultimately fill a grove of grafted apple trees which will presumably contain all branches of Knowledge. However the apples may be covered by an indictment on consumption, this time not by Jehovah but by the US food and drug administration!

Figure 7. Dr's Helyer and Albertyn at the UFS Microbiology Lab, Bloemfontien SA with GeneMusik bacterial cultures.

In a similar manner Helyer has nurtured his interest in the parallelism between Genes, Memes and Musical Notation as mnemonic structures capable of evolution and the embodiment of memory. In 2014 GeneMusiK rides again to create a re-mix of cultural, social and biological pathways. Working in South Africa with indigenous musicians GeneMusiK hybridises local ethnic music with the epitome of the western musical tradition, the string Quartet via the transformations of musical and genetic codes within Bacterial cultures. Musical patterns of the indigenous San peoples are genetically transformed to infiltrate the formal notation and performance values of western art music.

Figure 8. Drawing of a San Bushman playing the Gorah with musical annotation, from Travels in the Interior of Southern Africa, Burchill.

A Thought about Sound and Life - Under the Icecap

And a final thought about data. Under the IceCap is a long-term collaboration between Artist Nigel Helyer and Marine Scientist Dr Mary-Anne Lea at the Institute for Marine and Antarctic Studies, University of Tasmania (Hobart).

In a nut-shell the project team renders complex environmental bio-logging data-sets collected by Southern Elephant Seals [3] on their extended under-ice dives and long open ocean transits into 4D cartographic animations, sonifications and graphical music scores, which are used to generate live public performances. The decision to interpret environmental data via an aural process was based upon a hunch that musicians have the best pattern-recognition 'wet-ware' around and that our aural sensibility is in fact more finely tuned to detect variations in pattern and recognise subliminal differences, than our visual sense.

Figure 9. Elephant Seals with BioLogging device.

The byeline for the Institute of Marine and Antarctic Studies is Turning Nature into Knowledge. The Under the IceCap project supplies a second line Turning Knowledge into Culture encapsulating a powerful Art and Science synthesis. The primary aim of the project is to produce creative work which is compelling and affective but which is simultaneously a work of scientific utility - hopefully tapping into both sides of the brain! The key focus is to illuminate the relationship of the environmental knowledge generated from Antarctic bio-logging data with the Anthropogenic changes in the biosphere.

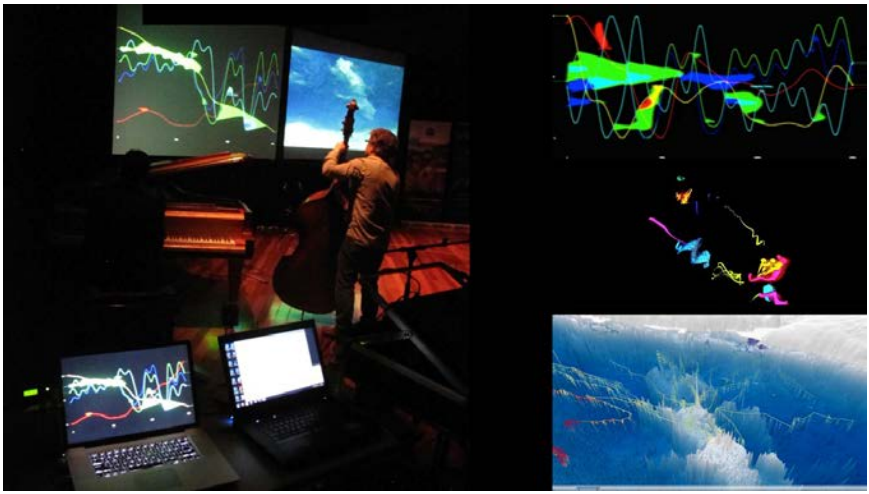

Figure 10. Under the Icecap live performance with data-visualisation screen shots.

Data generated graphical scores from the ice-blue waters of the Antarctic may, at first, seem at a far remove from the dusty caravans of the Silk Road, but they are entwined in the same historical fabric.

The silken sheen of a Dragon rampant or a Phoenix rising from the ashes contain the impetus that ultimately triggered the development of machine intelligence, transforming our surroundings into a ‘fleeting floating world’ of interconnected patterns.

Endnotes

1. Babbage - The Difference Engine (1820s to 1860s) 1822 paper “Note on the application of machinery to the computation of astronomical and mathematical tables" funded by the British Government. Essentially a mechanical (hand cranked computer).

2. Hollerith An Electric Tabulating System (1889)Columbia University PhD thesis — data tabulation. Founded the ‘Tabulating Machine Company’ which later merged with IBM. Basically an electrical data tabulation system employing punch cards built under contract to the US census department — later used by the National Socialists in Germany prior to and during WWII.

3. Southern Antarctic seals can dive to 2000 metres, stay down for 2 hours and make ocean transits of many thousand Kilometres.


BBC

Audio Nomad

Abstract
Audio Nomad comprises a series of cross-disciplinary art/science projects working on the concept of GPS-driven location-based audio applications. Project outcomes in the form of artworks enable a user or audience to experience a virtual audio world situated within the real world, as a spatial composition of sounds seeming to originate from realobjects. Two-dimensional audio spatialisation simulates realistic sound sources, and non-spatialised sounds may also be used as location-based content. Conceptually, sound is used to reveal information or create an aesthetic, often composed of a combination of oral histories, archival audio, site-specific historical information, field recordings, and music. The outcome is a culturally significant public sound artwork utilising this new location-based audio medium — an application of global positioning, audio technologies, and software engineering.

As GNSS technologies become more ubiquitous, *Audio Nomad* can take advantage of new platforms such as mobile phones. This unique multidisciplinary collaboration has driven the design of tools with great creative potential toprovide new alternative location-based services poised to engage and appeal to the imagination of future GNSS users.

Introduction
Audio Nomad comprises a series of cross-disciplinary art/science projects working on the concept of GPS-driven location-based audio applications. Project outcomes generally take the form of artworks that enable a user or audience to experience a virtual audio world situated within the real world, so that the user perceives sound content as though it originates from real objects

around them. Two-dimensional (2D) audio spatialisation is used to simulate realistic situated sound sources, while non-spatialised sound sources may also be used as location-based content. Conceptually, sound is used to reveal information or createan aesthetic, often using site-specific historical information amongst other audio elements. The goal at the outset of this project was to marry technology with art to produceculturally significant public audio artworks utilising this new location-based audio medium — an application of global positioning, sound design and software engineering.

The *Audio Nomad* team is a fruitful synergy balancing artistic and technical demands, aimed at pushing the research and development of location-based audio capability. The project has been funded for three years (2004 to 2006) as an Australian Research Council linkage grant with the Australia Council for the Arts (LP0348394). To date, *Audio Nomad* has deployed the location-based audio concept twice as aship-based multi-speaker installation: Syren, presented at the 2004 International Symposium on Electronic Art (ISEA) on the Baltic Sea, and Syren for Port Jackson on Sydney Harbour (March 2006). The team is presently testing a system for pedestrian users (Campus Navigator) and conceptualising one future pedestrian-based deployment before project completion (Virtual Wall).

Conceptual and Sonic Objectives

Audio Nomad projects place strong emphasis on a highly imaginative, creative approach to sound design and composition that highlights the potential of this emergent field of location-based spatial audio. Unlike conventional sound or musical composition, location based audio requires sensitive consideration of environmental and geographic context.

Pedestrian projects in particular require significant attention to user behaviour and their unpredictable interaction with the content via position, speed and heading in relation to the architectural/ urban environment. Conceptually and sonically, the principal challenge of all *Audio Nomad* projects, whether ship-based, or for pedestrian users is to develop a 'compositional' strategy able to deliver a non-linear but coherent 'field' of location-based audio.

Workflow and approach to create supporting technologies

A very important goal of the software engineering work is the development of reusable tools and workflow design for the creation of location-based audio content by non-technical users, not just a one-off implementation for each new work.

From the ISEA experience in 2004 we learned that the art community is usually focused on building exhibits as "one off" development exercises. We came to realise that our approach to develop tools for location-aware audio design was fairly unique in that community and gave us the capability to design location-aware content in an efficient manner that was not specific to one type of deployment environment.

Designing the tools around user needs [1], in this case the principal artist, helped the artist's ability to work efficiently with the tool and lock project focus on real problems. The design was participatory in conceptualisation but incorporated regular usability evaluations to identify both design issues and bugs in the software system.

Authoring tool

The editing tool is a compositional environment in which the location of the listener triggers audio as though it were a spatial "playhead". Unlike conventional audio tools where the playhead is directly related to time, location-based audio design has a 2D playhead that could follow a variety of paths.

The editing environment has undergone two revisions. The first prototype, VectorMap (Figure 1) was developed specifically for the ISEA deployment on the Baltic Sea. The second prototype, MapViewer (Figure 2) is a more general tool that can produce content for both multi-speaker and handheld environments. MapViewer adopts attributes expected of a software application used in a more conventional audio production environment.

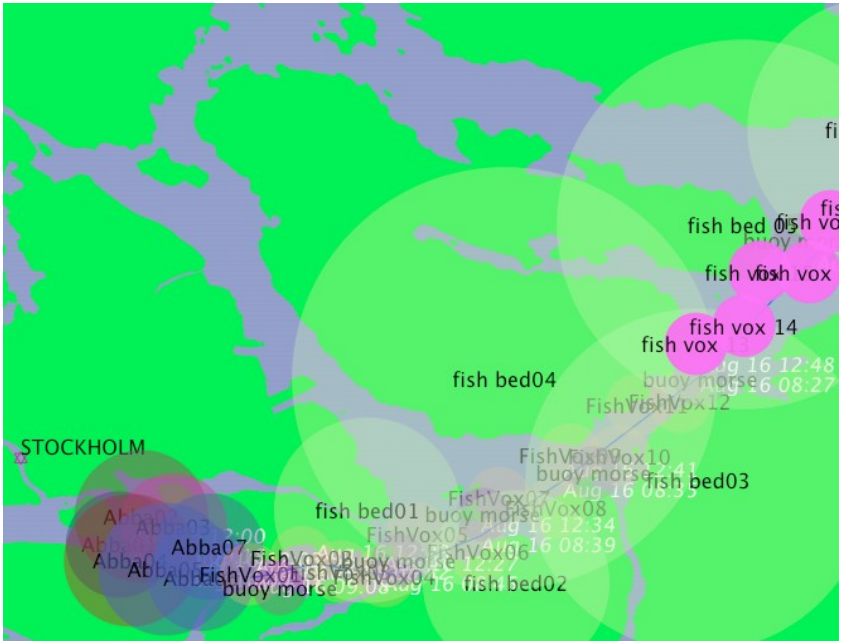

Figure 1 – detail view of VectorMap software used tocreate Syren content for ISEA on the Baltic Sea

Understanding the audio artist workflow is a significant aspect of the project. The mechanisms provided to the artist to choose, add, remove, adjust and refine the audio content will impact on the creativity and efficiency of the editing process. Being able to audition the evolving content and experimenting with different combinations is a key factor for success.

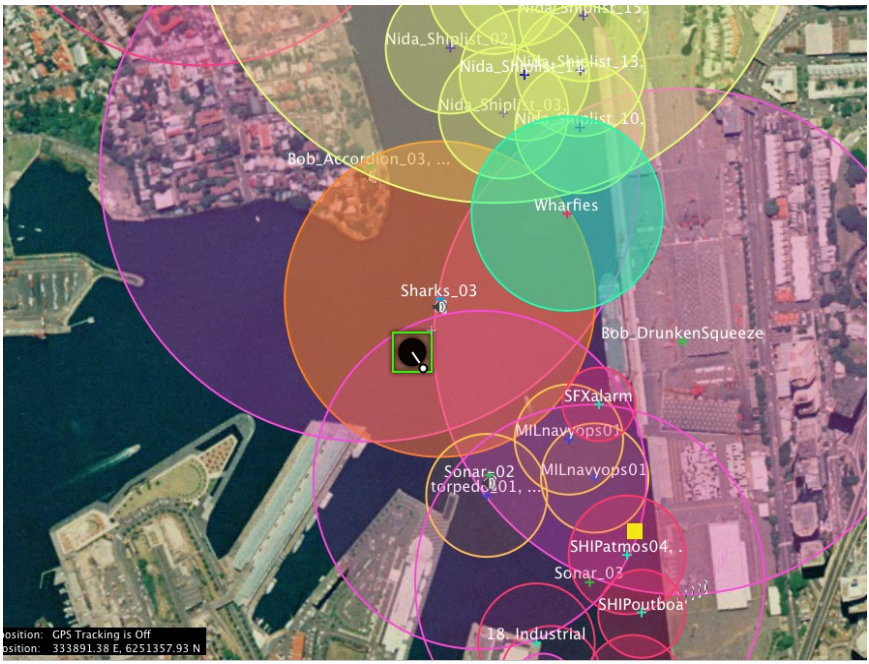

Figure 2 – detail view of Map Viewer software used to create Syren for Port Jackson content, with the square cursor at centre representing the ferry's position

The aim of the tool was to create "flow" [2] so that the artist could concentrate on audio design not the pragmatics of interacting with the tool. The artist is focusing on the interrelationship of sounds to the landscape, which is a 2D map-based editing surface. Being centred within a speaker array that is representative of the final

configuration removes the guesswork when designing the audio experience.

Editing in-situ

For both ISEA and Sydney Harbour testing runs were conducted before the actual events. For ISEA we had the opportunity to take a short cruise the day before the conference. Sydney Harbour, being in our home city enabled us to spend two test days on a much smaller boat. The editing tools were used in the field to fine tune content that had already been specified. Seeing the visual reality against the augmented audio experience is a necessary part of producing high quality outcomes.

***Syren* for international symposium on electronic arts**

Syren was presented as a ship-board exhibit at the 12th International Symposium on Electronic Art (ISEA) in August 2004 [3], [4]. Syren produced a continuous,spatialise soundscape that augmented the landscape of the Baltic Sea with location-based audio over a forty-one hour journey between Helsinki, Mariehamn, Stockholm and Tallinn (Figure 3). Listeners on the upper deck of the ISEA cruise ship (Figure 4) heard sounds rendered on a multi-channel speaker array so as to appear to originate from the location of visible geographic features and other positions along the journey, using custom *Audio Nomad*-developed software that enabled the artist to place location-based sound content over on vector map of the Baltic. A handheld GPS provided both position and direction data for the software system, built on Mac OS X, to render the soundscape from the current point of view of the ship on the map.

The Baltic Sea is a long way from Sydney, Australia and it was not feasible for a major resource commitment to be deployed to the

Figure 3 – view of Syren ISEA, showing two speakers andBaltic Sea landscape

Northern hemisphere before the actual presentation at ISEA. The need to design at a distance made it necessary to create a flexible design environment that could dynamically update content should unanticipated situations arise. An unexpected situation did arise when the boat docked at a different port in Stockholm. The real-time nature of the user interface allowed immediate repositioning of audio without having to halt the playback system.

Digital mapping data from the relevant hydrographic authorities, paper-based navigation charts and a position data from the shipping company were obtained. This collection of reconnaissance provided a good estimate of where we were expecting to be. However the editing tools were not limiting the audio design to a specific path dictated by the position data. The

path data was used as a guide to help the artist focus attention on the known course, rather than creating content that would be never heard since it was never coincident with the ship's course.

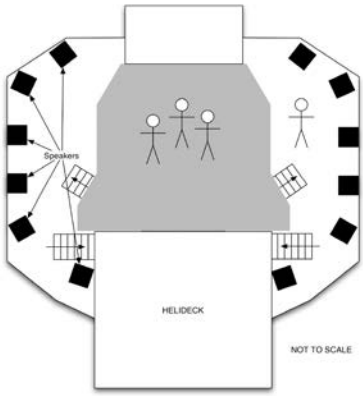

Figure 4 – Upper deck layout on the Opera cruise ship, for Syren at ISEA, depicting grey central audience area surrounded by 12 loudspeakers

Syren for Port Jackson

In March 2006, *Syren for Port Jackson* (Syren PJ) presented essentially the same concept deployed on Sydney Harbour (Figure 5, Figure 6) as an exhibit in conjunction with the New Constellations conference at the Museum of Contemporary Art. *Syren for Port Jackson* presented spatial audio relating to the contemporary and historical, natural, built and cultural environments surrounding Sydney Harbour. In Syren for Port Jackson, the content authoring software (MapViewer) was redeveloped to use orthophoto images as the background upon which the artist can lay out location-based audio content.

Figure 5 – Syren for Port Jackson: the ferry Regal, showing the DGPS antenna, with Sydney City in the background

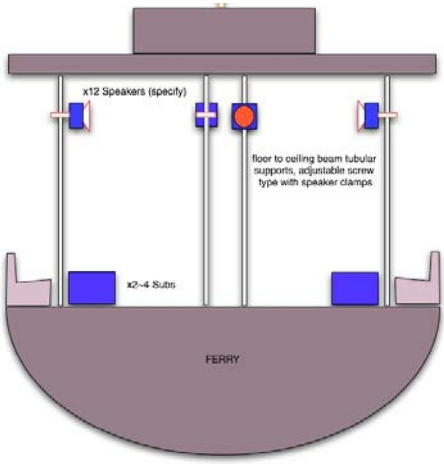

Figure 6 – Syren for Port Jackson: Layout inside the ferry Regal, showing loudspeaker placement and seating

Campus Navigator* and *Virtual Wall

Campus Navigator and *Virtual Wall* are both works-in-progress that deploy location-based spatial audio for pedestrians listening on headphones. The hardware platform is presently a handheld computer using an integrated GPS receiver, with head-mounted antenna and digital compass to determine the user's current position and orientation. Campus Navigator will provide an artistic location-based audio guide for the University of New South Wales campus, as an initial trial of the solution for a handheld platform.

Virtual Wall

Virtual Wall is an augmented audio reality artwork proposed for the Mitte in Berlin. The project will trace the physical course of the now absent Berlin Wall through the predominantly re-built city centre with a complex location sensitive soundscape formed from a mixture of historical material (oral histories and public speeches for example) with fictional audio narratives, music and ambient effects. Virtual Wall will operate in the space between the public and private lives — balancing material from public broadcast sources with intimate stories and characters.

Narrative themes will be developed from historical and cultural research and we anticipate forming partnerships to undertake both the background research and generation of content (recorded as multi-lingual voice narratives). Spatial and architectural 'keynote' objects are also important compositional elements.

Complexity, Time and Space

The construction and the experience of Virtual Wall will occur within both a time domain and a spatial domain. Whilst the

experience of audio is by nature temporal and generally continuous, the experience of a spatially constructed soundscape is far less predictable, particularlywhen the user is free to choose where to walk at any time. Further to this, the content of the work itself will address historical and contemporary time periods, adding further complexity, requiring compositional decisions about how to design interactions between user time and position, and content time and location.

Although the work is spatially bounded (albeit in a large area some 4,000 metres by 400 metres) and has a principal vector in the path of the wall, the compositional structure does not impose a spatial hierarchy or even propose an explicit spatial structure. Spatio-temporal complexity is generated by both the pace of walking through the physical landscape (and ipso facto through the soundscape) in combination with the temporal duration of individual sound events and their position which may be fixed in absolute space, coupled to a trajectory or positioned relative to the participants position.

Technical and Research Challenges

Virtual Wall proposes a range of complex technological challenges. Our proposed project area is a 4 km section of the wall running either side of the new Parliament building (for example, Figure 7) and thus needs to incorporate a huge amount of audio data, distributed over a large geographical area.

The compositional environment needs to address not onlycreative requirements, but also the pragmatics of cueing and guiding the users over a large geographical terrain, focused on the path of the vanished wall (a sharply defined linear track). Only a few ‘natural’ limits exist to where aparticipant can walk (e.g., the river) but

many competing points of interest will lie outside the project's geographicscope, therefore sound behaviour compositional designs must be developed to indicate the project boundaries and retain the auditor's interest.

Figure 7 – Berlin, adjacent to the Brandenburg Gate: one of the proposed sites of Virtual Wall audio content

Position determination that is reliable and accurate enough isa potential problem that may be addressed by using alternative technologies to GPS, discussed in a later sectionof this paper. Wireless LAN may also be employed to stream the many hours of audio required by thegeographically large active deployment area, which may notfit onto mobile device storage.

Multiple deployment capability

A core aim of *Audio Nomad* is to produce outcomes spanning multi-speaker ship-based deployments through tothe handheld version for pedestrian use. The development approach has been to focus on one design tool that could generate content for multiple platforms.

The second *Audio Nomad* software system, MapViewer, is scalable to several different deployment platforms of varying processing power and mobility. MapViewer, running on Mac OS X, can

itself function as both studio and laptop-based design tool, or as a deployment platform primarily for ship-based multi-speaker installations. Content developed using MapViewer can be also be deployed to a mobile device for individual pedestrian user playback. Deployment content data is packaged as an XML document and compressed mp3 sound files, which can be transferredto the mobile device using a memory card. Devices interpret the content and render it according to their processing capability. Currently, the sole deployment platform is Pocket PC. The *Audio Nomad* team is also developing a custom mobile playback device, and mobile phones or mp3 players may be targeted in the future.

Challenges of pedestrian navigation

Compared to shipboard location-based audio installations, *Audio Nomad* for pedestrian use presents several additional challenges. Practicalities of developing a mobile system for multiple individual users limit the bulk and expense of all hardware components, with concomitant limitations to their performance specifications. Predominant limitations are due to limited positioning accuracy and limited data storage capacity and computation processing power. These ultimately limit the extent to which an implementation achieves the project goals to provide a highly convincing augmented audio reality, and provide the end user experience envisioned by the artist.

Location-based spatial audio perception

Audio Nomad spatial audio quality depends on many factors of a particular implementation system. Ideally, location-based spatial audio would seem perfectly realistic, indistinguishable to the user from a situation where sounds were actually emanating from the objects chosen by the artist or other creative content producer. In

any practical system, however, the perceptual quality afforded by the implementation is limited by factors such as positioning and orientation accuracy, total system latency before this data affects the sound output, and computing power available to render convincing spatial audio. Subjective experiments being carried out by Mariette [5] intend to evaluate perceptual quality of spatial audio for mobile pedestrian users of audio augmented reality systems like Campus Navigator, with respect to various implementation andhuman factors. Ultimately, the complete characterisation of perceptual quality according to various implementation factors will enable a system design that optimises the match between artist intentions and end-user perceptual experience for given technology performance specifications. Perceptual experiment outcomes will also feed back into the authoring tool workflow and user interface.

Alternative positioning technologies

Audio Nomad authoring software and deployment systems have been designed with the potential to use any positioning technology. GPS has been the first choice because it is economical, readily available, and convenient, particularly for outdoors positioning and the maritime *Audio Nomad* projects. However, GPS is not suitable for some more likely pedestrian *Audio Nomad* environments, for example “urban canyons” and foliage-covered areas outdoors, or for any indoors applications, such as a gallery or museum tour guide. Ultimately, a pedestrian *Audio Nomad* application should support seamless service transition between outdoors and indoors use as depicted in Figure 8. Indoors, purpose built systems such as Active Badge, cricket, The Bat, and others, are available [6], although in many cases it is possible and cost effective to attain adequate positioning performance using existing infrastructure such as Wireless LAN. For high accuracy

performance both indoors or outdoors, pseudolite technologies such as Locata provide a solution. RFID technology is also being tested for simpler location-based audio applications such as gallery guides.

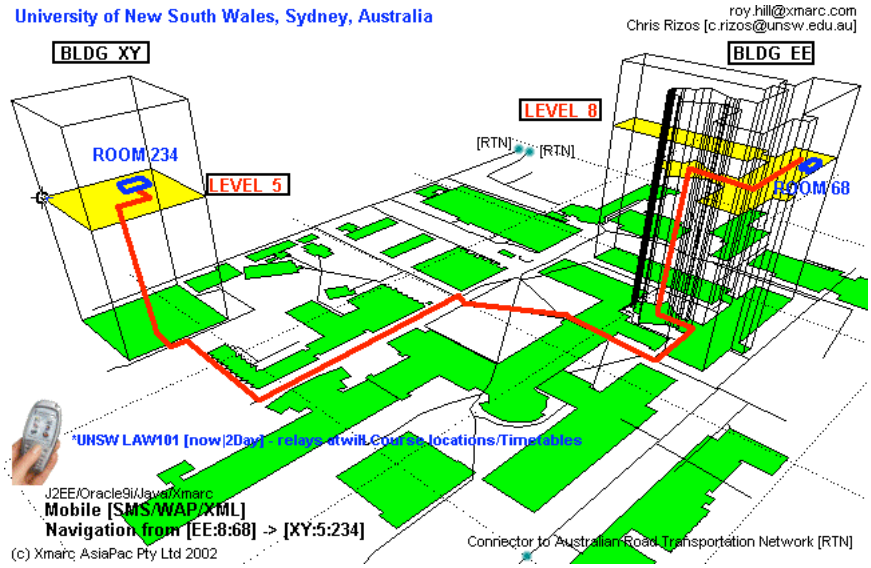

Figure 8 – Building to building navigation

Researchers at University of New South Wales (UNSW) [7], and elsewhere, have developed innovative implementations of indoors mobile user position estimation using signal strength of Wireless LAN (WLAN). WLAN is a technology that provides local wireless access to fixed network architectures and has seen rapid market growth, making consumer hardware cheap and readily available. While WLAN is not designed for positioning, signal strength measurements are easily made and display high spatial variance, enabling metre-level accuracy for the best techniques. Increasingly, WLAN positioning systems are seen as convenient for indoor environments, urban areas, or wherever WLAN is deployed. Additionally, applications such as Virtual Wall may use a WLAN

network to update or stream content data to the user device on demand.

While GPS is a popular and mature technology, it is heavily dependent on a relatively unobstructed sky-view and good satellite geometry. In “challenging” environments where satellite occlusion is common, such as urban environments, satellite-based technologies produce disappointing performance. A solution developed by the company Locata
[8] is to deploy a network of terrestrially based transceivers (LocataLites, Figure 9) that transmit ranging signals.

These transceivers form a positioning network called a LocataNet (Figure 10) that can operate in combination with GPS when available (as in urban environments) or entirely independent of GPS (for indoor applications). A special property of the LocataNet is that it is time-synchronous, potentially allowing single point positioning with cm-level accuracy.

