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To cite this article: Andrew Margetts, Giles Dawkes, Damian Goodburn, With contributions by Lucy Allott, Stacey Adams & Alice Dowsett (2023): What 'incomparable Jewells Havens, and sure harbours are': the remains of late 16th century Dover harbour and their wider significance, Post-Medieval Archaeology, DOI: [10.1080/00794236.2023.2166442](https://doi.org/10.1080/00794236.2023.2166442)

To link to this article: <https://doi.org/10.1080/00794236.2023.2166442>



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Published online: 19 Jan 2023.



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What ‘incomparable Jewells Havens, and sure harbours are’: the remains of late 16th century Dover harbour and their wider significance

By ANDREW MARGETTS, GILES DAWKES and DAMIAN GOODBURN,
With contributions by LUCY ALLOTT, STACEY ADAMS and ALICE DOWSETT

SUMMARY: During excavations undertaken for the Dover Western Dock Revival Scheme, Kent, UK, Archaeology South-East (ASE; UCL Institute of Archaeology) encountered substantial remains associated with the development of the port of Dover. Despite natural limitations, especially in the form of silting from the River Dour and longshore drift, Dover has historically been a strategic location in which to maintain a port. The remains presented here comprise a nationally significant waterfront revealed during the revival scheme; that is, the Tudor engineering commonly attributed to Sir Thomas Digges, overseen by the Privy Council and commissioned by Elizabeth I.

INTRODUCTION

On the calm warm night of the 7th August 1588 the Strait of Dover was home to one of the defining moments in British history. If the Spanish king’s great Armada had been successful, this would have marked the day his troops landed on the Kentish shore. As it was, the evening witnessed a breakthrough in the naval action between the English and Spanish forces. Inhabitants of nearby coastal towns may have stared aghast as far out to sea eight infernos raged. These were the ‘Hell Burners’, fire-ships sent by Francis Drake and Charles Howard to break up the Spanish fleet (Fig. 1). Though only one Spanish ship was lost, the engagement marked the culmination of over two weeks of exchanges between the opposing forces and the final break-up of the Spanish defensive formation. The eight-hour struggle that ensued, the Battle of Gravelines, resulted in English victory and the scattering of the Armada in rough seas. Many ships and sailors would later succumb to gales and lack of supplies as they rounded the coasts of Scotland and Ireland on their return journey to Spain.

England’s queen, her Tudor regime and the Anglican tradition were safe. The victory revolutionised naval warfare and provided a huge boost to national pride, issuing in a so-called ‘Golden Age’. Military success was no mere fluke however, nor was it the result of divine intervention, as some contemporaries claimed, but the product of technological and organizational innovation, underway for some thirty years or more.¹ It was the smaller, faster more manoeuvrable ships of the English as well as better ordnance that helped defeat the Spanish,² but the increasingly centralized and powerful government under Elizabeth was also able to manage more technically complex projects, resulting in stronger infrastructure, industry and commerce. Royal administrators were given the liberty to recruit trusted experts who served as mediators between the crown and those completing the works.

One such project was the 1583 rebuilding of Dover harbour under the supervision of Thomas Digges. Digges was a mathematician, astronomer and local landowner who had become frustrated by failed attempts to rejuvenate Dover port and create a safe



FIG. 1

Defeat of the Spanish Armada, 8 August 1588. Philip James de Loutherbourg, 1796 (oil on canvas).

haven for shipping.³ The port, a key member of the Confederation of Cinque Ports, was of importance during the 16th century for shipping along the south and east coast⁴ as well as for trade with the Low Countries and its proximity to Calais.⁵ The port had suffered continual problems with accumulations of silt and shingle deposited by a combination of long-shore drift, the River Dour and previous attempts at harbour construction.⁶ Digges' exasperation with the state of the port culminated in 1582 in his plea to Elizabeth I for development of Dover harbour, partly using a pier and other foundations laid by Henry VIII.

In his plea (which is often wrongly attributed to Sir Walter Raleigh) Digges declared:

There is not one thing moste renowned
soveraigne of greater necessitie (to maynteyne
the honor and safetie of this your majesties
realme), then by all convenient means to
encrease Navigation, Shipping and Maryners.
There beyng a strength in tyme of warre, and
in tyme of peace, members moste profitable
and comodius.⁷

Elizabeth I and the Privy Council subsequently approved new plans taking advantage of the sand and shingle bar that had accumulated in front of the town creating a lagoon fed by the River Dour (Fig. 2). The lagoon was to be turned into a permanent backwater 'pent' or reservoir, by building seawalls comprising earthen embankments reinforced by brushwood bundles and stakes. The river water in the resultant 'Great Pent' would be controlled by a sluice which allowed the release of water at low tide to scour the sand and shingle collected in front of the harbour mouth. Early in 1583, help was sought from the people of Romney Marsh who had much experience in building sturdy seawalls with a mixture of earth and chalk and roundwood stakes and bundles. Digges advocated the Romney method and on the 10th April 1583 the Dover commission hired labourers from across Kent to build the long and crosswalls of the Great Pent. More than 1000 men were employed on the works, often in dangerous conditions.⁸ Nevertheless, the new wall was completed in just over two months, much earlier than the two years it was projected to take. In 1595, the redesigned harbour was complete (Fig. 3) and Digges' plan shows the Port of Dover comprising three different



FIG. 2

Dover Harbour and bay 1581- Probably drawn for/by Thomas Digges; Add MS 11815 A.

sections, all situated on the western side of the harbour of today.

PROJECT BACKGROUND

The Dover Western Dock Revival Scheme comprised the widespread redevelopment of the harbour and

was the subject of a Harbour Revision Order (HRO) granted by the Secretary of State in 2012. A key part of the work was open area excavation, principally for the installation of a new Wellington Navigation Cut. The archaeological investigations, commissioned by Royal HaskoningDHV on behalf of Dover Harbour Board (DHB) were carried out by Archaeology



FIG. 3

State of Dover Haven by Thomas Digges, 1595 (© the British Library).

South-East between 2015 and 2018 and comprised a borehole and marine geophysical survey, rotary borehole monitoring, an excavation area, historic building recording and watching briefs (Figs 4–6).

SITE LOCATION AND GEOLOGY

The Navigation Cut, which is the focus of this article, comprises a section of land through the western end of The Promenade, along the Esplanade at Dover Docks (Figs 4–7). Prior to the works, the area was free from major development, comprising the Esplanade and paved parking. The western end of the site was bound by the east wall of the Wellington Dock, with a seawall, stone break water, and shingle beach to the east.

Dover Harbour is one of the oldest ports in the UK, but despite this, the location is a naturally unstable place for constructing harbour works. It is located in the small inlet of the River Dour between Archcliff to the south-west and Castle Cliff to the north-east. The inlet runs inland from a shallow bay. Though the cliffs provide some shelter from north and west winds, the tidal currents of the North Atlantic that flow into the English Channel carry with them large quantities of sand and shingle

through longshore drift. Only constant dredging and repairs can maintain a harbour on this part of the English coast.

