

The geotechnical setting of the forts of the Saxon Shore in SE England: A record lasting nearly 2 millennia

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ABSTRACT: In a document preserved originally at Ravenna and much copied, from the latter stages of the Ancient Roman Empire, probably early in the 5th Century CE, military officials and their commands across the Roman Empire are recorded. Some of these commands relate to a senior military official Comes Litus Saxonicum ('Count of the Saxon Shore') with a variety of units and locations under his command in Britannia. Many of those locations are still identifiable as ruined 3rd century Roman fortifications at sheltered coastal or near-coastal estuarine sites. These fortifications are commonly described as 'Saxon Shore Forts' in modern day archaeological descriptions. Since the document (*Notitia Dignitatum*) is much later than the construction of the forts, it is likely that the command covered only a subset of what was originally constructed, and at the time of construction, there may or may not have been any such commander.

However, of the nine sites listed in the *Notitia*, several have been damaged by marine or estuarine erosion, and one by landsliding not immediately connected to active erosion. At least one other has been completely lost to retreat of the coast. Paradoxically, several of the forts partly eroded by the sea have since been protected against further retreat by the development of saltmarshes at their toes, and one by coastal defence works.

It must be a matter of some speculation about why they were constructed in the first place, or to what purpose they were subsequently put to use, but even then, it is possible to disprove some of the hypotheses that have appeared in the literature by reference to the geotechnics of their sites. It must be remembered that the *Notitia* list may not include all the forts that were originally built, much less planned, and as they appear from the archaeological record to have been constructed at various dates, their origins may well reflect the responses to different original strategic threats, or even, as has been speculated, for Customs revenue collection purposes. The bastions make the latter speculation improbable.

The paper describes the geographical, geological and geomorphological settings of these forts along with some of the geotechnical investigation work carried out at one of them.

1 INTRODUCTION

When monitoring geological and geotechnical change in the landscape, a variety of techniques are used, most notably various types of in-situ geotechnical instruments and remote sensing techniques, but also surface monuments and stations that are surveyed periodically or continuously. Sometimes, the readings are serendipitous, as for example, the GPS base station at St Catherine's Point Lighthouse (Hutchinson et al. 2002) which revealed seawards landslide deflections on a station that the national survey organisation thought was a fixed point. It incidentally confirmed prior

geodetic surveying (Bromhead et al. 1988) but with an infinitely better temporal resolution. The lighthouse was previously known to ‘wobble’ as recorded with a pendulum, and this was shown to be the result of intermittent sliding along a gently dipping basal slip surface.

A major difficulty arises because of the short timescale over which measurements may be taken. There are exceptions, where long ago some individual with foresight installed something that was observed periodically thereafter: a good example being the Holm Post (Hutchinson 1980) where an iron column was driven into a peat deposit subject to wastage and recorded becoming progressively exposed as the peat wasted away in a series of photographs taken by a variety of individuals more for recreational than scientific purposes. However, the Holm Post was surplus to the construction of an exhibition hall for the Great Exhibition in Hyde Park in 1851, and even though the record is long compared to most instrumentation, sometimes even longer records than a century or so are desired.

Longer term records rely on observations on historical buildings and monuments, often recorded (since the invention of photography) in photographs, but otherwise in the form of paintings, drawings, and antiquarian records, although they are difficult to obtain exact measurements from. An especially good example of such a study is that presented by Dvorak and Mastrolorenzo (1991) in a study of the rise and fall of a Roman building in Pozzuoli relative to sea level as a result of volcanic inflation and deflation. The building was uncovered in an excavation, and surviving columns were bored by a marine organism, showing that the remains had been beneath sea level at one time. The building was long thought to be the Temple of Serapis, but now is known to have been a market.

The search for monuments of similar longevity in SE England has homed in on a series of Roman era coastal or near coastal fortifications, sometimes known as ‘the Forts of the Saxon Shore’, and what they tell us about coastal change since they were constructed, although many conclusions are necessarily speculative.

2 THE ROMAN PERIOD IN BRITAIN

The *Roman Period* as far as the British Isles are concerned extends from the Claudian conquest beginning in A.D. 43 and finishing with the withdrawal of the legions under Honorius in A.D. 410 (Figure 1) – a little less than 4 centuries, and different, for example, to the ancient Roman period recognised in Italy. No doubt the islands came under Roman influence before the conquest, not least because of trade and the incursions by Julius Caesar in 55 and 54 B.C., and the influence

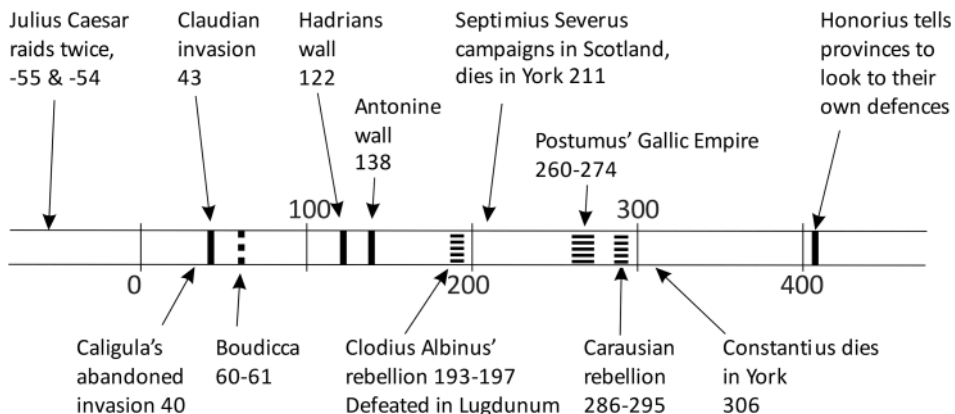


Figure 1. A timeline for the Romans in Britannia. The Saxon Shore forts were constructed in the century preceding 300 AD, and were therefore a century old at the time of the *Notitia*. Moreover, they are constructed in the period of the Gallic Empire, Clodius Albinus' Rebellion and the Carausian Rebellion.

continued to be felt largely through the influence of the Roman Catholic Church right up until The Reformation in the 16th Century and possibly beyond.

