

TILBURY FORT: A POST-MEDIEVAL FORT AND ITS INHABITANTS

By PETER MOORE

(Newham Museum Service)

SUMMARY: This paper reports the results of excavations at Tilbury Fort, Essex, undertaken for English Heritage between 1988 and 1995 in advance of various maintenance works, which produced a large and varied archive. This archive has been approached thematically to discuss the nature and development of the defences, the importance of the fort structures on the foreshore of the River Thames and the lives and deaths of the inhabitants of the fort.

Tilbury Fort is situated on the north bank of the River Thames in the county of Essex, 33km east-south-east of London (FIG.1) on the boundary between the East and West Tilbury parishes. This area is all marshland, long used as pasture but now much encroached by rail, shipping, power and sewage works. Across river from the fort lies the town of Gravesend, in the county of Kent, with a ferry service linking the two counties at this location since at least the fourteenth century.¹ The importance of this crossing point between Essex and Kent and as a strategic landing place for an invading force meant that the fort site was permanently fortified and garrisoned from 1539 until after the First World War.² The strategic importance of the area can be seen by the concentration of forts and defences between Tilbury Fort and the North Sea (FIG.1).

The fort, as seen today, is substantially late seventeenth century in layout and fabric but also contains some eighteenth to twentieth century structures and alterations. The fort is described in detail elsewhere³ but can be summarised as being a bastioned fort on a regular pentagon plan, with inner and outer moats, covered way, four complete and one truncated bastions and a range of military and domestic buildings (FIG.2). As the finest surviving example of seventeenth century military architecture in England it has been a national monument since 1950 and under the care of English Heritage since 1984.⁴ Earlier conservation and care works favoured the retention and display of the seventeenth century elements of the fort over later structures. This view has however been replaced with an aim of conserving, displaying and interpreting all aspects of the monument.

The importance of this national monument is not just as a particularly fine, and extant, example of military architecture. It is an extremely important in situ archive of archaeological deposits and structures relating to the lives of the fort's inhabitants but also reflecting part of the psyche of the nation. The very fabric of the fort through its history of construction and repair corresponds with periods of actual, and perceived, threat to the seat of government in London, and therefore the country, by attack or invasion.

Inhabitants of post-medieval artillery fortifications are rarely considered in modern publication⁵, and then only briefly.⁶ Research emphasis has mostly been placed on the nature and development of military architecture. This lack of consideration may be because medieval castles are perceived as homes while post-medieval forts are not. The design and importance of the domestic accommodation within medieval castles was extremely flexible within the purposes and purses of individual castle builders⁷, that is, they could be, and were, homes for individuals and families powerful enough to

construct and maintain them.⁸ Post-medieval fortification in southern England was almost all undertaken by the state for its own protection.⁹ The civil nature of these forts and their subsequent amalgamation into a national, permanent, military establishment meant that they were no longer the homes of the rich and powerful. Without forts having the appellation of "home" their actual inhabitants, mostly drawn from the poorer part of society, seem to have been "out of sight and out of mind" in archaeological and historical consideration. Tilbury Fort, however, did have inhabitants, men, women and children, for whom it was a home. For some, who were born and who died at the fort, it was their only home. It is an aim of this article to try and address the archaeological archive in a way that examines the inhabitants of Tilbury Fort as well as the military architecture.

Archaeological excavations at Tilbury Fort were undertaken between 1973 and 1995. Excavations undertaken in 1973 by Jerry Pratt and in 1980 by Patricia Wilkinson have been already published¹⁰, concentrating on the northern side of the fort on the Redan and Ravelin. Between 1988 and 1995 a series of excavations and watching briefs were undertaken by Newham Museum Service¹¹ in advance of restoration, conservation, access, safety, drainage and service works by English Heritage.

In 1988 Trenches 1-18 (FIG.2) were excavated in the Eastern Place d'Armes, Covered Way and Outer Moat in advance of the actual restoration of the Outer Moat and proposed restoration of the Place d'Armes and Covered Way (project name: TF-88). In 1989 the work continued in the Eastern Place d'Armes with Trenches 19-20 and 22-27, and two areas of the Thames foreshore were surveyed and sampled; the Central Foreshore in front of the Water Gate and the Eastern Foreshore where the Eastern Covered Way meets the river located (project name: TF-89). Trench 21 was excavated across a structure in the Eastern Foreshore area. Also during the 1989 season watching briefs were conducted on soil investigation pits excavated by English Heritage (Trenches 28-30) on the West Curtain Bank. Early in 1990 watching briefs were conducted on drainage inspection pits dug by English Heritage (Trenches 33-37) behind the Officers Block and on Trench 32 excavated for a sewage tank (project name: TF1-90). Major conservation and restoration works were also undertaken in 1990-1991 to the West Curtain Wall and Bank entailing excavation and watching briefs on Trenches 38-51 along the bank and on Trench 52 at the bank base (project name: TF2-90). At the same time a watching brief was conducted behind the Officers Block during the excavation (Trench 53) of a sewage tank sump. In 1991 Trenches 54-55 were excavated in the East Bastion and its Ammunition Store was recorded in advance of safety and access works (project name: TF1-91). Also in 1991 a Trench was excavated into the outer bank of the Curtain Wall to the west of the Water Gate for an electrical cable (project name: TF2-91). In 1995 Trenches 59-61 were excavated beside the Water Gate on the site of the Sutler's House in advance of access works (project name: TF1-95). Throughout this period other areas of the fort were photographed by the archaeologists working on the above sites where dry weather conditions revealed parch marks on the grass or structural timbers in the moats. The supervision of the TF2-90 and TF2-91 projects was undertaken by Ken Sabel and on the TF1-91 and TF1-95 projects by Mark Beasley; all the 1988-1995 projects were directed by the author.

The excavations undertaken between 1988 and 1995 maintained a continuous sequence of Trench and context numbers with over 1500 contexts being recorded. This work produced a large archive, consisting of context sheets, plans, section drawings, photographs, finds, environmental samples, specialist reports, conservation records, archive reports¹² and summary reports.¹³ The archive may be consulted by contacting the Inspector of Ancient Monuments, English Heritage, Historic properties, Midland and East Anglia Region, Hazelrigg House, 33 Marefair, Northampton NN1 1SR.

The nature of the archaeological finds, samples and data recorded and recovered varied enormously across the fort. This was largely because the archaeological projects were carried out in response to, and dictated by, maintenance works planned by English Heritage. The location of the archaeological work was therefore scattered and the size and scope of the work varied and scattered. The work in many of the Trenches raised more questions than answer them because of their small size, resulting in limited interpretation being presently possible. However a wide range of important data has been recovered overall; structural and military architectural information in the Eastern Place d'Armes, riverine structural information from the foreshore and material culture from the West Curtain Bank. The analysis of the finds and environmental archive has produced a large amount of important technological, personal, dietary, faunal and cultural information. Also available are map and documentary archives relevant to the construction and running of the fort and to the lives of its inhabitants.¹⁴

Because of the very large and disparate nature of the excavation and analysis archive a complete publication of all this data in its totality be a wasteful and partially uninformative exercise. A selective and thematic approach to the analysis and interpretation of the archive has therefore been attempted here. It is hoped that, while selective in nature, this approach will provide a useful interpretative vehicle for future consideration of the archive and that it will also enable social historical interpretation of the fort to be made. Specialist analysis has not been presented here in the traditional manner of appendices to the stratigraphic report. Rather, the parts of specialist reports included in this publication are presented in an integral format to the theme under discussion. Catalogues of objects solely by material types are also not presented, rather, objects are discussed where relevant, and all finds are numbered sequentially within this report. This approach attempts to follow that set in work on London¹⁵, Winchester¹⁶ and Norwich¹⁷ finds.

This article apart, it was also felt of importance to make available the full texts of the specialist reports, many of them of great importance in their own right. For copies of the following reports contact Newham Museum Service, Archaeology and Local History Centre, 31 Stock Street, Plaistow, London E13 OBX: clay tobacco pipes¹⁸, glass¹⁹, iron objects²⁰, pottery²¹, small finds²², animal bones (including fish)²³, eggshell²⁴, human bones²⁵, historical research²⁶, parish records²⁷. For the following reports contact Ancient Monuments Laboratory, English Heritage, 23 Savile Row, London W1X 1AB: analysis of glass²⁸, conservation²⁹, dendrochronology³⁰ and pollen³¹.

For the purpose of this article the site archive has been used to investigate four major research themes:

(I) what was the nature of the fort military structures and defences, how did they develop, what materials were used in their construction and to what extent did the surrounding landscape influence the fort's design and construction?

(II) What was the nature of the fort structures on the River Thames foreshore, how did they develop, what materials were used in their construction and of what importance was the role of the river in the running of the fort?

(III) What patterns of material culture, day-to-day living, diet, trade and military activities are reflected in the artefactual and environmental record from the fort?

(IV) Who were the inhabitants of the fort and how did they live and die?

Each of the above themes is discussed through the medium of the available archaeological, material and documentary evidence, which is presented as integral to the body of text. Throughout this project I have had the enthusiastic co-operation and help of all the contributors but any mistakes in this article are solely my own.

(I) THE MILITARY STRUCTURES AND DEFENCES

With the bulk of the fort consisting of structures purely military or defensive in nature it is not surprising that most of the archaeological deposits and structures excavated in all parts of the fort relate to military functions. However in trying to understand the nature of the military structures it is important to understand the environment and landscape within which they are set and which must influence them. To this end the study of a **(i) pollen** sequence is examined to give a greater definition to the study of the known **(ii) landscape**. Consideration and understanding the nature, and purpose, of the **(iii) defences** themselves as well as the **(iv) building materials** can then be attempted.

(i) THE POLLEN ANALYSIS (Andrew Evans)

A core 1.67m. long was taken on the Eastern Foreshore (FIG.2) in 1989 using a Russian borer. This location was chosen because survey work had located at least one peat deposit in this area and it was relatively accessible for sampling. The core started at the mud surface at a height of -0.62m. AOD though the liquid top 0.18m. of the 0.28m. thick estuarine clay/mud layer covering the peat was lost. The peat, found at a height of -0.90m. AOD, formed a 0.20m. thick zone underlain by further estuarine clays. The peat was sub-sampled every alternate centimetre, treated using standard pollen extraction techniques³², mounted on slides and examined using x400 magnification for general pollen counting but using x1000 in the case of problematic grains. The number of pollen grains counted varied depending on the relative abundance of pollen in each sample. In most samples counts of over 500 grains were obtained but in some samples where *Bidens* type was frequent, counts of over 1000 grains were made to obtain a more accurate assessment of the less frequent pollen types (FIG. 3). All values represented are expressed as percentages of total pollen and spores.

The peat zone assemblage is best characterised by the increase in *Bidens*, *Cyperaceae* and Graminae, and the falls in *Pinus*, *Chenopodium* and *Pteridium*. The levels of *Pinus* fall abruptly at the start of this zone to 1% Total Pollen or less. Other changes in the arboreal spectrum consisted of *Quercus* increasing in importance through the first half of the zone (however, the low values of the first two levels of the zone will be due to a statistical artefact caused by the very high amounts of *Bidens*), reaching it's highest values, 23% and 25% T.P.. It then declines through the rest of the zone, falling to 12% T.P. *Alnus*, *Ulmus* and *Tilia* are still present in similar amounts to those seen in the previous zone, while *Betula* is present at slightly higher levels. The increased frequency of *Fraxinus*, together with the new and consistent records of *Fagus* and *Acer* help to emphasise the differences between this and the previous zone, reaching a maximum value of 14% T.P., then dropping towards the assemblage end.

The increase in *Bidens* type is the most striking feature of the assemblage, up to 60% T.P. in the first two samples, dropping to 5% T.P. a few samples later only to rise again to 30% T.P.. *Cyperaceae* and Graminae both increase significantly from the previous zone but drop in importance through the assemblage, *Cyperaceae* falling from 23% to 5% T.P. while Graminae falls from 20% to 11% T.P.. *Aster*, *Plantago*, *Rumex acetosa* and Umbelliferae are all also seen to increase in this zone. *Chenopodium* type decreases from high values at the end of the previous zone to an average of 7% T.P., and a fall in the frequency of Liguliflora type can also be detected. The frequencies and importance of all fern spores drop at the beginning of this zone.

The interpretation of this pollen assemblage zone depends on the implications that the change in sediment type has for pollen taphonomy. That the peat was able to form at the site suggests a period of stable sea levels, with the site being occupied by a low energy estuarine environment, with only occasional incursions by the sea. It is therefore likely that the greatest proportion of pollen will have arrived by air transportation, largely from relatively local vegetation, with less material being fluvially transported to the site. It can therefore be assumed that this assemblage gives a better representation of the vegetation in the vicinity of the site than the assemblages from the clays above and below the peat.

A number of pollen types present, such as *Chenopodium*, *Bidens* and *Aster* are almost certainly derived from the peat forming community itself. The *Chenopodium* type is likely to represent members of the genus *Salicornia*, and *Bidens* and *Aster* pollen types recorded here could both be derived from the same plant species, the salt marsh species *Aster tripolium*³³. The higher levels of Cyperaceae and Graminae could also be at least partially explained by the presence of members of these families in a salt marsh community. The records of *Potamogeton* could also represent a salt marsh species, *Triglochin maritima*.

Deciduous woodland is well represented in this assemblage, as in the previous zone, *Quercus* and *Corylus* appearing the most important elements. However species who tend to be under represented in pollen diagrams, such as *Fagus* and *Fraxinus*³⁴, are present. The importance of pollen types that could represent halophytic species suggests that the peat derives from a salt marsh community. This indicates that the sampling site itself was on the fringes of the tidal range of the estuary, probably experiencing only occasional flooding.

There is also evidence of agricultural activity. The presence of *Plantago lanceolata* and *rumex acetosa*, together the higher levels of Graminae suggest pastoral activity. Even the low numbers of *Pteridium* and *Calluna* could be indicators of such activity. Although it is possible that the pollen grains of Graminae recorded in the size of range of above 50µ could represent Cereal pollen, it should be noted that pollen in this range is also produced by halophytic grass species such as *Elymus*. The records of *Cannabis* type pollen, are possibly better indicators of arable activity, suggesting the production of hemp or hops in the area.

It is not possible to establish an absolute chronology for the pollen diagram as no radiocarbon dates are available. However the presence of a number of anthropogenic activity indicators, together with the relative shallow depth the peat is situated at, suggest that it is relatively recent.

(ii) THE LANDSCAPE

Three kilometres to the north of the fort, across Tilbury Marsh, the Taplow and Boyn Hill gravels terrace rises and where human settlement has long been concentrated³⁵. While isolated by the extensive marshes from this terrace settlement area the fort was nevertheless on the major communication line of the River Thames itself. The fort's location in a marsh strongly influenced, if not dictated, both its structural design and preservation. Its isolation has ensured that it was never subject to the redevelopment pressures that less marginal land may have been susceptible to, and the wet, alluvial deposits and high water table have ensured a high degree of organic preservation in the archaeological record.

The fort was shown in 1740³⁶ to be surrounded by "Marsh Land" to the west and north-west, "Gallows Common" to the north-east, "Salt Marsh" to the east and "Marsh

Land" beyond that. The "Salt" marsh consisted of the land surrounding Bill Meroy's Creek, previously Pincock's Creek³⁷, while Gallows Common seems to have been its northern extension. Both the "Salt Marsh" and "Gallows Common" marshes were unreclaimed areas, indeed were not enclosed by any wall or bank until the early 1980's. The surrounding reclaimed marshland in 1740 was divided by drains, protected from flooding by river walls and seemed to be under pasture³⁸. The fact that much of the Essex estuarine marshlands had already been enclosed³⁹ for economic reasons was not as important as the strategic importance of having an unenclosed wet marshy area to the east of the fort, thus ensuring the salt marsh's survival in the long term.

The present marsh is the latest in a sequence of landscapes preserved as biogenic and inorganic deposits formed by relative sea-level changes and coastal movements over the last 10,000 years⁴⁰. Devoy's Thames type site sequence of alluvial deposits was identified at the World End Public House, with a 16m. deep sequence down to -13.4m. AOD⁴¹. Tilbury Fort was therefore constructed in the marshy floodplain of a major tidal river, in a on top of a very deep sequence of alluvial deposits. The site would therefore have been flat, been surrounded by both fresh and salt water marsh environments, had flowing water on two sides, been prone to flooding⁴², presented no shallow stable substrata for foundations and been isolated from contemporary human activity on the landward side but been very accessible to the major communications route of the River Thames.

(iii) DEFENCES

From the Medieval period onwards, the importance of the River Thames, not only as the lifeblood of the City of London but also as the potential route for any attack against the seat of government, has been recognised. Defences from the Tower of London in the west to the Offshore Forts to the east⁴³, together with the surrounding London Defence Positions⁴⁴, show the movement of defences eastward over time taking front-line defences further away from London. Strategic points between Essex and Kent were also defended as was the ferry route across the River Thames between Tilbury and Gravesend. This ferry is located at a natural crossing point, of vital importance for the movement of forces in the defence of, or in an attack on, London.

Temporary defences at Tilbury are known from the fourteenth and fifteenth centuries⁴⁵ but the first permanent defence was a blockhouse built as part of Henry VIII's coastal defences in 1539. Further defences were constructed in 1588 during the threat of invasion by the Spanish Armada⁴⁶. However the earliest defences visible today date from the late seventeenth century, work on which began in 1670, and which have been regularly altered until early this century.

The defences were constantly altered and updated over time because of the changing nature of offensive and defensive weapons and tactics. The advance in the technology of warfare had to be addressed by static defences for them to remain a deterrent against attack. The history of these defences is well preserved at Tilbury Fort for two reasons: firstly, because the fort was in a marsh, poor drainage prevented deep sub-surface chambers and bunkers being dug through earlier deposits and ensured the fort's ground level was constantly built upwards. Secondly, by the late nineteenth century Tilbury Fort had become strategically relegated, if not redundant, acting by 1900 as a mere ordnance store and mobilisation centre⁴⁷, leaving much of the fort without need for alteration.

- Henrican fort

No evidence has been found of what the medieval defences of the were like and their existence still comes from documentary sources alone. The Henrican defences were well documented with plans made of them in 1588⁴⁸ and 1670⁴⁹ showing a D-shaped blockhouse surrounded by an irregular ditch. The blockhouse, though modified, was integrated into the star-shaped fort and survived until it was demolished in circa 1867⁵⁰. The ditch surrounding the blockhouse was backfilled in 1681⁵¹ though it may have continued to be used for drainage. A barrel vaulted drain described on an 1911 plan as an "old barrel drain"⁵² can be traced back at least to 1715⁵³ and it shows a correspondence in alignment and shape to the blockhouse ditch backfilled in 1681.

- Armada refortification

It is known that the fort was refortified in 1588 during the threat of invasion by the Armada. Included within the works was the digging of an outer ditch with counterscarp bank⁵⁴. However this same ditch and bank were not maintained and there were complaints by Captain John Mason in 1630 that the ditch had filled up⁵⁵. It is possible that ditch 4021 found in Trench 32 (FIG.4) may be that outer ditch. 2.50m. wide by 1.00m. deep by 9.5m. long in size it had been filled by water deposited silts. Unfortunately it contained no finds, nor did pit 4051 which it cut, leaving its only datable relationship as being earlier than the 1670-1683 fort foundation clays (4011-13) which sealed it. There is doubt as to whether Genebelli's outer ditch was ever constructed⁵⁶ but the presence of a pre-1683 ditch situated within the inner fort area, on a northwest-southeast alignment suggests a correlation with Genebelli's plan⁵⁷.

- 'Star-shaped' fort and continued fortification works

Between 1670 and 1685 the construction of a major 'star-shaped' fort was undertaken at the site⁵⁸, incorporating the Henrican blockhouse but replacing all other buildings and defences. Over the next two hundred and thirty years the fort continued to be remodelled and rearmed. There are several general reasons for the continuous development of this fort, including the general psychological threat of attack, specific threats of attack during the French Revolutionary, Napoleonic and First World Wars and the development of military tactics and technology.

The psychological threat of the invasion of Britain or England has been of great importance in the development of its defence policies and therefore of its defences. The threat was real as witnessed by the scattered remains of the successful Roman and Norman invasions. The potential for invasion or attack by the Spanish, French, Dutch and Germans⁵⁹ continued over a long period of time. Neighbouring Scotland and Ireland, both before and after the Acts of Union, showed a readiness to seek foreign intervention in their struggles against England⁶⁰. The importance of commerce and trade for England meant that invasion was not the only tactical threat as raiding of ships and harbours could cause great damage. A raid up the Thames and Medway rivers in 1667⁶¹ by the Dutch showed the inadequacies of the contemporary defences against such attacks. These real and perceived threats ensured that remodelling of the defences was continually addressed by government, even if the improvement plans were not always followed through. Remodelling, repairing or re-occupation of defences commonly occurred during actual threats of invasion, for example during the Armada crisis, the Napoleonic Wars and World War II.

In the nineteenth century developments in technology meant that ships no longer tacked slowly up the Thames but steamed up at great speed, shortening the time available for firing at them. The introduction of iron vessels made penetration of the armour harder. Improvements in rifled artillery and the mounting of turreted guns on ships, rather than broadside weapons, meant that ships could fire accurately at the fort with greater power from a greater distance⁶². To address these developments the fort had to change its main emphasis from firing broadsides across the Thames to firing accurately at fast-moving targets down-river. This meant utilising powerful and fast guns from the commanding heights of the fort. An obvious result of these developments was the increase in the fort's height over time. Tilbury Fort was designed and built as a bastioned trace with defence in depth and a low profile to make it a harder target for attackers. It could be expected that the principle of keeping a low profile would lead to the keeping of a constant height during rebuilding. However the nature of the wet landscape required building up of the fort's earthen base to accommodate foundations for the increasingly large and heavy armaments.

- The Eastern Outer Moat

The moats contain river water which is introduced during high tides and emptied during low tides via sluice gates. The water in the River Thames is full of silt particles held in suspension which is deposited when stationary for a sufficient length of time. Silt was therefore, and continues to be, deposited in the fort's moats, at a rate which threatened their continued tactical value as wide expanses of water. That the Outer Moat (FIG.10) continuously silted up can be seen by contexts 71-3, 85 and 1115 in Trench 2 (FIG.5) and contexts 458-9 and 465 in Trench 10 (FIG.6), where a build up of 0.75m of silts was found between natural marsh deposits and the present surface. At least two recuts of the moat were identified, dated to between the late seventeenth and nineteenth centuries, recut 1117 in Trenches 2 and 10 and recut 1119 in Trench 10, though many more dredgings could have taken place. With the fort moats having a total length of circa 1500m. and a minimum width of 15m., any dredging work would have created considerable mud disposal problems.

- Rising level of the fort

A partial solution to the constant silting up of the moats would have been the increasing of the bank and surface heights around them, thereby redefining a bank/moat division. In Trench 19 (FIG.5) the Place d'Armes bank increased in height by 2.55m. from the top of wall 1106 (the earliest excavated bank remnant) to the present bank top. In Trench 1 the height increase between the original bank top (layer 19) and the present bank top was 1.55m. (FIG.7).

The ground level behind the banks in the Eastern Place d'Armes (FIG.10) also increased, as can best be seen in Trench 19 (FIG.5), where the successive (surviving) ground surfaces 1209 (late seventeenth century), 1104 (late seventeenth to early eighteenth century), 919 (eighteenth century), 112 (mid nineteenth century) and 911 (mid to late nineteenth century), show a total rise in ground level of 1.12m. The increase of the height of the Covered Way and its bank may have had an effect on the vertical angle of fire available to the next line of guns on the bastions to the west. Trench 54 in the north corner of the East Bastion showed some build up of deposits (FIG.8), with 1.20m of eighteenth century dumps (contexts 4520-4), and a further 0.64m. of deposits (contexts 4501-19) to the present ground surface, above which sat a further 1.80m.

concrete shield for a gun emplacement. Infilling of the East Bastion and remodelling of it and the Curtain Wall in 1868 and again before 1914⁶³ has almost certainly raised the height of this area of the fort. Along the West Curtain Wall excavation of its inner bank showed a build up of 1.50m. between the late seventeenth century bank top and the present bank top (FIG.9). The original height of the contemporary seventeenth century wall was obscured by the addition of a nineteenth century inner brick skin and post-World War II repairs to bomb damage.

- Eastern Place d'Armes (FIG.10)

The development of the defences of the Eastern Place d'Armes has been well preserved archaeologically. A brick wall (context 1106), of a mid to late seventeenth century date, acting as an internal revetment to an earthen bank was found in Trenches 1, 1A and 2 forming a *salient* within the outline of the present Place d'Armes. No evidence of a brick wall of seventeenth century date was found in any other Trenches to the south along the Covered Way so it is likely that this brick lining was for the Place d'Armes only. The wall had a maximum width of 0.78m. and a maximum excavated height of only 0.33m. as it was later deliberately demolished (context 1113) and the surviving stump sealed by clay layer 1105.

In Trench 1 it is uncertain as to whether layer 1108 was cut by wall foundation trench 1114 or whether it was dumped against the finished wall (context 1106). There seemed to be no foundation to this same wall in Trench 19 and nor did there seem to be any deposits built up against it. The nature of layer 1108 is important if at present unclear, as, in Trench 22 (FIG.11) it seals a roughly laid brick structure 1046 and a number of silty sandy lenses (contexts 1023-6) within shallow cut 1036. Unfortunately the western side of this brick structure was truncated by the nineteenth century construction of a magazine (FIG.12). Again of mid to late seventeenth century date brick structure 1046 is either earlier than, or would have been contemporary with, wall 1106 for just a short period of time before being buried. Unfortunately a very high watertable at this point meant that no deeper further excavations took place to determine whether this was a single-course structure such as a floor or a multi-course structure such as a wall.

The fact that the construction cut 1114 for wall 1106 in Trench 1 seems to cut the earliest banked deposit, clay layer 38, may give weight to the suggestion that there may have been a temporary defence along the Place d'Armes bank which was later replaced by a proper earthwork and parapet⁶⁴. The fact that it took twelve years to complete the original construction of the Covered Way, together with numerous contractors, suggests that the original specifications for the Eastern Place d'Armes may have changed during the course of construction.

Because of the great depth of the deposits and the limited extent of the trenches, total excavation right through the Covered Way banks was not achieved and the extent of the original banks remains unknown. However the slope from the original bank into the moat was very gradual, as seen by cut 1116 in Trenches 2 and 10 (FIGS.5 and 6), suggesting the use of low banks. It may be that there was not a bank as such, but a *glacis* extending downwards from the wall top into the moat. This would suggest that the moat would not have been very deep but rather a wide shallow expanse of water.

The presence of a brick inner revetment to the Eastern Place d'Armes bank suggests the presence of gun emplacements and this may be verified by a map of Tilbury Fort in 1698⁶⁵ showing the presence of a total of seven emplacements in this Place d'Armes. However after the late seventeenth century brick wall 1106 seems to

have become obsolete, as it was demolished (demolition cut 1113) and sealed by clay layer 1105. In Trench 1 the additional dumping of clay layer 18 defines a step of at least 2.10m. width which may have been a wide *banquette*, or possibly even a *terreplein*. The remains of a banquette survives in the north-east Covered Way and can just be traced south into the Place d'Armes. There seems to have been no brick wall associated with this period but clay layer 1118 was dumped on the glacis and the moat/bank edge re-defined by cut 1117 (FIGS.5 and 6).

In the mid to late eighteenth century the Place d'Armes ground level was raised with clay (contexts 939 and 1103), crushed chalk (context 919), and the construction of wall 921 (FIGS.5 and 13). The wall stands 1.08m. high above the foundation but its width is hidden by building of the later wall 53. It is likely that there was a gun embrasure in the immediate vicinity as a rectangular limestone slab (context 915) was found on the crushed chalk. Considerable raising of the bank was achieved with clay layers 1103 and 1115 in Trench 2 and 17 in Trench 1 (FIGS.5 and 7), and the surface of the bank was defined by the ashy rubbish layer 1102 in both trenches. The extension of the glacis in the area of Trench 19 had the effect of removing the furrow of glacis from the south corner of the Place d'Armes, leaving to this day a more rounded outer line to the Eastern Covered Way.

The next period of activity found in the Place d'Armes was a major improvement in the fire power and magazine provision in the mid 1840's. New gun embrasures were cut (context 935 in Trench 19), through the southern bank and the brick revetment, and concrete foundations (contexts 924 and 1201) and inner and outer rails constructed for supporting the traversing gun carriages (FIG.5). Only the concrete foundations of these platforms has survived, visible as parch marks during dry weather (FIG.14), as all the rails had been deliberately removed at a later date. Mortared into the wall (FIG.13) was the impression of the iron swivel pin (context 205) upon which the carriage would have turned⁶⁶. These gun embrasures would probably have been for the 32-prd. guns installed in 1846-8 in both Tilbury Fort and New Tavern Fort⁶⁷.

- Outer Moat palisades

The embrasure construction (921) probably took place at the same time as the major remodelling of the defences at the south end of the Eastern Covered Way which is known to have taken place in about 1779⁶⁸. A 10.60m. length of palisade 624 (not illustrated) was found at the south-west corner of the south-east end of the Outer Moat (in Trench 12), with a dendrochronology date for construction of post the winter of 1777-1778 (TABLE 2). Unfortunately the palisade was found by a machine excavator during revetment replacement work so that only the horizontal cross pieces and some of the vertical piles survived to be recorded in situ. Slots in the mud however showed clearly the positions of the lost wood and an accurate picture of its construction was recorded. Vertical piles spaced 2.10m. apart were connected by horizontal cross pieces to which vertical planks were secured 0.04-0.14m apart in the manner of a fence⁶⁹. A line of three earlier posts 623 (not illustrated) were found stratigraphically earlier than palisade 624 and are also likely to be a palisade. The one sample taken from this structure proved to be an undatable piece of alder. Palisades are known to have been intended for this area on all Sir Bernard de Gomme's, the architect for Tilbury Fort, plans for the fort between 1665 and 1670⁷⁰ and continued to be shown on many later plans⁷¹.