The Promenade occupies a partially natural spit of land formed by accrued silt and shingle, enclosing the Wellington Dock to the west, with the sea to the east. The bedrock geology of the site comprised chalk of the New Pit Chalk Formation, overlain by storm beach deposits and beach and tidal flat deposits of late medieval to early post-medieval date (Fig. 8). For a more detailed understanding of the geoarchaeological evolution of the location of Dover Harbour the reader is directed to the work of Dr Martin Bates (amongst others) in earlier articles and a forthcoming monograph.⁹

ARCHAEOLOGICAL RESULTS

THE WOOD REINFORCED EARTHEN EMBANKMENT

Beneath later harbour works, part of the 1583 long wall was identified in the Navigation Cut excavation area, in the form of an embankment (B2; G27/G34/G36) and attendant wooden structures (S8, S9 and S10; Figs 9–15). The embankment was



FIG. 4
Site location.

aligned north-east to south-west, broadly parallel to the shore and was part of the long wall of the Great Pent. The eroded remains of the wall were built upon tidal mudflats that had formed behind a shingle bar shown on historic maps and recorded in contemporary accounts (Fig. 2¹⁰). The eroded and truncated remains of the wall measured c.10–12.5 m wide and 2 m high and it was made of rammed layers of shingle, clay and chalk reinforced with two slightly built roundwood structures on the sheltered landward side

and a truncated piled timber revetment towards the more exposed eastern face. A small number of finds were recovered from the embankment including a single sherd of 16th century pottery, medieval roof tile and animal bone. It is likely that these artefacts had been scraped up with nearby harbour mud and shingle, which with rammed chalk, was used to build the embankment.

The deposits used to create the embankment (designated B2) accord with those described by Digges in



FIG. 5

Plan of archaeological investigations undertaken by ASE as part of the Dover Western Dock Revival scheme.



FIG. 6

Photograph of the Navigation Cut during archaeological excavation.

this discourse: the *'newe Baye [Great Pent], [was] to bee made of beach, oaze, and chaulke'*¹¹ and by Reginald Scot in an eyewitness account.¹² The latter document shows that the walls were primarily built of earth and then chalk, which was mixed with some of the earth and beaten to make it firm. The chalk interlaced with earth would form the core of the wall. Sleech (harbour mud) was then smothered on the outside and paddled with 'beetles' (a large, often iron bound, wooden mallet) until it was compacted. This would create a firm base for the timber 'arming' or reinforcements (see below) and would preserve the walls from the wash of the tides. Scot claimed the sleech performed this function almost as well as bundles of thornes and faggots.

The earth used in the construction of the wall was brought from two and a half acres of ground near to Dover Castle, as well as from Horsepool Sole behind St James Church. Each cart brought roughly 12 loads of earth a day to the walls. The chalk was taken from different places along Dover's famous white cliffs. The digging of this material was hazardous, causing rockfalls as the cliffs were undermined, burying some workers. Carts filled with chalk brought about 17 or 18 loads a day and this too could be dangerous, as Scot recalls a worker was run down by a cart. Sleech was obtained for the most part from Little

Paradise (sometimes known as Paradise Pent) in the west of the harbour, but also from close to the sides of the walls¹³ (Fig. 16).

The spreading of sleech was reserved for people from Romney Marsh called 'scaulmen' who were paid 12 pence and were aided by 'beetlemen' who were paid 8 pence to beat and drive the sleech against the sides of the walls and to break the chalk, level the earth and work it together. Many marshmen were also employed to arm the walls with timber and brushwood bundles and these were paid 12 pence or 16 pence a day. Experience on Romney Marsh and the Low Countries had shown that chalk, silt and shingle carefully couched and interlaced would '*singularly bynde*'¹⁴ and become resistant to the sea.

THE 'ARMING' OF THE EMBANKMENT

The long wall encountered at the site was, according to Scot, easier than the crosswall embankment to construct.¹⁵ It was intended to be started first and to be built in one summer. His account mainly deals with the crosswall, possibly as it was overseen by his relative Thomas Scot, however, it describes the 'arming' of the wall or its reinforcement with timber and bavin (brushwood bundles, faggots or fascines).

The order of arming was described as beginning at the foot of the wall where the workers laid down a row of bavin. Through each of these they drove a needle or stake about four foot long. These had an eye or hole at the wider end. The structure was then 'eddered' with thorn and lastly a 'keie' or wooden wedge measuring a foot and a half long was driven through the eye of the needle to keep down the edder, which in turn kept down the faggot. The description¹⁶ bears remarkable similarities to S9/S10 described below and it is probable that the methods used in arming both walls of the Great Pent were essentially the same.

The two elements of S9/10 were clearly built as one unified structure, comprising two lines of relatively small split or ('cleft') oak or needle stakes set c. 0.40 m apart with a pair of small roundwood bundles (bavins) wedged perpendicularly between the uprights, mainly of S10 (Figs 9–11 and 13–15). The roundwood weavers (edders) were found to mainly be hazel and a further third either willow or poplar. Although the latter two are very difficult to separate botanically, it is most likely that local wetland willow was used for the weaving in preference to small poplar roundwood, which is rather brittle. The other weavers were of field maple, members of the apple family such as hawthorn, rowan or apple, a single poorly preserved piece of ash and one larger piece of cherry/blackthorn; a mixture of species suggestive of hedgerow origins. The bavin bundles included willow/poplar, hazel, fruit woods (such as apple/hawthorn/rowan type and cherry/blackthorn), field maple, ash and oak. The top of S9 survived at c. +1.25 m OD, some 0.5 m higher than S10, and is likely to



FIG. 7

Historic photograph showing Wellington Dock and the rear of the Esplanade.

have originally been as high +1.5 m OD and presumably reflects the slope of the original embankment (B2). S9 was constructed after S10 and is likely to have been accompanied by the dumping of the uppermost embankment deposits (G36).

While most of the *in situ* stakes of S10 had suffered erosion, some survived intact and were of a very distinctive form not previously recorded, at least not in South-East England. They resembled large wooden needles with oval holes (c. 16–20 mm wide and 25–50 mm long) near the neatly axe bevelled tops and tapered to an elongated point. The ‘needle stakes’ were likely driven by pairs of workers using heavy mallets (‘beetles’ or ‘mauls’). They anchored the edders over the bavin and stopped the bundles from floating away with the help of wedge-shaped cleft oak battens or ‘keys’ set horizontally through the oval holes located in the tops of the vertical needles (eg needle stake [T124] and anchor peg or key [T138]; Fig. 10). The main function of the bavin was to help stabilise the revetment by trapping silt accumulations, but also aided workers on the foreshore at low tide by providing a firm footing.

The oak needle stakes were a mixture of cleft half poles (c. 90–100 mm wide and 45 mm thick) and radially cleft sections (c. 85–100 mm wide and 40–80 mm thick). The most complete example ([T89]

found loose in silt adjacent to S9); Fig. 17) was a radially cleft 1/16th section (1.29 m long, 85 mm wide and 40 mm thick) with sapwood on the thick edge. Another well-preserved needle stake ([T116] found loose of structure) was a 1/8th section (c. 1.1 m long, 100 mm wide and 80 mm thick) (Fig. 18). The best example of a needle stake made from a cleft half pole ([T128]; Figs 10 and 19) was only c. 90 mm wide and 45 mm thick.

