Nunn, Patrick. "What Else Might We Not Realise We Remember?." *The Edge of Memory: Ancient stories, oral tradition and the post-glacial world*. London: Bloomsbury Sigma, 2018. 167–200. *Bloomsbury Collections*. Web. 26 Apr. 2023. <<http://dx.doi.org/10.5040/9781472943255.0009>>.

Downloaded from Bloomsbury Collections, www.bloomsburycollections.com, 26 April 2023, 09:41 UTC.

Copyright © Patrick Nunn 2018. You may share this work for non-commercial purposes only, provided you give attribution to the copyright holder and the publisher, and provide a link to the Creative Commons licence.

What Else Might We Not Realise We Remember?

Back in the 1990s a greenhorn geologist, intrigued by the theoretical possibility of volcanic eruptions having occurred within the Fiji Islands archipelago during the period of its human occupation of some 3,000 years, determined to investigate a likely candidate for activity – the imposing, rainforest-cloaked mountain named Nabukelevu (meaning ‘the big yam mound’) at the western extremity of the island of Kadavu. A succession of boats got him to his destination, and the hospitable people of Daveqelevu village housed and fed him, while he spent several days on the mountainside following tracks made by feral pigs – the only thoroughfares – hoping to stumble across field evidence for recent volcanic activity. The nights he spent in Daveqelevu, listening to the people’s stories, enlivened by drinking *kava* made with the magical water that gushes from springs around the base of Nabukelevu, ultimately proved far more fruitful.

One of the stories told of a god named Tanovo, who resided on Ono Island, 50km (30 miles) north-east of Nabukelevu, and made a habit of sitting on the beach every evening contemplating the sun sinking slowly beneath the horizon. He did this until one day he found the horizon completely changed, besmirched even, by a monstrous protrusion – Nabukelevu – which had suddenly appeared to obstruct his view of the setting sun. In fury, Tanovo flew to western Kadavu to confront Tautaumolau, the upstart god of Nabukelevu. A battle ensued, but Tanovo was eventually bested and flew away, dropping earth as he went at the islands of Dravuni (meaning ash) and Galoa. Could it be, wondered the geologist, that an eruption of Nabukelevu – unarguably a youthful volcano – was witnessed by humans on nearby islands, who encoded their observations in myth so they

might be passed on through the centuries to warn their descendants ... and to intrigue outsiders? That geologist still thinks this is the case.¹

Up to this point the focus of this book has been on memories of coastline drowning – some plausibly recalling postglacial sea-level rise – that have come down to us today through largely oral means. The implication is that some such memories have been successfully passed continuously between hundreds of generations for several thousand years. This deduction is so astonishing yet apparently so unassailable that it seems worthwhile to now consider what other ancient memories we, as a species, might have ... and whether the antiquity of any of them matches those of the drowning stories. The example above is fairly solid evidence for a memory of a volcanic eruption having been preserved for perhaps 2,000–3,000 years. There are, of course, others, including the remarkable Klamath story of the eruption of Mt Mazama (and the associated formation of modern Crater Lake) recounted in Chapter 1, which appears to be around 7,600 years old. But how common are these stories? Are these examples anomalies, predestined for preservation by unique cultural circumstances, or are they representative of a largely undervalued body of knowledge? This chapter attempts to answer this question by looking – with a focus on Australia, where circumstances seem especially favourable – at stories of volcanic eruptions, abrupt land movements, meteorite falls and extinct animals.

Volcanic eruptions provide excellent material for mythmaking: they are frequently dramatic and therefore memorable; often shockingly disruptive and therefore imperative to explain to future generations so that they might recognise the warning signs and know what might follow. Volcano myths are common in the pantheons of collective memory created by many of the world's cultures whose people live or have lived in areas of volcanic activity. Japanese, Italian and Norse cultures, to name but three, are replete with volcano stories – about the fires within the Earth, about how feuding deities

rain fire on one another, and about how fire is used as a weapon or as punishment. However, this exemplifies one of the main challenges of identifying the antiquity of volcano myths in such places, namely that across a timespan of perhaps a few thousand years, volcanic activity has occurred so regularly that it is likely an original myth has been many times rejuvenated, and even embellished, by successive observations of similar phenomena.

Such a situation is well illustrated by the highlands of New Guinea, where legends about ash falls – often celebrated *post facto* for the fertility they restore to overworked soils – proved almost impossible to link to particular eruptions or even particular volcanoes by themselves.² New Guinea's active volcanoes are mostly coastal, often forming offshore islands that trace arcuate lines of crustal-plate convergence. Rarely, it seems, is one or other of them not active, but it was a particularly active period when William Dampier arrived there in 1700, encountering five of these 'burning' islands. All night on 25 March, he reported that the first

*... vomited Fire and Smoak very amazingly; and at every Belch we heard a dreadful noise like Thunder, and saw a Flame of Fire after it, the most terrifying [sight] that I ever saw.*³

What of New Guinea's southern neighbour, Australia, which as we have seen is today a somewhat geologically passive place? Have there been volcanic eruptions there within the 65,000 years or so that people have lived there?

Not surprisingly when you consider the vastness of Australia, the answer is yes. And yes, too, there are extant stories about some of these eruptions, which also comes as no surprise given the likelihood that Australia's Indigenous peoples have preserved other stories for perhaps more than 10 millennia. Yet critically, these eruptions have been isolated in both time and space in Australia, making any associated oral traditions relatively easy to link to particular events and places. This condition makes Australia an excellent place to study the antiquity of these oral traditions, better for this

purpose than New Guinea, Japan, Italy or Iceland, where the ubiquity of eruptions through time has rendered the relevant bodies of oral tradition far more nebulous and difficult to interpret.

The map in Figure 6.1 shows places in Australia where volcanic eruptions are known to have occurred within the past 65,000 years or so. They include at least five sites in northern Queensland (Lakes Barrine, Eacham and Euramoo; Kinrara and Nulla), five in southern Victoria (Napier, Eccles, Tower Hill, Warrnambool and Leura) and three just across the border in South Australia (Muirhead, Schank and Gambier). The activity of the volcanoes that these features represent must all have been witnessed by Aboriginal peoples and, as we shall see below, some of their observations have come down to us today.

It is something of a puzzle that young volcanic activity should have occurred on an ancient continent. Indeed, scientists are still struggling to explain some of this activity, although that in the south is possibly associated with the presence of a massive body of liquid rock – a mantle plume – that today lies beneath much of Tasmania and the adjacent ocean floor. This plume is a ‘hotspot’, a place where liquid rock from the Earth’s mantle protrudes into the overlying solid crust, coming so close to its surface (perhaps 80–150km/50–95 miles below it here) that some of this liquid rock has occasionally escaped upwards along cracks and come out at the Earth’s surface. It is not beyond the bounds of possibility that this might also occur in the future.