In answer to the question ‘What did the Romans do for us?’, parts of the strategic road network and the foundation of many of the major cities go back to this period. Forts and fortified towns often have names ending in ‘...caster’, ‘...caister’ ‘...cester’ or ‘...chester’ even in the present day, and even in the post-Roman era where similar meaning is implied by ‘...burgh’ (or other variants such as ‘...bury’ and ‘...borough’) the origins may lie with Roman fortifications. It transpires that although the Romans invaded what is now Scotland, they did not see much point in keeping it – a view that is often felt but not articulated even in the present day, and similarly, although there is evidence that there was trade with Ireland, that island also seems not to have figured largely in any Roman desire for conquest. Their settlement was largely limited to what is now England and Wales.

Although no buildings from that distant period have survived intact in the British Isles, it is commonplace for present-day building and civil engineering works to encounter foundations of Roman buildings known for their ornate mosaic floors, and also roads and military works, the latter including the well-known Hadrian’s Wall, separating England and Scotland and of course numerous fortifications, some of which still have significant above-ground remnants.

In a little over a century, Britannia was separated from the main Empire by three revolts (Figure 1), representing a tumultuous time. Each of the revolts was not a form of ‘Brexit’, but involved large sections of Gaul. The third revolt was led by Carausius, who after losing the Gaulish part of his possessions successfully withstood one invasion attempt, although he was then assassinated by his subordinate Allectus, who was unable to withstand a second invasion under the emperor Constantius Chlorus and his praetorian prefect Julius Asclepiodotus.

3 THE FORTS OF THE ‘SAXON SHORE’

The forts of the ‘Saxon Shore’ are a series of 9 late Roman period fortifications around the south-eastern coasts of England. The phrase ‘Saxon Shore’ comes from a single epigraphic source, the *Notitia Dignitatum* (‘List of Dignitaries’ or ‘Offices’) copied many times and thus preserved. The phrase derives from the title of an official described as commanding army units based at a number of sites, most of which can be identified as being the remains found today. Some of the locations at which various army units are based are known from other sources, and are identified by reference to a variety of *Itineraries*, which list distances from one place to another. Occasionally, the modern placename echoes the Roman name, as in, for example, Reculver from *Regulbium*. The *Notitia* is thought to have been composed in the early 5th Century from at least 2 sources, relating respectively for the Western Empire in around 400 AD, and a little earlier for the Eastern Empire.

Roman Fortifications are a subject of many works, including those intended for a lay audience (e.g. Wilson 1980), and even the fascination about the ‘Saxon Shore’ has extended to many accounts (e.g. Breeze 1994; Pearson 2002). However, in view of doubts about whether or not the forts under the command of the Count were originally a separate group, and in the light of the existence of other forts of a similar age and layout built in sheltered location, it has become conventional to drop the ‘Saxon’ and call them more simply ‘Shore Forts’.

The forts themselves are in various states of preservation (mostly ruinous), in part depending on the geology, geotechnics and coastal hydraulics of the sites where they were built, and on re-use at various historical periods in the last millennium. The names of the forts in the *Notitia* are (with modern names in brackets: Othona (Bradwell), Dubris (Dover), Lemannis (Stutfall Castle at Lympne), Branoduno (Brancaster), Garriano (Burgh Castle), Regulbium (Reculver), Rutupis (Richborough), Anderidos (Pevensey), Portum Adurni (Portchester – although this latter identification is far from certain). The spelling of the Latin names differs slightly from source to source, for example Lemannis-Lemanis, Branoduno-Branodunum etc.

Not listed in the *Notitia* are forts of a similar age and style (e.g. with closely-spaced bastions) at Caister on Sea, Walton Castle, Bitterne (*Clausentium*), Topsham, and possibly also Carisbrooke

on the Isle of Wight, with the distant Cardiff Castle fitting the general picture. It is tempting to believe that the foundations of Rochester Castle also originated in a Shore Fort, not least by virtue of its planform and location adjacent to a sheltered inlet, but also by the site being exploited for a Norman castle and the name of the settlement ending in ‘...chester’.

Most of the forts have been the sites of archaeological excavation campaigns from the middle of the 19th century up to the present, with the finding that the ones listed in the *Notitia* date from the 3rd century AD. However, not all appear to be of an identical commencement date, and some are much older than others. Some seem also to be replacements or modifications of older forts, notably at Reculver, Richborough and Dover.

The common feature of all of them appears to be the construction of projecting bastions at closely-spaced intervals around their periphery, although the forts have different planforms, with Lympne and possibly Burgh Castle having an ‘apsoidal’ side, and Pevensey being the outlier with an irregular ovoid planform. All of the forts are of sufficient public interest that the Internet abounds with photographs and maps, so that readily available information will not be duplicated here.

