Marine Salt Extraction: The Excavation of Salterns at Wainfleet St Mary, Lincolnshire

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THE EXCAVATIONS have shown how documented procedures of marine salt extraction were applied in practice in the later 15th and early 16th century on the Wash coast between Wainfleet and Wrangle.

The Central Archaeology Service of English Heritage was asked to undertake excavations at the site of a series of earthworks (Pl. XI), presumed to be the remains of medieval salterns, located at TF 495 574 in the parish of Wainfleet St Mary. The earthworks, which lie between 2.5 m and 5.3 m OD, consist of rows of long, mostly parallel, banks or mounds and are a Scheduled Ancient Monument. The excavations were occasioned by an application for a change in land use in one area from pasture to arable. This section contained few extant mounds and it was decided that this was an opportunity to examine the underlying features whilst retaining the better preserved earthworks immediately to the S. Excavation took place from February until April 1984 with a team of ten people under the direction of the author.

This report is primarily an analysis and presentation of the procedure of the industry. It is not intended to demonstrate the relationship of the saltworkers and their product to their political, social and economic circumstances. The archive, together with the finds, is held in Lincoln City and County Museum and a microfiche copy is available from the National Archaeological Record.[2]

LANDSCAPE AND ENVIRONMENT

The earthworks are sited upon a narrow strip of relatively higher ground, the 'toftland', between Wainfleet to Wrangle, a distance of *c.* 10 km. On its W. side are the 'Low Grounds' and the East Fen and to the E. is land reclaimed from the gently sloping shoreline of the Wash.

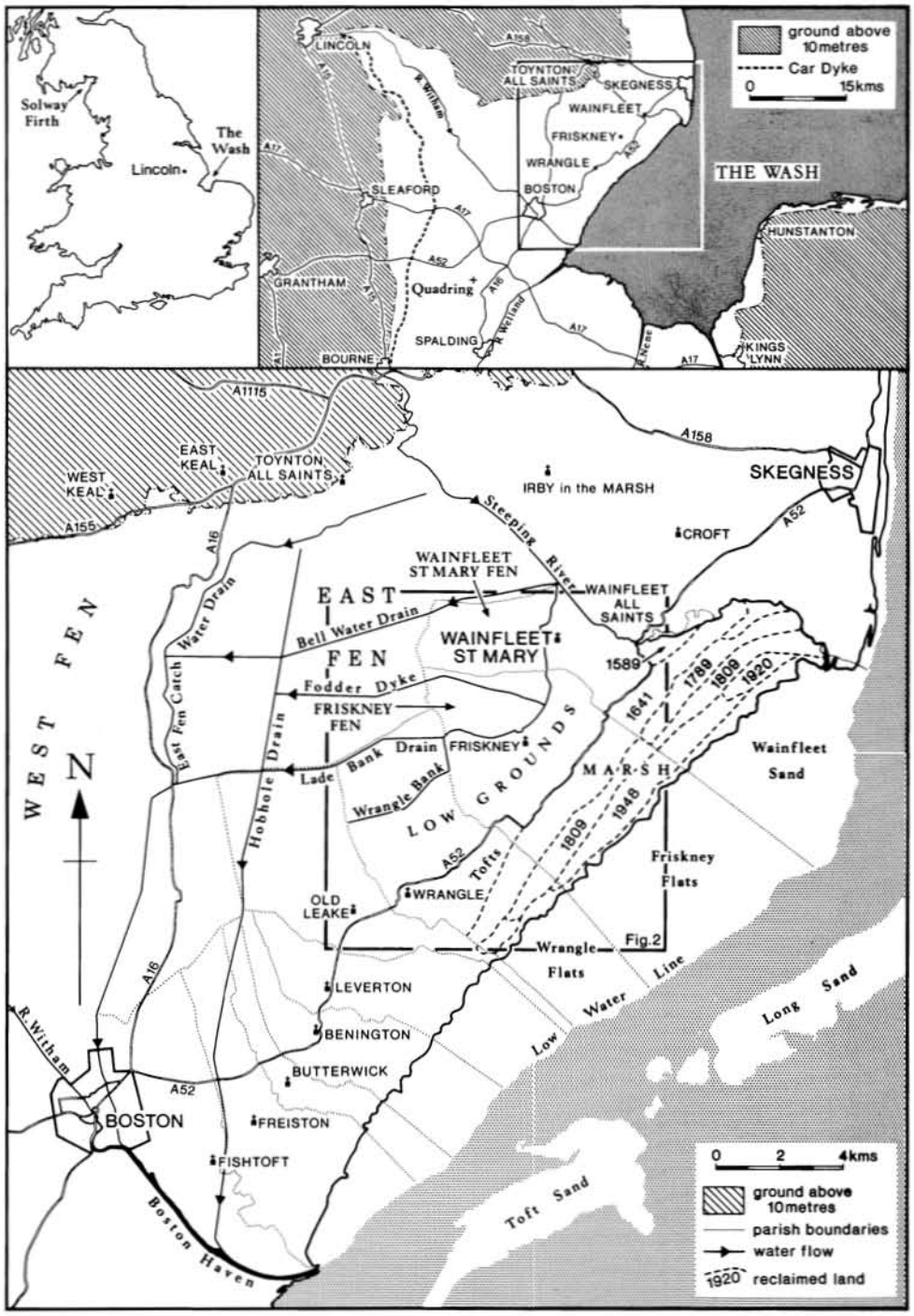


FIG. 1

Location map and major landscape components

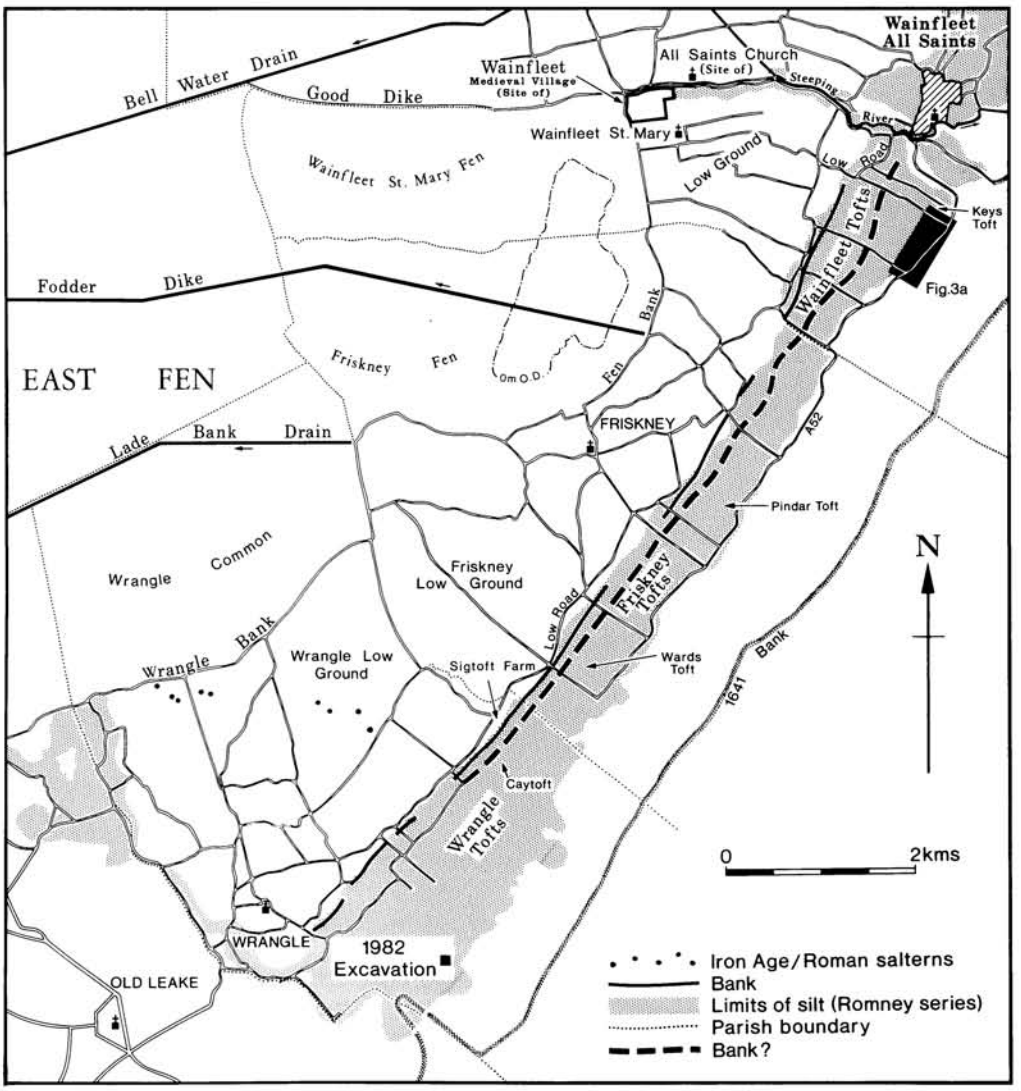


FIG. 2

Site location (Fig. 3a) and the area between Wainfleet and Wrangle

The landscape components are illustrated on Figs. 1 and 2. The sandbanks, islands and channels in the Wash, e.g. Long Sand and Toft Sand, are present day examples of the features which may have originally formed the base for the toftland.[3]

These offshore features were utilized by salters, presumably on a seasonal basis, in the Iron Age and Roman periods, when the coastline lay near the Car Dyke and the higher limestone and chalk to the W.[4] The waste from their activities, possibly combined with salt marsh growth, would have gradually raised the ground levels to a point where permanent occupation became viable.

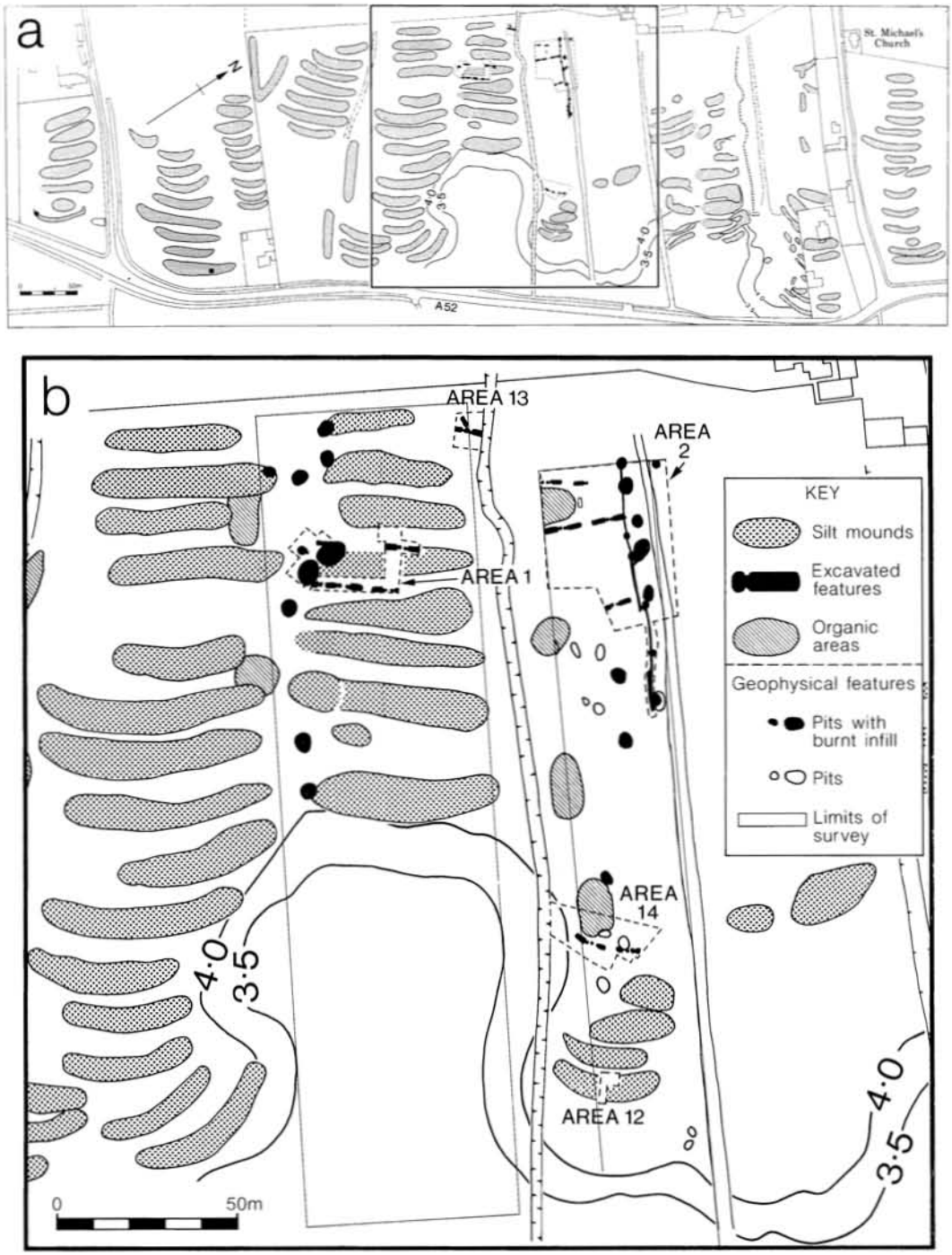


FIG. 3

(a) General plan of features within the study area. (b) Plan showing areas of geophysical survey and excavation

This occupation is noted in Domesday[5] and the recorded place names reflect the dominance of water in the environment. Wainfleet is derived from *Wegn fleot*, a stream that can be crossed by a wagon, Friskney from *Frescan ea*, a river with fresh water, and Wrangle from *Werangle*, bent or crooked, again referring to a stream.[6] It has not been possible, as yet, to trace Saxon saltworking activity but the industry was certainly in operation at the time of Domesday. Eleven salterns are mentioned specifically in Wainfleet and a further twenty are associated with Wainfleet and four other villages, Haugh, Calesby, Teddlethorpe and Mablethorpe.