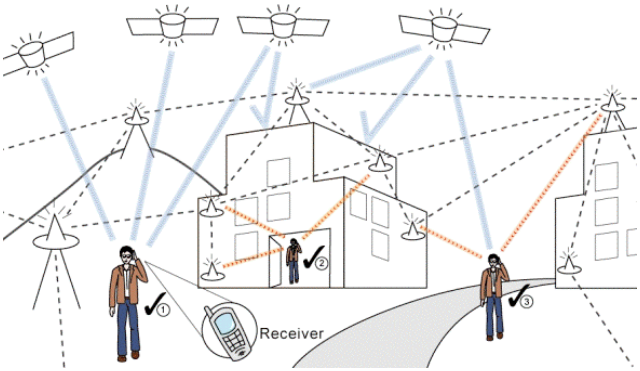

Figure 9 – Prototype LocataLite

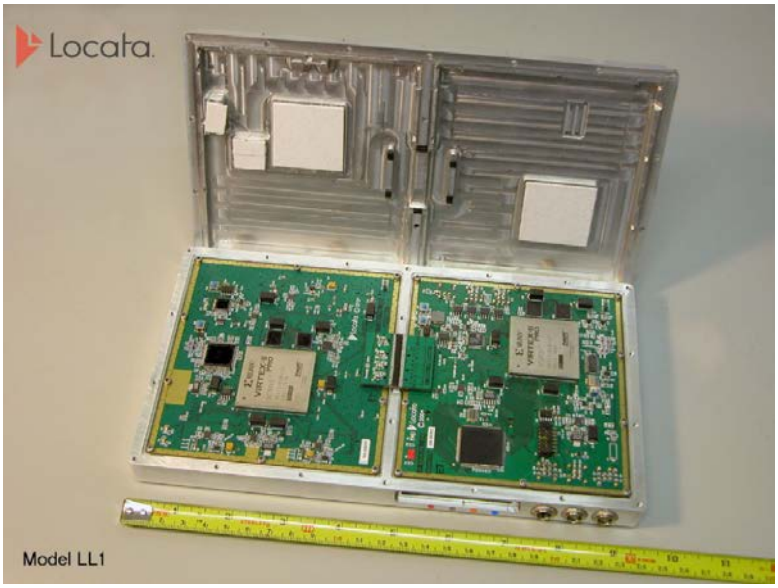

Figure 10 – Locata can be used indoors and in urban orother environments where GPS cannot

Summary

Audio Nomad projects are developing the creative and technical possibilities of location-based playback of spatialised audio content, using GPS and digital compasses to provide user position information. As GPS technology becomes more ubiquitous, *Audio Nomad* is well placed to take advantage of new platforms such as mobile phones. The developed technology considers multi-platform deployments, with playback architectures such as streaming audio and reduced sound spatialisation implementations to enable content scaling to fit devices from ship-based systems to pedestrian handheld devices. Research has also focusedon the design of efficient authoring tools, and workflows for the creation of content for multiple deployments. This unique multidisciplinary collaboration has driven the design of tools with great creative potential to provide new alternative location-based

services poised to engage and appeal to the imagination of future GNSS users.

Acknowledgments

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The Audio-Nomad team (at original time of writing)

Dr Nigel Helyer - Creative Director.
Dr Daniel Woo - Scientific Director
Prof. Chris Rizos, Director SNAP Lab UNSW.
Nick Mariette, James Salter, Doctoral candidates
School of Computer Science and Engineering, UNSW.

Biographies

Dr. Nigel Helyer (a.k.a. Dr Sonique) is an Australian-based Sculptor and Sound Artist with an international reputation for his large-scale sonic installations, environmental sound sculpture works and new media projects. He is actively engaged in collaborative and trans-disciplinary projects that seek to synthesise cultural and scientific practice. He is currently an honorary associate in Architectural Acoustics at the University of Sydney and a Professorial Visiting Fellowat the University of New South Wales working in the area of Virtual Audio Reality. http://www.sonicobjects.com

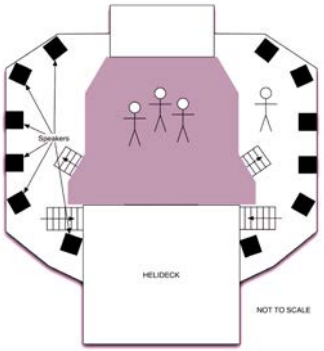
Dr. Daniel Woo is responsible for Human ComputerInteraction teaching and research in the School of Computer Science and Engineering, University of New South Wales. Current projects are focused around the development of user interfaces both in terms of

engineering and usability. *Audio Nomad* is a key research area for his group. His researchand commercial background is strongly associated with speech, audio and mobile computing, having worked on projects in the areas of speech recognition, speech synthesis, telephone applications and handheld software.

Chris Rizos is a graduate of UNSW; obtaining a Bachelor of Surveying in 1975, and a PhD in 1980 in satellite geodesy. Chris is currently the Head of the School of Surveying and Spatial Information Systems at UNSW. He has been researching the technology and high precision applications of GPS since 1985, and established over a decade ago the Satellite Navigation and Positioning group at UNSW, today the premier academic GPS and wireless location technology R&D laboratory in Australia. Chris is a Fellow of the International Association of Geodesy (IAG), Chair of the IAG's Commission 4 "Positioning and Applications", member of the Executive of the US Institute of Navigation's Satellite Division, and a member of the Governing Board of the International GNSS Service.

Nick Mariette is a PhD student researching spatial audio synthesis and perception in the augmented reality setting. He developed the multi-channel and binaural spatial sound software components for *Audio Nomad* artworks. Prior to resuming study, from 1998 to 2003 he worked at spatial audio company Lake Technology, first as an audio software and systems engineer, and most recently as product manager for the Huron spatial audio workstation. Nick also produces live and radiophonic experimental audio compositions, and practices ambisonic surround sound field recording.

James Salter is an MSc student at the School of Computer Science and Engineering, University of New South Wales. His research focuses on probabilistic human positioning using existing wireless network infrastructure. He hopes that by developing robust, accurate positioning using existing technology, context aware computing can flourish even in the absence of expensive dedicated positioning hardware. *Audio Nomad* is an application that benefits from this approach as well as a research platform. James also produces complex but allegedly musical electronic music in his spare time.


Speakers
HELIDECK
NOT TO SCALE

Genes, Memes and Dots

GeneMusiK is an artistic project that puts into play ideas about the capacity of physical morphologies to act as mnemonic systems by using DNA to transcode and re-mix musical structures. The project suggests that both biological and cultural information can function as both macro and the micro scale structures arrayed as physical loci and topologies which function as keys to the mapping of memory.

The author's attraction to this on-going series of sound-works which combine human and biological agency to re-invent musical scores, is directly proportional to the difficulty of the undertaking with its unpredictable outcomes and high failure rate. As a generative method the outcome is surrendered to the stochastic process of biological transformation, a strategy which substantially erodes the human agency and control invested in authorship. Ultimately the work is returned to the human sphere in the form of live musical performance which carries with it the additional complications of nuanced interpretation and virtuosity, all of which combine to create a fluid matrix of cultural, social and biological exchange that act to flesh-out life-forms (as forms of life) across temporal and spatial barriers.

Motile organisms are neurologically predisposed to seek patterns in their surroundings. Pattern recognition is a core cognitive ability, vital to evolution and survival, and is especially important in the human species. Pattern recognition affords the capacity of prediction. In life, as in art, we take delight in the symmetries, growth patterns and morphologies of the natural world as through them we recognise our own formation. However, there is a constant flux between the regularity, or predictability of a pattern

and an instability or turbulence that might threaten to render it indecipherable. The delicate balance between predictability and disturbance in creative works is well described by Dr Peter Vuust in his work *Musical interaction is influenced by underlying predictive models and musical expertise.*[1] To walk this tightrope between order and chaos is a common counterpoint technique used in art, whereas science is primarily concerned to disambiguate chaos and render visible structures otherwise hidden by noise.

In 1917, in his seminal work *Art as Device* the Russian Formalist writer Viktor Shklovsky coined the term *Ostranerie,* or defamiliarization, to describe a strategy for making strange, to render a common thing in an unfamiliar manner or context to create a fresh perception of it, such as art does, in order to make a clear distinction between prose and poetry. [2]

This trope of making strange with language has recurred throughout the twentieth century by employing various forms of dissonance to de-frame and re-frame both quotidian reality and artefacts. It has surfaced as Freud's elaboration of the *Unheimliche* in which the familiar passes to a state beyond one's ken; to the highly structured (anti)theatrical strategy of Berthold Brecht's *Verfremdungeffekt,* the estrangement effect, specifically designed to puncture the suspension of disbelief normally assumed by a theatre audience and thereby exposing the ideological and aesthetic mechanisms of theatrical performance to critique. More recently Jacques Derrida conceptualised *Différance*, a portmanteau term which hovers somewhere between difference and deferment and which points to the fissure between the sensible perception of the world and a textual representation of it, the latter being in a constant state of deferment. In the prosaic world the probabilistic learning that pattern recognition develops is extremely useful — it

is the way we navigate our daily lives. However, in creative practice complete predictability leads to rapid dis-engagement, therefore we always require a twist to a narrative, a dissonant metaphor in a joke, or an unpredictable note to conclude a melodic series. This partial instability is the sweetspot, the point at which our expectations of regularity in a pattern is disrupted — but not too much, just enough to throw the brain into mild confusion. It is the fissure, the reveal, the punchline that reflects on the narrative-arc and plays with our assumptions.

Entering into a compact with biological agents such as *Escherichia coli* to co-create is a guarantee of making strange — a blind-date with an entire community of collaborators who have existed for 100 million years longer than *Homo sapiens* but which are incorporated within our own gut, much like the non-chromosomal Plasmid DNA that bacteria incorporate to carry out essential functions, and which are the engines used by bioengineering.

In the beginning — GeneMusiK

The Data-sphere grows at an exponential rate and exists in an increasingly unstable environment, prone to failures in capacity, technical limitations and increasingly intentional disruption. Such considerations prompted scientist Wong Pak Chung at the Pacific Northwest National Laboratory, a nuclear facility, to consider developing the potential of data storage and retrieval within extremophile microorganisms, which are capable of surviving in the harshest conditions, such as deep space or radioactive environments. Unlike many microorganisms that are structured to mutate, evolve and adapt rapidly, extremophiles are capable of maintaining their genomic integrity over periods of many thousand, if not millions of years. In 2003 as a proof of concept Wong took the lyrics of the Disney tune *It's a Small World* and

inserted it into *Deiococcus radiodurans* a bacteria capable of surviving massive doses of gamma radiation claiming that, “once the DNA message is in bacteria, it is protected and can survive.” The encoded message sequence of 150 base pairs survived more than 100 generations intact.

The concept of encipherment, the translation of data into the four letter alphabet of the genetic code and its subsequent insertion into an unwitting host organism has developed beyond the purely pragmatic concerns of science to be embraced by artists and poets, quick to see the creative advantage of potentially immortal works. In particular the Canadian poet Christian Bök’s *Xenotext* project which aims to create a poem to also be carried by *Deiococcus radiodurans* into a future that extends well beyond human existence. Likewise Joe Davis who as early at 2000 created *MicroVenus* by encoding a visual image of human female genitalia in bacteria (undertaken at UC Davis and Harvard Medical school) is also currently working to encode three and four dimensional figures within *Halobacterium salinarum,* an extremophilic archaeon. Davis (et al) plan to embed the modified archaeon into mineral salt crystals where they can remain in stasis for hundreds of millions of years.proteins

First encounters

During 2002 the author was thrown into the deep-end of wet micro-biological processes as a visiting artist at the SymbioticA Lab (University of Western Australia) collaborating with the School of Agricultural Science to develop a proof of concept designed to translate music into DNA which when inserted into bacteria, would be mutated and subsequently extracted to be decoded as novel musical forms. At that time artists such as Peter Gena were busy generating musical scores and digitally

synthesised performance works that employed algorithms to translate the described DNA structures of a variety of biological factors (viruses, proteins, enciphered etc) via a process that Gena describes as *physio-musical* conversion. His methodology developed an interesting response to DNA morphologies but one which operated external to the organism, little work at that time appeared to employ the mechanism of genetic mutation within the organism itself to act directly upon the enciphered information, to the contrary, most effort being directed at preserving and protecting the *message* data intact.

Four months of intensive lab work revealed the complexities and physical difficulties of genetic manipulation. At that time labs could only synthesise short runs of base pairs so much energy was expended stitching shorter sequences together and coercing these into the plasmid DNA of *Escherichia coli* (a common intestinal bacteria used as a lab workhorse). Due to the constraints of time and budget this first attempt failed to complete the entire biological cycle, however it did produce a series of prototype scores by employing computer modelling of the action of restrictor enzymes on the generated synthetic DNA sequences and provided valuable technical and conceptual insights for the subsequent stages of the project.

Memory machines

The impetus behind GeneMusiK is a response to concepts of memory and memory engines that have the potential to embody instructions for the future in the form of code. It is the offspring of the mechanically encoded behaviours of the eighteenth century musical automata such as those of Jacques de Vaucanson, the famous flute player, the duck, and the tambourine player, themselves direct descendants of Medieval clockwork bell-ringing

mechanisms. These devices all stored performance behaviours — this ability to encode performance parameters in turn inspired the serial punch-cards of the Jacquard loom, which effectively controlled the pixel-like texture of machine woven silk. Industrial performance control flowed into the early mathematical engines of Babbage and Hollerith, to eventually return to the performance encoding paper rolls of the Pianola (Player Piano) and its digital reincarnation in MIDI and on into the optical control of computers via spools of punch paper tape.

This lineage finally merges with the contemporary revolution in encoding and encipherment based upon DNA. First recognised in 1869 by the Swiss physiological chemist Friedrich Miescherd as *Nuclein* and subsequently described by Francis Crick and James Watson in the 1950s as *Deoxyribonucleic acid.* The obvious functional difference between all earlier forms of mnemonic machines (including early computers) and DNA is the biological capacity to evolve, adapt and self-replicate.

GeneMusiK was conceived as an experimental biological music system that puts into play the parallel mnemonic structures of genes, memes and dots (dots, a.k.a. musical notation) posed as a fluid relationship between conventional Western music notation and microbiology; between code and morphology. Most early bio-art DNA sound projects, for example, the generative music of Peter Gena, interpreted known DNA sequences into musical analogues in a one way translation from genetic structure to musical structure. [note 1] Other artists such as Joe Davis, encoded information within the DNA of various species as data storage, in a form of simplex transmission to create a symbolic trans-species memory archive, albeit one that was largely inaccessible once encoded.

An early example of a work that attempts to move beyond the simplex form is Eduardo Kac's work Genesis (1999) which translated the biblical verse "Let man have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moves upon the earth." The text was translated into the binary form of Morse code in an epistemological reference to the first functional form of telecommunication and subsequently into a DNA sequence which was in turn incorporated into bacterial DNA.The project also integrated Peter Gena's 'physio-musical' transposition of DNA to generate a sonic accompaniment. The effectiveness of the operation was aesthetically revealed by irradiating the bacteria with UV light that activated a fluorescent protein. The sting in the tail being that UV light is also a strong mutagenic agent, therefore whilst the encoded message was revealed it was simultaneously subjected to degradation. At the conclusion of the exhibition the results of the mutagenic effect of the UV light could be extracted and re-read as a corrupted biblical text. The result being an ironic critique of the Judaeo-Christian imperative of man's domination over all other living beings made doubly ironic as it is achieved by performing exactly such an act of manipulation and domination.

While GeneMusiK has been inspired by aspects of Kac's Genesis, it was however conceived from the outset as an entire lifecycle — from musical notation metabolised via biology and returned to the form of a written musical score, available for performance — and is thus an intentional form of Duplex transmission. In brief outline; the project takes short sequences of melody and rhythm and converts them into DNA sequences. In most works in this series individual musical notes are assigned to individual three letter codons, whilst some codons may be assigned to performance instructions, for example play *molto forte.* The resulting sequence

of codons is then synthesised and inserted into the plasmid DNA of E.coli bacteria which are cultured and subsequently mutated, in most instances by chemical or UV exposure. The mutated DNA is then extracted from the bacteria's plasmid DNA to be re-sequenced and translated, using the same table of music to DNA assignation, into standard musical notation forming novel performance musical scores.

This process equates the encoding capacity of DNA and that of Musical notation as equivalent structures that are capable of reproducing themselves over time and which are possessed of the ability to manifest themselves from a stored core of memory but a memory that is subject to deformation, misinterpretation, and transmission losses — a form of *Chinese Whispers* played out in the biological and cultural arena respectively. In effect a counterpoint to conceptualisations of DNA enciphered data storage conceived as an incorruptible form. Whilst the genetic make-up of organisms generally functions to maintain the physiological integrity of a species over time it must also maintain the vital capacity to evolve and adapt to changing environmental conditions, walking the tightrope between order and chaos. In a similar vein a musical score can exist in stasis, perhaps for hundreds of years until it is reinterpreted, re-orchestrated and performed, whilst the performance outcome may attempt verisimilitude it is never identical to the unknowable original.

GeneMusiK works with the powerful mechanisms of memory and amnesia to create re-mixes of well known musical forms placed within biological vectors which are encouraged by human agency to produce variations or mutations and in which the concept of performance occurs at both the microscopic and macroscopic

register. This work is mindful of two views of memory that focus on location and physical structures.

Human memory processes are mediated by, or indeed dependent upon, a physical sense of and orientation within space -- our memory is structured around associative triggers, sensory experiences, odours, sounds and music but also physical structures, buildings, the landscapes and topography. In *The Art of Memory* (1966) Frances Yates [3] paints a vivid picture of the ancient technique that enabled orators to place memory objects, within the labyrinthine spaces of classical architecture. By visualising an architectural interior, real or imaginary, a speaker might imagine a series of loci serving as a mnemonic triggers each serving to locate a passage of rhetoric. By memorising a stroll through this virtual architecture, the orator could re-enact their steps and thus retrieve a vast amount of correctly sequenced material. The capacity to associate thought and more specifically memory — be it a classical argument or the entire cultural history of a tribal group — with a geo-spatial matrix is frequently overlooked or under-rated. Ironically it may well be that this form of situated knowledge is not only vital to human society, but is also fundamental to many non-human species, being essential to navigation, and the successful location of breeding sites for migratory species. Geographic location has been identified as a central feature in the processing of memory, managed by the hippocampus, which employs a complex network of place, grid and border cells to spatially situate memories. Thus, our sense of place -- of space infused with meaning -- is a product of the deep neuronal structures within our brain that perform an analogical linkage between real-world loci and our internal physio-electro-chemical spatial coding.

A second example of a memory structure that combines both physical site and morphology but at a microscopic scale, is the regular spacing of foreign genetic material found in microorganisms such as archaea and bacteria. These spatial sequences originally discovered in 1987 are now known as CRISPR (Clustered regularly interspaced short palindromic repeat). in simple outline, fragments of the genetic sequences of aggressor organisms (phages etc.) are incorporated in regular repetitive sequences within the DNA of bacteria (etc.) and function as a type of immune system -- in effect physically incorporating a memory of a previous assault. [4] & [5]

Eine kleine GeneMusiK — Prototype No 1

In 2014 the VryFees Festival in Bloemfontien, South Africa invited me as an artist-in residence to rekindle the original GeneMusiK project. Based between the micro-biology lab and a music Conservatorium of the University of the Free State,I was asked to work with indigenous South-African San musicians who live in the bleak re-settlement camp of Platfontien, situated some two-hours drive to the West, near Kimberly in the Northern Cape. The aim of the festival curators being to bridge the usually rigid divide between what is generally regarded as ‘ethnic’ music with the legacy of dominant musical forms of a colonial society — hence the double entendre of kleine in the project title, referencing both Mozart and smallness. The task was inter-culturally complex as it entailed developing a working relationship with San musicians and devising a methodology that did not diminish or simply appropriate their musical culture whilst simultaneously negotiating the protocols of lab work and the string quartet from the Odeion Music School.

During my sojourn in Bloemfontein, the project established a successful prototype of all the functional components that comprise the complex chain of transformations -- working directly with the San musicians to make field recordings and converting them, via audio analysis software, into musical data representing pitch sequences which were then transformed via a conversion table into synthetic DNA. These novel DNA sequences were inserted into E.coli bacteria to be cultured, mutated, re-extracted and ultimately rendered as scores for musical performance.

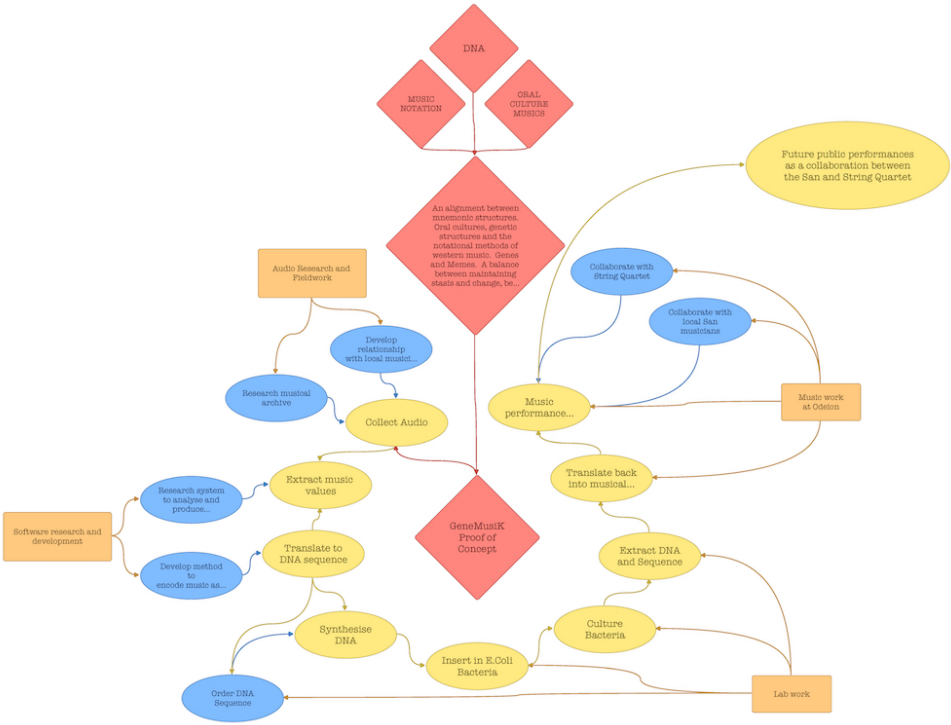


Figure 1. A production workflow diagram for *GeneMusiK* in South Africa.

On my research travels I uncovered a unique early transcription of San music discovered in an explorer's publication from 1822 by W. J. Burchell, a British polymath, scientist, botanist, musician and intrepid traveller. In his publication *Travels in the Interior of Southern Africa* I came upon an illustration of a seated San Bushman playing a mouth bow or *Gorah* accompanied by Burchell's musical transcription.[6]

Figure 2. San bushman playing the Gorah. Burchell, W. J. *Travels in the Interior of Southern Africa* Longman, Hurst, Rees, Orme and Brown, 1822-1824.

One of Burchell's many skills was that of an accomplished violinist and he held a keen interest in the traditional musics that he encountered on his travels. Naturally his conventional notation forced the non-western tonal range and temporal structure of the Gorah player into the straight-jacket of a European cultural form. Burchell's notation did however create a temporal bridge across two hundred years that paralleled the contemporary material I was recording in the dusty shacks of Platfontein. In order to avoid replicating Burchell's colonial perspective the contemporary material was analysed with *Sonic Visualiser*, a software that is not constrained by the harmonic regimes of conventional western musical form.[see note2]

Burchell's simple score was incorporated as an additional source of musical information, functioning as an echo from the past and a reminder of the cultural and political transformations that have taken place within South Africa. A complimentary DNA sequence was generated and incorporated with the contemporary San content to be merged into a final composition. Collaborating with Leon Snymann of the Odeion Music School the material was orchestrated and given to the Odeion String Quartet to play.[7]

The resulting score is a complex and challenging work to play and makes for demanding listening. Again it is important to note that the final musical score was created by a process of genetic modelling achieved *in-silica* rather than *in-vitro.* For a second time the project ran-over the projected timeline and production budget of the micro-biological work in the laboratory — This was due to the time and energy required to develop a trusting creative relationship with the San musicians in Platfontein, which had money in which to complete a full biological cycle.

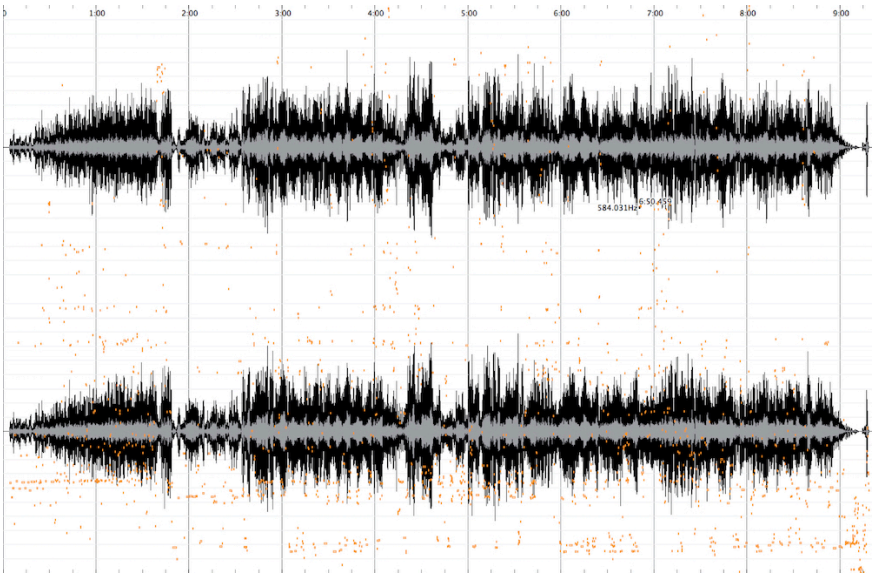


Figure 3. Screenshot of the *Sonic Visualiser* pitch analysis of a San song.

GeneMusiK — Over the Rainbow. Prototype No.2
However, in 2016 the Portuguese Art and Science organisation *Cultivamos Cultura i*n conjunction with the *Instituto Medicina Molecular* in Lisboa invited me to attempt the method again. [note 3]

Using the very simple melody of *Somewhere over the Rainbow* I tried several times to render the score as a viable DNA sequence but encountered on-going problems in which the DNA clotted due to the exceptionally repetitive nature of the codons in the DNA sequence. When quizzed by the DNA synthesis lab I had to explain that they were coding for musical notation which naturally

contained a lot of repeating patterns! Once again, I was forcefully reminded of the physical nano-scale morphology of proteins that a DNA sequence represented, code as micro-structure and micro-topography.

Figure 4. Dorothy in the Somewhere over the rainbow sequence, The Wizard of Oz MGM studios 1939. Showing the 45 codons used in the DNA encoding of the individual bars in the score (Helyer 2016).

Many years previously I had engaged in a series of conversations with Joe Davis regarding methods for encoding data in biological vectors. At the time Joe was beginning to develop his Supercode system of DNA manifolds that theoretically nestled layer upon layer of enciphered data, in contrast my aesthetic and methodological preference has always been for a kitchen-table ethos, creating translation tables by hand, eschewing algorithms

and aiming for simple solutions. In Lisboa I continued in this manner re-writing the music to DNA conversion-table multiple times but to no avail — the DNA lab was unable to produce the highly repetitive sequences.