The process of making the needle stakes involved cutting the logs to length, probably with an axe as no sawn tops were found. The selected straight logs would then have been split possibly with a combination of wedges and a combined blade and lever tool or ‘fro’ (also known as dole/dull axe more recently in Kent). The split sections were then lightly trimmed with an axe forming a sharp point at the base and a bevelled top for driving. The oval holes were made by auger in a similar manner to recent Kentish ‘gate hurdle’ end posts. The dimensions of these eyes varied between c. 30–50 mm long and 20–16 mm wide depending on the size of the auger used.

The production of the needle stakes was clearly a large-scale woodland craft made to only approximate dimensions by numerous workers. Slightly later historic sources indicate that these needle stakes were typically made in three lengths: three feet (0.92 m),

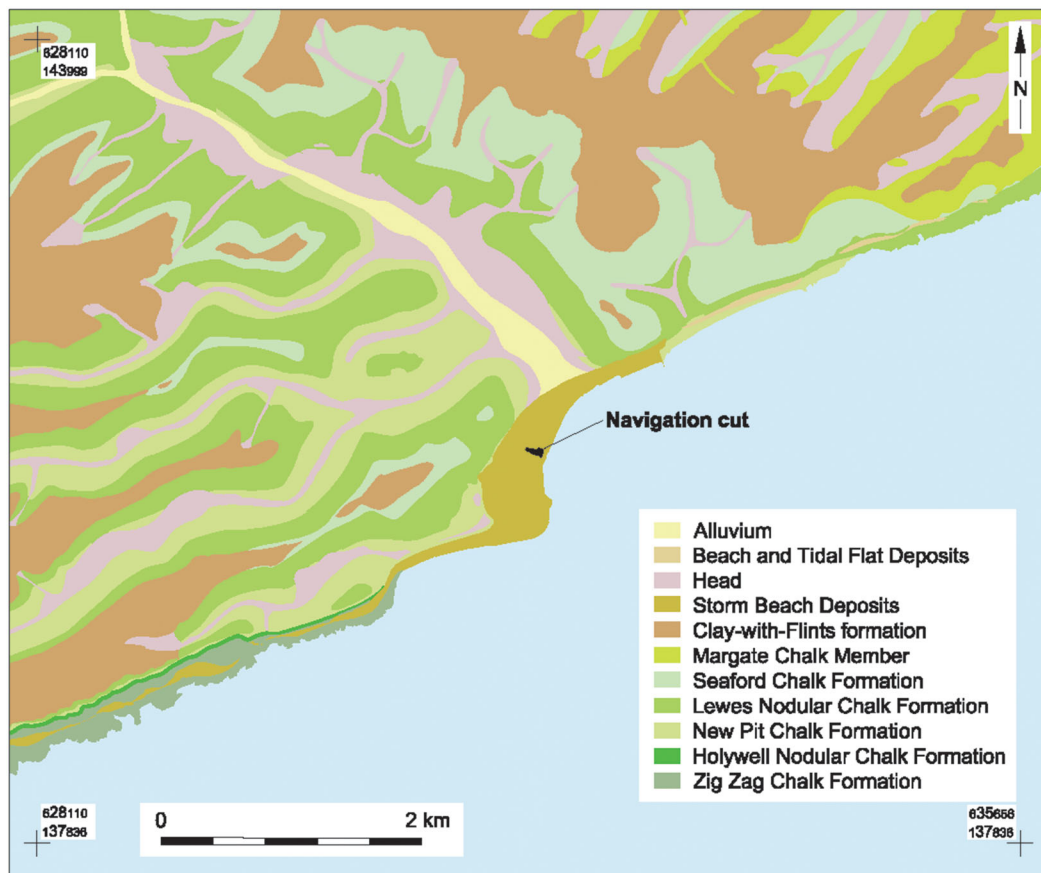


FIG. 8

Map of the geology of Dover (after Geological Map Data BGS © UKRI 2019).

four feet (1.22 m) and five feet (1.53 m) with four feet the most common.¹⁷ The examples from Dover include both lengths of approximate 3 feet and 4 feet, although with the rapid axe cutting of logs some variation is to be expected. Documentary evidence from Romney Marsh suggests that needle stakes used in the construction of seawalls there were sometimes of five or three foot lengths, but most commonly four.¹⁸

The most intact 'bavins' were *c.* 1 m long. The creation of faggot bundles was a woodland and hedgerow industry and utilised the small, less regular coppiced and pollarded stems and small loppings from all types of trees. However, the primary market for faggots was not construction, but as a fuel used domestically and in industries such as brewing and baking.¹⁹ Faggot type bundles of small roundwood, dry shrubby material and other organic matter were used in the building of seawalls and embankments from at least as early as the medieval period until the present in England.²⁰

Despite being a woodland industry, the making of faggots had a degree of standardisation, although the terms and sizes varied over time and from region to region. Nevertheless, it is worth noting that a royal statute was issued in 1542 on behalf of Henry VIII setting the dimensions of a faggot at 3-foot-long and three quarters of a yard in circumference; a size convenient for 'a reasonable man to compass under his arm' (*c.* 0.92 m long by 0.69 m; Rackham 1980, 143; Beck 1995).

This standard Tudor faggot size fits well with the most complete examples from S10 and the spacing of the needle stakes would also allow two 'standard Tudor faggots' to be carried (one under each arm) and set between each pair (Fig. 10). The anchoring effect of the S10 structure would have prevented the faggots from moving or floating away before gathering silt, being covered by more dumped material and becoming waterlogged. Despite their somewhat fragile nature and location at well below contemporary

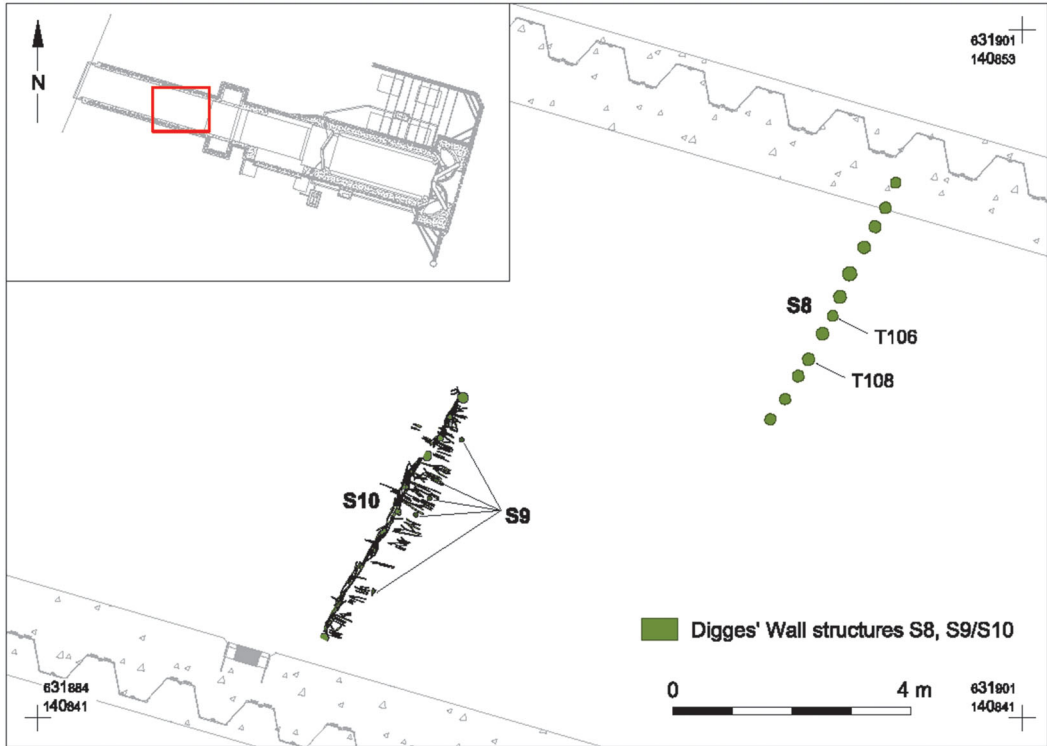


FIG. 9
Plan of Digges' Wall structures S8, S9/S10.

