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Other Oral Archives of Ancient Coastal Drowning

When Nantes-based artist Marjorie Le Berre was growing up in rural Brittany, France, in the 1970s, she once witnessed the activities of a *conteur* or traditional storyteller when he visited a farm close to Les Monts d'Arrée. He was an elderly man, probably in his seventies, and he came to the farm in fulfilment of his traditional role, to tell the people living in this area some of the old stories that he knew, which had been passed down to him by his ancestors, a line of hereditary *conteurs*. Marjorie's father and grandfather had had similar experiences of listening to *conteurs*, who play a traditional role in Brittany society; their stories are only ever told orally, never written down by them. Her grandfather remembered that when he was young, an itinerant *conteur* would be honoured by any village in which he arrived; its inhabitants would typically gather outdoors around a fire in the evening to listen respectfully to his stories, which were enlivened by performance.

One story often repeated by Breton *conteurs* and *conteuses* was about the drowned city of Ys (Caer Ys), which once stood on dry land within what is now Douarnenez Bay, close to the modern village of Camaret-sur-Mer. Prefacing the telling of this story, the *conteur* would recall how today, when the wind blows and agitates the waters of the bay, the bells in the drowned church steeple toll – a constant reminder of the presence of Ys here. Then the *conteur* would relate the story of King Gradlon of Ys, whose daughter did not obey his instructions about the security of the city and, opening its gates during a storm, let in the ocean, drowning Ys forever (see colour plate section).¹

This story has, of course, been written down on many occasions and in different versions. Various sites off the coast

of Brittany for the drowned city have been mooted, which may suggest that a similar series of events happened at more than one location.² For example, in the sixteenth century the city of Ys was believed by one writer to have been near Quimper:

*Still today [in AD 1588] the local people point out the ruins and remains of the [city's] walls, so well mortared that the sea has not been able to carry them away, and they say that King Gradlon was in it at the time it was ruined. These are accidents that have often happened elsewhere by similar encroachments of the sea ... but of those things there is no witness but an old rumour noised from person to person.*³

In a well-regarded 1899 account by Paul Sébillot, the town of Is (Ys) is said to have existed once off the coast of modern Saint-Malo, between it and the island of Cézembre, and was protected from the ocean by a dyke. But conflict erupted between the people of Is and those living in the forests of Corseul, inland of Saint-Malo. The king of Is gave the Corseulois a final warning, but they responded by cutting the dyke, making a massive hole through which the sea poured into the town: 'the city of Is was submerged and almost all its inhabitants perished'.⁴ Further east, Sébillot recorded that

*... the fishermen of Cancale say that when the sea is beautiful and clear, one sees between the Mont Saint-Michel and the Chausey Islands the debris of walls. They are the remains of a vanished city.*⁵

Slightly earlier, a prominent Breton abbot, François Manet, made a systematic collection of stories of coastal submergence along the northern coast of France focused, unsurprisingly, on the sites of former monasteries. He identified four of these – Menden, Taurac, Maudan and St Moack's – the last having been burnt 'in a fit of passion' in the year AD 709 by Rivallon, the King of Brittany's brother, who 'afterwards, being penitent, ... re-established it in a better state'.⁶

In the majority of the Breton accounts, the key details involve a town (or monastery) located on the Brittany coast at a time when this lay several kilometres seawards of its current position. It is reasonable to infer that the town's location had become, perhaps for several centuries, progressively threatened by the ocean to the extent that its inhabitants had constructed artificial structures to keep it out. The town's destruction came when this infrastructure finally proved unequal to the task for which it had been designed and the ocean poured into the city, flooding it probably more rapidly than the time it would have taken for everyone to leave – perhaps drowning many people. As time went on, the town was abandoned and the sea rose over it, obscuring it from view, perhaps even leading to its precise location becoming uncertain today.

Such a succession of events – the building of a coastal town, the construction of infrastructure to keep out the ocean, the flooding of the city and its eventual submergence – is plausibly explained as an effect of rising sea levels similar to the observations of Aboriginal Australians related in Chapter 3. The key difference here is that while the sea level reached its present level around Australia some 7,000 years ago, not generally rising more than a metre or two above it subsequently, this is not the case for Brittany, nor indeed for many other Atlantic coasts in Europe. In these places, the sea level has been rising pretty much continuously since the end of the Last Glacial Maximum – the coldest time of the last ice age – 18,000 years ago. Thus any stories about coastal drowning in this part of the world could be significantly younger than has been deduced for those in Australia.

Following the methods for assigning minimum ages to such oral traditions described at the end of the last chapter, we could apply the same to the Ys stories. Yet with these, we also have some historical detail that can be compared with our age estimates, for King Gradlon and others mentioned in some of the Breton drowning stories are believed to have been real people, historical characters whose exploits and their timing are a matter of record. For example, a biography of St Guenolé, who famously drowned the perfidious Dahut, daughter of

King Gradlon, to right the wrong she had done that led to the flooding of Ys, was written in the ninth century and records that he died on 3 March in the year AD 532 at the age of 72 at Landévennec monastery, which he had founded decades earlier.⁷ Clearly, if he was indeed involved in the story of Ys, then its drowning can be bracketed in time between about AD 490 and AD 530, just over 1,500 years ago. Yet events far back in history are subject to being concertinaed, transposed on one another even though they were actually separated by centuries, perhaps even millennia. Similarly people, particularly noted characters like King Gradlon, can find themselves having lived numerous lives, apparently involved in incidents centuries, sometimes millennia, apart. So perhaps sea level is a more reliable key to the antiquity of such traditions.