Effective water management was a precondition to the establishment of permanent settlement. This was accomplished by the erection of the Wrangle and Fen Banks to control the Fen floodwaters and the construction of a sea bank between Wrangle and Wainfleet. This bank is shown on Fig. 2 and lay just E. of the Low Road. Its line coincides with the western limits of a distinctive band of silts, generally 0.7 km wide, mapped by the Soil Survey of England and Wales.[7] This silt is the disposable waste product of the extraction industry — essentially mud from which salt has been filtered out — and would once have been heaped into mounds, almost all of which have now been levelled.

The area of this study lies on the E. limit of the silts and is shown on Fig. 3. The extant silt mounds do not extend seawards beyond the line of the A52 road so that this section provides physical evidence for the operations of the extraction industry up to, and including, its cessation. Reclamation and subsequent pastoral land use have effectively 'fossilized' the remains of this long-lived activity.

The plan of an extant mound is a facsimile of the arrangement of the underlying filtration units from which it was derived (Pl. XII, A) and one of the most striking aspects of these earthworks is the asymmetrical nature of their final disposition. Some of the rows of mounds continued further seawards than others and these are generally smaller and convex in plan, suggesting a spatial constriction.

Salt extraction was taking place within the upper tidal zones where height was critical in order to alleviate the risk of flooding. For this reason the salters were very closely tied to the development of salt marsh which could have been *c.* 0.4 m above the surrounding mud flats.

Salt marsh formation is dependent upon local circumstances, but growth is not unlimited and may become stationary at a certain distance from 'dryland' or a seabank.[8] In effect the arrangement of the mounds shown on Fig. 3 indicates the limits of this salt marsh growth. This may well have had a sharply defined edge,[9] now concealed beneath the final spreads of silt from the industry. The mounds which continued seawards would have been located on narrow 'promontories' of marsh, bounded by tidal creeks, which were developing out onto the mud flats. Sediments deposited during overflow around and at the heads of the creeks would have led to this natural characteristic formation.[10]

The salters, having reached the general limit of the salt marsh, would have had to confine their activities to the 'promontories' and this resulted in the changes to the layout of the lines of filtration units and their associated mounds.

A example of salt marsh development is shown in Fig. 4. which depicts the foreshore beyond the 1978 seabank. The significant features to note are: the

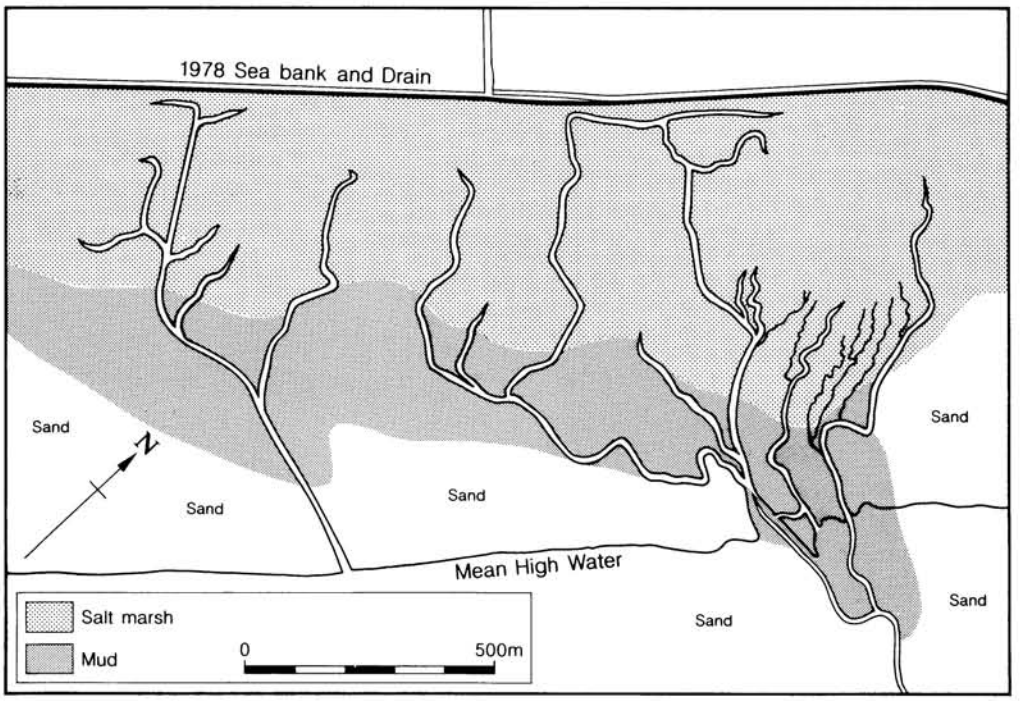


FIG. 4
Example of salt marsh development

dendritic nature of the creek system; the landward gradation from sand — through mud — to salt marsh and the position of the tidal levels. All these inter-related elements would have been present within the study area but it is not practical to attempt their exact location.

SALT EXTRACTION PROCEDURES

This section contains extracts from documentary accounts, followed by a description of the corresponding features found during the excavation. The accounts used are by: William Brownrigg,[11] who provided an overview of salt production published in 1748 and Henry Duncan,[12] who gave a description of salt extraction in the Solway Firth in 1812.

Collecting the raw material

'The sand from which they prepare the brine ... is collected on flat sandy shores on those parts which are only covered in the high tides ... before and after the full and new moon. This sand they collect ... when the sea has been exhaled from it by the sun ... and they rake it into heaps, to the depth of two or three inches and convey it to their works in carts; laying it up in a large heap' (Brownrigg).

At Wainfleet the gently sloping shore and extensive mud and sand flats would have been provided ideal conditions for natural evaporation and subsequent collection.

Filtering the sand and concentrating the brine

'A pit is next prepared, about 18 feet long, 4 feet broad and 2 feet deep, which is lined with clay. In the bottom of this pit is placed a layer of peats . . . covered over with turfs and the pit is filled with the collected sleech to form a kind of basin. The basin is filled with water which . . . pervades the mass, and oozing through the filter of turf, carries with it the solution of salt. Having reached the clayed bottom, it finds channels formed . . . by the peats, and, running along the clay, issues from a spout into a reservoir . . . the strength of the brine is tried from time by floating an egg. When three quarters of the egg are found to be covered by the brine the filtering is stopped and [the brine] is carried in pails to the salt-pans' (Duncan).

Twenty four of these 'filtration units' were recorded but only two were fully excavated. Filtration unit 27 (Fig. 5) in Area 1 was a typical example. At one end was a filter bed set in a shallow rectangular pit lined with blue clay (Pl. XII, B). A layer of 'turves' was placed upon the clay lining of the filter bed and a 'box' or timber frame was positioned over the turves. The presence of this frame was suggested by distinct

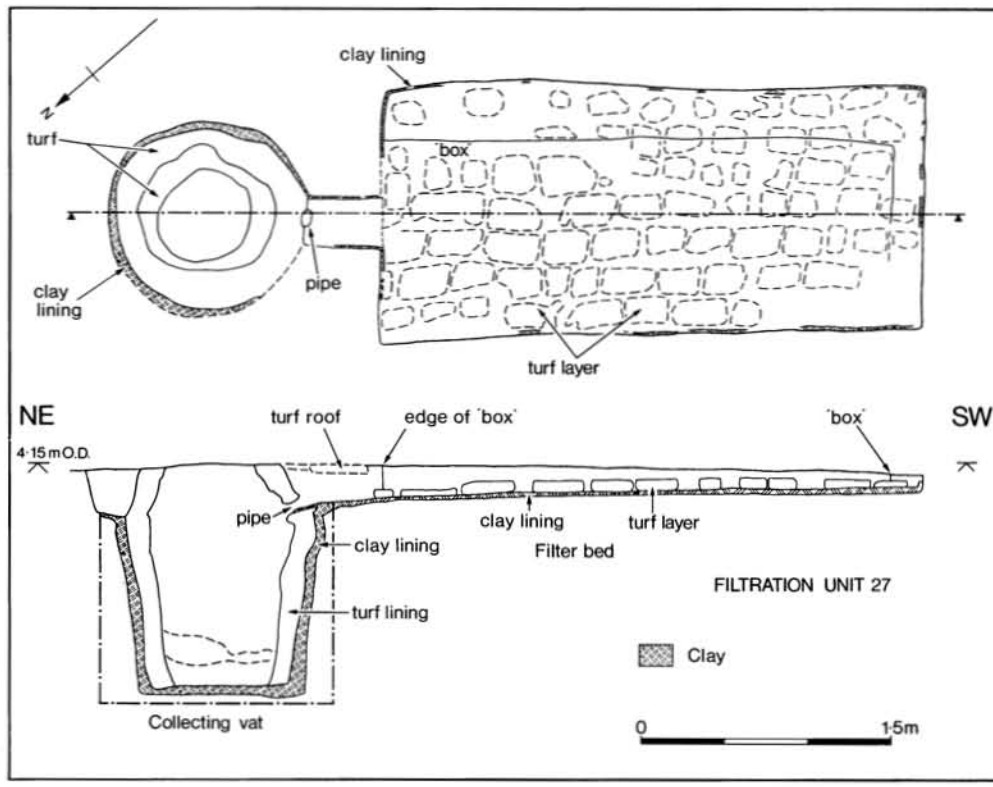


FIG. 5
Filtration unit (27, Area 1)

differences within the silt layer above the turves. The inner fill, presumably the last mud to be processed, was more compact, slightly darker and had a higher clay content.

Indications of frames were recognized in nearly all of the filter beds. They would, presumably, have stopped the silt from flowing into the collecting vat and would have allowed more mud to be processed whilst avoiding having to increase the depth of the filter bed.

The bottom of the filter bed sloped slightly down towards a clay lined channel which was roofed over with 'turf' to keep out rainwater. The channel led, via a pipe, to a collecting vat which had an outer lining of blue clay and an inner reinforcing wall of 'turves'. This wall continued, as a cone, above the clay lining to form a smaller circular opening which would presumably have had a wooden cover.

The average measurements for the filtration units were: overall length 4.8 m; individual filter beds — 3.42 m long, 1.42 m wide and 0.28 m deep; collecting vats — either circular, external surface diameter 0.81 m, or oval, 0.89 x 0.81 m, and 1.24 m deep. There were approximately 80 turves within each filter bed.

Collecting sea water for filtering the sand

'Not far distant from the saltern, on the sea-shore, between full sea and low water marks, they also make a little pond in the rocks, or the stones on the sand, which they call their sump. From this pond they lay a pipe through which, when the tide is in, the sea water runs into a well adjoining to the saltern' (Brownrigg).

Ten of these wells or sumps were identified in the excavation. They were circular clay-lined pits with regular sloping sides and flat bottoms. The average dimensions were: surface diameter, 2.18 m (external), 1.8 m (internal); depth, 1.24 m. The lining had been built up in blocks around the sides of the pits, giving a laminated appearance, but the pit bottoms were unlined. This would have allowed fresh/brackish groundwater to mix with the seawater collected within the well, affecting the type of salt produced.

On the W., landward, side of the pits were retaining walls of 'turves' (Fig. 9, Section 4). These were of one build with the clay lining and would have been necessary to prevent silt associated with earlier processing from spilling into the pit. Both turf walls and clay linings were sometimes reinforced with thin branches of oak.

The pits were served by pipes built of turf and clay, set in deep channels, (Fig. 6; Pl. XII, B) which entered the pit linings on the seaward side. The pipes themselves were usually horseshoe-shaped, *c.* 0.25 m wide and 0.12 m high. The excavated examples had been laid at a depth of *c.* 2 m OD, well below the inter-tidal levels beyond the edge of the salt marsh.

Boiling the brine

'The brine being thus prepared they boil it with turf fires in small leaden pans' (Brownrigg).