Eventually I decided to work with the score and lyrics at the level of the bar, rather than focus upon each individual note.This strategy meant that the project sacrificed the potential to generate unconventional melodic sequences as it retained the melodic structure within each bar, however this compromise paid off in two ways. Firstly it permitted the entire song to be encoded with an extremely short DNA sequence in which none of the forty-five codons required was repeated and secondly, because each bar remained intact as a unit it allowed the lyrics contained within each bar to be incorporated. In this lean form the lab DNA synthesis was easily achievable and for the first time the project went through the entire biological lifecycle, producing fifty sets of mutated DNA sequences — several of which have been laboriously transcribed by hand back into music scores, for example, *GeneMusiK_Rainbow_Mutation_021*

atcaaattatacatgtcaacgataatacaaaatataatacaaactataagatgttatcagtatttatt
atgcatttagaataaatttttgtgtcgcccttcgctgaacacattatcatacttgaactcctactgttat
tggttgtcgtagatgtgtttttcaatatgtgttgcgctaaggccgaagcagcgggtaaaggcgg
gggacctaaacccgacccaccgactaataagaccgatacaacgtctaataagtccaagtcatc
gagtagcaaaaattatgaatacaagtggcacaatcaacatcagcgtcaaagggcgacacccc
ctaattagcccgggcgaaaggcccagtctttcgactgagcctttcgttttatttgatgcctggcag
ttccctactctcgcatggggagtccccacactaccatcggcgctacggcgtttcacttctgagtt
cggcatggggtcaggtgggaccaccgcgctactgccgccaggcaaacaaggggtgttatga
gccatattcaggtataaatgggctcgcgataatgttcagaattggttaattggttgtaacactgac
ccctatttgtttatttttctaaatacattcaaatatgtatccgctcatgagacaataaccctgataaat
gcttcaataatattgaaaaaggaagaatatgagccatattcaacgggaaacgtcgaggccgcg

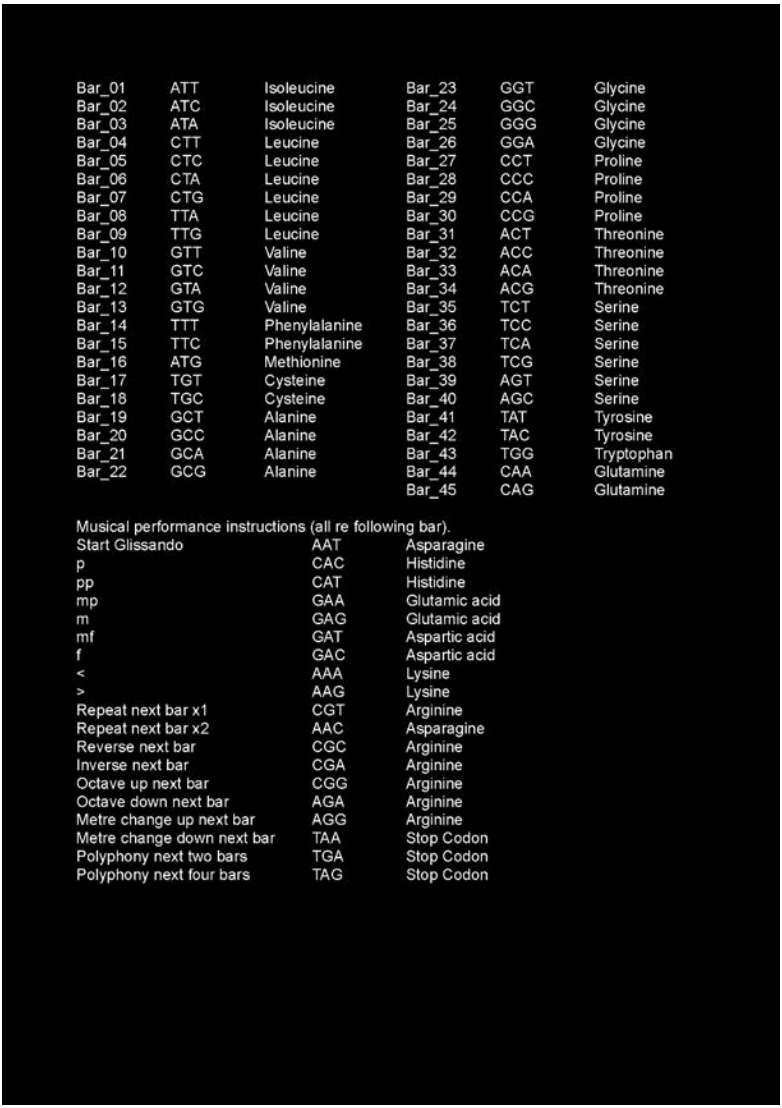
attaaattccaacatggatgctgatttatatgggtataaatgggctcgcgataatgtcgggcaatc
aggtgcgacaatctatcgcttgtatgggaagcccgatgcgccagagttgtttctgaaacatggc
aaaggtagcgttgccaatgatgttacagatgagatggtcagactaaactggctgacggaatttta
tgccacttccgaccatcaagcattttatccggtactcctggatgatgcatgggttactcaccactg
cggatccccggaaaaaacagcggttccaggtattagaaaaaatatcctggattcagggtgaaa
atattggttgaagccgctgggcagtgttccctgcgtccgtttgcactccaattccggtttggtaatt
gccccttttaacagccgatcggcgtattctgctctcgtctcaaggcctcatctcccaaatggaact
accggttctggtctgaagcccaattgatattcttcgtccc

In general, an *in-vitro* transformation of a score operating at the level of an individual note produces a highly abstract re-formulation, which contains only occasional familiar melodic sequences. However, working at the level of the bar produces an interesting performance effect — in which the score is quantised into bar sized units that are recombined in novel sequences.

The original song structure of *Somewhere over the Rainbow* is a linear sequence of forty-five melodic and lyric units which the DNA mutation can re-shuffle to create much longer musical sequences. The economy of this strategy also provided twenty-three spare codons which were employed to represent performance instructions (for example play *Molto Forte* or *Repeat Bar*). As the nineteen performance instruction condons were not required to encipher the bars of the original song they were only employed at the de-coding stage where the mutated DNA sequences were rendered into musical scores.

The *GeneMusiK_Rainbow* project produced fifty sets of mutated DNA, which are gradually being manually transcribed into performance scores (each takes some three days) Of these, two have recently been successfully rehearsed and performed by a singer and pianist and the scores and recordings included in the

Festival Art & Science Trans-disciplinary and Trans-national (FACTT) touring exhibition.[7] [8] [9] [10] [11] [12]



Bar_01	ATT	Isoleucine	Bar_23	GGT	Glycine
Bar_02	ATC	Isoleucine	Bar_24	GGC	Glycine
Bar_03	ATA	Isoleucine	Bar_25	GGG	Glycine
Bar_04	CTT	Leucine	Bar_26	GGA	Glycine
Bar_05	CTC	Leucine	Bar_27	CCT	Proline
Bar_06	CTA	Leucine	Bar_28	CCC	Proline
Bar_07	CTG	Leucine	Bar_29	CCA	Proline
Bar_08	TTA	Leucine	Bar_30	CCG	Proline
Bar_09	TTG	Leucine	Bar_31	ACT	Threonine
Bar_10	GTT	Valine	Bar_32	ACC	Threonine
Bar_11	GTC	Valine	Bar_33	ACA	Threonine
Bar_12	GTA	Valine	Bar_34	ACG	Threonine
Bar_13	GTG	Valine	Bar_35	TCT	Serine
Bar_14	TTT	Phenylalanine	Bar_36	TCC	Serine
Bar_15	TTC	Phenylalanine	Bar_37	TCA	Serine
Bar_16	ATG	Methionine	Bar_38	TCG	Serine
Bar_17	TGT	Cysteine	Bar_39	AGT	Serine
Bar_18	TGC	Cysteine	Bar_40	AGC	Serine
Bar_19	GCT	Alanine	Bar_41	TAT	Tyrosine
Bar_20	GCC	Alanine	Bar_42	TAC	Tyrosine
Bar_21	GCA	Alanine	Bar_43	TGG	Tryptophan
Bar_22	GCG	Alanine	Bar_44	CAA	Glutamine
			Bar_45	CAG	Glutamine

Musical performance instructions (all re following bar).

Start Glissando	AAT	Asparagine
p	CAC	Histidine
pp	CAT	Histidine
mp	GAA	Glutamic acid
m	GAG	Glutamic acid
mf	GAT	Aspartic acid
f	GAC	Aspartic acid
<	AAA	Lysine
>	AAG	Lysine
Repeat next bar x1	CGT	Arginine
Repeat next bar x2	AAC	Asparagine
Reverse next bar	CGC	Arginine
Inverse next bar	CGA	Arginine
Octave up next bar	CGG	Arginine
Octave down next bar	AGA	Arginine
Metre change up next bar	AGG	Arginine
Metre change down next bar	TAA	Stop Codon
Polyphony next two bars	TGA	Stop Codon
Polyphony next four bars	TAG	Stop Codon

Figure 5. The Score to Codon translation table for GeneMusiK_Rainbow.

It has become clear that the principal challenge for live performance derives from their familiarity with the simple melodic

structure of the original song, which in an encounter with a mutated version presents the singer and the pianist with non-sequiturs, multiple repetitions, inversions and octave changes that countermands the powerful memory of the original work.

Conclusion

The GeneMusiK project attempts to re-think the role of place, site and topography in the formation of mnemonic systems, drawing parallels between both physical structures — microscopic and macroscopic, as well as the spatial mechanisms used within human brain chemistry to store memory. The project counterpoints two views of memory (or data) storage within living DNA; one which is designed to preserve data, often with immortal intentions — the other engages with processes of change, evolution and degradation, with the aim of creating novel structures, structures that make strange with language. Finally this series openly embraces the stochastic processes of the blind-date with biology, relinquishing large parts of the creative processes to the invisible mechanisms of DNA replication and mutation and then faithfully re-performs them at human scale within the conventional context of musical performance.

Notes

1 Peter Gena, DNA Music works *https://www.petergena.com/DNAmus.html*

2 The *Sonic Visualiser* software was developed in the Centre for Digital Music at Queen Mary, University of London. Sonic Visualiser is an application for analysis, visualisation, and annotation of music audio files.

3 Cultivamos Cultura and Ectopia *https://cultivamoscultura.com/*

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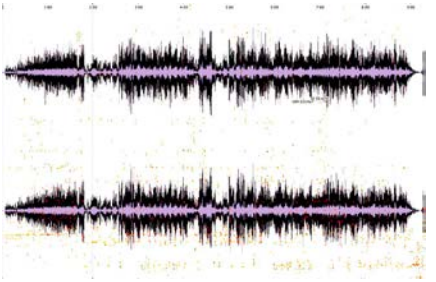
https://soundcloud.com/drsonique/mutation-1

10 Helyer, N. (2017) score of *GeneMusik Mutation No.2*
SonicObjects; Sonic Architecture, Sydney.
https://www.dropbox.com/home/Public?
preview=GeneMusiK_Mutation+Score+No.2.pdf

11 Helyer, N. (2017) mp3 audio of *GeneMusik Mutation No.2*
SonicObjects; Sonic Architecture, Sydney.
https://soundcloud.com/drsonique/mutation-2

12 FACTT – Festival Art & Science Trans-disciplinary and Trans-national.
https://cultivamoscultura.com/2017/09/30/factt-festival-art-science-nyc-30th-of-september-1st-of-october/



Snap; Crackle Pop.
On listening, memory and amnesia.

Your words are preserved in the tin foil and will come back upon the application of the instrument years after you are dead in exactly the same tone of voice you spoke in then…This tongueless, toothless instrument, without larynx or pharynx, dumb, voiceless matter, nevertheless mimics your tones, speaks with your voice, speaks with your words, and centuries after you have crumbled into dust will repeat again and again, to a generation that could never know you, every idle thought, every fond fancy, every vain word that you chose to whisper against this thin iron diaphragm[1].

Edison's Ars Memoriae concept for the phonograph.

Introduction

Broadcast media, recording and communications technologies have developed at an alarming pace since Edison proposed the phonograph as an Acoustic Ars Memoriae. A series of rapid iterations have overlaid and overwritten previous systems and modus operandi making it easy to forget the central role that radio has played within Australian communities ~ both rural and urban. The broadcast medium functioned as a form of entertainment, a mechanism for nation building and as a vital link able to transcend the 'tyranny of distance', be it real or imagined.

My interest is focussed, not so much upon a technological trajectory but primarily upon the role that listening plays in establishing memory, situated within a geophysical site, to form identity and place. The corollary of this interest also lies in its inverse — the realisation that individual memory, as well as

cultural histories, are extremely fragile and fugitive, evaporating under the pressures of technological and social change driven by the massive acceleration and saturation of media information.

Over the past few years I have become increasingly drawn to create a series of audio-portraits, manifest as sound installations, public sound works and radio broadcasts, woven from the patterns of listening and communication. These audio-portraits centre upon the nexus of sound, listening, location and memory, fusing the concept of soundscape with more narrative forms of orality.

This text will concentrate primarily on the recent *Wireless House* project, undertaken as a public-art commission for the City of Sydney, but will be contextualised by two 'snapshots' of previous projects, *KelleRadioActive*, commissioned by the International Art Space Kellerberrin (IASKA) in Western Australia and *GhosTrain*, commissioned by ABC Radio National as part of their Radiophonic Residency.

Project snapshot_01 ~ KelleRadioActive

The first of these projects, KelleRadioActive was the result of a three month Artist in Residence, undertaken in Kellerberrin, a small rural community in the sweltering wheat-belt of Western Australia, a few hours east of Perth[2]. The project developed an oral history programme that captured community experiences of listening to radio in the form of recorded interviews, discussions and even musical recollections that recalled radiophonic events from the past and the patterns of when, where and how people listened to radio in their homes, or used radio communication in the workplace.

Figure 1. KelleRadioActive exhibition remounted at The Tin Sheds Gallery University of Sydney.

The question that I posed to the community was beguilingly simple, “What did it mean to listen to radio?” My modus operandi was equally guileless, I became a collector of old (often defunct) radio-sets and simultaneously a collector of extensive oral histories. Bush communities never fail to surprise and Kellerberrin was no exception. I discovered the man who made all the original radio-sets for the community back in the 1930s. He and his father fabricated the sets from baking trays set with thermionic valves, his father supplying the cabinets and the pair installing the sets in outlying homesteads. Long-line antennae, dry cell battery banks and earphones were the order of the day, the families listening in, one person at a time to scratchy reports of distant cricket matches ~ with listening time strictly rationed to preserve battery power.

Even today radio reception in Kellerberrin is poor to non existent and so I resolved to establish my own station with a low-power, mini-fm rig. A I Watt Stereo Mini-Fm local radio station (KRA_88 Fm) was mounted in a bicycle trailer capable of automatically broadcasting content developed in the community to the township. My pirate station was complimented by a gallery exhibition of period radios each modified to transmit audio via very low power Fm, and where visitors to the exhibition were given transistor radios as a means to engage with the work.

Isolated communities are generally less media saturated and still rely upon (and enjoy) the vis-a-vis of oral communication, more recently extended via mobile telephony and VHF radio in work contexts. The KRA.88Fm mini-fm station acted as an acoustic mirror in the community affording encounters with a wide gamut of voices and narratives; the exuberance of the young coexisting with the recollections of the elderly. For many this was the first time that their stories moved beyond the individual into a form of public-address to participate in a sonic-commons.

Project snapshot_02 ~GhosTrain - History and Amnesia

I'm very, very concerned about this construction of history as somehow divided from the present, there is a continuity, there always will be. It suits certain interests to construct the past as a foreign country which can then be commodified for exploitation, be it cultural, tourism of some sort, or redevelopment of sites to make them appear unique, however I dispute this 'discontinuity' view of the past[3].

Lucy Taksa.

GhosTrain focussed upon the Eveleigh Railway Workshops, once the largest employer in New South Wales, and in its day a both a centre of technological innovation and of working class political organisation. The site was closed by the State government some decades ago and has recently been repurposed as a cultural zone, mirroring the redevelopment of its sister site (the Redfern Locomotive Workshops) as a technology park.

The Eveleigh site is impressive on a number of levels; its robust industrial architecture, the simple repurposing of the site as a cultural space; set against the lingering knowledge that this was a site of labour ~ of specialised knowledge and skill and of a lifestyle all but forgotten in Sydney's upwardly mobile affluent society.

When considering the changing socioeconomic landscape of our cities our attention is drawn towards the more obvious physical features of the shifting usage of architectural structures and major environmental infrastructures. However in marked contrast, it is the transient elements that are the soul of living cultures, but these are difficult to seize upon and tend to be overlooked and quickly forgotten; erased under changing patterns of work and social usage. The iconic sounds that characterise a locale are one of the most fragile and difficult of these transient elements to recognise, evaluate and maintain, yet in essence they often hold the key to memory and identity.

As Lucy Taksa indicates, the construction of history is a premeditated political enterprise that creates a sharp divide between the plural voices and narratives of individuals (which generally go unheeded) and the singular, authorised grand narrative that is History. The *GhosTrain* project was therefore not so much

about our experience of listening per se but about listening to the stories of a community that has been ignored. A listening-in to the silences of a location, not simply to a workplace, but to an entire culture that has been conveniently dismissed and transformed in a manner that erases all traces and renders it palatable and commodifiable.

The acoustic ecologies of industrial landscapes are a prime example of our extraordinary collective capacity for amnesia. Closely observed, every location has a characteristic soundscape, in effect a sonic fingerprint, formed from a complex mix of smaller incidental sounds, punctuated by unique, keynote sounds that are site-specific and directly associated with the particular structures and activities found at the location.

GhosTrain is designed in three stages and aims to recognise the importance of the soundscape that once characterised the site and endeavours to reinstate specific elements of its acoustic ecology and the memories contained within oral history. The first phase, a series of five short broadcasts produced at ABC Radio National (Sydney), established contact with a range of ex-railway workers and interlaced their oral histories with commentaries from historians, architects and the like. This was in effect the research phase, collecting material and getting under the complex skin of the site[4].

The second stage, currently under development, seeks to reinstate a keynote sound within the main architectural space, in order to re-sound the acoustic ecology of the site. The intention is to install a speaker rig that will broadcast the 1 o'clock siren (reputedly used by all the local shops to set their clocks). The siren will be followed by 30 seconds of a steam loco, shunting along the axis of

the building ~ a simple sonic event designed to re-kindle people's memory and associations and to honour those who spent their working lives in the Rail yards.

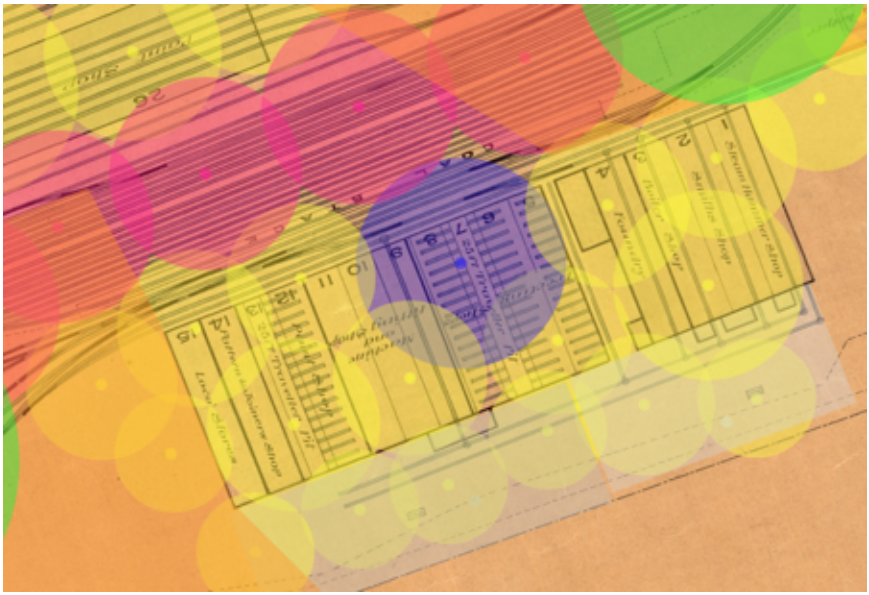


Figure 2. GhosTrain interactive map based upon the original blueprint, coloured sectors are sound trigger zones.

The final stage is a form of mobile acoustic Ars Memoriae. During my research it became obvious that many previous employees felt cheated of their working history, seeing the physical locus of their labours gentrified and none of the original meaning or heritage retained or represented (save for some well hidden brass plaques on the Redfern site).

The mere restoration of bricks and mortar is senseless in this context. What is missing is an acknowledgement of the social and cultural histories told in multiple voices from the community and situated in the appropriate places. It is my intention to develop a

location sensitive sonic-cartography which will operate on 3G phones delivered as a download via the AudioNomad system. This will provide an open access platform that can be developed and modified over time[5].

Re-Sounding the Wireless House

In 1930 Marconi, sitting on his yacht Electra, moored off the Italian coast, sent a radio signal to Sydney, Australia that activated a relay, switching on the illuminations of Sydney Town Hall.

In 1933 a suggestion was put to the Glebe Council (Glebe is an inner western suburb of Sydney) to establish a Wireless House in the public park on the corner of Glebe Point and Bridge Roads for the purpose of community entertainment. Commissioned in November of 1934, Wireless House was officially opened in February the following year with the installation of a wireless set donated by the local Grace Bros. department store. From then on the Wireless House operated on a daily basis from 10 am until 10.15 p.m., playing a range of commercial radio programmes, musical shows, sports events and radio serials.

Radio broadcast was making considerable changes to Australian society during this time and as a domestic social event, entire family groups would gather around a radio set for communal listening, even taking turns wearing headphones and narrating the events to the rest of the group. However, during the depression access to radio equipment was restricted to those of comfortable means and the majority of Glebe residents were doing it tough.

The Wireless House was revolutionary in that it catered to large crowds including many unemployed, who congregated in the park to enjoy the daily programmes. The project, although recognised as

a municipal innovation, attracted criticism from the church and sporting organisations (aka betting shops) both sharing concerns about a loss of patronage. The Wireless House eventually succumbed to accusations that it encouraged the unemployed to idleness and was eventually decommissioned. The initial research indicated that the Wireless House ceased to operate in the early 1950s but recent oral histories recorded in the community confirm that it functioned (at a reduced volume) until the early 1970s and it's closure was probably more a reflection of the ubiquity of affordable portable radios than any moral argument!

The intervening decades since the establishment of the Wireless House have wrought extraordinary changes in our attitudes to and acceptance of broadcast media and the fact that the Wireless House has survived intact, albeit mute, for over seventy years is equally extraordinary; however, this was all about to change!

In 2006 the City of Sydney ran an open competition for public art proposals along the axis of Glebe Point Road as part of a major upgrade of the suburb's infrastructure ~ I bid on the Wireless House site as a project and won a commission. Once again my approach was simple ~ the Wireless House would be resounded and would once again become wireless!

Re_Sounding, a strategy.
My approach to resounding the structure was threefold, a physical, sculptural treatment, an operational design and a content development and acquisition strategy. The physical structure of the Wireless House is (to be polite) uninspiring but it was an unpleasant surprise to discover, upon my first meeting with the city's landscape designers that the house was scheduled for demolition (but I was advised, I could work with the concrete

Figure 3. The *Wireless House* launch.

foundation slab!). This fait accompli more than rankled and so I set to work to establish if the Wireless House had any cultural significance beyond the local, that could be employed as an arguement for its preservation, as it was obvious I could not rely upon it's architectural merit! It soon became evident that the Wireless House was an unusual concept. The Sydney Morning Herald archives hold articles from 1935 hailing the structure as unique in Australian municipal history and none of my subsequent research located anything similar in Australia or abroad (save for propaganda kiosks and PA systems). Whist this evidence still failed to budge the destructive intent of the planning department, a National Trust listing of the structure put the ball in a different court and secured the future of the House.

Sculptural treatment.
The physical treatment of the house sought to open up the interior of the building by removing the original speaker baffles that closed the two window apertures as well as the heavy steel door, replacing them with clear Lexan. Large web-like laser-cut stainless steel shields based upon the radiation pattern of radio antennae clad each wall, affording visual access to the house (whilst also securing the structure and its technological contents). The interior of the structure has been retained in its original 1930s colours and visitors can view the original wooden radio stand supporting a period cabinet radio, its dial aglow, whilst on the opposite wall a substantial internet router and antennae array declares the contemporary version of wirelessness.

Technical design.
The operational design reestablishes the original function of the Wireless House and its capacity to play audio over a small area of Foley Park, employing motion sensors to trigger the playback of audio content randomly selected from a large data base. The audio database is stored on a small solid-state computer that is programmed to select content for playback, control the hours of operation, monitor the volume level of individual files and so on. The technical system is otherwise conventional except for the audio drivers. Instead of standard speakers, which are prone to mechanical damage and require an aperture in the exterior surface of the built structure, the project employs Solid-Drive transducers bolted to the Lexan windows, effectively turning the entire window surface into a speaker diaphragm.

The second layer of public engagement returns the Wireless House to wirelessness by providing the site with a free park-wide internet hotspot, indeed this is the first City sponsored free internet access

in an outdoor location and destined to become something of a test-case. The final layer of interactivity is reflected in the development of a comprehensive website sponsored by the City of Sydney and in addition a community access content sharing website on the ABC Radio POOL facility (no longer extant).

Content acquisition and generation.
The most complex, and possibly the most rewarding aspect of the project has been the development of appropriate content and this has followed two principal routes. Firstly the development of an ongoing partnership with the National Film and Sound Archive who have gone to great lengths to assist with the curation and digitisation of original radio content from the 1930s onwards. The second approach established a community based Oral History programme which has not only developed audio and video documents but has proactively developed skills within the community teaching recording, editing and computer skills and establishing additional content sharing social history web-sites.

Right from the start of the project it became crystal clear that both individual memory and community recall are fragile and transient, our task was complicated by the fact that even a child of five attending the opening of the Wireless House was now approaching their mid seventies. The very social and economic conditions that provided the impetus to create the Wireless House also explained why there were virtually no records, textual or photographic, as certainly very few community members could afford a camera! Thus began a long, slow and often frustrating search for long-term residents who could recall the Wireless House and recount their narratives of life in Glebe, gradually revealing a collective memory of prewar politics and culture, narratives full of idiosyncrasies and inflections normally excluded from official histories.

Whilst back at City Hall work was apace developing a Wireless House website to function as a portal within the park and to provide a historical context to the project, we soon discovered that community contributions to the City site (as audio and video oral-history uploads) would simply run into a tangle of red-tape. We therefore opted to develop a parallel site housed on POOL, a collaborative open source, creative-commons content sharing site. Posting material as we worked functioned to explain to others in the community (and at City Hall) the benefits and value of this grass-roots activity. This demonstrated the need to initiate a deeper level of social engagement which involved empowering individuals with the motivation and the technical skills to make their own recordings and contributions to the web.

Community response to public art is typically conservative in nature and frequently downright hostile, principally due to a perceived lack of ownership and consequent failure to identify with the project. In the initial stages, the response to Wireless House were no exception with the community evenly divided over the long-term fate of the structure and the benefit of its revitalisation. Many of the more influential members of the community were happy to see the somewhat 'plain' structure (used as a gardener's shed) demolished. However these views gradually began to shift after grass-roots community research allowed the topic to be circulated, evaluated and eventually honoured as a unique part of an almost forgotten history. It is a commonplace that it often takes an outsider to point out the obvious in a familiar situation ~ and perhaps it is easier to be filled with enthusiasm for something which to others appears mundane. It was the oral history project together with the community training undertaken by my studio assistant Julia Burns that delivered a platform for the

community to engage with its history and identity, focussing the content upon the Wireless House, allowing it to act as a conduit.