During the last ice age, sea level worldwide averaged 120m (400ft) or so below its present mean level. In north-west Europe, one of the clearest differences in the landscape would have been the connection of the British Isles to the European mainland. They were not as they are today, and have been for most of their written history, an island kingdom, but were then – some 20,000 years ago – an appendage of the continent. One of the last-surviving pieces of the land bridge – Doggerland – was discussed in Chapter 4, but the situation was also quite different further south and west, in the region between Brittany (France) and Cornwall (England). Today the French call the water gap La Manche, while their northern neighbours call it the English Channel, but during the last ice age it was all dry land, readily traversed and almost certainly comparatively densely populated. A river meandered westwards along its axis, cutting a broad valley and eventually emptying into the Atlantic Ocean across the continental shelf (Figure 5.1). Then, beginning about 18,000 years ago, the sea level started rising. Ponderously yet inexorably, the region's geography was transformed. A benign terrestrial landscape was converted to a formidable marine gap, with the few remaining islands generally close to the continent's margins on each shore.

Figure 5.1 *The coasts of north-west Europe today and at the coldest time of the last ice age about 18,000 years ago. The locations of some of the main places discussed are shown.*

Might the stories about submerged cities off the coast of Brittany be distant memories of the postglacial sea-level rise that created today's La Manche? Are there stories from the other side, from the coasts of the British Isles and Ireland, which refer to the English Channel and can be similarly interpreted?

The earlier analysis of the Breton stories – the transition from a coastal town/city that came to need protection from

the sea, and its subsequent drowning and submergence – is suggestive of the progressive effects of rising sea levels. As is the case with stories discussed later in this chapter, the drowning of such cities is often recalled as a catastrophic event, something that abruptly destroyed the habitability of such vulnerable coastal places. This is readily explained by the superimposition of extreme sea-level events (like storm surges or even tsunamis) on a steadily rising sea level. The effects of extreme events become incrementally greater even though their magnitude (relative to the average sea level at the time) may not differ significantly from earlier such events. The situation is similar to that of today. The global sea level is rising, but along many coasts it is not the effects of rising mean sea level that are having the most impact. Instead, it is the effect of the extreme events superimposed on this rising sea level that are proving most memorable.⁸

Even though the Breton stories about Ys and other submerged towns and cities might conceivably recall postglacial sea-level rise, there is a clear disparity – of perhaps several millennia – between the time of the observations on which these stories must be based and the time of their historical associations. Yet, as with the 21 groups of Australian Aboriginal stories (Chapter 3), most of which are saying the same thing, the existence of stories beyond Brittany from elsewhere along the coasts of north-west Europe, which all say essentially the same thing, provides the strongest evidence that they also represent ancient human memories of the effects of postglacial sea-level rise. For if they recalled only localised events, then why would they be saying the same thing? Here we review stories from the Channel Islands (off the coasts of northern France), Cornwall, Wales, Ireland and East Anglia, where – to greater or lesser degrees – there are extant stories similar to those from Brittany. Considered together, they are compelling evidence that the indigenous peoples of north-west Europe witnessed postglacial sea-level rise and enshrined their observations in stories that have reached us today, largely through oral means.

The **Channel Islands** (Îles de la Manche) comprise four large islands – Alderney, Guernsey, Jersey and Sark – and a number of smaller ones, close to the coast of northern France. One story, published in 1899, recorded how ‘in past times, the [English] Channel was not as great as it is now; one could go to Jersey [from mainland France] without encountering any obstacle other than a brook which was not very wide’.⁹ Many of the smallest, now uninhabitable islands in the Channel Islands show abundant signs of having formerly sustained larger numbers of people, presumably when the islands were themselves larger, as would have been the case when the sea level was lower. The names of some of these islands, particularly those like Ecréhous, Brecqhou and Lihou, which include the suffix *hou* (meaning house), suggest that they were once large enough to have support sizeable populations. Yet the main evidence of once greater populations comes from thick, dense shell middens on some of these tiny islands, thought to have accumulated the islands they were larger and inhabited by numerous shellfish-eating people.

Submerged forests are a tangible, although not always readily observable, feature of the shallow ocean floor surrounding these islands and separating them from the adjacent continental coasts. In 1787, a local newspaper on Jersey commented that:

*The trunks and roots of trees which showed themselves last winter by the agitation of the sea in St. Ouen’s Bay, and which are still visible, furnish us with a subject of contemplation relating to times very remote. One sees thousands of trees laid one close to another in this bay ...*¹⁰

Today, the ocean floor between Jersey and the nearest parts of the French mainland reaches depths of 10–12m (33–40ft).

