Lincs Time and Tide Bell
The Book

Introduction to Google Docs edition

This book is a community project written by Friends of the Lincolnshire Time and Tide Bell.

More information about the Bell is available on the website at http://bit.ly/TimeandTideBell

If you wish to contribute to The Book please do so below. You may wish to make minor edits and additions to existing sections - just do it - or you may wish to create a whole new section - just add you piece almost at the end of The Book. If you have just some vague ideas or suggestions that you think others may take up, put them in the last section headed 'Sandpit'.

The short link to this editing page is http://bit.ly/TimeandTideBellBookEdit

The Time and Tide Bell
for Lincolnshire

Foreword by the sculptor
Marcus Vergette

The Time and Tide Bell Project background and history and why Mablethorpe North End

I first became interested in bells at the end of the Foot and Mouth epidemic in my Parish in 2001, when the movement restrictions were lifted and we could leave our farms for the first time in six months. My neighbour, the captain of the tower, went up to the church and rang the church bells all day. I hadn't noticed that this sound had been missing all that time. I was drawn up the hill to the church where he showed me the bells in the bell tower. I was amazed to discover these enormous bronze sculptures secreted away in my small rural parish.

I was asked by, and made with, the residents of my village of Highampton, a commemoration of the hardship endured by the people in the parish, and the terrible slaughter of the animals during the Foot and Mouth epidemic. We made what is thought to be the first public access bell in the UK. In order to create a democratic bell that could be rung by anyone, there were many legal and social obstacles that were successfully overcome. The bell now celebrates the community's survival and strength, and is rung by many people, for their own reasons.

This bell was cast at Whitechapel Bell Foundry, where bells have been cast in essentially the same way on the same site for 600 years. While I was watching the tuning process of this bell the seed was sown for this present work. I used new computer modelling techniques for understanding wave-form and vibration in materials to invent a new bell form with new notes and harmonies within the bell. In exploring a new bell sound I explore a shape, and in a shape a sound.

The new bell and choice of installation sites draw a different map of our island. Each site brings something particular and unique to the whole group. Bells tell stories of the past very easily, but it is not the intention of this project to only mark and connect historic events, but also to look forward. Narrow horizons and short time frames are always misleading and make it difficult to understand the dramatic changes we have seen over the last few years and whether they will lead to chaos or a better future. These bells are designed to work for a long time. For me the character of each site, both in the people and their stories and the movement of the water, are directly related to, and are results of, the shape of the land. Although we are shaped by our land, we also shape it.

The first bell installation was Appledore, in North Devon, on the Taw and Torridge estuary. Appledore has some of the world's highest tides; this ancient shipbuilding port has connections to the west, through export of domestic ceramic wares to the West Indies during the slave trade, and to the east with ball clays which are still regularly being shipped through the Baltic to Russia. The estuary is surrounded by fertile green fields with hedges and livestock. Each day up to 9 metres of water flood into and out of the estuary. This rhythm is echoed by the dairy cows in the fields as they are milked twice daily. The bell sounds when the water is over the sand bar at the mouth of the estuary and the cargo ships and fishing boats may leave or enter the estuary.

The next site was Great Bernera in the Outer Hebrides. The island largely consists of Lewisian gneiss, it is some of the oldest rock and land on earth, which has been resisting the ravages of the sea for approximately 3000 million years, before the fossil record began. There is no sand on the beach, only crushed sea shells. There is barely a tree now left on the island. Even without knowing the age of the rock you feel the primitive power of this landscape. This seems reflected somehow in the people on the island; a place that has a long and complex history of courage and independence in the face of hardship and resource depletion. Where the bell is on Bosta Beach has been the point of arrival and departure for many different groups and cultures from the Vikings to the Clearances. Paradoxically, islands seem to be made larger by the sea that surrounds them. The element that might reduce them, which might be thought to besiege them, has the opposite effect. The sea elevates a few acres into something they would never be if hidden in the mass of the mainland. They become gardens in the world of water.

One possible function of this bell is as a time-piece or time-marker, both in the way the bell is rung daily by the movement of the sea at high tide, and as a long time marker of sea levels and present shoreline. The bell at Trinity Buoy Wharf, London, was installed on the embankment wall of the Thames, 28 seconds east of the prime meridian. Trinity Buoy Wharf now is an interesting development in urban planning, combining living accommodation, arts and creative industries, and business. Historically, at this wharf Michael Faraday built a lighthouse to conduct experiments with electric lights for lighthouses, lighthouse keepers were trained, and navigation buoys were made. Here is the junction of the Lea and the Thames, both of which twist and turn through grassy banks and fields, between walls and embankments, through factories and houses, as they wind their way to the sea from the central heart of England through the capital, out past the further control of the Thames Barrier.

Aberdyfi, Wales, where the fourth bell was installed, contrasts with the constantly reshaped and controlled landscape of the Thames. Here is one of the oldest legends of bells under the sea. Aberdyfi is referred to in ancient Gaelic legend and song about the kingdom of Cantre'r Gwaelod, a kingdom now submerged beneath Cardigan Bay. The origins of the legend are lost in the mists of time, but perhaps the ancient Gaelic legend refers to ice melt at the end of the last ice age, the inundation of the land, and the formation of the Bay. It is said that its bells can be heard ringing beneath the water. At low tide sometimes the tree stumps of ancient forests are revealed, radio-carbon dating suggests that these trees died around 3500 BC. On one side of the estuary are dunes, on the other, Snowdonia. The historic river Dovey, carves down Aran Mawddwy and flows into Cardigan Bay. Locals call The Dovey the dividing line between north and south Wales, but it also connects them.

The fifth bell in Cemaes Bay, is on the north coast of Anglesey. This is an area of outstanding natural beauty, and some of the most geologically complex shoreline in Britain, whose significance has recently been recognized internationally by UNESCO as a Geopark. Here in Cemaes Bay there is a long history and varied history of land use evident, with signs of farming, industry, and mining and, more recently, wind farms and a nuclear power station visible. Standing beside the bell one can see and consider our relationship to our environment and also the connections across the water; Dublin is closer than Cardiff, and local legend insists that St Patrick was shipwrecked on Ynys Badrig, where he founded a church in 440 AD.

Mablethorpe North End Beach, Lincolnshire, is critical in the constellation of the Bells, and brings something unique and particular to the whole project. Most of the west coast of Britain is unchanging stone cliffs and estuaries, whereas this stretch of Eastern coastline is some of the fastest changing coastline in Britain. Here people have been dealing with changes in sea level for hundreds, even thousands

of years, and have much to offer as the rest of us begin to confront these problems. Now in some places near Theddlethorpe and Mablethorpe the land behind the sea defences is 3 m below sea level at high tide, and in others the old sea defences have already been allowed to be breached and the sea reclaimed some of the land in front of new defences built further back. The tide peaking at different places at different times of day, means that when the other bells are silent the one at Mablethorpe North End will be ringing.

In the places where the Time and Tide Bell has been installed it has become a way for residents and visitors to connect with their own history and environment, as an instrument of measurement, as a musical instrument, as a sculpture. It has also become a focus for music, events, exchanges, etc., both locally and between the different Bell sites. Every Bell has its own inscription on the wave catcher, written by the community around the Bell; in this way the bell says what those who experience it regularly want it to say. Bells speak in celebration and in loss; they are a mouth piece for our culture. I would like to thank all those people in the communities where the Time and Tide Bell has been, or is going to be installed. Without their support, vision, and enthusiasm no Time and Tide bells would have been installed.

Marcus Vergette July 12, 2014

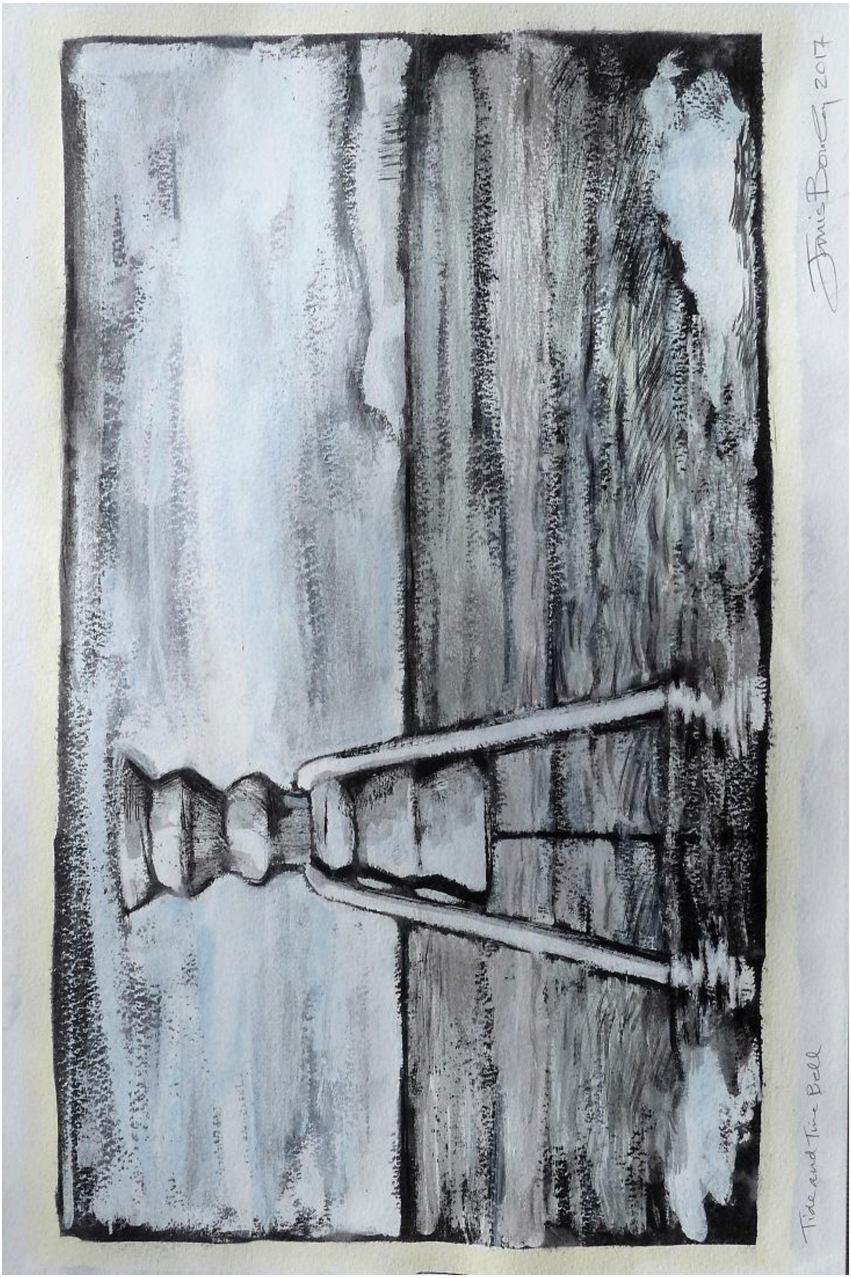

Tide and Time Bell

Figure 1 Time and Tide Bell - Cemaes. by Janice Bowley 2017

Introducing the Time and Tide Bell Project.

A permanent installation around the U.K. of bells rung by the sea at high tide.

Marcus Vergette has designed a bell with a new harmonic relationship, which can sound different notes from the same strike, and is played by the movement of the waves creating a varying musical pattern. This bell has been installed at the high tide mark at a number of diverse sites around the country, from urban centres to open stretches of coastline. To create, celebrate, and reinforce connections, between different parts of the country, between the land and the sea; between ourselves, our history, and our environment. Additionally as sea levels rise as an effect of climate change, the periods of bell strikes will become more and more frequent, and as the bells become submerged in the rising waters the pitch will vary.

The first bell was installed in July 2009 at Appledore, Devon: the second on Bosta beach Gt. Bernera, Outer Hebrides in June 2010: the third at Trinity Buoy Wharf, London in September 2010. The fourth installed in Aberdyfi, Wales August 2011, and the fifth Anglesey, Spring 2014. Lincolnshire will host the sixth.

The integrity of the Time and Tide Bell project nationally is in the choice of the sites and how they connect. Each site brings something particular and unique to the whole group.

Appledore, Devon (installed May, 2009), in North Devon, on the Taw and Torridge estuary, an ancient shipbuilding town with connections east and west, through export of domestic ceramics to the West Indies as part of the slave trade, to ball clay still being shipped to Russia. Here are some of the highest tides in Europe, the base of the bell marks the moment the water is over the bar and ships may leave or enter the

estuary.

Isle of Bernera, (installed June 19, 2010) on the northwest fringe Lewis, in the Outer Hebrides; is some of the oldest rock/land on earth, and has been resisting the ravages of sea for 3 - 400,000,000 years, from before the fossil record. This island has a complex history of courage, and independence in the face of resource depletion and oppression, with barely a tree now left on the island. Bosta beach has been the point of arrival and departure for many different groups and cultures from the Vikings to the clearances.

Figure 2 Bosta Beach, Great Bernera, Isle of Lewis

Trinity Buoy Wharf, (installed Sept 19, 2010) London, on the embankment wall of the Thames, 28 seconds east of the Meridian Line. One of this bell's potential meanings is as a time-piece or time-marker, both in the way the bell is rung by the movement of the sea at high tide daily, and as a long time marker of sea levels and present shoreline. Here Michael Faraday built a lighthouse to experiment with electric lighting for lighthouses, lighthouse keepers were trained, and navigation buoys were made. This site is the confluence of the Lee and the Thames rivers which twist and turns between walls and embankments, through factories and houses as it winds its way from the central heart of England to the sea.