'These pans . . . made of lead . . . are placed on bricks about 20 inches from the ground . . . to admit a line of peats beneath them. The pans are commonly about 4 feet long, 3 feet broad and 5 inches deep' (Duncan).

Lead offcuts, presumably associated with the pans, were found in layers of burning which must have been derived from the boiling hearths. Only one possible hearth (611, Fig. 10) was recorded in the excavation. It was a shallow rectangular scoop, 0.2 m deep, 2.6 m long and 1.1 m wide, aligned E./W. at right angles to a line of filter beds. Within the hearth was a rectangular 'brick' of fired silty clay which may have been an *in situ* stand for a lead pan. These soft silt bricks occurred in fragments throughout the burnt deposits found in and around the clay-lined pits.

A large area of organic soil (521) was found next to the hearth. It was roughly circular, 10 m diameter and 0.2 m deep and was discovered to be a fen peat[13] which may have been the remnant of the fuel supply.

Raw materials

The clays used as linings in the filter beds and collecting vats could have been found in the Low Grounds to the west and the copious amounts of peat required would have been available in the nearby Fen. The 'turves' used in the filter beds, the reinforcement for the collecting vats and the retaining walls of the clay-lined pits were formed from estuarine silts and clays and may have come from the foreshore on the seaward side of the salterns.[14] All the materials used, apart from the lead for the boiling pans, were therefore available locally.

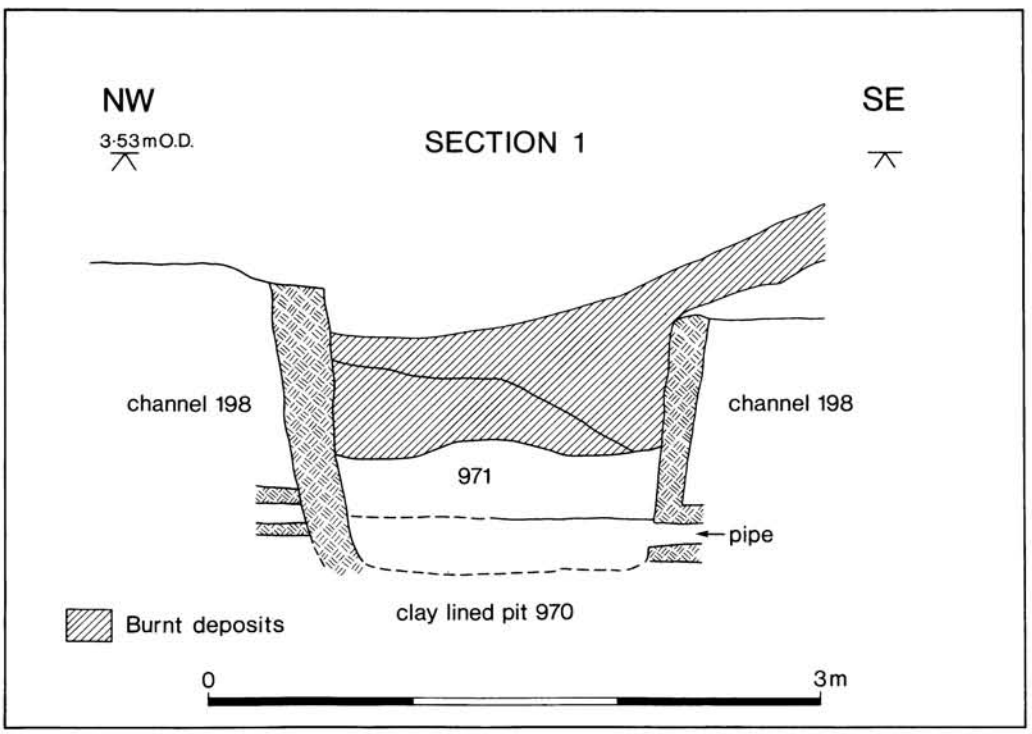


FIG. 6
Clay-lined pit with channel and pipes (970, Area 2)

THE EXCAVATIONS

A magnetometer survey was carried out by the Ancient Monuments Laboratory[15] and the results are shown on Fig. 3. The survey identified two categories of anomalies, one interpretated as possible furnaces/kilns and the other as pits. Excavation showed that both types were clay-lined pits and that the initial furnace interpretations were due to concentrations of burnt material in some of the upper pit fills.

Area 13 (Fig. 7).

This was the most westerly area investigated and was the only location where two phases of filtration units were uncovered. The earliest units, 77 and 78, were identifiable at *c.* 3.68 m OD and were cut through a series of very compact silts and clays, probably tidal deposits. The positioning of unit 78, the only example which does not fit into a linear arrangement, probably reflected a maximizing of space at the end of a row of filtration units, where there may have been a constraint caused by a nearby creek.

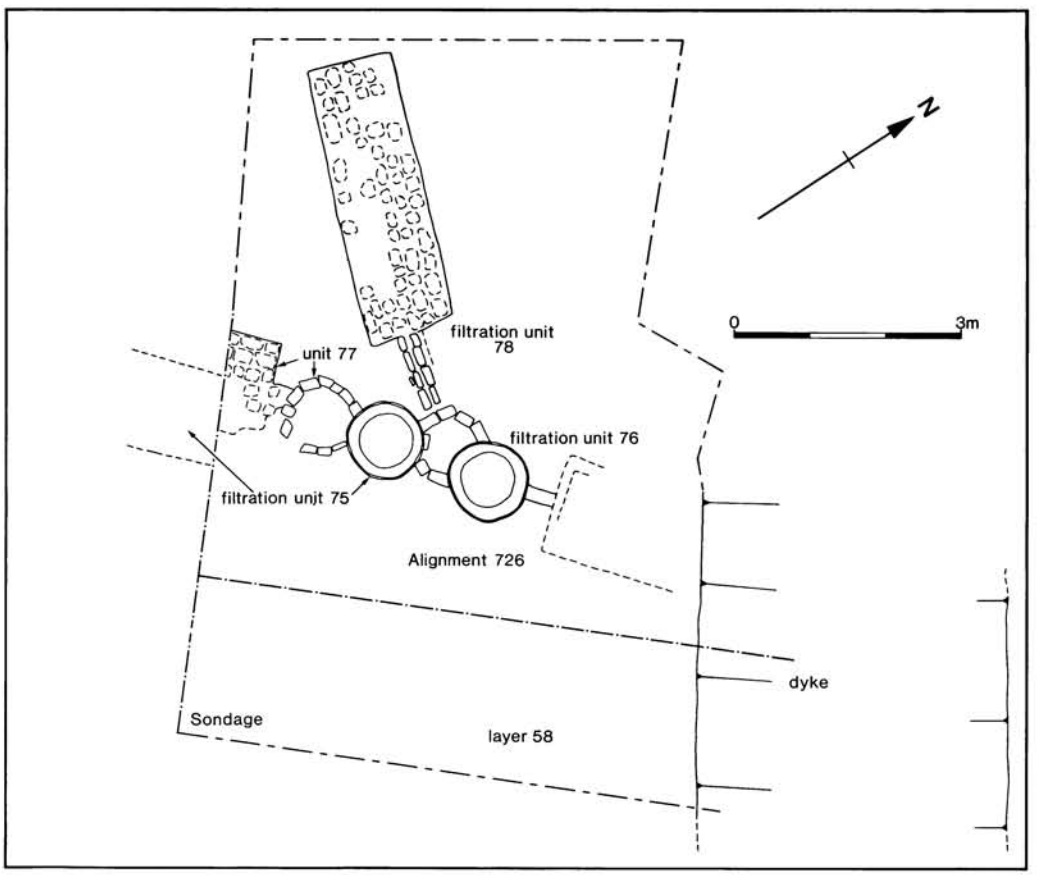


FIG. 7
Plan of Area 13

The tidal layers were removed in a sondage and proved to be above some thin spreads of silt (58) which were the earliest deposits encountered during the excavations. They contained a number of small, abraded, Toynton ware sherds and a single sherd of Langerwehe/Raeren stoneware datable to the mid to late 15th/early 16th century (see below).

The earlier units lay beneath a thick layer of silt which was, in turn, cut by filtration units 75 and 76, part of alignment 726. This has the same orientation as alignments 210 and 211 in Area 1 and alignment 727 in Area 2.

Area 1 (Figs. 8, 9)

This area was initially laid out to examine two possible furnaces shown on the geophysical survey but was subsequently extended.

The plan (Fig. 8) shows that the filtration units were laid out in precise, parallel lines, 10 m apart. Individual units were usually arranged in pairs, with the brine collecting vats in adjacent positions for ease of access. The units in both lines were constructed at the same level, *c.* 4.15 m OD, demonstrating the critical attention given to height.

A mound, as seen today, was formed in two stages, illustrated in Fig. 9, Section 3. The westerly line of filtration units, 211, were cut into to the top of a broad platform formed by layers 57 and 802. These were salt-denuded silts cast forward during processing in the filtration units which would have been located immediately to the W. This platform would have afforded additional protection from the higher tides.

Seawater was collected, via pipes, in clay-lined pits for use in the filtration units of line 211. One example, pit 51, was excavated and was shown to have been constructed from the salt marsh surface (*c.* 3.2 m OD) and cut into the front of the platform. The retaining wall of turf associated with this pit is not illustrated.

The residues from initial processing in line 211 were thrown seawards to form a new platform (Fig. 9, Section 3, layers 803–806) which were cut, in turn, by the filtration units of line 210. The residues from later processing in line 210 (Fig. 9, Section 3, layers 56 and 801) would then have been piled up behind the units to create the visible mound. The clay-lined pit, 51, associated with line 211, was infilled during the course of the move seawards with layers of silt and burnt debris from the boiling hearths (Fig. 9, Section 2). These layers contained lead off-cuts, some derived from window-leading (see below), which were presumably associated with manufacture or repair of the boiling pans. One of the silt infills (55) contained a sherd (Fig. 12, no. 7) of 15th- or possibly 16th-century date.

Area 2 (Figs. 9–11)

This was designed to investigate a region of general activity identified by the magnetometer survey with the aim of locating hearths and any associated structures. A problem encountered throughout the excavations, but particularly severe in this area, was the enormous amount of silt which had to be removed in order to expose contemporary features which were cut from very different levels. This has resulted in only partial recovery of the distribution of salt extraction features.

The principal results of excavation in this area were the disclosure of evidence for the organization of the industry: — in particular the clay-lined pits and their associated channels; and the recovery of datable material.

Four successive channels were recorded, each displaced slightly to the N. of its predecessor. The first (from W. to E.) was 198, and this was traced for 23 m; the second, 965, for 15 m, the third, 527, for 26 m and the last, 905, for 4 m.

The associated clay-lined pits had an average separation, centre to centre, of 13–14 m. Pre-existing channels were either cut into by clay-lined pits, as in pit 970 (Fig. 6) or diverted to supply seawater to a pit dug slightly off the line e.g. channel 438 and pit 439.