high-water levels, the revetments would have represented a reasonable 'armour' against erosion on the landward side of the Great Pent.

Although compressed and weathered, the overall stem diameters of both the wattle and bavin wood were similar, ranging between 5 mm and 28 mm (wattle) and between 3 mm and 24 mm (bavin). Annual rings were also similar (2–7 rings and 3–11 rings) albeit with some slightly older examples in the bavin roundwood. Many of the bavin stems were knotty, forked or retained twigs and some of the wattle wood exhibited oblique cuts, probably from the small axes or billhooks used to harvest and trim the material *in situ*.

Some 4 m to the seaward of S9/S10 was the decayed but clearly more substantial S8. This comprised 12 medium-sized, squared oak piles visible in the trench; the cross-sectional sizes varied from *c.* 305 mm × 140 mm to *c.* 145 mm × 125 mm and the most complete example was at least 1.9 m long. The relatively high level of the revetment (at *c.* +1.5 m OD) and its situation in somewhat loose dumped embankment material contributed to a considerable amount of decay and few tool marks were visible and

little sapwood survived. Nevertheless, the piles were clearly made from axe hewn and manually sawn box-quartered beams or boxed heart whole, medium-sized logs. While no clear axe marks survived, saw marks, most likely from pit-sawing, the most common method of the period, were evident on piles [T106] (Figs 9 and 20) and [T109] (Fig. 9; Goodburn 2009; Francis 2017). Despite its poor preservation, it is likely that the piles of S8 would have originally stood perhaps 0.5 m higher or more above the highest spring tides (Figs 9–11, 13 and 15).

The close regular spacing and more substantial size of the piles suggests they probably supported a waling beam or a low-planked revetment. The revetment would have helped to anchor the embankment deposits on its eastern seaward side and stop storm-driven sand and shingle entering the Great Pent.

The construction of S8 clearly involved more complex equipment, resources and men than the other two wooden structures (S9/S10). The driving of the S8 piles, up to 1.9 m deep into the embankment, would have required the use of some form of piling rig or 'ingin'. At its simplest, this could have been a tripod suspending a ram of timber and iron operated

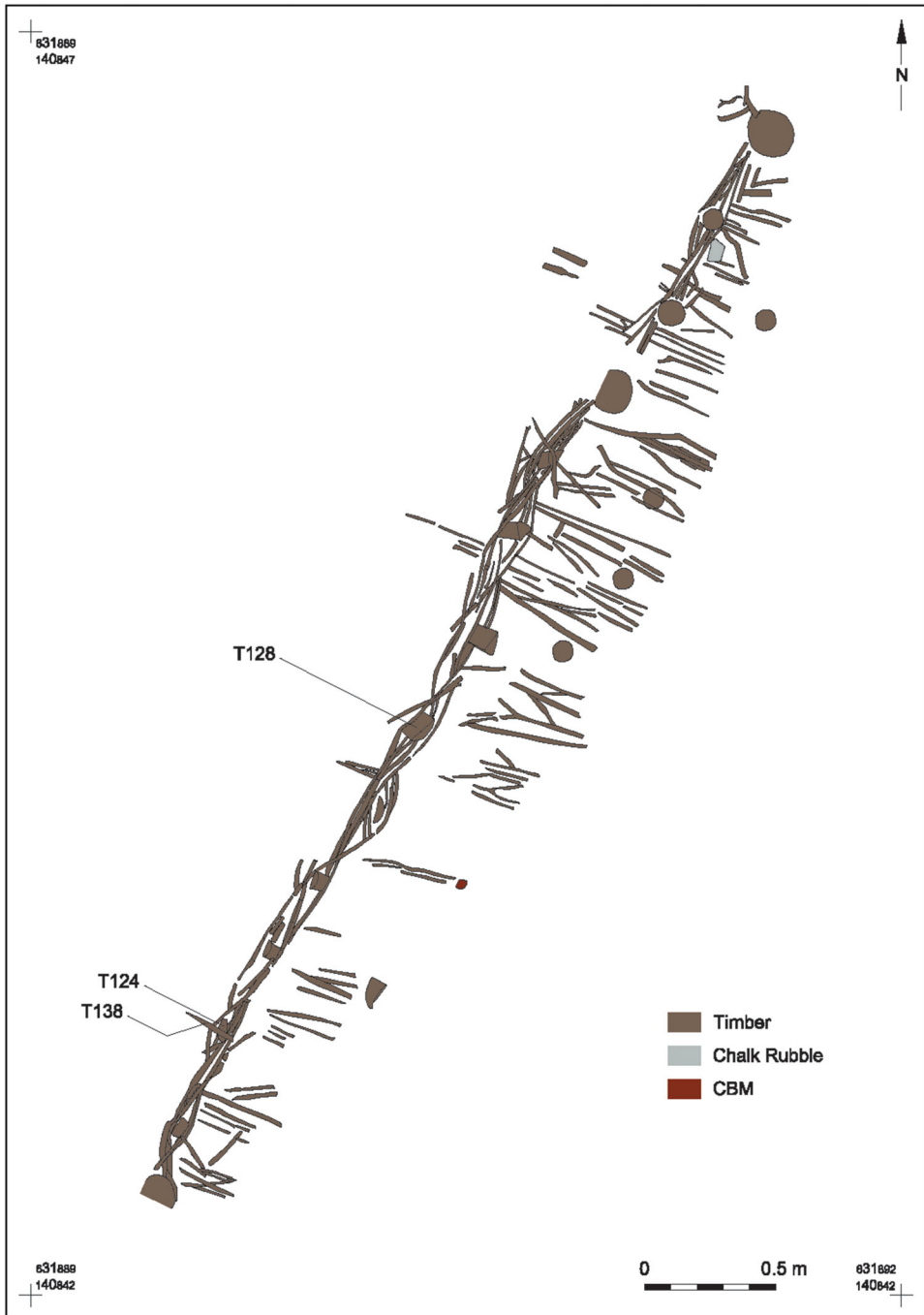


FIG. 10
Detailed plan of S9 and S10.

