Kata tjuta (The Olgas), NT

'There is a grandeur in this view of life'

Charles Darwin, 1859

Spanning some four billion years of complex evolution, this biography of continental Australia has, of necessity, been distilled to its barest factual elements. All the proper qualifiers and conditional clauses have been omitted in order to highlight the main thread of the narrative and express the majesty of the evolutionary drama that was played out here.

In other words, the events described did in fact occur, although in some instances their precise timing, duration and magnitude remains unresolved. Nevertheless, it would be sad indeed to miss the grandeur of the overview for the sake of academic consensus on the detail.

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LIFE'S FIRST SIGNATURE

3.86—3.47 billion years ago (Archaean).

Scattered across several crumbling ridge lines in north-western Australia there are fragments of a seabed that has monumental significance for us. The region's extraordinary stability for the past 3.5 billion-years has preserved even the ripples in its once-muddy surface, so you can't help but notice the curious, bubble-like eruptions that puncture it. Each puncture reveals the tip of a pile of limey waste left by a colony of microscopic bacteria that once lived there. Run a finger over those crumbling layers and you are tracing out life's oldest tangible signature on the face of the Earth.

We now know exactly what the fossils represent because you can wade waist deep among very similar piles of bacterial waste in the shallows of Hamelin Pool in Shark Bay, some 800 kilometres to the south-west. The similarity is not surprising. Their builders are the descendants of the bacteria that built the 3.5-billion-year-old fossils. But these ones are giants by comparison, for this is the oldest and largest population of 'living' stromatolites in the world.

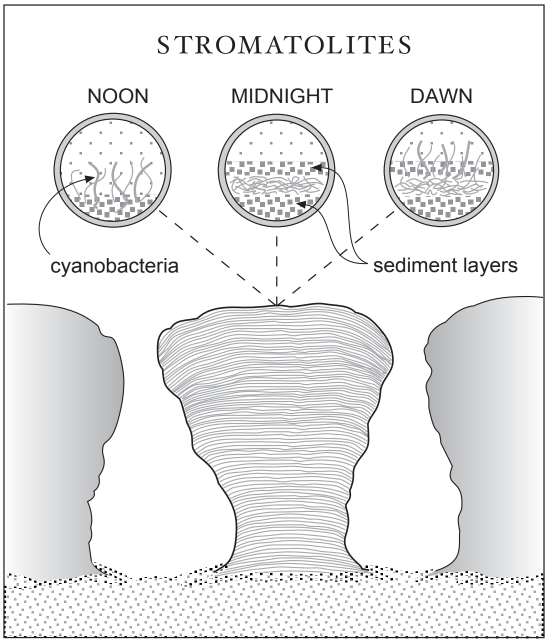
The surface of each stromatolite is inhabited by a dense mat of light-sensitive organisms that are often mistakenly called blue-green algae, or just 'blue-greens' because of their chlorophyll content. They are in fact bacteria, or more properly, cyanobacteria. Using sunlight as a power source and chlorophyll as a catalyst, they manufacture their own nutrient from carbon and other elements in the seawater. Their wastes include a small amount of oxygen gas and some limey minerals. Silt particles adhere to this sticky deposit throughout the day and build up during the night, burying the dormant cyanobacteria. When dawn breaks, they extricate themselves once more and migrate to the surface to resume their photosynthetic feeding. In this fashion, millimetre by millimetre, their waste pile grows. Some Shark Bay stromatolites are a metre tall and have been growing there for several thousand years.

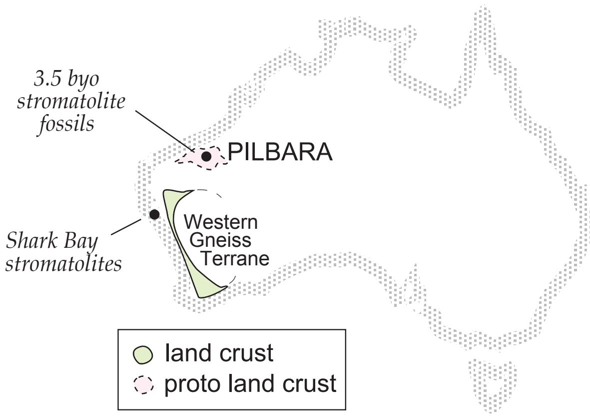
The diary of 'You'