We know this mantle plume has been in existence for several tens of millions of years, for it first encountered the Australian mainland more than 33 million years ago to form the Mt Jukes Volcano (Cape Hillsborough), near what is now the central eastern Queensland coast (see Figure 6.1). As the Indo–Australian Plate continued its slow, inexorable progress north-northeastwards, as described in Chapter 2, so the mantle plume passed under the continent and formed a line of volcanoes, just like the classic hotspot chains of oceanic islands.⁴ The resulting Cosgrove Hotspot Track is some

Figure 6.1 The eastern half of Australia showing all the volcanoes known to have erupted within the last 65,000 years, the probable time that Aboriginal people have occupied the continent. Four of these volcanoes are shown in northern Queensland, five in southern Victoria and three in the nearby part of South Australia. The origin of at least some of this comparatively young volcanic activity can be attributed to the presence of the mantle plume that created the Cosgrove Hotspot Track within the last 33 million years.

2,200km (1,367 miles) in length, the longest hotspot track yet to be documented on a continent.

This mantle plume is implicated in the young volcanic activity that occurred in southern Australia, but exactly how is still something of a mystery. The volcanic activity defines the Newer Volcanics Province (NVP) and includes at least 704 points of eruption from at least 416 separate volcanic centres within an area of some 19,000km² (7,336mi²). But as you can see from the map, the NVP does not lie on the Cosgrove Hotspot Track – it is not even really close. Yet, given that the earliest volcanic activity in the NVP began about five million years ago, the timing with the progress of the relative movement of the plume is about right; it would have been closest to the NVP at this time. So we can envisage a situation where a sizeable piece of the plume (a diapir) at this time branched or broke off to its west to form a body of liquid rock beneath this part of southern Australia where, for the next five million years or so, it has periodically leaked to create the NVP.⁵

Uncertainty feeds scepticism, especially when this fuels self-interest. The idea that scientists cannot explain why volcanic activity has occurred recently in Australia might indeed strain the credulity of some of its citizens about whether this activity really did occur. But we have two excellent ways of corroborating this: radiometric dating and, more tellingly for sceptics, eyewitness accounts.

Largely because its results contradict certain narrow partisan interpretations of the Christian Bible, the concept of radiometric dating has received a bit of bad press in some quarters,⁶ although it has been used routinely for decades by scientists to determine the ages of particular rocks. After these rocks first form, radioactive impurities within them start to change – or decay – over long time periods into different types of material. By knowing the rates at which such radioactive decay takes place, we can calculate the time that has elapsed since the formation of a particular rock by measuring the proportions in it of both the ‘parent’ radioactive substance and the ‘daughter’ (or decay product). Most volcanic rocks that have been dated, including those from Australia’s

younger volcanoes, have been subject to age determination using the potassium-argon (K-Ar) method. In this, an isotope of potassium (^{40}K) decays to one of argon (^{40}Ar). For half the ^{40}K present in the original rock to become ^{40}Ar , it takes around 1.3 billion years, so you can see potentially how powerful this dating technique is. Almost every volcanic rock that became solid (cooled from a liquid state) within the past two billion years or so can be dated using this method.⁷

Another important radiometric dating technique is radiocarbon dating, based on the decay of the radioactive isotope of carbon (^{14}C), and applicable to any substance with carbon in it. By measuring the ratio of ^{14}C to the non-radioactive carbon isotope ^{12}C , the age of a substance like a piece of shell, bone or hair can be measured. Its age is that from the time when the carbon-containing lifeform died, ceasing to renew its stock of ^{14}C from the food it ate, until the present. With a half-life of 5,730 years and with quantities of the two isotopes able to be measured very precisely, radiocarbon dating has been used widely. You cannot use it on most volcanic rocks, but you can use it on some of the things that are buried when lavas flow (or hot rocks are blown) out of volcanoes. They include items like soils or shell middens, and even old fire pits containing charcoal and bones. Some of Australia's young volcanoes cannot be dated directly because the erupted materials are too weathered; in such cases, radiocarbon dates from associated materials can be used to provide maximum (sometimes minimum) ages for a particular eruption.

There was once a man, a veritable giant named Craitbul, who with his wife, also of 'immense size', and two sons wandered through south Australia in search of a place where they might live in peace, free from fear of the evil spirit Tennateona.⁸ The family first settled atop Mt Muirhead, one of the younger volcanoes in the NVP, where they lived 'for a considerable time in peace'. Accustomed to cooking food in the ground, they dug a hole there in which they placed their food, covered it with earth and went to sleep, anticipating that it would be cooked when they got up the next morning.

But in the night they were awoken suddenly by the shrieking of a bird known as a *bullin*. Believing this portended the presence nearby of Tennateona, they fled, eventually settling on Mt Schank, where once again they camped and ‘began to enjoy themselves’. But one night, their cooking oven emptied, they were again awoken by the *bullin*’s cries and fled inland, away from the sea near to which they believed Tennateona preferred to be close. They travelled to Mt Gambier ‘and lived here a long time’, as usual making their oven within it. But one day water rose up from below, putting out their oven’s fire. So they dug another, and the same thing happened, and so on and so on. Finally they gave up and were last heard of living in a ‘cave on the side of the peak’.⁹

If we equate the ovens with the craters within these mountains, then we could also read the cries of the *bullin* and the emptying of ovens as euphemisms for the alarm accompanying the eruptions of these volcanoes, as well as the facts of this. The four craters of Mt Gambier are *maars*, products of spectacularly explosive eruptions that occur when superheated liquid rock (magma) rising up a vertical fissure through the crust encounters cold groundwater. The resulting phreatomagmatic explosion shoots out lava fragments and ash in every direction. When these fall to the ground they often harden to form a circular ridge – marking the spatial limits of the eruption – which may later become filled with rainwater to form a *maar* lake. Most of the *maars* of the Mt Gambier region are today water filled, so we can interpret Craitbul’s ovens as being the active *maar* volcanoes that were subsequently flooded. It is hard to see what other interpretation might be placed on such a detailed story (see colour plate section).

How old might the story of Craitbul be? Radiocarbon dating of plant material buried within volcanic ash on the floors of the *maar* lakes of Mt Gambier suggests that the most recent period of volcanic activity here took place around 4,300 years ago, about the same time as the last eruption of Mt Schank.¹⁰ Several other Aboriginal stories report fire being thrown from these mountains, and at least one

informant at Mt Leura identified some of the volcanic bombs, which are typical products of explosive eruptions, as just like 'stones which their forefathers told them had been thrown out of the hill by the action of fire'.¹¹

Mt Eccles is another young NVP volcano,¹² and there are said to be Gunditjmara Aboriginal stories that recall its most recent eruption. This is likely to be that of the Tyrendarra lava flow, much of which is now as much as 33m (108ft) below the ocean surface. Yet when it formed it covered only dry land; it did not run into the sea. So while the lava flow itself has proved impossible to date directly, we can estimate a minimum age of 10,500 years ago for the eruption that formed it – the time when the sea floor now 33m deep was last dry land.¹³

Much of the realisation that Aboriginal Australians had witnessed volcanoes erupting came from understanding the meanings of place names. Among some of the early European settlers in parts of Australia, there was a tradition of recording Indigenous names for particular places, something that has occasionally been found to hold insights into their history.