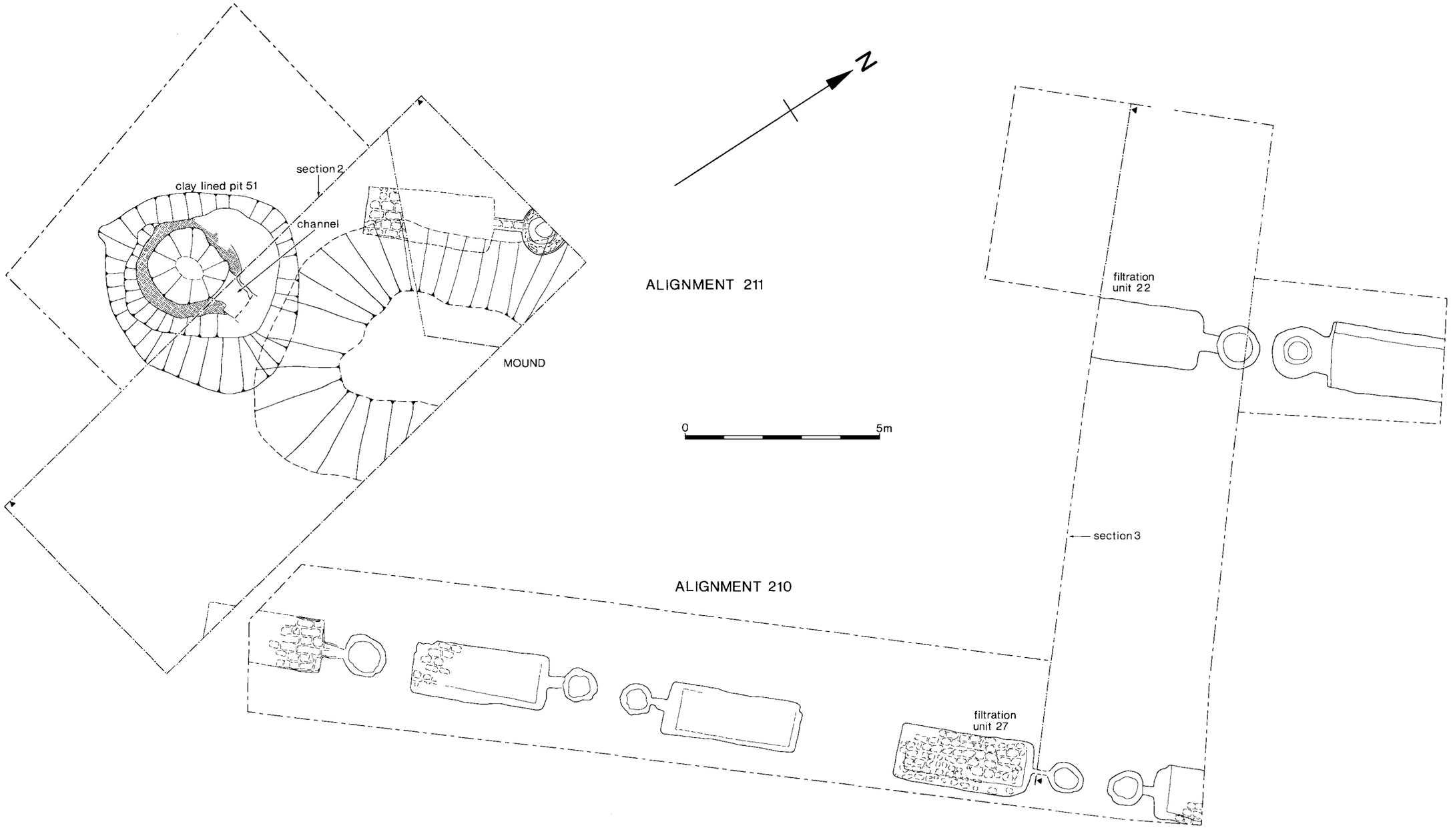
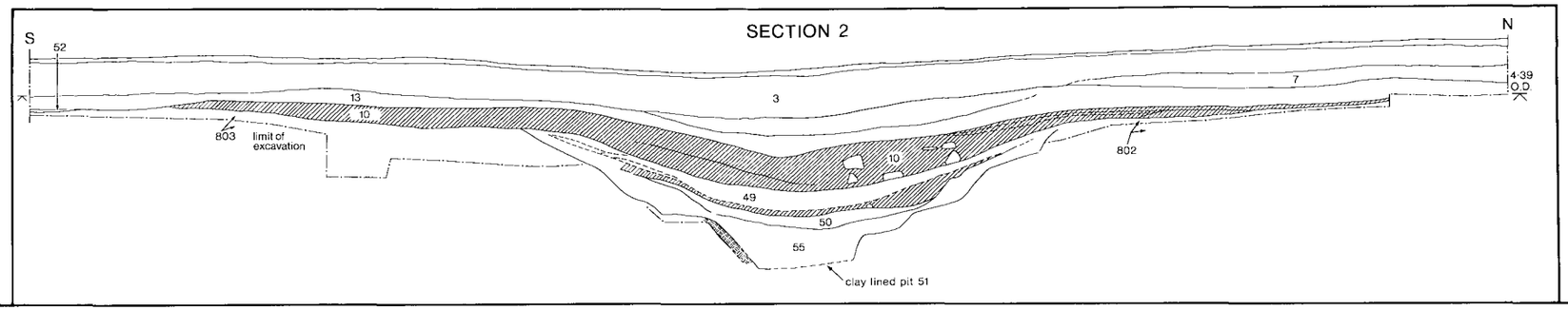
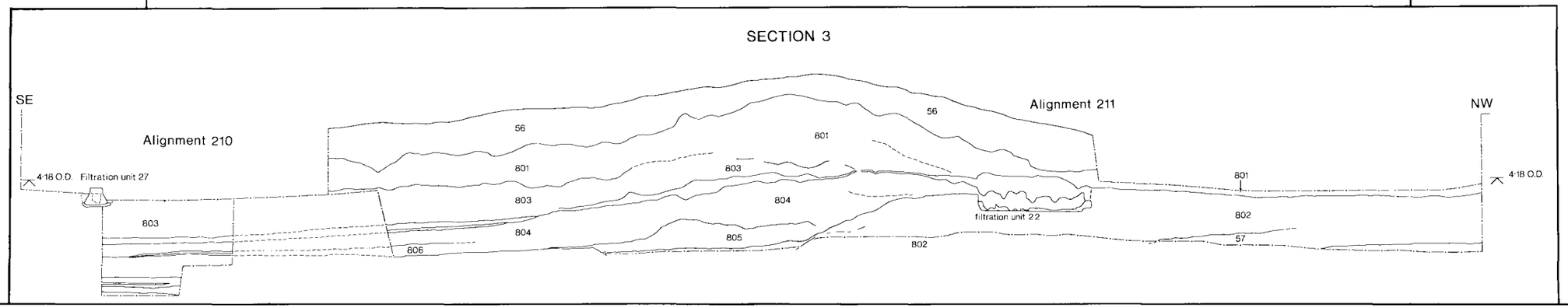


FIG. 8
Plan of Area 1





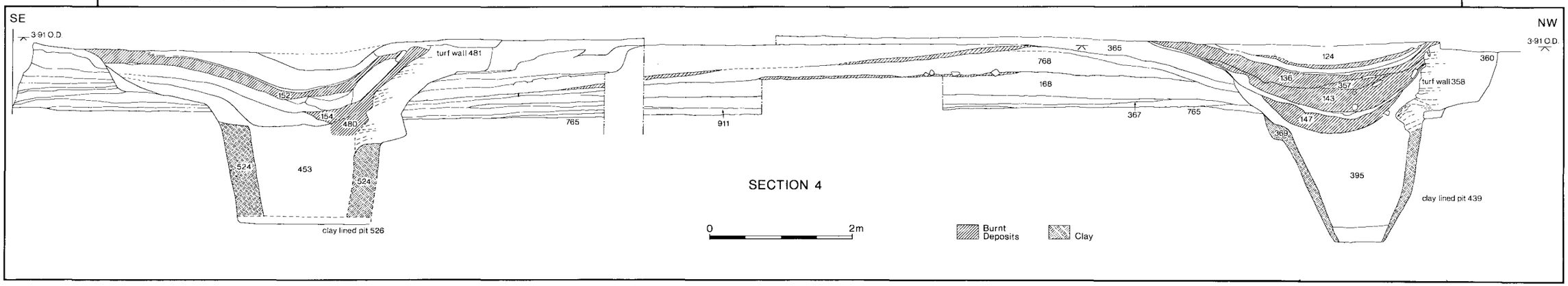


FIG. 9
Areas 1 and 2, Sections 2–4

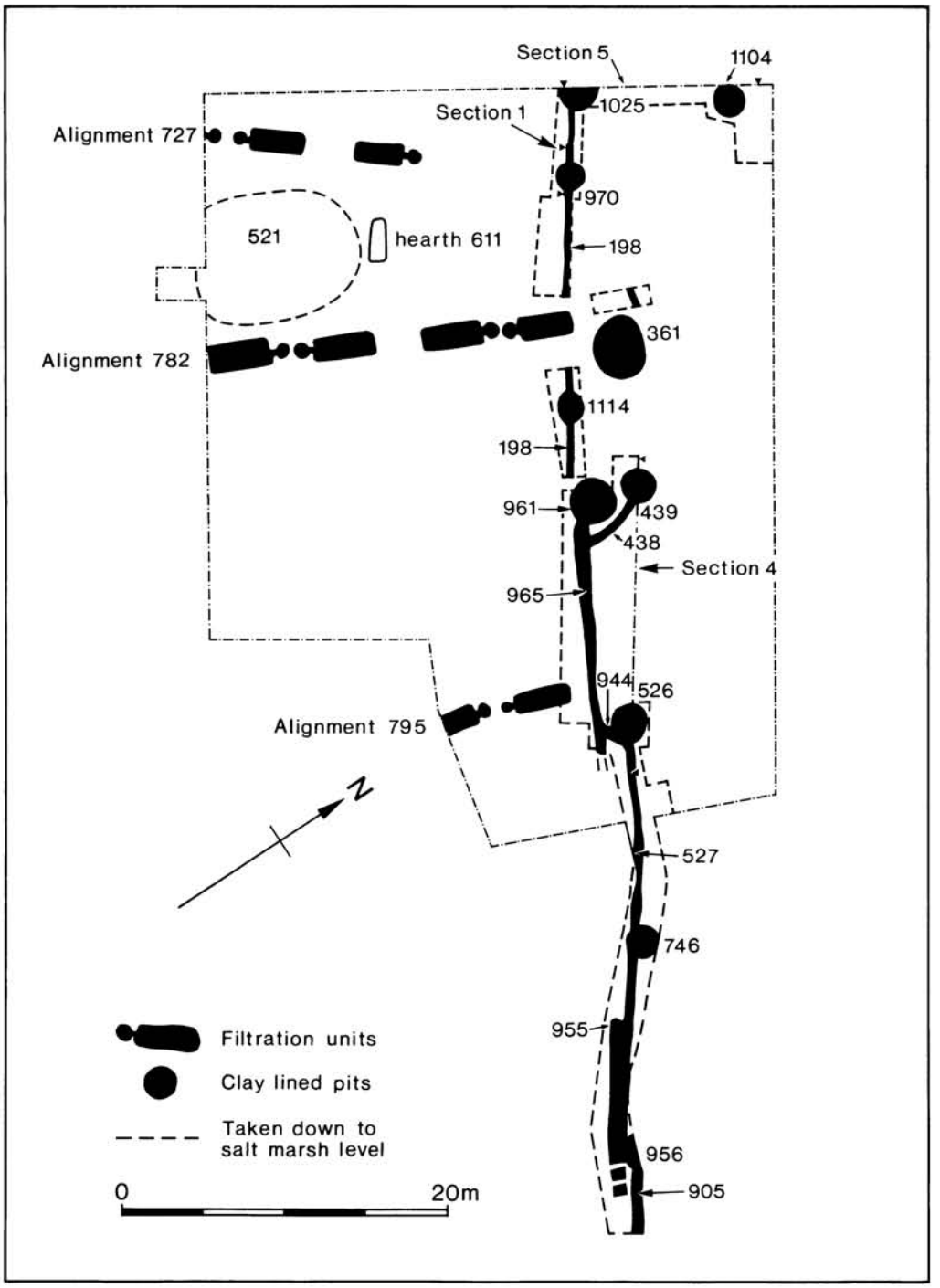


FIG. 10
Area 2, Salt extraction features

Individual features and dating

This section describes the sequence, from W. to E., along the line of the channels, noting any significant features and presenting the contextual evidence for datable artefacts.

The westernmost pit (1025, Figs. 10 and 11) was only partially excavated but one of its silt infill layers (1034) contained two leather turnshoe soles (Fig. 15, nos. 2031 and 2032). Traces of a turf retaining wall (1024, Fig. 11) were visible in section showing that the pit had been cut into layers which formed part of an silt mound immediately to the N. The upper part of this mound may have been revetted on the seaward side by a layer of clay (431, Fig. 11) and one of its lowest layers (973, Fig. 11) contained an annular buckle (Fig. 18, 2069) with a suggested late medieval date. This layer, and consequently pit 1025, post-date an unexcavated clay-lined pit (1104) located 9.4 m to the N.

Fig. 11 also shows the position of a trackway (233) defined by a thin layer of ash and charcoal which was spread over some wheel ruts. This layer contained 80 small sherds with a probable 16th century date along with a single 14th century sherd (see below).

The cutting of pit 970, next in the series, through channel 198, resulted in the pipe being relaid at a slightly deeper level (Fig. 6). This pit was associated with filtration unit alignment 727 and the northernmost unit in this line was removed by the cutting of a later gully.

Pit 361, associated with filtration unit line 782, was offset from the line of channel 198. Only the upper layers, burnt debris and silt, were excavated but these were almost certainly the final infills of a clay-lined pit. It may have replaced a pit which originally lay in the unexposed area beneath the northernmost unit of alignment 782. Alternatively it may have replaced pit 1114. This pit was unusual in that, despite a similarity in form with other clay-lined pits, it had no lining and no burnt infill layers. It is possible that it was intended to function as a clay-lined pit and was never completed, but its position coincided that of a large 18th century pit and it may have been contemporary with that feature.

There is a marked change in the orientation of filtration unit lines 727 and 782 at the W. end of the area together with a reduction in the distance between the clay-lined pits. This was probably the result of the influence of a creek located directly to the S. whose presence has already been indicated by the arrangement of the earliest filtration units in Area 13 (see above). The physical constraint of this feature would have caused the units to rotate against the fixed line of channels to the N. This realignment of the filtration units corresponds with a marked kink in the dyke immediately to the S. (Fig. 3) which probably closely reflects the course of this underlying creek.