The morphology of the project therefore developed a central loci, the physical Wireless House structure, visibly transformed (as is the park in which it is situated) but surrounded by an ever growing cloud of content, drawn from the wider psychogeography of Glebe. This admixture of tangible and impalpable content has energised the suburb providing a platform for celebrating and valuing their (almost) forgotten past ~ the City of Sydney's recent invitation to the launch of Wireless House casually ended with the line ~ "Refreshments available for the first One Thousand visitors".

References

1 Edison conceived the phonograph plain and simple as a memorial device, a means to archive the transient voices of relatives as a sonic counterpoint to the family photo album. That the future of the phonograph (and subsequently radio broadcast) was to rapidly evolve into a commercial device driven by musical entertainment is with hindsight an obvious irony, but one that Edison both missed and was resistant to. Naturally we should not overlook the fact that Edison was partially deaf!

2 Artist in Residency October ~ December 2005; Exhibition, 3rd December 2005 ~ February 2006 Kellerberrin Western Australia. *http://www.sonicobjects.com/index.php/projects/more/kelleradioactive_at_iaska*

3 Lucy Taksa is Associate Professor, School of Organisation and Management UNSW. Excerpted from the broadcast GhosTrain, Station No.1. ~ History and Amnesia.

4 ABC Radio National Radiophonic Fellowship 2008; GhosTrain Broadcast as x5 ‘stations’ on ABC Hindsight each week in May 2010.

5 Links to GhosTrain MP3 downloads.
http://www.sonicobjects.com/index.php/projects/more/ghostrain

Heavy Metal and the Oratorio for a Million Souls.

Nigel Helyer, John Potts, Jon Drummond

Abstract
This paper explores different approaches to the sonification and visualisation of two environmental projects.

Heavy Metal is focussed upon the real-time analysis and sonification of the chemical elements in a painting via a camera vision system, whilst *Oratorio for a Million Souls* concerns the behaviour and acoustic properties of live bee colonies manifest in the creation of real-time multi-channel sound compositions and associated sound architectures.

Whilst these two projects differ in terms of methodology, aesthetics and technical approach they both share a direct concern with a deep analysis of the underlying environmental structures and perceptual frameworks that emerge in direct 'live' encounters — on one hand the discovery of what lies behind the surface of a painted image in terms of chemical and colour structures — and in the case of Oratorio, a compelling immersion into the acoustic environment of Bees.

Heavy Metal

Heavy Metal[1] (2016) is an art installation with interactive camera vision system and digital audio by artist Nigel Helyer in collaboration with composer Jon Drummond and Environmental Scientist Mark Taylor. Heavy Metal was conceived and realised as

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[1] Heavy Metal archive <http://www.sonicobjects.com/index.php/projects/more/heavy_metal>

part of a three-year Australian Research Council Linkage Grant project, When Science Meets Art: an environmental portrait of the Shoalhaven River Valley. A creative research collaboration between artist Nigel Helyer, environmental scientist Mark Taylor, and media theorist John Potts.

The aim of the overall project is to create a complete environmental portrait of Bundanon[2], a region of 1100 hectares (2700 acres) in rural NSW bequeathed to the Australian people by the modernist painter Arthur Boyd[3] in 1993. The project uses techniques of environmental science, artistic practice, information technology, media technology and cultural history. Data representing environmental quality at Bundanon is digitally transformed into visual information and sound, and communicated by various means: in numerous artworks; on a website devoted to the project; through GPS onto smartphones for mobile users on site at the Bundanon property.

The environmental portrait of Bundanon also incorporates the social and cultural history of the region, as it pertains to its environmental condition. Science meets art in the communication of environmental data through artworks and media technology. Heavy Metal has been created as part of this process and invites us to interact with one of Arthur Boyd's paintings to discover a hidden world of elements and minerals in an experience that is simultaneously chemical, visual and musical.

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[2] The Bundanon Trust NSW Australia https://bundanon.com

[3] Arthur Boyd; One of the first Australian painters to be widely recognised internationally, specifically in the United Kingdom as one of the *Antipodeans*.

The initial concept for *Heavy Metal* arose after spending time on-site with Professor Mark Taylor. Mark and his students had been surveying the mineral composition of Bundanon, looking for traces of human activity that, for example, derived from farm and workshop activities, but also looking for the effects of upstream mining for gold and other heavy metals.

Elements and minerals lay buried in the landscape tracing diagrams of human activity. Specks of alluvial gold washed down to the floodplain from worked-out mountain mine shafts; existing as mineral auras that reveal the long-vanished outlines of farm buildings and the telltale chemical fallout from workplaces. Arthur Boyd painted this (mineralised) landscape with colours that were themselves formulated from earthy compounds and exotic metals, milled to a fine paste in linseed oil and turpentine.[4]

Our intention was to create a map of human activity based upon this forensic evidence. While we were taking environmental samples, Nigel invited Mark to visit Boyd's painting studio and bring along his portable mineral analysis machine[5] as it struck him that we may have a great opportunity for rethinking Boyd's works. The starting point was that Boyd was situated in this landscape, painting the physical features, and using (or making himself) colours that were substantially minerals (originally extracted from the earth), thus forming a metaphorical circuit. Mark was surprised by the massive levels of heavy metals in the materials used by painters and was keen to collaborate — so we proceeded to analyse the mineral composition of the entire colour range that Boyd used

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[4] Helyer quote from the Landscape/Portrait catalogue 2017. Pub Macquarie University.

[5] To generate the data programmed into Heavy Metal, we used a hand-held X-ray fluorescence spectrometer.

and came up with a massive database of minerals that corresponded to his palette.

Figure 1. Chemical sampling of studio paints.
Image Nigel Helyer.

The second stage was to sample the Steinway piano at the Bundanon homestead, note by note. Firstly, we recorded regular keystrokes; secondly, we recorded the reverberance of the sounding board resulting in one to two minute sound files per note. Working with another colleague, Jon Drummond, who is an expert in data sonification, we created a computer-driven audio-visual system able to read the video stream from a camera facing Boyd's unfinished painting *Return of the Prodigal Son* (c1997). The screen interface displays a highly magnified colour 'target' area from the painting along with the RGB values and the predominant minerals present, which are shown as elements of the periodic table.

Figure 2. Chemical sampling of studio paints.
Image Nigel Helyer.

The system then translates the stream of mineral data into sound, which is layered in two components: a generalised harmonic chord

structure that corresponds to the colour, overlaid by individual note highlights that illustrate the distribution of the most prominent minerals. The computer monitor gives feedback on the area of interest, colour ratios and a graphical display of the minerals detected.

Figure 3. Jon Drummond sampling the Steinway Piano.
Image Nigel Helyer.

The Cultural Theorist Cecelia Cmielewski invokes the presence of *Heavy Metal* during its debut in the following lyrical extract from the catalogue to the Landscape/Portrait exhibition that documented the *When Science meets Art* research project.

Winding toward Boyd's studio through the beautiful garden at Bundanon, with flowering azaleas and orange clivias, under the

shade of bright-green deciduous amber trees, the chord-like sounds of a piano become increasingly distinguishable. The sounds do not make a discernible melody but, once in the studio, they exert an immediate calming and almost meditative effect.

Visitors are intrigued and delighted by this work. Occasionally a high note pops into the space that jolts the listener into attentiveness. The sound of a painting - Artists have responded to paintings by playing music to them, but not until Heavy Metal have they composed music from their material composition.

This work is a genuine collaboration between scientist and artist. It is rare for such a collaboration to actually be a creative conjuncture of both disciplines. Usually one is at the behest of the other. Either the art is used to explain or 'communicate' the science or the science is made too simple by the art. Helyer has a good grasp of many scientific principles and has worked with scientists for over thirty years, the results of which we see in this collaboration.

Heavy Metal is interactive at a complex and conceptual level. The composition of chord-like sounds (recorded from the homestead Steinway) is created by a real-time analysis of the minerals in the colours of an unfinished Boyd painting, Return of the Prodigal Son (c1997). As a video camera is trained onto a section of the canvas, the screen displays the mineral content of the selected colours, in the form of the periodic table. The image and corresponding sound change each time someone selects a new section of the canvas on which to train the camera. Heavy Metal also brings together two kinds of science: environmental and computational.

Figure 4. In the studio with Elders from the Wreck Bay community. Image Nigel Helyer.

The creative leap of the artist is matched with the precise methodology of the scientist. Heavy Metal could have been quite a cold work — simply a digital archaeology of a painting. Instead, it is a lively work that uses the warm sounds of the piano and finely calibrated composition to bring the painting into a new space for contemplation. Heavy Metal provides participants with different ways to animate a 'static' painting. It takes some time for viewers/ listeners to put together what it is that they are experiencing. The sound is dynamic, based on the elements used in a particular area of Boyd's oil painting.

One little boy of about seven years old knows the periodic table. He is thrilled to be able to 'read' this painting because each sequence on the screen includes a representation of the elements from a particular section of the painting. All of a sudden he is able to correlate his knowledge of the periodic table with the materials

used by the artist. For another visitor, a writer, who does not usually 'get' art, the layers of sound and data provide a way for her to consider the work beyond that of colour and texture. For some of the men visiting from the Wreck Bay community, the data resonates with their use of naturally occurring materials used to paint their bodies for ceremony. Everyone who comes to Siteworks (and there is a large audience) spends time with Heavy Metal. The studio stays open for several hours longer than scheduled, and many visitors come back more than once. As the sounds from the studio close down, the chorus of the frogs in the nearby lake take over in the dark of evening at Bundanon.

Figure 5. The camera vision system, screen and target painting. Image Nigel Helyer.

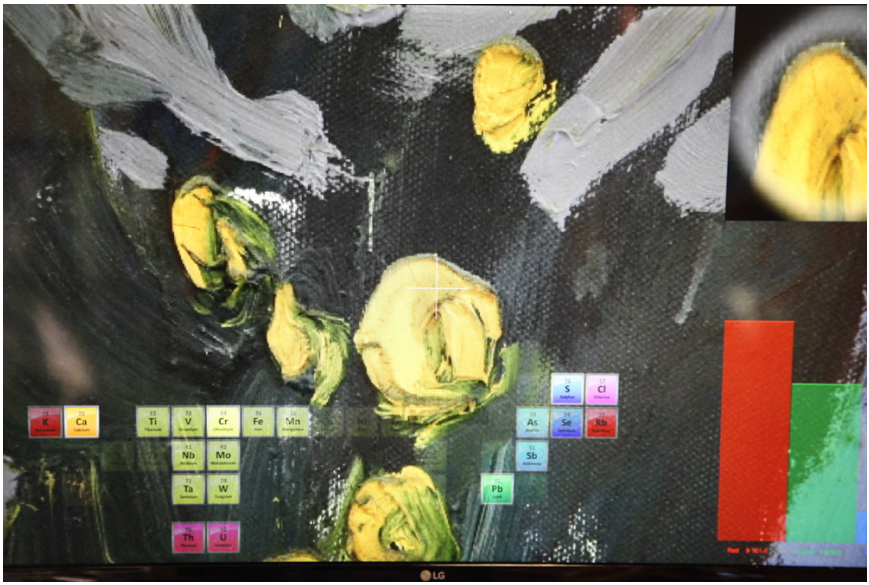

Figure 6. The screen showing the magnified target area and areas of the periodic table that correspond to the chemical analysis. Image Nigel Helyer.

Conclusion - Art Science and the Environment

Heavy Metal, draws upon recent research that has sought to develop collaboration between art and science, particularly in the context of technology and the environment. Siân Ede has proposed that there is 'much in contemporary science that can stimulate art's flexible, intuitive and visceral response to the world'. Ede also argues that 'the fragile environment might well become the most crucial matter for the future concerns of both artists and scientists'. Concern for the environment has become a central political and artistic issue in the contemporary world. Recent publications have emphasised the heightened regard for the environment in 'Eco-aesthetics', in 'Eco art in pursuit of a sustainable planet', in 'art and ecology now' as manifest in 'land art' incorporating landscape,

Earthworks, environmental art, sculpture, and nature-based installation art. Sean Cubitt has argued that Eco-politics is indeed 'the single largest unifying political discourse of the early twenty-first century' Cubitt suggests that artworks can voice the contradictions of their period, including the role of technology. It may be demonstrated that, 'not all technologies are instrumental, that is, used as instruments for domination over nature'. Media forms and art works may rely on certain technologies to communicate an ecological sensitivity.

Oratorio for a Million Souls - why Bees?

Why Bees? — There are two main reasons for such interest — firstly Bees, along with other colonial insects (such as termites and ants) display striking social organisation — that since ancient times they have provided powerful metaphors for human social structures.Secondly Bees have become a focus species in the public debate about the environment. Unfortunately the focus upon the threat to Bees; on Colony collapse and the subsequent effect on food production frequently masks the even wider issues of diminishing Bio-diversity in the face of industrial culture; agribusiness and climate change.

But to return to metaphor — historically the Bee has been and remains a symbol of good (hierarchical) government — with a vast population of obedient workers ruled over by a Queen. In English we still use the terms *As busy as a Bee* and *A hive of industry* as phrases that affirm diligence and application to a task. Until quite recently the reproductive cycle of the Bee was a mystery and the Queen was long regarded by the Christian Church as analogous to the Virgin Mary; until it was discovered that she made a single but prolonged nuptial flight mating with up to eighty males, retaining

Figure 7. A Bombus Terrestris nest. Image Nigel Helyer.

their sperm for the duration of her long productive life — not such a chaste Lady after all!

The workers who make up the vast majority of the hive population, have stood for loyalty, obedience, courage and selflessness ~ and much of their behaviour would seem to support these anthropomorphic metaphors we attach to them — perfect role models for Nineteenth Century industrial capital, which like the Monarchy is based upon an autocratic power pyramid.

However, recent research turns this pyramid image upon its head. Consider for a moment the behaviour of bees in Swarming mode. The hive has grown and the colony divides. The outgoing group muster, hanging from a branch somewhere, seeking a new location. The swarm sends out a stream of scouts, often over a period of

days, who report back, using methods similar to the bee dance to relay complex qualitative information. Somehow a collective process is engaged, the swarm considers this growing matrix of spatial data and eventually they fly to the most favoured location to begin a new colony. This is not the work of an individual mind, it is a product of parallel processing, a natural neural network, if you like, that has evolved over a 100 million years, the hive as *super-organism*.

Figure 8. The Oratorio at Buitenpost Gardens. Image Nigel Helyer.

European Capital of Culture Leeuwarden 2018.
The *Oratorio for a Million Souls*[6] was commissioned by the European Capital of Culture, Leeuwarden 2018 (Netherlands). Funded by a European Union Inter-Regional programme the

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[6] Oratorio for a Million Souls archive <http://www.sonicobjects.com/index.php/projects/more/oratorio_for_a_million_souls>

project has been realised in three botanical gardens; Dr Kruidhof in Buitenpost (Netherlands) and in Emden and Oldenburg (Germany). Each site consists of a 'green-architectural' listening space that houses two intelligent bee-hives to produce a four channel immersive soundscape in realtime.

The *Oratorio for a Million Souls* was developed in conjunction with a citizen science project in which one hundred sensor equipped beehives were distributed to schools in the Netherlands and Germany with the aim of mapping and assessing the pollen load (or floral productivity) of local ecologies. This research is taking place in a context which is commonly referred to as the European "Green Desert" a landscape which at first glance appears to be verdant and productive, but which in reality is the product of high-intensity industrial agriculture that is effectively eliminating bio-diversity and causing significant reductions in native species of birds and insects.

The concept behind Oratorio is to create a network of bio-acoustic listening spaces that allow visitors to immerse themselves in a world of insect sounds. By entering into the sonic heart of a Bee-city a visitor can for a moment become a fellow citizen — meditating at the centre of a sonic metropolis; all working; all buzzing — and taking an empathetic leap that we hope permits some serious thoughts about our collective effects on the natural environment.

Physically each Oratorio is constructed in traditional wattle and daub, intricately hand woven willow branches plastered with a thick layer of Leem[7] with a form based upon the shape of a traditional woven straw beehive (a Skepp in English). The

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[7] Leem - a mixture of clay, sand and chopped straw.

structures have a thatched roof reminiscent of the traditional farming buildings of the region, and this in turn supports a green-roof — sown with Bee attracting flowers — a sort of Bee-Helipad! The hemispherical interior of the Oratorios provide a special acoustic, similar to that found in the domed roofs of Cathedrals and Mosques where sound looses its directionality and forms an omni-directional *soundcloud*.

Figure 09. The Oratorio concert. Image de Kruidhof Buitenpost.

Each of these green architectures contains two sensor hives furnished with colonies of *Bombus Terrestris* the common Bumble the collective activity of the hive[8]. These two streams of live audio are mixed with sonifications of Bee entry and exit data which are rendered as short arpeggios of piano notes; rising upon exit and

[8]The bee nests we used were supplied commercially. In Holland much of the agriculture takes place in vast green-houses and the pollination is carried out by Bumble bees who are ‘buzz’ pollinators — using their wing muscles to vibrate pollen from the flower.

descending upon arrival, and which become more complex with the frequency of Bee activity. The arpeggios provide visitors with a direct sonic index of the intensity of Bee flight activity as this can only be seen from the exterior or the Oratorio. Hive temperature is rendered as a series of sustained tones that rise or fall as the temperature in the hive varies. The outputs of the two hives are combined into a four channel live soundscape which is augmented by a screen displaying realtime data of bee activity and data sonification.

The province of Fryslân in the Netherlands and the adjacent area of Ost Friesland in Germany boast many talented town Brass Ensembles and we were also commissioned to create a series of musical scores derived from the sounds and data sets recorded in the Oratorios, that could link each of the sites. By analysing the harmonic range of hive recordings we derived a tonal palette that we quantised into an equal tempered scale. Likewise by analysing the Bee entry and exit data from a range of the citizen science hives we established a temporal or rhythmic framework as well as developing an overall compositional structure based upon the diurnal activity of a hive (which is related to light and temperature).

We created a musical event in which three the Brass ensembles located in Buitenpost, Emden and Oldenburg, collaborated to play a multi-part score via a satellite Video and Audio link-up — a task not without technical or aesthetic challenges.

Creative Challenges - the Oratorios.
Working with living biological systems is always complex and unpredictable - Bees especially so in terms of handling nests of flying (and potentially stinging) insects who do not like being

disturbed! This made the work of testing and mounting microphones inside the hives a physical challenge. Acoustically the project also had to develop solutions to prevent feedback within the sound architecture, which contained the two hives as live acoustic sources. The highly sensitive DPA microphones[9] embedded in the Bee entry/exit ports provide an extremely detailed audio stream of flight and crawling sounds and as they are located on the building exterior are not affected by the interior soundscape. In contrast our early experiments with conventional microphones placed inside the hive boxes were a complete failure due to persistent feedback.

The interior of the nests produce a range of relatively quiet, crawling, peeping and contact events which when employing conventional studio microphones require too much amplification; the hive boxes themselves resonating with the sound energy from the four channel speaker array. The solution was provided by wiring together two large format Piezo discs and mounting them onto a small sounding board placed onto the upper surface of the nest enclosure. This extremely low-tech approximation of a contact microphone delivered good sound fidelity without the problems of feedback.

Creative Challenges - the musical scores.
From the perspective of traditional musical aesthetics both the temporal and pitch structures of the Bee audio and data derived composition are unconventional. Whilst the three Brass Ensembles are musically extremely competent but as our scores do not resemble their normal repertoire this generated some initial resistance — the score is certainly not an imagistic representation of the life of a hive (à la *Flight of the BumbleBee*) but rather an

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[9] DPA 4060 omnidirectional lavalier microphones

indexical translation of that life and activity. The debut of the composition *B-Rhapsodie* took place during June 2018 across the

Figure 10. B_Rhapsodie in performance. Image Nigel Helyer.

three sites. The collaborative rendition of the score by three geographically distant Brass Ensembles was a logistically difficult operation. We had to carefully synchronise the musicians and dealwith the inevitable time lag in satellite transmission. Each site could see and hear the other two distant ensembles — and somehow, despite cloudbreaks of cold European summer rain trickling into Tubas and English Horns the concert was a success!

Legacy.

In line with the objectives of the European Capital of Culture, works included in the programme are designed to have a legacy that benefits and extends the cultural life of the region. The *Oratorio for a Million Souls* project and its linked citizen science collaboration have an ongoing life in terms of research; public advocacy (for the preservation and growth of Bio-diversity) and in the very palpable form of the three*Oratorios* in their respective botanical gardens which are designed to function for at least three

years. Each botanical garden is free to incorporate the Oratorio into its visitor and education programme giving a new and extended meaning to the authors original intentions.

Figure 11. A BumbleBee about to enter the Oratorio. Image Nigel Helyer.

Walking; Thinking and Memory.

Nigel Helyer and John Potts

Walking and thinking; ancestors.

Homo Sapiens are by definition vertical and bipedal. As a species we have evolved to move slowly, consistently and in a sustained manner over the surface of the planet — and as we move we observe, we map, we remember and we think.

Thanks to the hundreds of thousands of years that our hominid ancestors have paced the earth the act of walking now takes very little of our mental capacity — it has, in contemporary terms, a low cognitive overhead — walking places scant demand on our attention, which in turn liberates our minds to engage in creative and speculative thought.

Surprisingly the equally pleasant occupation of, for example, small boat sailing functions in stark contrast, in that it demands a high and constant level of attention. To sail on the open sea is to be totally absorbed with the nuances of balance and the forces of wind and water, calculating trim and helm. The mind is fully occupied and enters into an oblivion where philosophy is banished by a focus upon the ever changing moment.

In this respect walking is unique. We have evolved to function at walking pace and all other velocities tend to distort and disturb our perceptual, cognitive and imaginative thought processes. At walking pace conversation is possible as it syncopates with the rhythmic cadence of the step and the lungs (whereas running renders conversation difficult or impossible). Moreover solitary walking offers the very special gift of imaginative reflection and there are several convincing reasons for this.

One could be forgiven for assuming that the optimal situation for thinking is to sit quietly in focused meditation but the efficacy of the sedentary state has time and again been contradicted by prominent thinkers throughout history. Henry David Thoreau reflected on the direct connection between walking and thinking.

> *Methinks that the moment that my legs begin to move my thoughts begin to flow.*[1]

There is nothing magical in this process, walking immediately increases the blood flow and thus supplies additional oxygen to the brain, which, when so exercised on a regular basis has been demonstrated to stimulate additional neural connections, generating fresh neurones, increasing the capacity for attention and memory.

Attention is a limited (but thankfully renewable) resource, however it gradually diminishes over the course of the day. Again, it has been well demonstrated that prolonged periods of sedentary work (which is sadly the norm for a large percentage of contemporary labour) is physically and psychologically damaging, diminishing the level of attentiveness, imaginative thought and memory. Even standing at a computer terminal is now widely recognised as beneficial as it remedies many posture related issues of sedentary work, but importantly standing also engages the hormone regulating endocrine system (parts of which shut down whist seated).

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[1] Henry David Thoreau, *Walking*, Atlantic Monthly 1862.

Walking and thinking; a cultural orientation.

If you have paid your debts, and made your will,
and settled your affairs, and are a free man;
then you are ready for a walk.[2]

Figure 1. From the Louis Huart, Physiologie du flâneur, Aubert et Cie 1841.

Thoreau explains that in the middle ages vagabonds would use the pretence of a pilgrimage to the crusades to ask for alms, claiming to be walking à la Sainte Terre - giving us the word saunter for an aimless walk undertaken by idlers. By the nineteenth century

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[2] Henry David Thoreau. *ibid.*

sauntering had developed into a fashionable middle class pastime — epitomised by the Flâneur, the "passionate spectator" of Charles Baudelaire who roamed the Paris boulevards taking in the endless urban parade.

Poets find the refuse of society on their street and derive their heroic subject from this very refuse. This means that a common type is, as it were, superimposed upon their illustrious type. ... Ragpicker or poet — the refuse concerns both.[3]

However to walk without explicit purpose and time constraints is perhaps one of the most productive and creatively liberating things we can do; and Baudelaire made an even more precipitous suggestion in the fifth stanza of his poem *Le Voyage* in the 1857 publication of *Fleurs du Mal*. His vrais voyageurs (or real travellers) foreshadow the spirit of the Dérive, a practice much vaunted by the Situationist Internationale in the mid twentieth century — in effect a pedestrian free-fall into fate. [4]

Mais les vrais voyageurs sont ceux-là seuls qui partent pour partir;coeurs légers, semblables aux ballons, de leur fatalité jamais ils ne s'écartent, et, sans savoir pourquoi, disent toujours: Allons![5]

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[3] Walter Benjamin, *Charles Baudelaire: A Lyric Poet in the Era of High Capitalism,* in *Walter Benjamin Selected Writings 1938 - 1940,* Havard University Press 1996.

[4] see Guy Debord, *Introduction to a critique of urban geography,* Les Lèvres Nues #9, Paris November 1955.

[5] Charles Baudelaire, *Le Voyage, Fleurs du Mal,* August Poulet-Malassis 1857.

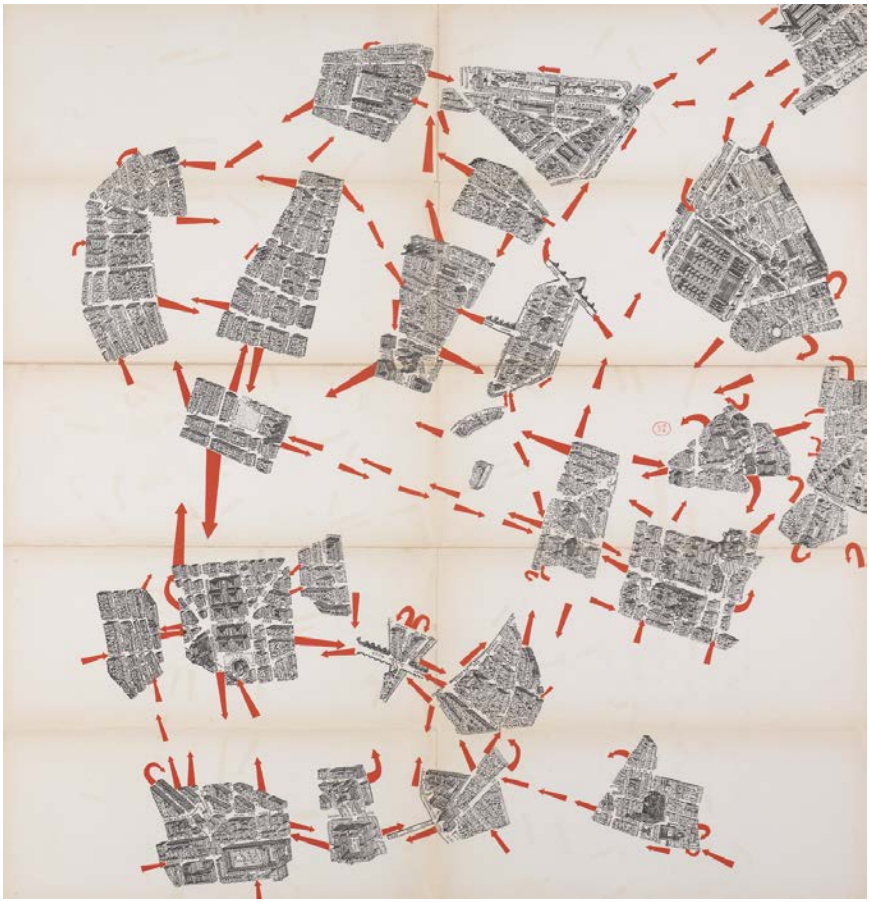

Figure 2. Guy Debord, Guide psychogéographique de Paris : discours sur les passions de l'amour, International Movement for an Imaginist Bauhaus 1957.