There never were elephants living in Australia, so the name Mt Elephant for the young scoria cone volcano in south-west Victoria is clearly one given by European settlers, one assumes on account of the pachydermic appearance of the mountain from a certain angle. Yet far earlier in time, the Aboriginal people of the area called this mountain Gerinyelam, meaning 'hill of fire'. Given that Mt Elephant formed 5,000–20,000 years ago, we can assume that its eruption was witnessed, a fact that was probably once preserved in stories that now appear to be lost, yet have their essence kept alive in the name Gerinyelam.¹⁴ Another example is that of the Gunditjmara people who call nearby Mt Eccles by the name Budj Bim (high head), and its associated spatter cones and tumuli *tung att*, or 'teeth belonging to it'.¹⁵

What of the other group of youthful volcanoes in Australia, those in northern Queensland? Their origins are perhaps even more elusive than those of the NVP.¹⁶ Like this group of volcanoes, they exhibit no age progression in any direction,

so that eruptions here cannot be readily explained by the movement of the Australian continent over a mantle plume, as can eruptions of the older volcanoes along the Cosgrove Track. Eruptions in northern Queensland have been continuing – on and off every 10,000 years or so – for the last nine million years, and the area is still considered ‘potentially active’.¹⁷

Aboriginal stories about eruptions in the Kinrara area belong to the Gugu Badhun people and describe events that may have occurred 7,000 years ago.¹⁸ One story recalls the time when the watercourses that flow through the area – and from which the local Aboriginal people rarely strayed far – caught fire. Another story is about a witch doctor who made a huge pit in the ground, filling the air with dust, in which people became disoriented and died. This eruption of Kinrara involved the emplacement of lava flows – some ran down the river valleys for tens of kilometres – which is a plausible explanation for rivers said to have caught fire. The dust cloud and the deaths of affected people are equally easy to explain, for this eruption – the youngest known at Kinrara – was focused on a crater (the witch doctor’s pit) and involved ash-rich eruptions likely to have created dense clouds suffused with poisonous gases that drifted over the surrounding area, killing many of its inhabitants.¹⁹

Further north, Lakes Barrine, Eacham and Euramoo on the Atherton Tableland are three *maar* crater volcanoes, one or more of which may have erupted during the time that people have been living in this area. By dating (using radiocarbon) the earliest layers of sedimentary fill in these craters, minimum ages for their formation – presumably during a volcanic eruption – have been obtained. In this way, we know that the most recent possible date for the last eruption at Lake Eacham was around 9,130 years ago; that at Lake Euramoo perhaps 15,000 years ago; and that at Lake Barrine some 17,300 years ago.

Several Aboriginal groups in the area have stories about the eruption of Lake Eacham (and Barrine and Euramoo in some versions), all of which are quite similar. The essence of

these stories is that two newly initiated youths were confined to camp, as was common practice, while their elders went to collect food. Needing to defecate, one youth went a short distance into the bush, accompanied by the other – breaking the taboo. The boys saw a wallaby and one fetched a spear that his companion threw at the animal. It missed, instead hitting a flame tree that is sacred to the Rainbow Serpent, the most iconic supernatural being in the Dreamtime bestiary. Thereafter things began to go badly wrong, and when the elders returned from hunting, they knew it. For although it was the middle of the day, the sky turned blackish-red – the colour of a striking sunset – and shortly afterwards the earth began to ‘crack and heave, spilling out a liquid that engulfed the camp and all the people in it, and forming the three modern crater lakes’.²⁰

Australian Aboriginal stories about volcanic eruptions have come to confirm what science has learnt only far more recently. We can rate the authenticity of these stories highly, for nowhere do we find them applied to features that are not youthful volcanoes. In northern Queensland, for instance, Aboriginal stories about eruptions do not refer to other, much older crater lakes like Lynch’s Crater, where the last eruption took place around 200,000 years ago, well before people first reached Australia. And in the NVP in South Australia, no Aboriginal eruption stories are applied to those volcanoes – like Mt Napier and Tower Hill – where the last eruptions occurred more than 30,000 years ago.

There are few other places in the world where indigenous stories, passed on orally, recall ancient volcanic eruptions that have been virtually unknown in modern (literate) times. Of course, such stories abound where there are currently active volcanoes that have been periodically active ever since people arrived in their vicinity. So while any associated oral traditions are of interest, they do not really hold any surprises.

Take the iconic Mt Fuji (Fujisan), a mere 100km (62 miles) from Tokyo on Honshu Island in Japan. Aside from its form – that of a classic volcano, which has been celebrated in Japanese art and spirituality for millennia, Fujisan has been periodically

active. Although its last proper eruption was in AD 1707–1708, the mountain groans audibly at times and belches gases continuously from fumaroles along its periphery, all signs that this volcano is far from deceased. There are numerous oral traditions about Fujisan's origin, one being about a giant who decided one day to fill up the Pacific Ocean with earth. Toiling all night, he was dismayed when dawn broke to find that he had made hardly any progress with his task, so he dumped the bag of earth he was carrying where Fujisan is today ... and stomped off sulkily. While entertaining and possibly containing some geological detail – perhaps about how Fujisan was created quickly – the story does not supply any details that are not already glaringly obvious. Similar stories abound in Icelandic lore, for example, as well as elsewhere.²¹

In the islands of Hawaii there are numerous stories about volcanic eruptions, but here – with a degree of precision that is almost unique – it is chiefly genealogies passed on orally for several hundred years that can be used to date particular events, something that science has since corroborated. For example, Hawaiian traditions (*mo'olelo*) recall that during the reign of Keali'iokaloa (approximately AD 1525–1600), a young chief from the Puna district of the Big Island (often spelled Hawai'i to distinguish it from the name of the island group) failed to properly acknowledge Pele, the fractious volcano goddess, so she pursued him downhill at high speed and followed him into the ocean – a likely recollection of a lava eruption dated to the same period.

There are three other examples of stories about volcanic eruptions that are worth mentioning since they contain significant information about particular events that science has not yet been able to fully verify.

The first example comes from the north-west United States, where lies Mt Rainier, perhaps the most potentially hazardous volcano in the Cascades. Rising almost 4,400m (14,436ft) above the ocean, Rainier can be clearly seen from most of Seattle and other densely populated coastal areas of Washington State. Rainier has been periodically active for

most of the 15,000 years or so that people have lived in North America, and they have witnessed – and presumably struggled to rationalise – the multifarious expressions of its activity. In a Nisqually Native American oral tradition, Rainier is a monster that moved through the landscape swallowing every creature it encountered, until one day it met a fox that had wilily fastened itself to a neighbouring mountain. Exerting itself to try and devour the fox, Rainier eventually burst a blood vessel, causing rivers of blood to flow down its flanks. It is suggested that this myth recalls the time some 5,600 years ago when a phreatomagmatic eruption at the top of Mt Rainier produced the phenomenal Osceola Mudflow, which travelled more than 120km (75 miles) (to the outskirts of modern Seattle), eventually covering an area of more than 200km² (77mi²). Studies of the nature of the flow structures within the mudflow sediments show that it moved as much as 19m (62ft) a second across the Puget Sound lowland – by any yardstick, a dramatic and memorable event worthy of becoming the subject of an important and enduring myth.