Crossing the English Channel, the people of **Cornwall** in south-west England (including the offshore Scilly Isles) have some stories about drowned coastal lands, perhaps the most famous of which is Lyonesse.¹¹

Lyonesse has become grounded in English legend as the rumoured site of Avalon, to which King Arthur was carried to die, yet it also appears to be anchored in history. One of the earliest references pinpoints the date of its submergence to 11 November 1099, when it is said that 'the sea overflowed the shore, destroying towns and drowning many persons and innumerable oxen and sheep'.¹² Much later, in *A Tour through Cornwall in the Autumn of 1808*, the Reverend Richard Warner recounts that:

*William of Worcester ... states, with a degree of positive exactness, stamping authenticity upon its recital, that between Mount's Bay [near Land's End] and the Scilly Islands there had been woods, and meadows, and arable lands, and a hundred and forty parish churches, which before his time were submerged by the ocean.*¹³

If Lyonesse ever existed, and there are many who regard the story of it as allegorical, then it is possible that it was submerged by postglacial sea-level rise. Perhaps, as might have been the case for Ys, sea-level rise served simply to amplify extreme wave events, one of which tore through Lyonesse and forced its abandonment; subsequent sea-level rise hid it from history. The big wave may have been a tsunami caused by an ocean-floor earthquake in the vicinity. It is a long stretch, but one story about the destruction of Lyonesse recalls that one of its prominent residents, Trevilian, succeeded in saving his family after the first wave hit, but then barely managed to save himself after the second (or third) wave washed over him and his horse. This wave was reportedly the highest of a series, similar to the tsunami wave trains that often characterise such events. Sometimes the earthquake not only generates a wave train but also causes islands close to the epicentre to sink rapidly,¹⁴ and it is possible that an island called Lyonesse was abruptly submerged during an earthquake off the coast of modern Cornwall. Tsunamis do affect this area. The great Lisbon Earthquake of 1 November 1755 that destroyed the Portuguese capital drove a train of tsunami waves onto coasts

around south-west England; the third wave was reportedly by far the highest.¹⁵

When visited by Romans, perhaps around the year AD 10, the Scilly Isles are said to have numbered just 10, but by 1753 there were 140 of them. This could be interpreted as evidence for sea-level rise within this period – larger islands being subdivided by inundation – although it would be imprudent to place too much faith on the precision of the Roman count.¹⁶ Yet there is considerable evidence from the Scilly Isles of their submergence within the past millennium or more. It includes traditions of once-contiguous islands, and the remains of stone walls (locally called ‘hedges’), former field boundaries running from one island to another along the sea floor now covered by 3–4m (10–13ft) of water.¹⁷ Together with the Lyonesse tradition, such evidence for submergence does point to an observed history of sea-level rise comparable to that inferred for Brittany ... and to points north.

Many traditions about ‘lost cities’ and ‘sunken palaces’ refer to the area off the west coast of **Wales**, particularly in Cardigan Bay, where perhaps ‘sixteen cities’ of Cantre’r Gwaelod are reputed to have been submerged. The similarities between the extant stories of the submergence of these cities and those in Brittany have been remarked upon and suggest that – at least at some point – traditions fused. The question remains whether there was in fact any original story in either Breton or Welsh tradition that, taken in tandem with empirical evidence for sea-level rise, suggests that people in these places observed the effects of rising sea levels ... and that their observations still survive. The review of the Breton traditions above implies that they did, but what about the Welsh?

In most Welsh stories about Cantre’r Gwaelod, the king is Gwyddno (rather than Brittany’s Gradlon), and it is his intemperate steward Seithenhin (rather than a dastardly daughter) who unlocks the flood gates causing the city to be drowned.¹⁸ The city, often said to be one of many, dominated a massive area of low ground named Maes Gwyddno (the

Plain of Gwyddno), perhaps more than 2,000km² (770mi²), in an area between Cardigan and Bardsey Island and the shores of modern Cardigan Bay.¹⁹ This land was said to have been ‘extremely good and fruitful and flat’, and its loss must have had a memorable impact on its occupants; an account from about AD 1450 mentions ‘the lament of Gwyddno ... over whose land God turned the sea’.²⁰

While some scientists have railed against any literal interpretation of these Welsh stories, rightly so in some of their more extravagant permutations, others have been persuaded that the story of *Cantre'r Gwaelod* is more likely ‘a legendary account’ dating from at least the fifth or sixth century ‘of an actual event’.²¹ As was argued for Australian Aboriginal societies (Chapter 2), ‘the conservatism of this tradition in both Wales and Brittany ensured the survival of this tale to the present day’. This analysis does not compel us to believe that these stories were based on observations in the fifth or sixth century, but rather that older stories about ‘great inundations’ became attached in medieval times to the heroes of the fifth and sixth centuries, people credited with founding Welsh (and perhaps Cornish and Breton) traditions.²² Similar stories about the Welsh coast that scholars have interpreted as built around memories of coastal inundation include that about Tyno Helig ([Lord] Helig’s Valley), which may have covered some 46km² (18mi²) of land now underwater in Conway Bay,²³ and the town of *Caer Arianrhod* in Caernarvon Bay, the ruins of which are reported to sometimes emerge at low tide.²⁴

In the case of Wales we do not have to depend solely on such echoes of ancient traditions, for there is an abundance of physical evidence of former shorelines in Cardigan Bay and elsewhere by which scientists have been able to track the progress of the postglacial sea-level rise that flooded the area. There are submerged forests within a kilometre or two of the modern coast of Cardigan Bay (see colour plate section), but further out there are sediments containing peats that mark a time when forests of oak and pine stretched across much of this shallow bay.²⁵ Were the sea level around 30m (100ft) below

its present level, much of Cardigan Bay – at least that between Cardigan and Bardsey – would be dry land, a condition that would have been met at least 9,000 years ago. Given that the present form of Cardigan Bay was established a thousand years or so later, it is difficult to imagine a sizeable land mass being emergent and connected to the mainland more recently.