Figure 3 Trinity Buoy Wharf, London

Aberdyfi, Wales (installed August 2011) clinging to the rocky edge of Snowdonia, on the estuary of the historic river Dovey, flowing down the mountain Arran Mawddy to Cardigan Bay, the dividing line between north and south Wales. Aberdyfi is referred to in ancient Gaelic legend and song as the former kingdom of Cantre'r Gwaelod now submerged beneath Cardigan Bay, and its bells which, it is said, can be heard ringing beneath the water. Here the tree stumps from the post ice age forests are revealed at low tide. The ancient Gaelic legend perhaps referring to ice melt at the end of the last ice age and the formation of the bay.

Cemaes, Anglesey (to be installed Spring 2013) Cemaes Bay is on the north coast of Angelsey and is an area of outstanding natural beauty,

with a unique history and some of the most geologically important shoreline in Britain, whose signifigance has been recognized internationally. Local legend insists that St Patrick was shipwrecked on Ynys Badrig, where he founded a church in 440 AD. However this project is not only to connect with the past but also to engage with the present and future. Around Cemaes there is a long history of varied land use, with farming, industry, and mining, and more recently wind farms, and a nuclear power station. The Time and Tide Bell has become a way for residents and visitors to connect with their own history and environment, as an instrument of measurement, as a musical instrument, as a sculpture, and a focus for music, events, exchanges, etc, both locally and between the different bell sites.

The Bell at Mablethorpe North End will be the sixth in the series and two more are planned for Morecombe Bay in Lancashire and Happisburgh, Norfolk.

The Inscriptions.

Each bell is rung by the motion of its wave catcher, a bronze paddle at the base of the bell that is moved by the waves and connected to the clapper at the top of the bell. The tradition of inscribing bells must be regularly want it to say. Bells speak, in celebration and in loss, they are almost as ancient as bell-making itself and each Time and Tide Bell has its own inscription on the wave catcher, written by the community around the bell. In this way the bell says what those who experience it a mouth piece for our culture.

Appledore Inscription:

In thrall to the moon rocked by her ebb and flow
I sing of swells beneath the stars black waves at the storms height
New ships' rhythmic passage west seabirds in the dancing wake
All who set sail in sorrow or joy and all who sleep below.

The London Inscription:

What is the song in the wave, if not that all living is meeting?
Nothing given up, or held for good: bats in the lantern light, cormorants scouring the tide.

The Aberdyfi Inscription:

Above the awesome tide Uwch llanw
I will rejoice erch llawenhaf

Bernera Inscription:

Gun mhuthadh gun truas
A' sluaisreadh gainneim h na tràgh'd
An àtaireachd bhuan
Cluinn fuaim na h-àtairreachd àrd
Mo leabaidh dean suas
Ri fuaim na h-àtaireachd àrd.

Without change, without pity
Breaking on the sand of the beach
The ceaseless surge
Listen to the high surge of the sea
Make my resting place be
By the sound of the surge of the sea.

Figure 4 The Bell at Bosta Beach, Great Bernera

Award

The Time and Tide Bell Project was a finalist for the Climate Change Awards 2011, Best Artistic Response to Climate Change.

"This is an inspired project. The link between ourselves and the elements are in danger of being lost in our 21st century life. The importance of that link, given climate change, is more important than it ever has been and such a beautiful reminder of the importance of tides and sea levels is truly inspirational." - Baroness Miller of Chilthorne Domer, House of Lords Climate Change Committee

Liminal

On a threshold

Our Time and Tide Bell takes a liminal position, occupying that space, undefined, neither land nor sea, and marks the temporal threshold between the Holocene and Anthropocene, the geological epoch gone, of post-glacial climatic amelioration and relative stability, and the epoch of future climate change, the result of anthropogenic global warming. The Bell sounds, with rising tides, a warning of sea level change, as our actions tip the threshold of ice-cap stability. The subliminal forcing of global temperature by greenhouse gasses to a new equilibrium will eventually bury the Bell under new marine sediments as the Lincolnshire Marsh becomes inundated once more by the waters of the Greater North Sea. Some may like to view the Bell as a votive offering, deposited without the intention of recovery or use, in a sacred place for their own religious purposes. There has been a long tradition dating back at least to the 4th century BC with the 'Witham Shield' and other Iron Age artefacts that were deposited near Fiskerton on the River Witham. Our Time and Tide Bell will not be deliberately discarded but the inevitable rise in sea level in coming centuries may force the issue.

The history of our coastline tells of the complex interplay of sea and land. Changes in sea level come about through change in the volume of water in the oceans, the rising and falling of the rocks of the land and through erosion of and deposition upon those rocks. During ice ages, the water of the oceans is locked up in ice caps and sea level falls. The weight of ice pushes down upon the land causing the crustal rocks to sink lower into the Earth's mantle below. They bounce back up when the ice weight is relieved on melting, but this isostatic rebound is a slow process, taking thousands of years, much slower than the immediate rise in sea level that comes with ice melt as an interglacial

period is entered.

The centre of relative uplift is over central Scotland reflecting the continuing impact of glacial isostatic adjustment. Rather than a simple pattern, there are three centres of relative subsidence: over southwest England, the southern North Sea, and the Shetland Isles. The picture is complicated by the ocean load on the Atlantic basin and on the continental shelf and the glacial isostatic effect of the Scandinavian ice sheets. After unloading, the isostatic recovery is rapid at first but the rate of uplift decays exponentially. As a result, 10 000 years since the ice left, the central Scottish coast is still rising at about 1 mm per year, perhaps a tenth of earlier rates, while the Lincolnshire Coast is falling, relative to sea level at a rate of about 0.5 mm per year.[1] These rates would have been much faster in the past. To this must now be added the recent sea-level rise of global warming origin on the order of 3 mm per year, a rate which may become much faster in the future.

There are also local effects. The ice erodes where it is actively moving, lowering the land surface, but eroded material is transported and then deposited at the edge of the ice sheets where they melt, raising the land surface. Erosion and deposition by the abundant meltwater around the ice front complicates further. In the intertidal zone, marine silts can accumulate, storm beaches and wind blown sand dunes can protect low lying areas inland that can then accumulate peat deposits. When close to sea level, even small changes such as those produced by sediment consolidation, can have significant effects on local geography.

[1]2009 Ian Shennan, Glenn Milne, Sarah Bradley. Late Holocene relative land- and sea-level changes: Providing information for stakeholders. GSA TODAY Volume 19 Issue 9 (September 2009)

A hundred thousand years ago, during the Ipswichian Interglacial, the Lincolnshire coast was at the foot of chalk cliffs, now the eastern edge of Wolds running from Candlesby northwards to Barton-on-Humber. As the Devensian Ice Age set in, sea level dropped, leaving dry land, 'Doggerland', across to Denmark. The ice repeatedly advanced and retreated, leaving moraines and meltwater deposits on the Lincolnshire Marsh and offshore, until the final retreat and warmer conditions allowed the growth of forests in the Boreal Period. Global sea level (the eustatic change) rose some 130 metres between the maximum of the Devensian glaciation, some 18 000 years ago and about 8000 years ago. In Scotland the isostatic rebound was about twice the eustatic change but that was not the case for Lincolnshire.

Doggerland had connected Lincolnshire to continental Europe but the North Sea shoreline spread southwards after around 10000 BP. The English Channel flooded around 8000 BP. The Dogger Bank was submerged about 8700 years ago with the present shape of coastline of southern Britain roughly established by about 7500 years ago, though more indented with the drowning of lowlands and estuaries that have since been silted up. In the south of the county the Fenland marine transgression started about 7850 BP. Deposition of clays, alternating with peats, filled the embayment as the sea rose. The final expansion of the tidal flats marked by a layer of marine clays and silts occurred between about 2750 and 1500 BP[2]. This may have coincided with the final flooding of the forests on the Lincolnshire Marsh, forming our submerged forest.

[2] 2000 David S. Brew, Tina Holt, Ken Pye and Rhonda Newsham. *Holocene sedimentary evolution and palaeocoastlines of the Fenland embayment, eastern England* Geological Society, London, Special Publications 2000, v. 166, p. 253-273. doi: 10.1144/GSL.SP.2000.166.01.13

The submerged forest was first described in the scientific literature by José Francisco Correia da Serra (1750–1823). He was a Portuguese Abbot, polymath - philosopher, diplomat, politician and scientist. He lived in England between 1786 and 1802 and, with the support of Sir Joseph Banks, was elected to the Royal Society in 1797. His paper "On a submarine forest on the coast of England," was published in the Philosophical Transactions in 1799[3].

It was a common report in Lincolnshire, that a large extent of islets of moor, situated along its coast, and visible only in the lowest ebbs of the year, was chiefly composed of decayed trees. These islets are marked in Mitchell's chart of that coast, by the name of clay buts; and the village of Huttoft, opposite to which they principally lie, seems to have derived its name from them. In the month of September, 1796, I went to Sutton, on the coast of Lincolnshire, in company with the Right Hon. President of this Society, in order to examine their extent and nature. The 19th of the month, being the first day after the equinoxial full moon, when the lowest ebbs were to be expected, we went in a boat, at half past twelve at noon, and soon after set foot upon one of the largest islets then appearing. Its exposed surface was about thirty yards long, and. Twenty five yards wide, when the tide was at the lowest. A great number of similar islets were visible round us, chiefly to the eastward and southward; and the fishermen, whose authority on this point is very competent, say, that similar moors are to be found along the whole coast, from Skegness to Grimsby, particularly off Addlethorpe and Mablethorpe. The channels dividing the islets were, at the time we saw them, wide, and of various depths; the islets themselves ranging generally from east to west in their largest dimension.

We visited them again in the ebbs of the 20th and 21st; and, though it

[3] 1799 Joseph Correa de Serra, *On a Submarine Forest, on the East Coast of England*. Philosophical Transactions of the Royal Society of London, Vol. 89, pp. 145-156

generally did not ebb so far as we expected, we could notwithstanding ascertain, that they consisted almost entirely of roots, trunks, branches, and leaves of trees and shrubs, intermixed with some leaves of aquatic plants. The remains of some of these trees were still standing on their roots; while the trunks of the greater part lay scattered on the ground, in every possible direction. The bark of the trees and roots appeared generally as fresh as when they were growing; in that of the birches particularly, of which a great quantity was found, even the thin silvery membranes of the outer skin were discernable. The timber of all kinds, on the contrary, was decomposed and soft, in the greatest part of the trees; in some, however, it was firm, especially in the knots. The people of the country have often found among them very sound pieces of timber, fit to be employed for several œconomical purposes.

The sorts of wood that are still distinguishable are birch, fir, and oak. Other woods evidently exist in these islets, of some of which we found the leaves in the soil; but our present knowledge of the comparative anatomy of timbers, is not so far advanced as to afford us the means of pronouncing with confidence respecting their species. In general, the trunks, branches, and roots of the decayed trees, were considerably flattened; which is a phenomenon observed in the Sartarbrand or fossil wood found in the neighbourhood of the lake of Thun, in Switzerland.

The soil to which the trees are affixed, and in which they grew, is a soft greasy clay; but, for many inches above its surface, the soil is entirely composed of rotten leaves, scarcely distinguishable to the eye, many of which may be separated, by putting the soil in water, and dexterously and patiently using a spatula, or a blunt knife. By this method, I obtained some perfect leaves of Ilex Aquifolium, which are now in the Herbarium of the Right Hon. Sir John Banks; and some other leaves, which, though less perfect, seem to belong to some species of willow. In this stratum of rotten leaves, we could also distinguish several roots of Arundo Phragmite.

These islets, according to the most accurate information, extend at least twelve miles in length, and about a mile in breadth, opposite to Sutton shore. The water without them, towards the sea, generally deepens suddenly, so as to form a steep bank. The channels between the several islets, when the islets are dry, in the lowest ebbs of the year, are from four to twelve feet deep; their bottoms are clay or sand, and their direction is generally from east to west.

For the establishment of such an extensive forest of mature trees there must have been lengthy periods without any marine transgression, the trees not being able to survive even quite short flooding with sea-water. Carbon dates given to two oak stumps from Anderby Creek are 4480 ± 55 and 4625 ± 55 BP.[4] Also recorded in the EH peat database is Swinerton's description from 1931 from Chapel Point, a little south of Anderby Creek: "*Two coastal peat beds: lower forest bed (with oak stools) on boulder clay and upper fen-wood peat. Separated by 6 ft [1.83 m] thick clay layer.*" The Upper Peat has been dated at 3340 BP but may have taken 700 years to develop. Dates from the Lower Peat suggest an age of 4000 to 4600 years. To the north at Wolla Bank, oak from the Lower Peat has been dated at 4865 ± 65 BP. Older samples have been found in the Humber Estuary near Immingham.

The forest's demise was probably gradual, rising relative sea level impeding drainage and the land becoming wetter. The tree stumps, rooted in the underlying boulder clay, are embedded in peat which formed as the trees succumbed to wetter conditions.

Establishing a Holocene stratigraphy for the Marsh and off-shore deposits is problematic. Land approximately at sea level for 8000 years

[4] English Heritage Peat Data Base http://www.english-heritage.org.uk/content/imported-docs/p-t/peat-database-lincs.pdf

is subject to repeated marine incursions and deposition, compaction and deposition in freshwater in conditions. Furthermore, deposits may not be laterally temporally continuous, but rather comprise lens-shaped bodies of clay, sand and peat of no great extent.