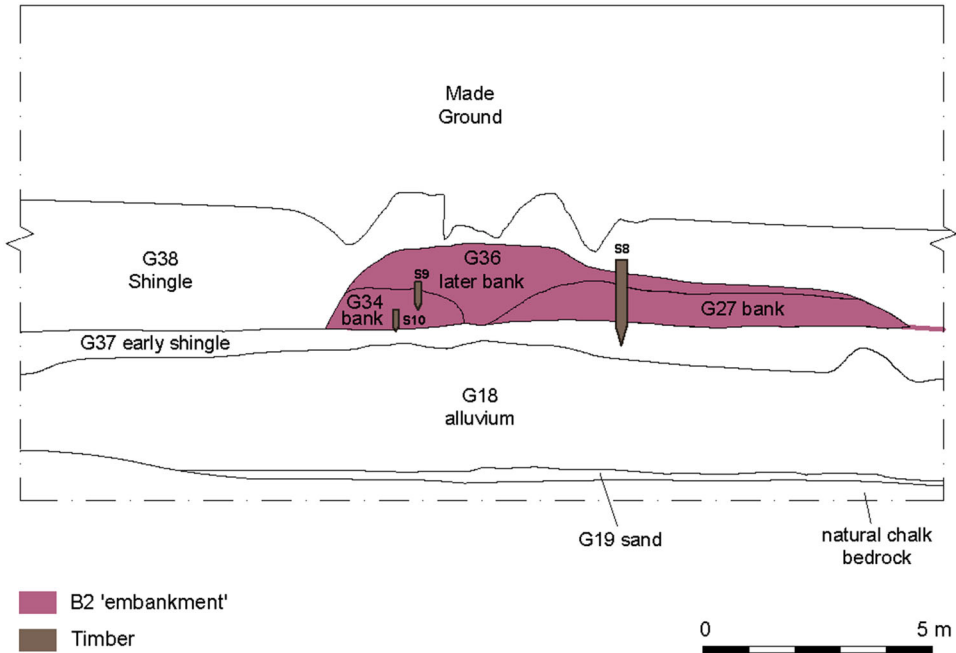


FIG. 11

Phased detail of south facing section of Navigation Cut, showing remains of Digges' Wall embankment (B2).

by a gang of men. The height of the embankment would have probably allowed the operation of this rig in the dry without reference to tides and may have allowed the delivery of materials by cart or barge. S8 was found to be quite different in form compared to S9 and S10 and is likely to be the remains of a piled base of a planked wall.

At the time of its construction the embankment was almost certainly still sheltered from the full force of the sea by a coastal shingle bar shown on the early historic maps located beyond the site to the east (Fig. 2). Thomas Digges in his discourse records this shingle barrier as being 15-foot-high and capable of retaining water.²¹

The choice to build the embankment on back barrier mudflat and beach deposits behind this shingle bar was evidently deliberate, as a shingle bank would not have retained pent-up water as effectively as the predominantly finer grained dumped deposits reinforced with wood. The mudflats and shingle bar may have mirrored the role of saltmarsh 'forelands' to break the energy of extreme tides and waves. This was clearly a commonly known feature by the 14th century as surveys of relevant medieval documentary sources for South-East England show.²²

It is known that by 1583 Digges and Thomas Walsingham (head of the Privy Council) had become reluctant to utilise timber walls due to cost, however,

the presence of this timber pile line (S8) has potential to reflect the continued influence of the master carpenters and shipwrights Pett and Baker as well as the naval officer William Borough who are known from documentary evidence to have been involved with the scheme. Although Digges ideas may have changed by the works commencement, details of his 1581 plans show how he initially proposed to build timber casework.

The other Jutties and, Bayes which I have wished to be made of stoane, all, save the damhed, which muste needes be of stoane, may better chepe and very substantially also be made of piled case work, ramforced with crosse stone, the least a foote thicke without planckes, as at Flusslinge [Vlissinge, Netherlands], may be sene, where thay indure greater rage of sea then at Dover. These piles must be 10 or 12 inches grosse [c. 0.25m – 0.30m], and 25 or 30 fote longe [7.62m – 9.14m], placed on ether side not 6 inches [c. 0.15m] distant one from another at the foote of the Baye, these rancks of piles shalbe a rodd distante [c. 5m], but at the topp, they shall not bee 12 foote [c. 3.65m] at the moste a sunder. They muste be crosse bound bothe with longe beames and crosse beames, and also crosse piled, which kinde of



FIG. 12

Photograph of S9/S10 under excavation facing south.

work the Italians call Palifcata trauata [probably Palificate travi, timber planked palisade]. It is of all other moste care against the vyolence of the sea, and nothinge so chargeable as plancked worke to mayntayne. In every rodd of length on ether side muste bee 12 piles of a foote or somewhat lesse grosse, which, at 30 foote in length will amounte unto about 14 lode of tymber, the said beames and crosse beames, together with the crosse rancks of pile, will require in every rodd ten lodes more, fo will the whole tymber to per- li. forme a rodd of this worke cost at the place about 20l.²³

Timber piles were not, however, unknown in association with the Romney method. Records of the construction of Dymchurch Wall state:

... as the worke shall fall out troublesome to be made as when it is filled with gravell or bache [beach], which they must first cast out to come to a firme foundation before they laye the faggotts, and also when it is hard ground and the needles will not easily drive. The groynes or knocks which defend and preserve this walle are made with pile and stone, every pile being

viii [8] foote at the least in length, some nyne, ten, elevean, twelve and thirteene foot and the longest not above viiii [14] foot, which piles are driven for the most part directlye downe from the topp of the walle into the sea in twoe rancks, some fower foote distance the one rancke from the other, and between the sayd rancks are placed and conveighed the rocks and stones, some of a tonne waight, some more, some lesse, under which stones are laid bushes, rice, and wood about a foote thick to keepe the stones from sinking into the sand. And the sayd rocks or stones are layd level or higher then the topp of the piles, and in the waste or middest of the walle the groynes or knocks are under sett with a lower rancke of shorter piles at either syde, which they calle benching the knocks, the sayd lower piles being driven some twoe foote and a half from the maine groyne or knocke, and stones and rockes also placed between them...²⁴

This passage shows how groynes or knocks defend the wall and are made with 8–14 ft [c. 2.4 m–4.2 m] piles driven down from the top of the wall in two ranks 4 ft [1.2 m] apart; these are then infilled with stone above sticks which prevent them sinking



FIG. 13

Photograph of S8 facing east, showing interlaced chalk, clay and shingle G27/G34/G36 and truncated oak piles.

into the sand. The groynes or knocks are underset with a lower rank of shorter piles driven 2.5 ft [c. 0.75 m] from the main groyne and stones placed between them. It also shows how a piling machine or engine was used in the work:

In driving of which piles aforesaid they use a certain ingine which they calle a ramme ...²⁵

After the completion of the walls, it is known from Reginald Scot's accounts that his cousin Thomas Scot oversaw the heightening of the embankments. Thomas fell sick during this time and his wife died, but the fact that Thomas was named as the 'principal piller' of these works²⁶ indicates that the heightening included pile work likely to be related to S8. Additional evidence that pile lines were part of the final fabric of Digges Wall comes from Reginald Scot who in discussing the events leading up to the completion of the harbour works makes brief mention of 'timber walls'.²⁷ It is possible that S8 is represented on Thomas Digges' 1595 State of Dover Haven, which appears to show timber lining the front and rear of the walls (Fig. 3).

