Clotted Life and Brittle Waters

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Clotted Life and Brittle Waters by Perdita Phillips

Abstract

This paper discusses the beginnings of a soundscape project, The Sixth Shore, at Lake Clifton in the Yalgorup National Park, south of Mandurah, Western Australia. The final endpoint of the project is a site-specific art installation at Lake Clifton where audiences will be able to hear on headphones a 3D sound environment composed of strata of sound recordings. The route that participants walk through the landscape will determine what they hear. The kinds of sounds involved will include in situ ambient sound recordings and birdcalls, sounds and voices from scientific knowledge about the environment, from human communities and from the local oral archive. The structuring of the project comes from the layering of six different timescales of differing ecological agents including birds, ecosystems and people. The focus in this essay is on just two layers: deep thrombolitic time and shifting shorelines. My aim in The Sixth Shore is to articulate the competing agents at Lake Clifton in a way that decentres the current environmental impasse to encourage new solutions to human-nonhuman interactions. Using the findings of scientific understandings of thrombolites and the sequence of changing sea levels and evolving coastal deposits, I then draw forth their metaphorical implications that in turn inform the composition of the sound world that I will be creating. As additional complexities are revealed I examine how ‘brittle’ non-fecund wetlands can be part of an expanded sense of place in Australia.

Boundary conditions

A thrombolite looks like a spongy rounded stone or rock-like column found in shallow sea and lake waters. Located at only a small number of locations around the world, thrombolites are made up of a complex community of microorganisms, including cyanobacteria, cemented with inert materials in the form of detritus or other collected mineral sediment. Cyanobacteria fix carbon dioxide to make their own food source by photosynthesis. Part of the living process of the microbial community also involves the precipitation of calcium carbonate (which is familiar to us as limestone) as...
the mineral aragonite. This combination of organic and mineral material gives the thrombolite mass as the bacterial colonies slowly grow over time until it becomes hard and rock-like inside. Because of the precipitation of calcium carbonate as a biosediment, the thrombites embody the idea of a mineral/vegetable thing that crosses the boundary between the living and the nonliving worlds.

I will come back to later why I have used the term 'thrombolite' in the case of the living communities at Lake Clifton, but they are also called by the much more common term stromatolite, and fit into the broader category of microbialites. Microbialite structures are found in a variety of shallow waters locations worldwide. Whilst the places where they grow vary, the water chemistry usually includes high levels of bicarbonates while competition and herbivory are usually low. Geologically recent (but not living) microbialites forms are also present in Lakes Pollard, South Newnham, South Preston, Hayward and Martins Tank Lakes in Yalgorup National Park (Moore). Many of these lakes have distinctive hard and brittle bottoms unlike the slushy carbonate muds of Lake Clifton.

Whilst living examples of microbialites are scattered around the world, their fossil distribution is much more extensive and these distinctive rock structures are significant evidence for the earliest forms of life extending as far back as 3450 million years ago (Allwood et al.; Van Kranendonk et al.; Tice and Lowe). There was an explosion of these biogenic sediments -- dominating the fossil record between about 2500 million and tapering off 540 million years ago (Awramik and Sprinkle). The cyanobacteria present in ancient stromatolites are a likely source of increased levels of oxygen in the atmosphere 2200 to 2400 million years ago (H. D. Holland), which transformed it from something hostile to aerobic forms of life to something hostile to anaerobic forms of life"1. The animals and plants we see today thrive in these oxygen rich conditions.

This link between living and fossil microbialites connects us to geological time. We can look at the genetic code of different bacterial types to gain an understanding of how the tree of life may have formed, but the fossilised microbialite rock deposits give a "singular visual portal" on the beginnings of life, showing the actual space and structure of communities ("About Stromatolites: Stromatolite Fossils the Oldest Fossils Encoding the Mysteries of Deep Time"). So the living thrombolites at Lake Clifton, with their incremental growth, probably over (only) 2000 years (Moore and Burne), give us access to a vast panorama extending from the beginnings of life itself to the present-day2. The pale brownish-drab geoids at our feet are, at scales beyond our senses, a window onto the sublime. We glimpse the deep time of the earth and our own temporal insignificance: if the whole of the geological timescale was compressed into the 21.5 km length of Lake Clifton, microbialites fossils come...
into existence at 16 km, Homo sapiens have existed over the last 9 metres, and recorded history in the last 46 millimetres.