The second example comes from Indonesia, some of the islands of which are spectacularly volcanically active, lying above the place where the Indo-Australian Plate is being thrust beneath its Asian counterpart. The 1883 eruption that destroyed the island of Krakatau (Krakatoa) and was heard across 8 per cent of the Earth's surface occurred here for this reason.²² Plate underthrusting and associated melting at depth also explain the brooding presence of the volcano of Tangkuban Parahu in western Java, 17km (11 miles) north of the city of Bandung, home to some three million souls, most of whom have witnessed (or will witness in their lifetimes) activity at this volcano (see colour plate section). A Sundanese oral tradition, first referred to in the *Bujangga Manik* (56 lines of narrative verse written about 500 years ago on 29 palm leaves), explains that a young man named Sangkuriang was once whacked over the head with a *centong* (rice scoop) by his mother, Dayang Sumbi, sustaining a wound that left a permanent scar. Sangkuriang and his mother parted company after this, but when he later went in search of a wife he fell in

love with her, not knowing that she was his mother, and determined to marry her. But Dayang Sumbi felt the scar on his head and knew he was her son, so refused to marry him. Sangkuriang was undeterred, so Dayang Sumbi challenged him to do what she thought was impossible – to create in one night a huge lake and a giant boat (*parahu*) for them to sail there. Damming the Citarum River and felling a giant tree, Sangkuriang almost did the impossible. Seeing this was about to happen, Dayang Sumbi caused the dawn to rise early that day and the cocks to crow. Believing then that he had failed, Sangkuriang smashed the boat, turning it upside down (*tangkuban*), and eventually both he and his mother drowned when the dam broke and the lake emptied. It is the existence of a former lake atop Tangkuban Parahu that gives some authenticity to this story as deriving from an eyewitness account. While poorly dated, it is clear that the Citarum Valley was once dammed by landslides, causing a lake to form and eventually to empty, perhaps 16,000 years ago.²³

A final example comes from Eurasia, from the breathtakingly beautiful Caucasus Mountains that mark the border between Georgia and Russia, and which formed as a result of the compression between the Arabian and Eurasian crustal plates. Numerous volcanoes, the highest of which are snow covered, tower over the landscape. Many have been active within the last few thousand years, a clear sign that a mantle plume has formed beneath the mountain range, exploiting lines of crustal weakness created during the prolonged compression. Even a passing acquaintance with Caucasian (*sensu stricto*) cultures is likely to throw up the name of Amirani, a hero of the region best remembered for having been chained to one of its mountains and attacked – like the Greek Prometheus and the situation at Mt St Helens (see colour plate section) – by an eagle drawing his blood. Another common story about Amirani relates how he cornered hordes of demons within the walls of a mountaintop fortress, then proceeded to massacre them; so much blood was spilt that the fortress walls finally gave way and rivers of blood poured down the sides of the mountain.²⁴ Like the Promethean stories about Amirani, this one seems

likely to recall a volcanic eruption, but from where and when? Within the Caucasus, the greatest concentration of Amirani traditions appears to be associated with Mt Kazbek volcano, which has not erupted for about 6,000 years. A better candidate for the Amirani stories may be Mt Elbrus, the highest in the range, which last erupted about AD 320 and may be due for another period of activity soon.²⁵

A summary of the likely longevity of the examples of volcano stories, preserved for most their time in oral form, is shown in Figure 6.2 overleaf.

There is no question that ancient stories of volcanic eruptions and kindred phenomena exist in many of the world's cultures and may extend back many millennia, perhaps 10 millennia in the cases of Eccles and Eacham, and possibly even more for Tangkuban Parahu. Science is indebted to indigenous stories of this kind, not simply because they confirm the existence – and sometimes give insights into the nature – of particular volcanic events, but also because in some cases they identify events that may not hitherto have been detected by scientific investigations.

The upper parts of our oceans are alive, yet much of what lives there is so small that we cannot see it with the naked eye – so often we naively assume the ocean water we swim in to be clean. It is not. Microscopic carbon-based organisms, often lumped under the name plankton, abound. When they die, their hard parts usually sink to the ocean floor, sometimes kilometres deep, where they may become buried by layers of sediment. They are out of sight but certainly not out of mind for heterotrophic bacteria,²⁶ which eventually find and consume them, releasing methane gas in the process. Pressure forces this gas upwards from the warm places within the sediment pile to its surface – the ocean floor – where it is much colder. Sometimes ocean water here becomes frozen around handfuls of gas, forming layers of methane hydrates that can themselves become buried at shallow levels within ocean-floor sediment. Now imagine this happening when the sea level was lower, as it was by

Figure 6.2 *Probable ages of volcanic eruptions recorded in oral traditions from Australia and elsewhere, details of which are in the text.*

120m (400ft) or so during the last ice age; then what happens subsequently as the sea level rises rapidly thereafter. Suddenly the weight of seawater above the layers of methane hydrates – layers of ice-encaged lumps of methane – increases, perhaps to a point where the ice cages are smashed and the methane escapes. The whole pile of sediments in which the gas hydrates had existed becomes buoyant, and is destabilised and liable to collapse.

Known as the clathrate-gun hypothesis, this explanation for massive collapses of continental fringes may account for why so many such collapses occurred during the time of postglacial sea-level rise.²⁷ In such cases it is often not the slide itself that causes most problems for people, but the massive waves it generates that can wash across nearby coasts. A little over 8,000 years ago, a sizeable chunk – more than 3,000km³ (720mi³) – of the Norwegian continental shelf abruptly collapsed, creating what has become known as the Storegga Slide. It generated waves 12m (40ft) high that swept across nearby coasts and even travelled further afield. The main wave is estimated to have been 20m (65ft) high when it reached the coasts of the Shetland Islands, and a couple of metres lower when it smashed into the Scottish mainland, inundating coastal settlements with little warning and scattering the stone tools used by their inhabitants across a wide area.²⁸

No oral traditions of this event have come down to us today, perhaps because it was so long ago and the subsequent admixing of people in many of the affected areas militated against the preservation of ancient stories. You can bet there *were* oral traditions about the Storegga Slide in Norwegian and Caledonian cultures, reflected echoes of which may be found in their extant myths about the destruction of worlds,²⁹ although no specific connections have been identified. The same is not true of other places where land has abruptly disappeared.

In island worlds, it is possible for entire islands to disappear comparatively quickly,³⁰ something that would clearly have caused consternation among the people of neighbouring islands, who often encoded their observations of such events in myths. To understand how an island might disappear, consider that most islands – especially those of volcanic origin in the middle of oceans – are both steep-sided and may have only a few per cent of their total mass exposed above the ocean surface. Just as happens on any steep-sided landform, landslides occur regularly on the sides of these islands, particularly those that are occasionally rocked by earthquakes.

Such landslides – or flank collapses as geologists more commonly refer to them – may take a chunk out of the side of an island or even remove its top, its entire above-sea portion. In the greater scheme of volcano and island evolution, this is not really significant, but to the air-breathing occupants of the island and its neighbours it is massive.

One comparatively well-documented example of such a ‘vanished island’ comes from the Solomon Islands archipelago in the south-west Pacific Ocean, where once an island named Teonimenu existed. Even though it disappeared hundreds of years ago, people living on nearby Ulawa Island know where Teonimenu was. Today it is a favoured fishing ground of theirs, with the top of the ancient island now being a submarine bank (named Lark Shoal) some 10m (33ft) below the ocean surface. The Ulawans say that on a placid sea, watchers may look down from boats above and see the ancient structures that people once made on Teonimenu, and sometimes even hear the beating of their drums and the sounds of their voices ...