- Place d'Armes magazine (FIG.12)

In the centre of the Place d'Armes the surviving outline of an ammunition magazine can be seen (FIGS.12 and 14). Trenches 20 and 22 (FIGS.15 and 11) were positioned across the southern and eastern brick walls 955 in the centre of the Place d'Armes. In Trench 20 a timber foundation framework (962) was uncovered in which piles 975-6 and 987-90 were arranged in pairs, on which were laid horizontal beams 965-9. Joists 971-2 and horizontal beam 970 were positioned across beams 968-9 and secured by pegged lap joints. It is assumed that floorboards would then have been used for the final floor surface (FIG.16). Apart from at the southern ends of beams 968-9 under wall 955 where there was slightly better preservation, the wood only survived level to the surface of concrete foundation 1123. Once the wooden foundation frame had been pegged into place layers of concrete (context 1125 followed by 1123) were poured around it. There was a slightly different arrangement in Trench 22 where the timber foundation framework (1045) consisted of plank 1041 being secured by piles 1042-3 forming a revetting edge to concrete layer 1125 (FIG.11). Beside these piles lay plank 1044 which may be associated with this structure. In Trench 20 brick wall 955 was built after, and on top of, the wooden and concrete foundations. In Trench 22 however a space between the wall and inner floor of 1.42m was filled by earth and rubble layers 1008, 1102 and 1108, which were all in situ prior to the construction of the wall, and which were subsequently left in place.

This magazine was probably an *expense magazine* built to supply the five new traversing guns in the mid 1840's⁷² (TABLE 2). However it seems to have been short lived as it was no longer depicted by 1849⁷³, probably due to the cramped nature of space in the Place d'Armes. The complex and massive nature of the wooden and concrete foundations would have been to allow the construction of a structurally heavy building in marshland and the earth filled corridor between the outer wall and inner floor may have been designed as an earthen bombproof lining to the magazine.

- Abandonment of Place d'Armes

It is known that Tilbury Fort was largely disarmed in 1868 prior to major reconstruction works but it may have been rearmed between 1874⁷⁴ and 1886⁷⁵. After 1886 the gun positions were completely dismantled, the iron work of the rails and swivel pin were cut out (cut 907) and most of the foundation concrete of the inner rail destroyed in the process. At the same time cut 61 was dug parallel with wall 921 (FIG.5) to enable the widening of the wall by 0.20m (context 53) with provision for *counterforts* 0.37m wide. The gun embrasure was bricked up and the wall heightened (context 53) by at least 0.75m (FIGS.5 and 13). Cut 61 was back-filled with clayey-loam deposit 56, and the bank in both Trenches 1 and 2 was built up with clay layers 55, 57-8 and 1101 to give a smooth profile (FIGS.5 and 7).

By circa 1905 the need for Quick Firing Guns on the commanding heights of the East Curtain Wall and Bastion⁷⁶ would have left the embrasured low-lying Eastern Place d'Armes outworks useless, and therefore between 1886 and 1914 the Eastern Place d'Armes would have been abandoned and remodelled to act as a more conventional revetted counterscarp to the outer side of the Inner Moat complete with a *glacis*.

The changes at the fort from the 1840's onwards with a reduction in, and then virtual abandonment of, landward aimed artillery for covering fire in the event of attack from the landward side, and an increasing requirement for the ability to fire at ships whilst still downriver, meant that the Place d'Armes was no longer used to give covering artillery fire along the Outer Moat. The obsolete nature of and abandonment of landward aiming artillery was also seen by the discovery of a gun platform along the

south wall of the North-West Bastion in Trench 39 (not illustrated) beneath a surviving embrasure. The platform was abandoned and demolished between 1849⁷⁷ and 1911⁷⁸.

- World War II

Two configurations of thin steel boxes filled with tarmac (FIG.14), found between the southern wall 955 (FIGS.12 and 15) of the Eastern Place d'Armes magazine and the southern wall 53 of the Place d'Armes (FIG.5), may have been associated with the positioning of World War II anti-aircraft guns or spotlights.

(iv) BUILDING MATERIALS

The construction of Tilbury Fort represented a huge investment in materials, principally ceramic building materials and timber. Earth and water were also used extensively for the creation of defensive banks and moats but were available at the site, earth from the excavation of the moats and water from the river. Ceramic building materials and timber however had to be brought to the site, sometimes from very far away.

It is likely that the pre-1670 Tudor blockhouse and its associated buildings on the site were of brick construction, as the excavation of a contemporary blockhouse across the river at Gravesend suggests⁷⁹. All curtain and bastion walls, barracks, magazines and other buildings within the fort were brick constructions with stone only being used for decorative effect. It is likely that most buildings would originally have been tile roofed, only later being replaced by slate. The ferry house and related buildings, located within the area of the inner fort until 1681⁸⁰ would almost certainly have been built with wood, brick and tile. The nature of the temporary medieval defences at the site are unknown⁸¹.

The marshy nature of the site required all walls to have substantial wooden piled foundations. Wood was also used extensively within the buildings, for temporary structures and most water or river related structures such as palisades, bridges and landing stages.

Sufficiently large quantities of bricks and tiles were found as rubble, with archaeological deposits and as archaeological structures in the TF-88, TF-89 and TF2-90 excavations to establish patterns of the use of these materials over time and to be able to compare the archaeological record with brick structures still extant at the fort.

CERAMIC BUILDING MATERIALS (Ken Sabel)

Brick and tile has been classified using the London Building Material Fabric Series⁸². Fabric numbers were allocated to each piece of building material but as individual fabric types were commonly used over long periods of time, studying size, inclusions and method of manufacture enabled narrower date ranges to be established within the lifetime of each fabric.

- Bricks

The earliest bricks found within the fort were deposited in the West Curtain Bank as rubble during the 1670-83 construction phase. Material was found representing both the demolition and repair of pre-1681 buildings and the construction of buildings in the 1670-83 period.

The bricks probably relating to the demolition or repair to pre-1681 structures from deposit 4242 were fragmentary, orange, of fabric types 3033, 3046 and 3039 and post-medieval in date. Some yellow, imported Dutch paving brick, fabric 3036, circa 1600-early eighteenth century, was also present, as was one fragment of wedge shaped yellow brick, fabric 3035 (FIG.17:3), which first appeared in the late seventeenth century. It is also possible that fabrics 3035, 3036 and much of the orange brick could have been 1670-1683 construction debris and fabric 3036 may have been used for paving.

Table 1 Variety of orange and purple bricks and fabrics

ORANGE BRICK OF FABRICS 3033, 3046 AND 3039

Structure/Deposit	Length (mm)	Width (mm)	Thickness (mm)	Frogged ?	Date
Wall 1106 (FIG.7)	230	100	55	n	pre 1683
ditto	?	?	?	n	pre 1683
Layer 4242 (FIG.9)	225	105-6	60	n	pre 1683
Landport Gate	226	103	63-6	n	1670-1683
Water Gate	210-3	97-105	55-61	n	1670-1683
Wall 4290 (FIG.9)	215	105	55	?	early 18th-early 19th century
Layer 1030 (Tr. 22 not illus.)	217	102	63	n	early 18th-early 19th century
W. Curtain Wall Repair	225	108	64	?	post-1945 (or re-used)

PURPLE BRICK OF FABRICS 3032 AND 3034

Structure/Deposit	Length (mm)	Width (mm)	Thickness (mm)	Frogged ?	Date
Wall 921 (FIG.5)	225	105-7	62-4	y	18th century
Layer 1030 (Tr. 22 not illus.)	224	102	63	n	late 18th-19th century
Wall 955 (FIG.12)	220-6	105	61-4	y	late 18th-19th century
ditto	?	?	67	y	late 18th-19th century
West Curtain Retaining -					late 18th-19th century
Wall 4279 (not illustrated.)	220-30	100-10	62-6	y	late 18th-19th century
Wall 53 (FIG.5)	227-32	103-4	66-8	y	late 19th-early 20th century
West Curtain Wall Repair	211	100	62	?	post-1945 (or re-used)
ditto	225	97-9	63	?	post-1945 (or re-used)

Unfortunately the size of the bricks used in earlier structures is unknown and the material excavated very fragmentary. The one complete example of fabric 3046 recovered, 225mm. x 105-6mm. x 60mm. (FIG.17:1), may have been from construction debris, being the same size as the bricks used in the Water Gate. Brick of the orange fabrics appeared in the late seventeenth century wall 1106 in the Place d'Armes (FIG.5) varying in size between 230mm. x 100mm. x 55mm. and ?mm. x 106mm. x 63mm.

Fabrics 3033, 3046 and 3039 were used in the 1670-1683 construction and at least two sizes of brick can be seen in contemporary extant buildings. In the Landport Gate they measure 226mm. x 103mm. x 63-66mm. In the Water Gate they have a similar length (210-233mm.), but their width varies considerably (97-105mm.) and they are much thinner (55-61mm.). As both of these structures were completed by 1682, it seems that bricks from several different sources with different sized moulds were used contemporaneously, which seems practical, considering the scale of the works.

Orange bricks within the same size range as those in the Water Gate continued to be used in the eighteenth century, appearing in a lining along the top of the West Curtain Wall 4290, though it is uncertain whether they were frogged. One complete unfrogged fabric 3033 brick (217mm. x 102mm. x 63mm.), late eighteenth to early nineteenth

century in date, was found in the Eastern Place d'Armes. Its speckled yellow surfaces were the result of developments in the firing process towards the end of the 18th century. No examples of frogged bricks of fabrics 3033, 3046 and 3039 were found nor can any of the fort's extant walls be said to contain orange frogged brick.

Hard purple bricks of fabrics 3032 and 3034 first appeared in the late seventeenth century in the London area and the retrieval of one fragment from late seventeenth century context 4230 would indicate the use of the most modern materials at the fort during this period. After the introduction of frogging, fabrics 3032 and 3034 both continued to be used at the fort. Wall 921 in the Eastern Place d'Armes (FIG.5), probably dating to the late 1770's, contained examples of fabric 3032 with shallow frogs. 225mm. x 105-7mm. x 62-4mm. with no surface discolouration (unlike all bricks of fabrics 3032 and 3034 in subsequent phases) these represented the earliest examples of frogged brick found in the fort. The relatively late introduction of frogged brick into the fort, may have been the result of a gap in new building works between 1715 and the 1770's or a continued reliance on traditionally produced local unfrogged brick.

Frogged bricks of fabrics 3032 and 3034 had widespread usage from the late eighteenth to late nineteenth centuries. Bricks of both fabrics were used in the construction of a retaining wall 4341 at the bottom of the West Curtain Bank. Very similar sized bricks, 220-226mm. x 105mm. x 61-64mm., were found in wall 955 of Eastern Place d'Armes magazine (FIGS.11-12), and probably date to the 1840's. Larger, frogged examples, 227-232mm. x 103-104mm. x 66-68mm., of these fabrics were found in the late nineteenth century wall 53 (FIG.5) with crude manufacturer's stamps (FIG.17:2).

Yellow London Stock bricks of fabric 3035, only appeared in the 1670-1683 construction and in the post-Second World War repair to the bombed West Curtain Wall. These later bricks had frequent voids and inclusions and measured 222mm. x 108mm. x 62mm. Some of these bricks and other bricks used in this reconstruction work, were probably re-used demolition debris brought in from Purfleet⁸³.

- Brick Fabrics

3032: Reddish purple, relatively hard, with many inclusions. Sometimes contains a quantity of domestic rubbish. It first appeared in the late seventeenth century and continued in use until the present day. Frogging was introduced in the early eighteenth century.

3033: Light orange-red to dull orange, made of local brickearths, relatively soft with some quartz (<0.7mm.), occasional black iron oxide and yellow small silty inclusions. Later examples contain an increased inclusions. Bricks of this fabric first appeared in the late 15th century.

3034: Similar to 3032 but permeated with silt lensing.

3035: Creamish to dark yellow containing moderate to frequent voids, occasional black iron oxide and slag. Represents London Stock Brick.

3036: Creamy yellow with purple silty inclusions, dense, represents imported Dutch paving brick c.1600-circa 1700 in date.

3039: Similar to 3033 and sometimes as sandy as 3046, but containing a larger amount of silt lensing.

3046: Similar to 3033 but with a higher sand content.

Roof tiles

The earliest form of roof tile found at the fort, from the 1670-1683 West Curtain Bank deposits, was thick peg tile (fabric 2271) dating to the late Medieval period. The presence of this material suggests the demolition of a Medieval structure or the reuse of Medieval tiles in a later structure in the vicinity. Fabrics 2276-near-2271, 2271-near-2276 and 2276 were also present in the same deposits but differ from fabric 2271 only in the coarseness of the moulding sand on which the tiles lay, prior to firing. Fabric 2276 is laid on the finest sand and is Post-Medieval in date. The tiles of the other fabrics, and possibly some of fabric 2276, came from the demolition of, or repair to, structures which pre-dated 1683, rather than from construction debris. Only one example of a peg tile (fabric 2276-near-2271) showing complete dimensions was recovered, measuring 270mm. x 154mm. x 12-14mm. (FIG.17:4). Two examples of fabric 2276 showed full widths, one 150mm. and the other 157mm. wide. Fragments of peg tiles of all these fabrics appear throughout the excavation record, showing the continued existence and repair of peg tiled roofs at the fort. Round, diamond or square shaped peg holes appear on tiles of all peg tile fabrics.

Pantile roofing was also used at the fort. These tiles of fabric 2275 were curved, overlapping each other to the sides, as well as top and bottom. Full dimensions could not be ascertained. The fact that they appear in context 4242 indicates that pantile roofs were used in at least some of the structures built between 1670-1683, for though pantiles have been found in the London area as early as circa 1620 to circa 1645⁸⁴ they only came into widespread use in the 1660s. Early pantiles were Dutch imports but the first English pantiles are thought to have been made in Tilbury in 1701 by a company in which Daniel Defoe had an interest⁸⁵. It is possible that some of the eighteenth century pantiles from Tilbury Fort may come from this local source. Their presence shows the use of the most fashionable contemporary materials in some of the buildings of the fort. Their continued appearance in subsequent archaeological deposits indicates the continued maintenance of these roofs. They were eventually superseded by roofing slates. It seems that the pan tile and peg tile roofing systems were both in use concurrently in the fort.

All ceramic tile roofs would have been topped with ridge tile. They appeared in fabrics 2271, 2276-near-2271, 2271-near-2276 and 2276. Only one ridge tile, from context [4242], (FIG.17:5) showed the full length of 330mm. and a 154mm. measurement from its apex to edge.

Roof Tile Fabrics:

2271: Varies from light orange-red to brown containing varying quantities of mica, calcium carbonate and occasional quartz. Represents medieval peg and ridge tile (1150/80-c.1500), laid on coarse moulding sand before firing.

2276-near-2271: Similar to 2271 representing late medieval to very early post-medieval peg or ridge tile, laid on sand slightly less coarse than 2271.

2271-near-2276: Represents peg and ridge tile of very late medieval to early post-medieval date, laid on finer sand than 2276-near-2271, though not as fine as 2276.

2276: Similar to 2271 representing post-medieval peg and ridge tile, laid on fine moulding sand (1480/1520-c.1900).

2275: Orange with varying quantities of calcium carbonate, sand and black iron oxide, representing pantiles. Dates from the late 1660s to early nineteenth century.

(II) THE RELATIONSHIP BETWEEN TILBURY FORT AND THE RIVER THAMES

As a visit to many harbours, ports or docks across the world will testify, good locations for the shelter and loading/unloading of boats have often been in use for long lengths of time. The remains of boat docking structures from previous eras can frequently still be seen, representing the processes of building and repair. Structures often had to be replaced because of the growing size and capacity of boats over time, because of technological innovations or because of damage to or decay in older structures. However earlier structures were rarely demolished beyond the necessity of preventing a hazard to shipping, because of the working difficulties in watery environments. Partially demolished or truncated boat docking structures are therefore often ideally located in muddy environments beneficial to their preservation. Essex, with a large inter-tidal zone, is proving to be very rich in well preserved inter-tidal archaeology including harbours⁸⁶. The importance of harbour sites can often be seen in the scale of fortifications constructed for their defence, as can be seen at Portsmouth⁸⁷, Chatham⁸⁸ and Bermuda⁸⁹. Tilbury Fort was part of the defence system of the River Thames and the Port of London, as well as being on an important cross-river ferry route. Circa 1100 timbers were recorded during a survey of the foreshore in front of the fort, representing the nature and importance of riverine activity to the fort. The **(i) riverine structures** will be examined followed by a **(ii) dendrochronological analysis** of the timbers used in the structures, to date them and assess the contemporary resource use they represent.

(i) THE RIVERINE STRUCTURES

The City of London's growth was intimately linked to the fact that the River Thames provided the best harbour in south-east England and an incomparable position for trading and political links with the continent⁹⁰. However as the main arterial route into London the River Thames could also potentially provide the quickest attack route for enemy forces. As such it was vital that the river was guarded and Tilbury Fort was part of that first wide ranging and permanent defence constructed in the 1540's⁹¹. Its enlargement into a bastion trace fort defending a large battery along the shore line was also to defend the Tilbury-Gravesend ferry against capture and to ensure a link across the river between Essex and Kent⁹².

The need to fire across and along the river dictated the fort's location in the alluvial marsh on the river edge and therefore influenced many aspects of its design and running. The fort had to withstand the influences of a tidal river and deep wet marsh and its survival is a testimonial to the engineering work in its construction. Land communication was poor, the roads around Tilbury were especially notorious for their bad condition in the eighteenth century⁹³, and Tilbury Fort could not be reached by rail until 1855⁹⁴. Excellent communications along the River Thames however meant that construction materials, supplies and men would mostly have moved by river resulting in the fort's own system of riverside landing stages (see below).

The river was used as an integral part of the defences supplying water to its Inner and Outer Moats which functioned as delaying barriers to attacking forces (FIG.14). What may also have influenced the choice of the fort's location is that the creek, known

variously as Pincock's and Bill Meroy's Creek⁹⁵, its tributaries and open wet land to the east of the fort would have effectively acted as a third moat, or outer barrier.

A survey with limited excavation on the central and eastern foreshore (FIGS.18 and 19) has enabled a sequence of riverside structures, building techniques and activities to be studied. A survey of the river wall undertaken in 1979 in advance of the construction of the new Thames Barrier Flood Wall⁹⁶ recorded the presence of timbers on the foreshore and is the only record of the area of ground since buried by the new Flood Wall and its apron of rock bunds and have been included here where appropriate. The 1989 survey concentrated on two areas of the foreshore because of the inaccessible nature of this tidal area, the known concentrations of timbers in these two areas and because of the detailed level of recording attempted. However an extant causeway in front of the Water Gate was only partly recorded and a further concentration of timbers in front of the present World's End Public House was only noted because of time restrictions. The timbers above, and in, the foreshore mud were surveyed as these surface mud deposits reached depths of up to 0.50m. in places, making exploration of deeper foreshore deposits, where timbers almost certainly lie, impossible.

Defining individual structures and alterations was done by recognising the pattern of timber alignments and timber forms. Species identification and dendrochronology were also used to try to identify and verify patterns of material usage as well as absolute dates. Unfortunately the use of timber that is of poor quality for dendrochronology as well as the widespread use of non-oak species meant few absolute dates have so far been obtained. This did not however mean that this same wood was necessarily poor for building purposes. British dendrochronology is based on the analysis of oak and is only just beginning to move into other non-oak species⁹⁷. The creation of the country's first spruce chronologies has enabled some relative dating site and may enable absolute dating in the future. Documentary and map evidence have enabled rough dates to be applied to the relative and stratigraphic chronologies as well as to other foreshore structures (see TABLE 2).

Foundations for the fort had to be designed for the soft, wet alluvial deposits of the riverine marsh. An artificial island had to be constructed in the marsh in order to raise the level of the fort above the surrounding ground surface. Large quantities of clay were used for this purpose, most probably deriving from the excavation of the two moats. Evidence of this clay platform or island was seen in the Redan⁹⁸, Eastern Covered Way⁹⁹, Trench 32¹⁰⁰ and under the bank of the West Curtain Wall¹⁰¹.

It is likely that all the major brick structures in the fort, such as the curtain and bastion walls must have had piled foundations, as at least several thousand piles are known to have been used in the fort construction of the late seventeenth century¹⁰². This construction technique was common practice in the seventeenth century with revetment masonry sitting on timber frames above densely packed piles¹⁰³. Within the fort, however, only a single horizontal timber (1208) found underneath wall 1106 in the Eastern Place d'Armes. Unfortunately it had insufficient rings to be dendrochronologically dated and may well have been unconnected with the foundations.

On the Central Foreshore the outline of the timber foundations, for the Water Bastion, survive and can still be seen at low tide. This bastion was intended to extend out into the river so as to have a commanding firing range directly downstream and it would have completed the regular pentagon design of the fort. Construction began on the foundations for this bastion but was abandoned between 1676, when a decision to include it in a contract was postponed, and 1681, when it was no longer mentioned¹⁰⁴. No reason is known for the actual abandonment of this work but our own experience of

trying just to survey the foreshore showed the enormous and costly problems of trying to work in such an environment.

Working in the foreshore mud was both difficult and at times very unpleasant because of its slippery viscous nature. Getting stuck and falling into it were common occurrences and the weight of mud on clothes and tools slowed down most tasks. Time available for work was limited to low tides in daylight hours, and even then some tides were not low enough to give sufficient time to complete tasks. To make best use of time excavations ran concurrently on the Eastern Covered Way, enabling work to proceed on land based jobs when tides were high. In order to make best use of the available windows of time task allocation was specific to tide levels. During daytime low tides the team would clean small sections of the 5m. x 5m. survey grids at the top of the foreshore, moving down into the next grid as the water uncovered it and so on down to the lowest area of wood revealed on that day. We then we planned and recorded the cleaned wood in the grids progressing back up the foreshore as the tide turned and proceeded to recover the timbers. There was a definite ratio between the numbers of complete grids that were surveyed, the numbers of timbers found and their location on the foreshore (FIG.20). While working methods in the 1670's would have been different, it is possible that some sort of anchored platforms may have been used on the foreshore as on the marsh¹⁰⁵, the same basic problems would have made the construction of the bastion foundations difficult, slow and expensive. In the late 1770's the building of the Water Bastion was again proposed but not enacted because of cost¹⁰⁶.

- Structure 1800

In all a total of 686 vertical piles and horizontal beams were recorded which can be interpreted as belonging to the Water Bastion foundations (structure 1800) (FIG. 21). More timbers probably survive at the north-west end of the structure but were too deeply buried by mud to be accessible. The structure consists of a 'V-shaped' horizontal frame filled and surrounded by vertical piles. The frame would have consisted of three rows of parallel beams in each arm of the 'V' crossing at the apex of the structure to form four boxes within a square. The end of the eastern arm had evidence of all three rows of beams surviving. Only beam 3016 survived in the western row and at only 4m. long was the shortest timber used in the whole structure. The central row consisted of three beams laid end to end, but seemingly not secured to each other, making a total length of 18.20m. Again in the outer eastern row only one beam survived, but measured an impressive 11.70m. in length. Circa 1.20m. from the end of the eastern arm a single crossbeam tied the three rows of beams together. The outer row beams were secured to the crossbeam with lap-dovetail joints while the centre row beam was secured by a simple lap joint. All the joints were further secured by two iron nails.

Towards the middle of eastern arm two gaps in the piles indicate that crossbeams also straddled, or were to straddle, this part of the arm circa 2m. apart. The southernmost beam (3043) in the central row was out of position, lying on its side. Its under-side was revealed to show a rough unfinished surface and a half-lap. It is probable that this was half of a lap joint with a beam crossing it from the inner row of the western arm. It is not possible to say whether beam 3043 was disturbed by the removal of a beam from the western arm or whether it was on its side awaiting its instalment.

Only one horizontal beam survived on the western arm but the spaces visible between the piles for horizontal beams indicate a similar pattern to the frame in the eastern arm with three rows of beams comprising the arm. This 9m. long beam had a half lap-dovetail intended for a crossing beam but differed from those in the eastern arm

in that its northern end was cut as an edge-halved scarf with angled butts. If this west end was to mirror the eastern arm end there would be no need for a scarf joint to lengthen the beam. Therefore either the beam was reused, or, this arm end was to be different from the eastern arm end. No other timbers in structure 1800 had any visible evidence of reuse, and a fresh yellow colouring on the wood was preserved under the mud, again suggesting that they were not re-used. Wood chips found beside the northern end of this beam, of the same wood species (spruce) as the beam, suggest that the scarf joint may have been cut in situ. It may have reflected the intention to incorporate a quay to the west of the Water Bastion, as intended by the 1670 plan by Sir Bernard de Gomme¹⁰⁷, into the bastion foundations.

No indication of any kind of piles supporting the frame could be seen, that is there were no joints, and in the space revealed by beam 3043 lying on its side, no deep piles could be found. This does not preclude their survival at a deeper level as the beam top surfaces were generally at the same height or slightly below the tops of the piles.

The piles were mostly roundwood, though some seemed to have been roughly shaped, and varied greatly in size from 0.05-0.39m. The piles were situated in the boxes within the horizontal beam frame with a single row of piles along the outer and inner edges of both arms. The respecting of the spaces where the horizontal beams were supposed to lie suggests that at least some of the beams may have been removed after the late seventeenth century. The piles were mostly organised in distinct groups or alignments such as in the middle of both arms. Piles from this structure are reported to have been pulled out when the new river flood wall was being constructed, measuring 2m in length with metal tipped points. Timber 1887, which was partially covered by the cement in the new river wall and which was dendrochronologically dated as being contemporary to structure 1800, may have been one of these piles.

Lines of very small posts were recorded respecting the inner and outer edges of the foundation, but set circa 0.5m. from it. These do not appear to have been structural being variously rectangular, triangular and oval in section, which suggests reuse of any available timber. It is possible that these posts were markers to set out the design of the Water Bastion foundations for the construction contracts¹⁰⁸.

- Structure 1866 (FIG.21)

Structure 1866 consisted of a line of posts running at a twenty degree angle to the line of the foreshore. Twelve posts of both oak and spruce were found to be in this structure, dressed variously into quartered and squared sections. Although it could not be traced further west because of later concrete constructions it does have a bastion-like shape and follows the line and axis of bastion foundations 1800. Post 1885 has been shown by dendrochronology to be broadly contemporary with the bastion foundations. This structure seems too flimsy to be part of the foundation for the bastion but it could have been a palisade which, after the construction of the Water Bastion had been abandoned, was situated outside the bastion rump. This is supported by a number of late eighteenth and early nineteenth century illustrations¹⁰⁹ showing palisades across the front of the fort with gaps through it for access to the landing stages and on the foreshore itself. A foreshore palisade is also known to have been situated around the Water Bastion and pier of Upnor Castle, on the River Medway, from the late sixteenth to nineteenth centuries¹¹⁰. In the absence of the Water Bastion at Tilbury Fort a palisade would have been doubly required to defend the foreshore against landing troops.

- Landing stages

As well as being used for defence the River Thames was important for transport and communications. A number of landing stages were constructed and which were recorded on the foreshore survey. The development of these foreshore structures can be seen in terms of the difference in military and civilian use and their development into function specific types. To facilitate their description a number of terms are used here for foreshore structures used for the disembarkation of passengers and goods from boats:

- Causeway -** solid linear structure extending perpendicularly from the shore, with a sloping top surface, following the line of the foreshore, to enable boats to come alongside at any tide level.
- Jetty¹¹¹ -** solid linear structure extending perpendicularly from the shore, with a roughly horizontal top surface.
- Landing Stage -** generic term for any structure or platform for the disembarkation of passengers and goods.
- Pier -** linear structure extending perpendicularly from the shore, with a horizontal top surface and open below, that is, water can flow through the lattice of vertical structure members.
- Quay -** revetment for securing boats broadside to the shore. This revetment may be extended out into the water by means of a rectangular platform. Can be either solid or open below.

Communication between Essex and Kent across the river are known to have been provided by a ferry between Tilbury and Gravesend since at least 1304¹¹². Early landings would probably have been on the foreshore beach itself but at some point a landing stage would have been introduced to make landings easier. This would probably have been in the form of a solid linear structure, such as a causeway, extending out from dry land to allow dry embarkation of people and goods to be made at low tide from boats. Because of river currents it is unlikely that causeways of unrevetted stone or earth would have been used, and it is likely that stone or wooden revetting would have been used to lend stability to any structures. In 1588 a sum of money was authorised for a wharf at the fort¹¹³ but it is unclear as to whether this was sanctioned for construction or repair. From Genebelli's 1588 plan of the fort¹¹⁴ onwards to the present day a landing stage is shown in front of the fort, which was used by both ferry passengers and the fort's garrison¹¹⁵ until the ferry was forced to move west to the now World's End Public House in 1681¹¹⁶.

The landing stage illustrated on Genebelli's plan begins at the south-west corner of the Henrican Inner Moat, runs east parallel to the front of the fort before turning south into the river in front of the line of the blockhouse. The construction appears to comprise a single row of posts on the west side with a double row on the east side. The east side is level with the top surface but the west side is raised above the surface creating a wall and both sides are seen to be lined with what appears to be planks or wattle suggesting a solid infill. This arrangement suggests the construction to be a jetty or causeway enabling landings to be made on the west side with the higher east side providing a windbreak from the prevailing easterly winds.