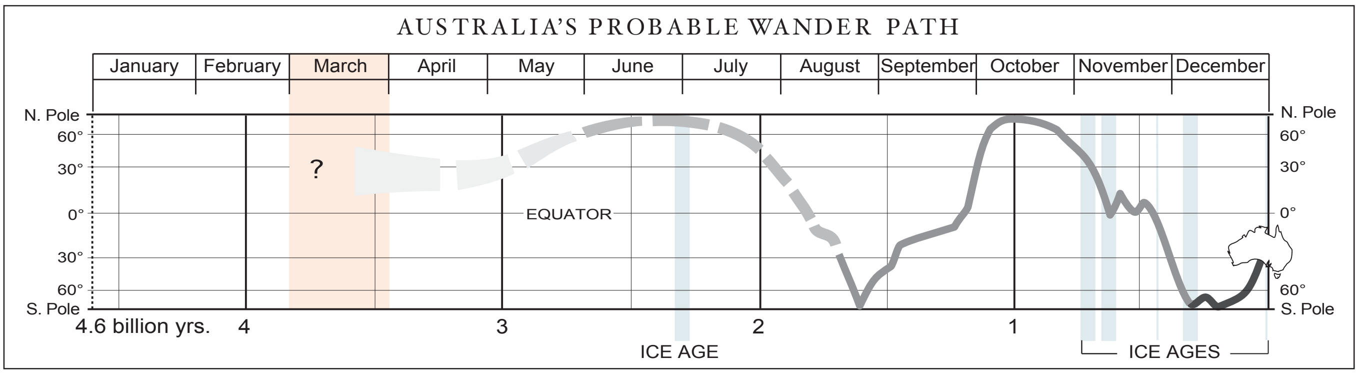
MARCH: By the end of this diary month genetic evolution will have mid-wifed an astonishing diversity of bacterial forms, and these will have resolved into two quite distinct evolutionary streams: the archaebacteria (archaea), and eubacteria ('true' bacteria).

We know relatively little about either at this early stage of evolution, but one of their most spectacular innovations has been incorporated in our eyes. It is the reddish pigment rhodopsin, produced by the highly-sensitive rod cells embedded round the edges of the human retina. Even dim light changes the shape of a rhodopsin molecule so we, like many modern creatures, use it to see in semi darkness. It was first incorporated into archaea more than 3.5 billion years ago and later passed to purple sulfur bacteria—which still use it.

Significantly, several features in your rod cells suggest that they are indeed bacterial in origin. So it seems that you owe your 'night vision' to about 100 million bacterial relics that live on, in a sense, within your eyes.

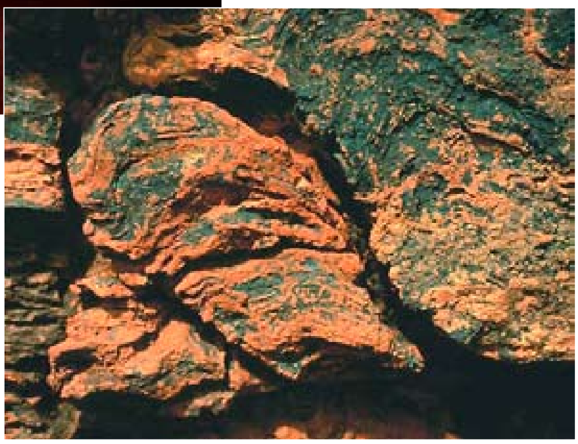






ABOVE: Submerged during high tide, these metre-tall Shark Bay stromatolites provide a refuge for small fish, while the bay's high salinity selectively excludes the gastropods and parrot fish that graze on cyanobacteria and prevent the growth of stomatolites in open waters.

LEFT: Many shoreline stromatolites become completely exposed during low tide. Normally grey, these were gilded by dawn sunlight.