Like Ulawa today, Teonimenu was once an emergent part of an undersea ridge, steepest on its eastern side where the sea floor descends to the Cape Johnston Trench, where a crustal plate further east is (or was) being thrust beneath that to the west. The area is often shaken by earthquakes, perhaps caused by nearby underthrusting of one plate beneath the other or – more likely given the origins of most of the area’s recent seismicity – the north–south compression of the Earth’s crust here. For the Solomon Islands rise from an isolated chunk of the Earth’s crust that is being compressed obliquely between the northward movement of the Indo–Australian Plate and the north–westward movement of the Pacific Plate. The result is that the Solomon Islands are uncommonly subject to earthquakes, some of considerable magnitude, which often generate tsunamis and may cause land to rise or fall abruptly. It is likely that, one day a few hundred years ago, a sea-floor earthquake close to Teonimenu caused tsunamis but also shook the island so much that it slipped a few tens of metres downslope in a massive flank collapse, removing itself in an

instant from the human geography of the central eastern Solomon Islands.

The story has reached us today through the mouths of local people, who will tell you about mad jealous Roraimenu from nearby Ali'ite Island, who married a capricious black-eyed beauty from Teonimenu named Sauwete'au. Tiring of Roraimenu, Sauwete'au one day eloped and returned to Teonimenu. Without compromise in mind, her husband went to consult a spell-seller on a nearby island, then sailed for Teonimenu prepared to plant the wave curse he had purchased there in order to destroy his errant wife's island. As he sailed on his way there, grim-faced, people on nearby islands, alerted to his purpose, called out to him in fear, 'Which island are you going to destroy?' (*Hanua i hei oto a nai warea?*), but Roraimenu did not respond. Placing the curse on Teonimenu, he then retreated to a high point on Ali'ite to watch the destruction of Sauwete'au's island. The water around Teonimenu churned and it was hit by a succession of giant waves as it sank beneath the ocean surface, never again to be seen. Oral histories from neighbouring islands recall how some inhabitants of Teonimenu saved themselves and where their descendants live today. Clearly the disappearance of Teonimenu resonated throughout this part of the Solomon Islands.³¹

For a second example of an island collapse, we turn to the Marquesas Islands of French Polynesia in the Central Pacific. The Marquesas are volcanic and are something of an enigma to oceanic geologists, for the total volume of material making up the islands today is just a fraction of that which has been eroded off them and encircles them in a vast debris apron. The inescapable conclusion is that these islands have many times built themselves up to a state rather like they are in today, before being almost wholly eroded, then rebuilding themselves, and so on and so on.³²

There is today a rather insignificant uninhabited rock named Fatu Huku in the Marquesas, but when Captain James Cook visited these islands in 1774 it was much larger and probably populated. Yet Porter's map of 1820 showed Fatu Huku to be much as it is today, perhaps a twentieth of its

original size, and thus likely to have been affected by a collapse that led to the disappearance of most of the island within the interregnum.³³ Believing that Fatu Huku was once supported by a pillar of rock rising from the Earth's interior (it was not), Marquesan legends attribute its collapse to the shark guardian of the island which one day – to punish its dissolute inhabitants – used its tail to lash the pillar, causing it to break and the island to topple over into the sea.

Something similar is found in Native American traditions, especially along the coasts of Cascadia where massive earthquakes, some of which lowered coastal lands abruptly, periodically occur. Consider the Yurok story in which

... Earthquake and Thunder were wandering across the land, discussing the form it should take. When they decided that the ocean should come farther inland, Earthquake told his companion, 'It will be easy for me to do that, to sink this prairie'. So as they traveled [sic] together, 'They kept sinking the ground. The earth would quake and quake again and quake again. And the water was flowing all over'.³⁴

Yet in this region, as elsewhere, observers tended to place more emphasis on the earthquake-generated waves – the tsunamis – than the land movements that actually cause the disappearance of coastal land.³⁵

This brings us to Atlantis, the fabulous island-continent described by Plato around 360 BC, which he wrote had abruptly and cataclysmically vanished beneath the waves. Atlantis never existed and no amount of wishful thinking – and there is certainly an abundance of that – can make it otherwise, but Plato wanted to make his story sound as realistic as possible, so he stitched together details from actual events to create his enduring fiction. Since he required Atlantis to disappear, it follows that many of these details referred to land sinking, often near instantaneously, examples of which were well known to scholars in Ancient Greece.

Many earthquakes occur on the Greek peninsula and in the Aegean Sea. The Gulf of Corinth, west of Athens, has

been a major focus of earthquakes in recent times, as it undoubtedly was during the time of Plato. We have some information about ancient earthquakes there. For example, in 464 BC, a mere 37 years before Plato was born, an earthquake flattened the city of Sparta and was probably much talked about during Plato's formative years.³⁶ For earlier evidence of the power of earthquakes to destroy cities, Plato need have looked no further than the island of Crete, where the Minoan settlements (their ruins still visible) of Agia Triada and Phaistos had been destroyed by massive earthquakes about 1700 BC.

Then in 426 BC, when Plato was just a baby, the Maliakos Gulf Tsunami affected parts of Greece, and it is likely that the reports of this came to influence Plato decades later when he wrote his story of Atlantis. At the time of this memorable tsunami, the Peloponnesian War between Sparta and Athens was in its sixth year and would last another 14. In this particular year, according to Thucydides, the principal chronicler of the war, the Spartans (heading the Peloponnesian League) were ready to invade Athenian territory,

... but numerous earthquakes occurring, turned back again without the invasion taking place. About the same time that these earthquakes were so common, the sea at Orobiae, in Euboea, retiring from the then line of coast, returned in a huge wave and invaded a great part of the town, and retreated leaving some of it still under water; so that what was once land is now sea; such of the inhabitants perishing as could not run up to the higher ground in time. A similar inundation also occurred at Atalanta, the island off the Opuntian Locrian coast, carrying away part of the Athenian fort and wrecking one of two ships which were drawn up on the beach.³⁷

While it is likely that some of this detail was written down in Plato's time, Classical Greek culture was still largely an oral one. Plato would routinely have heard the tales of travellers from distant lands, and his imagination would probably have been stirred by some of the outrageously fanciful explanations

for natural phenomena they related, his mind likely wondering at the gullibility of people and plotting plausible scenarios for Atlantis, his ideal society gone bad.³⁸

On 30 June 1908, a sizeable rock – probably an asteroid some 60–70m (200–230ft) in diameter – entered the Earth's atmosphere. Between 6 and 10km (4–6 miles) above the Earth's surface in Tunguska, Siberia, it exploded. The blast was powerful enough to flatten more than 2,000km² (772mi²) of the larch forest that swathes the natural *taiga* landscape in this sparsely populated part of modern Russia.³⁹ When scientists finally surveyed the area almost 20 years later, they had to be 'indirect and circumspect' when questioning Evenki eyewitnesses to this event, since many believed it had been a visit by their fire god, discussion of which – as for the Klamath entering the vicinity of Crater Lake in Oregon (see Chapter 1) – was awkward because of its religious and cultural connotations.