Interesting as the archaeology is, the surviving forts have the potential to tell us much about coastal changes that have occurred in the past 17 centuries, and it is that story which the paper intends to concentrate upon. However, a brief review of what is known, and also what is conjectured, about the forts is necessary for the paper to be put into context. The Antiquarian literature includes Stukeley’s important illustrated work (1776). More recent archaeological investigations are given e.g. by Roach-Smith 1850, 1852; Cunliffe, 1980; and Hilp, 2005.

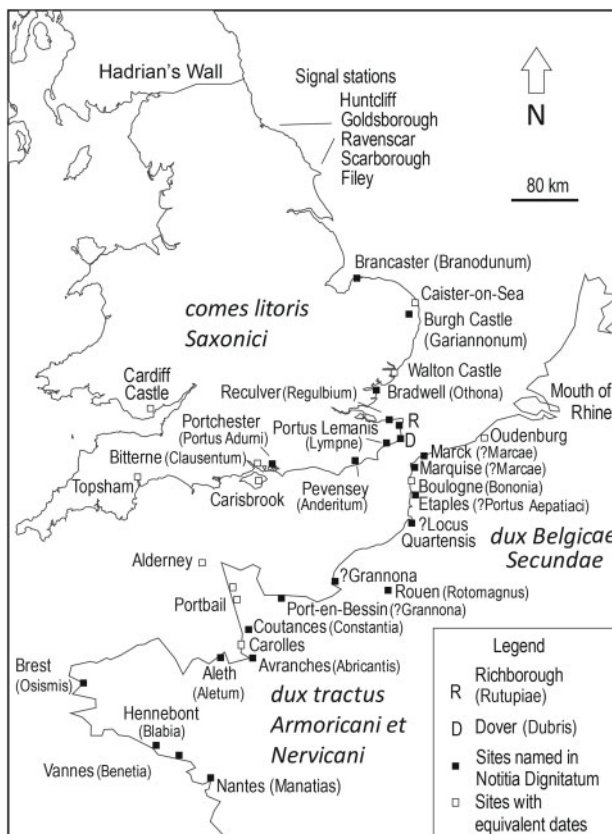


Figure 2. The Saxon Shore forts in context with the equivalent structures on the northern coast of Gaul.

All walled enclosures have the purpose of keeping what is inside safe from what is outside, or *vice versa*. In the former case the enclosures are defensive fortifications, and in the latter, prisons. The projecting bastions favour the fortification idea, because bastions and towers are force-multiplying structures, and show that the fortification is intended to resist siege from a large force and not a simple raiding party, as without that, a simple wall is adequate protection for the occupants, giving enough time for them to be mustered into defensive formations.

It appears that all the coastal forts of this period, ‘Saxon Shore’ or otherwise, were built not on exposed coastlines, but in relatively sheltered estuarine settings, and, for brevity, usually in association with the needs of a naval force known as the ‘British Fleet’ (*Classis Britannicum*). This conclusion is based on surviving examples and on an appreciation (i.e. surmise) of what the original purpose of the forts may have been. Philp (2005) speculates that Reculver may have been 1 mile from the sea originally, but that is necessarily based on it having been built in a sheltered location and taking account of 19th and early 20th century erosion rates. It would in any case have always been close to the Wantsum Channel, now reclaimed land, which separated the Isle of Thanet from the mainland and provided access to Canterbury for shipping.

4 GEOLOGY

The structural geology in SE England (Figure 3) is dominated by the Wealden dome (which is cut by the English Channel and has its coastal expression in the Dover-Lympne-Pevensy stretch of coastline), the London Basin to its north (west of Bradwell and Reculver), and the Hampshire Basin to its west (around Portchester and Bitterne). The dome brings weak rocks of Cretaceous age to the surface while in the basins, the deposits at sea level on the coast are of the Tertiary, again taking the form of very weak rocks. By ‘weak rocks’ we mean in the geologist’s vocabulary, as the strata, with some notable exceptions, are stiff, overconsolidated silty clays and sands in both the Tertiary and Cretaceous sequences, the most notable exception being the Chalk, which is a white, jointed weak limestone.

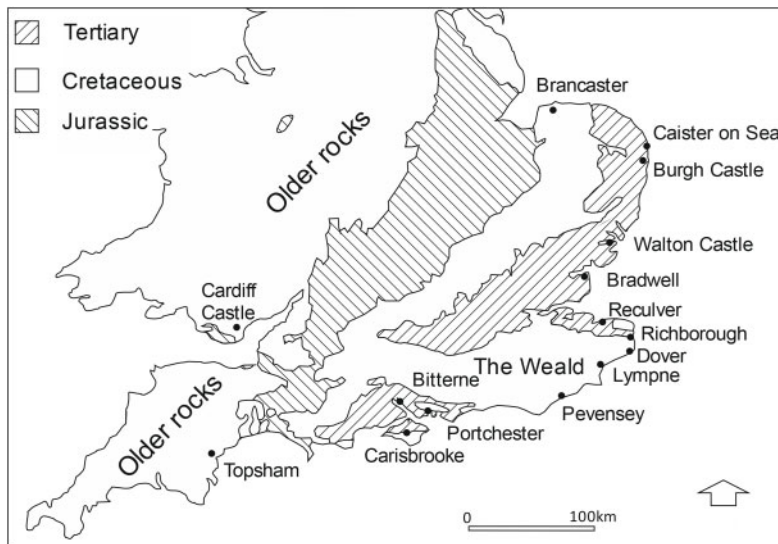


Figure 3. Outline Geology of SE England relative to the Shore Forts.