As the timber used in these structures was unsuitable for dendrochronological dating, eight wood samples for C14 radiocarbon dating were taken from S9 and S10, producing a consistent 16th/early 17th century date range (Table 1; Fig. 21). Bayesian modelling results suggests that S10 was constructed between 1520 and 1660 cal AD (95% probability) and that S9 and S10 are likely to have been constructed at the same time (statistically consistent at the 5% significance level; $T=1.0$).²⁸ No suitable dendrochronological or C14 radiocarbon dating samples could be obtained from S8 and this structure can only be very broadly dated to the 16th to 18th century, on the grounds of morphology and the materials used.

DISCUSSION

Through the efforts of the workers and their overseers, on St James' Day 27th July 1583, the long wall and the crosswall met. They were in effect finished, being joined and made above the high-water mark.²⁹ Though the walls would be further heightened (which probably involved the construction of S8) the major



FIG. 14
Photograph of S9 facing east.

components of the project had been completed. The cost of the two walls amounted to 2700 pounds and between the 1st of May and the middle of August 1583 the creation of the permanent backwater pent that many had thought impossible to be done in three years, was completed in just over two months.³⁰

The success of the project was thanks to the effective government of the Privy Council under Elizabeth I, but also the birth of British civil engineering. Trusted experts, such as Digges, acted as advisors and were able to serve as mediators between the crown and those completing the works. But beyond the higher echelons of the scheme, its success was also the result of the skilled and hard work of the ordinary folk of Kent and in particular the people of Romney Marsh who had for generations resisted the claim of the sea. The enthusiasm of the labourers and the rewards of the 'Romney method' is amply captured by Reginald Scot's account:

The poorer people ... labor at a small rate to the preferring and performance of this worke; and all with such forwardnesse and willingness of mind, as the like hath not béene knowne or seene in this age: the beholding whereof would have amazed anie man unacquainted with

Romeneie marsh works from whence the patterne hereof was fetcht.³¹

To Reginald:

there was never worke attempted with more desire, nor proceeded in with more contentment, nor executed with more trauell of workmen, nor diligence of officers, nor provided for with more carefullnesse of commissioners, nor with truer accounts or duer paie, nor contrived with more circumspection of the divisers and undertaken of the worke, nor ended with more commendation or comfort.³²

The success was clearly underpinned by the design, but also the endeavour of the labourers who were aided in their toil by a song to lift their spirits. They did not cease work all day save for bad tides, a break at 11 o'clock and the end of the day (6 o'clock in the evening). The workers often faced dangerous conditions, sometimes being submerged up to their necks whilst working on the walls. For speed, and the thrill of it, carts were also driven through the strongly flowing River Dour. On the flood tide, the channel suddenly swelled and many carts and drivers



FIG. 15
Reconstruction of Digges' Wall (B2).

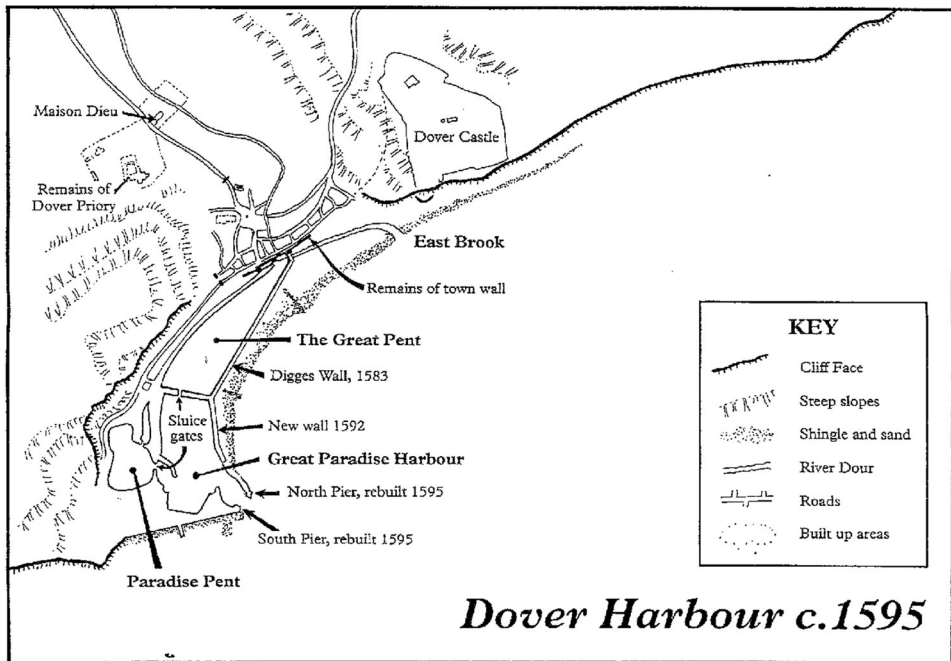


FIG. 16
Dover Harbour c.1595 (Dover Museum; DHB).

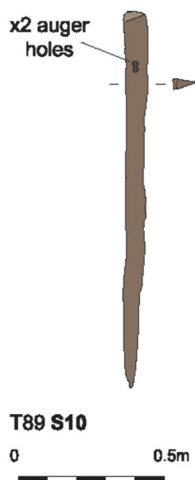


FIG. 17
Detail of [T89] S10.

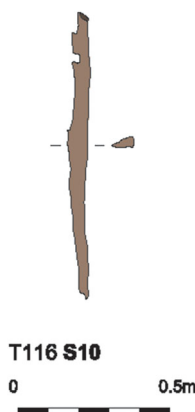


FIG. 18
Detail of [T116] S10.

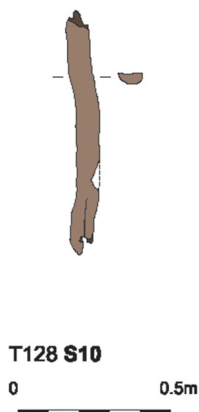


FIG. 19
Detail of [T128] S10.

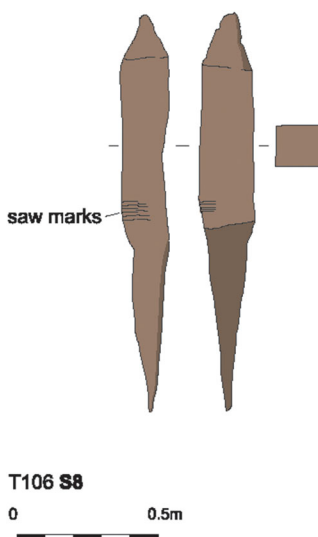


FIG. 20
Detail of [T106] S8.

were overwhelmed and forced to swim. Boys would strip naked and ride their carts through the channel until they were ducked over their head and ears. They knew their horses would swim and carry them through the stream.³³

Despite the dangers, the works were completed much earlier than the most hopeful projections (Fig. 22). The 'longwall' part of which is detailed archaeologically above, measured 120 rods from the Watergate to what was the location of the York

Hotel. It measured 40 feet wide at the top and 70 feet wide at the bottom.³⁴ The quantity of timber and roundwood needed for the task was huge and must have placed demands on the South-East's woodland resources.³⁵ Small and medium sized, straight-grained oaks were used for the cleft needle stakes. As the width of the radially cleft stakes represents just under half the diameter of the oak the 'parent log' can be estimated to c. 180–220 mm to the outside the bark. Some of the half log stakes came from smaller

TABLE 1
Radiocarbon dates from S9 and S10.