- The causeway

By 1660 the above jetty seems to have been superseded as Sir Bernard de Gomme's survey of the West Tilbury Blockhouse¹¹⁷ shows a landing stage extending straight out into the river from the south-western corner of the Henrican fort. This landing stage can be traced through all subsequent plans of the fort as a causeway¹¹⁸ and

is still extant (FIG.18), if in a state of ruin, today. I.P. Defmaretz's 1735 plan of the fort¹¹⁹ refers to it as a "Causeway or Landing Place" and clearly shows it as an externally revetted structure with horizontal beams tying the two sides together with what appears to be a gravel fill indicated.

This causeway had a dual civilian and military use until the ferry was moved to the west of the fort in 1681, and thereafter the causeway would have been for the exclusive use of the fort, as a 1698 map¹²⁰ shows a separate landing stage at the new ferry house. By 1684¹²¹ a quay was constructed to the west of the causeway, corresponding to a spur of land illustrated by Genebelli in 1588. Presumably the causeway would have continued to have accommodated small boats and passengers while bulkier items were dealt with at the quay. Between 1715¹²² and 1735¹²³ a pier type extension had also been added to the end of the quay consisting of vertical piles tied in pairs and which continued in use until between the 1770's and 1849¹²⁴.

Two phases of build (3107 and 3108) were recorded in the causeway structure at the time of survey (FIG.22). They were visible because the northern end of the causeway is highly decayed due to a constant exposure to both water and air, and subsequent destruction by wave action has all but removed the horizontal planking of the later build (3108) revealing the earlier structure (3107) behind. This area of wood decay in the structure is similar to the decaying zone noted by Milne on rubbing posts on the Thames foreshore at Trig Lane¹²⁵. The earlier build (3107) consisted of post and plank revetting, with the posts spaced 0.36-0.42m. apart and a gravel fill. The subsequent building of 3108 left the original structure in place, but filled the gaps between the earlier posts with stones and mortar, faced the sides with planks and then revetted the planked sides with a new series of posts spaced 0.88-1.35m. apart. Circa 13.5m. down the surviving causeway the single outer post arrangement was replaced by pairs of posts, presumably for greater stability. The interior of the causeway was seen to have a timber frame which is likely to have been associated with phase 3107, as was a stone slab surface. The later concrete surface which covered most of the structure was probably associated with the later phase 3108. No dating of the structure was undertaken so the dates of the phases are unknown.

- Documentary evidence for piers on the Central Foreshore

The pre-1684 and 1698 plans¹²⁶ show an additional landing stage to the east of the causeway extending directly out into the Thames in front of the Blockhouse. Again a landing stage at this particular spot can be traced through all subsequent plans of the fort to the twentieth century¹²⁷. From 1740¹²⁸ to 1849¹²⁹ it is called a "POWDER BRIDGE", that is a separate landing stage for the unloading of gunpowder. This operation would have been allocated its own pier, away from the causeway and quay so as to minimise the risk of explosion. Many of the other activities taking place at the causeway and quay may have had the potential of, and therefore danger of, creating sparks. As the old blockhouse acted as one of the fort's magazines, prior to the construction of the main powder magazines in 1716¹³⁰, it was possible to unload gunpowder and other armaments directly in front of it using the new pier. The 1698 map and 1715 section through the blockhouse and pier¹³¹ show a path from this pier to a raised door in the front of the blockhouse. By 1849 this entrance was no longer depicted and may have been defunct.

A pier construction would have also enabled the use of a wooden planked top surface, as the joists on the 1715 section indicate, cutting down the risk of sparks. If there was a blast on a docked boat, the pier, by its nature (open below), would be non-confining allowing greater dissipation of the blast, whereas a solid landing stage could

direct the blast potential towards the busier quay and causeway. The disadvantage of piers, however, is that they are vulnerable to the action of water¹³² and therefore do not have a long life expectancy.

Significant changes in the plan of this pier over time showed that it was frequently altered or rebuilt. The plans of 1684 and 1698 show the pier to be a linear walkway and longer than its contemporary causeway. The section and plan of 1715¹³³ also show a deck edged with a handrail and supported by piles, which appear to be free-standing unconnected to baseplates. An early eighteenth century prospect of the fort frontage from the river¹³⁴ also shows this pier as a deck with piles secured by cross-bracing between perpendicular pairs of piles (FIG.23).

By 1740¹³⁵ the pier seems to have either been lengthened, or widened, as the end of the deck widened into a trapezoidal shaped terminal, presumably for easier unloading. This pier design can be traced through to 1778¹³⁶ and 1779¹³⁷.

The pier had changed significantly by the 1849 survey of the fort¹³⁸, by when the deck of the "POWDER BRIDGE" led to a rectangular end. The deck is shown to be above horizontal beams extending equally beyond both sides of the pier and which presumably supported joists. A rectangular extension midway on the west side of the structure seems to be a set of steps down to the foreshore.

Between 1868, when the fort was remodelled¹³⁹, and 1894¹⁴⁰ a new pier was constructed with the terminal platform extending eastward. This is seen in greater detail on the 1911 map¹⁴¹, showing a "Pier" consisting of a deck ending with an "L-shaped" terminal. Vertical piles are indicated as lining the south edge of the platform whilst four piles and horizontal timber are shown on the east edge. This pier is also shown on a 1947 map¹⁴². By the time it was photographed in 1952¹⁴³ it was in an advanced state of decay, though extant enough to distinguish some of its component parts (FIG.25). It had been demolished by the time the foreshore was next photographed in December 1954¹⁴⁴.

With a predominantly iron pillar superstructure the body of the construction is reminiscent of the English seaside pleasure piers, mostly built between 1870 and 1900,¹⁴⁵ but its wooden terminal is more in line with piers used by industrial ships¹⁴⁶. The photographs taken in 1952¹⁴⁷ (FIG.25) showed pairs of pillars joined by diagonal cross-braces, on concrete bases, supporting horizontal iron girders. The end of the pier is surrounded by a frame of wooden piles. A "Crane" and a "Signal Head Light" at the pier terminal indicated on the 1911 plan can be identified from photographs as a simple wood and iron hand crane¹⁴⁸. The substantial use of iron in a pier used for unloading armaments must correspond with a change from the use, and therefore transportation of, loose gunpowder to shells, and the corresponding decrease in risk of accidental explosion from defused shells.

- The excavated landing stages on the Central Foreshore

The survey of the Central Foreshore found evidence of six landing stages, structures 1823, 1825, 3074, 3075, 3081/82 and 3083, between the extant causeway and eastern arm of bastion foundations 1800. Several other groups of timbers have been interpreted as being component parts of the above piers.

Structures 3074 and 3081/82 (FIG.26) are interpreted as being the oldest structures on the foreshore. Structure 3074 consists of a row of six posts with tenoned tops for supporting a base-plate, a parallel and offset row of three posts to the east and a single post to the west of the tenoned row. All posts were roundwood and the arrangement would suggest a base-plated revetted side of a jetty or causeway, though the survey limitations meant that no other parallel revetment was found. Row of posts 3081, when

combined with the row of posts 3082, forms a possible structure (3081/82), consisting of two parallel rows of posts. Of the widely spaced posts in row 3082 five are roundwood and one a quartered roundwood. Row 3081 consists of three squared timbers and eight complete or halved roundwoods. Posts 1918 and 1922 have tenoned tops which in combination with the halved roundwoods would suggest that this is the foundation for a base-plated revetment such as those used at Trig Lane, London¹⁴⁹. Because of the large size of the timbers and detailed construction joints structures 3074 and 3081/82 are interpreted as causeways (3081/82 with a larger and stronger revetted east side) rather than as components of palisades.

No dendrochronological dates were obtained from the timbers in structures 3074 and 3081/82. However the posts in structure 3074 were encased by the concrete apron associated with the base-plates of nineteenth century pier structure 1825 making 3074 stratigraphically older than 1825. It is difficult to imagine structure 3081/82 functioning with the piles of the bastion foundation in situ (all later landing stages were further to the west so as to avoid or minimise the hazard of the bastion foundation piles) so it must be older than 1675. With its structurally different sides structure 3081/82 may be the landing stage shown on Genebelli's 1588¹⁵⁰ map and structure 3074, because of its position among the later powder bridges, may be the first powder bridge shown on the 1698 map¹⁵¹.

Structure 3075 (FIG.27) is also stratigraphically older than pier 1825 because of the concrete apron encasing some of its piles. Nineteen piles from the 1989 survey have been interpreted as being part of this structure, arranged in parallel rows of three posts. An extra three piles on the eastern side may be for extra strength or repairs. Most of the piles are large squared timbers though small timbers were used at the northern and southern extents of the structure. Three posts were surveyed in 1979¹⁵² to the north of the present flood defence wall that are probably part of this structure. This pier has a very similar build to that illustrated on the 1715 section of the blockhouse and associated pier¹⁵³.

Pier structure 1823 (FIG.27) consists of four base plates of different sizes but all with the same central axis and a line of three piles. Spread over a total north-south length of 20.50m. the northern plate 1824 consists of a roughly shaped slightly curved timber 4.32m. long, with two mortises on the upper face. Plate 1964 is properly squared off with two mortises on the top face, but is only 2.50m. long. Two iron pegs on either side of its east mortise suggests a supporting pile below the plate or that this timber was reused. Further to the south of this plate lies pile 3015, measuring 0.30m. x 0.26m. At the south end of this structure lies plate 1982, 5.48m. long with four mortises on the top surface. The 1979 survey of the foreshore wall located a "wooden foundation", interpreted as a baseplate, but unlocated by the 1989 survey, 5m. to the north of plate 1982 and circa 3m. long, which almost certainly belongs to this structure as well as five piles, possibly belonging to this structure, to the north of the current flood defence wall¹⁵⁴. Still extant in their mortises were two wedges in plate 1982 and both wedge 3042 and post 1914 in plate 1824. Post 1914, measuring 0.24m. x 0.16m., had been deliberately cut down to just 0.03m. above adjacent plate 3035 (of structure 1825), suggesting a deliberate demolition of pier 1823 to build pier 1825. This post was oak and had a felling date of post-1784. The long southern base-plate to this structure suggests a platform end wider than the deck, but of an unknown shape.

Much of pier 1825 (FIG. 28A and B) survives comprising five baseplates, several vertical posts and concrete apron. Two phases of construction have been recognised in this structure with the terminal changing from a trapezoidal end to an extended rectangular end (see figs. 22a, b). The deck of both phases of the pier consisted of the

north four baseplates, each circa 6m. long, with three mortises and spaced 2.20-2.90m. apart.

The terminal of pier 1825 Phase A appears to consist of structure 3077 a much truncated uneven line of baseplates starting in a north-south line but then turning south-east. Plate 1950, partially covered by later concrete apron 1832, has one complete mortise and one truncated mortise at its north end. The 1979 survey located a further horizontal timber plus a pile immediately to the north of 1950, and on the same alignment, which almost certainly belong to this structure¹⁵⁵. Further south two horizontal plates, one with two mortises, were secured by re-worked piles from structure 1800. This line of plates seems to be cut by baseplate 3035 and structure 3078 and judging by the cut piles to the south it would possibly have continued in that direction. This configuration of baseplates if mirrored on the eastern side of the central axis of pier 1825 would have given a trapezoidal terminal to the pier.

Pier 1825 Phase B consisted of baseplate 3035, 6.14m. long with three mortises, with two upright posts (1923 and 1924) still in situ. An internally stepped mortise 0.12m from post 1924 and two shallow scoops, that is the beginnings of mortises, show that the design or alignment of the upright posts changed during construction. The remains of five braces, structure 3078, belonging to three sets of cross-braces with face-to-face lap-joints, were found to the south of, and centrally aligned with, plate 3035. This structure has been much truncated with all the braces having been cut down to, or below, the lap-joints and the south-west pair of braces is missing altogether. This cross-brace structure would have supported a rectangular terminal platform.

The stratigraphically latest pier in this long sequence of "powder" piers (TABLE 2) is pier 3083 consisting of six iron pillar bases arranged in three pairs over a north-south distance of 29.20m. The stumps of the iron pillars themselves were 0.14m. in diameter and in the north-east example widened into circular base 0.40m in diameter. On the eastern central example two iron rings, presumably where pillar cross-braces were attached, survived. Judging from the eastern central, and southern two examples, the pillars are sunk to a considerable depth but, at something like a contemporary surface level, have a framework of iron bars and wooden planks attached to them, onto which an apron of reinforced concrete was set, as can be seen on the northern two, and western central, examples. The remains of ten wooden piles were also found, comprising five from structure 3079 and 5 (including 3098-9) which had originally been interpreted as being part of structure 3075 but are more likely to be the western side of 3079. These form an "L-shaped" frame 10.40m north-south by 9.64m east-west extending north within pier 3083 and east beyond it. This is interpreted as being the last pier on the foreshore (FIG.25) which had a iron pillared deck and wooden framed terminal. This pier must have existed from at least 1894¹⁵⁶ to 1952¹⁵⁷. The construction technique was being used prior to this date as a pier with a similar construction, though with a "T-shaped" terminal, existed in 1866 at Southsea Common, Portsmouth¹⁵⁸

The four "powder" piers examined above represent a great diversity of structural approach to the same basic concept of a pier (a landing stage open below) but with the continuity of location and purpose. The development of these pier types and the causeways must reflect not only the tradition of exploitation of the inter-tidal zone and riverside construction along the Essex side of the Thames from the fifteenth to twentieth centuries¹⁵⁹ but also the use of technical developments gained in the riverine works of the industrial revolution¹⁶⁰.

- Eastern Foreshore causeway

The piers, causeways and quay of the Central Foreshore were not, however, the only landing stages located at the fort. While the above were permanent structures for the disembarkation of people, supplies and gunpowder, a seemingly more temporary causeway (1506) (FIG.19), was constructed on the Eastern Foreshore where the Eastern Covered Way abuts the foreshore. The remains of this structure consisted of posts, planks, wattle, chalk and paving slabs. The visible remnants above the mud were surveyed, one small area on the south-east edge of the structure was cleared and Trench 21 was excavated across the northern end to investigate the construction methods (FIG.19). Severe difficulties were encountered in this excavation as only small areas could be attempted before the tide had returned.

A total of one hundred and fifty-eight posts were recorded over a north-south length of 37m., mostly concentrated along the eastern edge of the structure. The quality and type of wood varied greatly with complete large roundwoods as well as quartered and squared timbers. Some timbers appeared no bigger than stakes but this may have been due to differential rotting. Peat was found around the northern end of the structure (see above for pollen analysis) but was not found at a comparable level under the causeway and it may have been either been cut away prior to construction or the causeway's weight could have compressed the peat into the silt below. Three rows of posts were recorded along the length of the causeway though very few posts were found in the central row. The east row consisted of paired posts and where there was a size differential between them, the larger post was always on the outer side. In between the pairs of posts in Trench 21 a vertical wattle panel survived in situ, with three rods and the fragmentary remains of four sails, showing a simple alternating weave (FIG.29). At the bottom of the trench, within the line of the causeway, after the removal of a considerable amount of chalk rubble, a large area covered by horizontal wattle panels was found, compressed but still in good condition. Because of the conditions of the excavation it was impossible to say whether there were further panels below those recorded. Most of the wattle examined was alder but two samples were of willow/poplar. These panels would have acted as a raft for the chalk rubble, a technique known from the Netherlands, where wattle and brushwood was used to support canal stonework in wet areas¹⁶¹.

On top of the chalk rubble filling there would probably have been a pavement of limestone slabs, a scatter of which were found around the survey area (FIG.30A). A different type of revetting was seen towards the bottom end of the causeway where two planks were found replacing the wattle with at least one post halved to create a flat side for securing one of the planks (FIG.30B). The change from wattle to plank sides must relate to an anticipated higher degree of pounding from wave action as well as being underwater for longer periods. A large roundwood post found to the west of the structure would probably have been a mooring post.

It is presumed that the eastern side of the causeway would have had the same construction as that seen on the west but it appears to have been almost totally removed. This causeway is shown on three plans of the fort, two dating to 1779, of which one¹⁶² shows changes to the south end of the eastern covered way and a simple linear landing stage at this spot. A more detailed plan and elevation from June 1779¹⁶³ shows a path passing the embrasures and leading to the beginning of a landing stage, shown as an externally posted structure. It seems likely therefore that the causeway was constructed to enable the movement of large amounts of construction materials to this area. The last map on which this causeway appears is dated 1830¹⁶⁴ after which it must have deliberately slighted so as not to be used for landing by attacking forces and so as not to be an obstruction for shipping¹⁶⁵. The fact that such a variety of post types and tree

species used in the construction, including spruce, oak, sweet chestnut, alder and willow/poplar, as well as the use of wattle panels, shows the deliberately cheap and non-permanent design of the structure.

- Sewage Disposal (I. Hanson and K. MacGowen)

The river was also used for sewage disposal. There were many fort drains which had to empty into the river, which could only be achieved if they pierced the defences and river revetments, while remaining secure but repairable¹⁶⁶. The War Office accounts hold many references to the continuous problem of building and repairing these drains. A number of drains in the fort connected to the "old barrel drain" or "Great Drain", which led to a sluice in the sea wall and onto what was described in 1740 and 1849 as the "Tail of the Drains"¹⁶⁷.

The "Great Drain" was built in 1686 by Antony Crosswell, measuring 728 feet long, 4.5 feet across and 2 feet deep, which together with two smaller drains, were constructed of brick with an arched roofs and oak plank floors. At the end of the drains was an oak trough 12 feet wide "to conveye the water from the drains out of ye fort into the river, in length 19 feet with a pinstock and clapper to ye outside", that is, a valve to allow sewage to flow out into the river at low tide but not the river water to flow back up the system at high tide¹⁶⁸. Structural details of the Tail of the Drains can be made out on the 1849 map of the fort¹⁶⁹, showing it as a passage leading from the then river wall to a outwardly flared end, presumably designed to ensure that the fort's waste was scoured away by tidal action on a smooth platform.

- Central Foreshore structure 1700

The 1979 survey of the area shows a shutter-sided passage with vertical wooden piling leading to a series of trapezoidal platforms made of timber and stone in the north-east corner of the Central Foreshore. The 1989 survey then found and recorded the southern 11.10m. of this structure (1700), interpreted as the Tail of the Drains, and showed it to consist of two phases of construction (1700A and 1700B). Phase 1700A (FIG.31A) consisted of vertical interlocking piled walls surrounding a stepped and flared platform. The walls were a solid construction using dovetailing tongue and groove edged piles. The western wall kinks out in the north-west corner of the structure and this survived to a higher degree than elsewhere. The walls of the passage secured parallel horizontal timbers which were tenoned onto piles and to horizontal plates which were arranged at an angle across the platform. These plates marked step edges and the space behind them was paved with stones.

Phase B of structure 1700 (FIG.31B) consisted of simple rectangular posts securing planked sides, enlarging the structure slightly to the west and 0.56m to the east of 1700A. The floor surface was covered by a spread of concrete which extended south beyond the end of the wooden structure.

No dating has been secured from the timber samples, however phase 1700A of the structure may be of early eighteenth century date. Captain John Perry's 1721 description of draining and securing the Dagenham Breach¹⁷⁰ includes a description of this very method of vertical timber jointing, describing the use of dovetailed piles for use in sluices and waterworks¹⁷¹. He states that their use in wetland construction was unknown in England in 1715 but that he had used them in Russia, and that the French had used them Dunkirk. It is therefore possible that this phase of the Tail of the Drains was

constructed circa 1715 and that phase B is probably the result of nineteenth century improvements.

(ii) DENDROCHRONOLOGICAL ANALYSIS (Cathy Groves)

Large numbers of waterlogged and semi-waterlogged timbers are present on the Central and Eastern Foreshore areas in front of Tilbury Fort, in the south-east corner of the Outer Moat and the Eastern Place d'Armes. During the 1988-9 excavations 213 wood samples were taken, from structures dating from possibly the late sixteenth to late nineteenth centuries, and analysed for species identification (the results of the identification of oak and spruce species is represented on FIGS.21, 24, 26-8 and 31) and dendrochronological dating in a major study that aimed at improving understanding of the fort and riverine structures and at establishing non-oak chronologies.

It was hoped that the oak (*Quercus* spp) samples would provide precise calendrical dates and that there would be sufficient quantities of the other species to establish species-specific chronologies so as to further the relative dating of the wooden structures. The potential of the coniferous timbers, which were later identified as Norway Spruce (*Picea abies* Karsten), for dendrochronological dating in Britain was to be assessed as such large quantities of non-oak material have not been previously available from archaeological sites in this country. The suitability of spruce for dendrochronological analysis has been proven by other European workers who have established reference chronologies for Norway, Sweden and Germany¹⁷². This was the first attempt in Britain at crossmatching with a view to providing dates for imported non-oak material.

Oak and elm samples were relatively easy to identify but other non-oak samples were identified by taking thin sections of wood from the transverse, tangential and radial planes and making temporary slides. The identification of these slides was through reference material in the form of permanent slides and an identification key¹⁷³, and then confirmed by use of reference material and a computer database¹⁷⁴ by Ian Tyers and Nigel Nayling at the Museum of London. The results of the wood identification is illustrated on the individual structure illustrations.

A random selection of fifteen coniferous samples were all identified by the above procedure. Key characteristics, such as the presence of resin canals and small piceoid pits, indicated that the coniferous samples were either spruce (*Picea abies* Karsten) or larch (*Larix decidua* Mill.). Anatomically a clear differentiation is not possible¹⁷⁵, but characteristics such as the transition from early to latewood being continuous rather than sharp, and the almost white colour of the timbers rather than the reddish colour of larch, indicates that the timbers were probably spruce. As all fifteen of the coniferous samples identified were spruce it is therefore assumed that the coniferous timbers on the foreshore are predominantly *Picea abies* Karsten (Norway Spruce).

It is usual to only measure one radius on oak samples but whenever possible more than one radius on a non-oak sample should be measured, since research into dating non-oak species is still in its early days in Britain and the measurement of several radii ensures accuracy and increases the reliability of the ring sequence¹⁷⁶. In this study three radii of each sample were measured, where feasible, then combined to give a single sequence for each timber. Dating is achieved by crossmatching the ring sequences of each species within a structure or site and combining the matching patterns to produce a species specific site master curve. All previously unmatched sequences are compared with this master curve and if additional patterns are found these are incorporated to produce a new master curve. The site master curve and all unmatched ring sequences are

then tested against reference chronologies to obtain absolute dates. A master curve is used for absolute dating purposes whenever possible as it enhances the common climatic signal and reduces the background noise resulting from the local growth conditions of individual trees.

The results only date the rings present in the timber and therefore do not necessarily represent the felling date. If the bark or bark edge is present the exact felling year can be determined. In the absence of bark surface the felling date of oak samples is calculated using the sapwood estimate of 10-55 years, the range of the 95% confidence limits for the number of sapwood rings on British oak trees over 30 years old¹⁷⁷. In the absence of sapwood the addition of 10 rings to the date of the last measured heartwood ring produces a probable *terminus post quem* for felling.

Once all structure and site crossmatching had been attempted the resulting master curves and ring sequences for the oak samples were checked against reference chronologies. The master curve (TFOAK/T4) and the unmatched oak ring sequences were checked against dated reference chronologies from southern England and then elsewhere in the British Isles spanning the period AD404-1981. A good match was found for TFOAK/T4 when it covered the period AD1703-1777. Timber 1914 dated to the period AD1678-1774, which confirmed a tentative match between TFOAK/T4 and timber 1914. This sequence was combined with TFOAK/T4 to give a new site master curve, TFOAK/T5, spanning the period AD1678-1777 (FIG.32).

As no consistent results were obtained for any of the other unmatched individual ring sequences, these were compared with oak reference chronologies from elsewhere in Europe, including Denmark, France, Germany, Holland, Poland, Sweden and also some American curves but no further reliable dating was produced.

Ten samples from foundation structure 1800 combined to from master curve TFSPRUCE/T10, which successfully matched with three further samples to produce a new site master curve TFSPRUCE/TF13 (FIG.33). On production of this 158 year spruce master curve, other European tree-ring work on spruce was looked at in more detail in the hope that a precise date could be obtained for the site master curve. Emphasis was placed on dendrochronological work in Norway as other evidence indicated that the spruce timbers associated with the initial construction of the defences at Tilbury may well have been imported from Norway¹⁷⁸. This suggests that if the spruce timber found at Tilbury is from Norway it is most likely to have originated from south-eastern Norway and may have been shipped from one of the harbours in Oslofjord¹⁷⁹.

Standard spruce chronologies exist for only two of the areas, the south-eastern region¹⁸⁰ and the northern area¹⁸¹, that have separate tree-ring chronologies for pine, but it is unknown whether these separate climatic provinces for pine¹⁸² are applicable to spruce.

Spruce chronology TFSPRUCE/T13 and the other mean curves (TF51/57, TF203/204, TF114/196 and TFSPRUCE/T2) were compared with the two standard spruce chronologies for southern Norway, individual chronologies included within them, the spruce chronology from Trondheim¹⁸³, and against chronologies from other areas of Europe, but all without success. The Tilbury spruce master curves were also tested against the pine chronologies¹⁸⁴ available from Norway but again no definite crossdating was achieved.

- Outer Moat palisade 624 (not illustrated)

Four of the twelve measured ring sequences, timbers 551, 553 and 559-60, were found to crossmatch, combining to form a 75 year master curve TFOAK/T4. Two other

timbers (556-7) crossmatched with a t value of 13.4. The excellent visual match and similarity of the actual samples suggest that these two samples were cut from the same tree. Their ring sequences were combined to produce a single sequence (TF6/7) for the tree.

Timber 553 had retained a full complement of sapwood, with complete outermost rings indicating that 553 was felled during the winter of AD1777/78. However, there are traces of the following year's growth ring which imply that 553 was felled in the early spring AD1778 just as the tree was coming out of its winter dormancy period. The outermost ring of timber 551, dating to AD1775, is within a few rings of the bark edge, and is therefore also likely to have been felled in the early spring of AD1778. Because wood for a palisade in a moat would not require seasoning this palisade was probably constructed shortly after the timbers were felled in AD1778.

- Structure 1506 (FIG.19)

Stake 1640, a complete stem with only nine growth rings, was of maple/sycamore (*Acer* spp) type. Nine of the eleven wattle samples were alder (*Aldus glutinosa* Gaertn) and two were of willow/poplar (*Salix/Populus* Spp) type. The wattle samples were all complete stems with only 4-6 growth rings. Fifty-six of the posts sampled were spruce, eight oak and one sweet chestnut (*Castanea sativa* Gaertn). None of the oak samples were suitable for measurement as they contained less than fifty rings and all but three of the spruce samples had under fifty rings. The three measured spruce samples, timbers 1528, 1537 and 1615, contained 101, 109 and 55 rings respectively. Their ring sequences were compared and a match was found between timbers 1537 and 1615. The high t value (12.3) and excellent visual match suggest that these two spruce timbers may have been derived from the same tree. They were combined to produce a single sequence (TF51/57) for the tree which was tested against sequence TFSPRUCE/T10, in case they overlapped or were even reused from an earlier structure. No conclusive results were obtained, however it may be significant that timber from the same tree has ended up in the same structure despite the potential processes of transport, storage and seasoning.

- Structure 1700 (FIG.31A and B)

All eight phase A samples and five of the phase B samples were spruce, while timbers 1749 and 1763 from phase B were both elm (*Ulmus* spp). Of the five measured samples from phase A only timbers 1704 and 1707 crossmatched to give a t value of 6.3 and combined to form a master curve TF203/204 which was compared with TFSPRUCE/T10, but no match was found.

- Structure 1800 (FIG.21)

The twenty-three samples taken from this the largest foreshore structure were all spruce. The nineteen measured samples had 64-153 rings. Nine piles and beam 3016 crossmatched and were combined to give a 158 year structure master curve (FIG.33) which while. Two other piles (1822 and 1913) also crossmatched (t = 5.1) and were averaged to produce a second structure master curve TF114/196, with 104 years. The two structure master curves were compared with each other and the unmatched ring sequences from 1800, but no further reliable matches were found. Wood chips (1949) taken from around the carved end of the western frame beam were also spruce but contained only 20 and 11 rings. The nine crossmatched piles and the horizontal beam

(3016) are all likely to be contemporary. The appearance of the timbers and the range of end dates indicates that the outermost measured ring of the majority of the crossmatched samples is probably close to the bark surface and bark surface was noted on beam 3016 during sampling¹⁸⁵. Although bark edge could not be positively identified on the sample taken it is likely that the outermost measured ring is either immediately below, or within one or two rings of the bark, implying a felling date range of 158-160 for this timber. It therefore seems probable that all nine piles were also felled before the relative year 161. It is known that this structure has a late seventeenth century construction date but in the absence of a crossmatch between this ring sequence and any dated sequence the timber used in this structure cannot yet be given absolute dates.

- Structure 1823 (FIG.27)

Post 1914 was measured and gave a 97 year ring sequence. This was tested against the master curve TFOAK/T4. A good visual match with a t value of 4.2 was produced when its outermost ring corresponded with year 72 of TFOAK/T4. The quality of the visual and statistical matches between post 1914 and the individual timbers in the master curve was such that this possible match was tentative. This post was identified as being oak with no sapwood. Its outermost measured ring dates to AD1774 indicating a *terminus post quem* for felling of AD1784. However, this post is virtually circular in shape and could well have lost only its sapwood and possibly a few heartwood rings. When these rings are taken into account it is possible that the timber was felled before circa AD1830. If this post is not reused, or a repair, it implies a late eighteenth/early nineteenth century construction date for structure 1823.

- Structure 1866 (FIG.21)

Two posts (1884-5) from this structure were identified as spruce. Post 1884 had circa 290 growth rings but the presence of several bands of extremely narrow rings resulted in the inner circa 214 rings being unmeasurable. The outer 76 rings of this post were measured as was the 94 year sequence from post 1885. The two ring patterns did not match each other and so were both compared with TFSPRUCE/T10 from structure 1800. No consistent results were obtained for 1884, but 1885 gave a high t value (5.2) with the master curve when it spanned the relative years 61-154. Comparison with the individual timbers included with TFSPRUCE/T10 confirmed this match. Post 1885 spans the relative years 61-154 of the site master curve TFSPRUCE/T13 (FIG.33). It appears to be broadly contemporary with the ten matched timbers from structure 1800 which implies that this palisade may also have been erected in the late seventeenth century.