But real travellers are those who just leave for the sake of leaving,
Hearts as light as balloons, never avoiding their destiny,
And without knowing why, they always say: "Let's go!"

In1955 Guy Debord, the principal protagonist of the Situationist International, characterised psycho-geography as — *the study of the precise laws and specific effects of the geographical environment, consciously organised or not, on the emotions and*

behaviour of individuals — An informed and aware wandering, with continuous observation, through varied environments. It can be sought and can lead anywhere.[6]

In effect this is the Flâneur turned forensic and with a modus operandi synonymous with the tools of the trade of the writer and the poet — acute observation and a prodigious capacity to recall events in-situ.

Psycho-geography has since entered into the literary sphere as the geospatial mappings of the literary imagination, manifest, for instance as physical tours which re-enact the trajectories of novels — the day's meanderings of Leopold Bloom around Dublin in James Joyce's Ulysses — or pastoral walking tours of the imaginative hinterland of the Brontes — a retro-fitting of the literary imagination.

Walking and thinking; some beginnings.
However the well-spring for this fusion of creative thought and walking can be sourced from an earlier time — the English Romantic poets, in particular William Wordsworth and his sister Dorothy.

Wordsworth, his diarist and poet sister Dorothy, and frequent companion and close friend Coleridge, were indeed remarkable in going against the grain and following their passion for arduous, long distant walks, in the often unforgiving Northern English terrain. At the time, travelling by foot on the public highways and roads was a risky business, as they were peopled by paupers, vagabonds and footpads: only those who were forced by circumstance or trade would walk. In other words, the public

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[6] Guy Debord, *ibid.*

highway was a contested and dangerous place. The wealthy restricted themselves to promenades in manicured gardens or leafy urban boulevards, where the purpose was to see and be seen rather than to commune with nature.

Wordsworth, in his coupling of the creative process with outdoor walking, is often credited as having initiated the English Romantic tradition; he has been described by the American author Christopher Morley as 'one of the first to use his legs in the service of philosophy.' The Wordsworths influenced one another: Dorothy provided material for a famous Wordsworth poem when she wrote in her journal in 1802:

> *I never saw daffodils so beautiful they grew among the mossy stones about & about them, some rested their heads upon these stones as on a pillow for weariness & the rest tossed & reeled & danced & seemed as if they verily laughed with the wind that blew upon them over the Lake, they looked so gay ever glancing ever changing.*

The Wordsworths' extensive walks developed into extended expeditions all over Europe, encapsulating the Romantic tradition: walking in the service of the imagination and finding the sublime in nature.

In 1792, during his second trip to revolutionary France, William Wordsworth met an extraordinary countryman by the name of John 'Walking' Stewart. Stewart had spent thirty years walking throughout India, the Middle East, parts of Africa, Europe and the North American colonies, and had come to the attention of the public through his two publications *The Apocalypse of Nature* (1791) and *Travels over the most interesting parts of the Globe*

(1792). These works espoused his own brand of materialist philosophy, based on his direct experience of the physical and cultural landscapes through which he had journeyed.

In the volatile atmosphere of revolutionary Paris, it is highly probable that the twenty- two-year-old Wordsworth was strongly influenced by Stewart, both by his depth of experience and by the dedication to the practice of walking as a source of knowledge and inspiration. Stewart may well have provided the impetus and the confidence to launch Wordsworth into the landscape. Shortly afterwards, Wordsworth's first volumes of poetry *An Evening Walk* and *Descriptive Sketches* were published (1793).

Wordsworth fused a rigorous physical walking regime with the engine of his creative practice. In his lifetime he walked some 175,000 miles; if we estimate a generous 3 and a half miles per hour, we can calculate some 50,000 hours of reflection, much of which found its way into his poetry. His work resonates with subsequent generations of visual artists, notably the generation of painters that immediately followed. These were the Romantic painters who shared his subjective vision of the sublime in nature: Caspar David Friedrich, J.M. Turner and John Martin.

Wordsworth's practice of pastoral walking continues to resurface in contemporary culture, almost as if his legacy has given permission for the visual arts to embrace nature and landscape as a subject. The pursuit of walking in landscape re-emerged in the 1960s conjunction of conceptual art, landart and systems art. In the English context, where 'rambling' had been something of a national pastime since the mid-nineteenth century, the de-materialisation of sculpture was manifest in the work of several artists, who began to devise long distance walks. These walks were

mostly undertaken solo, in which the walk itself was the programme (or conceptual activity). Byproducts of the walk could include ephemeral stone arrangements (produced en route), documentary photographs, and text works; post-produced in exhibitable or publishable forms.

At first appearance, the work of the British 'walking' artists such as Richard Long and Hamish Fulton may appear quite at odds, in their strict conceptualist formulation, with the subjective tableaux of Turner and Martin that foreground the sublime. However at heart they are driven by a similar programme of direct contact with nature which embraces physical endurance, hardship, and often solitude. Both Long and Fulton came through the experimental sculpture course at Central St. Martin's School of Art in London in the 1960s under the tutelage of Peter Atkins.

During this period sculpture was at a cross-roads, dematerialising and engaging in conceptual and linguistic structures; in the case of both artists, this evolved into relatively simple task-based conceptual programmes, with walking in the landscape as the core.

Unlike the American 'LandArt' movement, which used landscape as a location and physical material source to create large terra-formed sculptural works (generally funded and on-sold by galleries) the English walkers travelled light. The conceptual programme was often little more than a set of map co-ordinates (walking from John O'Groats to Lands End for example) with perhaps the creation of an ephemeral sculptural arrangement along the way — or writing short textual descriptions to accompany documentary photographs. These were not so much performative works as direct personal experiences of the landscape; in fact the walks were not claimed as art per se but as events that engendered

art — manifest as evidence, or reinterpreted in a gallery at a later date.

Richard Long's work *A Line Made by Walking* of 1967 was an early instance of walking art. A black and white photograph revealed a long path through grass made by Long's feet. As Rebecca Solnit has observed, the work, despite it earthiness, contained an ambiguity: was the work of art the performance of walking, or the line made by walking, or the photograph of this natural sculptural form, or all of these? From that point, 'walking became Long's medium.'[7]

It is ironic that although Long and Fulton appear to have initially eschewed the commercial gallery scene, heading off for the hills to create art, they have both enjoyed considerable public acclaim. Despite their insistence on a practice that would appear dematerialised in a sculptural sense, both maintain a consistent output of lightly physical works: Long's mud-smeared walls and floor-based stone arrangements; Fulton's landscape photographs and cryptic texts. More recently, Fulton has made rigorously designed public communal walks that play with the ratios of time and distance, and which he orchestrates and views as sculptural objects. These are in effect highly structured conceptually based group walking systems — as art experiences.

One eccentric addition to the 'walkers' is the gardener and poet — Ian Hamilton Findlay. Rather than traversing the terrain, Findlay has remained firmly rooted in the soil of 'StonyBrook', the artist's garden in Dumfrieshire, Scotland that he developed over several decades. Findlay combined landscape design, concrete poetry and

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[7] Rebecca Solnit, *Wanderlust, A History of Walking*, Penguin New York 2001.

an acute knowledge of history to form a living artwork which the visitor 'performs' — by walking the labyrinthine paths of the StonyBrook gardens, ponds and heathlands.

In the commercial frenzy centred on the YBA (Young British Artists), the landart movement produced a poster-boy in the guise of Andy Goldsworthy. He is of note for his delicate arrangements of leaves, ice crystals and other ephemera, situated before the camera in exotic, pristine expedition environments. Goldsworthy's extremely popular, well-publicised practice is also programmatic, but in the cool commercialisation of the sensibility pioneered by Long, Fulton and Findlay; here ephemeral art becomes a sediment in oversized coffee-table publications.

Walking and thinking; memory and loci.

In "The Art of Memory" 1964 Frances Yates[8] paints a vivid picture of the antique technique that enabled Orators to place memory objects, such as lengthy quotations, within the labyrinthine spaces of classical architecture. By visualising an architectural interior, real or imaginary, a speaker might place here a red cloak over a sculpture and there, a sword on a table, each act of placement serving as a mnemonic trigger to locate a passage of Rhetoric. By memorising a stroll through this virtual architecture the Orator could re-enact his steps and thus retrieve a vast amount of correctly sequenced material.

The capacity to associate thought and more specifically memory, be it a classical argument or the entire cultural history of a tribal group, with a geo-spatial location is frequently overlooked or under-rated. Ironically it may well be that this form of situated

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[8] Frances Yates, *The Art of Memory*, University of Chicago Press 1966.

knowledge is not only vital to human society but is also fundamental to many non-human species, being vital to navigation, and the successful location of breeding sites for migratory species. For humans, this is a deep-seated evolutionary feature that embodies thought as action in the physical environment. Thought and memory are therefore not abstracted and deracinated, but are complex products that link memory and cultural knowledge with specific places and to the many sensory attributes of such loci, their odours, visual markers and acoustic properties, which subsequently serve as powerful associative triggers.

These expanded sensory inputs that walking provides (especially in natural environments) afford different modalities of thinking that are in stark contrast to those based upon extant knowledge, contained in books and which support the assumptions of the status quo. Nietzsche was quite clear about his preferences then it came to thinking.

We do not belong to those who have ideas only among books, when stimulated by books. It is our habit to think outdoors — walking, leaping, climbing, dancing preferably on lonely mountains or near the sea where even the trails become thoughtful.[9]

Nietzsche who thought and wrote whilst on the move was explicit about his method.

Only ideas won by walking have any value.[10]

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[9] Frederich Nietzsche, *The Gay Science* (first published 1882) english edition Vintage Books 1974.

[10] Frederich Nietzsche, *The Twilight of the Idols,* Verlag von C G Naumann 1899.

Walking and thinking; augmented reality.

It is a series of short conceptual steps from the mnemonic techniques of the classical orators, or Nietzsche's insistence on thought gestated by walking, to a contemporary creative practice that employs the digital technologies of augmented reality to seed the terrain with thoughts, images, sounds and memories. Artworks that employ walking as a spatial foundation for thought and the establishment of memory are demonstrated in a prequel to the author's current research which took up the conceptual model of the Ars Memoriae but transposed it into the realm of digital technology. From 1997 to 2006 the author developed a series of collaborative cross-disciplinary art and science projects working with the concept of GPS-driven, location based audio cartographies designed to deliver an experience of a virtual audio world overlaid upon the landscape. Whilst such works share a common conceptual lineage with earlier examples of Land-Art they manifest in a radically different aesthetic form, inviting participants to 'perform' and literally 'compose' location sensitive experiences through the act of walking. In effect no two individual experiences could be identical which raises the question of where meaning and creative control resides — in the efforts of the author or the experience of the participant?

Two major project teams, *SonicLandscapes* (1998 ~ 2001)[11] and *AudioNomad* (2003 ~ 2010)[12] transposed the imaginary

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[11] http://www.sonicobjects.com/index.php/projects/more/sonic_landscapes - ISEA is the International Symposium of Electronic Arts

[12] http://www.sonicobjects.com/index.php/projects/more/audionomad_syren/, also see - Artful Media: The Sonic Nomadic: Exploring Mobile Surround-Sound Interactions published in the IEEE Multi Media Volume 16 Issue 2.

architectural metaphor of the Ars Memoriae into the cartographic space of digital maps, (themselves functioning as a representation of the physical location of each project). The software delivered a Sonic-Landscape, by assigning sound files, trajectories, and other acoustic properties and parameters to multiple locations within this virtual domain ready to be triggered by the GPS position and trajectory of a mobile listener.

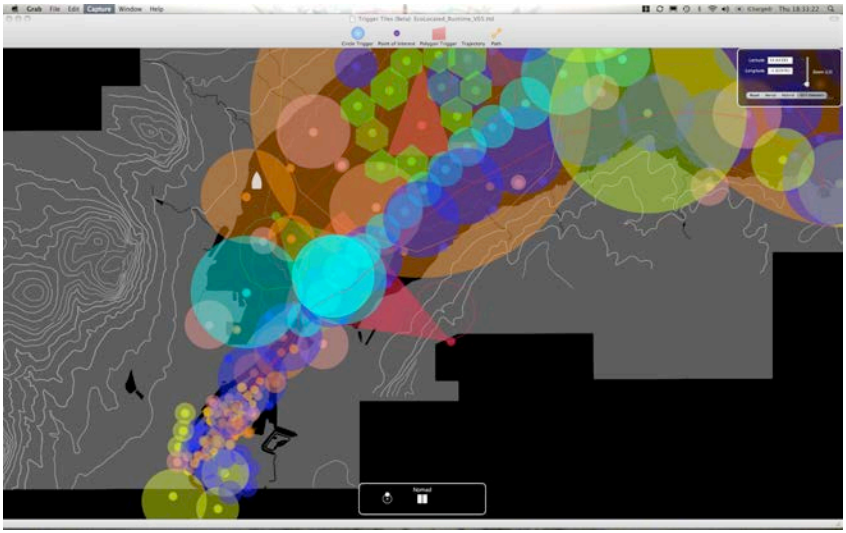

Figure 3. AudioNomad screenshot of spatial audio editing screen for the Ecolocated project - Belfast Lough, 2009.

Whereas the classical rhetorician would recall a walk through an imaginary architecture in order to retrieve the sequential elements of a speech, the participants in a *SonicLandscapes* or *AudioNomad* project could literally walk in a real environment. The walkers position and orientation data would drive a multi-channel soundscape, which software would delivered to them via surround-enabled headphones. In this manner the soundscape would appear to emanate from the surrounding landscape and its objects. Users experienced an uncanny parallel audio world in which (virtual)

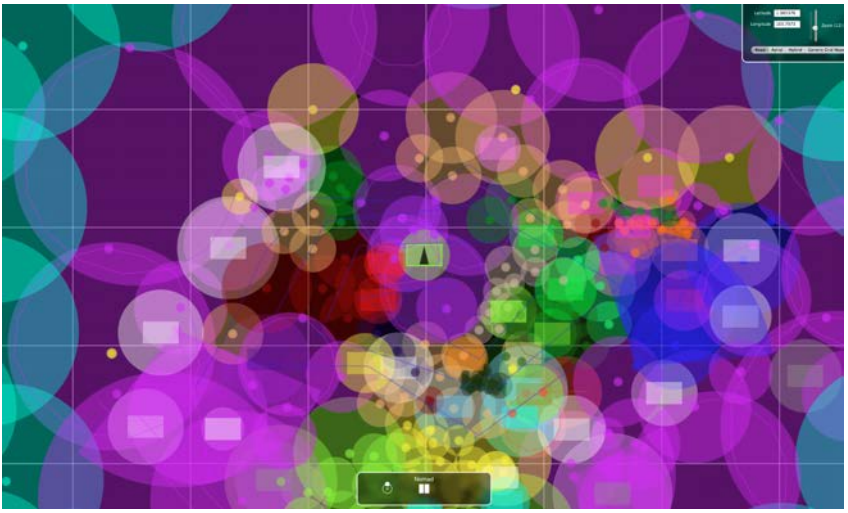

Figure 4. AudioNomad screenshot of spatial audio editing screen for the Run Silent Run Deep project, National Museum of Singapore, 2008.

aural memories of particular sites were superimposed over contemporary audio reality.

Alternative developments departed from the basic mode of walking as the interactive soundscape was deployed to massive surround-speaker arrays mounted within large mobile platforms, as in the case of the ship-mounted works Syren[13] for ISEA2004 in the Baltic Sea and Syren for Port Jackson[14] 2006 on Sydney Harbour in conjunction with the Museum of Contemporary Art.

Here the listener still moved through the landscape/seascape but as one transported both literally and metaphorically, on a ship. In a

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[13] http://locative.articule.net/audio-nomad/

[14] http://www.sonicobjects.com/index.php/projects/more/syren_for_port_jackson/

subsequent development for museum exhibitions, the system was configured to be driven from a console mounted interactive map allowing the user to navigate a virtual mapped space and simultaneously drive simultaneously drive a powerful, immersive, surround speaker array.[15]

Back to Earth.

Ironically the creative foundation for these sophisticated augmented audio reality works was always firmly rooted on the ground. For each project the audio content was painstakingly collected during hundreds of hours of field recording, amassing environmental and urban soundscapes as well as vocal and musical material. This is where the location of 'location-sensitive' really comes from — a gradually developed intimate knowledge formed by a process of deep listening to an environment, not to mention equally lengthy durations spent in the studio editing and designing the soundscapes..

Boots on the Ground.

At the beginning of the current Where Science meets Art research project[16] a simple question was posed — How does one get under the skin of a place, of an environment?

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[15] Run Silent Run Deep http://www.isea2008singapore.org/exhibitions/air_run.html and EcoLocated http://www.sonicobjects.com/index.php/projects/more/ecolocated/

[16] *Where Science meets Art* - a four year research project in collaboration with Macquarie University (Sydney), The Australia Council for the Arts and the Bundanon Trust; to develop a polyvalent approach to the physical, cultural and historical landscape of the Shoalhaven River at The Bundanon Trust.

The Bundanon Trust is located in rural New South Wales on Australia's east coast. Its landscape comprises some three thousand acres, with many kilometres of river frontage and a topology that ranges from open pastureland, wooded ridges, rain forest gullies to human occupation sites. It is complex in the physical, biological and historical domains — so how to get to know the terrain in all of its many forms?

One of the, perhaps simple minded, solutions has been to invite 'old hands' to take a walk. Each person was invited to decide on a route that contained points of interest linked to a thematic — some were focussed on history, others on botany, some simply on magnificent views of the landscape, but all were intensely personal and all were different.

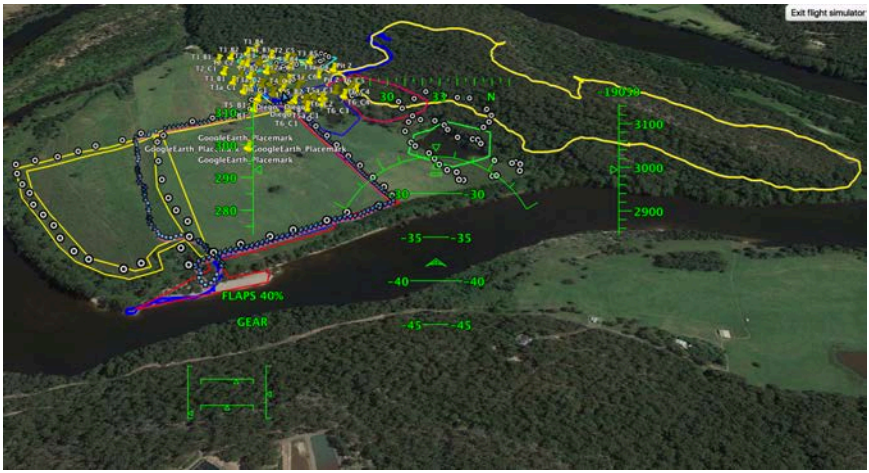

Figure 5. Screenshot of soil data sample locations at the Bundanon Trust also showing walking routes — the elements found at data points are sonified and visualised for mobile devices, 2016~18.

The residue of these walks; photographs, audio recordings and GPS tracks form a mosaic of personal knowledges, memories triggered by and situated in landscape. This process combined

serendipity with very specific and nuanced information forming an idiosyncratic ecology of memories, thriving in unique landscape niches, like hitherto unidentified species! It fleshed out the bones of the landscape and rattled the skeletons of history. The gradual accumulation of these individual psycho-geographies to become an archive of memories and stories that reveal the Bundanon landscape builds upon the western tradition in which knowledge is inscribed, circulates and laid in store.

However these personal journeys are but trivial fragments when compared to the complex, ancient networks of indigenous song and ritual which maintained the law and created the landscape. Traditional Song-lines situate cultural memories, knowledge and social organisation as shared narratives entwined across the landscape, or indeed which perform the landscape.

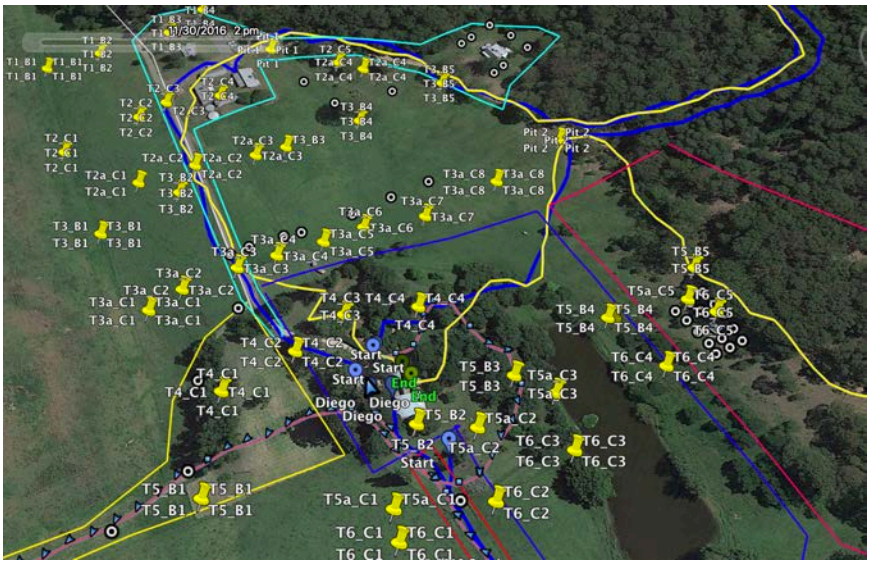

Figure 6. Screenshot of soil data sample locations at the Bundanon Trust also showing walking routes — the elements found at data points are sonified and visualised for mobile devices, 2016~18.

It is an unreconciled tragedy that European settler societies have been and still are, all but blind to the intangible cultures of First Nation Peoples, especially in regard to their sophisticated concepts of singing up the country — an art that perhaps many cultures, including, the ancient Europeans, may once have practiced but long ago lost.

European footsteps on this ancient land carried flags, symbols of possession in a land deemed Terra nullius. In short order flags were followed by the rational instruments of cartography, setting out a triangulation of ownership, of control and exclusion, enshrining paper boundaries that contained scant knowledge, but abundant information.

For millennia it was otherwise, the land owned it's people. People who had watched as the glacial climate transmuted the oceans, the landscape and every element of the ecology. They were both spectators and participants in cataclysmic acts of creation and transformation. The land-bridges between Australia and the rest of Asia came and went, the Mega-fauna died out and forest-cover expanded or shrank according to the availability of water in the cool arid environment. People looked and remembered, the knowledge woven into the fabric of ceremony and song embedded in the landscape so that none of this was forgotten — an intangible cosmos too subtle for Europeans to fathom.

Has much really changed since first-contact? Even as the colonisers dispossessed the traditional owners of their land and their culture, the colonisers themselves became deracinated, by casting aside lineages, ancestry and cultural bonds with place, they became alienated in the very land they sought to possess.

In exploring the pervasive conditions of suburbanisation and automobilisation Rebecca Solnit focusses on the increasing disembodiment of everyday life and a concomitant sense of isolation.

Many people nowadays live in a series of interiors...disconnected from each other. On foot everything stays connected, for while walking one occupies the spaces between those interiors in the same way one occupies those interiors. One lives in the whole world rather than in interiors built up against it.[17]

By trading being for having, by the crude attachment to material culture, to speed and to a belief in incessant growth we are effectively debarred from contemplating alternative ways to understand the natural world and ways to form new relationships with it. — save perhaps for a final and certainly unfashionable thought.

Consider the options: The automobilised individual is no longer a participant in the commons; is sundered from the public vis a vis; physical movement is restricted to minor foot and hand movements, amplified into a violence of speed. The eyes gaze through a screen as a panorama slides by too fast to be taken in by indifferent eyes.

The digitised individual: An even more sedentary existence, gazing, unblinking into the shallows of a screen — into a world one photon deep populated by ersatz relationships offering only the shadowy promise of a Digital Loneliness.

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17 Rebecca Solnit, *ibid.*

An alternative is to dream for a moment — pull on Thoreau's old leather boots and step through the door, alone or perhaps in company with Nietzsche, to walk an unknown path — walking, leaping, climbing, dancing preferably on lonely mountains. To walk and imagine a world unconstrained and unprescribed — to fall into an uncertain future but one full of potential.

And to misquote Timothy Leary's mantra:[18]

Turn off, Tune out and Walk on……

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[18] Turn on, Tune in and Drop out - Timothy Leary addressing the crowd at the *Human-be-in*, Golden Gate Park, San Fransisco 1967.

Supereste ut Pugnatis (Pugnatis) ut Supereste

My French raincoat (a membrane of sorts) bears the legend Impermeable, I can assureyou it is not, like most membranes worth their salt it is semipermeable! We are defined, structured and bounded by membranes, selective barriers that function at a molecular level within our bodies and operate at the macro scale as socio-political boundaries.

Supereste ut Pugnatis (Pugnatis) ut Supereste
Photo Ian Hobbs.

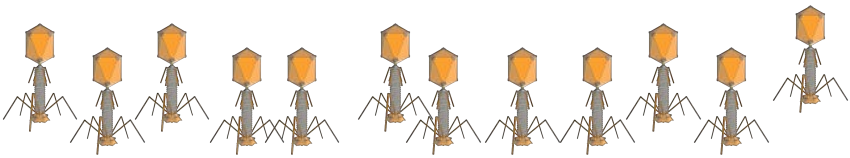
Membranes are selectively permeable structures, controlling the exchange of ions inour synapses, transforming photons into carbohydrates in plants, the meniscus of theworld ocean, trading gasses with the atmosphere and regulating our climate. Manifest as an architecture of power the membrane is the portcullis and

drawbridge regulating access to a Norman Castle. A filter of economic privilege to the VIP loungeand the algorithm that structures the flow of surveillance information at airport security.

It is the tissue of language describing the legal pressure valve that transported the poorand disaffected to Australia in a risible attempt to rid England of its criminal class, and the tongue twisters that policed the White Australia policy.

It is easier for a camel to pass through the eye of the needle, than for a rich man to enter into the kingdom of heaven.[1]

Supereste ut Pugnatis (Pugnatis) ut Supereste[2] drifts in these interstitial spaces between biology, politics, culture and history constantly recalling the functional significance of themembrane as border, as a cultural and linguistic filter, as a generator of difference.