The Roman engineers appear to have chosen sites somewhat inland of the mouths of estuaries or where an anchorage was protected from direct marine attack by a coastal spit, and mainly to

have founded their structures on the 'solid' rather than on any estuarine deposits except perhaps Portchester and Reculver. The three most northerly of the forts are founded on the glacial drift that covers East Anglia – the 'bulge' in the coastline hereabouts. Only Lympne is built on a slope, whereas the other forts are built on flat-lying ground.

5 THE NATURE OF THE PROBLEM

Rather sadly, the geotechnical lessons that can be learnt from the Shore Forts are related to the way that they have been damaged or even lost to natural processes, and there is no information available on anything that did not survive long enough to be utilised by the forces at the time related to the Notitia. In principle, deductions can be made with respect to coastline retreat at some of the forts, changes in the coastline due to silting up of harbours and movement of coastal spits, and in the case of Stutfall Castle at Lympne, landslide activity on an old slope.

It has become conventional to attribute the Carausian rebellion to the recall of Carausius to answer charges that when he commanded the British Fleet with the remit to cut off Saxon pirates, he intercepted them on their return from pillaging and kept their spoils rather than returning them to their owners. The Saxon Shore would therefore be defences erected by Carausius to fend off the Empire when the Gaulish lands were lost, or indeed, to fortify the ports against Saxon raiders. (Fields 2006; Ireland 1986; Pearson 2002). This rather simplistic overview neglects some important facts, notably that Saxons had already been relocated to Kent in South East England, and that the Shore Forts are concentrated at the closest point to continental Europe. Moreover, there is a further concentration of the related Shore forts on the coast of Gaul, and there they stretch much further to the west, including as far as the Atlantic coast. It is difficult to imagine Saxon pirates daring to enter the English Channel and travel that far in search of prey knowing full well that they must return to wherever they came from in the North Sea through the narrow Straits of Dover. It is akin to some future archaeologist observing that there were mid 20th century fortifications on both sides of the Channel and concluding that they were defences against American pirates (as indeed, the majority were) coming directly across the Atlantic and then proceeding up the Channel rather like the Spanish Armada had in 1588!

At least the WW2 fortifications differed on both sides of the Channel. In the 3rd Century AD, both sets were built by units of the Roman Army, whether rebels or not, having trained to the same norms and practices. Indeed, in the third century, it is inconceivable that an amphibious assault of such a magnitude as to require a fortification with high walls and bastions on the part of the defenders could be mounted except by a part of the Roman military. No one else had the numbers and requisite skill at the time in NW Europe.

The division of the Gaulish forts into two commands (see Figure 2) may also be a relic of the organisation of the invasion forces under Constantius Chlorus, who took an Eastern Fleet to an unrecorded landing site, and Julius Asclepidotus who took a western fleet to a landing site near the Isle of Wight. It is possible that Constantius Chlorus' forces laid siege to Reculver, making the breach in the wall recorded by Philp (2005) and slaughtering the inhabitants of the vicus before proceeding the Londinium. The extensive fortifications on the Gaulish side of the Channel may reflect an imitation of Carausius's strategy and a response to raiding parties from Britannia and whichever tactics Carausius employed to defeat the first invasion attempt. 'Bad weather' was adduced as the reason for the first failure, but that appears to be a euphemism for defeat: even Julius Caesar claimed it!

The sheltered, quasi-inland, location of the shore forts may therefore reflect both a defensible barracks and dockyard, capable of withstanding the first wave of an assault until reinforcements arrived, but not of withstanding a dual-pronged attack, especially under the command of the usurper Allectus who lacked the naval strategic skills of his victim, Carausius.

However, the critical point is that the evidence of location is critical in determining that Reculver, Bradwell and Walton Castle were not built directly on an exposed coastline but that coastal retreat has been extensive enough to reach those initially distant from the coastline sites.

5.1 Coastal erosion (coastline recession)

Walton Castle is known to have been wholly lost to the sea, with the remains only now visible on the shore at extremely low Spring tides, and details of its layout are only available from antiquarian records. Our knowledge of the fort derives largely from an improbably elongated outline drawing and plan of 1623, and some 18th-century literary rather than scientific accounts. The fort was in sufficiently good state of repair to have been used by the Normans who used it as the outer bailey of a castle constructed c. 1100 and dismantled in 1175-6. In 1722 the remains were described as

“’Tis 100 yards long, five-foot above ground, 12 broad at each end and turned with an angle. Its composed of Pepple and Roman bricks in three courses, all round footsteps of buildings, and several large pieces of Wall cast down upon the Strand by the Seas undermining ye Cliff all which have Roman brick. At low water mark very much of the like is visible some distance in the Sea. There are two entire pillars with Balls, the Cliff is 100-foot high.”

The cliff is actually less than half the quoted height. In an account of 1754, the length of the west wall is given more accurately as 187 yards, and it is described as being “nine feet thick”.

Several of the forts of the Saxon Shore as listed in the *Notitia* have lost part of their curtain wall due to erosion. Portchester, built at more or less present sea level in the inner reaches of Portsmouth harbour, lost a corner, but this was rebuilt in the Medieval Period when the fort became the outer bailey of a Norman castle, with an inner bailey and keep built in the NW corner of the fort originally in the 12th century and heightened in 1390. The damage from erosion was minimal and soon repaired.