I will be structuring my soundscape to suggest this great distance and depth, and the boundaries of life that the thrombolites represent. I envisage a spiral of tiny sounds like the descent into the geological past and tiny pinprick sounds like the multitudinous field of microbes beneath us with their sharp aragonite grains, oxygen burps and hydrogen sulphide farts.

Thinking like a sequence of shorelines

In his essay “Think like a mountain” Aldo Leopold wrote ‘Only the mountain has lived long enough to listen objectively to the howl of a wolf …I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer’ (Leopold 130-32). Here he alludes to the ability of mountains to ‘see’ in time spans sufficient to put in perspective the bloody killings of a North American wolf at the same time as it experiences the longer term damage to its tree cover by too many deer (and not enough wolves). Leopold’s appeal to humans was to be able to see ecosystems at these larger temporal and organisational scales.

If you close your eyes and think for a minute what it would be like to be a single bacterium in a living thrombolite, you would be surrounded by a complex array of other species all doing different jobs such as converting sunlight into energy, producing UV-resistant mucilage, literally the dozens of specialised chores essential for keeping the colony alive and well. You can imagine a minute chorus of sound in this bustling community. If you step backwards, you can begin to think as a rock and then as a landscape as a whole: you would be on the shore of a shallow brackish-to-salty lake stretching to the north and south, and this lake is the first of three such chains between you and the coast.
Figure 4 Moore's distribution of thrombolites in Lake Clifton (from Moore, figure 3.1, based on research in the late 1980s and early 1990s).

Figure 5 Map of Pleistocene geomorphic units on the Yalgorup Plain (from Semeniuk "New Pleistocene and Holocene Stratigraphic Units in the Yalgorup Plain Area, Southern Swan Coastal Plain" figure 1G).

Figure 6 Stratigraphic cross section through to the coast (from Semeniuk "New Pleistocene and Holocene Stratigraphic Units in the Yalgorup Plain Area, Southern Swan Coastal Plain" figure 2B). Note vertical exaggeration.

*Hydrobotanica*
Stage 1: buildup of the Mandurah-Eaton Ridge

Stage 2: Growth of Youdaland

Stage 3: Growth of Myalup Sand Ridge and Barrier Ridge

Stage 4: Growth of Kooallupland

Figure 7 Schematic of Pleistocene geomorphic units on the Yalgorup Plain (from Semeniuk “New Pleistocene and Holocene Stratigraphic Units in the Yalgorup Plain Area, Southern Swan Coastal Plain” figure 3) Note the different sea levels.

(see figure 2). You are on an undulating plain sloping down to the sea. Sinking beneath, you could then swim through layers of variously silts, sands and limestone sediments (see figures 5-7).
Whilst conveying a sense of the strata below Lake Clifton is one of my goals, I would also like to develop a sense of multiple shorelines advancing and eroding. If one stands on the shore of Lake Clifton looking to the east is the edge of the Yalgorup Plain formed from the Mandurah-Eaton Ridge. This ridge is a quartz sand/recemented limestone barrier seen on the surface as the hill between the Harvey Estuary and Lake Clifton (Semeniuk “New Pleistocene and Holocene Stratigraphic Units in the Yalgorup Plain Area, Southern Swan Coastal Plain”). During the Pleistocene a sequence of calcareous sands were deposited and the beach moved westward. Vic Semeniuk calls this plain You-daland. Over time it was exposed to the air, weathered and further transformed through karst and calcrete development. Lake Clifton formed some time later behind a quartz sand spit: the Myalup Sand Barrier that grew along the coast through longshore drift, forming a lagoon and then a lake. According to fossil shell evidence, Lake Clifton closed to the sea for the last time sometime around 4670 to 3890 years ago (Coshell and Rosen).

Again time passed before the Myalup Sand Barrier was partly eaten away and then new calcareous shorelines were deposited forming the Kooallupland east of what is now Lake Preston. In the final sequence Lake Preston and the Leschenault Inlet formed last when Holocene calcareous sands develop into a new lagoon and barrier dune sequence.