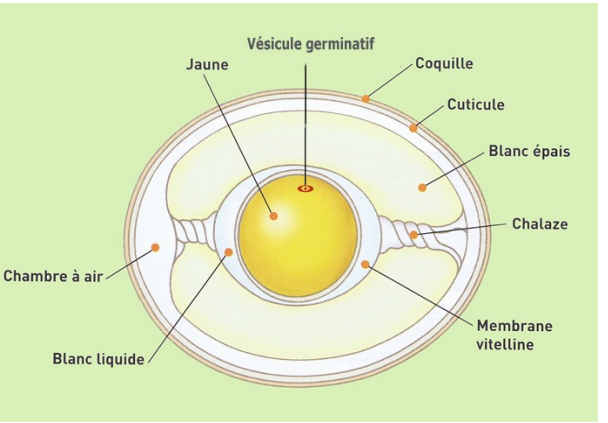


SPPS is offered as an omnisexual bacterium ingesting histories and narratives that associate through a labyrinth of metaphorical bonds, some feint and tenuous, others powerful and robust. A sonic sculpture illuminated by canary yellow — the yellow of eggyolk, the pallor of yellow fever, the threatening tide of the yellow races, the warning yellow flag of quarantine and contagion and more prosaically the globalised yellow of international art crates.[3] Take a journey down any of these wormholes to discover a centripetal force that pulls back to the centre of this metaphorical nexus. Here we encounter morphological references to antique Chinese gunpowder rocketry [4] carrying payloads of poisonous and infected

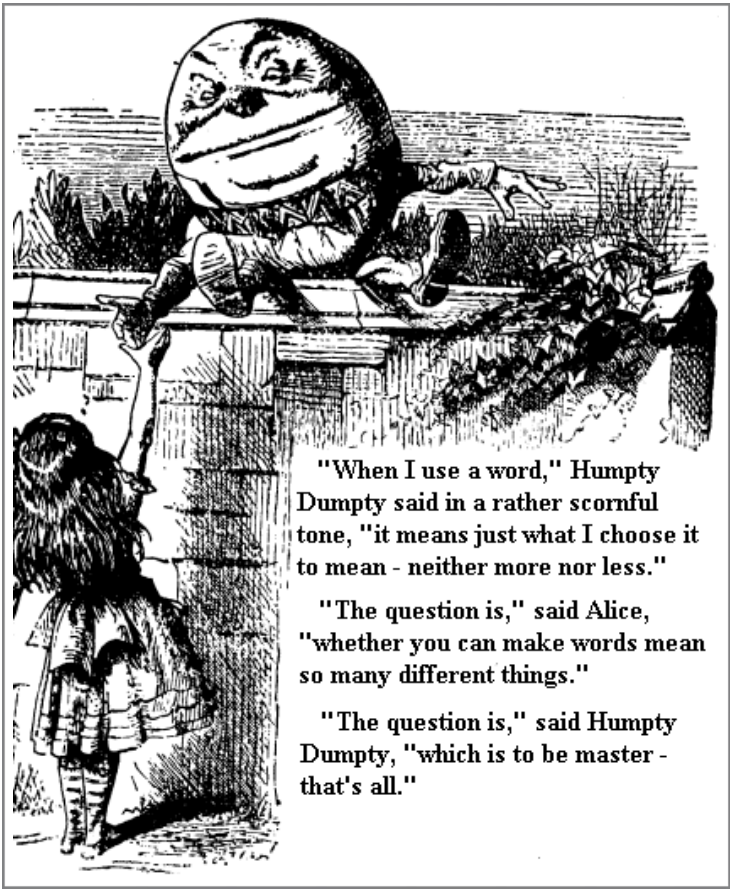
material, hybridised with the physical structure of the Bacteriophage[5] a semi-living viral entity that pierces the membrane of ahost Bacteria, injecting its DNA and commandeering the genetic machinery of the Bacteria to replicate itself ~ all this done without an entry permit!

My hand has found like a nest the wealth of the peoples; and as one gathers eggs that havebeen forsaken, so I have gathered all the earth; and there was none that moved a wing or opened the mouth or chirped.
Isaiah 10:14

The payload of these mutant rocket forms, glass cylinders containing infected eggs pay an ironic homage that reprises the origins of modern bio-warfare research, where chicken eggs were the bio-reactor of choice at the Chemical Defence Establishment at Porton Down[6] near Salisbury UK (the motto of which, Supereste ut Pugnatis, this work is named after) as well as the Russian weaponised Smallpox facility at Zagorsk.[7]



Humpty Dumpty sat on a wall
Humpty Dumpty had a great fall
All the Kings horses
And all the Kings men
Couldn't put Humpty Dumpty
Together again.



A Comment on Power From Alice in Wonderland!

And so to the slippery membrane of language, a tissue of words that wrap us in cultureand identity and one that attempted to render Australia as white as egg albumen, protecting these shores from the influx of Chinese migration, a migration according to the xenophobes, as yellow as egg yolk.

NOTE.

This Certificate will not be valid after the 24th day of May 1920. If the holder desires to prolong his absence from the Commonwealth, application addressed to the Collector of Customs Darwin N.T. may be made before that date to have the period extended. If granted, a fee of £1 will be charged.

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DESCRIPTION.

Nationality Chinese (Aust Born) Birthplace Northern Territory

Age 16 Complexion Sallow

Height 5'05" Hair Black

Build Slight Eyes Brown

Particular marks Scar below left ear

(For impression of hand, see back of this document.)

PHOTOGRAPHS.

Date of departure 24/7/20 Port of Embarkation Darwin

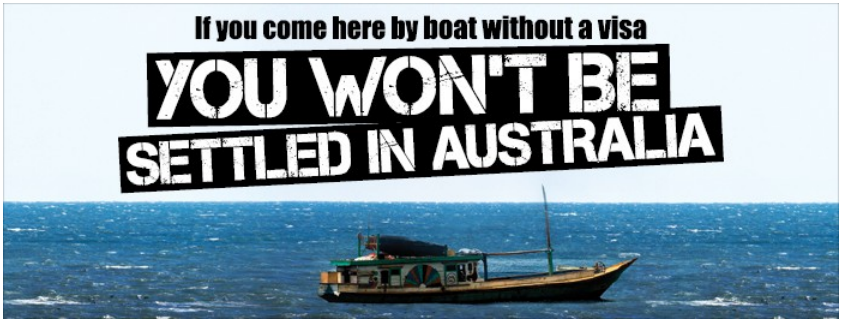
Ship Kanimbla Destination China

Date of return 29:11:25 Ship S.S. "Awah Ping"

Port Thursday Island

4.214/3.17.—O.2008.

Customs Officers.



A message was sent out to the world that coloured people could not settle inAustralia.[8]

心灵的控制首先在于物理的掌握。这是常人难以置信的简易。真正的掌握来自于宁静，从意图的思考到最终的言行。宁静是最高尚的美德。一位男士或女士的静坐是多么少见。

That mental control depends, first of all, on physical , mastery is so obvious that few believe it. Real control begins from stillness, from deliberation of manner, and eventually speech and action. Stillness remans the rarest of virtues. How seldom does one see a man or a woman sitting still?

These words are an example from hundreds of pages of Dictation Tests that operated in all Australian ports of entry from 1901 until 1958 with the primary function of excluding undesirables (specifically Asians) from migrating. This policy was coupled with the general and popular understanding that the indigenous population would be ‘bred-out’, lightened and whitened until their genetic traces disappeared. With an ominously contemporary resonance.

The membrane is after all a skin; a skin of colour; a skin of language and culture, a flexible container designed to keep what is of value within and what is perceived as a contaminant without — its permeability determines the nature, rate of change and adaptation, the type and efficiency of cultural metabolism. To conclude another Dictation Test passage for good measure, its jingoism recalling John Howard's obsession with Cricket trivia as a criterion for citizenship. Perhaps you might like to take the test?

The swagman wrapped his gnarled and desiccated digits round his minuscule ukulele and with prodigious and egregious deficiency of musicology essayed a resounding, cacophonous rendition of 'Waltzing Matilda' that caused a phobic frog to hurl itself suicidally into a brackish billabong.

Maybe that is Impermeable!

Supereste ut Pugnatis (Pugnatis) ut Supereste (detail)
Photo Ian Hobbs.

Notes

[1] The New Testament, Matthew 19:24, The Eye of the Needle was a small gate in the walls of Jerusalem.

[2] Supereste ut Pugnatis (Fight to Live) the motto of the Chemical Defense Establishment.

[3] In Ancient Chinese yellow was considered the colour of joy, glory and wisdom. However from the 3rd millennium B.C. yellow was associated with power and domination. In contemporary China it is associated with pornography as it is withprostitution in Russia.

[4] The Fire Drake Manual 14th Century Chinese military treatise edited by Jiao Yu and Lui Ji details the evolution ofrocketry circa C10th.

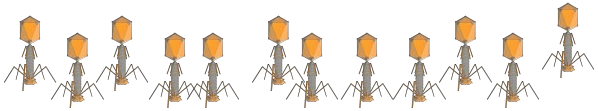
[5] A Virus that infects and then replicates within a Bacterium.

[6] In 1940 biological warfare work began at Porton Down, UK in a highly secret autonomous group called BiologyDepartment Porton now known as the Chemical and Biological Defense Establishment.

[7] The first smallpox weapons factory in the Soviet Union was established in 1947 in the city of Zagorsk, close to Moscow.It was produced by injecting small amounts of the virus into chicken eggs. An especially virulent strain (codenamed India-1967 or India-1) was brought from India in 1967 by a special Soviet medical team that was sent to India to help to eradicate the virus.The pathogen was manufactured and stockpiled in large

quantities throughout the 1970s and 1980s. An outbreak of weaponised smallpox occurred during its testing in the 1970s. General Prof. Peter Burgasov, former Chief Sanitary Physician of the Soviet Army, and a senior researcher within the program of biological weapons described this incident: "On Vozrozhdeniya Island in the Aral Sea, the strongest recipes of smallpox were tested. Suddenly I was informed that there were mysterious cases of mortalities in Aralsk. A research ship of the Aral fleet came 15 km away from the island (it was forbidden to come any closer than 40 km).The lab technician of this ship took samples of plankton twice a day from the top deck.The smallpox formulation— 400 gr. of which was exploded on the island—"got her" and she became infected. After returning home to Aralsk, she infected several people including children. All of them died. I suspected the reason for this and called the Chief of General Staff of Ministry of Defence and requested to forbid the stopof the Alma-Ata to Moscow train in Aralsk. As a result, the epidemic around the country was prevented. I called Andropov, who at that time was Chief of KGB, and informed him of the exclusive recipe of smallpox obtained on Vozrozhdeniya Island."A production line to manufacture smallpox on an industrial scale was launched in the VectorInstitute in 1990.

[8] Jupp, J. (2002) From White Australia to Woomera. Cambridge: Cambridge University Press.



Prometheus Bound; Art, Science, Creativity and the Imagination.

Prometheus Bound will attempt to examine the relationship between the creative arts and more conventional concepts of research and development held within industry and academia.

The approach will be from a contemporary position, but informed by a historical perspective. What is interesting is the close historical relationship of ‘creativity’ with research and development. The current attempts to once again meld these together seem to reiterate the many historical instances of scientific endeavour manifesting itself as exhibition and (frankly) showmanship.

Edison, Tesla, Franklin and Grey were all electrical experimenters prone to spectacular public demonstrations and performances. These researchers inhabited a world in which the boundaries between the arts and the sciences were less defined. Casting even further back in time, the work of anatomy was far more an artistic imperative than a medical or scientific concern until the seventeenth century.

This essay will attempt to tease out the possible mutual benefits of cross-sectorial creative research. As a counterpoint, it will also attempt to differentiate the potentially divergent research motivations and long-term goals defined by collaborating parties.

Why a resurgence of interest now?
Why the interest in creativity and sciences? Poetics and Techniks are once again being placed in a courtship. This belies our conventional wisdom, which comfortably isolates creativity within

the realm of the arts and supposes the intelligence that circulates within the sciences is fundamentally different (and by that token presumably exclude logic et al from the arts).

Who has the Monopoly on Imagination?
In order to avoid the pitfalls associated with questions concerning the ‘ownership rights’ to creativity it might be useful to adopt a clear position from the outset.

Whilst distribution may on occasion appear unevenly spread, creativity and imagination are ubiquitous, as are ingenuity and wit, they are the commonwealth that drive the cultures of both art and science.

"Science and art are two different approaches that complement each other, and (both) are needed to produce a balanced vision of the world. They also have much in common. Science is very much directed by aesthetics and beauty — notions of what fits, economy of means, and ideas of form and order. The same issues surface, in different ways, in art."

"Science boasts of being objective and value free, while art is concerned with value and human response.”

"These people (Artists) think deeply about issues that also interest scientists but the fact that they are not scientists is what is important, because they bring a different perspective."

Physicist and science writer David Peat commenting on Art/ Science collaborations.

Has it always been thus?
Is there in reality a distinct bifurcation in the minds and methodologies that separate Artists from research scientists? If so why? And how is it manifest? If not, why do we persist in supporting artificial boundaries?

Whilst the arts and sciences may both lay equal claim to creativity what differs fundamentally are the historical frameworks within which creativity and intelligence have been trained, applied and focussed. It is here that the differences and barriers are formed and are, in fact fostered by educational systems, perpetrating a mutual distrust founded upon a lack of familiarity or empathy.

Some interesting insights can be gained by considering the historical aspect of research activity in both the arts and sciences. Contemporary scientific method, characterised as experimental, impartial, rigorous, repeatable and ruled by logic is as such, a relatively recent phenomena, arising in an ad hoc manner from an amalgam of individual experimenters, enthusiastic amateurs, learned societies and more often than not disseminated by public demonstration and spectacle in a pre-digital form of ‘infotainment’.

Ironically the parallel research activities within the visual arts can be argued to have occurred at an earlier date, delivering viable and complex tools for communication and visualisation (not to mention expression). Clear examples are to be found in perspectival systems (a visual system that facilitated the development of both architectural and industrial mechanisms and structures — being partly responsible for the early ascendancy of industrial in the Occident rather than the Orient where perspective was not generally employed).

Again, within the study and representation of anatomy, this was (and to a minor extent still is) the preserve of artists. Leonardo Da Vinci successfully made wax injection moulds of the brain, and Michelangelo sculpted several muscle studies. Until the seventeenth century, anatomy was the work of artists rather than anatomists and was the basis for teaching art rather than medicine. When the two streams converged it was a short step into public entertainment and the popular waxworks, which in a manner served to maintain a popular cultural interest in scientific endeavour. This admixture of arts and science is amply demonstrated by the current touring exhibition 'KorpenWelt' featuring plastinated (real) corpses employing a system perfected by a German scientist who is at pains to model himself upon the late Joseph Beuys!

It is in the contemporary life sciences that the art of showmanship converges from both artistic and scientific fields of endeavour. Two critters come to mind, 'Alba' the rabbit genetically modified by French scientists, to 'glow' with fluorescent green genetic material (extracted from Jellyfish) under the direction of Eduardo Kac, and the infamous lab mouse sporting a human ear along its spine, created by Dr Vecanti. Both might be regarded more as photo-opportunities (or photoshop opportunities in Alba's case) than either good art or good science. Both have been strenuously pushed as image identities, their life as icons far outstripping their organic existence, Alba never escaped the Paris lab whilst Dr Vecanti's creation unravelled shortly after the photo-shoot, establishing another similarity between art and science — spin!

The Watershed in the Industrialisation of Creativity.

Genius is one-percent inspiration and
Ninety-nine-percent perspiration.
Edison.

The late nineteenth century marked a watershed in invention. 'R&D' as we understand it today exists primarily within the corporate and state sectors, highly specialised, rigidly systematised, industrially organised – Bell Labs, Xerox Parc, MIT, Microsoft even! These monolithic research machines are so commonplace that we tend to overlook their origins.

The Invention of Invention.
It has been remarked that Edison's greatest invention was the research organisation — but in reality Edison's stroke of genius was not simply to establish his 'Invention Factory' at Menlo Park New Jersey in 1876 (effectively the world's first research laboratory) but to rapidly couple this creative milieu with the industrial capacity of the factory. Two other elements were instrumental in Edison's phenomenal success.

He possessed an imaginative understanding of the marketplace and sought not only to create entirely new industries (Electric Lighting, Audio Recording and Cinema to name but a few) but effectively planned to control these emerging economies via strict patent controls, which naturally were designed to put Edison's manufactories in virtual monopoly situations.

Last but certainly not least, was Edison's keen appreciation of the press. As a young man he had worked as a telegraph operator sending Associated Press wire reports and had spent a good deal of

time in Newspaper offices. This experience provided Edison with a keen understanding of rapportage and public relations in general.

He used his insider knowledge to good effect when he dramatically announced to a group of New York reporters on September 15th 1878 that: - Firstly, he would within six weeks, solve the seemingly impossible problem of inventing a practical electric light bulb and secondly he planned to create an entirely new industry to provide public electrical power, using hydro power stations at Niagara Falls, to both illuminate America and change the World!

When I'm through, only the rich will be able to afford candles.

Such was his reputation that the following day stocks in Gas Lighting companies plummeted and JP Morgan scrambled to invest in Edison's new electric venture!

Science, Spectacle and Showmanship – a Rogues Gallery.

One for the Money, Two for the Show….

Leonardo Da Vinci.
It is well documented that Leonardo Da Vinci was as adept at turning his hand to producing designs for siege engines as he was at making anatomical studies and in the artisanal world of the Renaissance a commission for artwork and one for military hardware probably came from the same purse (plus ça change…).

Ironically, the economics of art, via the mechanisms of patronage and commissioning would seem to be well established long before science was systematically supported financially.

A brief examination of the economically necessary relationship between scientific research and public spectacle may serve to counter-balance rigid contemporary views that assume exhibition and spectacle are the sole province of art, reserving a more sober platform for science.

Jacques de Vaucanson.
Dubbed the 'New Prometheus' by both Voltaire and La Mettrie for his exquisite automata, (notably the Flute Player capable of virtuoso performances and a mechanical duck capable of eating and shitting) Vaucanson had a keen sense of high-society spectacle. Whilst these cybernetic marvels became philosophic icons of the Enlightenment and indeed stimulated serious debate for the hundred years that they were in circulation; they did so in style. The Flute player was first exhibited at an elegant showroom in central Paris in 1738 – the asking price for entry (three Livres) was equivalent to a worker's wage for a week. It was only after turning a substantial daily profit (seventy-five visits per day) that the French Academy of Sciences nodded approvingly, and the automata took their place in the first edition of Diderot's 'Encycopédie' (under Anderoïde).

Wolfgang von Kempelen.
Another world famous android example, which toured for decades with various owners, was the 'Automaton Chess Player', constructed in 1769 by Wolfgang von Kempelen.

This mechanism caused both a sensation and controversy for many years, a machine that beat many champion players in its time, 'The Turk' as it was commonly known, trounced Napoleon and refused to continue playing Catherine the Great when she resorted to cheating!

The debate about the Turk's intelligence was finally revealed in America – the automaton was a fraud concealing a human chess master, but which also contained some masterful mechanical engineering!

Mary Shelly.
"It was a dreary night of November, that I beheld the accomplishment of my toils. With an anxiety that almost amounted to agony, I collected the instruments of life around me, that I might infuse a spark of being into the lifeless thing that lay at my feet, by the glimmer of the half extinguished light, I saw the dull yellow eye of the creature open; it breathed hard, and a convulsive motion agitated its limbs."

Mary Shelly, Frankenstein, 1818.

Passing from mechanical life to the nexus between the human body and early electrical research, we encounter a consistent theme that moves from science into the realm of art and fiction and back again.

Ever since Mary Shelly's precocious novel (she was only 19 at the time of writing) the metaphorical relationship between life and electricity has become standard fare, especially in cinema. Filmic science-fiction narratives further associate the body as the subject of technology and volunteer the flesh to a process of 'mineralisation' and hybridisation.

Electricity was a fundamental Enlightenment research topic and again one played out in a voguish public arena. The list of experimenters who indulged in public and parlour spectaculars is too lengthy to detail. The fruit of the early experiments of Galvani,

Stephen Gray, Nollert and Benjamin Franklin eventually made their way into popular consciousness.

Duchenne de Boulogne.
The first attempt to systematically represent the physiological response to electricity was pioneered by Duchenne de Boulogne who made lengthy studies of the relationship linking muscular contraction (principally facial) and expressed emotion; a process, he termed 'Faradism,' in which electrical stimuli were applied directly to the skin.

Duchenne practiced this technique on both the bodies of his patients and upon still-malleable cadavers. It is noteworthy that he established a comprehensive photographic archive of his Electro-Physiologie Photographique in order to isolate and classify muscular reactions.

Fritz Laing.
'Metropolis' provides the template, sadly infrequently matched, for the transformative relationship between body and mechanism; mediated by electricity. The familiar setting, part medical, part research-laboratory, the subject, frequently restrained, the scientist, usually demented (or perhaps simply misunderstood)!

The switch is thrown and the body is bathed in an electrical aura whilst the soundtrack delivers high voltage arcs.

Stelarc.
"Bodies are both Zombies and Cyborgs. We have never had a mind of our own and we often perform involuntarily — conditioned and externally prompted. Ever since we evolved

as hominids and developed bipedal locomotion, two limbs became manipulators and we constructed artefacts, instruments and machines. In other words, we have always been coupled with technology. We have always been prosthetic bodies. We fear the involuntary and we are becoming increasingly automated and extended. But we fear what we have always been and what we have already become - Zombies and Cyborgs".

Stelarc

Stephen Gray.

The juxtaposition of Stelarc's earlier, fakir-like, body suspension pieces with his later electrode manipulated body-works evoke or perhaps replay the pioneering electrical research work of Stephen Gray. In London, on April the 8th 1730, Gray mounted a public demonstration of the electrical properties of the human body. He suspended an eight year old boy from silken threads, induced a negative charge in his body by applying a positively charged glass rod to his naked feet, with the result that the boys face was 'gilded' with flakes of brass leaf, attracted from a receptacle placed below him.

Georg Mathias Bose.

A few years later, the 'Venus Electrificata' (or Electric Kiss) had been developed by Georg Mathias Bose as a popular salon entertainment, the willing but unsuspecting guest receiving a startlingly powerful bisou.

SimOne.

Still at the point of fiction, but not beyond irony, the recent Hollywood production 'SimOne' represents a human actress playing her digital double. In this narrative, it is simply the packaging of the animating electricity that has changed. The

crackling high voltage arcs of earlier science fiction are here transformed into a flow of obedient electrons doing binary duties. In cinema the balance between the real and the virtual is soon to be challenged — in much the same manner as the economics of virtual gaming has recently exceeded global movie revenues.

Edison and Tesla.
For the pièce de résistance, there is a somewhat grisly corollary to Edison's desire to link technology to the life beyond (the original purpose of the phonograph was to store the voices of departed relatives). Edison might be best characterised as a pragmatist, an energetic entrepreneur, but not a philosopher. In effect he relied upon the remarkable intellect of Nicolai Tesla to solve many of the technological and mathematical problems that were out of his scope.

Tesla was, by contrast, theoretically brilliant but naive in his patent related business dealings (especially those with Edison)! The two eventually engaged in a gruesome technological duel to establish the format of electrical power generation and supply, as either direct current or alternating current. Edison's vested interests lay with DC, whilst, Tesla who was the inventor of AC had sold his AC patent to Westinghouse – Edison's principal business rival.

A 'Battle of the Currents' ensued guided by an Edison engineer Harold Brown. The Edison Laboratory attempted to convince both the scientific community and the general public of the dangers of Tesla's AC power, by staging a series of public demonstrations in which Edison hooked up large mammals (including horses and an elephant) to AC generators and literally fried them to a cinder.

Tesla (now working for Westinghouse) responded with a series of public demonstrations designed to suggest the safety of AC power. Tesla would touch one hand to a large AC generator, whilst a large gas filled globe would immediately illuminate in his other hand. Whilst these displays were spectacular, they were also misleading the uninformed public, as they operated only via static electric effects.

The eventual outcome of this latter-day inquisition was ironic. As we know alternating current was accepted as the most efficient form of power, but it was partly through the machinations of Edison that the US government adopted the Electric chair as a 'modern and efficient' form of capital punishment (Edison's Lawyer even suggested the 'Chair' be named 'The Westinghouse').

The New York State "Electrical Execution Law" was passed in 1885 with the first execution taking place in 1890 – by all accounts a horribly botched job, roundly denounced in the national and international press!

The New York financiers, JP Morgan conceded that AC was the power source of the future and forced a merger between Edison General Electric (renamed as General Electric) and Westinghouse who proceeded to build the world's first hydroelectric plant at Niagara Falls using Tesla's patent. Edison refused to enter the General Electric building for the next thirty years and turned to other things!

Science is more controversial than art can ever be.
Cornelia Parker, Artist.

The intention of such a kaleidoscopic romp is to dislodge the stubborn presumptions that most of us hold regarding the boundaries and behaviours of scientists, technologists and artists. Hopefully, it is apparent, that research and creativity can combine in a synergy that is unruly and provocative and above all unpredictable.

The Present and the Renaissance of the Renaissance.
In the contemporary educational context there is a burgeoning interest in developing relationships, motivations and skills that move freely between the established disciplines, we increasingly value the ability to form connective networks — but why are we so interested in these developments now?

It is difficult to imagine that we are collectively entertaining a nostalgic dream of the polymath. Surely, we all acknowledge that the world is too vast and too complex for a genuine resurgence of omniscience. However, if these developments are regarded as symptomatic, an object lesson illuminating our current situation, it may be possible to acknowledge that our strategies for science (and by implication the arts) are much too narrowly defined — restrictive to the point of losing touch with larger contexts as a consequence, suffering intellectually, ethically (and probably economically).

It seems that some institutions are taking this all quite literally. It is reported that the prestigious Rhode Island School of Design is in the process of establishing a ‘Renaissance’ department; call it a wishful (or wilful) spin on a new-media arts unit but this title illuminates current desires vis a vis the convergence of tools and technologies but can the digital realm become the Procrustes bed of all human endeavour?

Babies and Bathwater.
The first iteration of 'interdisciplinary' pedagogy within the Australian tertiary art education sector might be termed problematic and one all too frequently motivated by economic rationalism rather than a lucid understanding of research culture. Even when motivated by a genuine desire to dissolve the barriers between discipline silos, the net effect was often to literally eradicate the intellectual and physical boundaries of the studio discipline per se (a practical method for emptying problem studio areas from the 'too-hard' basket)!

The result — a 'deskilling' process, fuelled by a simple (oxymoronic) oversight that true interdisciplinarity ipso facto relies upon well established and sophisticated discipline knowledge. The real trick is how to overcome the inertia that clings to virtuosity (and/or academic fiefdoms) and to negotiate dynamic relationships capable of hybridising knowledge and practice — in often unpredicted (and unpredictable) ways.

The importance of being different.
As suggested above, the power of collaboration is generated by the creative confluence of difference, rather than by establishing a 'lowest common denominator' of similarity.

A second vital condition is that each of the collaborating parties is able and willing to recognise and value mutual difference; and resist assimilating or naturalising it within their own organisation or discipline. This is especially pertinent when artists are engaged within large corporate or academic research organisations.

It is frequently noted that successful (productive) research situations are difficult to characterise. The most common receipt

for success in ‘Blue-Sky’ research combines the sharpest specialist minds, very loose, or self-structuring parameters (i.e., do what you want) and a convivial environment. These conditions might also easily describe a good art school — sadly, the word milieu has been little understood as a key to creative research, forgotten under an avalanche of quality-assurance reports!

Edison’s success was largely due to his ability to establish a creative research and development milieu at the Menlo Park ‘Invention Factory’ which placed a strong emphasis on open and shared work methods with social and recreational activities creating a strong ambience of collectivity and loyalty.

Catch 22.
From the age of twelve, Edison gradually lost his hearing. By the time he had established the Menlo Park Laboratory he was hard of hearing but resisted several suggestions that he invent a hearing aid. His rationale was that the aural isolation he experienced helped him to be a better creator and a better inventor.