Lab code	Sample reference, material and context	Radiocarbon age (BP)	$\delta^{13}\text{C}_{\text{IRMS}}$ (‰)	Calibrated date (2σ)	Highest posterior density interval (95% probability)
SUERC-81982	S10, T127, waterlogged wood (bark): <i>Quercus</i> sp.	349 ± 26	-28.7	1460–1640 cal AD	1500–1640 cal AD (95%)
SUERC-81983	S10, T141/05, waterlogged wood: <i>Quercus</i> sp.	360 ± 26	-27.3	1450–1640 cal AD	1500–1640 cal AD (95%)
SUERC-82795	S10, T139, waterlogged wood: <i>Quercus</i> sp.	259 ± 24	-27.4	1520–1800 cal AD	1520–1580 cal AD (76%) and 1630–1660 cal AD (19%)
SUERC-82799	S10, T151 piece 5, waterlogged roundwood: <i>Acer campestre</i> (field maple)	318 ± 20	-28.4	1490–1650 cal AD	1510–1600 cal AD (84%) and 1610–1650 cal AD (11%)
SUERC-82800	S10, T151 piece 3, waterlogged roundwood: <i>Quercus</i> sp.	306 ± 24	-25.7	1490–1650 cal AD	1510–1600 cal AD (83%) and 1610–1650 cal AD (12%)
SUERC-82801	S10, T129, waterlogged roundwood: <i>Quercus</i> sp.	305 ± 24	-27.4	1490–1650	1510–1600 cal AD (83%) and 1620–1650 cal AD (12%)
SUERC-82802	S10, T141/46, waterlogged roundwood: <i>Populus/salix</i>	311 ± 20	-29.0	1490–1650 cal AD	1510–1590 cal AD (83%) and 1620–1650 cal AD (12%)
SUERC-82803	S9, T121, waterlogged wood: <i>Quercus</i> sp.	286 ± 20	-28.8	1520–1660 cal AD	1510–1580 cal AD (81%) and 1620–1650 cal AD (14%)

elements only *c.* 100 mm diameter and none had more than *c.* 20–30 annual rings. Old or ‘store coppice’ of oak grown for 20–40 years seems to have been the origin of this small, fairly straight timber. A small oak would provide at least two suitable logs with some upper sections of tree just being split in half. As each parent log would produce eight on average, a suitable small oak might produce *c.* 8–20 needle stakes. It should also be noted that the roundwood and stake material was all produced using a simple and light tool kit requiring the effort of only one woodsman, assisted by a carter for transport.

Archaeological analysis of similar small timber assemblages has shown that such material has been used sustainably and in large quantities in the Greater

London region from at least Roman times onward.³⁶ By contrast large quantities of small suitably straight oak trees are now very rare in Kentish woodlands as such material has been replaced by intensively managed sweet chestnut coppice, though some small patches of oak coppice can still be found in areas such as Bromley Woods in north-west Kent. The advantage of chestnut, introduced from southern Europe, is it grows quickly as coppice with much less perishable sapwood and is more easily split.

Oak of a different character was used for the piles found from S8. The timber was derived from trees growing moderately fast which had more branches. They must have grown in an open environment such as open managed woodland or possibly even

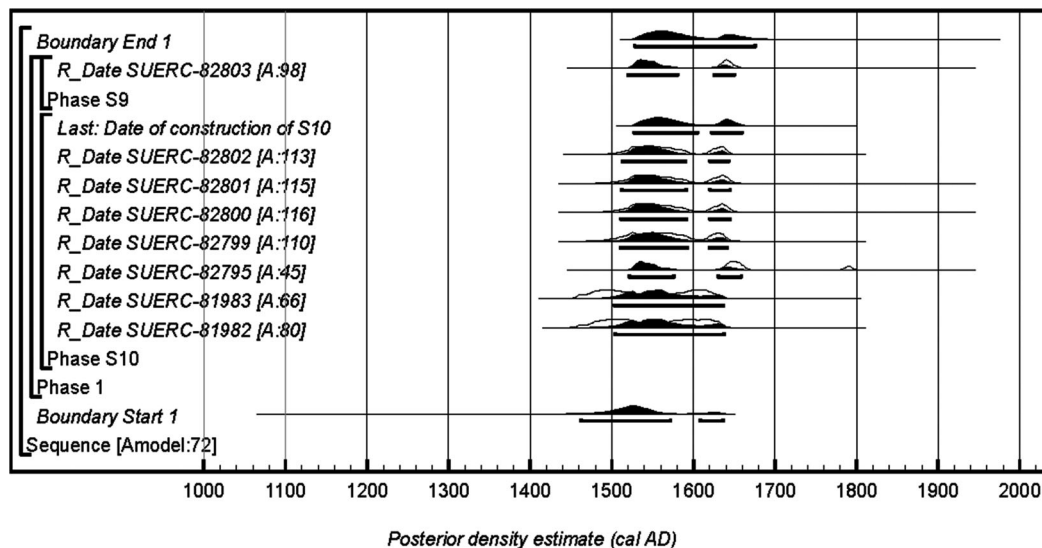


FIG. 21

Probability distributions of dates from S9 and S10 at Dover Western Docks. Each distribution represents the relative probability that an event occurs at a particular time. For each radiocarbon date, two distributions have been plotted: one in outline which is the result of simple radiocarbon calibration, and a solid one based on the chronological model used. The other distributions correspond to aspects of the model. The large square brackets down the left-hand side of the diagram and the OxCal keywords define the overall model exactly.

hedgerows. The diameter of the parent logs used was c. 0.4–0.45 m roughly twice that used for the cleft needle stakes of S9 and S10.

The source of the wood used in the project is possibly recorded in Digges' discourse.³⁷ Of procurement it states that the only timber that existed in Kent which was suitable for the purpose was in the Weald, but that Sussex had the best provision of wood for the work:

But to speede forward the weorke, it were convenient that before the felling season passe away, The commysioners meete to geve order that there bee provysion made for tymber, aswell for pile as planke, which muste in diverse partes of the woorke bee used. Allso for tunbotes especiall care muste be had of very choice tymber to make the caike boordes, and then muste they bee very well seasoned, for if those tooons leake, and receive water, thaye are utterlye unprofytable. There is litle tymber in Kent to be found for this purpose, excepte in the weald, but in Sussex I thinke will beste provysyon be made.