Viewing it from above we can see a linear landscape that slowly builds from the east to the west with long periods of progradation interspersed with erosion accompanying sea level rises. The concept of sound echoing back and forth east to west will form part of the soundscape I am building. Also envisaged is transforming borehole or seismic data into sound lines.
Taphonomy - ataphonomy

So far I have recounted fairly unproblematic stories of thrombolitic time and shifting shorelines, but one of the most interesting aspects of microbialites is the debate in the scientific literature about whether the early fossil traces were indeed fully biological in origin. These early stromatolitic forms with their distinct layers or laminae have been argued by some as being merely evidence of chemical precipitation in calcium-saturated seas (e.g. Grotzinger and Rothman). In younger fossil stromatolites the microscopic stripes of black material can be analysed for organic carbon. In the very oldest fossils, most have been subjected to heat that has removed the organic carbon. They have undergone other geological processes over time that may distort what they look like today. Positive identification is reliant upon detailed examination of the microstructures left behind (Science Daily). With all fossils what we see are traces, never a complete or full record of the past. It is important to consider the concepts of loss and complexity with the use of scientific data in this project. My development of a sound ecosystem will be the tracing of a place, never a full record, but reflecting the 'sketchy' remnants of multiple pasts found in the evidence of today. Correspondingly the sound installations will be built up of fragments.

Furthermore, it will be important in this work to set this scientific knowledge within a living matrix. Figure 10 shows a fossil root channel common to calcareous soils of the Swan Coastal Plain. The calcareous sands deposited along the coastline from the Pleistocene until today have been modified as the calcium carbonate constituents were dissolved and redeposited in the soil profile (Semeniuk and Searle). How do we account for differing scales? At the individual scale, plants excrete excess calcium from their roots (rhizoconcretions) and burrow down preferentially to groundwater forming solution tubes. The biotic is transformed into the abiotic. At the local scale, variations in groundwater discharge influence the precipitation of calcrete and the size and later on the persistence of wave cut platforms (Semeniuk “Western Australian Naturalist’s Club Half Day Excursion to Mudrurup Rocks, Cottesloe”). Moving larger still, the barrier reefs offshore (themselves relic sand
Figure 10 Fossil root channels commonly found in Swan Coastal Plain limestones penetrating cross bedding planes and showing complexity at the scale of centimetres (photo Perdita Phillips)

Figure 11 Cyanobacteria in a Lake Clifton thrombolite (image courtesy of K. Grey, Geological Survey of Western Australia)
Dune systems) have persisted as major influences on subsequent shorelines (Semeniuk "Pleistocene Coastal Palaeogeography in Southwestern Australia -- Carbonate and Quartz Sand Sedimentation in Cuspate Forelands, Barriers and Ribbon Shoreline Deposits", see figure 7). Thus a history seen on the surface is influenced by histories underneath. The initial model of parallel shorelines becomes more complicated.

Furthermore the lakes of Yalgorup are not the rich wetlands of Anglo-European sensibility. The lakes change over the season and some dry out completely at the end of summer. Each has a different limnology, different salinity, alkalinity and distinct biogeochemical processes (Western Australian Planning Commission). Principally because of their salinity, none of them evoke orthodox European notions of lake: instead of suppleness and fecundity we have brittle and transient waters. How am I to build a work that includes or at least alludes to this complexity?

Clotted life and complexity

As noted above the colonies of cyanobacteria and accompanying microorganisms tend to collect or precipitate particles accumulating over time and most of the early fossils have distinct layers, creating a striated form, or stromatolite (figure 9). Whilst the general exterior morphology (as massive rounded blobs) of living microbialites can look similar, thrombolites are different internally. Their inner texture is fenestrated and not laminated, lumpy and more like peanut brittle, with mesoclots or roughly centimetre-sized areas interpreted as "discrete colonies or growth forms of calcified, internally poorly differentiated, and coccoid-dominated microbial communities" (Kennard and James 492).

This differentiation of microbialites into laminar and clotted (or other) forms might be passed off as a scientific pedantry but I contend here that there is a significance in this clotted and more chaotic occurrence. Simple 'laminar' narratives are becoming more complicated.
Lake Clifton’s thrombolites form the largest lake-bound microbialite reef in the southern hemisphere at over 6 kilometres long and up to 120 metres wide (Moore). Environmental issues affecting the Lake Clifton area include land clearing, increased nutrient input from agriculture and a drying climate. Impact includes lower lake levels and regionally lower groundwater levels. In combination with localised groundwater extraction, the overall impact is decreasing fresh water and bicarbonate input into the eastern shore of Lake Clifton, and increased nutrient input, which favours photosynthetic competitors such as Cladophora algae (Luu, Mitchell and Blyth). This has had a visibly profound effect on the thrombolites, which were recently listed as a critically endangered community under federal EPBC Act (Threatened Species Scientific Committee).

