STUMPY AND CO.
- STROMATOLITES OF WESTERN AUSTRALIA

Charles Hiscock

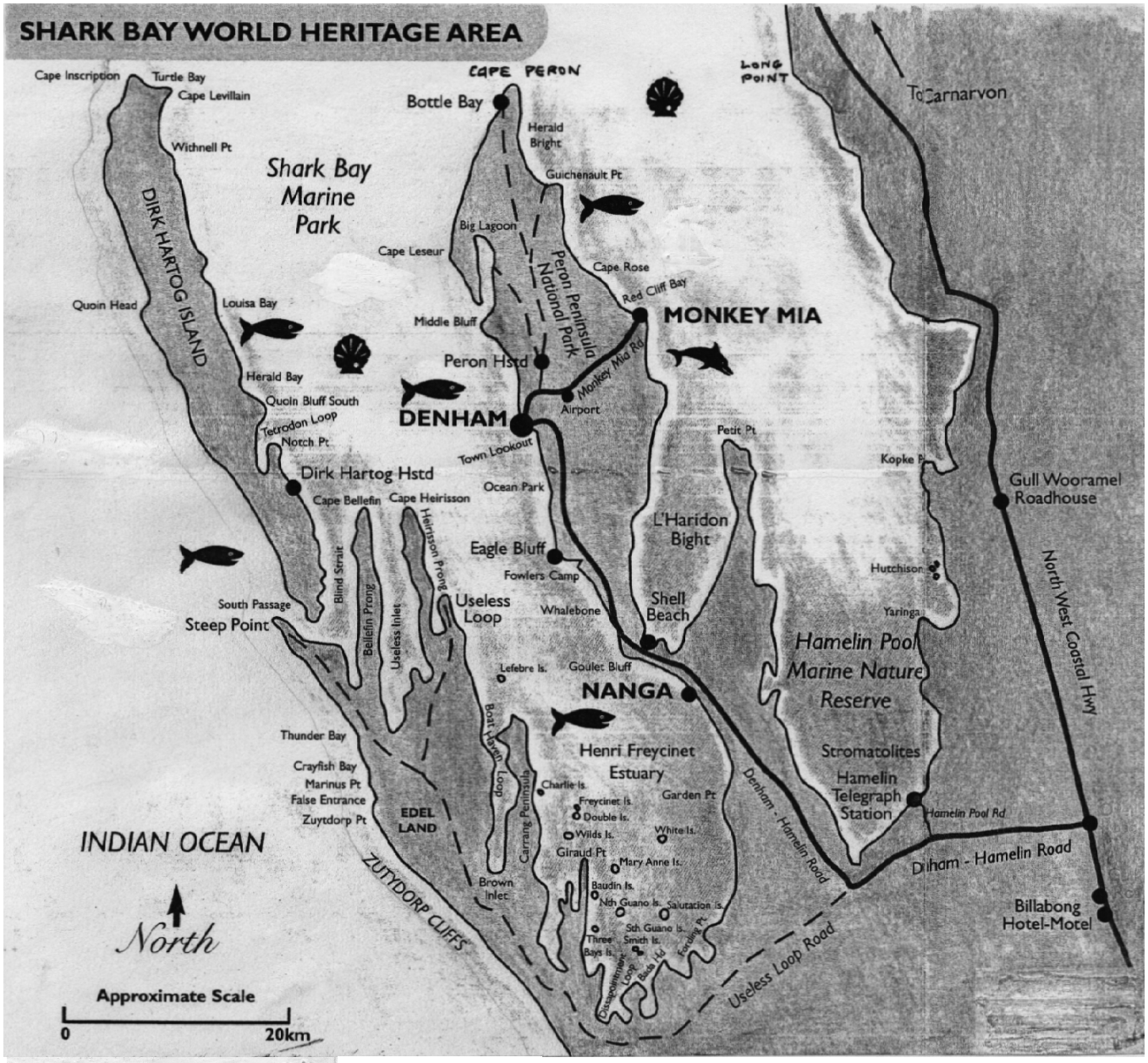
An odd title, you might think, for an article in the Bath Geological Society Journal; but all will be revealed. It started about 20 years ago when I was looking around 'my patch' of the Tortworth Inlier for fossils, minerals and rocks as part of my investigations of the area. On one occasion, I came across some algal limestone in the Brinkmarsh Beds (Wenlock division) in a dry stream bed. They were identified for me by Dr.V.A.Wright, described as stromatolites and compared with a locality I had never heard about - Shark Bay. "Where?" I asked. "Shark Bay in Australia - you can see stromatolites growing there as they have been for millions of years." After some enquiries, I read about and saw some pictures of these rather 'dull lumps of rock' in a sea lagoon. But, and you know how it happens, I had to see these rather 'dull lumps of rock' for myself - one of those 'must do' things!