- Structure 3075 (FIG.27)

Three of the spruce ring sequences examined from this structure (1854-5 and 3013) crossmatched. The high t value (10.5) and the excellent visual match suggest that 1854 and 1855 may have been cut from the same tree. These two sequences were combined to form a single curve for the tree and were then averaged with the sequence from 3013 to produce a 70 year spruce mean TFSPRUCE/T2, which remains undated.

- Structure 3079 (FIG.24)

Spruce pile 1896 had 138 rings. When tested against TFSPRUCE/T10 and gave a t value of 5.7 where it spanned the relative years 16-153, confirmed by comparison with the individual sequences included in TFSPRUCE/T10.

However map and photographic evidence strongly suggests that structure 3079 is part of the terminal of pier 3083, a late nineteenth century construction¹⁸⁶. As it is unlikely that circa 200 rings have been lost from this timber (with 138 rings this is one of the longer spruce ring sequences from the site already) it seems likely that this timber was reused, possibly taken from structure 1800 and thereby explaining the match with TFSPRUCE/T10.

- Timber from uncertain structure

Timber 1887 crossmatched TFSPRUCE/T10 when it spanned the relative years 49-145, confirmed by comparison with the ten individual sequences included in the master curve. It is a large round unstratified beam at the northern edge of the foreshore partially covered by the concrete base of the foreshore wall. It may therefore be one of the piles pulled out of structure 1800 during the construction of the wall in the early 1980's¹⁸⁷.

- Conclusions

The overall results of the analysis with regard to the production of a precisely dated framework for the development of the site were disappointing. The use of young timber at Tilbury combined with the use of large quantities of imported timber for structural purposes suggests a lack of readily available oak for building purposes. This ties in with other evidence from post-medieval sites in London which generally have knotty timber derived from young trees¹⁸⁸. Although the oak timbers are of poor quality for tree-ring analysis, they are not necessarily low in quality for building purposes. The lack of intra-site crossmatching and dating for oak is probably due to the shortness of the majority of the ring sequences and the frequent distortion of the ring pattern by the presence of knots. Some oak may have been imported into the country, possibly from Norway, with the spruce timber, which would again cause crossmatching problems. However the production of oak chronology TFOAK/T5 (FIG.32) from the site for the post-medieval period may in future aid the dating of London and, especially problematic, Essex timber.

As the first known dendrochronological analysis of a large assemblage of imported non-oak timber and first study of spruce to be carried out in Britain it has shown that it may be possible to provide precise dating evidence from such wood in future. The techniques used in obtaining a reliable ring sequence for each individual spruce timber patently differ from those standardly used for the study of oak in Britain, and the methods generally used at Sheffield were therefore varied accordingly. The most apparent difference between the study of oak and spruce is the time involved, with the analysis of spruce taking at least three times longer than that of oak. the percentage of relatively dated sequences (25%) appears to be low when compared with that usually achieved with oak. The lack of matching is probably due to the sequences being short and the apparent need for at least three radius measurements to be combined to form a sample mean. Little crossmatching has been achieved during this study with samples containing fewer than approximately 80 rings, and all those included in sequence TFSPRUCE/T13 (FIG.33) contain 88 or more rings. As more work is done in this and

other countries the presently undated Tilbury spruce chronologies may yet be precisely dated. At present however they provided some relative dating of the structures.

(III) THE ARTEFACTUAL AND ENVIRONMENTAL RECORD

Significant samples of artefactual and environmental materials pertaining to the fort's inhabitants have been recovered during the excavations at the fort, though most of this material comes from a single deposit with limited chronology. Layer 4242 in the West Curtain Bank (FIG.9) was partially excavated¹⁸⁹ and comprised re-used midden material, basically artefact and food debris, in an ash and clay matrix. This mixture was obviously deemed a poor building material (its ash content has prevented cohesion within the layer) as a contemporary attempt was made to seal it with compacted shell/clay, gravel and chalk layers (4241, 4240 and 4239 respectively). A later attempt was made to seal it with clay layer 4256 and it may be that layer 4242 contributed to the bank's instability, ultimately leading to the underpinning works of 1990. This strongly suggests that layer 4242 was not brought to Tilbury as building material but accumulated at the fort in the form of a midden prior to its use as building material. The sealing of layer 4242 took place between 1679¹⁹⁰ and 1685¹⁹¹, which suggests a mid to late seventeenth century date for the midden accumulation.

Finds and bones were found in all trenches investigated at the fort but little artefactual or environmental evidence was found of comparative importance or breadth in deposits other than layer 4242 in the West Curtain Bank. As a result the artefactual and environmental evidence discussed in this paper is, for the most part, limited spatially and chronologically. No other significant domestic rubbish deposits have yet been excavated¹⁹² to establish how representative the accumulation of 4242 actually was and to see what changes took place over time. Layer 4242 was examined for internal stratigraphy so as to date the process of its deposition. However the lack of any coherent stratigraphy identified this as re-deposited midden material, masking any chronological lifestyle changes represented within the original midden. The uncertainty of layer 4242's excavated versus total size makes estimation of the relative importance of some finds difficult. Small amounts of pottery from 1670-80's contexts 4210-1, 4241 (FIG. 9) and 4208, are included with the 4242 pottery as they are also part of the construction phase, and may in fact be contamination from 4242 itself. Occasional objects from later periods are discussed, especially the military artefacts, because of their inherent importance or the chronological nature of the object groups actually recovered.

The artefactual and environmental evidence is nevertheless of great importance and interest. The size of individual categories, such as pottery finds and clay tobacco pipes, is large enough to infer statistically valid interpretations and general observations. In other categories, such as animal bone, sufficient quantities were recovered to at least show a general picture of diet and to obtain a view of the fauna present in or near the fort. Important and valid inferences can therefore be made on many aspects of late seventeenth century lifestyle at the fort. Future discoveries may refine our understanding of life in the late seventeenth century and may extend detailed understanding into earlier and later periods.

The virtually single context nature of the material discussed here has led to its being discussed in topics rather than purely by object and material type. The detailed object descriptions can be found in the relevant material and object specialist papers¹⁹³. For ease of discussion all illustrated objects, including building materials, referred to in text have been given a continuous sequence of numbers and are shown in **bold type face**.

The topics to be discussed below will be **(i) domestic items**, to include pottery, table glass, clay tobacco pipes, cutlery and domestic tools **(ii) personal items**, to include coins, dress, games and pastimes, **(iii) diet**, to include animal bone and eggshell **(iv) military life** to include military dress and weapons, tools and horse furniture.

(i) DOMESTIC ITEMS

The use of the term domestic does not imply a family household, but rather has to take into account the sum of all families and individuals at the fort and the items essential for their day-to-day non-military activities. These activities consisted of eating, drinking, making, mending and certainly smoking, many of which would have taken place on a communal basis. Domestic items formed the largest group of material found at the fort, within which the categories of pottery and clay pipes were the major constituents. This partially represents their durability as artefacts but also their consumption in large quantities.

THE POTTERY (Dr F.M. Meddens)

Much of the pottery assemblage was re-constructable and fitted together; of 18.5% of the rim sherds a quarter or more of the vessels rim circumference survives, indeed with 3.6% of the rims the circumference is complete. Considering that the assemblage represents material from the excavated part of the redeposited midden layer 4242¹⁹⁴, it suggests that the material was kept together in its move from the original midden deposit to its deposition on the bank. The assemblage consists of 1564 sherds (30.45 kg) with 49.3 estimated vessel equivalents, EVEs, (calculated from rim sherds only). Because of the size of this sample, a high level of confidence can be had in it representing a true reflection of the assemblage it derived from. A minimum of 20 EVEs is required to validate the statistical analysis carried out on this kind of material¹⁹⁵. The vessel shapes represented in the dominant fabrics are presented below to show the composition and nature of the sample. Unless otherwise stated all percentage breakdowns are of sherd numbers.

The fabrics present in this assemblage are dominated by Post-Medieval Red Wares (52.2%) (FIG. 34-5) and Border Wares (24.8%) (FIG. 36-8), with smaller amounts of Post-Medieval Black Glazed Earthen Wares (8.4%) (FIG. 39: **74-9**), Local Tin-glazed Earthen Wares (3.8%) (FIG. 39: **80-90**), Frechen Ware (3.7%) (FIG. 40: **91-95**) and Staffordshire Butterpot-type Ware (2.6%) (FIG. 40: **96**).

All other wares present amount to a total of approximately 3.0%. Of these wares 1% are likely to reflect wares which have a true low rate of occurrence; Guys Ware, Metropolitan Slipware (FIG. 40: **98**), Post-Medieval Course Unglazed, Post-Medieval Greyware, English Stoneware (FIG. 40: **97**) and Westerwald Stoneware (FIG. 40:**99**). Others are likely to be earlier material re-deposited in the midden, or possibly long surviving heirlooms; Cistercian Ware (0.1%), Langerwehe Stoneware (0.1%), Langerwehe/Raeren Stoneware and Tudor Redware (0.1%).

The remaining 2% of the material (Creamware, Staffs/Bristol Slipware, Porcelain, Notts/Derby Stoneware, Staffordshire White Salt Glazed Stoneware, London Stoneware, Transfer Printed Ware, and Victorian China), is likely to have become incorporated in the collection through contamination from later deposits, as a result of the rescue nature of the excavation, is not discussed here. The remainder of the material (0.1%) remained unidentified.

The vessel shapes present are principally bowls (34.5%), jars (15.1%), jugs (14.1%), pipkins (8.9%), dishes (6.3%), Bartmann Jugs (5.4%), chamber pots (5.2%), plates (2.8%), bucket shaped vessels (1.7%), skillets (1.7%) and drug jars (1.4%). The other vessel forms present (0.4-0.7% each) are beakers, cups, ink wells, ointment pots, and (at 0.2% each) a candlestick, a salt, a strainer and a tyg. There were 601 sherds which could not be classified to shape.

Post-Medieval Red Wares (FIGS. 33-4)

Post-Medieval Red Wares, constituting 52.2%, form the largest single component of this assemblage. There are known production centres at Woolwich in London¹⁹⁶, Harlow¹⁹⁷ and Loughton in Essex, Potterspury¹⁹⁸ in Northamptonshire and Woodstock in Oxfordshire. They have a wide distribution, throughout Essex, in the London area, and in Kent¹⁹⁹.

The fabrics consist of a fine and a coarse red sandy ware with frequent fine sub-angular quartz and moderate mica inclusions. A total of 17.8% of the redwares are plain. The glaze used on the remainder is lead based, with iron as a colouring agent. Brown is the commonest colour (54.0%), with dark brown 9.1% and very dark brown 1.0%. Dark green accounts for a further 18.6% and green for 0.2%. A small amount of the material has a plastic decoration, consisting of thumb impressions placed on the vessel wall below the rim (FIG. 34: **8-9**), a type noted on Woolwich Ware vessels and dated to the second half of the seventeenth century²⁰⁰.

The principal vessel shapes represented are open-sided open bowls 19.5%, jars 16.4% and jugs 10.4%. One complicating factor is that 34.1% of the vessels constitute closed forms which could not be classified to more precise vessel shape categories. These represent a mixture of bowls, chamber pots and pipkins. Smaller quantities occur of pipkins 3.6%, dishes 3.6%, 3.3% each of bucket shaped vessels and plates (FIG. 34: **16, 18**), bowls with incurving sides 3.0%, chamber pots 1.3%, beakers 1% and 0.3% cups.

- Bowls and porringers (FIG. 34: **7, 10, 12, 14, 22**, FIG. 35: **25**)

The bowls with outcurving sides have an EVE of 4.07 and range in diameter from 9-22cm.; they have a mean of 14.4 (Standard Deviation 3.7), though there is one much larger one with a diameter of 37cm. (FIG. 35: **22**). They have flat bases and 88.9% have horizontally positioned rod handles on the body (FIG. 34: **7, 10, 12**). This shape is close to that of the porringer, a small bowl with a horizontal handle, common in the early Post-Medieval period both in Britain and on the Continent²⁰¹. Similar vessels have been found at the Woolwich kiln site²⁰² dating to the seventeenth century, and in the City of London²⁰³ dating to the late eighteenth century.

The bowls with incurving vessel walls (FIG. 34: **14**, FIG. 35: **25**) constitute 0.9 EVEs. The diameters range from 9-22cm. with a mean of 15.6 (SD 3.8) Some of these vessels have a flaring lip.

- Jars (FIG. 35: **20, 30-5**)

The Jars have an EVE of 2.4, diameters ranging from 10-22cm., and a mean of 15.5 (SD 2.7), though there is one outsize one at 34cm. diameter (FIG. 35: **20**). The vessel walls tend to be slightly convex and the bases are flat. Most of the rims have a variety of exterior thickening near the lip. Sooting is present on the exterior surface of

8.2 % of these vessels indicating that they were occasionally used in a fire, possibly to keep foods and liquids warm.

- Jugs (FIG. 35: **24**)

The jugs could not consistently be classified into recognised sub-categories of jug types because of the degree of fragmentation of the sample, and have therefore been subsumed in a single category. Jugs were used both for drinking and serving, although the latter would, on the whole, have been larger than the drinking jugs. They have an EVE of 1.0, their diameters ranging from 8-18cm., with a mean of 13.4 (SD 3.1). These vessels have a pronounced neck which sits frequently in a near vertical position on the body. The body tends to be rounded and these jugs have flat bases. The majority (76.4%) have a rod handle, although strap handles also occur (23.6%) (FIG. 35: **24**). A few of the handles have thumb impressions on the base of the handle near its attachment with the vessel body. Some of the jugs have sooting (7.7%) indicating the vessel was used in a fire, probably to keep a fluid warm.

- Flanged dishes (FIG. 34: **19**)

The dishes tend to have a pronounced flange and have a flat base. They are heavy with a comparatively thick vessel wall and base and are glazed on the interior. The rim tends to be somewhat thickened near the lip. The EVE is 0.8 and the diameters range from 17-45cm., although the commonest size range (65.5%) extents from 32-37cm. (SD 8.9).

- Pipkins (FIG. 34: **6, 8, 11, 13**)

Tripod pipkins are jar shaped cooking pots with a tripod base, often with a rim shape to accommodate a lid. They frequently have soot adhering. They tend to have a straight, hollow tubular handle protruding from the side of the vessel wall and are glazed on the interior. The pipkins in this group are closed vessels with tripod bases and rod handles (solid or hollow, straight or slightly curved) protruding from the vessel wall either horizontally or at a slight angle. The pipkins have an EVE of 1.0, diameters ranging from 13-18cm., with a mean of 15.6 (SD 2.4). Some 40% have sooting around the base and up the sides, and this vessel type was clearly extensively used in a cooking context.

- Skillets (FIG. 35: **26**)

Skillets are open vessels with a solid (straight or slightly curved) rod handle which protrudes from the vessel wall, either horizontally or at a slight angle. The glaze is exclusively on the vessel interior, the base is flat and all of these vessels are sooted, confirming their use in food preparation. The rims have pouring lips and one of the rims was sufficiently well preserved to measure its diameter of 20cm. (FIG. 35: **26**). A further contemporary rim (FIG. 35: **27**) from context 4233²⁰⁴ is worth illustrating as it shows the incurving type not to be exceptional. The presence of two handles indicates at least two examples in the 4242 sample.

- Chamber pots (FIG. 34: **15, 17, 35: 29**)

The chamber pots have incurving vessel walls, a flat base, and a slightly curved rod or strap handle, protruding from the vessel wall. These handles are either

horizontally or vertically positioned. One example has two thumb impressions at the base of the handle attachment with the body (FIG. 34: **15**). The EVE equals 0.7 and the diameters range from 17- 22cm., with a mean of 19.7 (SD 2.5). One example is sooted indicating that this chamber pot, at least, had been used in a different context from the one intended.

- Bucket shaped vessels (FIG. 35: **28**)

The bucket shaped vessels have an EVE of 0.6, diameters ranging from 16-23cm. with a mean of 18.8 (SD 2.9). These vessels are wider at the rim than at the base, and the vessel walls either have a slight convex curvature or are straight and the bases are flat.

- Beakers (FIG. 35: **21, 23**)

Of the small number of beakers only the diameter of two examples (6 and 8cm.) could be measured. These vessels have a wider diameter at the rim than at the base, the vessel's wall tends to be comparatively straight, and they have a flat base. One example had exterior sooting and some have wall profiles shaped like an elongated "S" (FIG. 35: **21, 23**).

Border Wares (FIG: 35-7)

The Border Wares divide into Green-glazed whiteware (7.7%), Olive-glazed whiteware (8.4%), Yellow-glazed whiteware (65.4%) and Brown-glazed whiteware (18.5%). The vessel shapes composing the Border Wares consist of bowls with open sides (3.8%), incurving sides (2.1%), chamber pots (8.9%), jars (11.3%), jugs (12.0%), pipkins (13.0%), flanged dishes (8.2%) and plates (1.7%). A total of 38.7% could not be identified to vessel shape category.

The Border Wares are not a local product, they were produced on the Surrey-Hampshire border²⁰⁵. It is a common ware on sites dating from the early sixteenth century through to the late seventeenth century in the City of London²⁰⁶ as well as on East London sites of this date²⁰⁷ and this pottery was clearly traded along the Thames.

- Bowls and porringers (FIG. 37: **53-61**)

There are three clear examples of porringers, two with an incurving wall profile (FIG. 37: **55, 61**) and one with an outcurving wall profile (FIG. 37: **59**).

The bowls with out-curving vessel walls have an EVE of 1.13, diameters ranging from 9-21cm., with a mean of 12.7 (SD 3.2). There appear to be two size groups, one with a diameter of 9-14cm. (FIG. 37: **61**) and a single much larger example with a diameter of 21cm. These vessels have flat bases and there is one example with a horizontal rod handle.

The bowls with incurving vessel walls have an EVE of 2.85, diameters range from 12-16cm. with a mean of 14.2 (SD 2.85). These vessels have flat bases (FIG. 37: **53-4, 56-7, 60**). The vessel walls of bowls tend to be thin and exterior horizontal ribbing made with the fingertips on the vessel wall is common.

These vessels, with one exception, are similar in size range to the porringers from late seventeenth and eighteenth century contexts in London²⁰⁸. Sooting is present on 29% of the pots which is less than is the case for London where 40% are blackened.

These vessels were probably used to prepare and serve small or individual portions of semi solid food²⁰⁹.

- Flanged dishes (FIG. 36: **37-40**)

The collection has an EVE of 1.6, diameters ranging from 22-41cm. and a mean of 34.6 (SD 6.3), however a total of 85.7% range in diameter from 32 to 41cm., which appears on the large side compared to London examples²¹⁰. Their height from base to rim ranges from 5.6-5.9cm. with a number of fragmentary examples of probably greater height.

Flanged dishes range in date from the second half of the sixteenth century to the end of the seventeenth century²¹¹.

- Deep Dishes (FIG. 36: **41, 47**)

Two examples of deep dishes are present. One with a pronounced incline to the vessel wall, a slightly folded rim and a diameter of 34cm. (FIG. 36: **41**), the second with a near straight vessel wall and no rim modification, with a diameter of 24cm. These vessels are contemporary with the flanged type above.

- Plates (FIG. 36: **42-6**)

These are similar to the flanged dishes above but their shallow base to rim height of 3.8-3.5cm. separates them. This is unlike the Museum of London's Reserve Collection where no such grouping was observed²¹². The base of both dishes and plates tends to rise up in the centre of the dish, resulting in a slightly concave rather than a true flat base.

They constitute 1.7% of the Border Wares, with an EVE of 1.17, diameters ranging from 22-29cm. with a mean of 26 (SD 2.7).

- Saucer candlestick (FIG. 38: **67**)

One saucer candlestick was recovered. From kiln sites this type of candlestick is dated to the second quarter of the seventeenth century, in London they are known from a late sixteenth century context and none have been found in mid to late seventeenth century contexts²¹³.

- Chamber pots (FIG. 37: **48-52**, 38: **68-9**)

There are four examples of type 1 chamber pots (FIG. 37: **48-50, 52**). There is one example, a type 2, with an incised groove along the top of the outer edge of the rim (FIG. 37: **51**). All the type 1's have been dated to the first half of the seventeenth century, the single type 2 to late in the second quarter of the seventeenth century²¹⁴. All have strap handles, with fluting along their length, where this is observable with a slight thumb impression on the base of the handle where it joins the vessel body. Bases are flat, tending to the concave near the centre. Diameters range from 13 to 22cm., with a mean of 17.25 (SD 3.7) and they have an EVE of 3.7²¹⁵.

- Jars (FIG. 38: **70-3**)

These consist of small rounded jars with flat bases but no rims survive. This type of jar is present in the Museum of London Reserve Collection but is unknown from the kiln sites²¹⁶. In the London area similar vessels have been recovered from the Inns of Court where they were described as ink pots²¹⁷.

- Jugs

The jugs have an EVE of 0.8 and range in rim diameter from 11-17cm., a very large diameter range compared to the London corpus group²¹⁸. This suggests that the jugs from Tilbury represent serving vessels.

- Tripod pipkins (FIG. 38: **62-6**)

With an EVE of 1.6, a rim diameter range from 12-18cm. and mean of 16 (SD 3.5), this rim diameter range is on the large side compared to London examples²¹⁹. 94.7% of this group has soot adhering, which is a significantly larger proportion than the London groups (75%)²²⁰. Examples with external lid seating occur (FIG. 38: **62, 64**), which consists of a horizontal flange markedly protruding somewhat below the top of the rim on the outside of the vessel wall. This feature in London is found from the seventeenth century onwards²²¹.

Post-Medieval Black Glazed Earthen Wares (FIG. 39: **74-9**)

These wares were produced in and around the Essex area, with known kiln sites at Harlow (Essex)²²², Loughton (Essex), as well as Woodside (Hertfordshire), Wrotham (Kent) and Potterspurty (Northamptonshire)²²³. Similar wares were also being produced in the Midlands around the same time²²⁴.

The fabric is reddish brown with a brown or very dark brown to black lead glaze with an iron based colouring. In 10% of cases the glaze has a lustre to metallic finish. Vessel forms consisted of 2.0% bowls with open sides and 5.0% with incurving sides (FIG. 39: **75**), 7.1% jugs (FIG. 39: **74, 76-7**), 1.0% tygs and 84.9% being unidentified to shape. This pottery tends to be somewhat thinner walled than some of the other wares, and possibly as a result is more fragmented. It is only with the jugs and tygs that enough survived to provide details of form and size.

The jugs have an EVE of 0.49 and diameters range from 5-7cm., with a mean of 10 (SD 4.4). The bodies are rounded and the bases flat, with a strap handle from the vessel lip to the body (FIG. 39: **74, 76-7**).

One rim fragment of a tyg was sufficiently intact to provide an EVE of 0.23. The diameter of this vessel was 9cm. and it had a flat base.

Local Tin-Glazed Earthen Wares (FIG. 39: **80-90**)

All the Tin-glazed Wares recovered are of English manufacture and consist of a mug, strainer, bowl with incurving vessel walls and a dish fragment (constituting 3.9% each), jugs (7.7%), jars/ointment pots (15.4%), plates and albarello type containers (30.8% each).

One example of a mug is present with an EVE of 0.1 and diameter of 13cm. It is decorated with a (cobalt) blue design, not enough of which is left to establish the nature of the motif. Mugs are known from seventeenth and eighteenth century contexts²²⁵. The somewhat primitive appearance of this piece suggests a seventeenth century date.

The strainer is very fragmentary and the surviving handle is undecorated (FIG. 39: **83**). It appears to have been part of a small vessel and seems to have been intended to be gripped between the thumb and index finger. Its use therefore is likely to have been related to straining small quantities of liquid. Strainers are comparatively rare in other British assemblages of this period, and besides this fragment there are no other examples at Tilbury.

There is one fragment of vessel with incurving sides (FIG. 39: **86**), in all probability a caudle cup, with a dark purple (powdered manganese) finish. A similar vessel of mid seventeenth century date is known from Hammersmith, London, and probably represents a Southwark product²²⁶.

The dish fragment is a body sherd and decorated in a blue design (FIG. 39: **87, 90**). Similar examples, probably of an early to mid seventeenth century date are known from the London area although it is unclear where they were made²²⁷.

The jugs have a short neck, rounded body, a ring base and are plain, white vessels. The EVE is 0.2 and the one example where a diameter could be measured was small, at 5cm.

Ointment pots/jars have an EVE of 1.4 and range in diameter from 4-7cm. with a mean of 5.7 (SD 1.5) (FIG. 39: **82**). The upper part of this size range is comparatively large and may represent a small form of jar, the finish is plain white.

The plates/saucers have an EVE of 0.4, the rims range in diameter from 13-18cm. with a mean of 15.5 (SD 3.5) (FIG. 39: **84, 88-9**), they tend to have a ring base. The size range is small for plates, but saucers are rare in other assemblages which include Tin-glazed Wares.

The albarello was probably used as a drug jar. Only one example of a sufficiently intact rim survived to establish EVE (0.1) and diameter (12cm.) (FIG. 39: **80**). The decoration on these vessels is geometric polychrome using blue (cobalt based) and dark purple (manganese based) on the white base. Similar pieces are known from the Southwark potteries produced in the mid seventeenth century²²⁸. This type of vessel has, besides London²²⁹, been found in seventeenth century contexts at Brentford²³⁰, Chelmsford²³¹, and Dover Castle²³².

Frechen Stoneware (FIG. 40: **91-5**)

The Frechen Stonewares constitute a German import from Frechen in the Rhineland area²³³. Bellarmine or Bartmann Jugs at 65.9% represent the most common vessel form in the collection (FIG. 40: **91, 93-5**).

The Bartmann Jugs have an EVE of 3.0 and all have a diameter of 2.5cm. A date of around the third quarter of the seventeenth century is indicated by the general narrowness of the examples from Tilbury Fort²³⁴. The finish is in a speckled brown salt glaze (39.3%), dark speckled brown (39.3%), very dark speckled brown (3.6%) and grey (27.9%). These vessels are likely to have been used to ship wine. The remainder of this group (2.3% each) constitutes jars and jugs (FIG. 40: **92**), with 29.6% being unidentifiable.

Metropolitan Slipware (FIG. 40: **98**)

The Metropolitan Slipware fragment present is dated to the second or third quarter of the seventeenth century. It is likely to have come from kilns in the Harlow area in Essex²³⁵. The body sherd is decorated on the exterior with a floral design (FIG. 40: **98**), but the vessel shape was not identified.

Westerwald Stoneware (FIG. 40: 99)

The Westerwald Stonewares were imported from the area of the Westerwald in Germany²³⁶. The Tilbury examples are typical of the seventeenth century, and are from a small biconic type of jug with a blue-grey salt-glaze, decorated with geometric designs in a dark blue (cobalt) colour, located in defined zones (FIG. 40: 99). The EVE is 0.5, and the vessels range in diameter from 4-5cm., with a mean of 4.5 (SD 0.7).

Staffordshire Butterpot-Type Ware (FIG. 40: 96)

This ware resembles Staffordshire Butterpot Ware but can probably be best defined as Staffordshire Butterpot-type Ware. It probably represents a variant on one of the many Post-Medieval Essex Redwares and fits in that tradition. The vessels consisted of 16.2% jars (FIG. 40: 96) and the remainder could not be classified. The jars have an EVE of 0.5 and range in diameter from 22-24cm., with a mean of 23.4 (SD 0.9). These vessels have a flat base and an exterior thickened bead lip, flat topped and grooved. They have a reduced and smudged surface, the reduction very superficial. The fabric is very hard with a fine red paste and occasional medium to large chalky inclusions. The rim profile is of a type known from sixteenth century assemblages. Staffordshire Butterpot Ware is dated to between 1650 and 1700, a similar date range for these pieces here would fit well with the dating of the rest of the assemblage.

Earlier Wares

The remaining fabrics, represented by single sherds each, appear to constitute earlier residual material, with Cistercian Ware (1450-1600), Guys Ware (1500-1600), and Tudor Red Ware (1500-1550). No vessel forms could be identified. The presence of small amounts of earlier residual material can be explained by the presence on or near the site of a ferry landing point dating to the medieval period²³⁷, a medieval hospital²³⁸ and a Tudor fort²³⁹.

Interpretation

This assemblage constitutes a utilitarian group with much of the material having been in or near fire as indicated by its sooted appearance. This suggests that little of the material was considered to be special table ware and very little of it can be classed as being particularly fine, in fact there are no items represented which would suggest high status. The dating centres on the third quarter of the seventeenth century.

The vessel forms appear to represent the activities of food preparation and serving. The sooting of many vessels shows their use for cooking or warming food, however the use of the vessels seems to be broader than their form alone would suggest, as much of the material appears to have been used in a variety of functions, such as the chamber pots which show indications of having been used in a culinary role. One presumes that these particular pots were reserved for a particular function when first purchased rather than them changing roles in mid-life. Vessels such as tripod pipkins, designed for sitting above direct heat could also be used as separate cooking containers within cauldrons, an economical seventeenth century practice²⁴⁰. Other handled pots and especially jugs²⁴¹ could also be used in this way for cauldron cooking. The absence of lids within such a large collection suggests that pots may have been sold separately from lids and that pastry may have been used as a sealant where required²⁴².

There is little indication from the pottery of any long term storage use. Neither is there any indication that it derives from a military establishment. The low number of items relating to lighting, one candlestick, suggests that other contemporary forms of lighting, such as torches, tallow candles and rushlights²⁴³ would have been used in addition to candles.