Consider what happened in the flood of 1953, when the sea defences were breached by a tidal surge and large waves pushed by strong on-shore winds. A great quantity of sand was washed inland from the breached beach dune system, burying the streets of Mablethorpe and Sutton-on-Sea. In places the sand was a couple of metres thick and covered a large area in a thinner layer. In the urban area much of this sand was cleared away, but at the notorious breach of Acre Gap, between Sutton and Sandilands, where aerial photographs of the time show an apron of sand spreading inland from the breach, the deposit is evidenced by a slope in the ground of a couple of metres from the foot of the sea bank, inland towards Henshaw Avenue, where the land is at about 1 metre OD. It is perhaps worth pondering on the fate of the newly built bungalows hereabouts, standing on land that must lie some four metres below the water level in a tidal storm surge.

But the point here is that we have here, formed within living memory, a lenticular sandy bed whose thickness increases from zero to perhaps three metres over a lateral distance of just a couple of hundred metres. Left to its own devices, without the intervention of engineering men, a new storm beach would have formed after the 1953 flood, protecting the low-lying land away from the beach which, with blocked drainage would have become a freshwater marsh, eventually filled in with freshwater lain silts and peat. Wind-blown sand might also contribute substantial quantities of fine material to the sediment layers, as happened in the prolonged spell of easterly winds in the spring of 2013. This accumulation would have continued until the next surge breached the natural storm beach and spread another layer of sand.

In this manner a precarious dynamic equilibrium is established

between sea and land levels. It is likely that such a situation has continued for the past 8000 years, the exact coastline shifting back and forth over the centuries but the land of the Outmarsh never far from marine influence. Whether the equilibrium will be maintained in the future, when global warming related eustatic sea level augments the isostatic subsidence, is a matter for speculation. What must be sure is that the construction of sea defences and the prevention of natural sedimentation to raise land levels, will increase the difference between the land level and the sea, making an engineered defence of the land progressively more problematic as time goes by.

This raises the question of when it will become wise to no longer increase the sea defences. Today it is a fairly straightforward cost/benefit analysis, comparing the cost of a proposed engineering work with the increased security that results to land, infrastructure and lives whose value is assessed. Currently the Environment Agency has a policy of maintaining the defences such that the risk of serious flooding has a probability of the order of 0.01 to 0.02% per year. This is sometimes stated in terms as a one in a hundred or one in two hundred years event, though this runs the risk of people thinking that if we have a flood today we are likely to be safe for the next 200 years. It is, of course, just a statistical probability; the chance of a flood this year is the same as for next year, whatever happened this year. And it does not imply any assumption that conditions will remain stable for two centuries. Far from it.

As we look into the further future a curious conundrum emerges. Sea defences are improved slowly and piecemeal, a raising of a bank here, a better sluice gate on an outfall there, the cost of individual projects often being judged worthwhile. Each incremental improvement is calculated to be cost effective by the policymakers of the day. But this surely cannot go on for ever? In different locations there various technicalities. Where the sea defences are essentially the natural sand dunes, permeable to water, there is the risk of salt water passing

straight through and reaching the land behind. To an extent, the pressure of freshwater on the landward side and the slow rate of permeability keeps the seawater out so long as the land is above the mean tide level, even though at high tide the water may be above the land level. In Lincolnshire the sand dunes often rest upon clay banks or there are man-made clay banks built upon natural clay deposits that support a greater land-sea level difference. In Florida, by contrast, the surface geology is dominated by sand and coral. Building an impermeable sea wall would be fruitless as the sea-water would quickly pass through, below any defences. Florida will be lost before Lincolnshire. In the Netherlands large areas of land are 4 or 5 metres below mean sea level and the Dutch have an existential incentive to keep spending on improving the sea defences. The cost, however, increases exponentially with height above sea level so will be difficult to sustain far into the future.

Forecasting the rate of future ice melt and hence sea-level rise is beset with unknowns. The IPCC AR5 projections speak of a rise of up to about a metre by the end of the 21st century. But there are two significant considerations: firstly the year 2100 is not far off – within the expected lifetimes of our smaller children; and secondly, these IPCC projections are based on models that do not take into account much of the dynamic behaviour of the ice-sheets, that their future rate of loss may be very different from their current loss rate. (For a fuller consideration of the IPCC work on sea-level rise see Stefan Rahmstorf at http://www.realclimate.org/index.php/archives/2013/10/sea-level-in-the-5th-ipcc-report/)

While timing is uncertain, a sea-level increase of 5 or 6 metres is regarded as pretty much inevitable, irrespective of humanity's best efforts to mitigate global warming; so much is already locked into the system. The timescale should be seen in the same light as the age of many of our buildings, many of Lincolnshire's medieval churches having

already seen more than half of their lifetimes.

The important thing to grasp about the various projections for future sea-levels is their uncertainty. As Rahmstorph[5] puts it *"Coastal protection professionals require a plausible upper limit for planning purposes, since coastal infrastructure needs to survive also in the worst case situation. A dike that is only "likely" to be good enough is not the kind of safety level that coastal engineers want to provide; they want to be pretty damn certain that a dike will not break. Rightly so. It is one of the fundamental philosophical problems with IPCC that it refuses to provide an upper limit for sea-level rise."*

By the time the last ice has melted in the Antarctic, many centuries in the future, the wall would have to be some 60 metres tall. Long before that, the decision would have to be taken to abandon the land, but just when? That will always be a difficult political call; politicians having a natural tendency to kick a hard problem down the road until it becomes somebody else's problem. And they keep their fingers crossed against something breaking on their watch.

But let's return to earth, or at least clay and sand. In 1931 H.H. Swinnerton[6] published his survey of the beach between Anderby Creek and Chapel Point.

---

[5] 2013 Rahmstorph, Stefan. RealClimate Blog-post, *Sea level in the 5th IPCC report* at http://www.realclimate.org/index.php/archives/2013/10/sea-level-in-the-5th-ipcc-report/

[6] 1931 Swinnerton, H. H. *The post-glacial deposits of the Lincolnshire coast.* Quarterly Journal of the Geological Society, 87. pp. 360-375

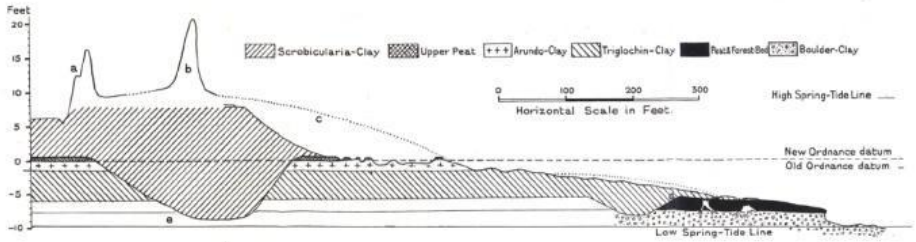


Figure 5 Diagrammatic Section across the Beach north of Chapel Point

The section was drawn ten miles south of our Bell's location but Swinnerton says it is representative of the beach from Ingoldmells to Mablethorpe.

The 'Old Ordnance Datum' marked was the Liverpool datum that was replaced by Newlyn, the 'New Ordnance Datum' in 1921 and which we still use. It is at about the mean sea level, halfway between the low and high tide lines, but the clear break of slope seen in the diagram, and on the beach at #Anderby Creek, is related to the underlying geology rather than the position of the tide lines and just happens to coincide with the somewhat arbitrary Ordnance Datum. The Arundo and Triglochin Clays are stiff materials, comparatively resistant to erosion while the overlying Scrobicularia Clay is a softer, sloppy material that survives only where protected by a covering of sand, the material left blank at a, b and c in the diagram. The clay of the lower beach is often not exposed but is covered by a thin layer of sand.

Swinnerton describes the 'Upper Peat' as a persistent horizon, just a few inches thick that "maintains a constant level slightly above mid tide". This is the layer that has been dated to 3340 BP. The 'Lower Peat' in places over 50cm thick, with its tree stumps rooted in the much older glacial Boulder Clay below, has been dated between 4000 to 4600 years ago.

The Boulder Clay was laid down be the melting ice sheet of the

Devensian Glaciation, perhaps ten or twenty thousand years earlier. It was eroded into a hummocky surface upon which the Holocene clays were deposited and is exposed at the extreme low tide below the submerged forest of the Lower Peat. It is much more resistant to wave erosion and, to the south it forms the promontory of Chapel Point

The names of the clays tell of their depositional environment. Triglochin maritima is arrowgrass, a brackish-water rush. This clay would have formed on salt marsh and is lagoons protected by a storm beach. The Arundo Clay, appears curiously named as Arundo grows in the Mediterranean and eastwards to India, but this is actually the old name for Phragmites, renamed by the botanists since Swinnerton's day. This then also was deposited in a salt-marsh environment. Scrobicularia is a marine bivalve so this upper clay represents a marine transgression, with the area submerged at least at each high tide.

Clement Reid had earlier, in 1913, described the evidence for submerged forests around the coasts of Britain but, unfortunately, he rather skips by Lincolnshire with this short paragraph:
Submerged forests of the ordinary type are often to be seen between tide-marks on the flat shores of Lincolnshire; but as they still await proper study they need not detain us, and we will pass on to the next large indentation of the coast-line, the estuary of the Humber.[7]
But at least he provided us with the map that showed us the once dry land of the North Sea.

[7] 1913 Reid, Clement. *Submerged Forests*. Cambridge University Press

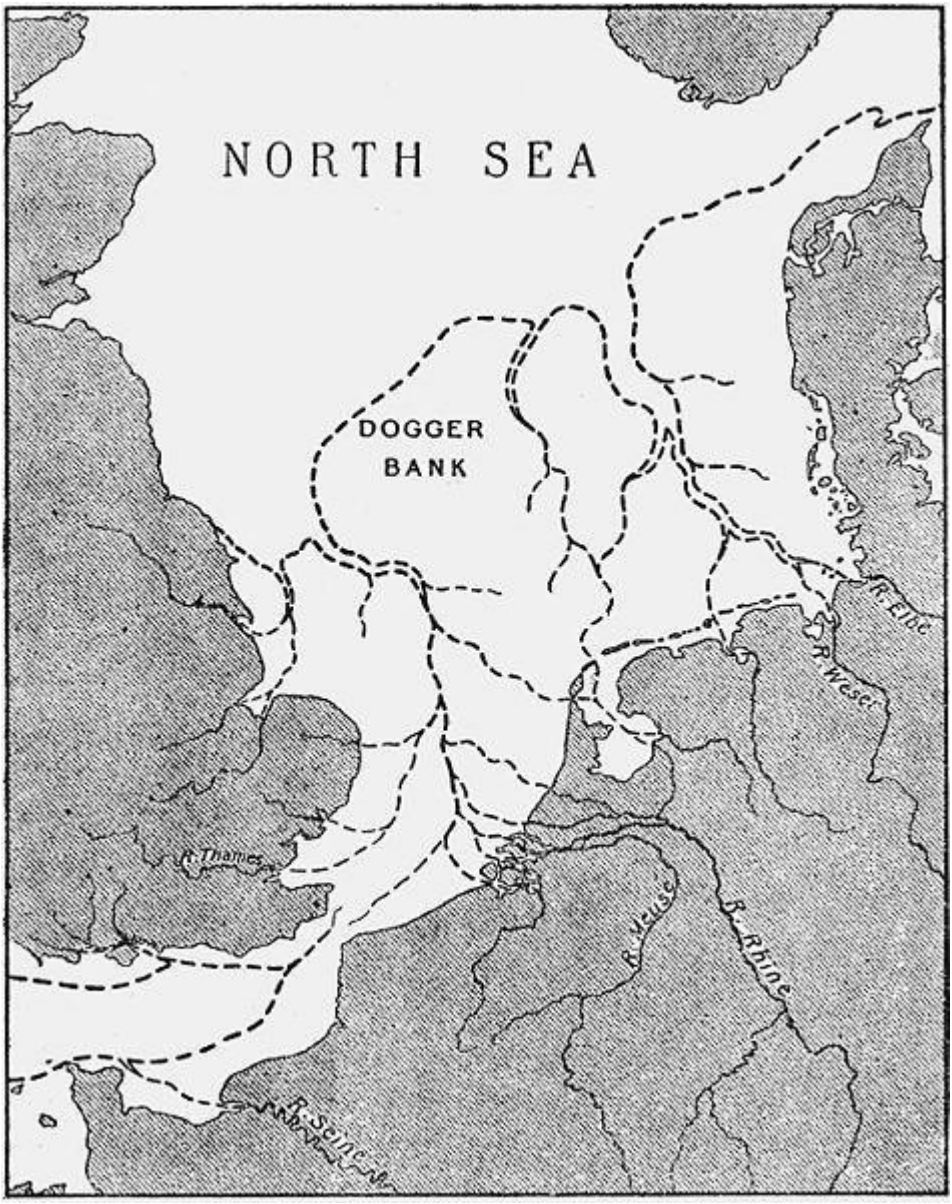


Figure 6 Map of Doggersbank, North Sea, showing approximate Coast-line at the period of the lowest Submerged Forest. Clement Reid, 1913. Submerged Forests

Reid was mostly interested in the deeper submerged forests found in harbour excavations in places such as the Thames, Humber and Bristol Channel, where he described layers of peat around 20 metres below sea level. He recognised that in Scotland there were raised beaches so concluded that there had been a subsidence of England and emergence of Scotland, a tilting of the British Isles. He made no mention of isostacy, the rebound of a landmass pushed down by the weight of ice, and neither did he discuss the eustatic changes of sea level associated with glaciation. It must have been a struggle to fit observations to theory when so much was not understood. Thomas Jamieson[8] had, in 1865, introduced the idea of isostatic equilibrium, but the concept took a long time to gain favour. More work had been done in Scandinavia, and by 1888 the Swedish geologist Gerard De Geer had produced an uplift map of the region.
But although the observations had been made and hypotheses made, scientific knowledge developed slowly a century and more ago, so it was not until 1914 that William Wright[9] published his book, *The Quaternary Ice Age*, in which he considered the combination of both eustatic sea and isostatic sea level change. Martin Eckman[10], in his book, *The Changing Level of the Baltic Sea during 300 Years: A Clue to Understanding the Earth*, recounts how the scientific knowledge of Holocene sea-level changes developed.