CONCLUSION

The Tudor construction of the Great Pent comprised one of the largest and most complex engineering projects of early post-medieval England. The construction of Digges Wall set the precedent for the modern harbour that still comprises one of the busiest passenger ports in the world. The wall and the resultant pent forms the basis of Dover Western Docks, its fabric and internal layout. The knowledge of coastal communities from the east of England and the Low Countries was key to managing the dynamic environment of the English Channel and the North Sea. Along with the expertise of early pioneering engineers, and the strength of a centralized government under Elizabeth I, these communities ensured the success of Dover harbour. The archaeological work presented here is just part of the story of the port's development, albeit the most significant. Later waterfronts, sea defences and installations were also encountered dating from the mid-17th century to late post-medieval and modern periods. All of these are detailed in a forthcoming monograph.³⁸

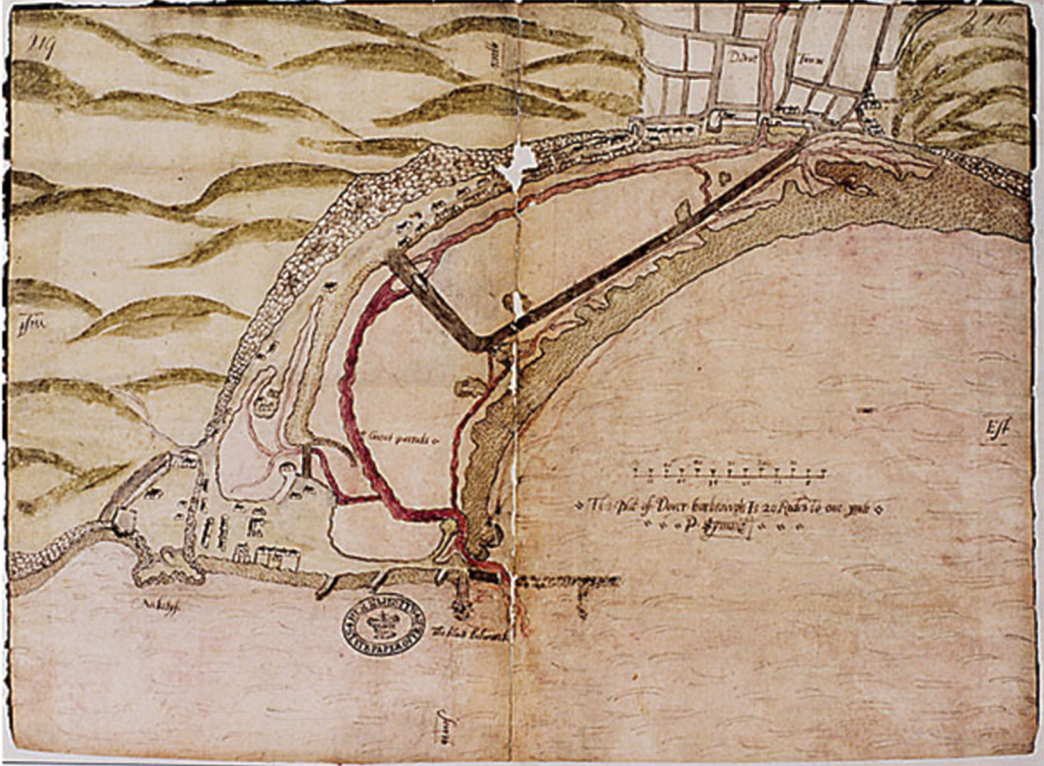


FIG. 22

Dover Harbour c.1584, thought to be drawn by John Symonds (British Library; MPF 1/122).

ACKNOWLEDGEMENTS

Archaeology South-East and Damian Goodburn would like to thank Dover Harbour Board and Vic Cooper of Royal HaskoningDHV UK Ltd for commissioning and facilitating the work. Thanks are also due to the members of the Heritage Steering Group for their guidance and monitoring (Jane Corcoran and Peter Kendall, Historic England; Liz Dyson; Ben Found and Simon Mason, Heritage Conservation Group Kent County Council); Ian Tyers (Dendrochronological Consultancy) and Martin Bridge (Oxford Dendrochronology Laboratory) for the dendrochronological advice; SUERC laboratory for the radiocarbon dating and Martin Bates for his geoarchaeological expertise. The fieldwork was supervised by Giles Dawkes, Geoff Morley and Kristina Krawiec with specialist on-site support from Damian Goodburn. Survey was undertaken by Vas Tsamis and geoarchaeological work by Alice Dowsett and Kristina Krawiec. Alice Dowsett completed chronological modelling

of the S9 and S10 radiocarbon dates using OxCal 4.4 and the internationally agreed calibration curve for the northern hemisphere (IntCal20). The project was managed in the field by Jon Sygrave and in post-excavation by Andy Margetts and Jim Stevenson. Lauren Gibson produced the illustrations including the reconstruction drawing. The analysis and publication was managed by Andy Margetts. Louise Rayner edited the draft prior to submission.

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<i>The Society of Antiquaries of London</i> SAL/MS/36	Digges Discourse on Dover Harbour (AD 1582)

The site archive including the finds is currently housed at the offices of Archaeology South-East and is awaiting deposition at Dover Museum.

This paper is published with financial assistance from Archaeology South-East Project 170148.

ABBREVIATIONS

ASE	Archaeology South-East
DHB	Dover Harbour Board
HRO	Harbour Revision Order
SUERC	Scottish Universities Environment Research Centre
UCL	University College London
UK	United Kingdom

NOTES

- ¹ (Ash 2004).
- ² (Martin and Parker 1999).
- ³ (Hasenson 1980, 28; Biddle and Summerson 1982, 757–759).
- ⁴ As demonstrated by medievalandtudorships.org/ database.
- ⁵ (Mate 2006, 89, 94, 98–99).
- ⁶ Some of the previous attempts are well illustrated by Minet (1922) and Macdonald (1937).
- ⁷ SAL/MS/36.
- ⁸ *Chron Eng.* 1587.
- ⁹ (Bates et al. 2011; Margetts et al. forthcoming).
- ¹⁰ SAL/MS/36.
- ¹¹ SAL/MS/36.
- ¹² *Chron Eng.* 1587.
- ¹³ *Chron Eng.* 1587.
- ¹⁴ SAL/MS/36.
- ¹⁵ *Chron Eng.* 1587.
- ¹⁶ *Chron Eng.* 1587, 863–864.
- ¹⁷ (Beck 1995, 164).
- ¹⁸ (Beck 1995, 166).
- ¹⁹ (Rackham 1980, 142–143; Galloway et al 1996).
- ²⁰ (Rackham 1980, 143; Tabor 1994, 110–111; Galloway 2009, 179).
- ²¹ SAL/MS/36.
- ²² (Galloway 2009).
- ²³ SAL/MS/36.
- ²⁴ (Beck 1995, 166–167).
- ²⁵ (Beck 1995, 167).
- ²⁶ *Chron Eng.* 1587, 866.
- ²⁷ *Chron Eng.* 1587, 867.
- ²⁸ (Ward and Wilson 1978).
- ²⁹ *Chron Eng.* 1587, 866.
- ³⁰ *Chron Eng.* 1587, 866–867.
- ³¹ *Chron Eng.* 1587, 857.
- ³² *Chron Eng.* 1587, 856.
- ³³ *Chron Eng.* 1587.
- ³⁴ (*Chron Eng.* 1587, 866; Batcheller 1828, 288).
- ³⁵ (Margetts et al. forthcoming).

³⁶ (Goodburn 2000).

³⁷ SAL/MS/36.

³⁸ (Margetts et al. forthcoming).

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