The quantity of Border Wares appears high. This probably relates to the fact that the fort is situated on the bank of the River Thames and was therefore on one of the major transport routes of this material, rather than such wares being especially favoured by the military establishment. Of potential importance is the absence of certain vessel types within the Border Wares. The absence of skillets, costrels and lids appears to be real considering the sample size. These types are present in contemporary deposits in London²⁴⁴ and may imply distinct food preparation, travelling and trading practices.

Of the rest of the assemblage much could have been obtained relatively locally, from the Essex hinterland or the London areas, particularly the Tin Glazed Wares, the Post-Medieval Red Wares and the Black Glazed Earthenwares. Where a specific source could be identified for the Post-Medieval Red Wares the Woolwich kiln was indicated.

THE TABLE GLASS

The table glass recovered from layer 4242 falls into two categories, wine bottles and drinking/serving vessels, and is a small group in comparison to the quantity of pottery sherds. However the recovery method was good²⁴⁵ and therefore the quantity of glass probably reflects the scale of usage of glass tableware, or at least the scale of its disposal.

Wine Bottles (FIG. 41: **100-10**)

A total of 142 sherds weighing 3608.25grms were recovered which could be attributed to wine bottles. The metal was dark green with the surfaces suffering from dullness, iridescence and patination²⁴⁶ due to the saline ground conditions. The material survived best where thick, that is at the bottle bases, and where structurally strong, that is at the bottle necks. The very thin nature of the bottle walls, especially at the shoulder, meant that these fragments were generally very small and unattributable to individual vessels. This meant that only one base and neck could, with any certainty, be attributed to the same vessel. A total of five (FIG. 41: **100, 107-10**) different necks and eight different bases (FIG. 42: **100-6**; one base not illustrated) could be identified giving a minimum vessel count of eight.

The vessels were generally of a very uniform shape with the walls sloping outwards from the base to shoulders, pronounced kick-ups, and high, wide string courses. The depth and width of the kick-ups varies slightly as do the string courses, which are quite uneven. The vessel diameters vary from 13-15cm. The vessel shapes are consistent with the Early Onion Type wine bottles dated 1680-1685²⁴⁷ though vessel **101** may be a Shaft and Globe Type dated 1670-1680²⁴⁸. This group is similar to the bottles found at Temple Balsall²⁴⁹. The string course of vessel **100** is very unusual with irregular lobes, caused by pinching or cutting when the metal was molten. Whether this is the result of a deliberate attempt at decoration or poor workmanship is uncertain, though the uneven string courses of the other vessels may point to a common source for the bottles.

- Drinking and Serving Vessels (FIG. 42: **111-6**)

Most of the glass identified as being fragments of drinking or serving vessels is very fine and, as with the wine bottles, the metal is very fragmented resulting in only the thicker and stronger structural elements, such as rims, stems, bases and a spout, being identifiable. In all 98 sherds with a total weight of 66grms. were attributable to drinking vessels. All the glass is colourless, though beaker **115** has a slight purple hue, and again all surfaces suffer to various degrees from dullness, iridescence and patination²⁵⁰.

Two bowls, a stem and foot are attributable to wine glasses. Bowl **111** has a very rounded convex profile of the roemer type, a style common in Germany and the Netherlands in the seventeenth and eighteenth centuries²⁵¹. A single rim piece (FIG. 42: **112**) represents a round funnel bowl, mould-blown with the edge of a ridged pattern, probably a lozenge. This bowl shape is common in English glass from the early seventeenth to early eighteenth centuries²⁵², but can also be found in the Netherlands²⁵³. The stem (FIG. 42: **113**) has a hollow knob with slightly twisted vertical ridges under an angular collar and is similar to examples from London²⁵⁴, Bedford²⁵⁵, to a possibly Venetian round funnel glass with stem from Temple Balsall dated circa 1670²⁵⁶ or knobs *à la Venise* from the Netherlands²⁵⁷. The foot (not illustrated) was extremely fragmented and could not be attributed to any of the above or below vessels.

Bowl **114** is that of a seventeenth to eighteenth century ale glass²⁵⁸ with a mould-blown lozenge design. The form is also found in the Netherlands though without the lozenge design²⁵⁹.

Base **115** consists of a mould blown circular base with low kick-up, tear-drop ridges on the body walls and radial ridges in the form of a star extending from the pontil mark. The sides open outwards very slightly towards the top and the vessel sits on three raspberry prunts. This highly decorated piece is almost certainly from the Netherlands from between the second half of the sixteenth and the end of the seventeenth centuries. It is most likely to be a miniature bossed beaker, possibly for serving a table condiment²⁶⁰, rather than a liquid.

A very fine spout (FIG. 42: **116**) was recovered consisting of an oval tube widening towards its base, attached to near vertically sided vessel and rising in a very elongated S-shape to the spout hole. The vessel body wall was even thinner than the spout glass. In form it is very similar to spouts from simple late seventeenth century posset cups of the single or double handled varieties²⁶¹. Its spout height however, at 118mm., is significantly greater than the 85-86mm.²⁶² total vessel heights of other illustrated pieces, so it is much more likely to be a spout from a Dutch decanter from the first half of the seventeenth century, similar to an example with a total vessel height of 142mm. and minimum spout height of 95mm.²⁶³.

While many of the more decorative elements in this group are very common on the Continental such as the raspberry prunts²⁶⁴ and mould-blown lozenge designs²⁶⁵, there were also contemporary English glass houses using these designs²⁶⁶. The combination of decorative elements with very Continental forms however strongly suggests that much of this collection of fine glass is from the Low Countries and may have arrived at the fort because of Tilbury's proximity to the Netherlands or its proximity to the huge market of London. Chemical analysis of some of the wine bottles and the drinking vessels²⁶⁷ showed the glass to have insignificant quantities of lead oxide. This means that the fine vessels in this collection cannot be George Ravenscroft high-lead oxide vessels, produced in England from 1676²⁶⁸, but are comparable to the soda-lime glass being produced in the Netherlands *à la Venise* before the end of the seventeenth century²⁶⁹.

The small quantities of wine bottles and drinking vessels is probably a true representation of their usage at the fort. It is likely that most drinking vessels used in the

fort were made of pottery or organic materials, such as wood and leather, which do not appear in the archaeological record. However, regardless of the nature of the drinking vessel types, if wine was a significant beverage at the fort, the evidence for more wine bottles could be expected. The low quantity and fine quality of the drinking and serving vessels, together with the low quantity of wine bottles, suggests that drinking wine was a luxury activity restricted to a small high status group at the fort, presumably the officers, as opposed to the growing accessibility of glass products to contemporary lower class groups in other parts of the country²⁷⁰.

CLAY TOBACCO PIPES (K.A. Heard)

The redeposited midden deposit 4242 in the West Curtain Bank produced 12543 fragments of clay tobacco pipe, in the following proportions: 3824 bowl, 8328 stem and 391 mouthpiece fragments. There were also a considerable number of pipe fragments recovered from sieving which were too small to identify and which were excluded from analysis. There were 2 marked pipes and 21 decorated pipes. The assemblage is predominantly of south-eastern English manufacture although there are 6 examples of imported pipes. No complete pipes have been identified and there is no evidence for pipe manufacture.

The English pipes have mostly been classified according to the London Typology of Atkinson and Oswald (AO)²⁷¹, although Oswald's Simplified General Typology (OS)²⁷² has been used to obtain closer dating of the eighteenth century material. Atkinson's typology of Dutch pipes (AT)²⁷³ has been used where appropriate. The prefixes AO, OS and AT are used here to indicate which typology has been applied.

The pipes were generally very fragmented. Out of a total of 3824 bowl fragments 1937 (50.6%) are too small and abraded to be identified readily. The poor state of preservation is also indicated by the fact that the assemblage contains considerably more bowls than mouthpieces. An attempt was made to reconstruct some of the pipes from the available fragments. Using a methodology devised by Higgins²⁷⁴ a search was made initially to find fragments which joined at the bowl/stem junction. None could be found and consequently no complete pipes were identified.

The English Pipes

- Bowl typology and date range

Table 3 Clay tobacco pipes: bowl types and date ranges

Date Range	Bowl Type	No. of Bowls	Percentage of Total
1640-1670	AO 12	1	0.05
1660-1680	AO 13	5	0.3
	AO 15	114	6
	AO 18	143	7.6
1680-1710	AO 20	91	4.8
	AO 21	15	0.8
	AO 22	1516	80.3
1700-1740	AO 24	1	0.05
	OS 24	1	0.05

Very few independently-dated groups of pipes have been studied in detail, making this assemblage of particular importance for clay pipe research. Analysis of the pipes from the West Curtain Bank should indicate the range and frequency of bowl forms in use on the site in the period 1670-85, during the construction of the fort.

TABLE 3 shows that the 1887 pipe bowls which are sufficiently intact can be divided into nine bowl types with a broad date range of 1640-1740. However, it is clear that most of the pipes fall within the date range 1660-1710. There is only one type AO 12 bowl (1640-1670) which is either residual or a very late example of its type. Only 2 bowls (a type OS 10 and a type AO 24) are dated post-1700, and these may be considered intrusive.

13.9% of the bowls are dated 1660-1680. Within this group there are only 5 (0.3% of the total) type AO 13 bowls which suggests that this form went out of common usage earlier than the contemporary forms AO 15 (FIG. 43: **117-8**) and AO 18 (FIG. 43: **119-24**).

The vast majority of the pipes (85.9%) are dated 1680-1710, and within this latter group type AO 22 variants predominate (FIG. 43: **129-32**). Most of these pipes have heels which are broader and flatter than the example shown by Atkinson and Oswald²⁷⁵, and resemble elongated versions of type AO 18 (1660-1680)²⁷⁶. These pipes may therefore represent a transitional form.

The relative scarcity of contemporary forms AO 20 (FIG. 43: **125-6**) and AO 21 (FIG. 43: **127-8**) (particularly the latter) is a feature which has been noted previously in other large assemblages in the London area and may indicate that these forms were less popular or perhaps more expensive.

It should be noted also that although no type AO 19 (spurred) bowls (1690-1710) are present, many of the type AO 15 bowls (1660-1680) are long and elongated examples (FIG. 43: **117-8**) which may represent a transitional form with a postulated date range of circa 1670-1690.

- Marked Pipes

The assemblage contains very few marked or decorated pipes. This is to be expected because in the latter part of the seventeenth century the vast majority of pipes manufactured in England were plain and unmarked.

One type AO 22 bowl (1680-1710) has the initials **WG** moulded in relief on the sides of the heel. A second example (not illustrated), from the same mould, was recovered from context 4206 (FIG. 9)²⁷⁷. The maker cannot be identified. (FIG. 44: **138**).

There are three type AO 22 bowls which have a single line of milling across the base of the heel, at a right angle to the line of the stem. This form of marking is recorded occasionally on seventeenth century pipes from London, although its significance is uncertain. It might not be a maker's mark, but simply a tally mark to indicate the completion of a particular batch of pipes. (FIG. 44: **134, 136-7**)

- Decorated pipes

Milled bowl: a type AO 22 bowl has a line of milling around the rim in the usual fashion, with an additional design consisting of cross-hatched lines of milling on the back of the bowl. A rare form of decoration (FIG. 44: **135**).

Milled stems: fourteen fragments of stem are decorated with a milled design, taking the form of either parallel bands (FIG. 44: **140, 154-8**), diagonal lines running around the stem (FIG. 44: **144**), more irregular cross-hatched lines (FIG. 44: **150, 153**) or irregular cross-hatched lines combined with bands of milling (FIG. 44: **141, 148-9, 151-2**). The milling is applied at various points along the length of the stem, and therefore does not indicate a point of balance. The more irregular designs are found most frequently at swollen or deformed areas of the stem which indicate repairs at points where the clay was pulled apart as the moulding wire was removed. This implies that the milling was not necessarily a decorative feature, but was applied in order to disguise the areas of repair or to help bind the clay together until it had been fired.

One similar example has a band of parallel diagonal slashes or grooves (knife or fingernail marks?) running around the stem at a point of repair (FIG. 44: **143**).

Pinched stem: there is one fragment of stem with a pinched design. This is found occasionally on seventeenth century pipes from the London region (FIG. 44: **159**).

- The pipes as indicators of socio-economic status

A number of factors affected the quality and therefore the price of clay tobacco pipes. These included stem lengths, the use of burnishing to create a glossy surface, and the presence and degree of milling around the rim. By assessing some of these factors it is possible to use the pipes from this deposit as indicators of the socio-economic status of the site during construction of the fort.

In order to assess the quality of the pipes from this group a random sample of 413 complete bowls of various types was examined in detail. The size of the sample was dictated to a certain extent by the availability of complete bowls of each type. It was composed as follows: type AO 22 x 200; type AO 21 x 11; type AO 20 x 40; type AO 18 x 80; type AO 15 x 82. All except one of the pipes in the sample had been smoked.

Burnishing: none of the bowls from the sample displayed obvious signs of burnishing to a high gloss, although most had been smoothed to some extent and the mould-lines removed.

Milling: contemporary accounts indicate that the degree to which the bowl rim was milled affected the value of a pipe. Thus, a pipe with a bowl rim which was milled fully was considered to be of better quality than one with only partial milling. The use of milling was almost universal on pipes in the London region during the first half of the seventeenth century but became less common later in the century and was virtually non-existent by the beginning of the eighteenth century. The majority of the bowls in the sample group were less than half milled and were therefore of a relatively low grade. Of the total 413 bowls only 25 examples had milling completely or almost completely encircling the bowl. Type AO 21 bowls had particularly little milling although experience has shown this type tended to be milled less often than the others.

Finish: In order to further assess the pipes in the sample group the type AO 22 bowls were examined for general indications of the quality of the finish. Although difficult to quantify the following points were noted: 43 of the bowls (over 10%) had been trimmed poorly at the heel or displayed other obvious faults such as indentations or accidental cuts made by fingernails or trimming knives. In addition, the milling on many of the pipes had been applied poorly.

The low incidence of imported pipes (see below) may also be significant. Dutch pipes (which accounted for almost all imports in the seventeenth and eighteenth centuries) were finished to a much higher quality than contemporary English pipes and would have been much more expensive to buy in this country. However, it should be

noted that in general surprisingly few imported pipes are found on sites in London and the south-east of England.

To conclude, it is possible to suggest that the absence of burnished pipes, the relatively low degree of milling and the generally poor finish on many of the bowls in the sample group indicates that the Tilbury Fort pipes were not of a particularly high quality.

The Imported Pipes

There are several examples of imported pipes mostly thought to be of Dutch origin but including one American import.

- The Dutch pipes

A Dutch bowl is similar to Atkinson's type AT 12 (circa 1660). It has fairly fine walls and a slightly rounded heel. The bowl, which is not polished, is one-half milled, on the side facing the smoker (FIG. 44: **139**).

A broken bowl with only the heel and part of the stem survives. The pipe is highly polished and the stem is thick. It is marked with a crowned **H**, stamped in relief on the base of the heel. The maker is unknown and the bowl type cannot be recognised but it is presumably of late seventeenth century date (FIG. 44: **133**).

Roller-stamped stems: a stem fragment has at least three parallel bands of dog-toothed design, applied poorly. It is probably Dutch and seventeenth century in date (FIG. 44: **146**). Another stem with a spiralling line of dog-toothed design, applied poorly is also probably Dutch from the seventeenth century (FIG. 44: **145**).

Stamped panel: one stem fragment has a repeated stamped motif separated by bands of milling. The design consists of a diamond divided into quarters, each containing a *fleur de lis*. Similar stamps are described and illustrated by Oswald²⁷⁸ from London, Plymouth and Newcastle. Possibly Dutch (FIG. 44: **147**).

- The American pipe

Two adjoining fragments of a hand-made pipe believed to be of Virginian origin. The pipe is made of red clay and is highly polished. The stem is very thick and tapered, and has a bore diameter of circa 10/64 inch. The stem is decorated with a milled design of parallel bands and cross-hatching. There are also lines of milling on the bowl, which is largely absent. The pipe compares well with examples from Martin's Hundred²⁷⁹ and Nominy Plantation²⁸⁰, and is probably a local copy of the Dutch "funnel elbow" export style, dating 1680-1720 (FIG. 44: **142**).

CUTLERY AND DOMESTIC TOOLS (Graham Reed and Peter Moore)

Relatively few items could be attributed to this category of finds probably because of the multi-purpose nature of many tools blurring any distinction between domestic and military usage. The only category of late seventeenth century cutlery recovered is knives, with twelve knives, a number of lesser fragments and two unattached knife handles. While knives are categorised here as cutlery this does not preclude their use by individuals for any number of daily tasks other than use at the table. No contemporary spoons and no forks at all were recovered. It is possible that a large array of organic

tools, for instance wooden spoons, were used but have not survived to appear in the archaeological record.

- Knives (FIG. 45: **160-71**)

Three knives (FIG. 45: **160-2**) with no integral shoulders have whittle tangs and deep blades inferring a more utilitarian use, such as kitchen equipment. Another group of knives (FIG. 45: **163-9**), although having whittle type tangs, also have integral shoulders or bolsters. A similar example to those of **163-6** is dated to 1700-1720 from Aldgate²⁸¹. The remaining items in this group (FIG. 45: **167-9**), have angled or deep shoulders, with similar examples from Chelmsford²⁸² and Ardingly²⁸³ are both dated to between 1550 and 1730-50 respectively. All of the items in this group are likely to be late seventeenth century table wear though knife (FIG. 45: **169**) was a residual find in a later context²⁸⁴.

The only clear example of a scale tang knife is **170**. It appears to have shoulders with the tang being pierced by three rivets. The remains of what seems to have been a wooden handle are still adhering to the tang with the blade being angled downwards and may possibly be some kind of tool. The only possible scale tanged handle plates found at the fort were found in much later contexts.

Knife **171** (FIG. 46) does not conform to any recognised typology and may be an example of a knife with a more specific function. The blade tip is rounded and there is a small step between the blade and the possible handle, which is pierced by a single rivet.

- Blade Tips (FIG. 46: **172-6**)

This group of blade tips show a range of forms which may be related to different functions, however, it was not possible to relate them to any of the above knives. Tip **172** seems to have a strangely pointed end, while **173** and **176** have curved backs and **174-5** have curved blades.

- Knife Handles (FIG. 45: **163**; 46: **177-8**)

Two bone knife handles unassociated with iron blades (FIG. 46: **177-8**) and one still containing parts of its tang and blade (FIG. 45: **163**) were recovered, all whittle tanged types. The survival rate of handles to blades is very low.

- Scissors (FIG. 46: **179-81, 183**)

A number of iron fragments produced two types of scissors of a similar size. The first (FIG. 46: **181**) has the arms from the blades joining the loops at the side, of which there are three examples. The other (FIG. 46: **180**) has the arms joining the loop at the middle of the curve of which this is the only example. Scissors of this type are known from Ardingly²⁸⁵ and are dated broadly to between 1550 and 1750. A possible scissors blade tip (FIG. 46: **179**), may belong to either type. A single fragment of copper alloy scissors (FIG. 46: **183**) consisted of a stem, broken in front of the loop and across the pivot hole. The stem is rectangular in section and slightly chamfered before the loop. On the outer face of the stem there are five incised parallel lines while on the inner face there are four similar incisions. Copper-alloy scissors are very uncommon and may have had inserted iron blades for added strength. Alternatively this piece could be part of another two handled pivoted object such as a candle snuffer.

- Handles (FIG. 46: **182, 184**)

A bone handle (FIG. 46: **184**) measuring 74mm. x 23mm. was probably for a brush. It was broken across the first three holes for the bristles and at the beginnings of two grooves for the attaching cord or wire holding the bristles. The other end has a hole for suspending the object. An iron handle (FIG. 46: **182**) is unattributable to any specific type of utensil. An almost identical handle from Norwich²⁸⁶ is given a date of between 1600 and 1700.

- Hone (FIG. 46: **185**)

A small hone (FIG. 46: **185**), broken at both ends and measuring 43mm. x 22mm. x 20mm., would have been used for sharpening small knives and other blades.

(ii) PERSONAL ITEMS

Three groups of late seventeenth century finds from the fort, coins, dress and games and pastimes, have been categorised as belonging to individuals rather than to groups or households of people. This has been attempted on the assumption that each object is likely to have only had a single owner at a time. On this basis these objects can also be used to examine the status of the fort inhabitants and their activities. However the paucity of finds in this category prevents too much generalisation and it must be assumed that many personal items would have been made of organic materials, such as wood, which have not survived.

COINS (FIG. 47: **186**)

Most of the coins found at the fort are of very low denomination, as demonstrated by the seven coins found in the West Curtain Bank, consisting of three Charles II farthings (2 x 1675²⁸⁷ and 1 x 1679²⁸⁸), one probable Charles II farthing²⁸⁹ (defaced by being hammered into an octagonal shape), one farthing token of Francis Stone²⁹⁰, mealman, "without Temple Bar" London, dated mid to late seventeenth century²⁹¹ (FIG. 47: **186**), and one halfpenny²⁹² (William III 1695-1701). As a group these coins represent the loss of the lowest denomination currency, and even though it could be expected that higher value coins would have commanded greater personal care, a financially poor community is indicated. The exception to this is an 1811 George III Three Shilling Bank Token²⁹³ which would represent a considerable sum for the average soldier and must therefore have belonged to an officer.

DRESS (Peter Moore and Graham Reed)

Evidence for the nature of clothing at the fort in the late seventeenth century consists of buttons, buckles, belt fittings, points, pins, fasteners, jewellery and shoe accessories. Indirect evidence for clothing also comes from the presence of lead cloth seals. No distinction can be made between military and non-military wear at this date nor between clothes worn by different sexes.

- Buttons (FIG. 47: **187-94**)

Of the nine buttons recovered six were made from copper alloy and three from lead. The copper alloy examples consisted of two hollow (FIG. 47: **187**) and two solid (FIG. 47: **188-9**) biconvex buttons, developed out of a plain medieval type²⁹⁴, and two solid hemispherical buttons (FIG. 47: **190-1**), one with a nipple (FIG. 47: **190**). All three lead buttons were solid hemispheres with nipples (FIG. 47: **192-4**).

- Buckles (FIG. 47: **195-203, 208**)

Three copper alloy and two iron buckles were recovered. One of the copper alloy buckles (FIG. 47: **195**), rectangular in shape, still had an iron pin preserved on it, and oval buckle **196**, had an iron central bar. Copper alloy buckle (FIG. 47: **197**) was the most decorative with lobes and frame points. Buckle plate **198**, which with a width of only 11.5mm. is very narrow, was probably for a belt buckle. The two rectangular iron buckles (FIG. 47: **199-200**) would have come from belts, as may have the three round iron loops (FIG. 47: **201-3**), for hanging equipment, while hook **208** may be a strap end.

- Points (FIG. 47: **204**)

The badly fragmentary nature of the thirteen points, or "lace ends", makes it hard to say much about the types of points used at the fort. The one complete example (FIG. 47: **204**) was 23mm. long, 4mm. in diameter and unpierced. None of the other surviving point ends were pierced.

- Pins (FIG. 47: **205-7**)

Pins were commonly used in the seventeenth century to hold garments together²⁹⁵, but would have had a variety of other uses, for example clothes making and mending. A total of 337 complete pins and pin fragments were recovered from the redeposited midden layer 4242, but as an inexpensive commodity they could be expected to have been bought in large numbers (FIG. 47: **205**). A few pins were sufficiently preserved to show that the heads were of the spiral type. The two pins over 50mm. long (FIG. 47: **206-7**) were probably dress pins and the prominent spiralling on the heads may have been decorative.

Table 4 Pin lengths in midden deposit

Complete Pins (shaft length in mm.)					Broken Pins		
16-20	21-25	26-30	31-35	50-60	Head	Shaft	Total
7	143	30	12	2	53	90	337

Using a head-only count the minimum number of individual pins is 247. To divide the pins into length categories only complete pins (head to point) were considered, giving a total of 194. The vast majority of the complete pins (74%) were in the 21-25 mm. length range. A comparison with analysis of seventeenth century pins from Winchester²⁹⁶ shows that there the largest group of pins is in the 20-29mm. length range. However, taking the total sample into consideration, Tilbury's 194 complete pins can be compared to Winchester's 57. Tilbury has a greater concentration of pins in the 20-29mm. range (expressed as a percentage of total pins), that is to say 90% compared

with 53%. An explanation of the greater conformity of size of pins at Tilbury Fort, as compared to Winchester, may be that the smaller population at Tilbury had access to fewer pin manufacturers than the city population of Winchester

- Fasteners (FIG. 48: **209-10, 213**)

There are several copper alloy wire cords or links and one iron chain which may be dress accessories. A 29mm. length of very fine twisted copper alloy wire (FIG. 48: **209**) with the strands returning at both ends to form hooking eyes. This may have been for clothing, suspending personal items or for jewellery. Fastener **210** is a shaft with an eye at one end made out of two strands of wire twisted together. As the other end is broken it is impossible to be certain that this fastener like the clothes fastener from Norwich²⁹⁷. A fine iron chain (FIG. 48: **213**) has rectangular links secured to each other by tiny rivets and may have been part of a decorative element on a belt or braiding.

- Jewellery (FIG. 48: **211**)

Thirty fragments were recovered of an extremely fine wire strand²⁹⁸ (not illustrated) twisted into a coil with a diameter of only 1mm. are probably decorative as this coil is too fine to have had a practical function. It may have been part of a piece of jewellery such as those used in Norwich²⁹⁹ and London³⁰⁰. A lead alloy mount, from possibly a brooch or large button (FIG. 48: **211**), consisted of a central disk surrounded by a raised edge. This piece is in poor condition but the raised edge may have represented wreaths, plaits or braiding. Inlaid in the centre of the piece is a thin copper alloy sheet with patterned discoloration in the shape of a cross in the centre. Obviously there had originally been some sort of inset at the centre of this piece. The reverse shows a casting mark and a broken shaft at the centre with the start of a possible hoop or shaft. This piece may have been worn in the manner of a button but is unlikely to have formed that function due to the inherent weakness of the metal. The suggestion of a cross is unlikely to have any religious significance as seventeenth century religious pieces in England are unusual.

- Shoe accessories (FIG. 48: **212, 222-3**)

The shoe accessories dating from the late seventeenth century consist of a spur, heel iron and patten, and are all made of iron. The rowel spur³⁰¹ (FIG. 48: **212**) has few diagnostic features because the rowel and both terminals have not survived. However a rowel spur of similar light construction, dated to the first half of the seventeenth century, was found at Bolingbroke Castle³⁰². The heel iron (FIG. 49: **222**), late seventeenth to early eighteenth century in date³⁰³, is heavy in form with a single fuller for the whole of its length, which is pierced by seven round holes. A representation of a heel iron in a civilian context is dated to 1807³⁰⁴. The iron sub-structure of a patten (FIG. 49: **223**) dated stylistically to between c.1625 and c.1720³⁰⁵, but because of its context must pre-date 1685.

- Indirect evidence for clothing (FIG. 48: **214-9**)

Indirect evidence of clothing on the fort comes in the form of four lead cloth seals (FIG. 48: **214-7**), which may represent textiles being used for clothes at the fort. The fact that the textile weaves, visible by impressions on the reverse of the seals, were from

coarse fabrics³⁰⁶, indicates the textiles may have been for poor people³⁰⁷. It is also likely that, with four seals, their presence resulted from textiles were being used at the fort rather than from accidental loss. The pins (see above) could also have been used for clothes making/repairs, and such work is also indicated by the presence at the fort of a bone³⁰⁸ needlecase top³⁰⁹ (FIG. 48: **218**). A bone³¹⁰ industrial piece (FIG. 48: **219**) is probably waste from the making of buttons.

- Discussion

Little distinction can be made between the types of seventeenth century clothing represented in the fort's archaeological archive and the clothing represented by the archaeology of contemporary populations elsewhere. The array of buttons, buckles, points, and pins are also seen in collections from Winchester³¹¹, Norwich³¹², Southampton³¹³ and London³¹⁴. However, what is apparent is that the above Tilbury Fort group, as a whole, is poor in nature and therefore in status. None of the material is outstanding for its workmanship or decorative nature; it is mostly plain and solely utilitarian. The large number of pins may reflect the status of the fort's inhabitants, as the use of pins was greatest among the poorest sections of society for holding clothes together³¹⁵. Much of the collection could have also doubled as part of any uniform as contemporary uniforms, for lowest ranks of soldiers, would have had little or no decorative elements.

GAMES AND PASTIMES (FIGS. 48: **220-1**)

A single gaming die (FIG. 48: **220**), made from a cattle sized long bone fragment, conformed to the Type Ai numbering system³¹⁶ with opposite numbers always adding up to 7. One complete toy marble³¹⁷, probably made of pipeclay, and a chip of one (both not illustrated)³¹⁸ were both of late seventeenth century date, but do not necessarily indicate children. A Jews Harp (FIG. 48: **221**) is the only definite evidence of musical activity on the fort.

The small size and portability of all the recovered objects of amusement and music recovered would have been an important factor in the lives of the soldiers and their families at the fort, as there would always have been the possibility of being transferred elsewhere.

(iii) DIET

Examination of the personal and domestic objects shows a mostly poor community with few luxuries. However, something better than abject poverty could be expected in the diet of garrisoned soldiers. The job of a soldier probably had a degree of security above that experienced by the urban or rural poor, in terms of tenure, wages and regular food. The provision of food would have been an important concern in the successful running of a garrison and defensive fort, and therefore the average soldier may have benefited, compared to whatever urban or rural environment they may have hailed from.

The mechanism for that provision changed over time. Originally an important position at the fort was that of Sutler, responsible for the supply of provisions to the soldiers. The Sutler's House to the east of the Watergate was constructed between 1698³¹⁹ and 1715³²⁰ and would have been a focus for supply of food, drink and tobacco.