The submerged forests are, as Clement Reid described, widespread off the shores of southern Britain, and a similar situation to Anderby Creek is found near Aberdyfi where another of the Time and Tide Bells is

---

[8] 1865 Jamieson, T (1865): *On the history of the last geological changes in Scotland*. Quarterly Journal of the Geological Society of London, 21, 161-203.
[9] 1914 Wright, W B, *The Quaternary Ice Age*. London, 464 pp.
[10] 2009 Ekman, Martin. *The Changing Level of the Baltic Sea during 300Years: A Clue to Understanding the Earth* Summer Institute for Historical Geophysics p55 http://www.historicalgeophysics.ax/

located. *The Submerged Forest At Borth And Ynyslas, Cardiganshire*[11] was published in 1938 by Godwin and Newton, based on the notes of a botanist, Mrs F.N. Campbell James, who had died before completing her thesis. The tree stumps are best seen at low tide on the beach between Borth and Ynyslas, to the south of the mouth of the River Dovey. They have been dated to 3500 BP, with some lower down the beach to 5500 BP. They have provided inspiration for the Welsh legend of Cantre'r Gwaelod; the fertile land which lay in Cardigan Bay which was lost to the waves in pre-historic times. The two Bell locations, at Mablethorpe North End and Aberdyfi, find congruence in their mid Holocene histories.

[11] 1938 Godwin, L. and Newton, J. *The Submerged Forest At Borth And Ynyslas, Cardiganshire* Article first published online: 2006 DOI: 10.1111/j.1469-8137.1938.tb06946.x http://onlinelibrary.wiley.com/doi/10.1111/j.1469-8137.1938.tb06946.x/abstract

Figure 7 The Submerged Forest. Photo by muba https://ssl.panoramio.com/photo/3331250

Some of the Lincolnshire wildlife occupies the liminal position, on the threshold of both geographical and temporal environments. Take the case of the swimming crab and the seagull[12]. The waters of the

[12] 2012 C. Luczak, G. Beaugrand, J. A. Lindley, J-M. Dewarumez, P. J. Dubois and R. R. Kirby *North Sea ecosystem change from swimming crabs to seagulls.* Biology Letters

southern North Sea have already warmed by about 1°C over the past three decades and the once rare in these cool northern seas, swimming crab, *Polybius henslowii*, has become abundant. It is now a significant food source for the Lesser Black-Backed Gull, *Larus fuscus graelsii*, that breeds in on-share colonies of southern England, Netherlands and Belgium. Their populations have enjoyed an expansion recently, aided by the calcium-rich diet of crab meat that benefits egg shell production and growth of young bones. Since the gulls spend much of their time ashore their droppings make a significant contribution to soil fertility, an allochthonous nutrient input, otherwise lost at sea, being brought back to land as a consequence of global warming. It would be foolish to expect climate changes typically to produce benign effects.

There is much good information about the creatures of our in-shore waters available from the Lincolnshire Wildlife Trust, which recognises that a significant part of the county's biodiversity is to be found on and under our beaches and out to sea. The Trust has a number of publications available in print of to download from http://www.lincstrust.org.uk/conservation/article.php?id=23

The dynamics of the North Sea ecosystem are complex but we are already, after just one degree Celsius of sea water temperature rise over the past three decades, seeing evidence of change. Anecdotal accounts of more frequent encounters with jellyfish on the Lincolnshire beaches support the scientific research. Kirby and Beaugrand[13] explain how the ecosystem dynamics have changed, favouring crabs and jellyfish at the expense of cod and other fish.

---

http://rsbl.royalsocietypublishing.org/content/early/2012/06/25/rsbl.2012.0474.full

[13] 2009 Richard R. Kirby, and Gregory Beaugrand. *Trophic amplification of climate warming*. Proceedings of the Royal Society B, vol. 276 no. 1676 4095-4103 http://rspb.royalsocietypublishing.org/content/276/1676/4095.full

On land the Bell's site lies near the southern end of the Saltfleetby-Theddlethorpe National Nature Reserve. This important reserve contains tidal sand and mudflats, salt and freshwater marshes and sand dunes. The larger part, 556 hectares, is a statutory National Nature Reserve managed by Natural England. Approximately 38 hectares (95 acres) are managed by the Lincolnshire Wildlife Trust on a licence agreement with the Ministry of Defence. Another 4 hectares (9.8 acres) are leased from Lincolnshire County Council, and the Trust owns about 3 hectares (7.5 acres) comprising the Sea View Field and Rimac Bridge. The total area within the SSSI is 951 hectares. The whole area is managed in close cooperation between the Trust and Natural England.

This important reserve contains tidal sand and mudflats, salt and freshwater marshes and sand dunes. On the foreshore, accreting mud and silt flats and saltmarsh in the north give way to a narrower sandy beach at the southern end. The sand dunes are also much wider in the north and there is an extensive freshwater marsh between two dune ridges, which converge into a narrower ridge south of Churchill Lane at Theddlethorpe. The much older landward dunes developed on a storm beach formed in the 13th century. The second ridge on the northern half of the reserve, enclosing the freshwater marsh, developed in the mid-1800s following the diversion of the Great Eau. New dunes are now forming along the southern half of the reserve.

According to Natural England:

Saltfleetby – Theddlethorpe Dunes stretches for 8 km along the north-east coast of Lincolnshire. Its constantly changing habitats, shaped by the wind and sea, are home to a wealth of plants, birds and insects. Although this wild area is the result of natural processes, it has been influenced over time by man. The site was purchased by the Air Ministry for use as a bombing range in the 1930s, and the beach was littered with old vehicles which were used as targets. During the Second World War tank traps and pillboxes were built, and the dunes were mined to defend against invasion. In 1969, part of the site was handed over to the Nature Conservancy and declared a National Nature Reserve (NNR). The bombing range eventually moved to Donna Nook in 1973.

The Dunes

The sand dunes we see today first began to form in the thirteenth century after some unusually large storms. The sea threw up shingle and strong winds blew sand to the back of the beach. This process continues today, creating new shingle ridges, dunes and saltmarsh. The sand at Saltfleetby is very fine and is easily blown off the beach onto the land. The dunes are stabilised by marram grass, allowing other plants like bird'sfoot-trefoil, pyramidal orchid and viper's bugloss to become established. These in turn support an array of bees and butterflies. The smaller insects are hunted by dragonflies and robber-flies that patrol the dunes. Prickly sea buckthorn, hawthorn and elder cover much of the dunes and is an important habitat on this coastline. It provides safe cover and a nesting site for birds, including dunnocks and wrens, as well as summer visitors, including whitethroats and willow warblers. Throughout the autumn and winter, its berries, along with hawthorn and elder berries feed the fieldfare and redwing which visit from Scandinavia.

The Marshes

The low areas between the dune ridges hold rain water. The freshwater marshes that have developed here are home to water-loving plants including yellow iris, meadow sweet and cuckoo flower. It is here that the dragonflies and damselflies breed, and it is also an important habitat for the increasingly scarce water vole.
Together, the sand, mud and saltmarsh at Saltfleetby provide food and refuge for the many birds that visit our shores from the arctic, over winter. Ringed plover and sanderling eat the small sandhoppers and shellfish found at the sea's edge, while curlew probe the mud for lugworms, brent geese graze the saltmarsh grass and flocks of twite and snow bunting feast on the seeds of the saltmarsh plants.

Figure 8 Saltfleetby-Theddlethorpe National Nature Reserve - Natural England

Further south, the Lincolnshire Wildlife Trust manages several small nature reserves along the coast. Wolla Bank Pit and Wolla Bank Reedbed are two reserves that lie about half a mile south of Anderby. In 1953 following the breach of the sea defences, clay was dug here to provide material for the repair of the sea bank. What remains are flooded clay pits with extensive beds of reed and sea club-rush, with great reedmace, fennel pondweed, wild celery, sea arrowgrass, sea couch and water-crowfoot. Small stands of sea-buckthorn occur here and there are also colonies of common spotted-orchid. Snipe are frequent visitors in winter, when bittern and bearded tit are occasional visitors. Reed warbler, sedge warbler, reed bunting and whitethroat all nest and many rare migrants have also been seen. Marsh harriers can be seen flying in spring and short-eared owls in winter.

Anderby Marsh lies to the south of Anderby outfall between the dunes and the road on Roman Bank inland. Once arable land, this new nature reserve is being transformed over time into a wildlife haven of traditional coastal grazing marsh and reedbed. It is expected that it will help support a range of conservation priority birds including lapwing, curlew, redshank, snipe, barn owl, starling and reed bunting. With the expansion of reedbed it is also hoped that marsh harrier and bittern may be attracted and otters, which formerly visited the adjacent Wolla Bank Pit, may also re-colonise the area.

Another nature reserve, between Anderby and Sutton-on-Sea, is Huttoft Clay Pit, the largest of the Sea Bank Clay Pits that provided clay for sea bank repairs after the 1953 floods. There is a large open water area as well as extensive reedbeds. Moorhen, water rail, reed bunting, reed and sedge warblers all nest on the reserve. Fifteen species of duck have been recorded. Short-eared owls occur in winter and marsh harriers breed in spring. Bitterns have become a regular wintering species. Sandilands Pit, a little further north still, is another flooded clay pit with wet grassland. Many duck and snipe congregate in the

winter and sedge and reed warblers nest in springtime.

North of Saltfleet is another Lincolnshire Wildlife Trust reserve, Toby's Hill. Largely dune grassland with scrub, it is of considerable botanical interest. The Toby's Hill area is a remnant of a 700 year old dune system which was separated from the present-day coastline by 19th century land reclamation. The reserve is named after the main hill, possibly the highest dune summit on the Lincolnshire coast; it is believed to have been artificially raised to improve its use as a war-time watchpoint / beacon site. The reserve is largely dune grassland with scrub and is of considerable botanical interest. The common grassland butterflies are all found on the reserve in very good numbers and there is a large breeding population of 'garden' birds.

The site had been protected from recreation or development damage but due to the lack of appropriate management, the nature conservation interest had been declining with the grassland largely dominated by coarse grasses and the area of scrub steadily increasing. The Trust now manages the reserve with the aim of enhancing floral diversity; grazing has been reintroduced and the amount of scrub is reduced.

And further still to the north is the Donna Nook National Nature Reserve, covering more than six miles of coastline from Saltfleet to Grainthorpe Haven with an area of about 340 hectares. It consists of dunes, slacks and intertidal areas which provide a home for many rare and important wildlife species. The area is particularly noted for its uncommon bird passage migrants and also has one of the largest breeding colonies of grey seals in the UK. Management is by partnership between the Ministry of Defence and the Lincolnshire Wildlife Trust. The trust is responsible for the conservation management of all the land within the reserve.

***Edit

The stumps, which in the picture on the film give the appearance of basking seals, are relics of the great forest which was swept under the tremendous inrush of sea on New Years Day, 1287.
The forest, the village of what was then named Malbtorp, and the church of St. Peters vanished for ever beneath the waves. Since then it has been recorded that fragments of masonry have washed up, but as time dims the pages of the past so there is less and less tangible evidence, other than written records, of the disaster. All, that is, but the tree trunks which appear only when the moon phases and a favourable wind take the tide back beyond its normal point.

Until the year 1287 when the meagre defences of the villagers were swept away and the humble dwellings crumbled before the might of the ocean, there were two Mablethorpes - Mablethorpe St. Mary's and Mablethorpe St. Peter's, which lay about a mile to the east of the present town.
The actual site of St. Peters church, of which no trace now remains is about a mile and a half north-east of the present church of St. Mary's approximately opposite the Golf Road pullover and under the sea.

Mablethorpe existed as two small villages;
Mablethorpe St. Mary and Mablethorpe
St.Peter. St. Peter's church was lost to the
sea during the 1540's

How high was the 1953 surge?
How high was the 5th December 2013 surge?
Immingham tide guage:
http://www.ntslf.org/data/realtime?port=Immingham&from=20131205&span=5
1.6m above astro prediction.