Other forts lost part of their perimeter wall but were subsequently defended naturally by the growth of littoral sediments, including Pevensey, Richborough, and Burgh Castle, the latter probably suffering the most loss, while Reculver was more or less intact until the 19th century (Roach-Smith 1850), and having lost much of its seaward side was protected against marine erosion with a seawall and control of the beach by means of groynes. Lympne’s Stutfall Castle lost its lower, seaward, section of the curtain wall but due to landsliding in the slope as a whole.

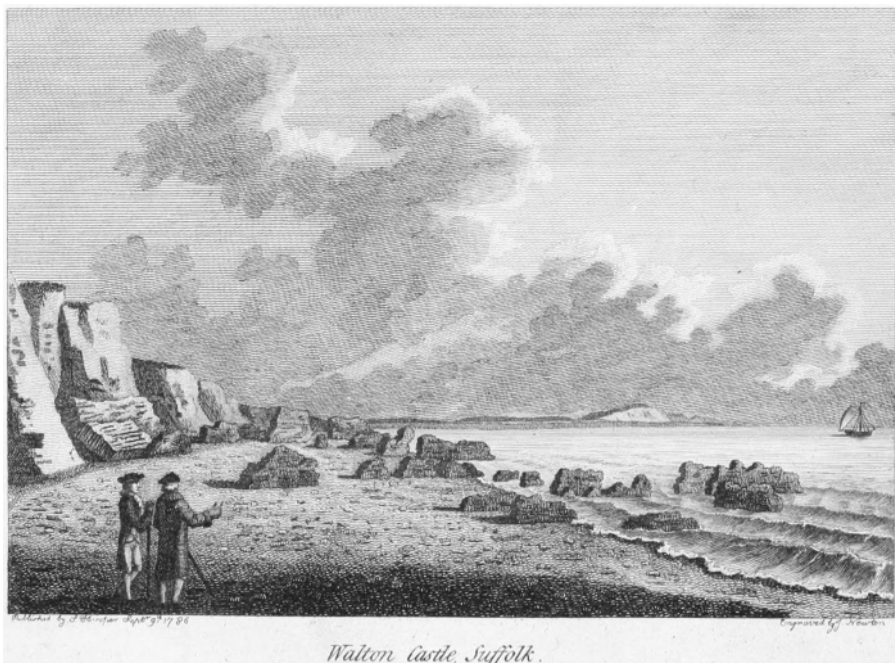


Figure 4. The loss of Walton Castle (Suffolk) to marine erosion as depicted by Francis Grose in 1786. The site, north of Felixstowe is not to be confused with a Victorian-era Walton Castle near Clevedon, Somerset.



Figure 5. Walton Castle sketched in 1623, and viewed from the seaward side: the coastal cliffs are shown in the foreground. There is a suggestion of bastions on the south wall: those at each end of the east wall are jettied outwards and the overall height is much more than indicated in the accompanying account. The gap in the wall is assumed to have been an original gate.

Rather like the case of Walton Castle, several of the forts were exploited under the Normans, who built keeps and retaining the original fort as an outer bailey, as at Portchester, Pevensey, Walton, Carisbrooke (possibly) and Cardiff Castles. At Pevensey, the keep wall is built on top of toppled towers. The castle is well above sea level, and the failures are concordant with a tiny amount of erosion at its toe, or possibly even just long-term slope processes in a steep abandoned cliff.

5.2 Coastal changes due to siltation of harbours and the mobility of spits

Coastal or estuarine siltation (growth of saltmarshes) has happened at Pevensey, with very little, if any, trace of the former anchorages in Pevensey Bay. Siltation has also protected the former coastal cliff at Richborough, and modified what may have been a harbour at Lympne, although that is more due to geodynamic changes in coastal gravel spits with a salt marsh developed to the leeward. It must be suspected that the site of Walton Castle in antiquity overlooked an anchorage in the lee of a coastal spit, as there is one to the north (Orford Ness) and had that shortened due to erosion in post-Roman or even early medieval times it would have exposed the Walton Castle site. Lympne is also interesting in the evolution of coastal spits as antiquarian sources (Copley 1977) note the existence nearly 500 years ago of a shingle spit defended channel from Hythe (immediately east of Lympne) for several miles along the coast, a channel that certainly no longer exists.

5.3 Landsliding processes on 'abandoned cliffs'

The Roman fort at Lympne is the only one of these sites built on 10-11° sloping ground, and what is known as an *abandoned cliff*. It has been damaged by at least two phases of landsliding: one unrecorded slide that has affected a part of the whole slope and dislocated the east wall and gate, and another episode of landsliding affecting the NW part of the fort, possibly the same event that displaced French House.