Asteroids, comets and meteorites (collectively known as bolides) regularly enter our planet's atmosphere, almost always being fragmented above the ground surface but more often than not – unlike the situation at Tunguska – smashing into the Earth's surface. Most bolides fall into the ocean, but some of course hit the land; impact craters pepper the landscape of every continent.

Bolide impacts are undoubted memorable events, worthy subjects for oral traditions, particularly in places where the extraterrestrial object hit the ground and created an impact crater. In Chapter 1 we saw how a bolide impact more than a millennium ago in Italy fast-tracked the people's adoption of Christianity. Features like impact craters often remain visible in landscapes for hundreds of thousands of years, a constant reminder to local people of the events that created them. In the same way that some cultural groups venerate gods within active volcanoes, beseeching them not to direct eruptions across their fields and villages, so too are there records of group worship at impact craters. Consider this translated description from the 1920s of local traditions at the Campo

del Cielo (Field of the Sky) site in the Argentine pampas, where there are numerous impact craters as well as scattered fragments of a giant iron meteorite:

The meteorite of the Chaco [province] was known since earliest American antiquity through stories from the Indians who inhabited the provinces of Tucumán. [These people] had trails and easily traversed roadways that departed from certain points more than 50 leagues [more than 278km/173 miles] away, converging on the location of the bolide. The indigenous tribes of the district gathered here ... in veneration to the God of the Sun, personifying their god in this mysterious mass of iron, which they believed issued forth from the magnificent star. And there, in the stories of the different tribes of their battles, passions and sacrifices, was born a beautiful, fantastic legend of the transfiguration of the meteorite on a certain day of the year into a marvellous tree, flaming up at the first rays of the sun with brilliant radiant lights and noises like one hundred bells, filling the air, the fields and the woods with metallic sounds and resonant melodies to which, before the magnificent splendour of the tree, all nature bows in reverence and adoration of the Sun.⁴⁰

This story may recall the arrival of this large meteorite, how it ‘flamed’ brighter than the sun, and the sounds that were heard as it exploded into pieces and smashed into the ground in dozens of different places within a short period of time.

To enable an understanding of how non-literate peoples may have recorded for posterity their observations of bolide falls and impacts, Australia again provides some useful examples. Not only is its Indigenous culture one of considerable unbroken longevity and demonstrably effective in preserving ancient traditions, but Australia – being comparatively dry in most parts – has environments that are particularly well suited to the preservation and study of bolide impact structures. The rocks – known as tektites – that form when a meteorite impacts the ground surface are strewn around the impact site (in what geologists call strewnfields), but are often found much further away. So powerful are some

impacts that in an instant they cause the earth-surface rocks to melt or vaporise, creating small pieces of molten material that can be widely dispersed. Some even enter the atmosphere and are carried well away from the impact site; for example, Australian tektites are found in China and Antarctica as much as 11,000km (6,835 miles) from their impact site.⁴¹

There are 27 known bolide impact craters in Australia, most in the (drier) Northern Territory and Western Australia. It is something of an enigma that there are comparatively few Aboriginal stories about the formation of these craters, yet comparatively many describing meteorite falls. Hints that local Aboriginal people knew the origin of the Henbury meteorite craters in the central Australian desert come from the story that told that they should not camp near the place, which they called *chindu chinna waru chingi yabu* ('sun walk fire devil rock').⁴² The Henbury meteorite falls took place around 4,200 years ago.

But understanding is not necessarily witnessing, and there are Australian Aboriginal stories about the origins of meteorite craters that formed long before people first reached Australia (see colour plate section). In these situations, it is obvious that the details of eyewitness accounts of particular events were transferred to landforms that were patently of the same origin, despite being far older.⁴³

In South Australia on the edge of the Nullarbor Plains, swathes of which are littered with meteorite fragments, there is a typical meteorite impact story. Belonging to the Adnyamathanha (Wirangu) people, a retelling for the school curriculum of the original story explains that:

A long, long time ago, a huge meteorite hurtled towards the earth from the northward sky, and smashed into the ground near Eucla. Because it was so big, a dent appeared in the crust of the earth and the meteorite bounced high into the air and out into the Great Australian Bight [ocean] where it landed with an enormous sizzling splash. It was hot from its trip through space so it gave off a good deal of steam and gas as it sank through the waves. But this was no ordinary meteorite. In fact, it was

*the spirit Tjugud. In the deep water near by, the spirit woman Tjuguda lay asleep. All the noise around her woke her up and she was very angry. She bellowed and the elements roared with her. The wind blew, the rain pelted from the sky and the dust swirled.*⁴⁴

Given that Aboriginal eyewitness accounts of meteorite falls in Australia are more common than impact craters, it is likely that – as at Tunguska – many of these events were airbursts, a solid bolide shattering above the ground surface and producing a rain of fragments, none of which proved large enough to create a visible crater when it hit the Earth's surface. One example from New South Wales (a state without a single impact crater) recalls that:

*The sky heaved and billowed ... the stars tumbled and clattered and fell one against the other. The great star-groups were scattered, and many of them, loosened from their holds, came flashing to the earth. They were heralded by a huge mass, red and glowing, that added to the number of falling stars by bursting with a deafening roar and scattering in a million pieces which were molten ... The disturbance continued all night. When the smoke and clamour had died away and morning had dawned it was seen that the holes had been burnt into the earth, and great mounds were formed by the molten pieces, and many caves were made.*⁴⁵

We cannot know the antiquity of this story because no airburst event has been identified in the area, but given the abundance of similar stories in Australian Aboriginal cultures, there is little reason to doubt that it is an authentic memory of a real event.

In other parts of the world, preliterate descriptions of meteorite falls are likewise somewhat vague and difficult to tie to any single event, something that would allow us to determine the antiquity of these stories. Just as there are stories in many cultures of a global flood, which are likely to be a palimpsest of stories of successive floods in particular

places,⁴⁶ so there are stories of a world fire that wiped out humanity in some cultures. In some of the associated stories, a cosmic origin is identified for the fire, suggesting that this tradition derived from successions of meteor showers or airbursts in particular locations.

Finally in this chapter, we turn to a little-studied topic of oral traditions, namely their potential for recollecting the existence of animals that are now extinct. The real challenge here is to move beyond the explosion in imagined creatures that has characterised post-nineteenth-century fiction and today transfixes many audiences, often confusing people's ability to distinguish fantasy from past realities.⁴⁷

One of the most extraordinary stories of this kind concerns one of our kin, *Homo floresiensis*, which is known to have co-existed with our own species on Flores Island in Indonesia until perhaps 12,000 years ago.⁴⁸ The discovery was made in 2003 in a limestone cave named Liang Bua, 25km (16 miles) from the sea. At a depth of nearly 6m (20ft) in sediment layers dating from about 18,000 years ago, the remains of this small-bodied, chinless bipedal hominin were found. The young age for the remains of *Homo floresiensis* puzzled scientists for a long time, but a recently revised age for the holotype at Liang Bua to some time between 60,000 and 100,000 years ago sits more comfortably with most.⁴⁹ This is because our species, *Homo sapiens*, was pretty intolerant of other hominid species, and adept at eradicating them shortly after coming into contact with them. The stone tools found at Liang Bua suggest that the *Homo floresiensis* people living there continued doing so until some 50,000 years ago, which fits with the revised age for the hominid bones, but there are hints from oral traditions that they may have survived into more recent times.