Melting of ice caps

Thermal expansion

Change in Earth's centre of gravity by melting ice caps - In *case the large ice sheets over Greenland and Antarctica start melting also the gravity field will change and produce a geoid change, i.e. a gravitational change of the sea level. Also this quantity will be a function of location*(Eckman p67)

Wind: *since about 1990 winters in northern Europe have been dominated by persistent westerly winds, leading to a higher mean sea level in the Baltic Sea*

Immingham, up to March 2008
Top 10 positive surges
2.43m 05:00 14 Feb 1989
2.13m 01:15 21 Feb 1993
1.88m 22:00 31 Jan 1953
1.85m 04:00 6 Mar 1968
1.84m 01:00 29 Jan 2002
1.83m 09:00 12 Dec 1990
1.78m 06:00 10 Jan 1995
1.70m 05:00 29 Sep 1969
1.69m 16:00 1 Feb 1983
1.67m 23:00 8 Nov 2007
http://www.ntslf.org/data/surgehilo?port=Immingham

Cromer, up to March 2008
Top 10 positive surges
2.49m 02:30 21 Feb 1993
2.11m 10:00 12 Dec 1990
1.92m 06:15 10 Jan 1995
1.88m 21:30 8 Nov 2007
1.86m 11:00 21 Dec 2003
1.80m 02:45 29 Jan 2002

1.77m 06:45 5 Feb 1999
1.76m 15:45 8 Feb 2004
1.68m 18:15 31 Oct 2006
1.67m 11:45 19 Feb 1993
http://www.ntslf.org/data/surgehilo?port=Cromer

What was the surge height in the 1953 flood?
The table above gives Immingham at 1.88m, with Cromer and Lowestoft not recorded in the Top 10 positive surges. However, the map at Figure 3 of the RMS report[14] https://support.rms.com/publications/1953_Floods_Retrospective.pdf gives Immingham surge at 4.51m, Lowestoft at 4.61m and King's Lynn at 5.76m. Clearly, or perhaps confusingly, different things must be being measured. RMS *states "A storm surge is defined as the difference between the predicted astronomical tide and the actual height of the tide when it arrives."*

Chart datum & ordnance datum
Tidal levels are quoted relative to chart datum (approximately the lowest level due to astronomical effects and excluding meteorological effects). The heights of chart datum (CD) relative to ordnance datum (OD, at Newlyn) at some ports on the East coast are:
North Shields − 2.60m
Whitby − 3.00m
Immingham − 3.90m
Cromer − 2.75m
Lowestoft − 1.50m
Felixstowe − 1.95m
Sheerness − 2.90m
So it appears that at Mablethorpe Ordnance Datum is about 3.5 metres

[14] 2013 1953 Risk Management Solutions *U.K. Floods: 50-year Retrospective* https://support.rms.com/publications/1953_Floods_Retrospective.pdf

above Chart Datum

In the UK, the Ordnance Datum (the 0 metres height on UK OS maps) is the mean sea level measured at Newlyn in Cornwall between 1915 and 1921. Prior to 1921 the datum was MSL at the Victoria Dock, Liverpool.

The Trinity House lightship, LV93, built in 1938 saw its last service at Inner Dowsing, about six miles east-north-east off-shore from Anderby Creek, before being sold in 2014 and towed to Trinity Buoy Wharf in London and the new owner, a photographer, who converted it into a photographic studio. It is moored very close to another of the Time and Tide Bells.
http://www.trinitybuoywharf.com/whats-on/event/time-and-tide-bell

Some numbers from Immingham

Ordnance Datum is 3.9m above Chart Datum
Highest Astronomical Tide (HAT) between 2008 and 2026 is 7.99m CD
That is 4.09 above OD
Top storm surge was 2.43m at 05:00 on14th February 1989.
Add the HAT to a big storm surge and we get to ~6.5m OD, close enough to the 6.7m 'transgression' in the literature. It will be the extreme storm surges that deliver the sudden influx of sediment that might be found in the stratigraphy. All that is required is the coincidence of storm surge with a time and place of insufficient protective beach, bars or barrier islands and sufficient sediment influx. No rise in mean sea level is required to account for the features found in the stratigraphy. This is a phenomenon that has sometimes been missed in accounts that have attempted to explain the development of the Lincolnshire Marsh in terms of changing sea level.

The Future

What might the shape of Lincolnshire look like? The Copenhagen Diagnosis stated *"Sea level will continue to rise for centuries after global temperatures have been stabilised, and several metres of sea level rise must be expected over the next few centuries."*[15] The map below is an estimate of where the coastline would be given a 9 metre rise in sea level. This might be expected when a substantial part, but not all, of the Greenland and West Antarctica Ice Sheets has melted. Few scientists would suggest that this is possible within this century but given another couple of centuries it becomes a very real possibility.

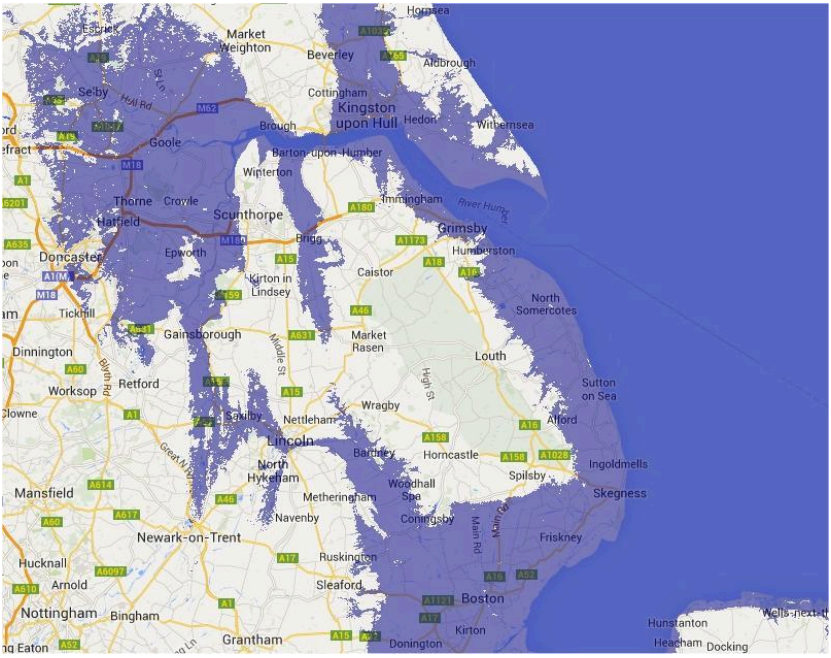


Figure 9 Geography after 9 metre sea-level rise

For information about how the map was constructed go to

[15] 2009 UNSW Climate Change Research Centre *The Copenhagen Diagnosis. Updating the World on the Latest Climate Science.* http://www.copenhagendiagnosis.com/

http://blog.firetree.net/2006/05/18/more-about-flood-maps/

It is very difficult to think seriously about the long term future. We know from personal experience that most predictions about the future turn out to be wrong, and that the future is full of surprises. Climate science cannot yet tell us exactly what will happen just when, but it can securely describe a probability space of future events. And it turns out that the probability space is skewed with a long tail on the bad side. Nasty surprises are more likely than nice ones. There is, for example, not much opportunity for the sea to rise more slowly and less far than is being forecast but there is plenty of scope for the ice to melt faster and further than we expect.

That said, it is still very unlikely that sea level rise on the Lincolnshire coast will be devastating in the next few decades. Much of the Lincolnshire Outmarsh lies at around 2m O.D. That's below sea level at high tide but is kept dry by the natural barriers of dunes and artificial sea-defences. Large areas of the Netherlands five metres lower than this, with the lowest points about 7m below O.D. Dutch engineering keeps the land dry and we should be encouraged in the knowledge that it will be physically possible to defend Lincolnshire's land against a few metres of sea level rise yet, given the political will so to do.
We do need to find some way of grasping the long term if we are to manage affairs for the benefit of future generations. We are, after all, obliged so to do; the United Nations Framework Convention on Climate Change, to which the UK, is a fully committed party states: "The Parties should protect the climate system for the benefit of present and future generations of humankind". So how can we begin to take seriously the interests of future generation? Let's start with the more familiar ground of looking at past generations. 2015 saw the 500th anniversary of the completion of the spire of St James' church in Louth. We can only guess as to whether the medieval masons thought their work would survive five centuries, but we can now see that a sea level rise that threatens the church within the next 500 years is likely. Half of St.

James' history is over.

Design

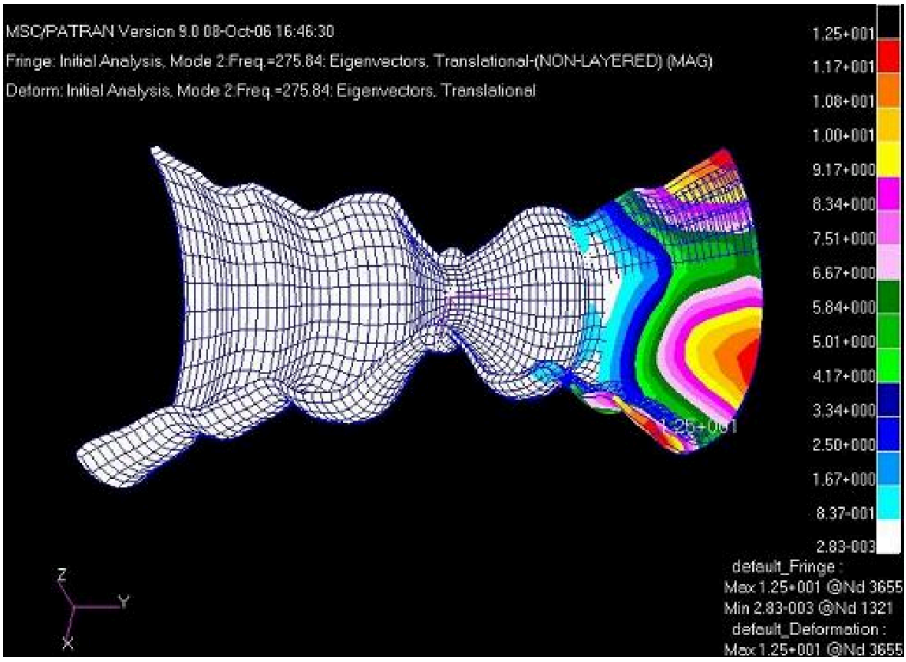


Figure 10 Computer generated simulation of bell vibration

The Time and Tide Bell design came as a result a collaboration between Marcus Vergette and Dr Neil McLachlan, Associate Professor in Psychological Sciences at The University of Melbourne. Neil McLachlan has broad professional experience in music, acoustic design, engineering, and auditory neuroscience. In 2000 he designed the World's first harmonic bells, and more recently has designed a new harmonic percussion ensemble for use in educational and other community contexts.

Uniquely, from one strike, the Bell sounds different notes one after

another as a melody. This form has never existed before and has only been possible as a result of recent developments in computer modelling. It required the Bell's unconventional shape.

To hear the Bell, recordings are available at:
http://audioboo.fm/boos/186220-time-and-tide-bell-trinity-buoy-wharf-sept-20-2010
http://audioboo.fm/search?q=bosta+bell
http://audioboo.fm/search?q=appledore+bell
http://www.marcusvergette.co.uk/bell.htm

When the first Bell, at Appledore, Devon, was mooted, concerns were raised regarding potential noise nuisance. Consequently the initial planning consent was temporary. After commissioning the requests were received from local residents to adjust the Bell to make it louder. Local Authority granted permanent consent. The Lincolnshire Bell will not be audible from residential properties or other buildings.

Here follows a descriptive note by Dr Neil McLachlan:

Designing the Bell - A Collaboration with Marcus Vergette

Introduction

I have a doctorate in physical sciences but have worked professionally in music and musical instrument design since 1986. Over the last decade I have developed extensive experience in designing musical bells. This work featured the first design of a bell with harmonic overtones and unambiguous pitch. Marcus approached me in late 2005 about designing a bell that could be sounded by the action of waves. After a series of emails over the next 6 months we arrived at a design concept of a bell that could produce multiple pitches when struck at different locations. This required designing a bell where the maxima of

vibration of groups of modes occurred in distinct regions of the bell profile, and that these groups of modes be tuned to harmonic relationships within each group and some musical relationship between the groups. Musical relationships can most easily be described as simple frequency ratios such as 3/2 (a just 5th) or 5/3 (a just 6th). Chromatic tuning are small deviations from these ratios. From previous experience I knew that a generally cylindrical form would best separate modes with different numbers of nodal rings (see later for mode shape details). With the support of seed funding some preliminary explorations were undertaken in Melbourne before visiting Marcus in Devon for 3 days in September 2006. During this visit the design was further developed and the 'hourbell' shape was proposed by Marcus to introduce more possible tones to the design. The design was then further refined upon my return to Melbourne. The 'hourbell' bell can produce four distinct pitches by being struck near the rim or centre of the bell at each end. In the following section the various mode shapes and frequencies of bell overtones and an example tuning process are described. In general vibratory modes that efficiently radiate sound can be classified by the number of nodal lines that run vertically through the centre of the bell (n) and nodal rings around the circumference (m). Each vibratory mode is given the identifier n,m. The bell is stationary along a nodal line and the vibration changes phase across a nodal line.

For the detailed design data see
http://www.timeandtidebell.co.uk/bell_design.pdf

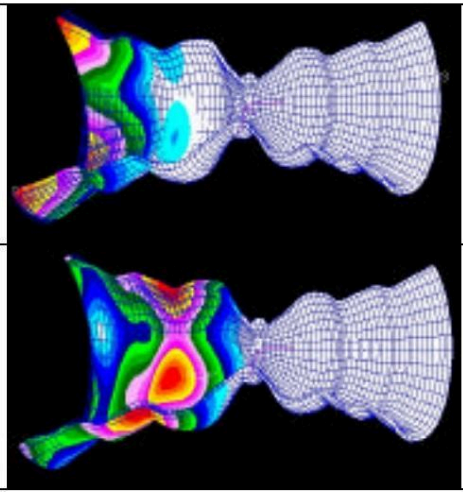
Large bell			
	Mode type	Freq (Hz)	Example Mode shapes
1	2,0	204	
2	2,1	441	

Figure 11 Examples of computer modelling of bell vibration

Red colours show the region of the displacement maximum for each mode shape. The unperturbed geometry is the blue grid. Note that striking the bell 1/2 way up the wall will excite the n,1 and n,2 modes much more than the n,0 modes, whereas striking the bell about 1/8 way up (on the n,1 nodal ring) will only excite the n,0 modes. The shape was optimised to align overtones to harmonic ratios of 2 pitches with a harmonious relationship between them. Rescaling the bell and joining the two bells end-to-end creates an hour-bell shape able to produce 4 discrete pitches.