No trace of the Roman port has been found, but a drone photo of the site clearly shows a road leading to the west gate and which crosses the slope obliquely, so has a more suitable gradient for carts that straight up and down the slope. The road is shown in Roach-Smith's work (1852) (viz. Figure 6). That would put the fort astride the ramp from port to the crest of the slope and the pentagonal, apsidal, shape of the fort would be more explicable if it were built to block a road than that it was somehow intended to point upslope but was set out incorrectly. The fort experienced two major phases of instability: an earlier event that affecting the East wall and gatehouse in a lobate slide running all the way down to the toe of the slope, and a later slide affecting the NW wall. The date of the earlier slide is unknown, but the later slide can be tentatively dated to 1725

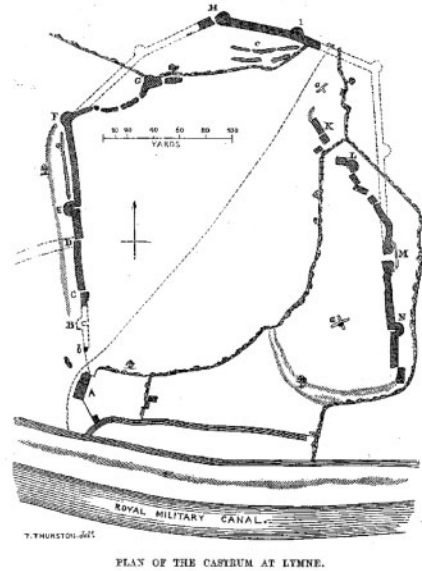
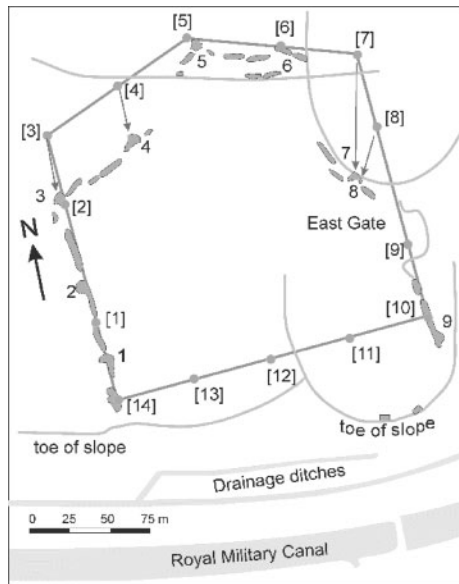


Figure 6. Plan of the landslip damaged fort Stutfall Castle at Lympne. Left: modern plan with reconstruction (Bromhead 2018; Hutchinson et al. 1985). Right: Roach-Smith, 1852 drawn for him by T. Thurston.

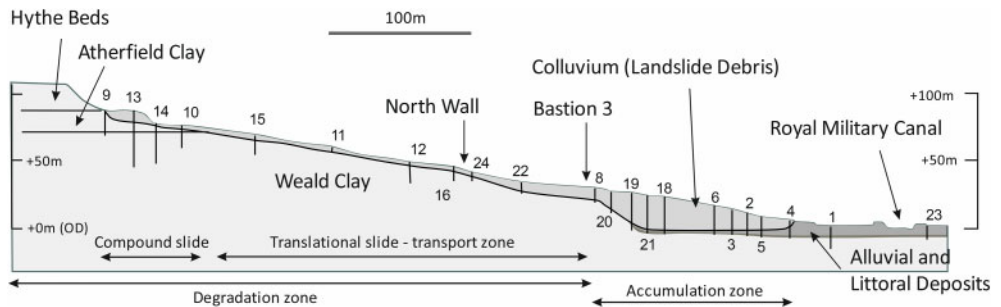


Figure 7. Cross section through the slope at Stutfall Castle, Lympne (Bromhead 2018; Hutchinson et al. 1988).

as it postdates the etching by Stukeley dated 1722 which shows the wall standing. Hutchinson and Bromhead (1996) considered the stability of this wall, which was founded on short wooden piles and concluded that its toppling was in part due to an initial landslide displacement. The study followed on from an extensive combined geotechnical and archaeological investigation conducted via a series of boreholes (Figure 7) elucidating the landsliding on the site, and pits to explore the original position of the north wall indicated by the wooden piles still in their original place with the walls having slid or toppled off them (Hutchinson et al. 1985).

The putative 1725 event affected a building called French House (now the site of the Port Lympne animal park) just below the crest of the slope somewhat to the west of the Stutfall Castle fort, but the earlier slide is undated. However, the east wall slide cannot have happened in the 4th century as that would have rendered the fort ineligible to be included in the Notitia. Since the NW wall / French House slide occurred early in the Little Ice Age, it is tempting to associate instability with a period of climatic change, and if that speculation were correct, then perhaps the East wall slide could be

dated in the Dark Ages (or post Roman, but before the Norman Conquest). An alternative might be that the NW wall / French House slide was a result of slope remodelling or water (mis)management at the French House site. In line with that supposition, it is equally possible that the East wall failure was associated in some way with the construction of Lympne Castle and Church on the crest of the slope through factors such as quarrying the Hythe Beds for building materials or surface water management. Lympne Castle (at the top of the slope) is a fortified manor house of Medieval date, possibly exploiting a lookout or signal station site contemporary with the fort.

Support for both landslide causation hypotheses comes from the 1988 failure a few km E of Stutfall Castle (Bromhead et al. 1998), which failed during an especially wet year, but also took out the remnants of a site built in the 1930s as part of a research programme into aircraft early warning systems using parabolic sound reflector dishes. Some reprofiling had been done, and remnants of a drainage pipe network from the military site were involved in the failure.

An important geotechnical problem arises with slopes that have been defended from coastal or other erosion by the growth of marshes at their toes. Where the land has been reclaimed or a sea wall built, such slopes are termed 'defended cliffs' and where the defence is a natural process (such as can include a river meandering away from them) they are termed abandoned cliffs. The distinction is made by Hutchinson in publications that arose from his study of coastal landslides, and discussed by Hutchinson & Gostelow (1976) in a study of landslides on such a slope affecting a medieval castle at Hadleigh. Specific geotechnical interest arises when the slopes degrade to a slope angle where instability is infrequent, and then what is required to make them unstable?