RIGHT: This fossilised stromatolite is one of the oldest tangible traces of life on Earth. Sliced through vertically by faulting and erosion, its laminated, columnar structure proclaims its bacterial origin. It appears in marine sediments that have been securely dated as 3.5 billion years old. They once formed the bed of a shallow lagoon that was studded with many such piles of bacterial waste. A second stromatolite column, still embedded, is faintly visible on the right. These fossils are now exposed on a rocky outcrop west of Marble Bar in Western Australia's Pilbara.

EVOLUTION'S ICY SPUR

770—380 million years ago (Proterozoic-Phanerozoic).

Australia was drifting south into the tropics when global temperatures began their ominous decline. Yet paradoxically, latitude was to have little bearing on Australia's climate in this instance, for even the tropics froze for some 10 million years. And less than 40 million years later, as Australia drifted across the equator, much of the planet froze over a second time.

The cause of such global glaciation remains a mystery, but the biological impact was immense. As usual, hardship would prove to be evolution's spur. The evolutionary process accelerated, and when warmth finally returned, the seas were filled with new forms. Many of these organisms were multicelled, complex, and extraordinarily large (one species grew almost a metre long). Since recognised in many parts of the world, such fossils are still called Ediacaran after the site near the Flinders Ranges where such fossils were first found. One mystery remained: how could such complex organisms burst so abruptly into the fossil record when their ancestors left no physical impressions in the seafloors of the world? The answer may have been the Ediacarans' ability to make the tough, fibrous protein, collagen. Collagen can only be made when environmental oxygen levels climb above 10 per cent. Lacking collagen, the Ediacarans' ancestors would have swiftly disintegrated when they died, leaving no bodies to fossilise. It means that Ediacara's fossils may also signal a significant oxygen threshold. The success of the Ediacarans was short-lived however. Within 40 million years most were extinct and a new crop of experimental forms burst on to the evolutionary stage. Among these were the ancestors of most modern species.

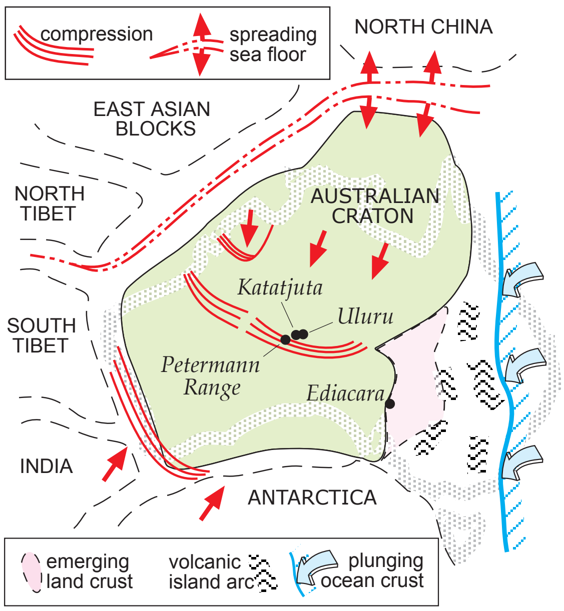
About this time too, Australia's ancient weld lines ruptured once more and heaved skywards in mountainous folds. Aeons of sun, rain, wind and ice, subsequently reduced most of these deformities to rubble and sand, and mountain torrents spewed their debris across the plains. One massive slab of that debris was itself later folded and eroded. Standing now in eerie isolation, two weather-beaten relics of that slab have become the predominant icons of the modern nation. We know them as Uluru (Ayers Rock) and Katatjuta (The Olgas).