The use of a variety of ceramic vessels for cooking food, bowls, skillets, chamber pots, jars and jugs, fits with the descriptions given of cooking arrangements in 1808, that

is small individual portions of food being cooked, rather than communal cooking. On 20th July 1808 a Major Gravatt pointed out that the men were currently cooking in their rooms and eating in small messes and that by building a kitchen and mess for the whole garrison the space saved in the Barrack Block could easily house an additional 60 men³²¹. This he proceeded to design and build as a plan of 9th June 1830 shows a Cooking House and Mess Room behind the soldiers barracks against the West Curtain Bank, and a Canteen on the previous site of the Sutler's House³²².

The provision of centralised cooking and eating facilities may have been of benefit to the fort's inhabitants. A regular diet, with possibly improved hygiene, that was now the responsibility of the army to supply and regulate, would have enabled improved standards of health. This is not to say that the army diet was what is now considered a balanced diet, a look at the 1911 map of the fort shows storage provision for meat and bread only³²³, though it is known that at least some vegetables were grown in the flat land between the East and West Curtain Walls and the Inner Moats³²⁴.

The bulk of what we know about the diet of the inhabitants comes from the midden material³²⁵ used in the late seventeenth century construction phase of the West Curtain Bank, giving us detailed information about the mammals, birds, eggs and fish that were available and/or eaten. Because an unknown amount of the midden remains unexcavated, the scale of the bone composition is unknown and therefore quantification of the total dietary composition of the midden and the significance of small numbers of bones from certain species compared to the whole assemblage cannot be estimated.

The presence of a number of wine bottles and glasses within this deposit suggests the presence of some higher status individuals within the fort population, who may possibly have had a different diet. Apart from the utilisation of less common species for food, for example pheasant, it is impossible to identify a high status diet from the archaeology remains, as the manifestation of a such a different, and higher status diet, may have been in the nature of the quality of the cut of meat or in the nature of the vegetable and/or cereal part of the diet.

THE ANIMAL BONES AND EGG SHELL (Jane Sidell, with fish bone by Alison Locker)

Domestic mammals (TABLE 4)

- Cattle (*Bos taurus*) and cattle-sized remains

This group, which includes a proportion of bone identified as cattle-sized (anatomical elements such as rib and vertebral fragments) was very small, prohibiting detailed analysis of the biometric or ageing data. The assemblage of butchered material, which consisted of 53% of this bone, points towards on-site primary butchery. Secondary butchery, that is the preparation of smaller meat units from the prepared carcass, is exhibited on the girdles, spinal column and some of the long bones. A further point of interest is that this assemblage contains a large quantity of what appears to be primary waste from preparation rather than waste from the later stages, that is table waste. The fact that only one fragment of cattle (sized) bone was gnawed may indicate that the bones generated at Tilbury may not have been fed to dogs, and were not generally accessible, implying a fairly hygienic standard of waste disposal.

Table 5 Animal species by fragment number and weight from seventeenth century construction phase of West Curtain Bank

Species	Number	Weight (g)
Cattle (<i>Bos taurus</i>)	174	9559.2
Cattle-sized	512	6924.1
Sheep/goat	802	7694.5
Sheep (<i>Ovis aries</i>)	9	293
Sheep-sized	2231	4308.8
Pig (<i>Sus scrofa</i>)	63	662.3
Horse (<i>Equus caballus</i>)	1	39.9
Rabbit (<i>Oryctolagus cuniculus</i>)	91	61.3
Hare (<i>Lepus europaeus</i>)	19	15.1
Lagomorph	21	3.7
Cat (<i>Felis catus</i>)	9	5.4
Dog (<i>Canis</i> sp.domestic)	2	0.7
Field vole (<i>Microtus agrestis</i>)	1	0.1
Vole (Muridae)	1	0.1
Mouse (<i>Mus</i> sp.)	35	0.1
Mouse/vole	14	0.1
Small mammal	287	20.2
Chicken (<i>Gallus gallus</i>)	49	51.1
Goose (<i>Anser</i> sp.)	5	12.0
Duck (<i>Anas</i> sp.)	28	30.5
Mallard (<i>Anas platyrhynchos</i>)	4	8.6
Crow (<i>Corvus corone</i>)	11	6.4
Corvid (<i>Corvus</i> sp.)	180	56.1
Dove (<i>Columba</i> sp.)	14	4.8
Buzzard (<i>Buteo buteo</i>)	10	8.1
Turdid (<i>Turdus</i> sp.)	10	0.5
Lapwing (<i>Vanellus vanellus</i>)	4	1.9
Heron (<i>Ardea cinerea</i>)	2	5.2
Gull (Laridae)	1	0.8
Pheasant (<i>Phasianus colchicus</i>)	1	1.6
Bird Fragments	1221	155.5
Unidentified Fragments	7367	2124.8
Total	13179	32056.5

- Sheep (*Ovis aries*), sheep/goat, and sheep-sized remains

The sheep/goat assemblage from this group is the largest species group from any excavation at the fort and it was possible to characterise the assemblage in some detail. The ageing evidence suggested that the individuals represented here were fully formed. The attrition stages show the majority of individuals between approximately three-six years old, with very few individuals falling a year or so either side of this bracket. Measurements were only possible on the mandibles, and were used to look at patterns of size and sex. A small group was shown in both exercises which may have represented females. Otherwise a normal distribution testified to a group with a regular size range. The butchery evidence presents a possible case for on-site slaughter of animals, and suggests that this assemblage is primarily kitchen waste, rather than table waste. A good proportion of the butchery marks appear to be a result of carcass division. In some contexts, such splitting may be interpreted as smaller units of meat being purchased. It would be expected that in a fort, the garrison would not be such that only small units of an animal would be required. It would therefore seem likely that the splitting of an animal into sides would simply be part of the jointing procedure, unless, as is suggested

by the cooking and eating arrangements (see above), people were purchasing and preparing small portions of food, and therefore meat. Seven of the eight sheep bone skull fragments were found to have been butchered, split along the sagittal plane, presumably for removal of the brain. Additionally one of these had the horn chopped off, probably for the removal of the horny sheath for use as a raw material for working. The large quantities of sheep-sized bones with burning, though possibly accidental, and the lack of gnawing may imply a fairly high standard of hygiene within the fort.

- Pig (*Sus scrofa*)

Only sixty-three pig bones were identified from this phase, which is a very small group when compared to the cattle and sheep/goat assemblages. Due to this number, it has been difficult to characterise the group, but in general, the pig remains appear to be from largely immature and healthy specimens. The composition of fragments indicates a kitchen waste collection, possibly with on-site slaughter, including one skull fragment split along the sagittal plane, presumably to remove the brain.

- Horse (*Equus caballus*)

There was one possible identification of a horse bone, a distal femur fragment, with a knife mark on the articulation. It may be a fragment of a fort horse which was disarticulated prior to burial. It is unlikely that it was eaten; the consumption of horse by humans being extremely rare in this country since the Iron Age, although consumption by dogs may be possible.

- Domestic Carnivores

The only domestic carnivores so far identified from the fort consist of the nine bones of domestic cat (*Felis* sp. domestic), and two of domestic dog (*Canis* sp. domestic) from this midden deposit. These bones appear to be isolated occurrences, presumably from fort animals that died, were disposed of and subsequently became disarticulated and incorporated into the midden. It is not presumed that the bones are from animals that were consumed. However, it is an interesting point that there are no long bones, and the carnivore bones recovered are only small ones, and it is possible that the assemblage is not representative of rubbish disposal across the fort.

Wild mammals

- Rabbit (*Oryctolagus cuniculus*), hare (*Lepus europaeus*) and Lagomorphs

Both rabbit (*Oryctolagus cuniculus*) and hare (*Lepus europaeus*) were recovered from this phase in moderate quantity, including twenty-one fragments where it was not possible to differentiate between the two (lagomorph). These latter included vertebrae and phalange fragments. The rabbit bones are much more evenly distributed anatomically than the hare bones. Long bones and girdles make up over half of the group, but head and foot elements are still noticeable. It would be unusual if the rabbit but not the hare meat had been taken off the bone. It may be that the hare group is too small to be representative, or it may be that the animals were prepared in different ways. The bones are presumed to be food debris, indicated by some butchery marks. It is possible that traps were used in the vicinity to vary the diet.

- Small mammals

Bones of several small mammals were recovered, although specific identification was not generally possible. Thirty-five bones of mouse were identified, one of field vole (*Microtus agrestis*), one of unspecified vole, and fourteen unspecified between mouse and vole. A further group of unspecified small mammal fragments were also noted. The field vole is a grassland species, but is also known to inhabit marshes or riverside environments³²⁶. Although only one vole was specifically identified, there was marshland and possibly some grassland in the close vicinity of the fort. The remaining vole bones will probably be of water or field voles. The mouse bones are more difficult to use for ecological analysis because the different species have such varied habitat requirements. House mouse (*Mus musculus*) is a likely species, living within the fort and scavenging. However, if voles found their way into the fort, perhaps caught by cats, then various rural species of mouse could also have entered the fort in the same way. So, the data available from the small mammals in terms of ecological indicators is very restricted.

Domestic birds

- Chicken (*Gallus gallus*)

A small assemblage of forty-nine chicken bones were recovered from this phase, five bones identified as chicken size, three as chicken/duck, and over one thousand small fragments were identified as unspecified bird. The chicken bones were mainly long bone fragments, but also some skull and girdle elements. Chicken does not seem to have been a particularly important component of the garrison's diet. Only four instances of certain butchery were observed, one of which was on the back of the skull and presumably is a result of decapitation or skinning. The others were on the long bones, which may have been derived from preparation or separation of meat portions. It is possible that either this assemblage is not representative of the original deposit and chicken is underrepresented, but, as one of the femuri contained medullary bone (spongy bone which forms in the cavity within a bird bone when laying) perhaps a small amount of mature chickens were kept for a supply of eggs rather than meat (see below).

- Goose (*Anser* sp.)

Only five bones identified as goose were identified, and no attempt was made to identify the species involved because of the difficulty in separating goose species, and therefore the bones may represent domestic and/or wild birds. This is an extremely small assemblage, and as with chicken, it would seem that goose was not an important food resource. Medullary bone and butchery marks have been identified from this context and perhaps the birds were kept (or captured) for limited amounts of meat and, in the case of domestic individuals, eggs (see below).

- Duck (*Anas* sp.)

The twenty-eight bones were attributed to duck species, four to mallard (*Anas platyrhynchos*), and three to chicken/duck, may be wild and/or domestic. Again with such a small group, it is difficult to make many valid statements. As with both chicken and

goose, medullary bone and butchery marks were observed and it is possible that wild species were caught in the vicinity and eaten, or that a few individuals were kept in the fort for eggs (see below) and eaten occasionally.

Wild birds

Forty-two bones from six wild species were identified, and one hundred and ninety-two bones were identified to family level (Corvidae, Turdidae, and Laridae). However, although the species diversity for this phase is quite good, the abundance is very low.

- Crow (*Corvus corone*) and crow family (Corvidae)

One hundred and eighty bones were identified as corvids, with a further eleven specifically identified as crow, which tended to be more fully formed and more complete. This assemblage is the largest bird bone group recovered at the fort, and if the total bone group is representative of the deposited material in the midden, then the corvids must have been played a moderately important role in the diet of the fort, though it is rare for crows to be consumed. The unspecified corvid assemblage contains all the major skeletal elements, including head and foot fragments. The crow group is restricted to long bones, but this may be a result of the difficulties of identification. Very few cut marks were observed. There are only three certain marks on crow bones, a knife cut on the proximal femur, and two marks on the proximal ulnae. These latter marks may be a result of disarticulation, and removal of the meat portion of the wing. There are four certain and two uncertain marks on corvid long bones. Three on the distal humerus, one on the distal radius and the others are on the proximal tibiotarsus. These are perhaps caused by a knife disarticulating the carcass. Although the amount of butchery evidence is small, it seems likely that this size of assemblage is something more than the odd dead scavenger. It is possible that the crow bones are just this, but there is a possibility that many of the corvids may be rooks. Young rooks are known to have been consumed³²⁷, and it may be that this assemblage is a food waste group. Rooks are known as agricultural pests³²⁸ and it may be that they were seasonally culled and then consumed. In view of the biased nature of the assemblage which is dominated by lower leg bones (an element likely to be discarded when preparing the carcass) and the nature of the other species assemblages (butchery/kitchen waste), it seems possible that this is evidence of utilisation of a wild avian resource for food.

- Buzzard (*Buteo buteo*)

Ten buzzard bones were recovered representing no more than a few individuals. They were mainly long bones (humerus, radii, carpometacarpus, tibiotarsus and tarsometatarsus) with 1 scapula, were all fully formed with no modification in terms of butchery, pathology, burning or gnawing. The buzzard is known as a scavenger on urban archaeological sites up until the end of the medieval period, but then seems to die out in towns³²⁹, though with a population still existing widely in the countryside. It is probable that the birds were scavenging refuse and were killed by, for instance, a soldier taking a shot at them. It is extremely unlikely that the carcasses were consumed in view of the carrion/refuse diet of this species.

- Dove (*Columba* sp.)

The anatomical composition of the fourteen bone fragments identified to dove species is quite diverse, with both long bones, (humerus, radius, carpometacarpus, femur and tibiotarsus), a scapula, furculi and two phalanges. One chop mark on a distal tibiotarsus was noted, also a chop on a proximal ulna, similar to those of the crow bones, which may have resulted from removal of the meat portion of the wing. A puncture on a humerus was observed, probably caused by a cat or rodent. This may be from a cat catching the bird, or scavenging the bones after they were initially deposited. These bones may simply be feral pigeons (*Columba livia*) which used the buildings to nest in or on. The birds may simply have died on site (whether by natural means or not), or been birds killed and brought in to eat either by man or cat, or a mixture of both. Certainly the butchery marks point towards consumption, though the comparative rarity of the material seems to indicate a fairly opportunistic use of this resource.

- Thrush family (Turdidae)

The ten bone fragments recovered from this phase could not be separated into different species. The elements are mainly long bones (humerus, radius, ulna, carpometacarpus, tibiotarsus and tarsometatarsus) with one phalange. The bones are probably the remains of several birds which died in or around the fort, or which may have been consumed.

- Lapwing (*Vanellus vanellus*)

All four lapwing bones recovered were long bone fragments; two humeri (both left side and therefore two individuals), one ulna and one carpometarpus. The habitat requirements of lapwing includes cultivated fields and freshwater margins, and with the freshwater marsh to the west of the fort and agricultural activity to the north, this could well be local bird. The bones may be the remains of individuals which have entered the fort system in some way, perhaps being caught/shot by a member of the garrison, and may subsequently have been consumed.

- Heron (*Ardea cinerea*)

The two heron bones identified consisted of a tarsometatarsus and a phalange. One possible butchery mark was observed on the tarsometatarsus, which may have been caused during removal of the feet, which means that there is a strong possibility that the heron was eaten. Herons may have been present in the Thames Estuary and so it is likely that, as with some other species, the bird was caught or shot locally and perhaps consumed, possibly by higher ranking individuals.

- Gull species (*Laridae*)

The two gull bones recovered compared favourably, but not positively with kittiwake (*Rissa tridactyla*), and were a femur and a sternum. With many types of food favoured by gulls present in the fort deposits, fish, eel, small crustaceans³³⁰, the birds represented could well be local. However, whether they were feeding from refuse deposits in the fort or from the estuary cannot be determined. As with the heron, these bones seem to represent isolated catches.

- Pheasant (*Phasianus colchicus*)

A single pheasant femur was identified, and it seems likely that this is from a bird which was consumed, and in view of the isolated occurrence, it would seem an opportunistic catch of a local bird.

The wild bird bones from this phase of the fort represent a diverse assemblage of avifauna, and although the actual numbers of bones are fairly limited, it is a particularly interesting group in the context of a fort. It seems likely that the majority of remains are simply isolated catches, some of which may even have been victims of "target practice", for example the buzzards. It also seems likely that not all birds were consumed, particularly those species with a diet of carrion and/or refuse, for example the crows. However, the butchery marks on some bones may indicate that some species were eaten, for example the doves. The assemblage appears to be a group of local species, all of which would be likely to have been available in the surrounding countryside, or may even have come to feed from the refuse deposits in the fort itself. The corvid group is particularly interesting as a possible food resource, used, following seasonal culling as an agricultural pest.

Eggshell

Eggshell from three species of bird has been identified from this phase, with chicken as the dominant species followed by goose and duck. Unfortunately there are no particular characteristics that can be linked to single eggs and therefore it is not possible to quantify the amount of egg that the eggshell represents³³¹. The identifications, when taken in conjunction with the analysis of the bird bones demonstrate that chickens were probably being kept within the fort both for eggs and meat. As with much of the bone material it has not been possible to separate wild from domestic goose and duck eggshell. It is therefore possible that this eggshell, when taken in conjunction with the bone material, represent birds being kept within the fort to provide meat and eggs and/or this eggshell may be the result of foraging and opportunistic finds in the marshes and the estuary. If it was the result of foraging it would imply seasonal exploitation of the local resources to supplement the diet of the fort inhabitants.

The eggshell assemblage from the fort shows that eggs, a simple but nutritional food, were part of the diet for the garrison, although the quantity of the material indicates that either eggshell was disposed of elsewhere, or that eggs had a very small role as a diet supplement. The preservation and techniques of recovery were good, and it is therefore not assumed that a heavy bias has affected this assemblage.

Fish (TABLE 6)

The fish bones were recovered from sieved samples and about half of them were identifiable to species, the remainder being indeterminate fragments of fin ray, ribs and crushed skull. Apart from a few cod vertebrae, all the fish are small individuals, typical of the material recovered from the sieved samples. Although the sample is small, there are some indications of selectivity. The flatfishes (plaice, plaice/ flounder and sole) occur frequently forming 39% of the identified sample and may have been caught or netted along the shoreline of the Thames Estuary.

Table 6 Fish species and elements identified from seventeenth century construction phase of West Curtain Bank

Species	Tooth	Fin Ray	Skull Fragment	Vertebrae	Total
Cod (<i>Gadus morhua</i>)			2	5	7
Cod family (Gadidae)			4	35	39
Conger eel (<i>Conger conger</i>)				2	2
Eel (<i>Anguilla anguilla</i>)			16	104	120
Gurnard (Triglidae)				17	17
Herring (<i>Clupea harengus</i>)			23	63	86
Mackerel (<i>Scomber scombrus</i>)		6	2	52	60
Plaice (<i>Pleuronectes platessa</i>)			24	91	115
Plaice/flounder (<i>P.platessa/Platichthys flesus</i>)			30	113	143
Shark	1				1
Smelt (<i>Osmerus eperlanus</i>)				1	1
Sole (<i>Solea solea</i>)			3	18	21
Whiting (<i>Merlangius merlangus</i>)			44	52	96
Total	1	6	148	553	708

The gadid group or "white fish", here composed of cod and whiting, would be part of line (for cod) and net (for whiting) fisheries in the North Sea, or at the Outer Thames Estuary. Cod, in particular, but also whiting, were often preserved (dried, salted or pickled) and these remains may have been part of this pattern despite the coastal proximity of the site. The whiting were of average (30-40cm.) or smaller size, from comparative measurements on the dentaries or premaxillae. This may suggest the fishery was prosecuted inshore, since the immature fish are not found in deep water.

Herring had declined in importance by the post-medieval period but was still cheaply available, often smoked. Similarly, mackerel was eaten smoked as well as fresh, caught on lines seasonally in the North Sea. The shark tooth could not be identified to species, the skeleton is cartilaginous and does not survive well. The two vertebrae of conger eel were from a small, immature specimen. These fish live hidden in crevices on rocky shorelines and are considered good eating, but do not feature greatly in this deposit. The eel remains are quite numerous (17% of the identified assemblage) and the size of individual fish range from 25-50cm. total length. The latter is the largest size for males, whereas females can grow up to 100cm. Eels would have been trapped in the Thames along with smelt which was a popular seasonal fishery caught in the river using fine nets.

This assemblage, although small, represents quite a mixture of species and would appear to reflect a rather opportunistic exploitation of marine resources. However, the sample is really too small to be considered an accurate reflection of the role of fish in the diet.

Summary

The mammal, bird and fish bone recovered from this late seventeenth century phase represents the majority of bone excavated at the fort and contains by far the highest species diversity. The assemblage is dominated by sheep/goat and sheep sized material, with cattle and some pig playing a lesser role. In terms of meat weight per individual cattle is more important, however, sheep/goat still appears to be the dominant taxa. The quantity and type of butchery seen in conjunction with the types of anatomical

elements recovered indicates that much of the assemblage is primary butchery waste, with the following stages of dressing and jointing demonstrated. Other species which probably were not consumed, for instance buzzard, indicate that this assemblage also contains a quantity of general, non-dietary refuse.

The species identified indicate a good range that may have contributed to the diet of the fort inhabitants, however, in terms of quantity, it is apparent that the staple elements were very restricted. The bones and eggshell of the chicken, goose and duck may indicate at least a small scale practice of keeping fowl for both meat and eggs, though the importance of this as a diet supplement is uncertain. Only sheep/goat and cattle represent a good-sized meat assemblage, with the birds, fish and possibly the eggshell representing only isolated occurrences, probably opportunistic catches or finds.

(iv) MILITARY LIFE

MILITARY DRESS (Graham Reed and Peter Moore) (FIG. 50: **224-5**)

No dress items of a definitely military nature, of a seventeenth century date, and only four of a later date were found in excavations anywhere at the fort. The use of service and regimental buttons and badges began in the mid eighteenth century, before which mostly lead or pewter buttons were used in the ranks. Thus the late seventeenth century lead and copper-alloy buttons (FIG. 47: **187-194**) were as likely to have been used by soldiers as by civilians. The buckles, loops, hooks, heel irons and pattens (FIG. 47: **195-200, 208**; FIG. 48: **210**; FIG. 49: **222-3**) could again either be for military or civilian use.

All four of the identifiably military dress items were late nineteenth to early twentieth century in date, and consisted of an Inniskilling button (not illustrated)³³², a shoulder flash from the West Yorkshire Regiment (not illustrated)³³³, one artillery button dating to 1873-1907 (FIG. 50: **224**)³³⁴ and one General Service button dating to 1871-1907 (FIG. 50: **225**)³³⁵.

MILITARY WEAPONS (Graham Reed and Peter Moore)

- Edged weapons (FIG. 50: **226-8, 230-2**)

Edged weapons such as swords and knives, can often be taken to be part of the "dress uniform" of soldiers, the examples represented by pieces excavated at Tilbury are more likely to be more functional in nature. A copper-alloy chape³³⁶ (FIG. 50: **227**) consisted of an oval tube, tapering to a shaped ball end with a very faint seam mark and crude decoration of flowing incised curves. Inside, the end of its leather scabbard (FIG. 50: **226**) had been preserved, if slightly crumpled, due to drying. The stitching is a flesh/grain stitch forming a ridge of seam on the outside³³⁷ with the stitches 2.5-3mm. apart. The relatively narrow shape of the chape, (maximum diameter 10mm.), suggests that the scabbard and chape were most likely for a rapier, bayonet or "small" sword. These were developed towards the end of the seventeenth century and popular among both "officers and civilian gentlemen"³³⁸. An iron chape (FIG. 50: **228**), has an oval opening tapering to a crimped end. This chape is also likely to have belonged to a rapier, bayonet or "small" sword scabbard. A similar example from Portsmouth³³⁹ is dated to between the late sixteenth and seventeenth centuries.

A sword guard (FIG. 50: **230**) of a type known as a "shell guard", is datable stylistically to between the late seventeenth century and circa 1760³⁴⁰. It probably came

from a "small sword" and has a quartered design decorated and made lighter by piercing. Other smaller areas of piercing and dot designs are also visible. There is a rectangular hole in the centre of the guard for the blade tang. An example of this type of guard is to be found in the collections of the Royal Armouries, Tower of London (IX-1012), and belongs to a "small sword" dated to c. 1660.

Although the two examples of blade tips included here (FIGS. 50: **231-2**) are only small fragments, the symmetric nature of the spear or centre point tips implies that they are from weapons. Tips such as these are to be found on "small swords" and basket hilted swords of the late seventeenth and eighteenth centuries³⁴¹.

Much of the twisted copper-alloy wire found in redeposited midden layer 4242 and other late seventeenth century contexts (not illustrated) may have belonged to sword hilt grips, or been intended for them, as twisted wire was a commonly used grip style³⁴².

- Gun cartridges and components (FIG. 50: **234-42, 245**)

Twenty-one cartridges for handheld guns were found, fourteen .303 rounds, five .202 rounds and two .45 rounds. The .202 cartridges are unfired rounds (FIG. 50: **239**) with no headstamps and would have been used for practice firing in .303 calibre guns using internal barrel sleeves. The .45 cartridges (FIG. 50: **238**) are also unfired and are type ELEY 450 NITRO of late nineteenth century date³⁴³.

The .303 rounds were very varied, consisting of: two unfired rounds, a round nosed type Cordite MK I (FIG. 50: **237**) and type Cordite MK II³⁴⁴, dated 1891 and 1893 respectively³⁴⁵; five fired rounds of type Cordite MK II (FIG. 50: **235**) dated 1893; two unfired rounds with their bullets removed and the open ends crimped for use as blanks, types Cordite MK II (FIG. 50: **234**) dated 1893, and Cordite MK VI³⁴⁶ dated 1904; three rounds with bullets and firing caps removed, four holes drilled into the casing in facing pairs and two of the cartridges still containing "dummy" wooden bullets, one blackpowder type Cordite MK II (FIG. 50: **236**) dated 1890, one type Cordite MK VI³⁴⁷ dated 1904 and one indecipherable³⁴⁸. Such altered cartridges would have been used for practice loading.

Most of the cartridges came from layer 4257 (FIG. 9) in the West Curtain Bank representing its use for practice firing at butts to the west of the fort, but also implying carelessness in the loss of unused, or reusable, rounds, or that there was a clearout of old or obsolete equipment. The range of types ammunition and the variety of practice cartridges suggests a picture of a wide variety of available guns at the fort and of the military training which must have taken place.

Several late seventeenth century pierced casings and plates were excavated and may be the butt caps from musket stocks. The reinforcing strips (FIG. 50: **240-1**) are similar in shape and section and may well come from the same piece, with a curved section and pierced by four round holes. The plates (FIG. 50: **245**) are all very similar³⁴⁹ in that they are all very thin, are pierced by tiny rivets and all have evidence of a non-ferrous coating. Strip **242** is similar to 240-1, but has a different shaped convex section. Its shape seems to imply a curved end, pierced centrally and may be another piece of casing or re-inforcing strip.

- Ordnance (FIG. 50: **229, 233**)

Only two objects relating to ordnance have been found at the fort, a friction tube (FIG. 50: **229**), also from layer 4257 (FIG. 9), and an unstratified shot (FIG. 50: **233**). The friction tube has a single seam along the tube length and is open at both ends with a

4mm. diameter hole 3mm. from one end³⁵⁰. Used for firing muzzle-loading cannon such items could have been used at the fort throughout the nineteenth century. The size of the shot (FIG. 50: **233**), 31mm. in diameter (1.25 inches), makes it a candidate for grape shot. Weighing 110 grams. (3.9 oz.) it was cast in a two part mould, with the remains of runner scars still visible. Grape shot of this size was used by the British army and navy from the late eighteenth century with 3 pounder cannon firing 1.21 inch diameter (weight 4oz.) iron grape shot in 1780³⁵¹.

HORSE FURNITURE (Graham Reed) (FIG. 51: **246-8**)

Two horseshoes were recovered from the redeposited midden layer 4242 but seem only to have parallels from the later medieval period. The first (FIG. 50: **247**) has two very distinctive "fiddle key" nails still in situ. Examples of such nails from Bramber Castle³⁵² are dated to the fourteenth century and slightly later. The other shoe (FIG. 51: **246**) may have a wider date range as an example with a similar square ended terminal from Northampton³⁵³ is dated generally to the early medieval period, while similar "keyhole" shoes are dated to the Tudor and Stuart periods³⁵⁴. A smaller shoe (FIG. 50: **248**) is too large to be a heel iron, and with its rather straight branch and square end may be a donkey shoe, but can only be dated stratigraphically to pre-1939³⁵⁵. While there must have been horses at the fort, as stables on fort plans show³⁵⁶, it may be that the two horseshoe examples relate to the earlier use of this site as a river crossing point.

TOOLS (Graham Reed) (FIG. 50: **243-4; 249-260**),

All of the tools recovered have been considered as a single group because of the small number involved (fourteen) and their possible multi-functional nature. Many of the tools described below typologically also have a broad chronology, so by themselves are not useful as dating material. The late seventeenth century chisel (FIG. 51: **252**) may be a cold set as used by blacksmiths and has a rectangular section and slightly burred head which tapers to a broad edge. It could have been used for cutting blanks from stocks of bar or rod. Examples from Norwich³⁵⁷ are from deposits dated to circa 1507. Both chisels **253** and **254**³⁵⁸ are broken at approximately the same distance below the head, have burred heads due to hammering and rectangular sectioned shanks with rounded corners, which would allow them to be handheld. It is possible that such chisels, or 'drifts' with heads³⁵⁹, could also be used by a blacksmith. The punches, (FIG. 51: **250-1**), are very similar in form, with a square section tapering to a point. These may have been used for such functions as piercing nail holes in horseshoes.

Three examples of blades (FIG. 51: **257-9**) with serrated edges, that is saws, were recovered. Saw **257** has a surviving whittle tang and, compared to the others, has the coarsest teeth. It is similar to an example from Chelmsford³⁶⁰ dated to between circa 1590 and 1630. A saw such as this could have been used in a number of different crafts or trades. A small complete blade (FIG. 51: **249**) with rounded back tapering to a splayed cutting edge 4.5cm. wide may belong to a type of spoke shave³⁶¹, as used by carpenters or wheelrights.