During the Last Glacial Maximum, about 20,000 years ago, when the sea level in this part of the world lay some 125m (410ft) or so below its present level, **Ireland** was connected to Wales and England, which were in turn connected to what is today mainland Europe. Postglacial sea-level rise gradually drowned the Ireland–Wales land bridge, leading to its submergence about 9,600 years ago, or perhaps a few millennia earlier.²⁶ The timing is important, for it has the potential to lend credence to or to dismiss the idea that the traditions of unassisted human crossing of the Irish Sea may be based on actual events. The most common story is that of Brân the Blessed (Bendigaidfran), a Welsh hero, who went with his warriors to Ireland to rescue his sister from a bad marriage. In one account, at a time when the Irish Sea was ‘not so wide’, Brân crossed at least part of it ‘by wading’, but thereafter ‘the deep water grew wider when the deep overflowed the kingdom’.²⁷ The story is reminiscent of Aboriginal Australians once having crossed places like Backstairs Passage or Clarence Strait by ‘a combination of walking and wading’, something that has not been possible for several thousand years (see Chapter 3). So might a similar explanation apply to the Irish Sea at the time of Brân? It may, but there are currently too many uncertainties to consider this likely, although one can see how, to rationalise the crossing of what is now a deep sea, it is necessary for Brân to be a giant in most extant versions of this story.²⁸

What, therefore, can we say about the possible antiquity of stories of coastal drowning from the Atlantic coasts of north-west Europe? Using the same methods as for the Australian stories, explained at the end of the last chapter, we start by estimating the minimum depths below present sea level at which each group of stories (clustered by location) would be

true. These depths are shown in Figure 5.2 below, together with sea-level histories for Brittany, Cornwall and Wales that cover the later part of the period of postglacial sea-level rise.

The depth minima on the right of Figure 5.2 are of course estimates – the stories are too vague for anything else – but considered realistic nonetheless. Thus, for example, a submerged town (like Ys) a kilometre or so off the modern coast of the Baie de Douarnenez would today be 15–30m (50–100ft) below sea level. And if Cantre'r Gwaelod existed somewhere between 5 and 20km (3–12 miles) off the modern coast of Cardigan Bay, then it would today lie beneath 10–20m (33–66ft) of water. These kinds of numbers are not intended to be definitive, beyond disputation, but rather

Figure 5.2 Sea-level changes along the coasts of north-west Europe over the past 10,000 years or so are shown on the left. On the right is shown a selection of locations of compelling stories about sea-level rise from north-west Europe, represented by bars showing the minimum depths at which these stories would be true.

realistic approximations of where submerged places may once have been – a necessary preliminary to determining the minimum ages of these stories.

By relating the minimum depths shown on the right of Figure 5.2 to the appropriate sea-level curve on its left, minimum ages for these groups of stories can be calculated. For instance, by drawing horizontal lines from the top and bottom of the depth range for stories from the Baie de Douarnenez to the Brittany sea-level curve, then vertical lines from the points of intersection to the age scale, we can determine that for these stories to be true – to be a distant recollection of something people actually observed here – they must have endured for a minimum of 8,750–10,650 years. Similarly, for the stories from Cardigan Bay to be true, assuming the sea level at the time of observation to have been 10–20m (33–66ft) lower than it is today, they must have been created at least 9,000–10,250 years ago. The full set of dates for these stories is shown in Table 5.1.

Similar caveats that were identified for the analysis of the Australian stories at the end of the last chapter apply here, principally those involving the crudity of both the water-depth data and the uncertainties in the stories. Before proceeding, mention needs to be made of Lyonesse, which in several accounts is said to have once occupied the area *between* the Scilly Isles and Cornwall now covered by ocean. In the analysis below (Table 5.1), it is assumed – solely for reasons of parsimony – that the stories about Lyonesse

Table 5.1 *Water depths and age ranges for the seven groups of sea-level rise stories from the Atlantic coasts of north-west Europe. Age ranges refer to the most recent time at which the observations of lower-than-present water depths could have been made.*

Story location	Water depth relative to modern sea level (metres)		Age (years ago)	
	Minimum	Maximum	Minimum	Maximum
Baie de Douarnenez	15	30	8,750	10,650
Jersey (to mainland France)	10	12	7,800	8,200
Îles Chausey	5.5	6	5,800	6,200
St-Malo Cézembre	2.5	3	2,850	3,400
Caernarfon Bay	5	20	7,700	10,250
Cardigan Bay	10	20	9,000	10,250
Scilly Isles (platform)	5	10	7,700	9,000

recall a time when the shallow platform from which the Scilly Isles rise today was dry land; in other words, Lyonesse was Scilly. This is assumed because the ocean floor between the Scilly Islands and Cornwall is today comparatively deep. A narrow, sinuous dry-land connection may have been possible when the ocean surface was 65m (210ft) lower, but for this to have been a few kilometres wide, it would have to have been 70m (230ft) lower. Although these depths are not shown in Figure 5.2, it is likely that the minimum age for the narrow land bridge would have been around 14,600 years ago, that for the wider one a millennium or so earlier.²⁹

There are other drowning stories in Europe that do not lend themselves to being dated in this way but are still worth mentioning.