Nearby the forests are affected by Tuart Decline (Department of Conservation and Land Management, Ecoscape and Tuart Response Group (Western Australia)) which has no one cause, but appears to be the result of complex interactions between climate change, habitat loss and fragmentation, changes in land management (e.g. fire management, forestry practices), changes in hydrology, pests and pathogens (Tuart Health Research Group, Barber and Hardy). Despite being in a national park, Yalgorup is subject to increased population and housing pressure along its borders and as the city of Mandurah expands regionally.

It would appear impossible to convey the entire factual content of these issues (and of the many unknowns) and hence my search for deriving geological and geomorphological metaphors. Nevertheless my practice is material-driven (the substance of the place is important – and this is why the final artwork will be situated down at Lake Clifton and not in a gallery) and aligns with a philosophical naturalism in the sense that it is connected to the physical world and aims to sensitise people to ecosystemic processes. I hold to a position of ”artifactual constructivism” (Instone 133), combining “epistemological anti-realism with ontological realism,” acknowledging both the physicality of the

Figure 13 Tuart (Eucalyptus gomphocephala). The tree on the left is beginning to show ‘dieback’ in its upper branches (photo Perdita Phillips)
world and the emergent nature of its reality as it is practised into existence. Nonetheless it is a challenge to be conscious of the social cultures of a scientific nature (in a Latourian sense) at the same time as using it as a way of accessing landscape thinking (‘thinking like a lake’).

How can we develop a practice of language/poetics/ethics that also respects the moments at which nature refuses both its cultural construction and scientific investigation and the moments of alterity that permeate human/more-than-human interactions? William Grassie argues for conceiving of metaphor as tension; “a metaphor achieves its effect by holding in tension two incompatible meanings that reveal some new insight.”

No less clotted are the theories of Deleuze and Guattari, whose work abounds in geological and geographic metaphors and is indebted to complexity theory. Notable is their material and earthy geophilosophy: “thinking takes place in the relationship of territory and the earth” (Deleuze and Guattari 85). Might not a Deleuzoguattarian perspective (or variation thereof) lead to alternative structures of thinking and ecological action? There has been some recent interest in this demanding area of ecophilosophy (Herzogenrath Deleuze/Guattari & Ecology; Chisholm; Herzogenrath An [Un]Likely Alliance: Thinking Environment[S] with Deleuze[Guattari]). Deleuzoguattarian philosophy decentres humans and human subjectivity, working against the limitations of human stewardship and against the concept of a "balance of nature," instead highlighting “a plethora [of] local balances and imbalances which have to be assessed not from some global perspective, but from myriad local ones” (E. Holland). It is Deleuze and Guattari’s concern with the quality of subjectivity that binds together ecology and art (Genosko). In The Three Ecologies Guattari proposed ecological action three-fold at the level of the self, the environment and society (Guattari). Maskit argues that reducing our consumption can be rethought not as denial but more positively as a rearticulation of the self through Deleuzoguattarian philosophy (Maskit).
Figure 15 Ecosystemic/Deleuzoguattarian network doodle (image Perdita Phillips)

Figure 16 Dead bird skull (probably a cormorant) (photo Perdita Phillips)

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Entropy and Vitality

My investigations have raised three further areas of coagulation or ‘thickening’ within The Sixth Shore project. Firstly, as noted by others, the search for the last universal common ancestor (LUCA) is compromised by the lateral gene transfer in the very early evolution of life, leading to a model not of a tree of life but to a coral of life. Secondly, the knotty issue of problems with the relationship between the metaphors ‘lifted’ from science by Deleuze and Guattari to serve their own (valid) philosophical ends and the science itself. Is there common ground between their rhizomatic thinking and the rhizoconcretions of fossil roots common in the limestones and soils of Yalgorup National Park (see figure 10), the rhizosphere or even the scientific concept of the phytotarium (soils altered by plants and microorganisms to suit their own needs)?

Deleuzoguattarian philosophy is a process-based emancipatory program that advances heterogeneity over homogeneity (and minor science over major science). It is antithetical to the idea of forms of life work to create the maximal conditions for their own survival (and hence the building of microbialite structures). Organisms and ecosystems strive for self-organisation, contrary to entropy. Figure 17 captures a small seedling’s regular leaf pattern as a fleeting anti-entropic moment. Mycorrhizal symbiosis is common in many plant species in southwestern Western Australia. Will this seedling be susceptible to attack by the creeping mycelium of the introduced oomycota (water mould) species Phytophthora multivora recently found to be attacking tuarts (Scott et al.) and implicated in Tuart Decline?