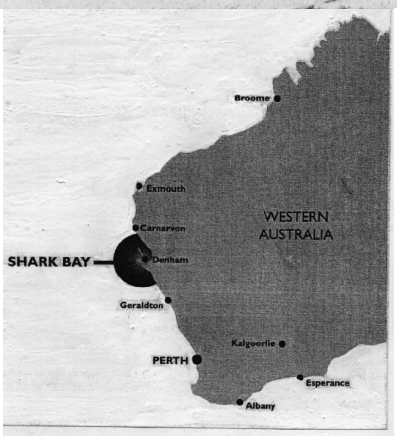
Photograph 1: Block of cemented Cardiid shells from Hamelin Bay beach quarry

So it was, in early October 2005 that myself and my wife, Gill, set off from Heathrow for the other side of the world. Our first port of call was North Island, New Zealand, to re-visit the Taupo Volcanic Zone and to climb, as far as we could, the volcanoes of Mounts Ruapehu and Taranaki. After a few days in Melbourne, Australia, we flew on to Perth, Western Australia where we picked up a camper van for the long drive north to Shark Bay, *(maps 1 and 2)*. The drive took us along endless straight and undulating but almost empty State Highway 1 through varied countryside - sorry, bush - with two overnight stops at campsites on the way. Our destination was Denham, 831 km north of Perth, but our prime target was Hamelin Pool, about 732 km from Perth.

We arrived at mid-morning at the tiny village in glorious weather, not hot, but pleasant with a cool breeze. All around, the earth was red; what I think of as typical Australian terrain with sparse vegetation but alive with colour from the spring flowers. The village consists of a café, a visitor centre (opened on request) a campsite and buildings and a large car park. Behind the café was the remains of a dunny (an outside loo, to you and me) and one or two other small outbuildings. To our surprise, the main buildings were built from rectangular blocks of cemented whole small shells. These are quarried from the beach and are still used to restore the older buildings with the 'stone' being cut using power saws and shaped on site. The 'stone' is composed almost entirely of *Cardiid* cockles, none larger than 1.0 cm diameter, with occasional other bivalve species and very rare gastropods, *(photograph 1)*. This was our introduction to the unique circumstances of Shark Bay Marine Park, of which Hamelin Pool is the southernmost area. Indeed, much of Shark Bay is one huge coquinite, a shell deposit which stretches from the shallow sand bar in the north, between Cape Peron North and Long Point on the mainland, south to Hamelin Pool, a distance of 115 km. Shark Bay Marine Park is the eastern of the two bays with the Peron Peninsula dividing it from the western bay, Denham Sound, which is 125 km long. Both bays are hypersaline with lime sand beaches derived from the breakdown of the shells and the Tamala Limestone (26-100,000 years) which underlies the west coast along much of its length and extends out into the Indian Ocean, forming a treacherous reef from a few 100 metres to 4 or 5 km from the shore. While its presence protects the coastline from the storms which blow in from the Indian Ocean, it has claimed hundreds of ships over the last 300 or so years. The hypersaline nature of Denham Bay and Shark Bay Marine Park has one important industry - evaporation of sea water to produce salt. On Useless Loop, we could see two huge glistening piles of sea salt across the bay. (Other names conjure up the desolate nature of the area which confronted the early settlers such as Disappointment Beach, False Entrance, Blind Sound, Hopeless Reach). In spite of all its desolation for humans, the unique nature of Shark Bay caused it to be one of the earliest World Heritage Sites in 1991, to protect the environment for the wildlife on land and in the sea, all of which have adapted to the conditions which we see as 'desolation'.

We went into the café-cum-giftshop and found a warm welcome. We were given all the information we needed to explore the area and visit the stromatolites; all for free, too. Behind the café, the 'dune', composed of 100% seashells rose about 50ft (15m) in front. Climbing the slope, we arrived at the top to be greeted by a wide expanse of brilliant white, undulating beach with sparse flowering plants and bushes. Beyond the beaches, a beautiful blue, green and turquoise sea spread far out into the distance, lined by these brilliant white seashell beaches, backed by





bright red land under a clear blue sky flecked with fluffy white clouds. What a lovely place (in spite of those damned flies which look for all the orifices on the head like terriers in a rabbit warren.) And there, from just above high water mark out into the sea for about 100 metres, were those "rather dull lumps of rock", *(photograph 2),* extending from left to right for about 300 metres. In the still clear water, we could see that they were roughly mushroom shaped with dark brown to black bun-shaped tops just above the water level.