Long before the discovery of *Homo floresiensis* remains, the people of Flores Island had stories about the *ebu gogo*, the name given to 'short, hairy and coarse-featured' hominoids said to have lived on the island until quite recently. In 1984, when anthropological researchers started work in the Nage region of central Flores, they were told a story by descendants

of the inhabitants of the (former) village of 'Ua how its people had once cornered a group of *ebu gogo* in a cave called Lia Ula several generations earlier. Fed up with them abducting children and stealing their crops, the people of 'Ua set fire to a quantity of palm fibre and immolated these *ebu gogo*.⁵⁰

Ebu gogo stories are known from other communities on Flores and may be part of the 'wildmen stories' that are comparatively common in island South-east Asian cultures,⁵¹ and in some other parts of the world. What is of key interest about the *ebu gogo* stories is whether or not they recall the presence until very recently of *Homo floresiensis* on Flores. At present there is not enough information to test this suggestion, especially since science would currently have this hominid species becoming extinct about 50,000 years ago. But it is an intriguing story that science may one day answer more satisfactorily. Another explanation is that the *ebu gogo* stories (not the *ebu gogo* themselves) have endured for thousands of years, ancient cultural memories being transposed onto more recent incidents; perhaps the occupants of the cave at Lia Ula were mere bandits, subsequently labelled *ebu gogo* to help justify their extermination.⁵²

We now move to Australia and, again taking advantage of Aboriginal cultural ability to preserve stories millennia old, ask whether there are ancient creatures – perhaps long extinct – that were observed by Aboriginal people who then started the process of commending these stories to posterity. There are indeed such stories. Take that of the *bunyip*, a huge beast said to live, forever groaning and bellowing, in the deepest waterholes, from which it would emerge after dark to prowl the land in search of humans as food. One account from the 1840s reports through a colonist's words the attitudes of Aboriginal Australians towards the *bunyip*:

... a large animal having at one time existed in the large Creeks & Rivers & by many it is said that such animals now exist & several of the Fossil bones which I have at various times shown to them they have ascribed to them. Whether such animals as

*those to which they refer be yet living is a matter of doubt, but their fear of them is certainly not the less & their dread of bathing in the very large waterholes is well known.*⁵³

Long-standing Aboriginal beliefs in *bunyip* certainly fed into the interpretation of sightings of other creatures in recent times. Consider the observations of cattleman Thomas Hall, who worked at Canning Downs (New South Wales) and visited an Aboriginal ceremonial site (a *bora* ring) in about 1858, where he saw a drawing of a *bunyip* painted with 'raddle, pipe clay and emu oil' on a large tree. Later he saw one, a creature local people knew as *mochel mochel*:

*Mr Hall was bringing a mob of brumbies [wild horses] down from Swan Creek, and when some distance ahead of his companions, was startled by a scream coming from a place known as the Gap Creek Junction Hole. Riding over to investigate, he saw an animal in shape similar to a low set sheep dog, the colour of a platypus, head and whiskers resembling an otter, coming from shallow water across a strip of dry land into deep water ... the impression made on Mr Hall's mind was that the Mochel Mochel or Bunyip was a kind of otter ... [local Aboriginal people], he says, had a great dread of it and nothing could persuade them to bathe in, or even go near a water-hole believed to be the home of the Mochel Mochel.*⁵⁴

In this case, it was indeed perhaps an otter. Yet the extract exemplifies the point that distant Indigenous memories of the *bunyip* – like those of the *ebu gogo* – were perhaps transposed onto other, comparatively unfamiliar creatures long after the originals had died out. The avoidance behaviour that characterised their distant ancestors' attitudes towards *bunyip* also became transferred by Aboriginal people to these other creatures, as did their role in Aboriginal ceremonial life.

Most of what are regarded as authentic Aboriginal descriptions of *bunyip* picture them as 'long-necked, maned, tusked, [and] horse-tailed', so the discovery of fossils in numerous Australian contexts of a herbivore, the extinct

marsupial tapir *Palorchestes azael*, ‘about the size of a horse ... [and unlike] no other creature known’, has raised the possibility that Aboriginal stories of *bunyip* recall encounters with this animal.⁵⁵ Once thought to be a giant kangaroo, *Palorchestes azael* has also been likened to a bull in size and had ‘huge koala-like claws, enormously powerful forelimbs, a long ribbon-like tongue and a large elephantine trunk’. It occupied eucalypt woodlands close to shallow lakes or marshes, and once lived across much of eastern and southern Australia. Its possible representation in Aboriginal rock art (see colour plate section) strengthens suggestions that it may be the basis of *bunyip* stories.⁵⁶ Direct dating of the fossil remains of *Palorchestes azael* shows that it lived mostly 40,000–50,000 years and more ago, but an age of 23,000 years ago – from surrounding terrace deposits – has been reported for its presence at Riversleigh, now a World Heritage Site, in Queensland. An age for a megafaunal bone cache at Spring Creek in Victoria suggests that this animal may have survived even longer here, perhaps to sometime within the last 20,000 years.⁵⁷ Is it possible for Aboriginal traditions of this creature to have survived almost 20 millennia, or does the likelihood of its recollection in those traditions signify that it must have survived until even more recent times?⁵⁸

To put into context Aboriginal stories of the *bunyip* and other possibly legendary creatures that might recall observations of megafauna, consider that the fossil record of Australia shows that it was once populated – like many other continents – by innumerable species of large-bodied animals, or megafauna, most of which are now extinct. The question of why megafaunal extinctions occurred in Australia, as well as in North America, South America and several other regions, has taxed scientists for more than 100 years and still occasionally provokes robust debate. Basically there are two camps: those who believe that, through predation, humans were responsible for rapid megafaunal extinctions; and those who regard climate change, perhaps a rapid cooling event like the Younger Dryas (see Chapter 4), to have led to megafaunal death from starvation and water deprivation. In

deciding which explanation is correct or, indeed, whether both contributed in some measure to megafaunal extinctions in particular places, two things are important to consider.

The first is that megafauna are/were big and that, because most smaller animal species clearly did not suffer the same comprehensive degree of extinction at the same time, it follows that their large size made megafauna singularly unable to adapt to whatever it was that caused their extinction. It might be, for instance, that their large size made them especially attractive to bands of hungry human hunters who devised ingenious ways of killing them and, encouraged by their success, continued the blitzkrieg until their prey disappeared, unable to sustainably reproduce itself.

The second consideration is timing. If megafaunal extinctions occurred simultaneously on every continent, then it is a big ask to put the blame solely on people, because then you would need to suppose that they behaved independently in exactly the same ways towards megafauna at exactly the same times – and what are the chances of that? So simultaneous extinctions must point to some global (or near-global) cause, such as rapid cooling or, as in more imaginative scenarios, massive bolide impacts or volcanic eruptions blotting out the sun for several years and plunging the Earth into a prolonged ‘volcanic winter’.