The eighth iteration of design refinement produced this form:

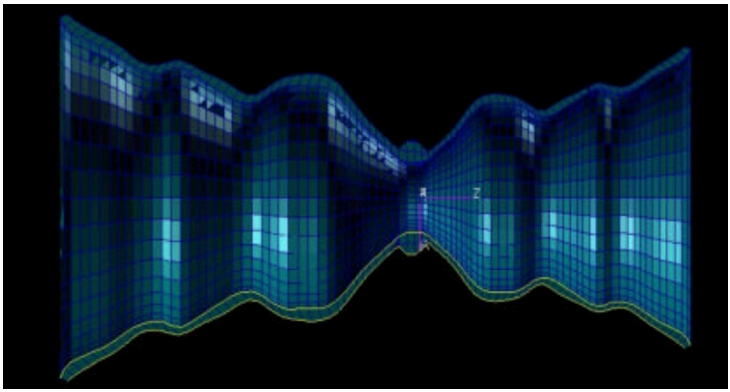


Figure 12 Hourbell 8 Neil McLachlan, Tuned Percussion Instruments.

Discussion

The hourbell will produce pitches at A3, C#4, G4 and A4 by the use of a central pivoting rod with offset cams that strikes the bell at one of four locations depending on the direction of motion. The T3 mode that has been shown in table 2 has been tuned to 1.99 of G4 will not sound when G4 sounds. It will produce a weak secondary tone that is likely to be masked. A further complication is that the manner of the bell support and the joining of the two halves of the hourbell will significantly affect the frequency of this mode (assuming the bell is cast in two halves). This tuning can be adjusted with the cast prototype. Casting this bell will present a number of technical difficulties. Any geometrical deviations from the profile or porosity in the casting will alter the frequency of modes from the computed results. Computational accuracy can be expected to be within 1%, and it is possible to cast to within 2% of the calculated frequencies. However combined errors can accumulate to require retuning on a lathe. This is further complicated in that in general metal can only be removed in tuning – although some stiffening by welding ribs has been successfully undertaken on bells cast in silicon bronze.

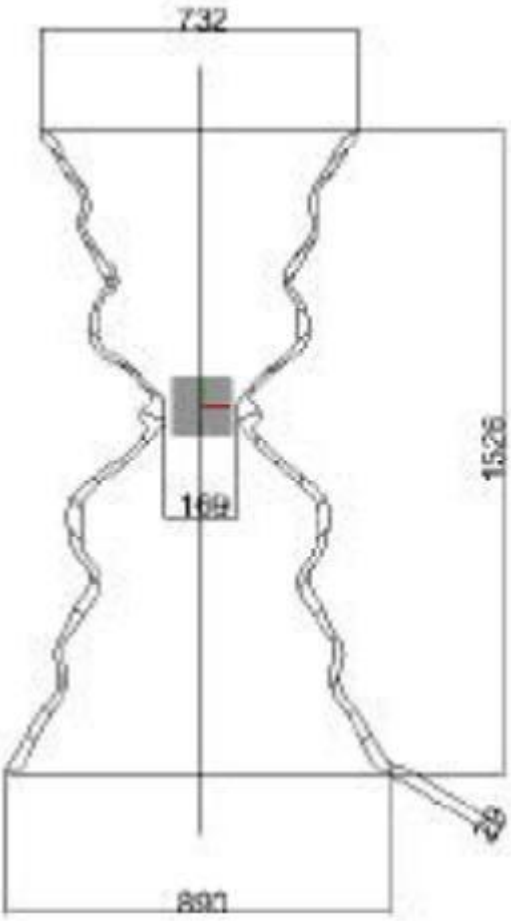


Figure 13 Final profile scaled up to produce pitches E3, G#3, D4 & E4

Construction

The Bell is of cast marine bronze made at the John Taylor & Co Bell Foundry at Loughborough. It will develop a greenish patina which protects the metal from further oxidations and so will not degrade in seawater.

Figure 14 One half of a Time and Tide Bell being broken out of the mould

A frame, constructed from pieces of oak connected by marine grade 316 stainless steel nodes and standing on a hexagonal ring on the beach surface, suspends the Bell at a height where the movement of water at high tide operates the wave catcher, a paddle at the bottom, connected to the clapper that rings the Bell. At the highest spring tides the Bell could become largely submerged. The frame is anchored to the ground by a ring of helical piles that are screwed into the beach

sand.

Figure 15 The two halves of the Time and Tide Bell being worked on

The modular construction enables community involvement. On the day of frame construction much of the work, being of a human scale, can be done by the community with nothing more than a large spanner to tighten the bolts that fix the oak to their housings.

The Time and Tide Bell is designed to be permanent, the materials used being long-lasting. The bronze of the bell is virtually indestructible by natural processes and if not removed from the sea will become lost in future sedimentation and become part of the geological history. The timber components, with their shorter lifespan can be removed and replaced one at a time in situ.

The site at Mablethorpe North End is unlike the sites in western Britain in that there is no solid rock upon which to build. The location is on the cusp between and accretionary shore line to the north, where sediment brought southwards is accumulating, and an erosional shore to the south, currently being maintained by artificial 'beach nourishment, the dumping of sand dredged from offshore sites in the wash. There is a realistic possibility of shifting sands that has to be included in design and planning. Future policy on sea defence maintenance by the Environment Agency could also change the current beach regime. The modular design allows for the possibility that the Bell may need to be moved in some future time.

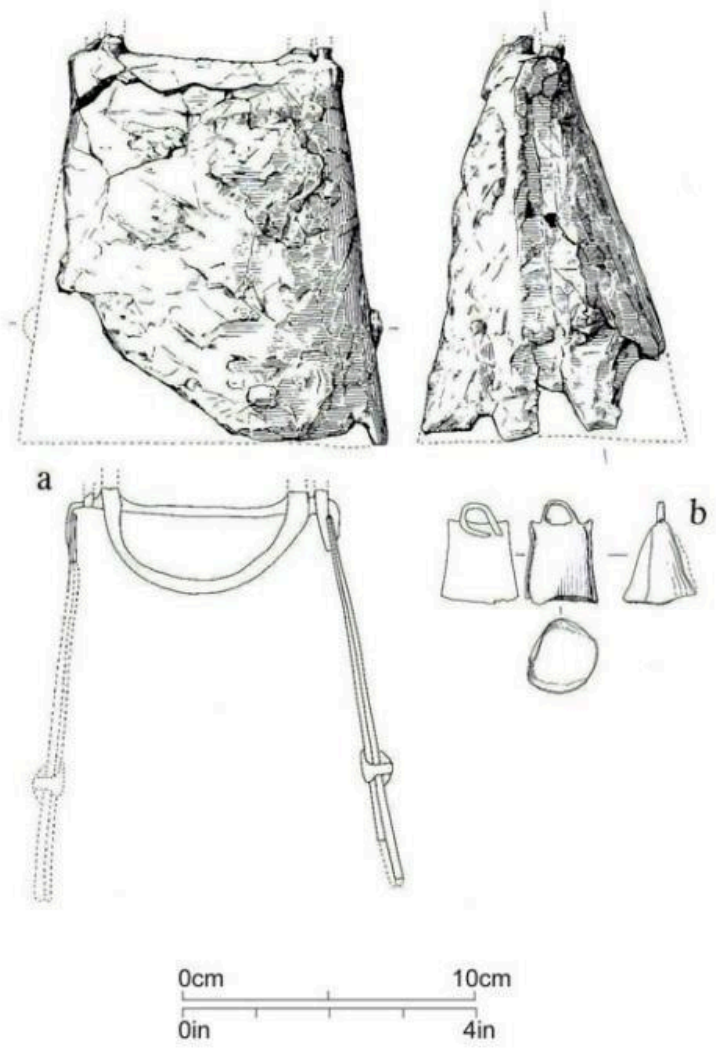
Bell History

Metal bells were first made in China about 4000 years ago and from about 3000 years ago bronze bells of suitable composition and shape to make a good sound were produced. Bronze for bell-making is an alloy comprising about 80% copper and 20% tin. It was suitable for many purposes such as eating utensils and sculptures but its properties of ductility and elasticity allowed good resonance, combined with its corrosion resistance made it the ideal material for bells. The fresh metal surface oxidises to form a greenish layer of verdigris that protects the metal from further corrosion. A small proportion silver or antimony was sometimes added to alter the resonance. This created the sound of bells typical of the early Russian Orthodox Church.

The Collection, Lincoln, has on display three small (about 3cm high) Roman bells, found at Skellingthorpe. Two are square in section and one is a circular cone.
Similar bells have been found at Brill in Buckinghamshire and at Colchester.
https://finds.org.uk/database/artefacts/record/id/245256
Another Roman bell was found at Thirsk, Yorkshire.
https://finds.org.uk/database/artefacts/record/id/511860

Anglo-Saxon bells were usually made from a single sheet of iron, folded in two leaving the seams to be riveted or joined with the copper alloy brazing metal that also covers the body. A ring was set in the top to act as both handle and suspension for the clapper. It has been suggested that small bells may have been used for animals but this is considered unlikely for the brazen bells since the degree effort and skill involved in their manufacture would hardly be justified if the purpose was just to hang round a cow's neck. The monastic environment in which many of the bells have been found also suggest religious use. Copper-brazed

iron bells of quadrangular form originated in Ireland in the 7th century, and continued in production until the 10th century. Those found in Ireland and Scotland tend to be larger than English bells of this period.



Anglo-Saxon Bells from Repton and York - Patrick Ottaway
http://www.pjoarchaeology.co.uk/docs/14/anglosaxon-ironwork-part-2.pdf

A bell was found amongst the grave goods in a 7th century Anglo-Saxon burial, thought of have been of an itinerant metal working smith or tinker, at Tattershall Thorpe. This bell, and the other material from the grave, are on display at The Collection, Lincoln.
http://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=MLI42790&resourceID=1006

This bell, and the other material from the grave, are on display at The Collection, Lincoln. Also at The Collection are three small Roman bells and three small Viking bells.

The Little Carlton Bells

Little Carlton is a village just six miles to the west of the Time and Tide Bell at Mablethorpe North End. Recent archaeological excavation has revealed what may be a monastic settlement on an island site near the edge of the salt-marsh. Iron fragments thought to make up about eleven individual small bells have now been discovered. Here follows the description by Adam Daubeny, Finds Officer for the Portable Antiquities Scheme:
BELL
Unique ID: LIN-B17DA7
A small iron hand-bell plated with copper-alloy using the 'fusion-plating process' (Bourke 1980; 1983).
The bell is corroded but appears to be made from a single piece of iron that has been folded in two; the seam, which is located to the side, is now open and was presumably once riveted together. The bell has

pulled shoulders, which results in a very narrow apex. In plan the bell is sub-oval. A ring was set in the top of the bell which served both as a handle and for a suspension of the clapper. The former is evidenced by two small knobs of iron at the apex; the latter is perhaps evidenced by a small sub-oval shaped piece of iron that was discovered in soil removed from the centre of the bell. Copper alloy corrosion is visible on both the exterior and the interior, which suggests this bell has been brazed. Copper-brazed iron bells of quadrangular form originated in Ireland in the 7th century, and continued in production until the 10th century (Bourke 1980: 55-61).

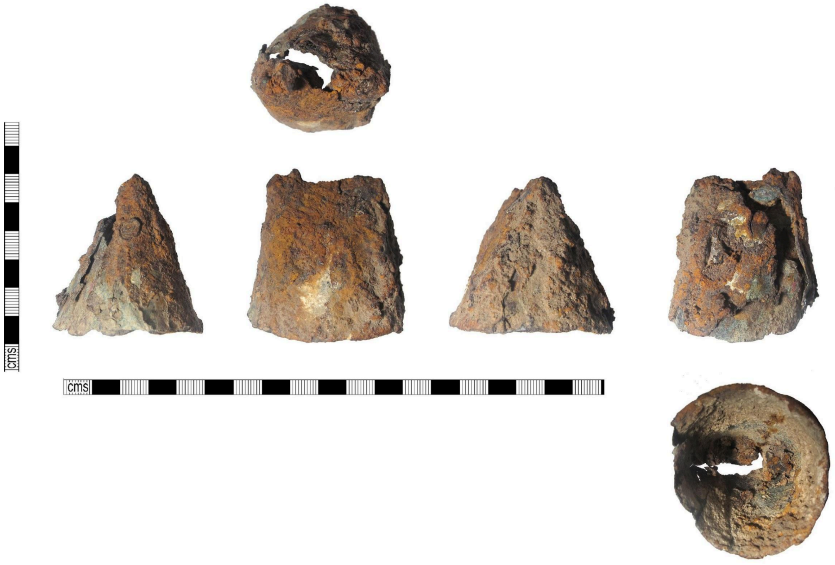


Figure 16 Anglo-Saxon iron and copper-brazed bell, Little Carlton

The bell is smaller, but similar in form to one discovered in the grave of an Anglo-Saxon smith at Tattershall Thorpe, Lincolnshire, dated to

between c. 660-670 (Hinton 2000), p.44, fig. 30). The condition of the Tattershall Thorpe bell suggested that it was already old at the time of deposition, and the location of the item in the grave demonstrated that it belonged with other tools rather than with the scrap metal. Iron bells have also been found in association with tool hoards elsewhere at Flixborough (Leahy 1995) and Mastermyr (Arwidsson and Berg 1983 in note 15, 28-9). Other examples from graves have all been dated to the 7th or early 8th centuries (Hinton 2000: 45; Geake 1997: 102). Parallels on the PAS database include WILT-99FB4B and WMID-09C695.