The east coast of England defines the western limit of the North Sea, the county of **East Anglia** marking the western stepping-off point for Doggerland, the broad land bridge that connected the British Isles to mainland Europe during the last ice age. The rise of the sea level in postglacial times that saw the dismemberment and finally the drowning of Doggerland has also had dramatic effects on the poorly consolidated (and easily eroded) sediments that comprise much of the East Anglian coast. When you visit the coastal village of Dunwich (population about 183) today, it is astonishing to consider that it was once among the 18 largest towns in England, sitting at the head of a sheltered natural harbour, the bustling hub of a vibrant trade in fish, salt and cloth.³⁰ However, well before it reached its zenith, Dunwich had already started losing its battle with the sea. Long affected by shoreline erosion (marked by cliff retreat), some 600 houses are reported to have been washed offshore during the winter storms of AD 1287–1288. Since then this sad story has continued, involving a loss of status, abandonment by merchants and a continuing physical loss; the last piece of All Saints, the only church to remain standing after the AD 1740 storms, collapsed into the sea in AD 1922 (see colour plate section).

The sedimentary vulnerability of the East Anglia coast is amplified by land sinking, one expression here of the slow,

enduring downwarping of the North Sea Basin. Not only is this basin sinking – like many similar basins – under the growing weight of the sediment accumulated on its watery floor over millions of years, but it is also being undermined by the flow of its underlying crust to areas of surface rise, for example in Scandinavia.³¹

Given such a situation, you might expect East Anglian traditions to be rife with stories of ‘sunken cities’ and the like, but they are not. Aside from those that insist – as in countless other places with similar histories – that the droll sound of tolling bells can be heard from beneath the sea’s surface when it becomes agitated, I know of no other known folk memories of what was a prolonged and memorable process for the region’s inhabitants. This may be because, unlike in most other places from which we have such ‘drowning stories’, East Anglia has been substantially repopulated – quite frequently, perhaps, during the past few millennia – as successive waves of migrants and invaders, from Vikings to Normans, overran the country. Traditions would have been lost, and connections between people and place forgotten, while the vagaries of living along an unstable coast would have been rediscovered anew on many occasions.

Along the shores of the **Mediterranean Sea** are numerous ‘sunken cities’ that are of only passing interest to the topic of this book. For these cities are well known, and many have been fulsomely documented, not least because of the mass of written records that recall their existence ... and sometimes the turmoil that accompanying their disappearance. Many of the cultures associated with them were literate so there is little dispute, if the obvious fictionalisations are sidelined, that they once existed and are now underwater. There is no need to depend in most instances on oral traditions. Add to this the fact that the material culture associated with most submerged Mediterranean cities is generally conspicuous; you cannot readily miss the statuary, the columns and harbours, towers and temples, walls and wells, indeed all the constituents of Greco-Roman civilisation that are well known to travellers and museum-goers in much of modern Europe.

A good example comes from the Nile Delta, where the Greeks built two cities – Herakleion³² and Eastern Canopus – to facilitate trade with Egypt and other parts of North Africa around 2,000 years ago. Once located on the now-infilled Canopic distributary channel of the Nile, the remains of these cities currently lie 5–7m (16–23ft) below sea level. Some 60 per cent of the sinking these cities have experienced is attributed to a combination of rising sea levels and the slow yet inexorable compaction of the delta sediments on which they were built. The remaining 40 per cent or so happened more abruptly as a result of the episodic collapse of the water-soaked sediments on which the cities were stood.³³ Owing to the abundant written records about and from these cities, they were never truly ‘lost’ to humanity, although until about 1999 no one was quite sure exactly where they had been. Deltas are dynamic places, routinely flooded, with waters moving the loose sediments from which they are built from place to place; new distributary channels are carved during floods while others may be come infilled. Physical collapse often occurs, particularly along a delta’s seaward fringes, where underwater slopes are generally steepest. And of course in the eastern Mediterranean, which is more affected by tectonic paroxysms than most places, the impact of nearby earthquakes and locally generated tsunamis has often been to destabilise places like the Nile Delta.³⁴

The seismo-tectonic and volcanic activity that affects much of the Mediterranean is another reason why this region’s submerged cities do not get much of a mention in this book. The land moves up and down – sometimes slowly, occasionally abruptly – as a result of the converging African and Eurasian plates. The former pushes northwards, while the latter resists but of course periodically fails, so in places each is sliced up and thrust beneath its neighbour. Friction causes earthquakes and oftentimes these cause the abrupt – and catastrophic – sinking of coastal lands. Take the Greek city of Helike, once the principal city in the district of Achaea, which is recorded as having been comprehensively destroyed during an earthquake (and accompanying tsunamis) in 373 BC. In fact,

so comprehensive was its destruction that for centuries no one was quite sure where Helike had actually been ... or indeed whether it had ever been! The basic problem was that the earthquake, which occurred along a thrust fault associated with the movement of the African Plate beneath the Eurasian, had caused Helike to sink by 3m (10ft) within a very short period of time.³⁵ Then the tsunami came and dumped a layer of sediments over the top and thereafter, because the geography of the area had been comprehensively reconfigured, the site of Helike found itself within an ocean passage, and subsequently became buried by river and ocean sediments. It took some extraordinarily persistent detective work to relocate Helike, which today, because of all this sedimentation, is now back on the land – where almost nobody had thought to look for a sunken city.³⁶