Ironically, Edison’s creation of the (systematised) research organisation was fundamentally antithetical to Edison’s personal working method, which was essentially non–theoretical. A talented and intuitive ‘Technologist’ but certainly not a theoretically trained scientist or mathematician, his one time collaborator and subsequent rival Tesla would ridicule Edison thus:

"If Edison had a needle to find in a haystack, he would proceed with the diligence of a bee to examine straw after straw until he found the object of his search”.
Individual reverie is the key issue, a fulcrum — and one that is emphasised by Paul de Marinis, a prominent sound artist and

Stanford professor. De Marinis has a practice that is deeply influenced by and concerned with the archaeology of technology and mirrors the pre-industrial reverie available to the creative individual before the advent of the ‘Fordist’ research techniques pioneered by Edison.

“What's interesting to me in my own work is the degree to which, within my research process, I can maintain my thoughts observations and perceptions in a unified pre-linguistic blur for a sufficient period to come up with solutions to problems posed by works, that function inter-relatedly and more or less equally in the areas of object, content, history and metaphor.

My experience in collective and collaborative works (many of which have proceeded with synergy & satisfaction) is that many issues, thoughts, curiosities, management strategies, skill sets, and unspoken but pre-visualised outcomes, become articulated early in the process in ways that tend to linearise the definition of the project. In other words, the participants expound, contradict, haggle, persuade and clarify common purposes in ways that tend to put limits on the collective imagination.

Exceptions to this are systems that use oblique communications or that explicitly decouple the efforts of the participants (like the music for Cunningham "events") that in ways dissuade communication and clarification but nonetheless encourage simultaneous action.Thus, by working alone I can sustain a state of wordless thought for months on end, often with favourable results.” Paul De Marinis (private correspondence).

This is very close to the traditional function of the artist’s studio — a place where thoughts are developed in a preverbal dialogue with

a physical process. A dynamic evolution, without script or prescribed outcomes that is evaluated in a variety of often, subjective registers.

As such, a mysterious process, which when the planets align can produce remarkable results, it is also still linked in a subterranean manner to the process of invention in scientific research. As De Marinis hints, it is vital to retain and nurture this powerful internal creative reverie, whilst simultaneously negotiating effective methods for entering into collaborative situations.

Technotopia.
It may be a very tall order for tertiary Institution to cultivate, in its graduates, the combination of a robust and independent creative practice with the ability to collaborate and move effectively between disciplines. As from a cursory glance, the two modes appear to be mutually exclusive.

Unpacking the differences and conjunctions that exist between creativity and research, especially between, creative research and collaborative research, we may discover that there is little or no real opportunity for an artist to undertake ‘research’ (defined in a conventional scientific sense) in a solo mode. Even were they to persist the individual must inevitably form connections with institutional resources and knowledge bases.
Therefore, to a significant extent all research is a collective occupation.

Collaboration itself, whilst not unheard of as a creative practice, is still an unusual modality for those undertaking tertiary training in the visual arts. The entire pedagogical structure still follows the age-hallowed stereotype of individual ‘genius’ and the

development of a coherent signature style. Anyone who baulks at this suggestion should dwell for a moment upon the structures of critique and assessment evaluation, most of which cannot tolerate ‘collective creativity’. Likewise, a cursory glance at the professional (economic) arena within which the visual arts operate will quickly reveal the primitive (almost protocapitalist) relationships that exist between artist and dealer gallery, the latter having a strong vested interest in the branding rights based upon individual identity.

All this augers poorly for the artist inclined towards a collective manner of creative production. This turns out to be a double hurdle — as not only, will the tertiary trained artist lack any practical knowledge of research methodology, but will in addition, have little or no experience of collaborative work practice.

Frequently attempts at creative synergy are supplied by agencies other than the tertiary sector. ZeroOne is a latter-day i.e. post-tech-crash utopian (read West Coast) vision of dynamic coupling between art, science and commerce; and I paraphrase their website:

Based in Silicon Valley in San Francisco, ‘ZeroOne's’ vision is to fuel the engine of culture by inspiring innovation and creativity, by bringing artists and technologists together and to build community through the intersection of art and technology.

Their objective is to enliven communities through the empowerment of artists within sites of technological, capital and technical expertise. Through entrepreneurship collaborations between new media artists and technology firms ZeroOne hopes to build and nourish a cultural and social capital in the United States.

This is a strongly ‘systems building’ approach which recruits the ‘real world’ directly to drive the ‘engine of culture’ rather than the protracted institutionally based ‘dry run’.

Conclusion.
At the beginning of this essay the question was posed, why is there such current interest in creativity and research and in collaboration between the arts and the sciences? With luck it is by now self-evident that a close nexus between the disciplines is more the rule than the exception. However there may be merit in highlighting some points and cautions in conclusion.

In an increasingly specialised world, there exists a diminishing possibility of establishing a coherent view (a.k.a. the big-picture). Frames of reference frequently require only a minor re-orientation to provide a substantial benefit and such a shift can result from accepting the ‘difference’ provided by a colleague from another specialisation.

Convergence #1 Digital Tools - convergence of means.
A factor that assists to establishing a common ground between disparate fields of endeavour is the advent of digital technology. Even if it has not completely levelled the playing field, it has once again put artists and scientists in roughly the same ballpark. They are using similar tools and concepts to expound their ideas.

It is pertinent to note in this regard the early introduction of computers into music schools which some claim was driven by the manufacturers (and their military clients) who identified the creative environment as the ideal context for testing this emergent technology!

Convergence #2 Real World - convergence of methods.
A second form of convergence can be identified in a discernible shift away from familiar representations of social and aesthetic issues, expressed in conventional artistic media, towards a more direct 'experiential' modus operandi that is frequently focussed upon an ideological or ethical concerns. This may take the form of 'Activist Art' that subversively takes on the mantle of political or industrial structure (for example The Critical Art Ensemble) or becomes engaged directly in the methodologies and philosophical concerns of science. The 'Tissue Culture and Art Project' artists within 'SymbioticA' at the University of Western Australia is a good example of this approach. SymbioticA was established as a collaborative art/science laboratory working directly with the materials, concepts and methodologies of biotechnology, whilst at the same time generating a powerful and penetrating critique.

SymbioticA is rightfully cautious about the negative effects of economic rationalism on both Art and Science:

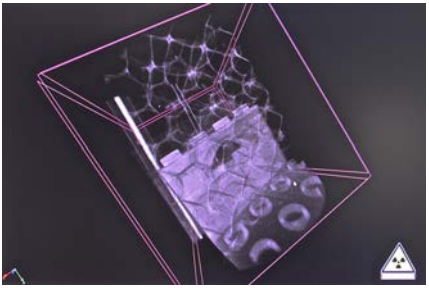
"I think that art and pure scientific research have a lot in common, and are significantly different from applied art (sometimes called design) and applied science (sometimes called technology).
Both applied activities (design and technology) are taking over the "purer" activities due to funding structures and economic rationalism."

And concerning the conjunction of artists with corporate partners….

"This pseudo-creative gloss (not unlike the previous green-gloss) is in many cases only superficial and capitalistically driven. My

advice to artists is to be aware of the role they are supposed to play in these scenarios."
Oron Catts, Artistic Director, SymbioticA.

In closing it is worthwhile to reiterate the assertion that whilst creativity and imagination, ingenuity and intelligence are common property, the production of brilliant scientists, virtuoso performers and artistic genius without nurturing both, rich webs of interconnectivity and well-developed cultural politics is foolhardy.



The Sound of Place: Environmental Artworks at Bundanon

Nigel Helyer and John Potts

This essay listens to the sound of place: of Bundanon, a three thousand acre property in the Shoalhaven River Valley in rural NSW, Australia. Bundanon is today an artists' colony and education centre, following the gift to the Australian people in 1993 of the entire property — including homestead, artist studio and extensive collection of art works — by its previous owner, the Modernist painter Arthur Boyd. Every year, 300 artists take advantage of the artist residency program, living in rustic isolation at Bundanon while working on art projects in all forms and media. This essay considers four artworks made at Bundanon by the artist Nigel Helyer: *Milk and Honey; Biopod* versions 1 and 2, and *Heavy Metal*. Each of these installation works was first exhibited onsite at Bundanon, before their inclusion in an exhibition in 2017 entitled *Landscape/Portrait: An exploration of the Shoalhaven River Valley*[2]. Each work has an audio component; the essay focuses on the role of sound in evoking aspects of place in these artworks.

The four artworks were created as part of a three-year Australian Research Council (ARC) Linkage Grant project, *When Science Meets Art: an environmental portrait of the Shoalhaven River Valley*[1]. The overall aim of the project is to create a complete environmental portrait of the Bundanon region, using techniques of environmental science, artistic practice, information technology, media technology and cultural history. Science meets art in the

fusion of data — collected by environmental scientists — with the communication of this information through artworks and media technology. Each of the artworks conveys part of the greater environmental portrait of Bundanon undertaken by the research project.

The Silent Forest (1996) National Gallery of Victoria
Helyer

The research process involves the analysis of soil and river water quality by a team led by environmental scientist Mark Taylor. The paints used by Arthur Boyd in his former studio have also been subjected to mineral analysis; sonification of this data is incorporated into the work Heavy Metal. The data representing environmental quality is digitally transformed into sound and visual information in numerous artworks. The environmental portrait of Bundanon also incorporates the social and cultural history of the region, as it pertains to its environmental condition.

Social history is included in the project as it embodies the environmental shaping of the region.

The Bundanon region is the site of our environmental portrait because of its distinctive natural and cultural character. The 3000 acres have been overseen by the Bundanon Trust since 1993. The vast property, including a winding section of the Shoalhaven River, incorporates eleven different vegetation communities, an abundance of flora as well as native wildlife. The landscape is central to the Trust's activities, which include replanting of native vegetation, and the removal of exotic weed species from the riverbanks.

The four artworks considered in this essay all probe the question: What is it to know a place, and how is it that we know? Do we slowly accumulate intimate details gathered during repeated visits to a familiar terrain, or are we perhaps transfixed and transformed in an encounter with a solitary natural phenomenon? Does our knowledge of the place's history condition our experience of that place in the present? Does imagination colour our perception of place? We have contributed to the Bundanon Trust's annual Siteworks festival as a means of manifesting our reflections upon and relationships to the landscape. We hope to act not as distant and impartial observers but embodied within the terrain, moving through it, working with it. The greater research project addresses the issue of how an environmental portrait might be conceived, and what constitutes a landscape. The approach is to think about landscape as an amalgam of lives, cultures, histories, sounds, biologies and economies; never the one thing, always a jostling of the many; the different and incommensurate; some obvious voices, some quiet and hidden. The sounds of nature, and of cultural

history, are invoked within the multi-voiced environmental portrait of Bundanon.

An environmental history of Bundanon

One of the fascinating aspects of Bundanon is that the region's social and cultural history has left an imprint on the landscape. The Indigenous people whose traditional country encompassed the contemporary Bundanon Trust properties were part of the Yuin group, with close ties to the Wodi Wodi people to the North. An Indigenous Cultural Heritage Plan commissioned by Bundanon Trust in 2011 found only two sets of axe-grinding grooves and possible stone tools in the region. The scant traces of habitation suggest that the lower Shoalhaven was an area moved through rather than settled, with the river an important means of travel by canoe. Extended family groups moved through their country responding to seasonal availability of resources, managing country by fire. These groups came together with others for ceremonies or activities such as kangaroo drives or burning country[3].

European occupation brought a radical transformation of the landscape, through tree-felling and then clearing for agriculture. Cedar-cutters felled valuable red cedar trees (cedar was reportedly Australia's first export) from 1811; in 1812 there were nine ships transporting cedar back to Sydney. The clearing of the forest removed the site of traditional Indigenous life, and opened the land for agriculture. 600 acres of land were sold to R. H. Browne in 1832, on the condition that '55 acres were to be cleared and cultivated and fences erected[4].' This and other adjoining properties were bought by Dr Kenneth McKenzie in 1838; the McKenzie family endured severe periodic flooding of the Shoalhaven River to establish their farm and farm buildings. The destructive flood of 1860, which wiped away buildings along the river, prompted

McKenzie's building in 1866 of the two-storey homestead, built of sandstone and local cedar, along Georgian lines and on high ground: this house today is open to the public as the former house of Arthur Boyd.

The McKenzie agricultural estate of Bundanon focused on dairy farming and maize crops; access to Nowra was by river ferry. Other farmers cleared and cultivated land in adjoining areas, among them the Biddulph brothers, who owned Earie Park. The Biddulph diaries are used as a source by Nigel Helyer in his work Milk and Honey (2013), originally installed in the Bundanon homestead; these diaries display a farmer's sensitivity to the weather, the productivity of the land, and a watchful eye on the river (there were disastrous floods in 1870, 1891 and 1898). By the early twentieth century, the Bundanon homestead was the central building of a working farm that included stables, a curing shed, orchard, vegetable garden, pigpens, dairy, beehives, as well as workers' huts.

The McKenzie family left Bundanon in 1926, following a tragic double drowning in the river. The property was leased to tenant farmers for half a century, running dairy and beef cattle. The next major transformation of the Bundanon landscape occurred in 1968, when the property was sold to art historian Sandra McGrath, her husband Tony, and art dealer Frank McDonald. Most of the working farm buildings were removed, trees planted, and an English-style cottage garden installed. A magazine article in the 1970s, entitled 'The Happy Valley', commented that, 'a Sydney art dealer has built a mid-nineteenth century landscape on a grand scale'[5]. Bundanon was now less a working farm than an artists' community; it was this environment that Arthur Boyd visited in 1971. He was so captivated by the landscape that he bought the

nearby property Riversdale in 1974, then Bundanon itself in 1979. Boyd built his studio at the rear of the homestead in 1981 (the studio was the initial site of Heavy Metal in 2016).

During his tenure at Bundanon, Arthur Boyd fought to preserve the environment from development and damaging activities such as sand-mining. He was quoted many times in his belief that, "you can't own a landscape". He realised his vision of protecting the natural and cultural heritage of Bundanon when the Commonwealth accepted Bundanon as a gift in 1993, establishing the Bundanon Trust. Boyd saw Bundanon as "a place for the community to enjoy the bush and the river, and a place to be used as a forum where those from every facet of the arts and science could get together". Collaboration and interaction were essential: "I like the idea of people talking to one another," he stated[6]. These four artworks, with their collaboration between art and science, and focus on the landscape and environment of Bundanon, develop the spirit of creative inquiry advocated by Arthur Boyd.

Hearing Place

The distinction between place and space has been made in a number of disciplines since the 1970s. Place is understood as the subjective rendering of space, the personal appreciation of a section of space or territory. The architect and theorist Colin Ripley has remarked that place emerged in architectural thought in the late 1960s as an "antidote" to the modernist conception of space. The "homogeneous and abstract built world" constructed by modernist architecture began to appear disenchanted and "devoid of poetry" to many architects in the 1970s.

A more sensitive architectural practice valued place over abstract space, enabling a "poetical dwelling" as well as greater harmony

with the environment.[7] Place was further emphasised in human geography in Yi-fu Tuan's book Space and Place: The Perspective of Experience (1977): Tuan focused on the significance of human experience in constructing and defining places.[8]

Theorists of sound art and acoustic ecology have been particularly attuned to the function of sound in evoking place. Because sound fills space, it is strikingly effective in conjuring the experience of place or "soundscape", as sound artist R. Murray Schafer articulated in his highly influential 1977 book *The Tuning of the World*.[9] Generations of artists working with sound have evoked place using recording technology; this evocation may take the form of a recreation of sounds within a specific space, or a creative response to the sonic profile of a particular environment. As the sound artist Ros Bandt has observed: "place is constructed, remembered, embodied, restored and re-created through certain aural signatures that enable us to interact with that place in new ways."[10] The 2007 anthology Hearing Places, co-edited by Bandt, offered thirty-four perspectives on the general theme of localised sound: the way "hearing place" is understood and interpreted. This may refer to a specific location or "sonic habitat", or to an artistic response to an acoustic environment, using recording technology or invented sound work. The ethical dimension of experiencing place through sound is frequently emphasised in critical writing on acoustic ecology and sound art. Attentiveness to the sounds of the other or of the past is invoked as the basis of cultural and political dialogue.[11]

Recent theorising of place has emphasised the complexity of the personal rendering of space, incorporating memory and history of place. Lucy Lippard's book *The Lure of the Local* defined a city as "a layered location replete with human histories and memories.[12]"

Rebecca Solnit's *Infinite City: A San Francisco Atlas* proposed an infinite number of subjective maps of a city, comprising the personal experiences of all those who traverse the city's space. For Solnit, "every place is if not infinite then practically inexhaustible."[13] This complexity of time and space pertains to rural environments as well as urban spaces: every place has a history which shapes our appreciation of the place in the present. There is a strong, but largely unacknowledged, relationship between sound, site and memory, both personal and cultural, that allows us to form complex associations and communal identities with particular loci. John Potts has described the sound of place evoked by two recent sound-art works, both exhibited at Documenta (13), 2012, in Kassel, Germany. *FOREST* (for a thousand years) by Janet Cardiff and George Bures Miller pursued the idea of emplacement through the medium of sound. This audio installation within a densely wooded park created a spherical sound field with 30 loudspeakers, which played voices and sound recordings evoking different periods of time. The audience had the sense of "experiencing the passing of a millennium from the perspective of this one patch of territory in the park…the artists in this work complicated the experience of place by invoking the passing of time."[14] At the same Documenta, Susan Philipsz achieved a similar feat of inscribing a specific place in Kassel with layers of time evoked by sound. The timescale — 1941-1944 — was much briefer; the site was Kassel's former Hauptbahnhof, still in marginal use. Seven loudspeakers above the train platform played *Study for Strings* (1943) by the Jewish composer Pavel Haas, who died in Auschwitz in 1944, after being deported by train from this very platform. The effect of this work was of "the past speaking to the present at this haunted place" as the music drifted in to the platform as if from the past. Listeners were affected by the

melancholy weight of the past, their experience displaced "through the intersection of place with the plane of time."[15]

Recent sound works by Nigel Helyer have incorporated a historical dimension in creating an audio portrait of a specific place. John Potts has called these works, such as *Silent Forest* (1996) and *The Wireless House* (2009), "multi-faceted sounding-boards of history and culture."[16] The original "wireless house" was built in 1934 in a park in inner-city Sydney, with the aim of providing radio broadcasts for the poor during the Depression. Helyer's work re-sounded this long-forgotten site with contemporary audio technology: the re-constructed site detects visitors and plays audio sequences from its archive, as if quietly announcing its memories to visitors. Other recent works – *Ecolocated* (2011) and *VoxAura, The River Sings* (2011) — create a "sonic cartography" in evoking specific places, with an environmental emphasis. The audio of *Ecolocated* blended location-sensitive sounds, sonfication of water quality data, and oral history material into "a multi-layered composition that rendered densely intertwined sonic narratives of and by the place: Belfast."[17] *VoxAura* focused on maritime life and marine ecology at the port city of Turku, Finland. Two ships' lifeboats were moored either side of a pedestrian bridge over the River Aura in the centre of town; one lifeboat played audio including local narratives and music, while the other played sonification of local water quality data. The work asks the audience to reflect upon the river — and the Baltic Sea - in an environmental context, to appreciate its "vital role as a chemical interface that controls our climate and our atmosphere."[18]
The four works discussed below use similar methods, incorporating environmental data, historical material, and environmental sound recordings, to evoke a specific place: Bundanon.

Milk and Honey

Milk and Honey (2013), was an eight-channel sound-sculpture installed in the music room of the old Bundanon homestead. As if stranded by an ancient flood, two sonic punts “floated” in the Bundanon homestead, carrying cargoes of milk and honey, sounding out their riverine environment with fragmentary voices in a strange new world.

Milk and Honey (2003) Bundanon Homestead
Helyer

Milk and Honey invoked the voices and atmospheres, the actions and beliefs of generations of Bundanon settler inhabitants as they struggled to eke out a living in these strange surroundings. “A land flowing with milk and honey” is the biblical phrase that describes the agricultural plenty of the chosen land. Early colonial settlers to the Shoalhaven region forged their own path toward realising this metaphor in a life that melded European practices and stereotypes with an unknown, even unknowable, landscape.

The audio of this work comprises sounds of farm life, and a mingling of Old Testament voices with the prosaic and terse entries from the Biddulph farm diaries of the 1880s. Extracts from these diaries summon a life of constant physical action and interaction; a life in which the ebbs and flows of the river provide both a daily pulse and a lifeline to the outside world; a life where the constant routines of farming were interrupted and supplemented by the more ancient rhythm of hunting and foraging in the bush:

Shipped 22 bags of corn on punt
Picked preserving dish full of grapes to make jam
Got a small swarm of bees, mother practiced her hymns
Mother had a yarn with Hugh at Cowtails.[19]

In the *Milk and Honey* soundscape, oars and seats of the punts emit voicings of segments of the diaries. The piano plays farm sound-fragments including the buzzing of bees; the slapping of oars against the water as the punt transports people and things to and from the farm on the fast-flowing river; the squirt of fresh cow’s milk onto the side of galvanised buckets; and segments of a concert played on the Steinway piano by a family member, who stays at the homestead from time to time.

As in previous Helyer installations, the work has a “visceral” quality derived from the audio technology. The sound-sculpture does not employ normal speakers but a series of eight “audio actuators” that transform the sculptural objects (the punts, the bee hives and oars) into sounding objects that literally vibrate. The many audio sources in the work - historical, biblical, ambient environmental and those referencing Boyd — form a fragmentary, multi-vocal attempt to portray the complexity of the lived landscape. Having eight sound channels allows the sounds to literally move around and through the various components of the sculptural work – which has at once a familiar but also an alien presence in the homestead.

Milk and Honey crosses time, re-creating a sense of the arduous repetition of farm life back then; the isolation both blissful and demanding. Working the punt required attention to the river and its conditions, but also provided timeout and a chance for reverie on the smooth-flowing system. In her catalogue essay, Cecelia Cmielewski describes the “quality of reverie that the composition of sound and objects in *Milk and Honey* evokes”. The work asks us to compare the pace and rhythm of life then and now; the close proximity and forms of mobility and markets then and the ease and environmental havoc of the transport and dispersal of produce now. *Milk and Honey* is also “a deeply political query into the rapid shift that has happened in the short time of farming at Bundanon.” It provides a space for contemplation that can “lead to an enquiry into the ways in which land management shapes the environment and those who live in it and benefit from it.”[20]

BioPod_V01

BioPod_V01 (2014) was a site-specific, micro-architectural sculpture designed to facilitate active listening in the natural environment. Positioned on the lake, a sonically significant site at the Bundanon property, a single-person capsule allowed for an overnight acoustic vigil. *BioPod_V01* combined sculptural, architectural and acoustic experiences that could create an extended narrative of aural experience. Participants were invited to make digital recordings of their sonic surroundings as well as their own voice as contributions to the ongoing sound archive — a type of ship's log. *BioPod_V01* functioned as an escape pod, a re-entry capsule, an ark, in which an overnight acoustic reverie could be recorded on the pod's user-friendly audio system.

Transporting participants to BioPod V1 (2014)
Bundanon Lake.

For many, the combined sensations of camping alone in the (extremely vocal) Australian bush and floating in the middle of a lake in total darkness proved a severe challenge, but the temporary withdrawal from the quotidien permitted an acuity in listening, experience and thought: a brief period of transformation and identification with the environment.

The *BioPod_V01* Survival Guide offered this advice for users:
Our species makes a lot of noise – we have created a world in which silence is a rare commodity. The BioPod invites you to spend an overnight acoustic vigil where you can maintain your silence and listen to the voices of other species.
During your overnight stay you are invited to make a series of short audio recordings of the soundscape and to also record a personal audio-log reflecting on your experience.[21]

BioPod_V01 was an immersive experience for the intrepid soloist. Cecelia Cmielewski, who experienced a night in the pod, describes the aftermath: a "deeper consideration of the biology of the lake" and the opening of a sonic world that "feels like prehistory." The recordings she made of this acoustic environment included: kangaroos which "thump loudly as they come to and from the lake to drink; frogs are abundantly loud and varied; egrets and kookaburras swoop close by, wings touching the water; the smallest of insects are out and about. It is not peaceful; it is a rowdy, hectic cacophony and one not heard during the day, but only at night in places where people don't often go." The experience in the biopod slowly revealed "a complex world that cannot be seen, only heard." It was the sound of Bundanon, at night, on the lake. The result was "a disarmingly humbling experience in which the human is completely disregarded and not

required. For a moment, it is as if the Anthropocene had not begun."[22]

BioPod_V01 was a sound-work designed to "make itself". Instead of controlling the audio content, Helyer's aim was to establish a situation in which participants engaged with a natural soundscape (in a way that they would not normally experience). This allowed then to produce their own content/response, creating in the process a generative work.

BioPod_V02

BioPods_V02: the Nebuchadnezzar suite (2015) responded to the 2015 Siteworks thematic at Bundanon, *The Feral Amongst Us*. The suite of three biomorphic sculptures could be considered as 'biology turned feral as sculpture' or, conversely, 'sculpture turned feral as biology'. Each structure contained a narrative of a feral or rewilded being. Each of the works was designed to be inhabited in a single mode — standing, sitting and lying down — and each form was equipped with a solar-powered audio resonator system that played the narratives of the outcast King Nebuchadnezzar II. Moreover, visitors were required to crawl on all fours to enter the works, emulating the posture of the savage king.

The orientation and motivation of the work was drawn from a large series of Arthur Boyd paintings depicting Nebuchadnezzar, a Babylonian king of overarching military ambition, who, for a period of seven years, was outcast into the wilderness to live as an animal (or rewilded) as a form of rehabilitation and redemption. The Book of Daniel recounts how King Nebuchadnezzar was punished for his overbrimming, warlike ambitions by being exiled into the wilderness to live as a feral creature:

BioPod V2 (2015) Riversdale

and he was driuen from men, and did eate grasse as oxen,
and his body was wet with the dew of heauen,
till his haires were growen like Egles feathers,
and his nailes like birds clawes.[23]

Possibly in homage to the iconic image by William Blake, Boyd painted Nebuchadnezzar in an almost obsessive manner over several years. He produced some seventy allegorical works featuring an outcast, tortured figure in a blazing Australian landscape: the human reduced to the subhuman, beyond society, alone.

The following are narrative extracts from the three sound sculptures – Helyer's responses to Boyd's images; a repertoire for exile:

The King stands in a burning desert weeping.
The King stands for his portrait.
The King stands and stares at the horizon.
The King stands and bows his head in sorrow.
The King stands but does not brush the flies from his face …

The King sits and birds peck at his head.
The King sits under a tree with melancholic thoughts.
The King sits in judgment of emptiness.
The King sits on a throne of dried grass.
The King sits in his own excrement and is foul …

The King lays staring at his claws.
The King lays engulfed by his own stench.
The King lays with aching bones.
The King lays dreaming of a huge tree.
The King lays dreaming of four monsters …

These narratives, spoken by the artist, described the physical and emotional toll of Nebuchadnezzar after his fall from grace due to acts of tyranny and arrogance. The three audio sculptures, situated on a hill at Riversdale (part of the Bundanon Trust property), were feral in the most appealing way: they became playful objects for all ages. Children crawled, climbed and jumped from them; teenagers and younger adults enjoyed being safely enclosed in the vessels while drifting off or listening attentively. Older adults were absorbed by the meaning of the text and stood alongside, closely listening to the sound work. Many listeners had the experience of being isolated from the external world and immersed in the Nebuchadnezzar reveries. One surprising effect of the feral sound sculptures was that many people felt protected and/or invisible once ensconced in these quite visually transparent structures; it

was as if the soundscape had enveloped them in an impenetrable mist.