The only hearth found in the excavations (611) was situated between alignments 727 and 782 (Fig. 10). Whilst there is no direct evidence to link the hearth to salt production activity it conforms to a shape one might expect if it were being used to boil rectangular lead pans. It was also next to the possible peat fuel stack, 521. The linear arrangement of these features can be clearly seen on aerial photographs[16] which show them being in direct association with individual ploughed down mounds.

Channel 198 was traced to just S. of the next pit in the series, 961, but excavation in the area immediately to the E. was not deep enough to establish its continuation. Pit 961 was not fully excavated but appears to have collapsed whilst in use and was probably replaced by pit 439 situated slightly to the N. Pit 961 was serviced by a new channel, 965, dug from a slightly higher level than the earlier channel, 198. After the collapse of pit 961, the flow of seawater was re-routed through channel 438, to serve pit 439. The filtration units associated with pit 961 and its replacement 439 were not uncovered. The lower fill (395) of pit 439 contained leather fragments, one of which (Fig. 17, no. 2029) may date from the end of the 15th or early 16th century.

Channel 965 was traced to just S. of its junction with channel 944. This was a short channel used to convey water from a new channel, 527, until, with the construction of pit 526 and filtration unit alignment 795, channel 965/438 became redundant.

The retaining walls of turves (358, 481) on the landward side of clay-lined pits 439 and 526 are illustrated in Fig. 9, Section 4. This section also shows the general character of deposition between the two pits; — a mixture of lower natural deposits (e.g. 367, 765 and 911) and, above them, deliberate dumps of salt-denuded silt and some layers of burnt debris (e.g. 168, 365 and 768). Each pit has been infilled with layers of silt and burnt debris from the hearths. The apparent extension of the original pit cuts on their W., seaward side, for example the relationship between pit 439 and layers 365, 366, 768 and 168, is illusory. This was caused by firstly, the cutting of the pits through the lower tidal/salt marsh layers and then the cutting back of layers of dumped silt which had accumulated around the pits.

A leather turnshoe sole, (Fig. 15, no. 2030), was found *in situ* on the surface of layer 765 (Fig. 9) between pits 439 and 526. The loss of this shoe predates the construction of pit 526.

A 25 m long trench was stripped seawards along the line of channel 527 in a further attempt to identify the sumps or ponds mentioned in the documentary accounts. This was unsuccessful but the exercise did expose two further clay-lined pits, 746 and 956, both cut into channel 527. Pit 746 may still have used the pipe in channel 527 in a similar way to pit 970, as excavation could only confirm that the pipe on its landward side did not come through the clay lining. Pit 956 was, however, certainly associated with a new channel, 905. Between the pits, to the S. of channel 527, was a linear feature, 955, which, at a depth of only 0.5 m, may have been an unfinished channel.

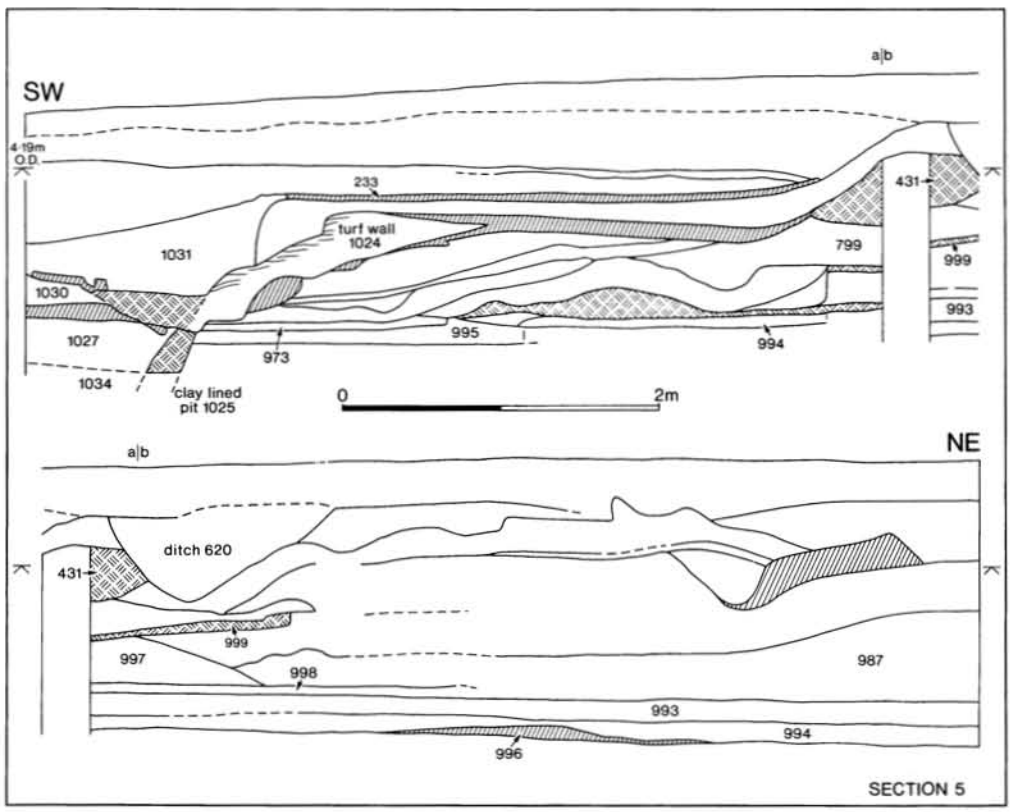


FIG. 11
Area 2, Section 5

Area 14 (Fig. 3)

This area was intended to expose two pits shown on the magnetometer survey. In the event, the depth of silt which needed to be removed made it impossible to locate these features in the time allowed. A curving line of filtration units was, however, uncovered and this convex arrangement is mirrored in the shape of the mounds at the extreme seaward end of the system where the creek system would have been converging.

Area 12 (Fig. 3)

This was the most easterly, and the first, area to be investigated. A section was dug by hand across the mound and a small area opened up behind it in an unsuccessful attempt to locate associated structures.

The other excavated areas produced no further significant information regarding the salt industry and are described in the site archive. This also contains details of various features:- ditches, gullies, post-holes and a large pit, which post-date the salt-extraction phases in Area 2. These are presumably associated with agricultural operations and the finds recovered from these features suggest a 16th to 18th century date for this general phase of activity. The digging of gullies and the erection of posts in Area 2 does not, of course, necessarily mean that salt extraction had ceased at the E. end of the system, although this may be implied by the digging of a substantial ditch (Fig. 3), which was cut through levelled mound silts.

THE FINDS

THE POTTERY *By* R. H. HEALEY (Figs. 12, 13).

Introduction

The total quantity of pottery from the Wainfleet excavation, excluding unstratified material, amounts to 757 sherds of which 309 are from a post-medieval feature, pit 139, not described here. The number of sherds from features associated with the salt industry itself is small, and in many instances consists only of body sherds, few of which have any of the characteristics that would provide dating information. Most of the pottery originates from local production centres, chiefly those at Toynton All Saints [17] and Old Bolingbroke,[18] *c.* 12 km W. of Wainfleet, and Boston,[19] 20 km to the S. A small number of sherds of other post-medieval wares as well as non local and Continental imports occur elsewhere on the site in the later contexts.

Toynton was the principal centre of local pottery manufacture in East Lincolnshire from the late 13th century to at least the 16th century. The dating information from three of the Toynton kilns derives from coins and archaeo-magnetic sampling.[20] Several of the waster groups at Toynton have been dated approximately on the basis of form and the style of decoration. At Old Bolingbroke, only 3 km W. of Toynton, the industry started in about the late 15th century and continued into the 18th century.[21] The excavated kiln at Bolingbroke was of similar size and brick construction to the latest Toynton kiln (numbered kiln 2), although the Bolingbroke forms are not precisely the same and may be of a slightly later date. The same clay stratum runs through both parishes and therefore fabric analysis cannot be used to distinguish between the wares. Not only did both centres produce similar forms at similar dates but some of the forms, pancheons in particular, changed little over two or three centuries, which makes both attribution and dating almost impossible. There is, however, the potential for recognising distinctive decorative features that appear to originate from a single source or from one of the villages only. At Toynton, for example, intensive recording by the late Mrs E H Rudkin identified fourteen separate kiln sites,[22] to which four more may now be added.[23] A smaller number of kiln sites has been noted at Old Bolingbroke.[24] As a

rule all wares from these sources are classed either as Toynton type ware or, if occurring in recognisably late forms, as Toynton/Bolingbroke type wares.

FABRICS

Local wares

Toynton/Bolingbroke ware (fabric code 1) has been described elsewhere by several writers including Healey[25] and Hayfield.[26] It is a medium sandy fabric, generally oxidized, although hollow wares frequently have reduced interiors. Reduction beneath the clear lead glaze produces the characteristic olive green glaze colour. The wares from the later kilns tend to be increasingly oxidized, with glazes more brown than green, often with red or orange tones.

A single sherd of 13th- 14th-century Potterhanworth shell-gritted ware[27] which was found on a trackway (context 233) is the only evidence of earlier medieval activity near the site. Some of the Toynton sherds may be of the same period but none of the fragments are distinctive enough to be attributed to the early kiln.

A small number of ceramic products from outside the area are represented on the site, including a rim sherd of a Langerwehe/Raeren drinking mug from context 58 and sherds of Low Countries wares of later medieval type imported into England from the 14th century onwards (fabric code 3). Also present in small quantities are Cistercian wares, slipwares, English stonewares and tin-glazed earthenwares. Details of the fabric descriptions, published references, microscopic examination and fabric codes are included in the archive. A total of twenty-one different fabrics was recorded, including modern pieces.

The most common Toynton, Bolingbroke or Boston ware form found at Wainfleet is the pancheon, a bowl with straight sides that slope outwards from base to rim and well glazed internally. This is a vessel form traditionally associated with milk and dairying purposes. The word is still known locally although the modern pancheon, in use earlier this century, is a somewhat wider, shallower variation. Vessels with a more rounded profile have been classified as bowls. Jugs are chiefly recognized from handles, one or two with part of the rim attached, and there are also examples of the type of handles found on the large two-handled storage jars. This form could also be used as a cistern by adding a bung-hole. Finally there are handles from pipkins, a type of vessel not noted at Toynton earlier than kiln 2 (*c.* A.D. 1475–1525).

The illustrated pottery has been arranged according to the excavated areas following the same broad stratigraphic sequence as described in the main text. For comparative reasons a complete vessel profile of a cistern from Toynton All Saints is included. All the illustrated sherds, unless stated otherwise, are of Toynton/ Bolingbroke ware.

Area 13

The sherds from context 58 are largely undateable; all are of Toynton ware, apart from one fragment of an imported Langerwehe/Raeren stoneware mug, which dates from the mid to later 15th/first half of the 16th century. It is not illustrated.

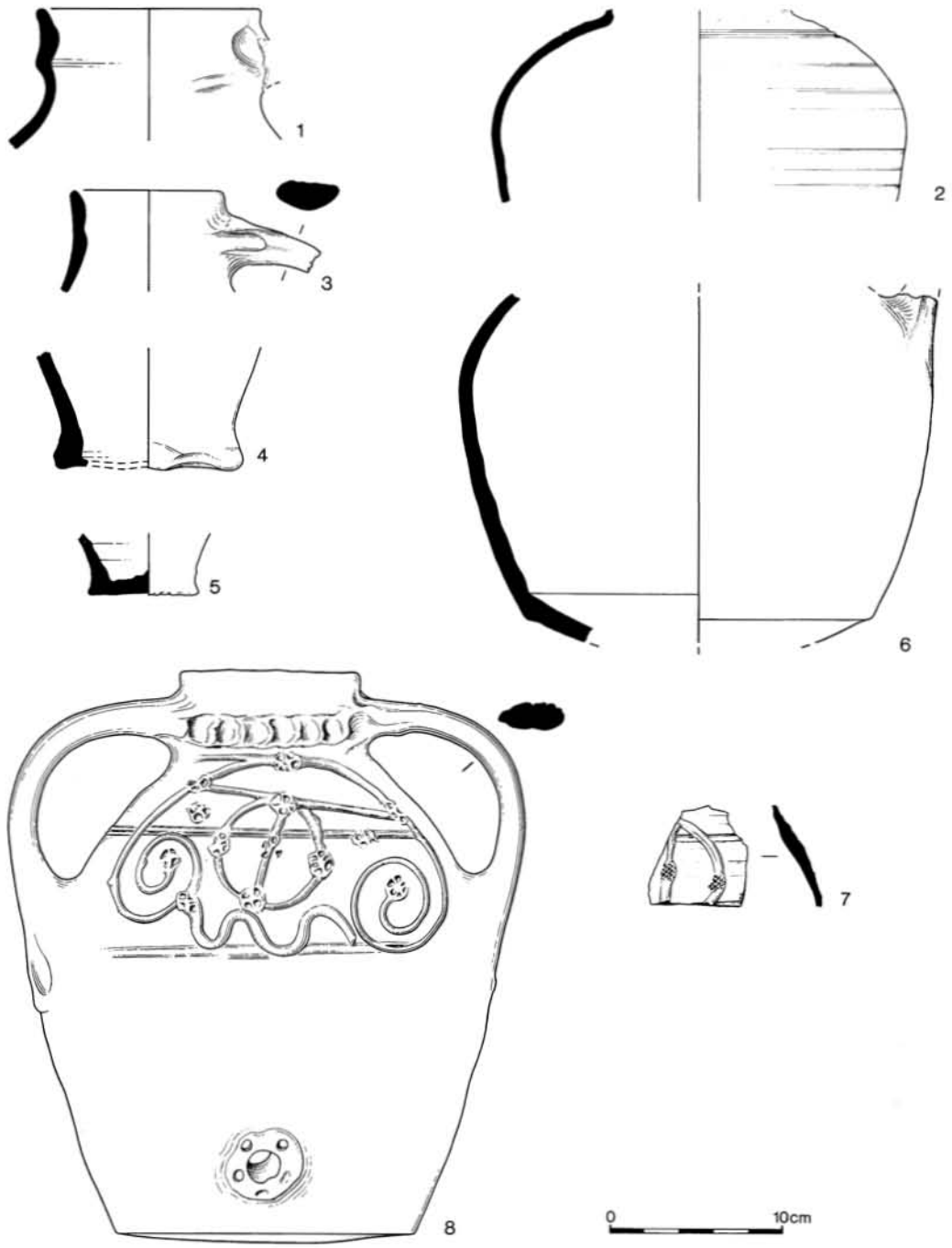


FIG. 12
Pottery. Scale 1:4

Area 1 (Fig. 12)