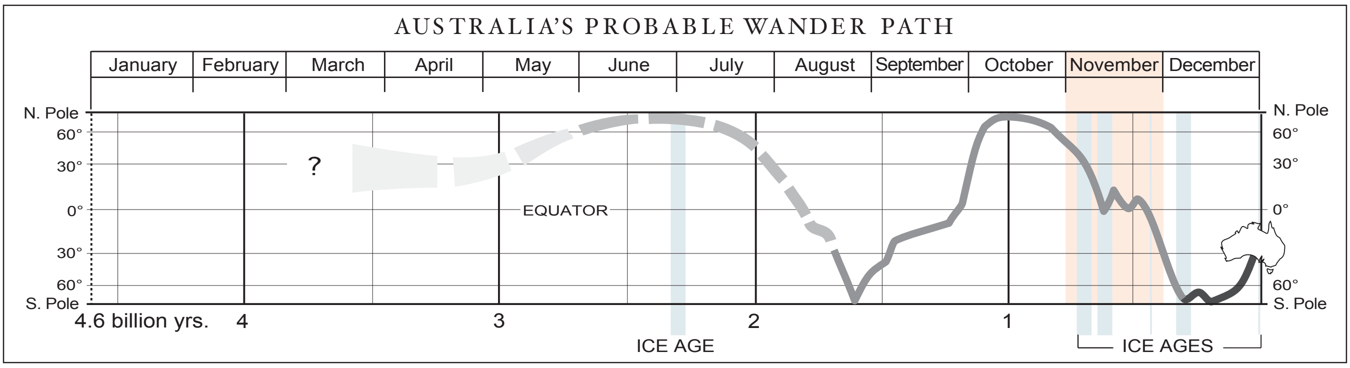
The diary of 'You'

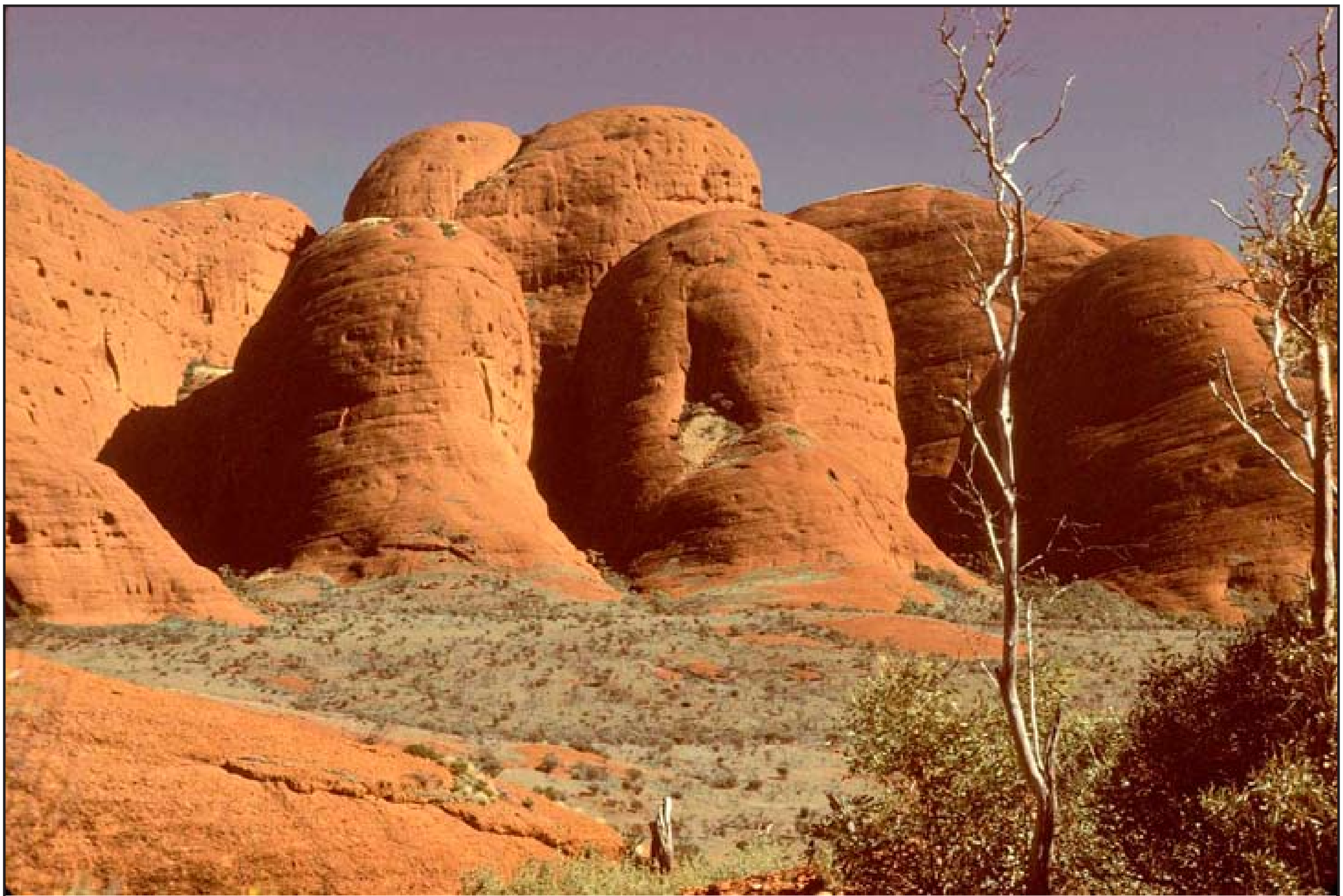
NOVEMBER: This is the month in which multicelled organisms begin to flourish along the seashores of the world, and it raises an intriguing question: life first appeared with 'miraculous' speed—almost as soon as water became available on Earth's surface. So why did it take almost 3 billion years for cells to learn to cooperate to any degree, and a further half billion years to form corporate bodies?