6 THE SURVIVOR BIAS ISSUE

All discussion of the long-term behaviour of anything based on a description of their status today is subject to what is known as 'survivor bias'. For example, we know that all the forts mentioned in the *Notitia* were actually still in commission and functional at least a century after they were built, and sometimes more. It tells us nothing about any forts that were abandoned, ruined, lost to coast erosion or even found unsuitable for military use in the intervening period. Indeed, as noted above, it is known that some forts along the coastline of SE England are NOT mentioned in the *Notitia*, for example the fort known as Walton Castle is known from Antiquarian sources to have been intact in the 17th century and lost to marine erosion in the 18th, and was actually used as the outer bailey for a medieval fortification, so had survived almost up to the modern era despite not being used by its original constructors at the time of the *Notitia*.

The questions here are why did Walton Castle not make it into the *Notitia*, and also, as illustrated, it lacks the regular bastions of surviving Shore Forts. The answer may lie in the geography, as the former fort's location is close to the mouths of the rivers Deben, Stour and Orwell (the latter pair still with a common mouth). Moreover, somewhat to the north a coastal spit deflects the River Alde and slightly to the south there is a complex of estuaries. If any or all of these all shared a common mouth in the earlier part of the Roman period but were separated by coastal retreat or loss of the protection afforded by a spit in the century prior to the date of the *Notitia*, and this also lost any port from the time, it would account for the loss of importance of Walton Castle. Today, of course, Felixstowe has become important as it is the site of a huge container port just inside the estuary.

Had Walton Castle itself not survived so long it would be completely unknown, except for some vague mentions in medieval accounts. The absence of bastions except at the corners may well have been due to robbing in the medieval era, and indeed, the peculiar shape of the fort may have been the result of some remodelling necessitated by the recession of the coastline. However, it is much more likely that the only known plan of the fort is grossly out of scale, as evidenced both by the drawn thickness of the walls and the casual inaccuracy of a reported dimension.

The speculation above also relates to the Shore Fort at Bradwell-on-Sea (Othona) constructed adjacent to the estuary of the river Colne whose mouth is very close to the mouth of the River Blackwater in Essex (Blackwater is a common name for several rivers in England) and could easily

have had a common mouth in the 3rd Century. The Colne provides access to the important Roman city of Colchester. The Bradwell fort is almost entirely consumed by coast erosion.

Also affected by coastal retreat is the fort at Reculver (Regulbium) on the N. Kent coast at the northern end of the now-reclaimed Wantsum Channel that in Roman times and later separated the Isle of Thanet from the mainland. This fort was intact when examined by antiquarians in the 18th and early 19th century, but its seaward margin was lost to coast erosion before that stretch of coast was protected by seawall and groyne construction. Partial loss of the SE corner of the Shore Fort at Richborough may also be the result of coast erosion, and indeed, the entire South wall has failed, but the site is not protected by a coastal sediment growth, and later the construction of a railway line. Reculver appears to be of an earlier date than a number of Shore Forts, and there were certainly earlier defences at Richborough.

Whether or not Portchester Castle is Portus Adurni is a moot point, because the River Adur (some 70 km further East) has its mouth in Shoreham Harbour, and this would seem to be a logical place for a fort, although there is a view that the river was named Adur in recent times on the belief that there must have been a fort there! The fort is conveniently close to present sea level and safe from significant wave action to have only lost its SE corner to erosion, rebuilt at some uncertain date in the early medieval period when the Roman fort became the outer bailey to an inner bailey built inside the NW corner of the fort with an imposing keep springing off the Roman walls. There must be a question therefore whether the real Portus Adurni is yet to be discovered (or is irretrievably lost) and Portchester 'fits the bill' solely because it survived in such relatively good condition. Portchester Castle is of rectangular planform with regular bastions and two gates and is therefore the archetypal lay person's view of what such a fort should comprise, and that provides additional motive for its inclusion in the list of 9 Shore Forts.

7 CONCLUSIONS

Probably the best book on the subject of the Shore Forts is that by Pearson (2002), although he does perpetuate the 'Saxon Raiders' hypothesis. What is clear is that more forts were built than feature in the Notitia list a century or more later than their building. At this distance in time, it is impossible to attribute the shortness of the list to a changed strategic situation, changes to the nearby anchorages, or merely the relative suitability of the chosen sites in terms of accommodation for the units billeted there, the proximity of settlements and transport routes for supplies, etc. The Notitia list of 9 forts does not include all the forts known in relevant locations, and must reflect the needs of the Roman army over 100 years after many of the forts were constructed and even longer in some cases (errors and omissions in the Notitia excepted). It is therefore impossible to deduce Carausian needs and objectives from the Notitia forts alone.

An analogous situation relates to the chain of Martello Towers built c. 1800 around 2 sections of coast, coincidentally with some similarity to the locations of the Shore Forts. By the time of an invasion scare in the mid-19th century, many were abandoned, some were lost to coastal changes, and some had been subsumed into later defences. In the 20th century (WW1 & 2) the number in military use was even smaller. Contemporary larger scale fortifications were built at various dates, and at least one is still occupied by the military, but by a naval radar training and research establishment using technology as alien to the fort's builders in the mid 19th century as to the Romans 16 centuries before!