There are several large sherds in this area, including a number which join, suggesting contemporary deposition rather than redeposited material. The most interesting sherd from the whole site, in context 55, has a motif and type of decoration parallelled by a complete bung-hole jar, or cistern, from Toynton itself. This jar (Fig. 13, no. 8) was part of a group of almost complete vessels found in 1981–82.[28] The combination of this vessel form, not recorded at Toynton before the latter part of the 15th century, and the decoration in self-coloured slip, (as against the iron-rich slip of the early 14th century jugs) suggests a 15th- or 16th-century date, although cisterns are found in Lincolnshire from the 14th century onwards.

1 Jug rim and handle junction. Rim diameter 120 mm. Context 58.
2 Cooking pot, body. Context 7.
3 Jug rim and handle. Low Countries type earthenware. Rim diameter 150 mm. Context 13.
4 Jug base. Diameter 110 mm. Context 3.
5 Drinking vessel or bottle base, thumbed. Diameter 30 mm. Context 10.
6 Jug. Base diameter 200 mm. Context 13.
7 Body sherd from two-handled jar. Applied self-coloured slip brooch or buckle motif, stamped with a finely hatched grid stamp. Context 55.
8 Complete two-handled jar from Toynton All Saints, Spilsby, showing same motif as no. 7, for comparison. On this example the decorative stamp has a less closely hatched grid.

Area 2 (Fig. 13)

The pottery recovered from features directly associated with salt-extraction activity cannot be precisely dated and comprised mainly glazed and unglazed body sherds, some of which may be residual items. A Toynton/Bolingbroke base, no. 10, came from clay-lined pit 970, nos 9, 11–12 were found in layers which formed part of the mounds and no. 15 came from a layer of peat found adjacent to a hearth.

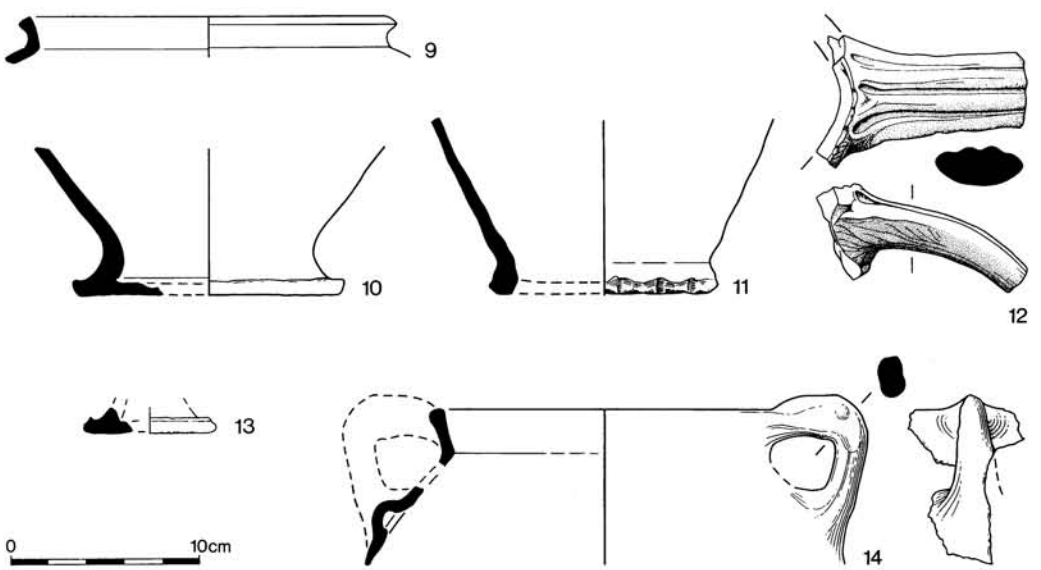


FIG. 13
Pottery. Scale 1:4

Out of a total of 81 sherds associated with a short length of trackway (233) one, the Potterhanworth sherd, is of 13th/14th century date and it is possible that some of the undiagnostic Toynton sherds are contemporary with this sherd. All these pieces however must be residual, since the assemblage also includes twelve sherds of Low Countries type red ware of probable 16th century date, including part of a cauldron. Although this type of two handled tripod cauldron (Fig. 13, no. 14) has a date range of the 15th to 17th century, this example is most likely to date to the middle of the range.[29] The broad date range would be consistent with the presence of disturbed soil from features of an earlier date than those excavated.

9 Cooking pot rim. Diameter 190 mm. Context 903, part of clay layer 431 (Fig. 11).
10 Jug, splayed base. Diameter 145 mm. Context 971 (Fig. 6).
11 Jug base, slashed decoration. Diameter 150 mm. Context 800, equivalent to context 993 (Fig. 11).
12 Jar rim and handle. Rim diameter 100 mm. Context 124 (Fig. 9).
13 Base, splayed, of goblet or candlestick. Diameter 70 mm. Context 233, Fig. 11).
14 Rim and handle of cauldron. Low Countries type earthenware. Rim diameter 170 mm. Context 233.

The pottery found in features which post-date salt extraction activity is of 16th to 18th century date and consists chiefly of Toynton and Boston types, the former predominating. Certainly there was some activity on the site during the first half of the 18th century, as is demonstrated by the quantity of ceramics recovered from a single large pit. A report on this later material is contained in the archive.

SUMMARY

In the absence of sufficient ceramic material for close dating, the evidence is that the pottery has a date range between the 14th and 16th century. Only the single Potterhanworth sherd is definitely 14th century or earlier. With this exception, the pottery from the salt extraction deposits has a general date of the 15th and 16th centuries. The dating of the local material is supported by a sherd from a Langerwehe/Raeren drinking jug of the well known type dating to the late 15th/first half of the 16th century. This concurs with the dates given to the leather fragments (see below) of the turn of the 15th/16th century.

THE LEATHER *By* Q. MOULD (Figs. 14–17)

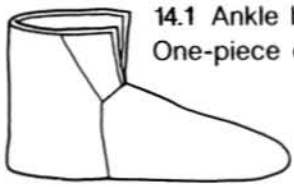
All the leather was examined following freeze-drying by the Rescue Conservation section of the Ancient Monuments Laboratory, HBMC (E). Species identification was made by grain pattern, where possible, using low powered magnification. Shoe sizes were calculated using modern English Shoe-Size Scales with a 10% allowance for shrinkage.

The leather items mentioned in the text are followed by their four-figure object number in brackets, and are illustrated. A full descriptive catalogue of all the leather recovered is provided in the archive.

The nature of the assemblage

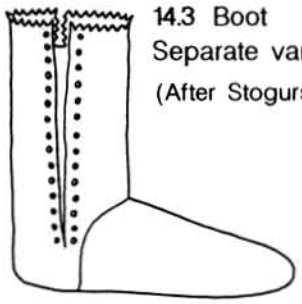
The leather was recovered principally from the fills of three clay-lined pits (439, 526, 1025) with a single sole (2030) being found *in situ* on the salt marsh surface (layer 765) between two of the pits, 439 and 526 (Fig. 9, Section 6). The small assemblage of 93 items comprises late medieval shoe parts of randed turnshoe construction,[30] with one possible exception (see dating below). The shoe components include six soles and small fragments from a seventh, along with fragmentary pieces of upper. In only one case can the associated sole and upper components from a single shoe be recognized with any certainty but it is likely that the upper fragments and soles derive from the same shoes.

The shoe components are heavily worn and much repaired which, together with the styles of upper represented, suggest practical working footwear. No waste from shoe making

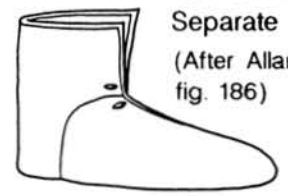


14.1 Ankle boot
One-piece construction

14.2 Boot
Separate vamp & quarters
(After Grew & de Neergaard 1988, 73 no 107)



14.3 Boot
Separate vamp & quarters
(After Stogursey Castle)



14.4 Boot
Separate vamp & quarters
(After Allan 1984, 330 L47, fig. 186)

FIG. 14
Leather Boot Styles

or repair was found but the heavily repaired nature of the shoe parts and the presence of components with areas deliberately cut away to salvage reusable leather (soles 2012, 2032; uppers 2006, 2009, 2015) suggests that the assemblage is cobbling debris. Insufficient leather was recovered, however, for the assemblage to be regarded as the deliberate dumping of cobbling waste from a workshop. The small quantity of debris suggests that the reusable leather had been retained for *ad hoc* repairs, probably by the wearers themselves.

The soles

The shoe soles of cattle hide have short, pointed toes, 'petal-shaped' treads and relatively narrow waists (2008 and 2013 being particularly narrow; these sole shapes have been stylistically dated to the 1460's–1470's.[31] All the soles recovered were for the left foot, those sufficiently complete to measure (2008, 2012, 2030, 2032) were large enough to have been worn by men (adult sizes 4–7).

The soles had been heavily repaired before being discarded, with one exception (2030), having tunnel stitching present on the grain side for the attachment of repair clumps to forepart and seat; one sole (2008) was found with its seat clump (2010) *in situ*. Many of the rand fragments also had tunnel stitching where clump repairs had been sewn to the perimeter of the sole. A vamp fragment (2016) had stitches likely to have come from the attachment of a large forepart clump repair which overlapped the sole and rand and was attached to the upper above the lasting margin. Two examples of foreparts of two-part soles (2013, 2031) were found, having the edge/flesh perimeter seam continuing across the lower waist for the attachment of a separate seat piece. This economy feature is frequently seen in small quantities amongst medieval shoe assemblages. The soles may have been constructed in two pieces at the outset in order to utilize smaller pieces of leather, alternatively they may have