A few hundred kilometres away from these thrust belts, perhaps the same distance below the surface, the melting of downthrust crust produces masses of liquid rock that often finds its way to the ground surface, producing lines of active volcanoes in places like the Aegean Volcanic Arc (along which Santorini famously erupted, perhaps inspiring Plato to invent Atlantis, in 360 BC) and the Calabrian Arc (responsible for a range of volcanic activity from Etna to Vesuvius and beyond). A good example from the latter region of how volcanic activity can cause coasts to sink concerns the Roman-era ports of Baia, Miseno and Pozzuoli, parts of all of which now languish several metres below sea level. These former ports are all located within a caldera of the Phlegrean Fields volcanic complex (Campi Flegrei), which is notoriously active today. They were repeatedly submerged and uplifted on at least three occasions since their Roman occupation (see colour plate section).³⁷

European and North African coasts do indeed have many submerged cities associated with them. Yet *both* the submergence of most of these is ascribable to processes other than postglacial sea-level rise (so submergence is consequently more recent than most of the other examples described in this book), *and* written records exist for most, removing any need

to rely on oral traditions (which are the main source for the 'recollection' of stories about the other examples in this book). We now therefore shift our attention east to the coasts of the Indian subcontinent, where drowning stories more akin to those of Australia may exist. But before we describe these stories, consider that parts of the coast of **India** have been affected more recently by some epic subsidence.

On 17 December 1846, the members of the Geological Society of London assembled for their quarterly meeting. The title of one of the items, forwarded from a correspondent in India and read to the meeting – *Extract from a Letter concerning a Depression lately produced in consequence of an Earthquake in Cutch*, by Mrs Derinzy – puts one in mind of a nervous memsahib suffering regular attacks of the vapours, who experienced a minor earth tremor and suffered a breakdown as a consequence. But it is not that kind of depression that Mrs Derinzy wrote about. The depression was that of the ground surface.

The Rann of Kachchh (Cutch or Kutch) is a low-lying, shallow basin, fault bounded, and close to the modern border between India and Pakistan. It is unclear how long this *rann* (salt marsh) has existed, for in medieval times the area where it is now was connected to the Arabian Sea by a prominent distributary of the Indus River named the Kori. Today the Kori is no more, a natural dam 80km (50 miles) in length having blocked it. This dam, named Allah Bund, was created during the earthquake that rocked the area on 16 June 1819. The uplift that created Allah Bund was complemented by subsidence, which dropped an area at least 7km (4 miles) in diameter (including the British fort at Sindri) more than a metre.³⁸ The resulting landscape change was even more impressive, for the combination of the uplift and the subsidence created a basin with a surface area of more than 1,000km² (385m²) – the Rann of Kachchh.

Earthquakes affected the same area in the 1840s; Mrs Derinzy's Depression probably occurred in the course of the one in June 1845. During this event, as in most, the earthquake was followed by a tsunami that flooded the low-lying Rann.

Subsidence also occurred. An extract from Mrs Derinzy's letter talks of a man crossing the area on a camel, expecting it to be dry. Instead,

*... the guide travelled 20 miles [32km] through water ... up to the beast's body. Of Lak [Lakhpat] nothing was above water but a Fakeer's pole (the flagstaff always erected by the tomb of some holy man); and of Veyre and other villages only the remains of a few houses were to be seen.*³⁹

The subsidence experienced in the Rann during the 1840s served to extend its lowland area, but it also raised the Allah Bund to new heights, creating a more effective dam for the Kori and ensuring that the landscape changes enacted in 1819 would endure.

Differential tectonics have affected the area now occupied by the Rann of Kachchh for probably millennia, but details of the earliest changes that the people of this area witnessed have probably been lost forever. Yet maybe they contributed, along with countless other similar examples, to oral traditions that eventually became formalised when literacy reached India more than 3,000 years ago, and the earliest and still some of the most revered books about the history of the subcontinent were produced. For example, the poems of the *Rig Veda*, perhaps the earliest extant Sanskrit text, include one about Varuna, the Hindu god of water and the ocean, who 'led the watery floods of rivers onward ... [and] made great channels for the days to follow'. The poem talks about when 'he sinks in Sindhu ... ruling in depths and meting out the region, great saving power hath he, this world's Controller'. It may not be beyond the bounds of probability to link the tradition of Varuna, who occupies an underwater world, with millennia-old observations of land subsidence along the coast of India.⁴⁰

There is more such material in the *Ramayana* and *Mahabharata*, the Sanskrit sagas considered to have been originally compiled from oral traditions. Three case studies, each deriving from one or both of these texts, which recall the

submergence of coastal land, are recounted below: Dwaraka (Gujarat), Ramasetu (Tamil Nadu) and Mahabalipuram (Tamil Nadu) (Figure 5.3). The imprecision of these stories – compared to some described earlier in this book – makes it impossible to reconstruct the depths of sea level to which they might refer, and therefore to calculate minimum ages for the stories using known sea-level history.