Larger brazed hand-bells are well known in Ireland where many have been discovered on monastic sites dating between 600 and 900 (Bourke 1980). Indeed, one such site at Clonfad, Co. Westmeath has provided evidence for the production of copper-brazed iron hand-bells (Stevens 2010). Those known from Scotland - which are also assigned a 7th or 8th century date - are attributed to the influence of the Irish church but have a greater size range, from 60mm to 326mm tall (Bourke 1983: 464). The Scottish series of brazed iron bells have been interpreted as evidence for the activity of Columban monks and the influence of the Columban church (Bourke 1983: 466). Caldwell et al note that 'bells appear in some of the earliest surviving literature on the Insular Church, and that by about AD600 the bell appears to have become such an accepted part of the Christian landscape that a monk's response to its sound can be regarded as one of the distinguishing features of a life of holiness' (Caldwell et al 2012: 227). Stevens (2010) argues that copper-brazed iron hand-bells, which frequently appear - and seem to be produced - in monastic settings in Ireland, were a type of bell exclusively used in ecclesiastical settings. Bourke elaborates, noting three primary uses of insular hand bells: to regulate monastic time, to punctuate the liturgy, and to animate religious ritual. Bourke also notes that 'their status was subject to elevation and bells were routinely transformed into trophies or relics of the saints despite their origin as accessories in communal ownership' (Bourke 2013: 2).

A key question is whether the English series of bells - which are frequently of much reduced size, and which often have sub-oval bases rather than quadrangular ones - share the same monastic associations. In England Anglo-Saxon bells have been found on a variety of high status sites and also within graves (Hinton 2000: 47), and the series demonstrates a greater range of sizes to those from Ireland and Scotland, particularly at the lower end where one example from York stands just 17mm tall (Ottaway 1995: 7). At the other end examples from Repton (Ottaway 1995: 7) and Tattershall Thorpe (Hinton 2000) stand over 100mm tall, though these are still much smaller than the Irish and Scottish examples. The present example falls somewhere in between at 37mm tall.

Ottaway has suggested that smaller bells may have been hung around the necks of beasts (Ottaway 1995), but recent attempts to reconstruct the technological process of making copper-brazed iron bells have shown it is a demanding and complex task. To this extent it seems unlikely that they were used simply as animal bells.

It is possible that they were used by private individuals as a way of alerting others to his or her presence. Hinton, for instance, points to King Wihtred's law code of c. 695, which states that 'if a man from a distrance or a foreigner goes off the track, and he neither shouts nor blows a horn, he is to be assumed to be a thief, to be either killed or redeemed (Hinton 2000: 47; Whitelock 1979: 398).

However, the present bell was discovered on a site that has produced a large quantity of objects dating to the Middle Saxon period (circa 650-800), including a further five probable bells (LIN-4B37F8; LIN-4B30F1). The apexes of these latter bells differ to the present example by being rectangular in plan, and slightly domed, which is a feature more in keeping with the Irish and Scottish examples, including the example contained within the Kilmichael Glassary Bell-shrine (Caldwell et al 2012). The opening at the base on both examples are

appear to be quadrangular in form, though this is somewhat speculative since the bases are incomplete. The site assemblage also includes a significant quantity of Ipswich ware, imported glass, an inscription in lead, several hundreds of pins, stylii and a glass mount that shares similarities with Irish ecclesiastical objects. The site is located on a marsh-island close to the coast, and recent excavations have begun to illustrate the monastic nature of the settlement. Radiocarbon dates from some of the burials indicates 650-710.

Detailed measurements
Height: 37mm. Length: 44mm. Width: 41mm. Thickness (wall of bell) 2.31mm. Width across apex: 30.37mm. Thickness at apex: circa 4mm. Weight: 34.95g.

References

Arwidsson and Berg (1983) The Mastermyr Find: A Viking Age Tool Chest from Gotland
Bourke, C. (1980) 'Early Irish Hand-Bells', The Journal of the Royal Society of Antiquaries of Ireland, Vol. 110, 52-66
Bourke, C. (1983) 'The hand-bells of the early Scottish church', Proceedings of the Society of Antiquaries of Scotland, 113, 464-468
Bourke, C. (2013) 'Early Breton Hand-bells Revisited'. Melanges Bernard Merdrignac, pp.275-281.
Caldwell, D.H., Kirk, S., Markus, G., Tate, J. and Webb, S. (2012) 'The Kilmichael Glassary Bell-shrine'. Proceedings of the Society of Antiquaries of Scotland 142, 201-244
Geake, H. (1997) The Use of Grave-Goods in Conversion Period England, c. 600- c. 850, British Archaeology Reports British Series, 261 (Oxford)
Hinton, D. A smith in Lindsey: the Anglo-Saxon grave at Tattershall Thorpe, Lincolnshire, Society for Medieval Archaeology Monograph Series No. 16
Leahy, K. (1995) 'The Flixborough Hoard', Current Archaeology 141

Ottaway. P. (1995), 'The Products of the Blacksmith in Mid-Late Anglo-Saxon England, Part 2' http://www.pjoarchaeology.co.uk/academic-consultancy/anglosaxon-ironwork.html accessed 14.6.2012.
Whitelock, D. (ed.) (1979), English Historical Documents c. 500-1042, 2nd edn. (London)

https://finds.org.uk/database/artefacts/record/id/507962#3

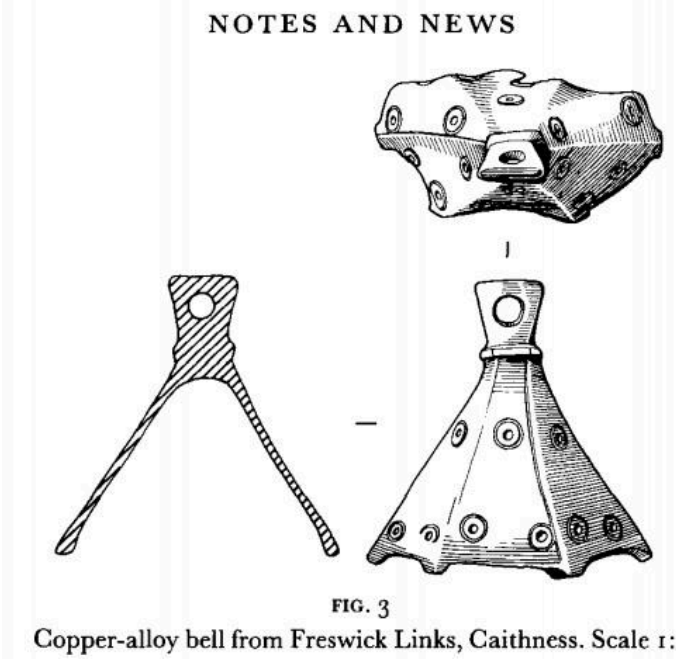


FIG. 3
Copper-alloy bell from Freswick Links, Caithness. Scale 1:1

Source:
http://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-769-1/dissemination/pdf/vol32/32_213_216.pdf

These are small, about 4cm high, hexagonal bronze bells found within Lincoln at Holmes Grain Warehouse and St. Mark's Station. One has

small projecting lugs at each of the six corners giving a scalloped appearance. Similar 10th century bells are known from Viking contexts at Freswick Links in Caithness, Moels in Cheshire, the Isle of Man and from York. The function of these bells is unknown but horse harnesses decoration or as charms worn on clothing have been suggested.
The bell from Freswick, Caithness is remarkably similar to one of the Lincoln bells.

65

The Goltho bell is described as “Probably a bell, hexagonal in section and with the bottom edge rolled inwards. The suspension loop is broken. Some ferrous corrosion inside may indicate that there was originally an iron clapper.”
https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-1416-1/dissemination/pdf/9781848021563_all.pdf

At St. Peter's Church, Barton-on-Humber, excavations in the nave and tower have found evidence of bell-making in the 12-13th century and again in the 14th-15th century. Bell-mould material and metal scrap were found.
http://services.english-heritage.org.uk/ResearchReportsPdfs/104-2002.pdf

What the Neighbours Said

Neighbour Comments sent to East Lindsey District Council regarding the Time and Tide Bell planning application:

I think we need a focus for the phenomenon of global warming which in this respects is evidenced by rising sea levels. At the moment the dangers, imminently threatening us, and all creatures besides ourselves our fresh water, our seas, our air and our land itself is NOT being addressed adequately by our leaders and those with the power to effect positive change. Rather the other way around.
This means that the movement to safeguard our future and our children's future has to be grow into a groundswell that culminates in change, and quickly too. Public awareness is vital for this movement and a focus that is tangible, showing irrefutably that the dangers that are real can also be SEEN by all who care to look, may just help to stir PEOPLE as well as governments, local governments public and powerful businesses and international cooperation. This bell has a huge support around the country. It is not a one off just for Lincolnshire, it is if you like a cord that unites all areas of our country, acting as a beacon that could in times of great danger tell us that the alternatives are the choices each individual now has to make...as in a

time of crisis. The groundswell is there...at least the talks, and the support...there is so much in place now...I urge the move to give it consideration. P.B.

I would like to lend my support to this important project. As well as performing an important climate monitoring function for our increasingly vulnerable coastline it enhances the artistic status of the county.C.B.

I think that this is a worthy project, with a natural feel to it, that should be supported. It will be an interesting yet unobtrusive addition to our coastline, which may well help to bring visitors to our shores. L.S.

I believe that it is an honour for Lincolnshire to be offered the chance to give a home to one of Marcus Vergette's inspirational Time and Tide Bells. This will be a major asset to the local area, attracting visitors and raising the profile of our wonderful and under-recognised coastline. As such, it will be fully in line with East Lindsey's plan to further develop tourism in this part of our County. I look forward to this planning application being approved. J.S.

I want to say that I am very supportive of this bell. I think we are very lucky to have been offered this fantastic piece of interactive sculpture. The bell sounds twice a month on the spring tides reminding us of the passage of time in our own lives and also of the importance of the natural world – it won't sound unless the tide works it – particularly relevant in an area where farming is the main industry. I think will help draw tourism (why isn't it at Anderby, they already have the Cloud Bar, another piece of great interactive art).
I am also very supportive of the artist and artisans who conceived and will make and erect the bell. P.M.

I fully support this application. The Lincolnshire coast is under threat from global warming, and this is a highly effective way of making

people aware of rising sea levels. As a former merchant seaman I am used to the concept of bells, on buoys and also on board ships to mark the watches. I believe that this project will provide an attractive and non-intrusive addition to the coast, where I spend a lot of my time. I look forward to its implementation. M.S.

I'm sure the Time & Tide Bell would be a positive and thought provoking attraction for our coastline, but it will need your support to allow it to happen. Please support this application and help bring this nationally acclaimed artwork to our region. J.P.

This would be a wonderful enhancement to the coastline and an attraction to tourists. It has my full support. H.Y.

A rare example of high quality public art which must be supported. Grant planning permission. J.P.

Having read all the literature relating to this submission it seems to me to be the perfect addition to our coast. As it says, it will be culturally and environmentally interesting and will serve as an unusual attraction for visitors. The fact that there are 5 other bells at various beautiful and interesting coastal positions makes it even more desirable that we should have a bell on our coast.
The actual construction of the bell has already been financed so the only costs to be met locally are for the installation which I'm sure can be raised.
I do hope you look favourably on this application since I think we would be missing an important opportunity for something interesting to be installed on our coast if it is refused. M.S.

A big support for this art work on our beach. I feel East Lindsey district does not have enough interesting features in our coastal areas. Not only will it be a visual experience, it will enhance public curiosity, promoting the arts, tourism and a healthy lifestyle. J.V.

Having been a visitor to this part of the Lincolnshire coast for over 50 years, I am delighted to add my support for the Time & Tide Bell installation. I believe that an attraction of the sort would provide a beautiful focal point for the beach, whilst being in keeping with the councils desire to develop tourism for the area. As I see it, this is a win-win situation for the county. M.W.

I support this application and ask ELDC to give it favourable consideration.

The planning aspects, while unusual, are for ELDC as the planning control authority to consider taking account of the views of local people and others.

In my view, there are three fundamental reasons why consent should be given:

First, the bell itself is to a design that has already been installed in several places on the coast of the UK and many of the generic planning aspects have already been examined. It has proved popular in these locations and there is little doubt that it would prove a local attraction at its proposed site in Lincolnshire.

Second, it is an artwork of considerable merit that has wide support from individuals and national institutions.

Third, it draws attention to the problem of climate change and potential loss of natural habitat that is an issue of high importance for people both in the UK and overseas and for the present generation and those to come.

I therefore ask the planning committee to approve the application. S.M.

I wish to register my resounding support of this project because of its potential :to create community cohesion to expand tourism to link with other Time And Tide bells / Cloud Bar +++ to be intriquing, interesting, thought inducing to provide a beautiful enjoyable experience of the flow of sea and land, tidal patterns, moon cycles - and us ! Thank you for your considerations of this exciting innovative potential. J.G.

I am writing to support the application of the Time and Tide Bell at North End, Mablethorpe.
I have lived in Lincolnshire all my life (63 years!) and feel we are tremendously lucky to have been offered such a cutting edge piece of sculpture that interacts with the environment in a way that raises lots of comments and questions about the autonomy of nature and man's effect upon his environment. It will raise the cultural profile of Lincolnshire, offering an alternative aspect to Pleasure Island/Butlins et al. A.B.