Two flanged strap fragments (FIG. 51: **255-6**), differing slightly in shape, are probably from two different spade shoes. They both have nail holes in two axes to secure them to the wooden blades. A number of other seventeenth century examples are known, most notably from Bolingbroke Castle³⁶².

A triangular, or three cornered, file (FIG. 51: **260**) with a whittle tang, but missing tip, has fine cut teeth on at least one of the faces but is dated stratigraphically to the early nineteenth century³⁶³.

Two late seventeenth century awls were recovered (FIG. 50: **243-4**), have identical ends in form and taper to a point with a rounded edge. Awl **243** seems to be complete with a short whittle tang but 244 has a broken shank. Awls, or boring tools such as these, may be associated with carpentry or other wood related crafts.

(IV) THE FORT INHABITANTS: THEIR LIVES AND DEATHS

This section examines the evidence for the health of the population at Tilbury Fort through the available artefactual, environmental and historical records. By the very survival and nature of these records we are drawn to three interlinked themes, that is to say disease, death and the diverse nature of the fort population. So prevalent are the themes of disease and death through the record that they must have been of inescapable significance to the people, who were variously brought to, sent to, forced to and born in the fort. While the evidence available is incomplete, and the conclusions drawn from it tentative, it is nevertheless important to start examining hitherto ignored post-medieval group of people. The evidence available for examination consists of **(i) personal hygiene artefacts**, **(ii) the human bones** and **(iii) the parish records**. Hygiene artefacts represent the health concerns of the contemporary population as well as the state and practice of hygiene, the analysis of two skeletons allow individuals to be represented in the archaeological record, while the parish records record a great wealth of statistical data on the fort population as a whole.

(i) PERSONAL HYGIENE ARTEFACTS

A factor in determining the health of the population must be that of personal hygiene. The link between health and hygiene was not generally accepted until the latter half of the nineteenth century, and, while hygiene was not universally practised after this time, it was used as a tool against the spread of disease, such as in the fight against the typhoid epidemic in Terling, Essex, in 1867-8³⁶⁴. Before this date hygienic practices were generally accidental in nature and their presence or absence greatly effected the potential for the occurrence and spread of disease.

Two types of personal hygiene artefacts were recovered at the fort, namely hair combs and toothbrushes. Fragments from eight late seventeenth century combs (FIG. 52: **261-8**)³⁶⁵ were recovered, all of which were double sided with both coarse and fine teeth. All were broken along their lengths, with widths varying between 49-61mm. The number of coarse teeth only varied between 3-4 teeth over a 10mm. length. The fine teeth varied between 9-17 teeth over a 10mm. length.

These combs are common on post-medieval excavations and generally date from the sixteenth to eighteenth centuries with little variety in form. This form of comb was used for both combing and removing lice from hair. This would have been more to combat the discomfort and appearance of lousy hair but would have been of the greatest importance because lice transmit many diseases, especially typhus³⁶⁶, and therefore their removal would be important in keeping the spread of disease in check. The greater use of bone rather than ivory³⁶⁷ for making these combs compared with all 14 combs at Norwich being made of ivory³⁶⁸, suggests that this collection belonged to a poorer community. This is reinforced by the fact that when comb **265** originally broke its

broken end was smoothed off so that the comb piece could be reused. The concentration of so many combs in one deposit may suggest either an attention to hygiene or a problem with lice. Perhaps the concentration of people, as an isolated community, had the same problem of endemic lice that found on ships of the period³⁶⁹.

The only other hygienic objects recovered from the fort, also all from the West Curtain Bank, were three nineteenth century toothbrushes (FIG. 52: 269-71) and may show a change in emphasis between the seventeenth and nineteenth centuries in hygiene concern, from that of parasitic infestation of the fort population to that of the improvement of the individual's personal hygiene. Toothbrush handle 271 inscribed with TAYLOR DRUG CO SPECIALY may have been made in New York in the second half of the nineteenth century³⁷⁰. The two seventeenth century skeletons recovered from the fort (see below) seemed to have had no oral hygiene.

While not strictly hygienic in nature, the sherds of seventeenth to nineteenth century apothecaries bottles or phials recovered from the site (not illustrated) do show an attempt to cure medical ailments. The nature or effectiveness of their contents is unknown but they are found in numbers on many sites of this period³⁷¹.

(ii) THE HUMAN BONES (Janice Conheeny)

Human bone was examined from two skeletons [80/73] and [80/89] found beneath the eastern rampart of Redan and late seventeenth century in date³⁷². The third skeleton in this burial group and another found beneath the southern rampart did not survive excavation³⁷³. With such a small sample only identification of the remains could be made.

- Skeleton [80/73]

About 95% of the skeleton was present though the torso in particular was fragmented. The individual was a fully mature (that is over 25 years) but young adult male. The stature, calculated using the right femur, was 1.67m. (+/- 3.94cm.). This is quite short compared to the modern average height for British males of 1.74m.³⁷⁴ The fragmentary nature of the skull and other parts meant that it was not possible to take all the standard measurements. A subjective assessment of the physique of the individual was that the bones were quite robust for their length, resulting in a "stocky" appearance, but bore no marks of hard, physical labour (no entheses were present).

The only pathology observed affected the vertebrae and dentition. The sixth to eleventh thoracic vertebrae and the first lumbar vertebra had slight to moderate Schmorl's nodes, lesions caused by degeneration of the intervertebral disc³⁷⁵. The interior surface of the eleventh thoracic and the superior surface of the twelfth had very early indications of intervertebral disc disease, possibly representing a progression from the development of Schmorl's nodes on the surrounding vertebrae. A popular explanation of the onset of Schmorl's nodes is over-lifting in immature individuals. The third to twelfth thoracic vertebrae also had very slight ossification of the ligamentum flavum, generally believed to be the result of wear and tear on the spine.

The teeth themselves were in very good condition with no caries present. However, there was slight calculus surrounding the majority of the teeth, suggesting a lack of dental hygiene. Similarly the individual suffered with slight to moderate periodontal disease³⁷⁶ around all those teeth with the adjacent alveolar bone sufficiently well preserved to assess. This was in keeping with the level of calculus present as it is thought to be an irritant which can contribute to the onset of periodontal disease.

- Skeleton [80/89]

About 80% of the identifiable skeleton was present and the bone was poorly preserved. The individual was a fully mature, but not elderly, adult male, that is over 25 years but less than 45-50 years. His stature was 1.66m. (+/- 4.57cm.), calculated using the right humerus, and similar to [80/73] was short compared to the average modern male. Again few standard measurements could be made.

The only skeletal pathology was of a degenerative nature. Slight Schmorl's nodes were observed on the eleventh thoracic vertebra and first lumbar, slight ossification of the ligamentum flavum on the seventh to twelfth throacic and moderate osteophytes around one of the nine right rib tubercle articular facets present. The latter suggesting non-specific wear and tear of that particular joint.

The enamel of the teeth, particularly in the maxilla, was badly eroded and damaged, but from what survived, the individual was free from caries. All teeth that could be assessed had slight calculus and slight to moderate periodontal disease but much of the alveolar surface was eroded away. This again suggests a generally healthy diet but poor dental hygiene.

(iii) THE PARISH RECORDS (Peter Moore with contributions by Bernie J. Truss and Ray V. Popkin)

Tilbury Fort straddles the boundary between the parishes of West and East Tilbury and therefore the respective churches of West Tilbury and Chadwell St Mary contain information on the burials, baptisms and marriages of people from the fort. The information covers the dates 1646-1888 and 1670-1907 for burials, 1725-1899 and 1813-1916 for baptisms, and 1714-1916 and 1844-1899 for marriages for the churches of West Tilbury and Chadwell St Mary respectively. In all 621 burials, 147 baptisms and 37 marriages are recorded relating to the inhabitants of the fort.

The information and conclusions made from the parish register data should not be viewed as a total record as it is limited by several factors. The fort inhabitants may have been buried, baptised or married at different churches in the surrounding Essex or Kent countryside and burials such as infants or still-born babies may not have been recorded. In addition a burial ground at the fort was in existence by 1711 and the fort chapel was built in 1715, but for which only an imperfect register was being kept by the early nineteenth century and which has since been lost³⁷⁷. Therefore the burials, baptisms and marriages that may have taken place at the fort have been lost to this study.

The total population at the fort at any one time has yet to be calculated. This is hindered by incomplete army returns and therefore the differences between the recorded population and the composition of the complete contemporary population is unknown.

TABLE 7 Data from the parish registers of West Tilbury and Chadwell St Mary. Where “?” is used under “Children” the sex of the was not stated in the registers

Number of:					Percentage of Total Deaths:			
Baptisms								
Marriages								
Deaths								
Adults		Children			Adults		Children	
male	female	male	female	?	male	female	male	female

											Total	
1646-74			6	1				7	85.7	14.3		
1675-99			25	1	4		5	35	71.4	2.9	11.4	
1700-24		1	71	21	3	7	7	109	65.1	19.3	2.8	6.4
1725-49	1	1	134	19	3	4	2	162	82.7	11.7	1.9	2.5
1750-74	1	1	42	12		2		56	75.0	21.4		3.6
1775-99		1	48	4	3	5		60	80.0	6.7	5	8.3
1800-24	39	1	50	6	8	6		70	71.4	8.6	11.4	8.6
1825-49	67	7	32	4	19	18		73	43.8	5.5	26	24.7
1850-74	31	10	6	2	18	12		38	15.8	5.2	47.4	31.6
1875-99	6	13	1		7	6		14	7.1		50	42.9
1900-16	1	1	1		1	1		3				
	146	36	416	70	66	61	14	627				

The information does warrant examination however, as the fort's inhabitants do represent a nucleated and isolated settlement with its own population dynamics. A permanent nucleus garrison with families can be expected to have been a constant feature of the fort. Due to the widely recruited and mobile nature of the army it is unlikely that the garrison would have been recruited locally, though at least some wives were locals and, as the residence of many women at marriage was given as the fort, some may have been the daughters of soldiers. Often in the eighteenth century the garrison consisted of Invalid Companies³⁷⁸ as was common in many coastal forts at the time³⁷⁹. Other groups of soldiers would also have passed through the fort, troops in transit and recruits. Tilbury Fort was used as a stopping point for troops and regiments moving to or from duty. It is known that between the 25th June and 24th September 1811, 561 troops from 50 regiments passed through the fort³⁸⁰. By the 1870's Tilbury Fort was considered so unhealthy that the soldiers were relieved every six months³⁸¹ which ended the pattern of a settled nucleus at the fort. Many of these soldiers may have been accompanied by their families³⁸². The fort also acted as a depot to which recruits were sent³⁸³, and as a group these recruits may have been stationed longer, would have been younger than the average soldier and likely to have been single. While the death rate at the fort is not known the national average death rate for soldiers garrisoned in Britain at the beginning of the nineteenth century was 15 deaths per 1000 population per year³⁸⁴.

The inhabitants of the area surrounding the fort would have consisted of a rural population with an Essex marshland profile. The distinguishing characteristics of this marshland population, as oppose to populations living on the drier uplands further inland, were mirrored in the Kent marshlands across from Tilbury³⁸⁵. The annual death rate in the marshes before the nineteenth century was at least 50 per 1000 people compared to 20-30 per 1000 in the uplands³⁸⁶. Infant mortality was exceptionally high³⁸⁷; a higher ratio of males to females was reinforced by men moving into the area for pastoral work³⁸⁸ though this may have been on a seasonal basis; the death rate of married women was higher, probably in childbirth³⁸⁹ and the death rate fluctuated greatly³⁹⁰.

TABLE 7 shows the summary of the parish records information. Not included as part of this population are the statistics on men working on the fort's construction, drowned people found in the river by the fort and prisoners. For the purposes of this study "children" are taken as all contemporary descriptions of "child" and "infant" and

all those up to and including the age of 14 years old. The term "infant" in modern usage is technically used to describe an individual between 1-12 months old³⁹¹ but for the purposes of this article is taken to indicate an individual less than 1 year old. In the periods where ages at death are given, those described as "infants" are counted as being 6 months old for statistical purposes. The division of 25 year groups, or quarter centuries, is entirely arbitrary and for comparative purposes only.

Where ages are given, from about 1813 onwards, the mean age of adult males at death declines from the 1800-1824 mean of 35.32 years to 30.00 years in the 1850-1874 period. The mean age of both adult and female children at death fluctuates with rises in the 1825-1849 period and in the 1875-1899 period for the children. Male children mean ages at death also fluctuate, rising only in the 1825-1849 period.

The numbers and details of deaths at the fort can give some ideas of the population dynamics of the fort from the relative proportions of males to females and children. The numbers (and their percentage of total deaths) of children dying rises from about 1800 onwards and may represent a rise in the birth-rate suggesting a rise in the number of fecund marriages within the population.

Women and children were moved about with the army as a matter of course. An idea of the living sex/age composition of a military group on the move can be examined from the 12216 soldiers and dependants who were moved across the Thames at Tilbury between 25th and 28th July 1804³⁹². Of these 87.7% were male, 7.89% female and 4.41% children. Because the Tilbury Fort statistics are for deaths they show a much greater percentage of children within the group: between 1800-1824 the percentage of child deaths at the fort is 18.43% (14 child deaths) and rises to 49.32% (36 child deaths) in 1825-1849, 78.95% (30 child deaths) in 1850-1874 and 92% (13 child deaths) in 1875-1899. Infant mortality was disproportionately higher in the marshland compared to the death rates of older children and adults³⁹³, however if child deaths and baptisms are examined for family names over the same period then there are 25 mother/father couples from 1800-1824, 77 couples from 1825-1849, 49 couples from 1850-1874 (plus one child of unknown parents and one child to a single woman) and 16 couples from 1875-1899 registered as being from the fort with children being baptised or buried. Although there must certainly have been soldiers who were married and had children, but who do not appear on the records examined here, there is still a suggestion that the proportion of soldiers either settled in, or passing through, the fort who are married and having children, rose from the eighteenth century into the nineteenth century.

In the absence of total population statistics on which to calculate birth and death rates, the patterns of crude numbers of deaths and baptisms can still be examined (see TABLE 7). No baptism data is available before 1725 and may be incomplete prior to 1813, though the few burials of children may be genuinely reflected in the low number of baptisms and therefore of births. In common with other marshland parishes in Kent³⁹⁴ total burial numbers are greater than total baptisms throughout this period, though this may be affected by an unknown element of unmarried soldiers in the fort. When infant and child deaths are compared to the numbers of baptisms of children there is a rise in the ratio between the number of children being buried and the number being baptised between 1800 and 1899. This is surprising, especially as the number of adults being buried falls over this same period. Unless factors such as baptism elsewhere in the area, children not being baptised at all or children born elsewhere are taken into account, these figures suggest an increase in child mortality accompanied by a fall in adult mortality. The burial rate average, in Essex and Kent, shows a steadily declining rate from 1701 to 1850, suggesting other factors at work or appalling conditions at the fort for children. Another explanation may be that by the 1870's the relieving of soldiers on

a six monthly basis³⁹⁵ may have reduced the adult death rate but may not have been a sufficient measure to reduce the death rate of children.

To seek the reasons for such death rates the study of the fort hospital records would be revealing but they are unfortunately lacking. We know that a new hospital was built in 1808 and that it contained four wards for thirty patients, a kitchen and surgery³⁹⁶. The only records found relating to sick troops were those from the monthly returns for the Invalid Company for 1759-1803³⁹⁷, the Battery for 1759-1794³⁹⁸, the sick returns for those working for the Engineers Department³⁹⁹ and occasional references to individuals in the hospital⁴⁰⁰. The monthly returns for the Invalids and Battery however, very incomplete with information for only twenty-nine years out of the total group of forty-three being available and even then there are only three years for which there are complete twelve month records. Fifteen "artificers and labourers" employed by the Engineers Department are listed as being sick while working at Tilbury and Gravesend between 1808 and 1834, of whom eight were said to have ague⁴⁰¹. Of the twelve deaths noted at the hospital between 1813 and 1815 only three causes of death are given, consisting of "Tebris", "apoplexy" and consumption⁴⁰².

Few causes of death are given in the parish records for the fort's inhabitants. These being, three cases of drowning, two of consumption and one each of fever, smallpox, "under inoculation by cowpox", "died suddenly", "killed by accident", shot and suicide. The two cases of soldiers dying of smallpox and cowpox inoculation were both in November 1808. These causes of death may have been noted because it was in this year that Parliament had the National Vaccine Establishment set up to organise the use of the vaccine, derived from cowpox, against smallpox⁴⁰³. The real cause of death of the inoculation victim however is more likely to have been the result of sepsis⁴⁰⁴. With the given causes of death of "fever" and "consumption", these are more likely to be symptoms rather than truly diagnosed diseases⁴⁰⁵.

The diseases, whether in endemic or epidemic form, of the seventeenth to nineteenth centuries which could have killed the inhabitants of the fort included cholera, diphtheria, dysentery, influenza plague, scarlet fever, smallpox, syphilis, tuberculosis, typhoid fever, and typhus⁴⁰⁶. However, the location and nature of the fort is of great importance in discussing which diseases may have caused deaths at the fort. On the one hand the fort was isolated at a marsh edge, in the sense of surrounding settlement, but on the other its position as a River Thames crossing point, as well as its importance as a staging point for the movements of troops, meant that it was in contact with highly mobile groups of people.

The fort's isolation may have lessened the potential for attacks of plague, as the much lower incidence of the disease in the countryside around Colchester, Essex, compared to the town during the 1665-66 epidemic showed⁴⁰⁷. This isolation and the tiled nature of the fort building roofs do not constitute the black rat's favoured habitats⁴⁰⁸, and indeed no rat bones were identified in the late seventeenth century midden deposit in the West Curtain Bank⁴⁰⁹. Cholera was a disease spread with devastating effects by the contamination of drinking water with infected faecal matter⁴¹⁰. There is no upsurge in the number of deaths at the fort during the years when cholera is known to have spread to England in 1831⁴¹¹ along the Thames Valley in 1832, 1849 and 1854⁴¹². The supply of fresh water was a problem with much of it collected in cisterns from roofs of buildings (see above). The draining of sewage and waste was also attended to from 1686 when the Main Drain, a brick-built covered culvert was constructed with "pinstock and clapper" for drainage into the Thames at low tide but no in-letting of tidal water⁴¹³. This, apart from any use of river water, seems

to have been an accidentally hygienic arrangement for the separation of waste and drinking water.

The nature of its site as a landing area for travellers, soldiers and sailors would have put it at risk from people carrying highly mobile diseases. Some may have become infectious within the fort, others may have been diseases indigenous to far flung places of the Empire and may not have killed beyond the initial victims. Soldiers were notorious throughout the medieval period for carrying and spreading diseases (especially typhus)⁴¹⁴. In the post-medieval period armies continued to spread disease, notably typhus following the British Army in Flanders in 1743⁴¹⁵. Ships and sailors were responsible for the spread of diseases up to the inter-continental levels of yellow fever between West Africa and the West Indies⁴¹⁶, a disease which also had sporadic outbreaks around British ports⁴¹⁷. There is a possible coincidence between the largest numbers of people dying in the fort, 41 people between October 1741 and April 1742, and the fact that in October 1741 the Regiment of the 45th Foot was sent in to Tilbury Fort to guard recruits of the 38th Foot⁴¹⁸ awaiting shipment to the West Indies. That a greater degree of security than usual was required⁴¹⁹ may relate to the fact that the 38th Foot served in the West Indies between 1716 and 1765 "where men died almost as fast as they were shipped out"⁴²⁰. It may have been that a knowledge of the terrible death rates in the West Indies combined with an unusually high death rate at Tilbury Fort lead to disturbances amongst the soldiers.

There seems to have been a low number of deaths of women at the fort relative to the number of children being born; 6 women died between 1800-1824 out of the known 25 who had children baptised or buried in that time, 4 out of 77 between 1825-1849 and 2 out of 50 between 1850-1874. An endemic danger to women giving birth was puerperal fever, a septic infection, at the time considered more deadly than cholera⁴²¹. Especially rampant where pregnant women shared insanitary hospital conditions⁴²², it may be that the hospital facilities provided at the fort were for soldiers only, and that lying-in women remained in their own quarters. This would isolate and contain any incidence of the fever, by accident rather than design.

In addition to the above diseases, the inhabitants of Tilbury Fort would have been very susceptible to malaria. Malaria used to be prevalent along the southeast coast of England from Norfolk to the Isle of Wight⁴²³, in marshy coastal areas. Essex and Kent, especially the Thames, North Kent, Romney and Essex Coastal Marshes⁴²⁴ were particularly noted for their unhealthy nature which has been recognised as being the result of malaria of the *Plasmodium vivax* strain⁴²⁵, a parasite passed between humans and the mosquito *Anopheles atroparvus*⁴²⁶.

The lack of historical records detailing causes of death makes attributing direct cause of deaths to malaria difficult, especially as "*Plasmodium vivax* is a more benign tertian strain and mortality directly associated with untreated *vivax* is under 5%"⁴²⁷. The disease is, however, debilitating, and as ague or marsh fever has been noted in the Essex marshes for hundreds of years⁴²⁸. So much so that a Vicar for the parish of West Tilbury in the eighteenth century gave his reason for not living in the parish as the "extream unhealthiness of the place"⁴²⁹. As a debilitating disease the malaria of the Essex marshes was a killer because it significantly weakened people who then succumbed to other infections very quickly because of broken resistance and strength⁴³⁰. It is not until the 1870's that malaria (or ague) can definitely be identified as being a disease present at Tilbury Fort, indeed as an endemic disease⁴³¹. By then soldiers were being relieved every six months because of the disease and even then 34 out of 103 soldiers came down with the disease in the first six months of 1872 and 12 out of 102 soldiers in the first six months of 1873⁴³². Establishing malaria as a an important disease at the fort

prior to this date however must be made by examining the characteristics and signal effects that malaria makes the death rate of a community.

As the malaria parasite requires a temperature of 16 degrees centigrade for at least 16 continuous days for it to complete its sexual cycle and infect man⁴³³, it was therefore very prone to the vagaries of the English weather. The pattern of the disease's symptoms was also regular, with primary infection in the autumn and a relapse attack in the spring⁴³⁴. The mosquito's breeding pattern was affected by climate, as in dry years when there was standing water its habitats suitable for breeding increased⁴³⁵.

The three factors of the parasite requiring certain temperatures, the seasonality of the malarial attacks and climate affecting the breeding of the vector mosquitoes, mean that malarial outbreaks have strong signature patterns in the death rates of populations. Significant instability in annual death rates of studied groups in Kent⁴³⁶ are intricately linked to marshland environments and this to average summer temperature and malarial outbreaks⁴³⁷. An unstable annual death rate can be assumed at Tilbury Fort because of the fluctuations from 0 to 35 burials per year. The number of years in any quarter century with no burials recorded varied from 16 in 1675-1699 down to 4 by 1825-1849 and up to 13 by 1875-1899), but other years, or groups of successive years, that is 1695-97 (25 burials), 1715-16 (19 burials), 1719-20 (24 burials), 1740-44 (103 burials), 1779-82 (31 burials), 1813-16 (27 burials), 1826 (16 burials), 1840-42 (15 burials), 1846-48 (12 burials), and 1851-53 (13 burials), had significantly high numbers of burials⁴³⁸.

A wide range of causes of death awaited seventeenth to nineteenth century populations: in the years between 1657 and 1661 a total of 40 different causes of death were given for 639 burials in the burial register of St John, Wapping, London⁴³⁹. Seasonality of death recorded in the population buried in the crypts of Christ Church with All Saints Spitalfields, London, points to adult deaths peaking between January and March, suggesting cold weather respiratory disorders, while child deaths peaked between August and November, suggesting warm weather gastric infections among this urban population⁴⁴⁰. The pattern of deaths in rural Essex marshland, however, has peaks of shorter duration, in September to October and again in February to March, and correlate with the specific climatic requirements of the malaria life cycle⁴⁴¹.

One of the most significant aspects of the Tilbury Fort burials is their strong seasonal patterning matching the Essex malarial pattern (FIG. 53). The pattern is very different for children and adults when looked at in quarter centuries. From 1700-1749 and 1800-1899 the two groups either have opposite patterns or child burials are more evenly spread throughout the seasons. Only from 1675-1699 and 1750-1799 can the pattern of child burials be said to mirror that of adults. The seasonal pattern of burials associated with malaria, that is spring and autumn peaks, can clearly be seen in all quarter centuries between 1725 and 1849. When all burials at the fort are combined for the years 1675 to 1899 the seasonal pattern of peaks in March and September is strikingly clear. Comparing it with a seasonal mortality curve showing all burials in seven Essex marsh parishes between 1561-1820, which is characteristic of the occurrence of *Plasmodium vivax* malaria⁴⁴², and shows a very good correlation. It is therefore likely that the underlying cause of death at the fort was malaria.

One group of "inhabitants" at the fort not dealt with above is prisoners. It can be assumed that over the years prisoners taken during England's many military campaigns in were held at the fort. However we have detailed accounts of only one group, a number of prisoners from the 1745 Jacobite rebellion, who were shipped to Tilbury Fort from Inverness, Scotland, on 10th June 1746⁴⁴³. Many seem to have died on the ships before arriving at Tilbury⁴⁴⁴, a common feature of transport ships for both prisoners⁴⁴⁵ and soldiers⁴⁴⁶ of the period, and are not considered here. Those that arrived

alive seem to have been variously incarcerated on the ships before being transferred to the forts' powder magazines. A total of 311 such men are listed as having been prisoners at the fort between June 1746 and January 1750, of whom a total of 45 died. It is likely that these men were in a poor state of health, but if it is realised that the vast majority of these prisoners had been transported, had died and a few released, by the end of March 1747 (only 13 are listed as having still been at the fort after March 1747) , it shows that 14.45% of the men died within an eight month period. This period at the fort seems to represent a respite in the death rate between the imprisonment in Scotland and journey by transport ship to Tilbury⁴⁴⁷, but what the onward transportation, for most of the Tilbury survivors, to the West Indies was like is unknown.

The cause of so many deaths is probably a combination of many factors, and none is named in the records, but two diseases may have been present in this situation and been particularly deadly, namely typhus and scurvy. Typhus would have found the cramped, insanitary conditions of the magazine a more than suitable breeding ground, and in fact it was long known as a goal or prison fever⁴⁴⁸. It was identified as being responsible for “committing great ravages among the French prisoners” held at Portchester and Winchester castles early in 1761⁴⁴⁹ and that among the contemporary French and Spanish prisoners 12.5-15% had Typhus at any one time⁴⁵⁰. Another disease associated with prisoners and prison-like conditions was scurvy, a debilitating and then deadly disease caused by a deficiency of vitamin C in the diet⁴⁵¹, as well as greatly contributing to death by diarrheas and dysentery⁴⁵². The causes of and cures for this disease were continuously investigated by the navy⁴⁵³, as a lack of fresh food, in particular vegetables and fruit, made scurvy a common and serious problem on ships. Despite these efforts it was not until the nineteenth century that an even an argument developed between reformers and those demanding no “luxury” in the diet of prisoners⁴⁵⁴. Because of this scurvy remained a common and recurring disease in British prisons, both among military⁴⁵⁵ and civilian⁴⁵⁶ prisoners. If the presence of malaria is also taken into consideration, even if only as a debilitating agent, then a reasonable idea can be formed of the prevalent conditions the Jacobean prisoners would have been subject to at Tilbury Fort.

Of notable interest is the different death rates within different groups of the prisoners. Approximately one-third of the total number of prisoners were identified as having one of three family, or clan, names, namely Grant (45), M'Kenzie (44) and M'Donald (28). Approximately another third of the prisoners (89) were the sole representatives of their names. If the percentage of deaths within each of these groups is compared there is a startling difference. Only 5.98% of the 117 members of the three main families died compared with a huge 26.97% of those from the single name group. What can be inferred from this is that, whatever the conditions were at the fort, mutual comfort and support, whether it was in the form of verbal encouragement, pooling of resources or fighting together for resources, with people from the same clan or family gave a better chance of survival.

The overall pattern of death and disease at the fort seems to differ slightly from the known pattern for the rest of Britain. The course of disease was clear by 1700-50 with infection shift from epidemic to endemic forms, though several notable epidemics were still to occur⁴⁵⁷. Because of improved agricultural techniques the numbers of cattle being reared increased which offered a preferred source of blood to mosquitoes which in turn broke the chain between humans, mosquitoes and the malaria virus⁴⁵⁸. The result was a reduction in England of malaria between 1650 and 1750⁴⁵⁹. What happens at Tilbury is that there is no significant reduction in the death rates until the nineteenth century. This seems to occur because the population at Tilbury consisted mostly of

people brought in from elsewhere, whether as individuals or groups, rather than being people indigenous to the area or born and raised there as a result of a settled community. At various times there were permanently stationed units at the fort but the constant attrition by death meant that unit numbers had constantly to be replenished from outside. A non-indigenous population would have been particularly susceptible to malaria and therefore susceptible to catching and being unable to fight other infections. The effect of malaria on the population of Tilbury Fort may therefore have been to amplify the action of endemic infections so that they occasionally acted in an epidemic fashion.

CONCLUSION

The nature of the fort's defences has been well illustrated through previous documentary, architectural and archaeological studies⁴⁶⁰. Archaeology allows the actual mechanics of constructing such a huge structure in a marsh to be examined. The limited excavation undertaken has shown the messy processes of repair, rebuilding and remodelling to be far removed from the beautifully sharp, straight lines that architectural intent and surveys appear to imply. The fort's marshy situation and the materials used in its construction required, and still require, constant attention and repair and this process together with the deposition of river silts on the site ensured that the surface level of the site had to, and did, increase over time. The usefulness and permanency of the fort and its structures seem almost belittled by the obsolescence implied by the constant remodelling that evidently took place.