The golden city of **Dwaraka** (sometimes Dvaraka or Dwarka), long the abode of Lord Krishna, was somewhere close to the western extremity of the Saurashtra Peninsula, about 250km (155 miles) west of the Rann of Kachchh, and

Figure 5.3 *The coasts of India and Sri Lanka today and during the coldest time of the last ice age, about 18,000 years ago. Locations of key places are shown, together with a satellite image showing a shallow Ramasetu. Satellite image credit: Jacques Desclotres, MODIS Land Rapid Response Team, NASA/GSFC.*

well positioned to play a prominent role in former cross-ocean exchange networks, especially within the Arabian Sea to the west.⁴¹ The *Mahabharata* tells that a town existed on the site of Dwaraka before it was built, a place called Kusasthali that was destroyed by the sea. Dwaraka was then constructed on the same part of the coast, including an area of 12 *yojana* reclaimed (or needing to be protected) from the sea.⁴² Why anyone would want to reclaim land on which to build a city when plenty was available above sea level is unclear.⁴³ A plausible explanation is that two separate (and significant) stories are conflated here, as often happens with such ancient traditions. The first concerns the construction of a coastal city, the second the growing need – its urgency perhaps amplified by the destructive impacts of an extreme wave event – to protect that city from rising sea levels, a process involving major earthworks along the shoreline. But in the end all this proved insufficient, and shortly after Lord Krishna left the city was submerged ... since which time it has become lost, its precise location uncertain. It is possible that extreme waves (storm surges or tsunamis), superimposed on a rising sea level, brought about the end of Dwaraka. A story in the *Mahabharata* states that many residents vacated the city before it was flooded,⁴⁴ implying that the submergence was neither sudden nor unexpected. In fact, it may be that this detail conflates the experiences of many generations, and that submergence, perhaps punctuated by extreme short-lived events presaging the ‘end’, could even have taken 100 years or so to accomplish.⁴⁵

Today, thanks largely to the efforts of Indian underwater archaeologists, we are fairly sure that Dwaraka was located in coastal Okhamandal and included offshore Bet Dwarka Island. At the latter site, underwater surveys have shown the existence of stone walls – perhaps jetties – and slipways, as well as numerous anchor stones and other artefacts (see colour plate section). Similar features are found on the adjacent mainland around the mouth of the Gomati River. Widely heralded as ‘proof’ of the stories in the *Mahabharata*, these discoveries do yet pose some difficulties concerning the time when Dwaraka was submerged.

Three dating methods have been employed. The first involved thermoluminescence dating of buried potsherds at Bet Dwarka; the earliest set of dates suggested that these were fired some 2,220–3,870 years ago (an average of about 1100 BC).⁴⁶ This result is broadly consistent with that obtained from celestial observations during the lifetime of Lord Krishna that are found in many ancient texts; an age range of 1500–1400 BC has been suggested.⁴⁷ But then there have been several suggestions that Dwaraka (or perhaps earlier Kusasthali) existed during the later part of the Harappan Period, perhaps around 2000 BC or even earlier.⁴⁸ Whether or not we might confidently ascribe the submergence of Dwaraka to postglacial sea-level rise is dealt with below, after the discussion of the other two sites in India.

The rock bridge of **Ramasetu** (Rama's Bridge), between part of the South-east Indian coast and that of nearby Sri Lanka, is reported in the *Ramayana* as having been constructed by the monkey army of Lord Rama, who used it to cross the gap to rescue his wife, Sita, who had been kidnapped by the demonic king Ravana.⁴⁹ The monkeys built the bridge using rocks from the hills and trees ripped up by their roots (see colour plate section). Led by Lord Rama, a huge monkey army then crossed to Sri Lanka, and Sita was eventually restored to him. Astronomical and historical-genealogical dating places the writing of the *Ramayana*, generally thought to pre-date the *Mahabharata*, some time between 4000 and 2000 BC.⁵⁰

When the sea level was lower during the last ice age, there would have been a broad land bridge in the area connecting what are now India and Sri Lanka. As the sea level rose, so the land bridge would have gradually been reduced in size and eventually drowned, undoubtedly to the consternation of people living at its extremities. Perhaps, as elsewhere in the world, memories of the time when a land connection between India and Sri Lanka existed found their way into folk traditions that in turn informed the stories in the *Ramayana*. Tens of generations after such a bridge existed, how would people ever explain that it had? Perhaps they melded the story with

religious beliefs and culture heroes, massaging their reported antics to accommodate the story, resulting in the memory of Ramasetu being preserved.

One point of interest to geologists is that in some stories about Ramasetu, before Rama's monkey army built its bridge, there had been another: one that ultimately failed.⁵¹ Might this represent the memory of a rise of sea level that drowned the land connection between India and Sri Lanka and was followed – perhaps hundreds of years later – by a fall of sea level that once again exposed it? Then came its final submergence, leading to the situation we see today where an underwater trace of such a connection is visible on satellite photos (see inset in Figure 5.3). That may strike you as a bit far-fetched, a *deus ex machina*, but actually from a geological standpoint it is not, for many scientists studying postglacial sea-level rise have found evidence consistent with oscillations – wiggles – rather than a smooth rise. So it may be that people witnessed the submergence of the India–Sri Lanka land bridge on more than one occasion, a detail that has also succeeded in finding its way down to us today.⁵²

The final case study refers to the city of **Mahabalipuram** on India's east coast, which has a long history of submergence, so much so that its earliest part once slipped into the realm of legend – once, that is. For shortly before the great Indian Ocean Tsunami struck Mahabalipuram on 26 December 2004, local fisherfolk saw the sea draw back an incredible 500m (1,640ft), exposing on the bare sea floor the remains of temples and associated statuary, numerous pieces of which were subsequently ripped from their shallow sandy graves and dumped inland as the massive waves rushed onshore. In the aftermath of the tsunami, the shoreline here was found to be littered with huge granite blocks (once parts of defensive walls), and statues of lions and elephants that once sat proudly above gates to a Pallava-era port city, perhaps 1,300 years ago.⁵³ However, Mahabalipuram was an important port far earlier, perhaps as much as 2,000 years ago, and had trade links with Imperial Rome, China, Sri Lanka and of course

other parts of India.⁵⁴ Subsequently, at least since Marco Polo's time (around AD 1275), Mahabalipuram was known as the City of the Seven Pagodas for its seven famous temples (topped with iconic pagodas, or *kalash*), all but one of which later disappeared beneath the ocean surface. In the year 1776, memories of these were fading, for then only older people