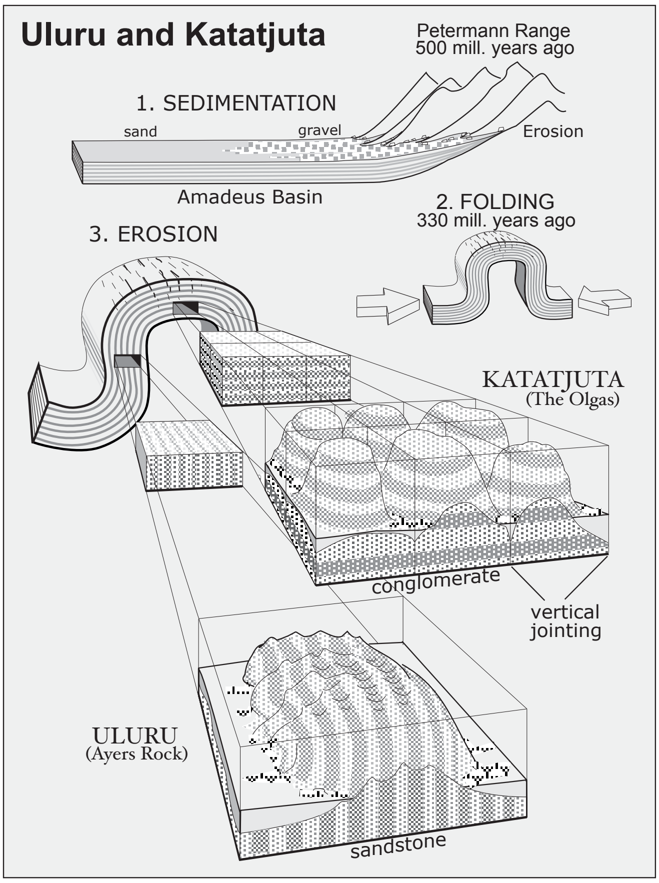
Whatever the answer, the solution to the problem of cooperation between cells represents the key to the kingdom of planet Earth. The building of multicelled masterpieces such as the jellyfish, the flea and 'you', will be simple by comparison, and by evolutionary standards it will happen with blinding speed.

As soon as the 10-percent-oxygen threshold is crossed, evolution takes off in a series of explosive surges that are checked only by major extinction events, such as those caused by the impact of comets. The most recent of these is occurring now and has already decimated the global biota. This time however, the cause is not a comet, it is us.









ABOVE: The domes of Katatjuta are the weathered remains of a vast bed of boulders that washed from a range of central Australian alps about 500 million years ago.

BELOW: Lying to the east of Katatjuta, Uluru has been carved from the same river-laid deposit, but here the strata has been tilted by subsequent folding.

ABOVE: Ediacaran fossils like this Dickinsonia costata, *represent the earliest trace of complex life.*