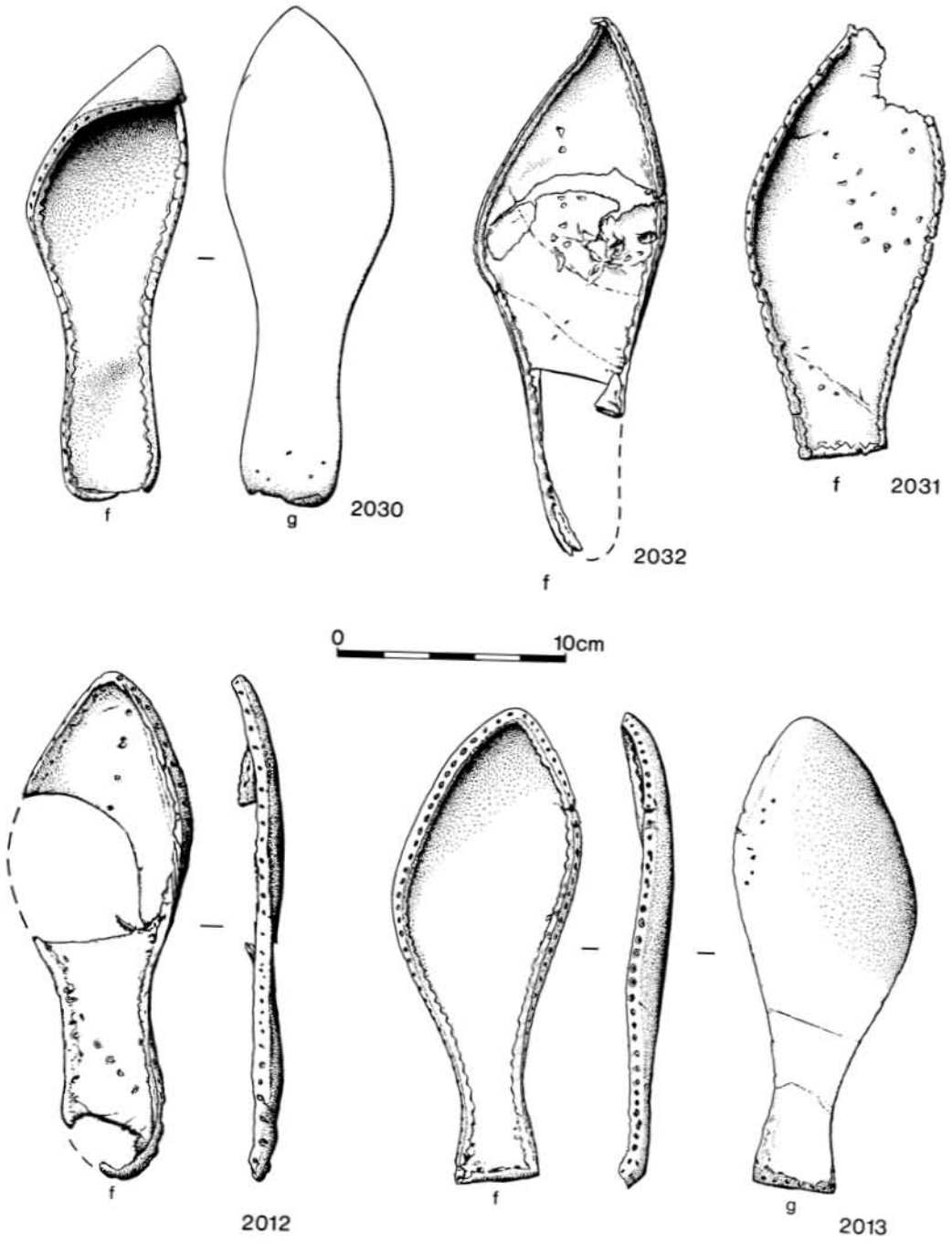


FIG. 15
Leather. Scale 1:3

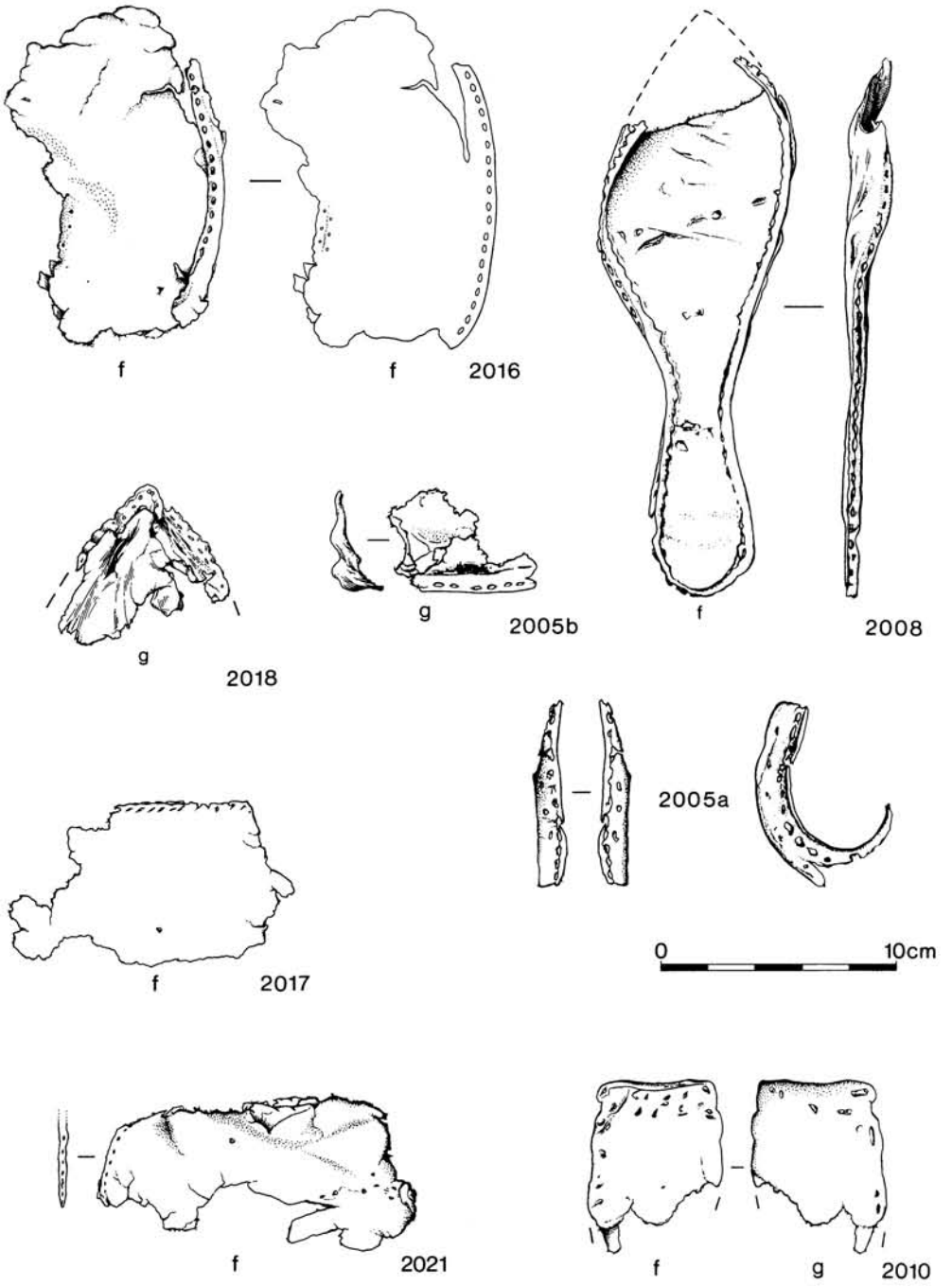


FIG. 16
Leather. Scale 1:3

had their original seats cut off when heavily worn in order to attach new seat pieces. A craftsman making modern reconstructions of the turnshoes regards the latter as almost impossible to achieve successfully[32] so that the former explanation is favoured.

Upper styles

Unfortunately only small fragments of the calfskin/cattle hide shoe uppers were recovered and few diagnostic features were present. The upper components were joined together with butted edge/flesh seams, the surviving top edges having whip stitching present for the attachment of a top band. The centre back of the heel was supported by the addition of a separate heel stiffener sewn to the shoe interior with whip stitching.

The fragmentary upper pieces surviving suggest that two styles of shoe are represented, an ankle boot of one-piece upper construction and boots with separate vamp and two-part quarters (Fig. 14.1 and 14.4).

Ankle boot

The fragmentary components which could be attributed to a single shoe appear to come from an ankle boot of one-piece upper construction with an angled side seam (Fig. 14.1). The shoe comprises a sole (2008), rand (2005a), clump repair for the sole seat (2010), a heel stiffener fragment (2005b) and a fragment from the right side of the vamp (2016), fragments of upper (2017, 2021) from the backpart (quarters area) probably belong to the same shoe. Whip stitching present in a small area close to the torn throat area of the vamp (2016) suggest that a tongue was attached, part of a bellows tongue (2018) was found in the same context and may belong to it.

Ankle boots with uppers made principally from a single piece of leather, often with small additional insert pieces, two examples of which occurred in the same context (2004, 2022) were a popular constructional style through much of the Medieval period. Shoes of similar style and date were found in an industrial pit (316) at Trichay Street, Exeter.[33]

Boots

Fragments of three two-part quarters were found (2006, 2007, 2015), each with a butted seam up centre back and remains of either a straight (2007) or a curved front seam (2006). Shoe construction employing two-piece quarters with a butted seam at centre back is a late medieval feature, on present knowledge restricted to the 15th century. Insufficient features remain to indicate the styles of boots represented but the curving front seam can be parallelled on a calf-length, front-fastening boot from Trig Lane, London, dating to the 1440's [34] (Fig. 14.2), calf-length, side-lacing boots from Stogursey Castle, Somerset[35] (Fig. 14.3), from a late 14th- mid 15th-century assemblage and an ankle boot from an industrial pit fill at Trichay Street, Exeter[36] (Fig. 14.4) dated to the late 15th/early 16th century. The boots from Stogursey Castle, and probably Trig Lane, are of high quality, the Wainfleet boots are more likely to have resembled the shorter working boot from Exeter.[37] An upper fragment (2020) has a length of whip stitching on the flesh side for the attachment of a tongue suggesting it also comes from a boot. Another fragment (2009) with a right-angled top edge, with whip stitching for a top band, comes from the front opening of a boot, both may come from boots of either of the constructions outlined above.

Dating

The method of shoe construction, sole shapes and upper styles, as suggested by the limited evidence from the uppers recovered, indicate a mid–late 15th-century date for the assemblage. Ostensibly it is unlikely to date much beyond the end of the century as by the 1490s pointed toes were no longer fashionable and turnshoe construction was being superseded by welted construction,[38] although it is likely that the spread of new construction

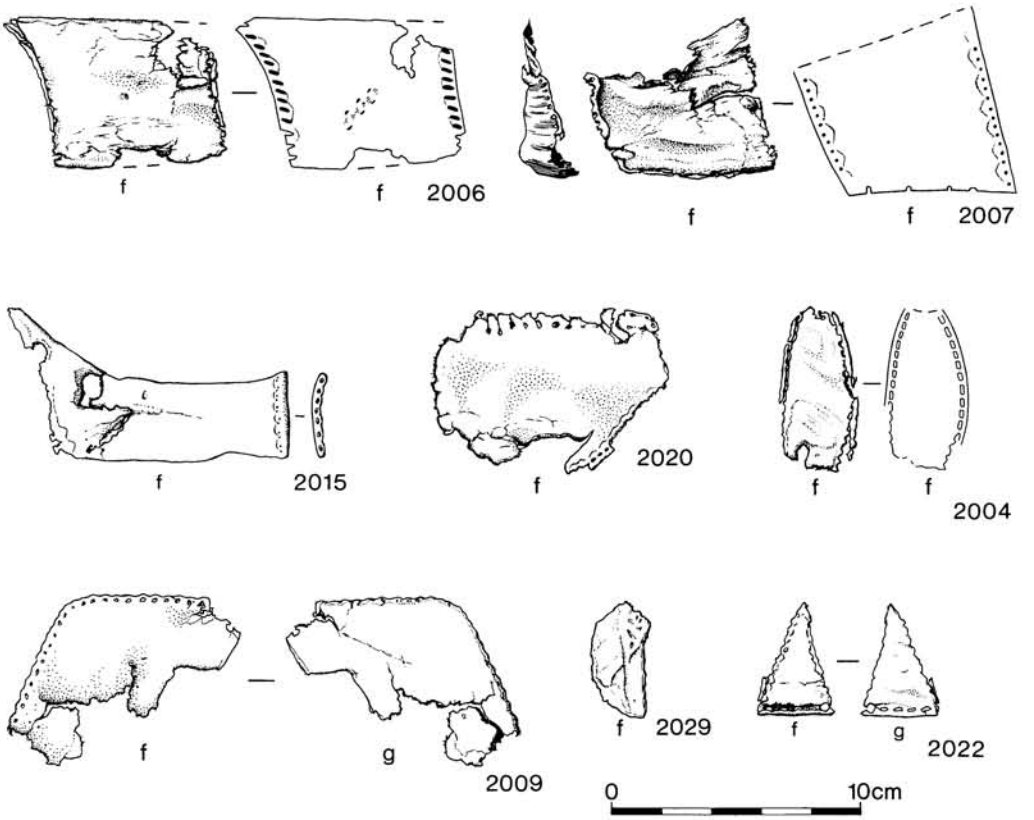


FIG. 17
Leather. Scale 1:3

methods and styles was slow to reach the isolated rural communities on the Lincolnshire coast. This picture is clouded, however, by the occurrence of two small, compacted fragments with remains of a broken edge/flesh seam, along with scrap fragments broken from them; the only finds from the fill (395) of a clay-lined pit (439). One of these scrap fragments (2029) has the impression of crossed bracing thread clearly visible on the flesh side suggesting the fragments come from a welted insole. Unfortunately no other diagnostic features are preserved. The impression of bracing thread frequently occurs on components of welted construction, and while bracing may also have been employed during the construction of turnshoes[39] the bracing thread impressions would be obscured by wear and no examples on turnshoe soles are known to the author.