Heavy Metal

Heavy Metal (2016) provides the sound of a painting. Specifically, it was initially the sound of Arthur Boyd's Return of the Prodigal Son (c1997), left unfinished in his studio at Bundanon (Boyd died in 1999). To generate the data programmed into Heavy Metal, a hand-held X-ray fluorescence spectrometer operated by environmental scientist Mark Taylor was directed at paints used in the painting. The starting premise of the work is that Arthur Boyd painted this (mineralised) landscape with colours that were themselves formulated from earthy compounds and exotic metals, milled to a fine paste in linseed oil and turpentine.

The interactive screen from Heavy Metal (2016)
Arthur Boyd's Studio

Heavy Metal invites us to interact with one of Boyd's paintings to discover a hidden world of elements and minerals in an experience that is simultaneously chemical, visual and musical.

Helyer and Taylor analysed the mineral composition of the entire colour range used by Boyd, developing a huge database of minerals that corresponded to his palette. The spectrometer analysis of the paints used on the unfinished Boyd painting revealed that the paints contained up to 35% cadmium and 60% lead. Because Boyd frequently painted with his fingers, preferring to feel the metal-rich paints with his hands rather than use a brush, he may have inadvertently contaminated himself in the process of painting.

The second stage in the creation of *Heavy Metal* was to sample the Steinway piano at the Bundanon homestead, note by note. Regular keystrokes were recorded, along with the reverberance of the sounding board resulting in one to two minute sound files per note. Working with another colleague, Jon Drummond, an expert in data sonification, Helyer created a computer-driven audio-visual system able to read the video stream from a camera facing Boyd's painting. The screen interface displays a highly magnified colour "target" area from the painting along with the RGB values and the predominant minerals present, which are shown as elements of the periodic table. The system then translates the stream of mineral data into sound, which is layered in two components: a generalised harmonic chord structure that corresponds to the colour, overlaid by individual note highlights that illustrate the distribution of the most prominent minerals. The computer monitor gives feedback on the area of interest, colour ratios and a graphical display of the minerals detected.

Heavy Metal is interactive at a complex and conceptual level. The composition of chord-like sounds is created by a real-time analysis of the minerals in the colours of the painting. As a video camera is trained onto a section of the canvas, the screen displays the mineral content of the selected colours, in the form of the periodic table. The image and corresponding sound change each time someone selects a new section of the canvas on which to train the camera. *Heavy Metal* also brings together two kinds of science: environmental and computational. The installation provides participants with different ways to animate a 'static' painting. The sound is dynamic, based on the elements used in a particular area of Boyd's oil painting.

In designing the soundscape, Helyer and Drummond decided that as the installation would operate constantly, the audio should constitute a subtle, harmonic composition. While correctly representing the data-base, the audio would automatically re-write sequences of the selected notes, thus avoiding the 'looping effect' common in generative digital works. The soundscape operates like the 'strange attractor' phenomenon in Chaos Theory, in which iterations are similar but never identical.

Deborah Ely, Chief Executive Officer of Bundanon Trust, has remarked that in these four artworks, Nigel Helyer "has developed a language that engages visually and aurally with the physicality of the place". This engagement is with both the "literal material" of Bundanon, and with the "ideas held within its histories and the artist's imagination."[24] The sounds of Bundanon are reinterpreted for us through these artworks, as is the presence of Arthur Boyd, and the wide landscape of his mind. The acoustic environment of Bundanon, recorded in *BioPod_V01*, mingles with Boyd's

imagination and with the history of the place, creating a portrait in sound of Bundanon.

Endnotes

1.Milk and Honey (2012) was an eight-channel sound-sculpture installed inside the homestead at Bundanon. Biopod_V01 (2014) was a single-person capsule floating on the lake at Bundanon. Biopod_V02 (2015) was a suite of three sculptures exhibited at Bundanon for the annual Siteworks festival. Heavy Metal (2016) was an interactive installation situated in the artist studio at Bundanon, opening at the 2016 Siteworks festival. Heavy Metal and Biopod_V01, along with documentation of Milk and Honey and Biopod_V02, were included in the exhibition Nigel Helyer: Landscape/Portrait: An exploration of the Shoalhaven River Valley, curated by Nigel Helyer and John Potts, Macquarie University Art Gallery, 1 March – 13 April 2017.

2.This research project, based at Macquarie University, has as its personnel the researchers Professor John Potts, Adjunct Professor Nigel Helyer, Professor Mark Taylor (Macquarie University) and Professor Mark Evans (UTS). Industry partners for the ARC Linkage Grant project are Bundanon Trust and the Australia Council of the Arts.

3.Sue Feary and Heather Moorcroft, An Indigenous Cultural Heritage Plan for the Bundanon Trust Properties. (Bundanon: Bundanon Trust, 2011), 34–35.

4.Bundanon Conservation Heritage Plan, Vol 2. (Bundanon: Bundanon Trust, 1997), 3–4.

5. ibid, p 20.

6.Siteworks: Field Guide to Bundanon. (Bundanon: Bundanon Trust, 2014), 236.

7.Colin Ripley, “Hearing Places: Sound in Architectural Thought and Practice”, in Bandt, Duffy and MacKinnon (eds), Hearing Places: Sound, Place, Time and Culture. (Newcastle, UK: Cambridge Scholars Publishing, 2007), 87. Ripley cites Christian Norberg-Schultz’s Intentions in Architecture (1968) as an early and influential study of architecture and place.
8.Yi-Fu Tuan, Space and Place: The Perspective of Experience. (Minneapolis: Minnesota Press, 1977).
9.R. Murray Schafer, The Tuning of the World. (New York: Alfred A. Knopf, 1977).
10.Ros Bandt, Michelle Duffy and Dolly MacKinnon, “Introduction” in Bandt et. Al. (eds) Hearing Places, 1.
11.“Listening and not listening have moral and ethical implications, not only for the voices that speak and are heard, but also for the ways in which voices constitute particular forms of power…”.Ibid., 1.
12.Lucy Lippard, The Lure of the Local: Senses of Place in a Multicentred Society. (New York: New York Press, 1977).
13.Rebecca Solnit, Infinite City: A San Francisco Atlas. (Berkeley: University of California Press, 2010), 2.
14.John Potts, The New Time and Space. (Basingstoke: Palgrave Macmillan, 2015), 91.\
15.Ibid., 92.
16.Nigel Helyer and John Potts, “Ecolocated: Art, Science, Environment”, Studies in Material Thinking Vol. 8 2012 at http://www.materialthinking.org/papers/94. 6.
17.Ibid., 4.
18.Ibid., 5.
19.Thomas Tregenna Biddulph, diary extract, 1880s, archival material, Bundanon Trust.

20.Cecelia Cmielewski, “Edges, Proximity and the Creative Leap”, in Nigel Helyer: Landscape/Portrait: An exploration of the Shoalhaven River Valley catalogue (Macquarie University Art Gallery, 2017). 30.
21.Nigel Helyer, BioPod_V01 Survival Manual, 2014.
Cecelia Cmielewski, “Edges, Proximity and the Creative Leap”, 31.
23.Daniel 4:33.
24.Deborah Ely, “One World” in Nigel Helyer: Landscape/Portrait: An exploration of the Shoalhaven River Valley catalogue (Macquarie University Art Gallery, 2017). 37.

The Plural Forest:
Traces of Nature in Thai identity.

Apologia.
This essay was composed during a research visit to northern Thailand and was designed to accompany the Chiang Mai Social Installation project 2536/7 — (1993/4) as a parallel to its programme of re-situating Art activity within a Social and Environmental context. The specific orientation of this text arises from my reflections surrounding the recurrent references to "Nature" within contemporary Visual Arts practice in Thailand – It is this Culture/Nature axis; brimming with contradictions and mythologies (cosmological and political) which provides our speculative terrain.

All theory my friend, is grey,
But green life's golden tree.
Goethe (Faust 1).

Buddha Nature.
The Buddha once said that his knowledge of nature was too vast to reveal and that most of this knowledge would not contribute to the betterment of mankind — one grain of wisdom, which did pass his lips on the subject of natural philosophy, was;

one grain of rice is composed of seven louse heads.
one louse head is composed of seven fine drawing lines.
one fine drawing line is composed of thirty-six pollen particles.
one pollen particle is composed of thirty-six sunlight rays.
one sunlight ray is composed of thirty-six molecules.
one molecule is composed of thirty-six atoms.

If, in the above schema, we calculate a rice grain at 5mm, the Buddhist atom has a diameter of 6 x 10-11 meters. This century Niels Bohr calculated the nucleus of the Hydrogen atom as 5.3 x 10-11 meters. A coincidence perhaps, or a remarkable example of pawana maya panya , a Buddhist form of knowledge, acquired through purification of the mind, which permits deep insight into nature.

What are National Parks for?

Between 1976 to 1982 the Phu Hin Rong Kla area was the strategic headquarters for the Communist Party of Thailand (CPT.) and its tactical arm The People's Liberation Army of Thailand (PLAT.). This area is rugged, forest covered mountain terrain, well isolated from Urban centres, but having the strategic advantage of being only 50 kilometres from the Lao border. After the 1975 fall of the Laotian government (to Pather Lao) China's Yunnan province was still only 300 kilometres distant, with the city of Kunming providing the principal training site for CPT. cadres. The CPT. Phu Hin Rong Kla camp was especially active after the 1976 October student uprising in which hundreds of protesters were massacred in Bangkok by the Thai military – many students fled for their lives here.

The mountain terrain was the site of prolonged skirmishes between the Thai 3rd army division (garrisoned at Phitsanulok) and the PLAT. In 1972 the Thai 1st, 2nd and 3rd Armies in conjunction with the Thai Navy, Air force and National Guard mounted a major offensive to rout the encampment but this attempt was in vain. Again in 1980 and 1981 the military made further, and partially successful attempts to re-gain the territory. However the decisive move was not military but political – the 1982 amnesty for students who had joined the communists after 1976 saw the 're-

patriation' of most of the students. The thus weakened PLAT. was unable to withstand a final military push, and in 1982 the final surrender of the area was effected. Phu Hin Rong Kla was subsequently declared a National Park with the remains of the PLAT. encampment forming a small Museum.

Culture on the Edge of Forgetting.
Consider the English saying, to throw the Baby out with the Bath water. An image in which a well meaning, but distracted parent is instantly dispossessed of their cherished offspring by a careless, but physically fluid action. An act of forgetting combined with irretrievable loss.

Despite the omnipresence of traditional practices and forms, contemporary Thai society balances uneasily on the cusp of forgetting or abandoning its cosmological symbolic order, in exchange for a new, materialist form of 'dreaming'. This historical intersection is particularly precarious for the Artist – who is confronted with the dilemma of shedding the security of a coherent, but isolated cultural identity, to 'compete' in the uncertainties of the International cultural market. In effect this is to step from a site fixed in both time and space (a context) to the fluidity of a 'non-site', characterised only by spatial slippage and temporal disjunction.

All dressed up and nowhere to go?
In a pragmatic sense any move the artist makes beyond the finite iconographic canon of Buddhism invokes an immediate crisis in philosophical, methodological and formal issues. The breakage with tradition activates a strong gravitational movement towards the plurality of International style and is accompanied by an inevitable series of arbitrary decisions concerning the adaptation or

adoption of new aesthetic modes and professional methodologies. These too are invariably in direct contradiction of traditional beliefs; if not traditional practice!

To establish a cultural praxis which mediates tradition and the new is the utopic project that elusively confronts Thai Artists. One 'neutral' ground, which appears to bear direct parallels to the development of Thai cultural identity is the generic term "nature". The co-option of nature, to be harnessed to cultural production would seem to provide a convenient bridge of continuity between the legacy of the past and the hybridisation of the future. However a careful scrutiny of the cultural construction 'Nature' may reveal its 'naturalness' to be anything but neutral.

Cultures of Dependency.
Global economies exist as a network of economic and technological dependencies which broadly operate between first and second world states and the third and fourth world 'client states', along the principal, North/South axis. It is also vital to acknowledge that the in-equalities of most national economies intentionally replicate the 'four-worlds' within their own social structures, making the streets of Manhattan a 'home' for the Homeless as well as a parking lot for the equally ubiquitous stretch-limousines.

Artists of technologically dependant cultures are inevitably 'commodity consumers' destined to play out remedial loops on the surface of technology; in emulation of the central clichés of the medium — as if to provide proof of their 'membership'. This situation applies equally to the technologies of oil paint, as it does to those of the Digisphere – and effects Artists from technologically dependant 2nd world countries (such as Australia).

Radical and innovative cultural action is denied to Artists whose principal aim is to approximate to the perceived notions of an International movement or style. In this mimetic situation the 'transfer' is only of a technological form, per se, rather than of a critical praxis, which uses technological 'tools' as a vehicle.

Technology Transfer – An Historical aside.
The contemporary concept of 'technological transfer' is an ironic re-playing of the historic trade in ideas and applied science between the Orient (principally China) and the Occident. Suffice it to say that lodged within the ethical and social mores of East and West lay fundamentally divergent attitudes toward science and the technologies of commerce.

The East, whilst being technologically precocious held such knowledge in distain, actively suppressing its social role in favour of the development of agricultural, civil and scholarly skills. In contrast the emergent European states, driven by intense economic and political competition, seized scientific principals and technological applications as central to their development. This obsessive drive culminated in the imperialist expansions of European states, which tragically re-imported to the East many of their own inventions, but in new virulent and violent forms.

Old Nature – New Nature.
As an ill-informed, but curious admirer of Temple mural paintings, I have noticed my gaze constantly 'drifts' away from the principal iconic focus, to rest in the dense backgrounds of forest cover. Here arises a powerful intuition that lurking in the distance of time lays another culture, pre-existent to Buddhism. Here remains a pre-history of animism, a matriarchal forest culture now lingering as a repressed 'backdrop' to Buddhism.

This genetic memory trace somehow signifies the inverse of the foreground action, with its iconography of aristocratic bearing, military power and patrilineal monarchy sited within urban complexes. Albeit a philosophy of light (enlightenment) Buddhism shades its origins, perhaps even more effectively than Christianity (which still lives with its elves, fairies and of course Satan – diminutive survivors of pre-Christian deities).

It's only 'Natural' – recourse to nature symbolism.
How is the concept 'Nature' mobilised as an Artistic vehicle? – firstly a return to the assertion that nature is frequently harnessed to Artistic production, in order to provide a bridge of cultural continuity between tradition and those emerging cultural formations which go beyond the traditional symbolic order. Such a use of 'nature' attempts to both foreground and buffer Thai identity within the transitional process of absorbing International cultural forms.

Once upon a time…
The principal mode of co-option is as 'nature mythologised'. In this usage the culture/nature nexus embodies a series of values, which emphasise cultural purity and historical authenticity. These values are clustered about a homogenous lineage of Thai tradition centred upon the harmonious symbiosis of the village and its natural environment.

Such a mythic construction operates as a proto-critical vehicle, frequently ranged in opposition to contemporary 'western' values and urban developments. In this manner the contemporary fragility of Thai cultural identity is equated with the corrosive effects of western industrial capitalism with its resulting alienation from the natural world. Those who subscribe to this proposition rely upon

the equally mythical assumption that the industrialisation of Thailand is driven by neo-colonial agencies external to Thai society — a fate that must be accepted with reluctance.

Emotional High.
The conjunction of nature with emotion is currently in vogue with young Thai Artists. Nature is again cited as a receptacle for innocence and purity but here the metaphor embraces the individual psyche of the Artist rather than the social psyche at large. Nature becomes the matrix, which houses the emotional self, a source of inspiration — an echo filled space, which faithfully returns the monologues of the individual. To operate within such a 'privatised' nature provides an alternative terrain to the difficult realm of social space. Nature is conceived of as a space beyond ideology — an escape route from contemporary social conditions, perhaps promising a re-entry to an imagined cohesive past.

Cosmological Nature.
Perhaps the most legitimate 'mythologising' of the natural realm is one in which nature is subliminally recognised as the original 'cosmological site'. Under this configuration the conception of nature expands to occupy its actual dimensions forming an infinite resonant space adequate to house the equally vast symbolic worlds of Brahmanism and Buddhism. Within this 'full-size' conceptual universe there is room enough to provide dwelling places for shamanism and animism — forces, which inhabit the pre-histories and contemporary peripheries of the major theologies.

Brahman and Buddhist cosmology's have incorporated nature symbolism as their iconic and conceptual foundation, within this continuum the tree figures as the total cosmos, the branches are heaven, the lower branches the plane of earth, the roots the

subterranean world with the trunk representing the axis Mundi, the pivotal vertical axis which aligns and unites these layered worlds. As the axis Mundi the tree is a prominent aniconic representation of the Buddha, who is in turn the anthropomorphised form of the cosmic, or solar pillar. The Bohdi tree is specifically associated with the Buddha as both the site and sign of his enlightenment, and trees act as symbolic markers for each of the significant events in Buddha's story. Here, where the essential and its materialisation constitute the intelligible and the sensible aspects the universe, where everything is both what is visible but also what it represents symbolically – here we have come full-circle, to the ground-zero of a powerful belief system – to a source of creative energy!

Wild Nature – the Environment and Fear.
Despite the almost total de-forestation of Thailand leaving the remaining 'natural' mountain/forest-scapes as secondary re-growth – the institutional and political consciousness still retains a genetic memory of 'Wild Nature'. But here the wildness and its concomitant danger are generated by the intersection of political frontiers, the trade in contraband (narcotics and weapons) and ideological or inter-ethnic conflict, all played out in the physical context of malarial and monsoonal conditions. 'Wild nature' is nature beyond the long arm of the law, a form of nature not to be tolerated.

It is not without irony that the 'meta-physics' of Wild nature are the mainspring of the tourist economy in Northern Thailand. Here, an entire fabric of double-speak serves to exoticise the fringe existence of ethnic minorities, whose varying fates at the hands of the government have included, physical suppression, relocation and assimilation. Their current status as tourist commodities at least ensures them the 'insurance policy' of a public profile. In a

similar mythologising operation, authentic experiences of 'Wilderness' are commonly advertised for general consumption (as a brief stroll in Chiang Mai will show). Here the often charming, but totally man-altered, Northern landscapes of forest re-growth and verdant rice paddies stand in for what was once dense primal forest — certainly no place for urbanised Europeans!

The 'taming' of nature by traditional Thai village society is perhaps not simply an expression of the economies of logging with a subsequent influx of rice economies developing on the cleared land. This environmental transition from the 'natural' to the 'cultural' may also be viewed as an expression of the basic fear of 'chaos' found in nature which has been systematically eradicated under the logic of economic progress. Re-forestation projects naturally proceed along the rational gridiron of the surveyor's chart, and frequently employ non-native, rapid growth hard-woods (Australian Eucalypts) – This form of forest regeneration is also a form of 'pacification', here nature obediently forgets 'chaos'.

The Environment and Reprisal.

The perception of 'Wild Nature' existing at the peripheries of the State result in habitually violent responses to both the environment and to the fringe dwellers who inhabit the geographic and political margins of the State. Reports of institutional violence against nature are the daily fare of Thai national newspapers, which demonstrate an alarming complicity between the State/Military and the Entrepreneurial ventures engaged in this war of attrition. Two recent reports, paraphrased from "The Nation" demonstrate the scale and political involvement of these environmental incursions; "Burma dams are clearly a crime against humanity" — might be aptly re-titled "How to kill two birds with one stone?". This report outlines plans for massive hydroelectric dams on the upper and

lower Salween River, permanently flooding over 1000 km2 of forest on the Burmese side of the frontier. These dams are projected to supply energy greedy Thai industry with 4,540 megawatts (per dam) in addition water will be pumped to the depleted Bhumibhol reservoir (as if to say that dams can work as replacements for watershed forests – logged out by short sighted enterprises). Not only will these projects impart respectability and inject hard currency into the SLORC. dictatorship, but as part of the entente cordiale established between the two governments, eradicate (by flooding) the homeland of the Karen, destroying their way of life and effecting a "final solution" to the forty year self-determination struggle the Karen have waged against Burma's Military dictatorship. The Karen, dispossessed, will have to choose between SLORC. concentration camps or Thai refugee camps!
"The forest killing fields in Cambodia" – described as an "environmental massacre" the result of a war against nature waged during the decades of civil unrest in the region has left only 50% of the original forest cover (with only 25% of the primary forest intact). The western zones of Cambodia have been literally stripped bare of minerals and hardwood by the Khmer Rouge in conjunction with their clandestine Thai 'business partners' (and ordinance suppliers). Neighbouring Thailand, Laos and Vietnam, whilst officially supporting the UN. total ban on Cambodian timber exports, have continued to buy Cambodian timber as have Japanese concerns. The Cambodian Environment minister Mok Mareth terms the situation an "Environmental Catastrophe".

Thailand as an (over)Developing Country.

It is especially pertinent to note that both of the above catastrophes are located in the 'trans-border' areas of 'Wild Nature'. These 'sensitive' border zones are the preserve of Military governance that seem free to extend neo-colonial practices of environmental

exploitation, in defiance of Thai government policy and International law. Such an obvious lack of political and economic control, coupled with systematic disinformation and un-responsive government bureaucracy combine to project the "Ugly-Thailand" image held by many of Thailand's less developed neighbours, who view the Thai version of 'western' industrial capitalism as an irresponsible and socially inequitable disaster.

Pax Britannia, Pax Americana:
Traditional Cosmology and the New World Order.

Buddhist tradition has been unable (to date) to provide a system of ethical 'checks and balances' when confronted by the historical process of Thailand's incorporation into the world market economy by colonial and neo-colonial agencies. This process commenced with the concessions made under the Anglo-Siamese Treaty of 1826 and the Bowring Treaty of 1855, which initiated the free export of rice and the controlled import of opium. Combined with the expansion of British teak logging industries from Burma into northern Siam during the reign of King Mongkut the traditional subsistence economy disintegrated developing as a 'client' economy in the mould of 'early' industrial capitalism, un-fettered by European concepts of Unionism and 'Social-Contracts' — governed only by a fierce free market ideology.

The effect of a Free Market Economic system (the Pax Americana) within the 'developing' countries is essentially twofold. The overt mode develops an economic/industrial base in the image of the western market, increasing the overall standard of living but invariably tethering the developing country as a dependant 'client' state (which is 'allowed' to supply the developed world with cheap raw materials)!. The price tag on this 'development' is hidden within the second principal mode of this double-edged sword.

The Free Market economic system, even when adopted by authoritarian and centralist governments (e.g. Communist China :- "It does not matter if a cat is black or white, if it catches mice it's ok!" D. X. Ping) not only effects the political and economic complexion of the state but acts as a corrosive force within the ethical and philosophical systems of the society. Its principal effect is to dissolve ideology, ethics and cosmology. It is not simply the case that Western forms of commodity production and exchange are incommensurate with traditional Buddhist precepts – but that the mechanism of the free-market acts like a viral invasion to dissolve and permanently 're-write' the ethical and philosophical 'codes' of traditional modes of being and conduct.

As the architectures and consumer durables of industrial capitalism slowly drown the ancient walled cities, their symbolic order, manifest in temples and imperial structures, become embalmed as material signs of that which is disappearing as a modus vivendi. Juxtaposed against the multi-storey shopping mall, the temple and palace are fossilised as national heritage, commodified as historic artefact and consumed by visitors from the 'developed' world.
The main goals of U.S. strategy were to promote stability, to facilitate internal development, and to promote security to prevent a take-over by internal communism. To achieve these ends, the strategy operated ….on many levels, affecting virtually every aspect of Thailand's economic, political, social and cultural development. It was a major effort at social transformation, which involved all….parts of the governmental corporate – foundation – university – military complex.

Grit Permtanjit — Between the Devil and the Deep Blue Sea.
It's question time! How do Thai artists propose to operate within the National and International cultural 'circuit'? It would seem from the above that however earnest re-enactments of Thai traditional forms might be, they operate as a desperate expression of loss within a cultural context of inevitable transformation. In reiteration;

To establish a cultural praxis which mediates tradition and the new is the utopic project that elusively confronts Thai Artists. The principal task would appear to be to establish the ground-rules and game plan for the development of Thai culture within an International context. This must be accomplished in a manner which avoids the com modification of Thai identity as exotica or folkloric, and equally resists the co-option of Thai Artists as stylistic 'clones' who replicate the appearance (and little else) of the current International vogue.

Artists have options – They can choose to operate (as an ancient metaphor puts it) as the root or the flower of culture. As the flower their task is to amplify the status quo, to affirm that which is already evident, to act as 'social grease' — the advertising agents of institutional culture. From the perspective of the root Artists become pro-active cultural critics and spiritual or ideological reservoirs, willing to work in the debris of the collision between tradition and the (un)ethics of the new world (dis)order.
For the Artist using 'nature' as an artistic vehicle who adopts the complicity of the 'flower' stance the natural is inevitably adopted in its mythologised configuration, providing a nostalgic and temporarily comforting respite in stark contrast to an uncertainties of a future in which the symbolic and ethical order is dissolving to be replaced by unknown but certainly 'alien' values. It is not

without irony to note that the iconic systems employed to portray nature and the natural are frequently adopted from (alien) European sources.

Those who take the alternate, critical position, who consider nature as both a cosmological site and an ecosystem – who work with both aesthetics and ideology, will find little support or acclaim in a cultural system which formed its social conventions of harmonious and non-confrontational conduct some two thousand years prior to the emergence of capitalism. To work as a 'root' may mean to work in darkness!

Conclusion.
The Chiang Mai Social Installation Group is a nucleus of positive cultural energy, which has the potential to shift contemporary Art development away from the moribund beaux-arts confines of the gallery to the fresh air of a social and environmental context. This open arena is the only place where the Realpolitik of cultural and philosophical material can occur – tested out, offered as a gift, fought over and savoured. It is not a question of training and taming the 'public' to learn to 'love' art, but a vital opportunity for Artists to actively join the world.

As a final comment, it is highly significant that the Chiang Mai Social Installation Group has intentionally situated this cultural experiment within the physical precincts of Buddhist culture. That the project was officially opened in Wat U-Mong (a forest temple) is for me doubly resonant. In this manner the group actively chooses to engage sites of traditional philosophy as an active force in the development of an independent and vigorous contemporary Thai culture.

About the Author

Nigel Helyer (a.k.a. DrSonique) grew up in a small village on the Sussex-coast in England. He trained in sculpture at the Liverpool College of Art; undertook his masters research in Environmental Media at the Royal College of Art, London and gained his doctorate in sound-art from the University of Technology Sydney.

Nigel is an independent artist with an international reputation for large-scale sound-sculpture installations; environmental artworks;

museum inter-actives and new media projects that focus on our relationship with the natural world.

He lives with his wife Cecelia Cmielewski in Jervis Bay (New South Wales, Australia) and together they share a crew of four children and five grandchildren.

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