The partial surface survey of the foreshore in front of the fort adds a not unexpected but rarely examined aspect to the fort and its life. Located alongside and guarding the River Thames, with poor inland communications, at least until the mid-nineteenth century, the fort could be expected to make a significant use of the river for communications, transport, defence and waste disposal. The foreshore environment has on the one hand preserved the organic elements of the structures these activities required, but on the other hand has deterred their study because of the logistical difficulties of such a work environment. The constant need for a number of different landing stages, each for a different purpose, lead to a long sequence of structures using different materials, techniques and designs. The in situ timber at the fort, especially the foreshore wood, has been shown through dendrochronological analysis to be a potential source for future research on post-medieval wood.

The vast majority of the objects found at the fort show the existence of a poor community, with few valuables and only small portable personal belongings. Any higher status objects, especially the glass tableware, can be identified as belonging to the officers at the fort, but even they represent no great social heights. Their diet is mostly represented by the animal remains and seems to have been basic, with cattle, sheep/goat, pig and chickens present, but supplemented on an opportunistic basis with animals and fish from the local marsh and riverine environments. In the artefactual record so far recovered, smoking seems to represent a significant activity. Very little of artefactual record is attributable to having come from the hinterland of Essex, probably because of the difficulties of transportation. Rather, the River Thames provided the main conduit for goods, with pottery coming from Hampshire and glass probably from the Low Countries. London may have been the market which provided easy access to these goods.

Until some nineteenth century deposits are considered it is virtually impossible to identify military activity or equipment from the artefactual record. This may indicate a lack of distinction between military and civilian dress, a paucity of contemporary

equipment or its disposal in another manner or location than those so far recorded. The nineteenth century ammunition shows that small arms practice was an important element of military life at this time.

The fort was a permanent or temporary home, prison or workplace for a great number of people, including men, women and children. This mixture gave the fort a distinct, if as yet not totally defined, demographic identity, which was poor, with a large number of unmarried, often transient, males. The lack of a permanently settled, self-generating community meant that no native resistance was built against the local scourge of malaria. The fort's population was therefore particularly susceptible to the weakening force of malaria and as a result less able to fight other infections. The consequence was an extremely high death rate with some endemic infections occasionally behaving in an epidemic manner. The isolation of the fort in an environment that was recognised by all as unhealthy, even if the causes were unknown. The constant attrition by disease and death must have made life hard for its inhabitants.

It is hoped that the above paper illustrates the wealth of the Tilbury Fort archive, in its various paper, artefactual, environmental and in situ forms. This paper attempts to use various parts of this archive to examine particular topics, but several shortcomings are obvious. Because the archive is largely the result of archaeological excavation and recording in advance of, and during, other works undertaken at the fort the nature of the archaeological results has been a product of chance. That so much information has been recovered at the fort shows the potential wealth of archaeological information that has still to be tapped. It can be assumed that any further excavation at the fort, either on the same rescue basis or on a research basis, will variously supplement, confirm or refute the interpretations made in this paper. Further documentary research will yield valuable results for this site, area and period. One of the main problems about the patchy approach possible with the current data has been the inability to cross-reference information, on a large or consistent scale, from different sources for any one period and to examine the development and change of individual activities and processes over time.

The multi-disciplinary approach to the archive using various topics as the basis for discussion has enabled the potential of the present archive for further research and analysis to be illustrated in a new, and hopefully rewarding, manner. By including the Tilbury Fort inhabitants as a valid and integral part of the archaeological record, the analysis and interest in these post-medieval monuments may be broadened beyond their architecture and typology. It should be remembered, especially by archaeologists that the classification of a monument should not be considered its the only object of its investigation and its contemporary relevance forgotten.

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GLOSSARY

<i>banquette</i>	Firing step along the interior of the parapet ⁴⁶¹ .
<i>counterforts</i>	An internal buttress between an earthen bank and a brick wall.
<i>expense magazine</i>	Small magazine in a forward position of the outer defences ⁴⁶² .
<i>glacis</i>	Parapet of the Covered Way extended in a long slope to meet the natural surface of the ground ⁴⁶³ .
<i>terreplein</i>	Surface of rampart behind the parapet where guns are mounted ⁴⁶⁴ .

FIGURES

FIG.1

Location of Tilbury Fort and other forts in the vicinity

FIG.2

Fort layout and location of trenches and areas discussed in text

FIG.3

Pollen diagram

FIG.4

Trench 32, south facing section

FIG.5

Continuous Trench 2 and Trench 19 south-west facing section

FIG.6

Trench 10, south facing section

FIG.7

Trench 1, west facing section, and Trench 1a, north-west facing section

FIG.8

Trench 54 north-west facing section

FIG.9
Trench 45, north facing section

FIG.10
Eastern Place d'Armes and location of trenches

FIG.11
Trench 22 north-west facing section

FIG.12
Eastern Place d'Armes magazine and Trenches 20 and 22

FIG.13
Trench 19 north-west facing elevation

FIG.14
Photograph of the Eastern Place d'Armes, Covered Way and Inner Moat (to the right of picture) and Outer Moat (to the left) and River Thames looking south, during excavation of trenches 19 and 20 in 1989. Two World War II iron-sheathed tarmac formations lie between the magazine in the foreground and the bank revetting wall in the middle distance. Gun embrasure foundations are just visible as parch marks against the revetting wall. (photograph: English Heritage, B891865)

FIG.15
Trench 20 south-west facing section

FIG.16
Place d'Armes magazine, exploded view of construction

FIG.17
Ceramic building materials: **1-3** bricks: **4** peg tile: **5** ridge tile

FIG.18
Location of survey area in Central Foreshore

FIG.19
Survey of Eastern Foreshore

FIG.20

Timbers recorded in the Central Foreshore. The eastings and northings relate to site grid.

FIG.21

Water Bastion foundations 1800 and palisade 1866

FIG.22

Extant causeway on Central Foreshore showing the earlier phase of build 3107 revealed by the decay in later phase 3108. One of the 3108 planks is shown in outline only to reveal the features behind.

FIG.23

Detail of drawing of foreshore structures between 1715 and 1740 (photograph: Public Record Office, Works 31/1212)

FIG.24

Central Foreshore structures 3083 and 3079

FIG.25

Photograph of the end of derelict pier 3083 on Central Foreshore taken in June 1952 (photograph: English Heritage, A.1873/2)

FIG.26

Central Foreshore structures 3074, 3081 and 3082

FIG.27

Central Foreshore structures 1823 and 3075

FIG.28

(A) Central Foreshore structure 1825 phase A with structure 3077 (B) Phase B with structure 3078

FIG.29

Trench 21 in the Eastern Foreshore causeway 1506 showing details of the vertical and horizontal wattle hurdles

FIG.30

(A) Reconstruction and part section of the northern end of causeway 1506 (B) southern end of causeway 1506

FIG.31

(A)Eastern Foreshore structure 1700 phase A, (B) phase B

FIG.32

Bar diagram showing relative positions of the dated oak ring sequences included in the master curve TFOAK/T5. White bars - heartwood rings; shaded bars - sapwood rings; C - pith; B - bark edge.

FIG.33

Bar diagram showing the relative positions of the spruce ring sequences included in the master curve TFSPRUCE/T13. C - pith.

FIG.34

Pottery: **6-19** Post-Medieval Red Wares

FIG.35

Pottery: **20-36** Post-Medieval Red Wares

FIG.36

Pottery: **37-47** Border Wares

FIG.37

Pottery: **48-61** Border Wares

FIG.38

Pottery: **62-73** Border Wares

FIG.39

Pottery: **74-9** Post-Medieval Black Glazed Earthen Wares; **80-91** Local Tin-glazed Earthen Wares

FIG.40

Pottery: **92-6** Frechen Ware; **97** Staffordshire Butterpot-type Ware; **98** English Stoneware; **99** Metropolitan Slipware; **100** Westerwald Stoneware

FIG.41

Table Glass: **100-10** Wine bottles

FIG.42

Table Glass: **111-4** Drinking glasses; **115** Miniature beaker base; **116** Decanter spout

FIG.43

Clay Tobacco Pipes: (English) **117-8** type AO 15; **119-24** type AO 18; **125-6** type AO 20; **127-8** type AO 21; **129-32** type AO 22

FIG.44

Clay Tobacco Pipes: **134-8, 140-1, 143-4, 148-59** English; **133, 139, 145-7** Dutch; **142** American

FIG.45

Knives: **160-70**

FIG.46

Cutlery and Domestic Tools: **171-6** blades; **177-8, 182** knife handles; **179-81, 183** scissors; **184** brush handle, **185** hone

FIG.47

Personal Items: **186** mealman token; **187-94** buttons; **195-7, 199, 200** buckles; **198** buckle plate; **201-3** loops; **204** point; **205-7** pins; **208** hook

FIG.48

Personal Items: **210** suspension loop; **211** brooch; **212** spur; **213** chain; **214-7** cloth seals; **218** needle case; **219** button making waste; **220** die; **221** Jew's Harp

FIG.49

Personal Items: **222** heel iron; **223** patten

FIG.50

Military Dress, Weapons and Tools: **224-5** buttons; **226** scabbard; **227-8** chapes; **229** friction tube; **230** hilt; **231-2** blades; **233** shot; **234-9** cartridges; **240-2, 245** plates; **243-4** awls

FIG.51

Tools and Horse Furniture: **246-7** horse shoes; **248** donkey shoe; **249** spoke shave; **250-1** punches; **252-4** chisels; **255-6** spade shoes; **257-9** saws; **260** file

FIG.52

Hygienic artefacts: **261-268** combs; **269-271** toothbrushes

FIG.53

Pattern of deaths at Tilbury Fort as illustrated by the number of burials, of people identified as coming from the fort, per month in 25 year periods from the parish registers of West Tilbury and Chadwell St Mary. Total burials from the fort can be compared with statistics on the seasonality of deaths in the marshes of Essex between 1561 and 1820, taken from Mary Dobson, ‘“Marsh Fever” - the Geography of Malaria in England’, *J. of Hist. Geography* 6 (1980), Fig. 13.

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- ⁵⁶*Ibid.*
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- ⁵⁹Saunders, op.cit. in note 9, 9.
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- ⁶³Saunders (1980), op. cit. in note 2, 20.
- ⁶⁴Wilson, op. cit. in note 51, 121.
- ⁶⁵Plan of Tilbury Fort in 1698 (from Bodleian Lib. Oxford, Gough maps 8. Essex f. 49) in Wilson, op. cit. in note 51, Fig. 3.
- ⁶⁶Smith, op. cit. in note 43, 19.
- ⁶⁷*Ibid.*, 20.
- Saunders (1960), op. cit. in note 2, 164.
- ⁶⁸Saunders (1980), op. cit. in note 2, 9.
- ⁶⁹This is similar to the palisade shown on a 1742 section through the Covered Way and Ravelin (from Public Records Office (P.R.O.) WO 78/1727 MR 559) in Wilson, op. cit. in note 51, Fig. 4.
- ⁷⁰Saunders (1960), op. cit. in note 2, Plates XXVII-XXXI.
- ⁷¹E.H.M.R., op. cit. in note 53 and WORKS 31/1209 (1778).

- ⁷²Smith, op. cit. in note 43, 20.
- ⁷³E.H.M.R., WO 78/744 (1849).
- ⁷⁴Smith, op.cit. in note 43, 29.
- ⁷⁵Wilson, op. cit. in note 51, 123.
- ⁷⁶Saunders (1980), op. cit. in note 2, 25.
- ⁷⁷E.H.M.R., op. cit. in note 73.
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- ⁸¹Saunders (1960), op. cit. in note 2, 152.
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- ⁹⁰Gordon Jackson, *The History and Archaeology of Ports*, (Kingswood, Surrey, 1983), 16.
- ⁹¹Smith, op. cit. in note 79, 342.
- ⁹²Sparkes, op. cit. in note 1, 209.
- ⁹³John, Booker, *Essex and the Industrial Revolution*, Essex Record Office Publication 66 (1974), 103
- ⁹⁴*Ibid.*, 144.
- ⁹⁵Bingley, op. cit. in note 37, 15.
- ⁹⁶E.H.M.R., DOE S 42/75, S 44/75, S 53/75.
- ⁹⁷ Personal communication, Cathy Groves, Sheffield University, Department of Archaeology & Prehistory.
- ⁹⁸Wilkinson, op.cit. in note 10, figs. 11 and 13.
- ⁹⁹See context 1110 in Trenches 1, 19 and 20 (FIGS. 7, 13 and 15).
- ¹⁰⁰See contexts 4011-3 (FIG. 4).
- ¹⁰¹See contexts 4226 and 4236 in Trench 45 (FIG.9).
- ¹⁰²Saunders (1960), op. cit. in note 2, 162.
- ¹⁰³Duffy, op. cit. in note 6, 41.
- ¹⁰⁴Saunders (1960), op. cit. in note 2, 163.
- ¹⁰⁵Wilson, op. cit. in note 51, 115.
- ¹⁰⁶Saunders (1960), op. cit. in note 2, 165.
- ¹⁰⁷*Ibid.*, Plate XXXI.
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- ¹⁰⁹W. Cooke, illustration called 'Tilbury Fort, Essex', *Views on the Thames* (c.1810).
Royal Commission the Ancient Monuments of Scotland, drawing of river front of Tilbury Fort in Ayers Album, Neg. No. XSD/279/1, third quarter of eighteenth century.
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P.R.O. WORKS 31/1213, unlikely to be later than 1684, the year of the enclosing of the Northern Redoubt.
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- ¹¹²Sparkes, op. cit. in note 1, 209.
- ¹¹³Colvin, op. cit. in note 48, 604.

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- ¹¹⁴Ibid., Plate 44.
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- ¹¹⁷Saunders (1960), op. cit. in note 2, Plate XXVIII
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- ¹²¹P.R.O., op. cit. in note 109.
- ¹²²E.H.M.R., op. cit. in note 53 and WORKS 31/1202 (1715).
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- ¹²⁴E.H.M.R., op. cit. in note 73.
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- ¹²⁶Wilson, op. cit. in note 51 and E.H.M.R., op. cit. in note 109.
- ¹²⁷Ordnance Survey (O.S.), 1:10560 Essex [New Series] Sheet XCV. S.E. (1947).
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- ¹²⁹E.H.M.R., op. cit. in note 73.
- ¹³⁰Saunders (1980), op. cit. in note 2, 13.
- ¹³¹E.H.M.R., op. cit. in note 122.
- ¹³²Michael Jenner, *The Architectural Heritage of Britain and Ireland* (London, 1993), 263.
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- ¹³⁴P.R.O. WORKS 31/1212, dated by comparing its structural form to E.H.M.R. maps, op. cit. in notes 36 and 122, to between 1715 and 1740.
- ¹³⁵E.H.M.R., op. cit. in note 36.
- ¹³⁶E.H.M.R., op. cit. in note 71 and British Library Kings Topographical Collection XIII 56a.
- ¹³⁷P.R.O., op. cit. in note 109.
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- ¹³⁹Smith, op. cit. in note 43, 29.
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- ¹⁴⁸Jackson, op. cit. in note 85, 97.
- ¹⁴⁹Milne, op. cit. in note 125, Plates 43-51.
- ¹⁵⁰Genibelli, op. cit. in note 48.
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- ¹⁹⁰A *terminus post quem* date from coin SF133 in layer 4242.
- ¹⁹¹The date by which construction work on the fort had been completed. Wilson, op. cit. in note 51, 113.
- ¹⁹²Several very large pits containing domestic-type rubbish were seen on the western side of the parade ground, near the site of the soldiers' barracks, during paving works. Personal communication, Bernie Truss.
- ¹⁹³See notes 18-31.
- ¹⁹⁴Very small amounts of pottery from contexts 4208, 4210-1 and 4241 are included here as they are also seventeenth century construction deposits. The material from these deposits may have originated in the very friable 4242 layer but moved into these other deposits via cracks in the dry clay.
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Ruth Hurst Vose, *Glass* (London, 1980), 119.
Hugo Morley-Fletcher, 'Seventeenth Century Glass', in Dan Klein and Ward Lloyd (eds.), *The History of Glass* (London 1984), 107.
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- ²⁶³Henkes, op. cit. in note 253, 225-6, No. 49.2.
- ²⁶⁴Victoria and Albert Museum, op. cit. in note 251, Plates 10, 18.
- ²⁶⁵R.J. Charleston, 'Glass: Vessel Fragments', in A.M. Terlinden and D.W. Crossley, *Post-Medieval Glass-making in Brabant: The Excavation of a Seventeenth Century Furnace at Savenel, Nethen*, *Post-Medieval Archaeol.* 15 (1981), Fig. 5, No. 3.
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Vose, op. cit. in note 256, 146-7.
Vose, op. cit. in note 257, Figs. 10-11.
- ²⁶⁷Mortimer, op. cit. in note 28.
- ²⁶⁸Vose, op. cit. in note 256, 118-9.
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- ²⁷²A. Oswald, *Clay Pipes for the Archaeologist*, British Archaeological Reports 14 (1975).
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- ²⁷⁵Atkinson and Oswald, op. cit. in note 271, London typology 1660-1710, No. 22.
- ²⁷⁶Ibid., No.18.
- ²⁷⁷Context 4206 is dated to between the end of the seventeenth and beginning of the eighteenth centuries.
- ²⁷⁸Oswald, op. cit. in note 272, 116.
- ²⁷⁹A. Noel Hume, 'Clay Tobacco Pipes Excavated at Martin's Hundred, Virginia, 1976-1978', in P. Davey (ed.), *The Archaeology of the Clay Tobacco Pipe II. The United States of America*, B.A.R. 60 (1979).
- ²⁸⁰V. Mitchell, 'The History of Nominy Plantation with Emphasis on the Clay Tobacco Pipes', in B. Sudbury (ed.), *Historic Clay Tobacco Pipe Studies 2* (1983), 1-38.
- ²⁸¹Thompson, op. cit. in note 195, 102, Fig. 51, No. 35.
- ²⁸²Cunningham and Drury, op. cit. in note 231, 53, Fig. 32, No. 30.
- ²⁸³Owen Bedwin, 'The Excavation of Ardingly Fulling Mill and Forge, 1975-76', *Post-Medieval Archaeol.* 10 (1976), 61, Fig. 92, Nos. 2-6.
- ²⁸⁴Knife **169** comes from context 4200, a pre-World War II twentieth century layer.
- ²⁸⁵Bedwin, op. cit. in note 283, 61, Fig. 92, Nos. 8-10.
- ²⁸⁶Margeson, op. cit. in note 17, 130, No. 860.
- ²⁸⁷Farthing SF101 recovered from context 4206, SF123 from context 4241 (FIG. 9), not illustrated.
- ²⁸⁸Farthing SF133 recovered from redeposited midden layer 4242 (FIG. 9), not illustrated.
- ²⁸⁹Farthing SF714 recovered from redeposited midden layer 4242 (FIG. 9).
- ²⁹⁰George C. Williamson (ed.), *Trade Tokens Issued In the Seventeenth Century II* (London 1967), 765.
- ²⁹¹Token SF25 recovered from redeposited midden layer 4242 (FIG. 9).
- ²⁹²Halfpenny SF74 recovered from context 4204 (FIG. 9), not illustrated.
- ²⁹³Three Shilling Token SF79 recovered during machine excavation from context 4239 or anywhere stratigraphically above (FIG. 9), not illustrated.
- ²⁹⁴Geoff Egan and Francis Pritchard, *Dress Accessories 1150-1450*, Museum of London, Medieval Finds from Excavations in London 3 (HMSO, 1991), 274, No. 1377.
- ²⁹⁵Martin Biddle and Katherine Barclay, '“Sewing Pins” and Wire', in Biddle, op. cit. in note 16, 564.
- ²⁹⁶Ibid., 562, Table 76.
- ²⁹⁷Margeson, op. cit. in note 17, Fig. 9, No. 86.
- ²⁹⁸SF166 from layer 4242.
- ²⁹⁹Margeson, op. cit. in note 17, Fig. 2.
- ³⁰⁰Hinton, op. cit. in note 254, 404, Fig. 185, No. 196.
- ³⁰¹This was recovered as an unstratified find.
- ³⁰²Peter Drewett, 'The Excavation of the Great Hall at Bolingbroke Castle, Lincolnshire', *Post-Medieval Archaeol.* 10 (1976), 31, Fig. 15:52.
- ³⁰³From context 4231, not illustrated.
- ³⁰⁴June Swann, *Shoemaking*, Shire Album No.155 (Aylesbury, 1986), 13.
- ³⁰⁵Bedwin, op. cit. in note 280, 62.
- ³⁰⁶The weave is visible on seal **214** which has a count of circa 6 warp/12 weft and on **216** with a count of circa 7 warp/10 weft, both of which are course weaves. Geoff Egan (with contribution by Mike Cowell and Hero Granger Taylor), *Lead Cloth Seals and Related Items in the British Museum*, British Museum Occasional Papers 93 (London, 1994), 14.
- ³⁰⁷Francis Steer, *Farm and Cottage Inventories of Mid-Essex, 1635 to 1749*, (E.R.O., 1969), 45.
- ³⁰⁸Cattle sized long bone fragment. Personal communication, Jane Sidell, M.O.L.E.A.S.
- ³⁰⁹This needlecase top was found unstratified in the West Curtain Bank. A parallel was found unstratified at Winchester. Martin Biddle and Linden Elmhirst, 'Sewing Equipment', in Biddle, op. cit. in note 16, 817, No. 2535.
- ³¹⁰Cattle sized long bone/rib. Personal communication, Jane Sidell.
- ³¹¹Biddle, op. cit. in note 16,
- ³¹²Margeson, op. cit. in note 17.
- ³¹³Colin Platt and Richard Coleman-Smith, *Excavations in Medieval Southampton 1953-1969* (Leicester, 1975).
- ³¹⁴Thompson, op. cit. in note 195.
- ³¹⁵Biddle and Barclay, op. cit. in note 295, 564.
- ³¹⁶David Brown, 'Dice, a Games-Board, and Playing Pieces', in Biddle, op. cit. in note 16, 693.
- ³¹⁷SF48 from context 4231.
- ³¹⁸SF696 from context 4242.

- ³¹⁹Wilson, op. cit. in note 51, 119, Fig. 3.
- ³²⁰E.H.M.R. op. cit. in note 53.
- ³²¹P.R.O. WO 55/765.
- ³²²P.R.O., op. cit. in note 164.
- ³²³E.H.M.R. op. cit. in note 52.
- ³²⁴P.R.O. WO 55/2589 Ordnance Land at Tilbury.
- ³²⁵Layer 4242.
- ³²⁶G. Corbet and D. Ovenden, *The Mammals of Britain and Europe* (London, 1980).
- ³²⁷Derek Goodwin, *Crows of the World* (Suffolk, 1976).
- ³²⁸E.M. Nicholson, *Birds and Men* (London, 1951).
- ³²⁹T. O'Connor, 'Birds and the Scavenging Niche', *Archaeofauna* II (1993).
- ³³⁰S. Cramp, W.R.P. Bourne and D. Saunders, *The Seabirds of Britain and Ireland* (London, 1974).
- ³³¹E.J. Sidell, *The Identification of Archaeological Eggshell; a Feasibility Study*, unpublished MSc dissertation, Institute of Archaeology, University College London (1991).
- E.J. Sidell, 'The Identification of Avian Eggshell, *Archaeofauna* II (1993).
- ³³²From context 4521 (TF1-91), Trench 54.
- ³³³SF24, unstratified.
- ³³⁴Gwen Squire, *Buttons, a Guide for Collectors* (London, 1972), VIII-IX.
- ³³⁵Ibid.
- ³³⁶The scabbard and chape were found during machining from late seventeenth to early eighteenth century deposits (context 4203/4/6) probably dating the sword the end of the seventeenth century.
- ³³⁷Jane Cowgill, 'Manufacturing Techniques', in Jane Cowgill, M. De Neergaard and N. Griffiths, *Knives and Scabbards*, Museum of London, Medieval Finds From Excavations in London I (HMSO, 1987), 37.
- ³³⁸Stephen Bull, *European Swords*, Shire Album No.298 (Aylesbury, 1994), 13.
- ³³⁹Russell Fox and K.J. Barton, 'Excavations at Oyster Street, Portsmouth, Hampshire, 1968-71', *Post-Medieval Archaeol.* 20 (1986), 232, Fig. 145:10.
- ³⁴⁰Anthony North, *An Introduction to European Swords* (HMSO, 1982), 22, Fig. 44.
- ³⁴¹Arthur Richard Dufty, *European Swords and Daggers in the Tower of London* (HMSO, 1974), Plate 54, Fig. C.
- ³⁴²Laurence Flanagan, *Ireland's Armada Legacy* (Gloucester, 1988), 101.
- Bull, op. cit. in note 338, 14.
- ³⁴³S.E. Ellacott, *Guns* (London, 1955), 62.
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- ³⁴⁶SF630 from context 4257.
- ³⁴⁷SF635 from context 4257.
- ³⁴⁸Ibid.
- ³⁴⁹SF 239 from context 4242 and SF 580 from context 4242.
- ³⁵⁰Ellacott, op. cit. in note 343, 35.
- ³⁵¹Adrian B. Caruana, *British Artillery Ammunition 1780*, Museum Restoration Fund (1780, reprinted 1979), 18.
- ³⁵²K.J. Barton and E.W. Holden, 'Bramber Castle, 1966-67', *Archaeological J.* 134 (1977), 64-5, Fig. 20, Type 1.
- ³⁵³John H. Williams, *St Peters Street, Northampton. Excavations 1973-1976*, Northampton Development Corporation Monograph No. 2 (Northampton, 1979), 275, Fig. 121:114.
- ³⁵⁴Ivan G. Sparkes, *Old Horsehoes*, Shire Album No.19, (Aylesbury, 1976), 17.
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- ³⁵⁶E.H.M.R. op. cit. in note 73.
- ³⁵⁷Margeson, op. cit. in note 17, 175, Fig. 125:1354-5.
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- ³⁵⁹John Seymour, *The Forgotten Arts* (London, 1984), 69.
- ³⁶⁰Cunningham and Drury, op. cit. in note 231, Fig. 31, No. 1.
- ³⁶¹Seymour, op. cit. in note 359, 82.
- ³⁶²Drewett, op. cit. in note circa 302, Fig. 14:34.
- ³⁶³File **260** is from context 4257 (FIG. 9).
- ³⁶⁴Peter Mansfield, 'The Great Typhoid Epidemic in Terling 1867-1868', *The Essex Family Historian* No. 69 (August 1993), 19
- ³⁶⁵**261-270** from context 4242 and **271** from context 4239.

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- ³⁶⁸Margeson, op. cit. in note 17, 66.
- ³⁶⁹Flanagan, op. cit. in note 342, 139.
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Gooder, op. cit. in note 224, 221.
- ³⁷²Wilkinson, op. cit. in note 10, 132.
- ³⁷³Personal comment, Patricia Wilkinson, N.M.S. Assistant Manager.
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- ³⁹¹British Medical Association and Royal Pharmaceutical Society, 'Proscribing for Children', *British National Formulary* (1988).
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- ⁴³⁶*Ibid.*, 359.
- ⁴³⁷*Ibid.*, 380.
- ⁴³⁸There may, in some of these cases, be a connection between the high numbers of deaths and major military campaigns by the British army, for instance 1779-82 encompassed the American War of Independence and 1715-16 marked the defeat of Napoleon on the Continent.
- ⁴³⁹Cobb op. cit. in note 405, 5-6.
- ⁴⁴⁰Molleson op. cit. in note 406, 182.
- ⁴⁴¹Dobson op. cit. in note 386, 379.
- ⁴⁴²*Ibid.*, 380-1, Fig. 13.
- ⁴⁴³English Heritage, *Tilbury Fort: List of Prisoners from the Jacobite Rebellion 1745, Kept in the Powder Magazines, Tilbury Fort 1746/50*, (HBMC), reprinted as a pamphlet from Seton and Arnot, *The Prisoners of the 45*, Vol. 1, 163-4.
- ⁴⁴⁴This may seem like a short distance to travel but William Jack wrote from Tilbury Fort on 17th March 1747, two weeks before being transported, "that he had been 8.5 months at sea, during that time only 49 survived out of the 157 prisoners put on board". If this death rate was common to all the transport ships that set out together it would explain why seven transport and one escort ships delivered only 311 prisoners to the Tilbury Fort. *Ibid.*, Prisoner No.1369. However, brutality and bad conditions apart, the

North Sea was recognised as a dangerous place for sailors particularly from malaria. Trotter op. cit. in note 382, 297.

⁴⁴⁵English felons in transport ships especially going to America and French and Spanish prisoners in ships. Dr James Lind *A Treatise of the Scurvy* (London, 1753), reprinted in Lloyd op. cit. in note 382, 88, 92.

⁴⁴⁶Trotter op. cit. in note 382, 295.

⁴⁴⁷English Heritage, op. cit. in note 443.

⁴⁴⁸Zinsser op. cit. in note 366, 279.

⁴⁴⁹Lind op. cit. in note 445, 85, 94.

⁴⁵⁰What is shocking about this figure is that it was considered as a “small number taken ill”! Ibid., 91.

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⁴⁵⁴Carpenter op. cit. in note 452, 99.

⁴⁵⁵Ibid.

⁴⁵⁶Ibid., 99, 100, 103, 105.

⁴⁵⁷McNeill op. cit. in note 411, 209.

⁴⁵⁸Ibid., 227-8.

⁴⁵⁹Ibid., 229.

⁴⁶⁰Saunders (1960), op. cit. in note 2.

Wilkinson op. cit. in note 10.

⁴⁶¹Wilkinson op. cit. in note 10, 160.

⁴⁶²Smith, op. cit. in note 43, 20.

⁴⁶³Wilkinson op. cit. in note 10, 161.

⁴⁶⁴Ibid.