In the light of the consistent nature of the majority of the leather it would be unwise to push forward the dating of the assemblage on such tenuous evidence for the use of welted construction. It must be remembered, however, that to dating an assemblage of shoes using purely stylistic criteria may give a somewhat false idea of date, as the rate of adoption of new shoe styles and construction in the provinces is unknown. It may be that practical working footwear, as represented by the bulk of the assemblage, continued to be made in the traditional turnshoe technique for a time, whilst more fashionable shoes, as represented by the possible insole fragments, were constructed using the new welted technique. Using this hypothesis the leather assemblage may date slightly later to the end of the 15th century or

possibly into the early years of the 16th century with both turnshoe and welted constructions being in use during a period of constructional transition.

THE OTHER OBJECTS. *By* A. THOMPSON (Fig. 18)

The small collection of artefacts recovered from the excavations were generally not well-preserved although condition varies by material group. The more notable objects are discussed here, and unless stated, are not illustrated, with the remaining objects included in summary form. Full details of all the objects are given in the catalogue deposited in Lincoln City and County Museum.

Many objects were in a fragmentary state and had been subject to corrosive action — with some of the iron objects in particular coated with thick corrosion products. All of the iron objects were subject to X-radiography at the English Heritage Ancient Monuments Labora-

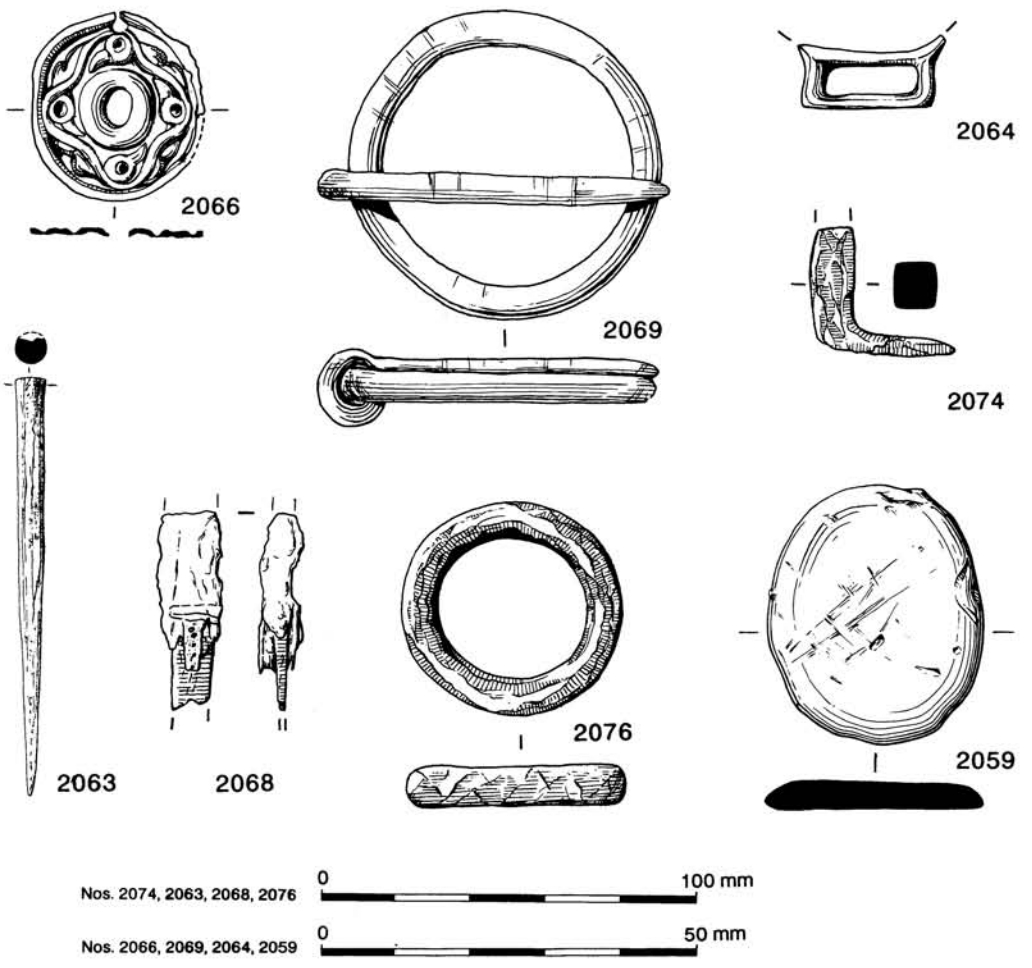


FIG. 18

Miscellaneous Objects. Scales: Copper Alloy and Lead 1:1; Iron and Bone 1:2

tory (London) to aid identification and object no. 2059 was also subject to XRF examination to determine the nature of its composition. The five copper alloy objects had been treated and cleaned at the Ancient Monuments Laboratory prior to examination.

Most of the artefacts recovered derived from general layers across the site that are associated with the destruction, or cleaning out, of hearths used in the brine boiling process. However some objects were retrieved from more specific contexts. These include a bone awl (Fig. 18, 2063), an iron fitting (2091) and wall hook (Fig 18, 2074) from the infills of the clay-lined pits used to collect seawater and an iron nail (2075) and possible nail/bolt (2078) each from the infilling of a brine collecting vat.

Only a few personal objects, all of copper alloy, are included in the artefact assemblage. 2066 (Fig. 18) A copper alloy belt fitting (context 233, diameter 24 mm), comprises a thin disc with central perforation and marginal rib on both the disc and perforation edges. Two opposing copper alloy rivets on the outer edge of the disc will have attached this decorative object to a leather belt. The band of repoussé decoration consists of repeating s-shaped swirls with tiny bosses and dimples in the loops of the s-shape that create a bird/duck head motif. Similar types of belt fitting from Northampton[40] date this object from the 12th to 15th century.

2069 (Fig. 18) A complete copper alloy annular buckle of circular-section with a blunt-ended tongue of square-section, (context 973, diam. 40 mm). J. P. Allen[41] has identified this form also as a brooch to be worn at the neck to close a tunic, or on the shoulder to fasten a cloak. Similar examples from Colchester[42] and Northampton[43] agree on a late-medieval date (up to A.D. 1500) for this form of buckle/brooch.

2064 (Fig. 18) A Copper alloy buckle fragment with only the rectangular 'open' end surviving (context 196, length 19 mm).

2067 (Fig. 18) A Copper alloy buckle tongue or brooch pin, a thin strip with a broken loop at one end and tapering to a blunt tip at the other (context 799, length 30 mm).

An unidentifiable fragment of copper alloy (2065) was recovered from context 10.

A number of functional objects were recovered from the excavations: a selection of iron tools and structural fittings and just one bone object.

2074 (Fig. 18) An iron wallhook with square-sectioned shank. Only one prong survives (context 50, length 40 mm).

2076 (Fig. 18) A complete iron ring of circular-section. Possibly a harness fitting (context 360, diameter 55 mm).

2068 (Fig. 18) An incomplete iron knife comprising a thin rectangular-sectioned blade with two copper alloy shoulder plates held in place by a rivet (context 58, length 52 mm). In addition there are a number of smaller rivets (visible on the X-ray plate) used for attaching the shoulder plates to the now missing handle. The handle could have been made of either wood or bone.

2063 (Fig. 18) A bone awl, sub-circular-sectioned and polished, with slight faceting along its length (context 50, length 111 mm).

A small fragment of an iron knife blade (2088), two hollow tube fittings, that may have acted as some sort of protective coverings (2091 and 2073) and an unidentified fragment with a blade-like protrusion (2090) are not illustrated as they are in a very fragmentary state. The remaining iron objects consist of structural nails for use with timber (2070, 2072, 2075, 2077–2078, 2086, 2089 and 2092) and a possible bolt (2087) — all of which are examples of types identified and illustrated at other sites, such as Southampton.[44]

The largest material category of artefact recovered from the Wainfleet excavations is lead. Of the 24 pieces of lead recorded only one (2059) is an identifiable object and is illustrated. This is an irregular oval-shaped disc with a flat reverse and bevelled obverse edge. This disc appears to have been beaten into shape with a smooth obverse face. Such a disc may have been used as a counter (context 207, length 35 mm).

The remaining 23 lead objects are fragmentary and consist of irregularly-shaped pieces. Some of the fragments appear to be window-leadings — rectangular-sectioned strips, sometimes grooved (2036–2038 and 2056) sometimes twisted (2052) — similar twisted

window-came examples have been recorded at Colchester.[45] Small lead fragments 2039–2051, 2053–2055, and 2057–2058 complete the list of lead objects. The quantity of lead fragments suggests that these objects may represent 'off-cuts' from the lead boiling pans that were used to evaporate the brine. As 'off-cuts' they would then have either derived from the production or repair of salt pans on the site or the breaking down of these pans for scrap. Given the presence of window-came fragments within the lead assemblage there is a suggestion that lead fragments were being brought to the site for re-use — either to produce or repair the salt pans.

SUMMARY

Almost without exception the recorded finds from Wainfleet cannot be closely dated as they are either too fragmentary to determine the specific type of object represented, or they are a type of object that belongs to a broad date range within the medieval period. Nevertheless, of the objects that can be attributed to a shorter date range, it would appear that a later date for activity on the site of *c.* A.D. 1500 is suggested.

The small quantity and limited range of artefacts recovered reflects the impermanent nature of settlement on this site. Salt-making has been identified as a seasonal activity[46] therefore only a few personal belongings and basic tools would have been required by the inhabitants during their temporary occupation of the site. Again the largest material category represented in the artefact assemblage, lead, reflects the concentration on activities related to salt-making.

OTHER FINDS. *By* F. MCAVOY

29.8 kg of animal bone was found during the excavations but only 1.5 kg was retrieved from contexts associated with salt extraction features and this did not merit analysis. Fragments of glass were only recovered from the fills of an 18th century pit.

13.5 kg of fired clay was retrieved, principally from the layers of burnt debris which infilled the clay-lined pits. Most of this material was simply burnt silt from around the hearths but some may have been formed into stands for the boiling pans. No complete examples were found and a selection of this material is retained in the site archive. Bricks were recovered from an 18th century pit.

CONCLUSIONS

The procedure by which marine salt was obtained on this stretch of coast in the late 15th/early 16th century has been established along with the enterprise shown by the salters in utilizing their natural resources. Excavation has identified many of the individual components of the particular methodology which was in use and demonstrated the uniformity of these features and the relationship between their systematic arrangement and natural coastal development.

These results may be compared with those from other medieval marine salt extraction sites in Lincolnshire. The same procedure, methodology and organization was certainly being employed by salters operating at the presumably contemporary site excavated at Wrangle,[47] 4.5 km to the S. Identical features, in this instance found in association with late Saxon ceramics, were uncovered in roadside ditches during improvements to the A52 N. of Quadring[48] (Fig. 1).

The form of the salterns associated with these latter features was, however, very different from that which occurred at Wainfleet. Instead of compact linear rows, the

visible remains consist of very large single mounds created by the successive deposition of waste sand and silt, indicating a similar salt extraction procedure. A 14th-century example of one of these large mounds was excavated to the S. at Quadring,[49] located in the, now reclaimed, large inlet of Bicker Haven.

Many other examples of this form of saltern can be found on the Lincolnshire coast and are particularly well documented around Marshchapel and Tetney.[50] Large single mounds also appear to have been present around Wainfleet and Friskney and perhaps near the first sea-bank.[51]It may be that this was the customary form of medieval saltern and that the Wainfleet arrangement was an adaptation which reflected very particular coastal circumstances. Alternatively the organization seen at the Wainfleet salterns may have been an entirely later Medieval or post-Medieval development.

Whilst the Wainfleet excavations, have, in themselves, provided no direct evidence for the cessation of the industry in this area, a *terminus ante quem* is apparent from the large scale reclamation which occurred in 1641 [52] (Figs. 1 and 2). This does not, of course, mean that production, either individual or collective, continued up to that date. Localized reclamation, between the most northerly of the salterns and the River Steeping, occurred in 1589[53] and this may be seen in the context of the curtailment in production which would necessarily have taken place during the 16th century after the salters were restricted to the salt marsh promontories.

In an earlier period this disruption, and other setbacks such as the storm of 1570 which destroyed many of the salterns on the Lincolnshire coast [54] would have been overcome and reclamation, with its possible stimulus to salt marsh growth, might have preceded a return to full production. That this did not happen, assuming the continued availability of a local fuel supply, would ultimately have been due to a changing view of the value of the product.

Salt produced in the Firth of Forth was being shipped through Boston in the 16th century[55] and would have become more attractive in price after the removal of tax in 1601. This pattern of trade altered in the 17th century when salt from the North-East, boiled in iron pans using plentiful supplies of coal, was shipped down the coast.[56] It was probably this ready availability of imported salt which finally outweighed the benefits of undertaking the always arduous and unpredictable labour of local production.

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