My third point of thickening returns to the issue of how you use scientific data as one way to allow landscapes to speak at the same time maintaining a connection to the materiality and specificity of a place that science cannot capture?

Figure 17 Small seedling with opposite leaves (photo Perdita Phillips)
Figure 18 Textures of place: limestone weathering (photo Perdita Phillips)

Figure 19 Textures of place: lake-like corrugated iron from the lake’s edge (photo Perdita Phillips)
Some of this will occur through the ambient sound recording, which is a relatively direct way of facilitating the voices of Lake Clifton and the complexity of the place. My artistic investigations into the textures of Yalgorup National Park via photography and drawing (eg figures 18, 19 and page backgrounds) will also convey ‘place’ and no doubt other aspects will be covered in the other ‘shores’ of the project. Moreover, because I am a visual artist the process involves an act of double transformation: as I seek structures and patterns from this material and from what is the science discourse about Lake Clifton, I will transform it into a visuality that I can comprehend and thence from this compose it into sound structures, rhythms and landscapes that I can use in the final work.

I am keen not to use the scientific information in a purely representational way, to just observe and record, to merely analyse a landscape, its veins of rock and mineral or its flora and fauna, or to just think about landscapes, but to shift the process to ‘joined up thinking,’ to think as landscapes, to present an artwork that beguiles us into more complex thinking processes. To do so is to take advantage of the structure of the thrombolite with its clotted structure and convoluted air spaces.
Brittle waters

In sum, I have outlined important geological and geomorphological metaphors derived from what is known about Lake Clifton. I have discussed how I am dealing with complex communities and complex issues. Using different sound ‘shores’ will allow some of this to come across in the final artwork, although some of the deeper dilemmas of the research process discussed here will not be obvious to listeners. Wetlands have been theorised by a number of contemporary ecocritical thinkers\textsuperscript{12}. Giblett and Webb discuss how wetlands have been a site of contestation in Australian culture (Giblett and Webb). The Yalgorup lakes are no less contentious for being un-fecund and are another instance of being cautious of the limits of an aesthetics of care\textsuperscript{13} that utilises a narrow definition of the beautiful. We also need to be challenged by a dry lake. By articulating the competing human and nonhuman agents at Lake Clifton I hope to contribute to this by encouraging ecosystemic thinking and the inherent brittle and clotted beauty therein.

Notes

1 The so-called Great Oxygenation Event or Great Oxygen Catastrophe (for the anaerobic prokaryotes existing at that time).
2 see also Barbara Stafford’s discussion of deep time (2007).
3 See Mitchell (2010) for a further discussion of strata as a metaphor in contemporary literature.
4 The conditions and processes by which organisms become fossilised (How does a living thing become fossilised?)
5 There are numerous references to geological processes but in a language and interpretation idiosyncratic to their own devices: strata, desert, geology of morals, geomorphism (referring to birdsong), earth, ground, landscape and landscapicity (Mark Bonta and John Protevi).
6 e.g. Vaneechoutte and Fani; Glandsorff, Xu and Labeled; Doolittle; Forerterre et al.
7 “The tree of life should perhaps be called the coral of life” Charles Darwin (1987 25-26).
Creative catachresis.

6 literally, the sphere of influence of the plant root (rhiza): a definition which has also come to include not only the area around a root colonized by microorganisms, but also the parts of a root which contain microorganisms” (Wylie).

7 “higher plants and micro-organisms display an intrinsic capacity to be proactively involved in pedogenetic processes. ‘Bio-engineering’ of this kind is deemed to be spearheaded by principal deep-rooted tree and shrub species and to result in optimisation of command and conservation of water and nutrients within an ecosystem” (Verboom and Pate 71).

8 Deleuze and Guattari’s use of science to build structures of philosophy is not the prime focus of my concerns, but more the reliance on entropy as a ‘structure’ for change. Analogies can be drawn to the problem of the management of ecosystem disturbances and the invasion of introduced (feral) species such as Phytophthora into ecosystems.

9 See for example Huijbens and Pálsson; Lioi; Howarth.

10 See Nassauer (1997) for a further discussion of an aesthetics of care.

A high quality print version of this paper is available from the author.

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