The fact of conspicuous megafaunal extinctions in Beringia (a region centred on far-eastern Russia and Alaska), and North and South America, gives us an opportunity to test competing explanations. It is generally assumed, albeit not proven, that the earliest Americans entered the continent through Beringia, thence into North America, and thence into South America. The first humans in the Americas were no fearless explorers determined to push the geographical limits of the known world, but were merely following the trails of mammoths and mastodons, camels and cheetahs, and horses.⁵⁹ Radiocarbon ages for extinct megafauna in these three regions do indeed show a time progression suggesting that human overkill was a major factor in these extinctions, but the same is not true elsewhere.

Take Patagonia in the cold far south of South America, for instance. Here megafauna, including bears, horses, giant ground sloths and the various llamas and guanacos (whose smaller surviving relatives are essential beasts of burden throughout this region today) once ranged across the seemingly endless steppes. Humans first arrived in this part of Patagonia just before a cold (stadial) period – the Antarctic Cold Reversal – began. After it ended, about 1,700 years later, megafaunal extinction had begun and was quickly completed, so here it is attributed to a combination of climate change and human predation.⁶⁰

The extinct megafauna of Australia are much more than the bull-sized marsupial tapirs, and included two even larger marsupials (notably the hippopotamus-sized *Diprotodon*), a number of kangaroos and wallabies – giants in comparison to their modern counterparts – and the ferocious tree-dwelling marsupial lion (*Thylacoleo carnifex*): ‘the fellest and most destructive of predatory beasts’, in the words of the nineteenth-century palaeontologist who gave it its scientific name.⁶¹

Australia also had many large birds (dromornithids) – taller and larger bodied than today’s native emus and cassowaries – which have been extinct for millennia, including one (*Genyornis newtoni*) that may feature in Aboriginal artwork and stories (see colour plate section). As for the *bunyip* (see above), this possibility suggests that some of the extinct megafaunal species co-existed with people in Australia for some time, implying that the overkill model may not apply here. This is something of a departure from earlier views that envisaged most species of large-bodied mammals in Australia becoming extinct more than 40,000 years ago as a result of their rapid overkill by recently arrived humans.

The first data-informed suggestion that humans and megafauna had co-existed in Australia for at least 15,000 years came from measurements of rare-earth elements (REE) in megafaunal bones. The context of this research was that such bones had long been recognised in comparatively young sedimentary sequences, such as river terraces, but had been suggested as not being in situ. In other words, it was argued

that these bones must have been moved (typically by flood waters) from the places where the animals died much earlier, to become incorporated within these much more recent landforms. If this scenario is correct, then the pattern of REEs in the buried bones would be expected to be quite different from that in the water filling the pores in the sediments enclosing the bones. Analysis of a whole series of megafaunal bones from Cuddie Springs in south-east Australia showed otherwise, leading to the conclusion that people (at least here) did not rapidly deplete Australian megafauna following their earliest encounters with them.⁶²

This then raises the likelihood that it was climate change rather than humans – or a combination of factors – that drove megafaunal extinction in Australia. But the mechanisms are ‘fiercely contested’ and most recent scientific commentary still favours humans as the principal cause of this. A case in point is the timing of megafaunal extinction on Tasmania. While most megafauna on mainland Australia became extinct some 46,000 years ago, implicating expansionist humans, megafauna on Tasmania were once thought to have disappeared before humans reached this now-offshore island, exonerating human predation and implicating climate change. Yet improved dating of megafaunal remains from Tasmania tells a different story. It has shown that humans overlapped for just a couple of millennia with megafauna here, many of which they pursued across the land bridge then linking Tasmania with the Australian mainland, before exterminating them.⁶³

It was several thousand years ago in southern Australia. Nothing stirred in the midday heat, the gum trees stood in desultory clusters. Within their foliage perched half a dozen Aboriginal hunters, unmoving, their barbed spears poised at arm’s length ready to dispatch with maximum speed in an instant. Their scent made the giant flightless birds they hunted inquisitive yet unsuspecting. Slowly a group moved closer to the trees, within spearing distance. Standing over 2m (6½ft) tall, their ‘heads ... as high as the hills’, these birds – *mihirung paringmal* to the Tjapwurung hunters – were feared for their vicious kicks, which could easily ‘kill a man’, yet

prized for the huge amounts of meat even one would provide for the community. Closing on the trees in which the hunters waited, the birds peered upwards and, at the agreed signal, the hunters launched their spears in unison. The birds ran, faster than could any person, but those most severely wounded eventually collapsed and were dispatched by the pursuing hunters.⁶⁴

It has been proposed that the *mihirung* was *Genyornis newtoni*, a flightless bird (averaging 275kg/606lb in weight) that was one of a number of huge-bodied dromornithids that once occupied most of Australia. Excavated *Genyornis* bones have been identified by Aboriginal informants as being from what they knew as *mihirung* and there are also rock-art images that appear to show this bird (see colour plate section).⁶⁵ If correct, this suggests that far from being an early casualty of human contact like many other species of Australian megafauna, *Genyornis* did in fact survive until comparatively recently. Debate rages. Most scientists do not believe there is any evidence for *Genyornis* having lived within the past 41,000 years, while others take a contrasting view.⁶⁶ The answer may lie in an egg.

Found typically in eroding sand dunes along Australian coasts, a distinct type of fossil eggshell has long captured the attention of palaeontologists. Reconstructed eggs – none have been found unbroken – typically have a long axis of around 16cm (6¼in), far larger than emu eggs, and are smooth as opposed to having the crenulated exterior of these. For some 30 years, it was generally believed that these eggs were those of *Genyornis newtoni*, and radiocarbon ages from them in every part of Australia have been used to argue a recent date for *Genyornis* extinction, perhaps just a few millennia ago. But then some nagging suspicions began to surface. For instance, the sizes of the reconstructed eggs are improbably small given the likely size of *Genyornis*. More recently, chemical analyses of the eggshells led researchers to conclude that they are ‘unlikely to have been laid by a dromornithid, whereas several characters support a megapode origin’.⁶⁷

There are several species of megapode living today in Australia. They either bury their eggs in natural deposits (like sand dunes), or build mounds where these are lacking. Giant megapodes once existed, too, and because of their characteristically outsize eggs would probably have become rapidly extinct upon making contact with egg-eating humans. So it seems that these eggs belonged to a giant megapode and not to *Genyornis*. The implications of this deduction are huge, for much of what has been previously inferred about the diet and time of extinction of *Genyornis newtoni* (mistakenly obtained from megapode eggshell) is now incorrect. This leaves open the question of whether *Genyornis* survived longer, even long enough to have humans recall how best it was hunted and to paint how it appeared.⁶⁸

The most likely scenario for the extinction of Australian megafauna is that many species were in fact driven rapidly to extinction following early contacts with people, but that others, perhaps because of where they lived or how effectively they were able to dodge (and reproduce away from) human predators, survived much longer than the blitzkrieg 41,000 years ago. It is possible that some species of megafauna became extinct only within the past few thousand years, and that Aboriginal stories of the *bunyip* and kindred creatures may have their roots in observations of now-extinct megafauna. Of course this raises the possibility that the same may apply in other parts of the world.

The next chapter discusses ways of measuring other types of story (folk tales, for example), and where the new frontiers of knowledge of oral history may lie. It concludes by asking whether we have underestimated ourselves by denying that oral recollections can reflect human history across a far greater time span than we might intuitively suppose.