To view the stromatolites, a. substantial boardwalk extends across the sea with explanation boards spaced out at intervals explaining the origins and existence of the stromatolites. And this is where Stumpy came on the scene. 'He' (or perhaps 'she') explains on the boards that he has three types of relatives - one that lives right on the water's edge with their caps just at surface level, a group that live in the intertidal zone and finally, those that live sub-tidally. In the area of Hamelin Pool, they form stromatolites in the same way. (Elsewhere, the organisms grow in other ways under different conditions.) The Cyanobacteria, with a different species for each of Stumpy's relatives, grow during the day, at less than one millimetre *per year,* photosynthesising to produce small bubbles of oxygen and the green and blue pigments. At the same time, they generate a mucus layer which traps sand and shell particles when the tide comes in and during rough weather. These particles coalesce to form the

Photograph 2: Intertidal stromatolite mounds at Hamelin Bay

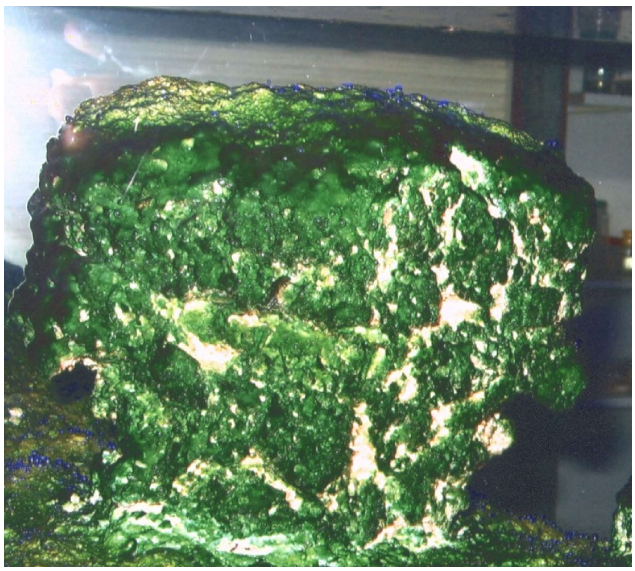
mounds. Many of the stromatolites, although only about 30cm or so high are estimated to be over 1000 years old. The cyanobacteria range from 1 to 10 microns (thousandths of a millimetre) so these mounds equate in human terms to a structure 105 x 75 km. Stumpy also explained that the flat eroded stromatolites on the beach were his dead relatives, some going back l000s of years, *(photograph 3).*

Photograph 3: Eroded stromatolite left behind by falling sea level. Its age is in 1000s of years.

So, after taking numerous (too many) photographs, we considered their history and origin. In the north of Western Australia, in the Pilbara range at the oddly named North Pole, Precambrian rocks dated at 2,700 million years old have yielded fossilised organisms which closely resemble the cyanobacteria of Hamelin Pool. It is clear that they photosynthesised, *(Ref. Sanders, H. "Biochemistry and the Fossil Record" Journal of Bath Geological Society, Vol. 24 Autumn 2005)*, and built huge reef areas characterised by the high levels of iron present. Indeed, the rocks are known as Banded Iron Formations, are an important source of iron ore not only in Australia but elsewhere in the world, and are mainly of Precambrian age. Like most other parts of the world, the rocks in Western Australia have been metamorphosed but the fossil bacteria can still be recognized in thin section.

So, how have Stumpy and his relatives existed for so long in Shark Bay? Although major and minor extinctions have come and gone, taking with them vast numbers of families and species, these lowly beings, which need sunlight, water and a protected environment, have hung on through all of them. All they need to grow is those three important factors which they get in Shark Bay; the tidal movement and exchange of seawater in the bay is almost excluded by an ice-age barrier across the northern end, accentuated by a tidal range of less than 0.5 metre. There are no rivers providing sediment into the bay and a high number of days with sunlight. Over thousands of years this has produced a hypersaline lagoon of vast proportions. The high salt content prevents the growth of creatures which would otherwise graze on the cyanobacteria e.g. gastropods, bivalves, so allowing the bacteria and algae to grow uninhibited. Indeed, it is the hypersalinity of the water that has encouraged the monoculture of the Cardiid cockles that form the extensive coquinites that exist in the bays. These shell reserves are so huge that they are considered a renewable resource and so are quarried for the surfacing of tracks, pavements, gardens and as a source of calcium for poultry.