That so many sites were lost or damaged in the past 3 centuries points to the likelihood that there were even more constructed originally than the Notitia's nine, and also to either an acceleration of coastal retreat in the Little Ice Age, or more probably that the forts were built an appreciable distance from exposed and eroding coastlines originally.

Slopes even in sheltered estuarine locations or coasts protected by spits can suffer toe erosion (Richborough, Pevensey), resulting from river meanders (Brancaster), removal of spits by littoral drift, or long-term slope processes, the latter possibly exacerbated by anthropic interventions involving earthworks, quarrying or interference with site hydrology. (Lympne)

Rapid coastal erosion may cause the mouth of a river and estuary system to retreat landward, so that even what is *ab initio* a sheltered location may be outflanked by the coastal erosion. (Walton, Bradwell), although the changing environment may well occur over a millenium or more.

Not only does the Stutfall Castle (Lympne) case give us considerable insight into the long-term behaviour of abandoned and defended slopes that continue to degrade and move sporadically, the failure of the curtain wall of the fort reveals that there is more to the failure of a wall in a landslide system than simple earth-pressure theory can account for.

REFERENCES

- Breeze, David J. 1994. *Roman Forts in Britain*. Princes Risborough: Shire Publications.
- Bromhead, E. N. Curtis, R. D. & Schofield, W. 1988 Observation and adjustment of a geodetic survey network to monitor movements in a coastal landslide. *Proc. 5th International Symposium on Landslides, Lausanne*. 383–386. (Balkema).
- Bromhead, E. N., Hopper, A. C. & Ibsen, M. L. 1998. Landslides in the Lower Greensand Escarpment of South Kent. *Bulletin of Engineering Geology & the Environment*, Vol. 57, No. 2, 131–144.
- Bromhead, E. N. & Ibsen, M-L. 2004. Landslide and coast erosion damage to historic fortifications in SE Britain. *Landslides* Vol 3, No. 4, 341–347.
- Bromhead, E. N., Ibsen, M-L. & Tapete, D. 2013. 19th and 20th century coastal military installations affected by coastal erosion in the UK. *Geotechnical Engineering for the Preservation of Monuments and Historic Sites*. Editors Bilotta, E; Flora, A; Lirer, S. & Viggiani, C. 191–198 CRC/Balkema
- Bromhead, E. N. 2018. The landslip-damaged Roman fort at Lympne in SE England. *From: Rose, E. P. F., Ehlen, J. & Lawrence, U.L. (eds) Military Aspects of Geology: Fortification, Excavation and Terrain Evaluation. Geological Society, London, Special Publication 473*
- Copley, G. J. 1977. *Camden's Britannia: Kent*. Hutchinson & Co., London.
- Cunliffe, B. 1980. Excavations at the Roman fort at Lympne 1976–8, *Britannia*, Vol. 11, 227–88.
- Dvorak, J. & Mastrolorenzo, G. (1991) The Mechanisms of Recent Vertical Crustal Movements in Campi Flegrei Caldera, Southern Italy (Special Paper (Geological Society of America)), Geological Society of Amer, 47p.
- Fields, N. 2006. *Rome's Saxon Shore – Coastal Defences of Roman Britain AD 250–500* (Fortress 56). Botley: Osprey Publishing.
- Hutchinson, J. N. 1980. The record of peat wastage in the EastAnglian fenlands 1848–1978. *J. Ecology* 68, No. 1, 229–249.
- Hutchinson, J. N. & Gostelow, T. P. 1976. The Development of an Abandoned Cliff in London Clay at Hadleigh, Essex. *Philosophical Transactions of the Royal Society of London. Series A, Mathematical and Physical Sciences*, vol. 283, no. 1315, *The Royal Society, 1976*, pp. 557–604.
- Hutchinson, J. N., Poole, C. Lambert, N. & Bromhead, E. N. 1985. Combined archaeological and geotechnical investigations in the Roman fort at Lympne, Kent. *Britannia*, Vol. 16, 209–239.
- Hutchinson, J. N. & Bromhead, E. N. 1996. Back analysis of the collapse of a Roman wall built on landslip. *7th International Symposium on Landslides, Trondheim, Balkema*, 1243–1250.
- Hutchinson, J. N., Bromhead, E. N. & Chandler, M. P. 2002. Landslide movements affecting the lighthouse at Saint Catherine's Point, Isle of Wight. *Conference on Instability: Planning & Management, Thomas Telford, May 2002*.291–298.
- Ireland, S. 1986. *Roman Britain: a sourcebook*. Routledge (Second edition 1996: Taylor & Francis).
- Pearson, A. 2002. *The Roman Shore Forts: Coastal Defences of Southern Britain*.
- Philp, B. 2005. *The excavation of the Roman Fort at Reculver, Kent*. Dover: Kent Archaeological Rescue Unit.
- Roach-Smith, C. 1850. *The Antiquities of Richborough, Reculver, and Lympne, in Kent*. London: John Russell Smith.
- Roach Smith, C. 1852. *Report on Excavations on the site of the Roman Castrum at Lympne in Kent*, London. Published privately for subscribers, and republished by Harry Margary, Lympne Castle, Kent (undated).
- Stukeley, W. 1776. *Itinerarium Curiosum or an account of the antiquities and remarkable curiosities in nature or art*. Second Edition, London: privately published.
- Wilson, R. J. A. 1980. *Roman Forts: An illustrated Introduction to the Garrison Posts of Roman Britain*. Bergstrom and Boyle Books.