*... remembered to have seen the tops of several pagodas far out in the sea, which being covered with copper, probably gilt, were particularly visible at sunrise as their shining surface used to reflect the sun's rays.*⁵⁵

A Dutch portolan chart made in AD 1670, named DE CVST VAN MALEBHAER (The Coast of Malabar), is believed to show some temples at Mahabalipuram that were at the time very much onshore. It is possible that some of these later disappeared and perhaps gave rise to – or helped sustain – older stories about submerged temples here.⁵⁶ Yet most evidence, including that provided by underwater surveys, suggests that the six vanished temples with their pagodas were submerged at least 1,000 years ago, but perhaps no earlier than AD 600, when the Pallava culture, which seems likeliest to have created these gilded temples, began to flourish at Mahabalipuram.

We now, therefore, turn to look at the history of sea-level changes along the coast of India to try to determine the antiquity of the stories from these three locations. Surprisingly, there has been little effort to utilise the vast amount of local information about the evolution of the coast of India to produce a region-wide picture of sea-level change since the last ice age. In the absence of such information, sea-level histories from Malaysia, Singapore and the offshore islands of the Maldives can be brought together to produce a reasonable approximation of the situation in India. That is not really good enough, you might charge, but remember that its purpose is not to interpret with a very high degree of precision, but only to obtain an approximate measure of how old particular stories might be.

Our synthetic sea-level curve for India involves the sea level rising rapidly after the end of the last ice age to reach its modern level about 6,800 years ago – similar to Australia. It slowed down a bit after that before rising again to a maximum, perhaps 2m (6½ft) higher than it is today, about 5,200 years ago. It then started falling but then once again started rising, reaching another maximum – a bit lower than the earlier one – about 2,350 years ago, after which it fell, probably with some minor oscillations, to its present level (Figure 5.4). What this means is that the drowning stories from India recounted above could recall any one of these three highstands of sea level. The question is which one.

If we accept that Dwaraka – and its predecessor Kusasthali – were indeed Harappan cities, then the most likely scenario is that Kusasthali was established about 3,000–3,500 years ago. Then, as the sea level started rising thereafter, the city began to suffer from the effects of this. A bold new leader – Lord Krishna – arose and declared that Kusasthali should be comprehensively redesigned so that it might be protected from the rising sea. This leader oversaw the building of the sea defences recalled in the *Mahabharata*, and the new city, when completed around 2,800 years ago, flourished in the twilight centuries of the Harappan culture, as the focus of this was driven southwards into moister Sausashtra by an increasingly drier climate further north. Yet the sea level continued rising and gradually the golden city succumbed to the waves by about 2,400 years ago.

It is a different situation when it comes to Ramasetu, simply because the *Ramayana*, in which it was first written about, is thought to have been produced some time between about 4,000 and 6,000 years ago, so that the story is likely to pre-date the most recent sea-level maximum. Perhaps we should not place too much trust in that deduction, for ancient books are notoriously difficult to date and of course many evolve; it is even possible that the story about the building of Rama's bridge, today considered such a defining detail of the *Ramayana*, was in fact a more recent addition. But for the sake

Figure 5.4 Sea-level changes around India over the past 9,000 years or so. These are represented by an envelope to show the uncertainty based on imprecision of dating, as well as the tidal niches in which particular indicators are found. The sea reached its current level (dashed line) about 6,800 years ago, and stabilised for a while before peaking about 2m (6½ft) higher than it is today about 5,200 years ago. Then it fell, reaching a low about 3,200 years ago, before rising once more to a lower peak about 2,350 years ago, from which it fell more or less to its present level. Likely age ranges for stories about Dwaraka, Ramasetu, and Mahabalipuram are shown as solid bars.

of argument, assuming that this was *not* the case, then the most parsimonious interpretation is that Ramasetu was last visible when the sea level was lower than it is today some 6,800 years or more ago. This may make it a clear contemporary

of the majority of the Australian Aboriginal stories described earlier.

Finally to Mahabalipuram, jewel of the Pallava monarchy. Given that the sea level has been largely stable since Pallava times, the most likely explanation for the progressive submergence of Mahabalipuram's coastal fringes over the past 1,300 years or so is that the land has been slowly sinking.⁵⁷ This indicates that the City of Seven Pagodas came into existence only around a millennium ago. Of course, for Mahabalipuram as well as other comparatively young stories of submergence along the coast of India,⁵⁸ just as for the 'young' stories about Bremer Bay and Oyster Bay in Australia, the probability of a story being young does not render it immune from earlier influences. And it may well be that the story of the drowning of Ramasetu and similar places echoed through Indian cultures for millennia, influencing later observations and inferences about the history of India's coast.

If drowning stories could have endured many millennia as oral traditions (in Australia, Europe and India, among other places), then so, perhaps, have other types of story that are based on eyewitness accounts of other memorable events. This is the subject of the next chapter.