Returning to the village, it was time to meet Stumpy. Paying my $A 2.5 (£1), the visitor centre was opened for me and the video about stromatolites started. Next to me, in an aquarium, was a stromatolite about 20cm high and 20-25 cm in diameter, lit by an ultra-violet light on a timer and immersed in seawater from the bay. In the gloom of the aquarium there was no evidence of colours but to my surprise and delight, when I printed my photo, it showed the green and blue of the cyanobacteria*, (photograph 4).*



Photograph 4: 'Stumpy' in a sea-water filled aquarium, lit by ultra violet light. Note the oxygen bubbles, particularly along the top of the mound.

Clearly visible were the bubbles of oxygen that they produce during photosynthesis. When we were looking at the stromatolites from the boardwalk, the bubbles could be seen on the surfaces of the mounds and rising to the surface. It is now generally accepted that it was the

production of oxygen by these and similar organisms in the Precambrian that provided an ever-increasing presence of the gas in the atmosphere to allow and support the divergence of life that occurred in the Precambrian and early Cambrian eras. Alongside the aquarium, with specimens of other stromatolites, was a fine example of the 2,700 million year old Pilbara stromatolite, *(photograph 5).*

Photograph 5: 3,500 million years old Pilbara stromatolite, showing 'banded iron formation'

There is so much more to tell about the Shark Bay area — the dolphins being fed at the shore, birds, beautiful Spring flowers, the vivid contrasts of colours, the endless bush - that I could continue for some time. However, reaching our goal and seeing Stumpy and his rather dull, lumpy relatives and realising that these simple organisms are the basis of life on earth today was satisfaction enough.

Postscript - Returning to Perth via the town of Cervantes, we visited Lake Thetis, which is an inland hypersaline lake once connected to the sea but now separated from it by a series of ancient lime sand dunes. On the shallow floor of the lake, stromatolite mounds grow much as they do in Shark Bay, up to 1 metre across, many eroded to show concentric patterns of layers. The microbial forms at Lake Thetis are common in Precambrian rocks and quite different from the Shark Bay species. Unlike those, the Lake Thetis ones usually have an algal growth which produces a wide pink halo of carotene. (At Port Gregory near Kalbarri, is Pink Lagoon which is a large lake coloured bright pink by carotene-producing algae. The carotene is harvested for the production of Vitamin A).

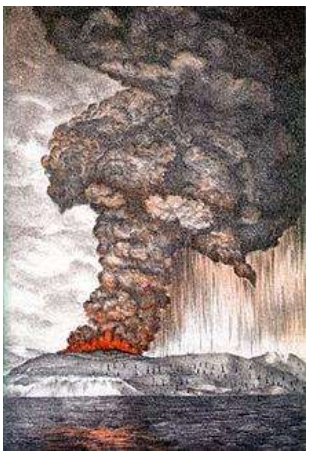
References

McNamara, K.J. Stromatolites. 1992. Western Australia Museum

BOOK REVIEWS

KRAKATOA – the day the world exploded.
Simon Winchester

I really enjoyed this book, once I got used to Winchester's style of writing, which might be described as slightly old fashioned. I would have been happy with an account of the 1883 Krakatau eruption, but this book gave much more.



It describes the fauna and flora around the area, the history of the Dutch East India Company (VOS), and a short history of the telegraph system. There is a certain amount of plate tectonics theory, which I feel that even a non-geologist would understand, the build up to the eruption, the event itself, with wonderful descriptions of the immediate effects and later effects.

It brings the whole thing to a conclusion with what is happening today with Anuk Krakatau (Son or child of Krakatau) and what may happen in the near future.

All in all it is a very readable book and recommended to people who haven't yet 'seen the geological light'!

Penguin Books, ISBN 0-141-00517-3, £7.99

John Willmouth

OUT OF EDEN; the peopling of the world
Stephen Oppenheimer

I can thoroughly recommend this book; it makes racial differences insignificant and climatic fluctuation quite the norm.

All of us have an African female and male ancestor in common - we are all ultimately descended from an African origin.

It can now be proved that all modern non-Africans sprang from a single exodus out of Africa, across the mouth of the Red Sea, about 85,000 years ago. The people, like those remaining in Africa, were already intellectually modern. The book traces their progress around the world to Australia, Asia, Beringia (now submerged), to Europe and the Americas.

It is "a brilliant synthesis of genetic, archaeological and climatic evidence - - -" *(Economist)*

Robinson, London, ISBN 1-84119-894-3, £8·99

Elizabeth Devon