Local Bells

Mablethorpe, St. Mary's
6 Bells
Tenor 9cwt - 0qr - 25lb (1033lb or 469kg) in Ab (840.0Hz)

Alford, St Wilfrid
6 Bells
Tenor 12cwt - 1qr - 24lb (1396lb or 633kg) in F# (753.0Hz)

Trusthorpe, St. Peter
3 Bells
Tenor 6cwt - 2qr - 0lb (728lb or 330kg) in Bb (935.5Hz)

Theddlethorpe, St Helen
3 Bells
Tenor 12cwt - 2qr - 9lb (1409lb or 639kg) in Ab (812.5Hz)
These bells are dated about 1415.

Theddlethorpe, All Saints
6 Bells

South Somercotes, St Peter's
3 Bells
There are three medieval bells, which were hung here in the early 15th century, probably when the tower was built. Two of them, called Gabriel and Peter, are dated 1423 and the smallest, named Mary, is probably of about the same date. All three are thought to have been cast by J. Smith of Louth. They are decorated with lettering in Latin script bearing the names of the bells and surrounded by pictures of beasts, saints, foliage and the head of a Bishop. The bell called Peter also bears the names of Wills Snarri and L Moyn, thought to be benefactors who helped to pay for them. - Iris Dainton, South Somercotes, May 2011

North Somercotes, St Mary's
3 Bells
In 1983 when the oak bell frame, built around 1700, was declared unsafe, the Church was faced with an estimate of £15,000 to repair it, remove the three bells, (dating from 1600), for re-tuning, new headstocks, wheels, bearings and clappers. Rev Trevor Walker applied for permission from the Church Commissioners and Villagers rallied round and completed much of the work. A new frame was fabricated from second hand steel girders brought from North Coats by Ray Davy to a shed at Jim Brown's farm. The bells were transported to Taylor's the bell founders in Loughborough for expert work costing £2,700, then fetched back and re hung on the new frame. Money was raised by raffles and dances to finance the project and ensure that St Mary's Bells would ring for future generations.

Smugglers’ Tales

Contraband landed on the beaches here could not always be spirited away immediately, and tubs were frequently buried in the dunes to await later collection. Early in the 20th century a partly decayed barrel of tobacco was unearthed in the sands: the owner had clearly been unable to return to claim his cargo, or perhaps had failed to take accurate bearings to locate the hiding place among the drifting sand-dunes.

Oliver's gap was a regular highway for smuggled goods, and two local smugglers had houses near here: Ned Bell lived at Bleak House, and is reputed to be buried in the family plot at Theddlethorpe St Helens some three miles north. William Twigg lived at North End Farm, which also still stands. To the north a mile or so, a brick cottage called the Curlew, half hidden by the dunes, was home to another smuggling family, though it was demolished in the last century.

In the 18th and in the early part of the 19th century, smuggling was common along the Mablethorpe coast. Customs duty on tobacco, spirits, tea and silk made it a lucrative occupation although very dangerous. They were hard times so desperate measures were taken to make money.

Movement

Hominids came out of Africa long ago and were certainly living on the Norfolk coast, and so probably in Lincolnshire too, some 300000 years ago but ice sheets have come and gone, sweeping away most traces of habitation. Following the last retreat of the ice there was a period a couple of thousand years during which much of the southern North Sea was dry land and the Neolithic folk could wander at will and by the time Britain was properly an island, boats may have been invented.

There is a widespread scatter of Neolithic arrow heads and other pieces of worked flint across the Lincolnshire Wolds though finds are scarcer on the Marsh where marine transgressions have deposited material that covers earlier signs human life. Stain Hill, an 'island' of glacial till in the marine alluvium of the Outmarsh, about 3km south-west of the Time and Tide Bell is an exception. Worked flints have been found here.

As the University of Hull's Humber Wetland Project[16] put it, "The Mesolithic and earlier Neolithic periods are not well-represented in the survey material, with only eight findspots dated to these periods in the region. These is little doubt however, that sites from the period up until ca. 5500 CalBC remain buried within the wetland sequences of the Lincolnshire Marsh."

Bronze Age activity is represented towards the southern end of the Lincolnshire Marsh, near Willoughby, lies the Butterbump barrow cemetery. This site is effectively located on a peninsula surrounded on 3 sides by wetlands. Seven barrows have been identified from aerial photographs, and a further four are suggested. At one of the barrows

[16] Hull University Humberhead Levels Project
http://www2.hull.ac.uk/science/waerc/origins/lincolnshire_marsh.aspx

earlier excavation evidence indicates that a possible cist covered a cremation burial - indicated by preserved planking, and a bronze dagger with wooden sheath was found.

The early Bronze Age, around 2900BC, was the time associated with the migration from continental Europe of the Bell Beaker folk, with their culture of pottery and metal working. The name ‘bell beaker’ comes from their bell-shaped pottery vessels, rather than any real bells!

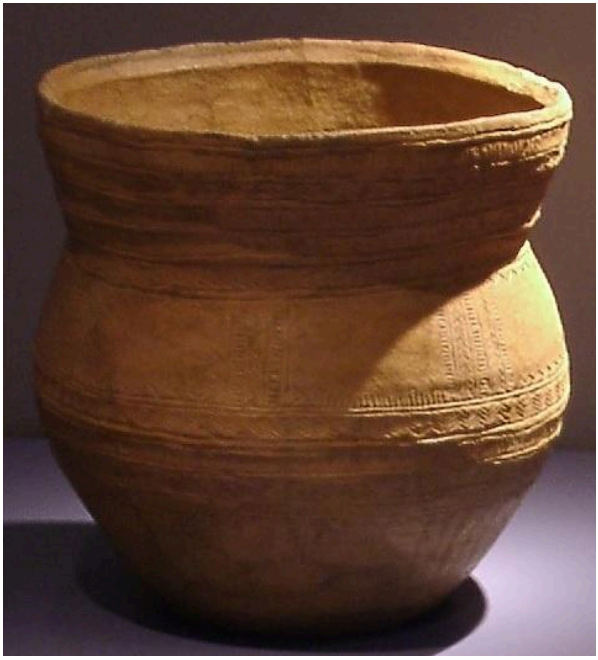


Figure 17 Bell Beaker, Netherlands

No beakers quite like that in the photo have been found on the Lincolnshire Marsh but some of the people living here in the late Neolithic and Bronze Age may have migrated from the Netherlands where this beaker was found and is now in The National Museum of

Antiquities in Leiden.

The three ‘Ferriby Boats’, boats found in the Humber Estuary near North Ferriby in the 1930s and 40s, have been dated to around 1800BC and their size and sophistication suggests that sea-going may have been ongoing for a long time previously.

A Celtic influence may have been established in the Late Bronze and Early Iron ages of the 2nd millennium BC and the Hallstatt and La Tène cultures represent movement in the 1st millennium BC, though it is always difficult to know how much an introduction of new ideas and technologies also represents a significant movement of population. After Caesar's conquest of Gaul in the 50s BC, some Belgic people seem to have come to Britain from the continent. Possibly because of this migration, the names of the tribes Parisi (in Eastern Yorkshire), Brigantes and Atrebates can be found both in Britain and on the continent.

The Roman occupation from mid 1st to early 5th centuries AD was more a movement of ideas and forms of governance rather than a mass migration of populations but of those who came many did not actually come from Rome, some of the legionaries based in Lincoln, for example, coming from Spain. Stain Hill, 3km south-west of the Bell, is important in the Roman context as a scatter of 53 late 4th century coins were found here, by far the largest such find on the Outmarsh, and indicative of a substantial Roman settlement.

It is an over simplification to say that Anglo-Saxon colonisation began in the 5th century; there seems instead to have been a transition from British to Anglo-Saxon dominance before the Romans left. Stain Hill has not only given up Roman material but also a notable concentration of post-Roman finds from the early Anglo-Saxon, through Middle Saxon

and Late Saxon to Anglo-Scandinavian periods. Caitlin Green[17] argues Stain Hill may have been locally significant in both the Late Roman and the pre-Viking eras. Occupation continued until it became one of the many 'lost medieval villages' but in Saxon times this may have been the nearest settlement to the Time and Tide Bell location. As a medieval village the site maintained its significance with a moated site containing manor house, church and fishponds being located to the south-west of the hill.

The monument description records:
"The moated site takes the form of a rectangular island, which measures 70m by 40m, surrounded by a moat measuring 10m to 12m in width and approximately 1m deep. The eastern part of the island is raised up to 1m above the surrounding ground level; this area is believed to represent a building platform for the manor house. In the western part of the island is a large, roughly rectangular pond, approximately 30m by 10m and 1m in depth, thought to represent a fishpond. The ground to the west of the pond, at the edge of the island, is again raised above the surrounding ground level. The moated site was formerly associated with the remains of a medieval village and church at Stain which are no longer visible, and are not, therefore, included in the scheduling."
**
About 50000 French Huguenots came to England in the 16th century. Most settled in London or east midland towns such as Bedford and Nottingham but a few seem to have come to the Lincolnshire Marsh. Riggall, Rigall and Riccall are common surnames on the Lincolnshire Marsh and it is thought that the name derives from a French Huguenot family that fled persecution in the early 16th century. Jean Ricalde Rigaud, Count de Vaudreuil,came to Covenham in about 1500.

[17] Caitlin Green 2014 Stain Hill and the Lincolnshire Marshes in the Anglo-Saxon period http://www.caitlingreen.org/2014/11/stain-hill-anglo-saxon-marsh.html

In the early 1600s groups of French-speaking Protestants from Spanish-controlled Netherlands and northern France, Walloons & Huguenots, fled persecution and came to England. They were welcomed by the drainage engineer, Cornelius Vermuyden, involved in schemes to reclaim land from the fens in Lincolnshire and north Cambridgeshire.

An account from Sandcroft reads:
"The drainage of Hatfield Chase was commenced in 1626. Two years later 80 Huguenot families from Walloon Flanders, fleeing persecution, settled in the area. In 1635 there was another large influx of Huguenots, mostly artisans and farmers from Normandy and the Walloon country. A chapel was erected at Sandtoft for their use, and here the public service was read alternately in Dutch and French.

"The fenland natives were hostile to the drainage of the Level, believing that the participants (as the partners in the drainage undertaking were here known) were robbing them of their rights of common established by John de Mowbray in the reign of Edward III. In the years 1628 to 1631 there were fourteen outbursts of violence. This was followed by some years of comparative peace, but the beginning of the Civil War in 1642 saw the start of a period of greater lawlessness. In Dec 1645 the sheriff of Lincolnshire was instructed to suppress the riots, making use of train-bands of the county, and any parliamentary forces which might be there, to protect the participants and repair the damaged drainage. The fenmen took their case to law, but when the Court of Excequer ruled against them in 1650, a great riot broke out: the Chapel at Sandtoft was defaced, the village which had grown up round it demolished, the floodgates opened, and the River Trent allowed to overflow the Level once more.

"The mistreatment of the Huguenots by the fenman had always encouraged a small number to leave for more friendly surroundings:

the riots of 1650 turned a trickle to a flood. Many found their way to the Huguenot settlement at Whittlesey, and thence to Thorney, where the French Church assembled in 1652. “

**

Global warming and the associated sea level rise will result in unprecedented movements of people. It is arguable that the 2005-2010 drought in Syria, the worst drought in the Fertile Crescent since agriculture was invented there in the Neolithic, was a significant contributory cause of the Syrian civil war. The drying of the Sahel has led to internal migration in sub-Saharan states and triggered conflict there. But these will be as nothing compared to the adaptations that will need to be made when many of the world’s greatest cities and large areas of the best agricultural land succumb to rising sea level.

For a while at least, the British Isles will maintain a relatively benign climate and is likely to be a favoured destination for migrants. The Time and Tide Bell stands on the continent-facing eastern shore and can be seen as a beacon of hope, welcoming the dispossessed stranger.

A 3-Dimensional Exploration of LiDAR in Lincolnshire's Northern Coastal Grazing Marshes
The Time and Tide Bell site is in the middle of the picture at about 1 minute 37 seconds into the video.
https://www.youtube.com/watch?v=zZjqzcMFXi8&app=desktop

Dr John Cooper Clarke has created a coastal poem for the nation to help us celebrate all that's special about the sea. Clarke created the first verses of the poem and over the summer you helped him finish it by sharing your memories and love of the coast.
Be inspired to plan your next trip to the coast by reading the Nation's Ode to the Coast.

https://www.nationaltrust.org.uk/news/renowned-poet-helps-us-celebrate-coast

Sandpit

Nation's Ode to the Coast

Dr John Cooper Clarke

A big fat sky and a thousand shrieks
The tide arrives and the timber creaks
A world away from the working week
Où est la vie nautique?
That's where the sea comes in…

Dishevelled shells and shovelled sands,
Architecture all unplanned
A spade 'n' bucket wonderland
A golden space, a Frisbee and
The kids and dogs can run and run
And not run in to anyone
Way out! Real gone!
That's where the sea comes in…

Impervious to human speech, idle time and tidal reach
Some memories you can't impeach
That's where the sea comes in
A nice cuppa splosh and a round of toast
A cursory glance at the morning post
A pointless walk along the coast
That's what floats my boat the most
That's where the sea comes in…

Now, voyager - once resigned

Go forth to seek and find
The hazy days you left behind
Right there in the back of your mind
Where lucid dreams begin
With rolling dunes and rattling shale
The shoreline then a swollen sail
Picked out by a shimmering halo
That's where the sea comes in…

Could this be luck by chance?
Eternity in a second glance
A universe beyond romance
That's where the sea comes in…
Yeah, that's where the sea comes in…