

The Big Dig

Archaeology and the Jubilee Line Extension



**museum of
LONDON**
ARCHAEOLOGY
SERVICE



Jubilee Line Extension Project

Foreword

2000 Years of Construction

In the past, builders and civil engineers have often had an uneasy relationship with archaeologists. This was for the very sound reason that the unplanned discovery of historically important artefacts on a construction site generally brings work to a halt while archaeologists investigate. Inevitably there are delays and a consequent impact on building costs. I am delighted to report that this was not the case with the Jubilee Line Extension Project.

From the very early planning stages we worked closely with the Museum of London Archaeology Service and we were able to include a phase for archaeological investigation within our Project construction programme. We did so not just to pacify the historians and politicians but because there is a genuine common interest in London's historical and cultural heritage — which London Transport has championed for many years. Such interest is shared by all of us who have worked on the Jubilee Line Extension Project.

In addition to discovering how our ancestors lived, there is also professional interest for the Project staff and contractors in learning how the London of centuries ago was planned and constructed. More than anything, the discoveries made on our sites, and detailed in the following pages, provide tangible links with our past and remind us that in building our new underground railway we are also writing our own page of London's history.



Hugh Doherty,
Project Director, Jubilee
Line Extension Project



Introduction

Between 1992 and 1998 the £2.76 billion Jubilee Line Extension Project was the largest civil engineering project in Europe. Running through Westminster and north Southwark, it traverses some of the most archaeologically sensitive areas of London, ending up at Stratford on top of a medieval abbey. The tunnels for the Jubilee line are themselves so deep that they pass well below any archaeological remains. However, since by its nature a tube tunnel lies deep underground and the people who want to use it live on the surface, there has to be a myriad of holes connecting both levels.

The new ticket halls, the sinking of escalator shafts, ventilation shafts, grouting shafts and escape shafts, the diversion of countless services, the construction of new buildings and the underpinning of existing ones all have the potential to uncover an important fragment of the past history of London, whether it is a Neolithic arrowhead from Westminster, a Roman building under London Bridge station or a medieval monks' cemetery at Stratford.

London Underground fully realised the archaeological potential of the Extension and commissioned archaeological investigations wherever groundworks were to take place along the route. The Museum of London Archaeology Service dealt with the stretch of the Extension between Westminster and North Greenwich, and managed the Newham Museum Service and Oxford Archaeological Unit on the remaining part to Stratford between 1992 and 1998. The full results of the excavation programme will be published in due course. In the meantime, this booklet briefly describes the archaeological remains uncovered during the construction of the Jubilee Line Extension.





Homerton



Stratford



West Ham

Station entrance at West Ham

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Canning Town



North Greenwich

Canary Wharf

Isle of Dogs

Canada Water

Ermondsey

Rotherhithe

Deptford

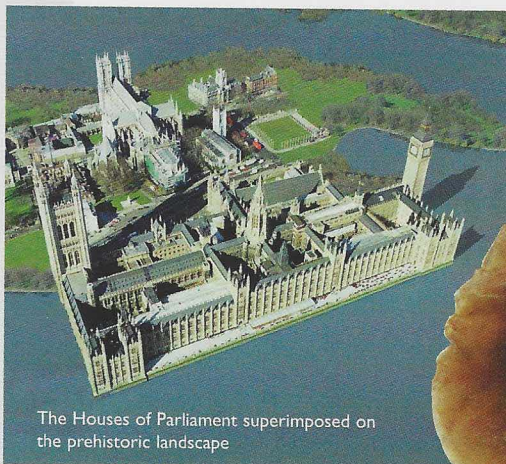
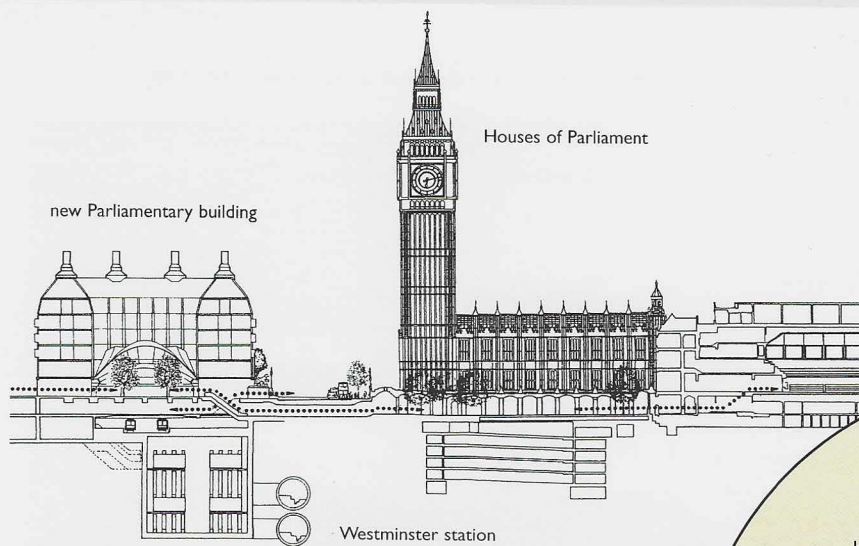
THAMES

Westminster

Extensive works were required for the new Jubilee line station at Westminster in order to link it to the existing District and Circle line station. Particular care had to be taken here to ensure that Big Ben and the Houses of Parliament were not affected by the new tunnels. A series of shafts was dug in and around Parliament Square to allow grout to be pumped into the gravel subsoil, so as to prevent ground movement and damage to nearby buildings.



This part of London was originally an island — Thorney Island — and the Houses of Parliament (more properly known as the Palace of Westminster) themselves sit in what used to be the River Thames before the land was reclaimed from the river in the medieval and later periods. This was achieved by the construction of a series of massive river walls, each built successively further out into the river. Stretches of these walls still survive and were uncovered by work in Bridge Street for service diversions and the construction of a new subway.



Prehistoric periods in Britain

Palaeolithic 450,000–10,000 BC

Homo Sapiens replaces Neanderthal Man.
Evidence comes mainly from bones and flint tools

Mesolithic 10,000–5000 BC

End of last Ice Age. Britain becomes an island. Small tribes survived by hunting animals and gathering wild plants

Neolithic 5000–2000 BC

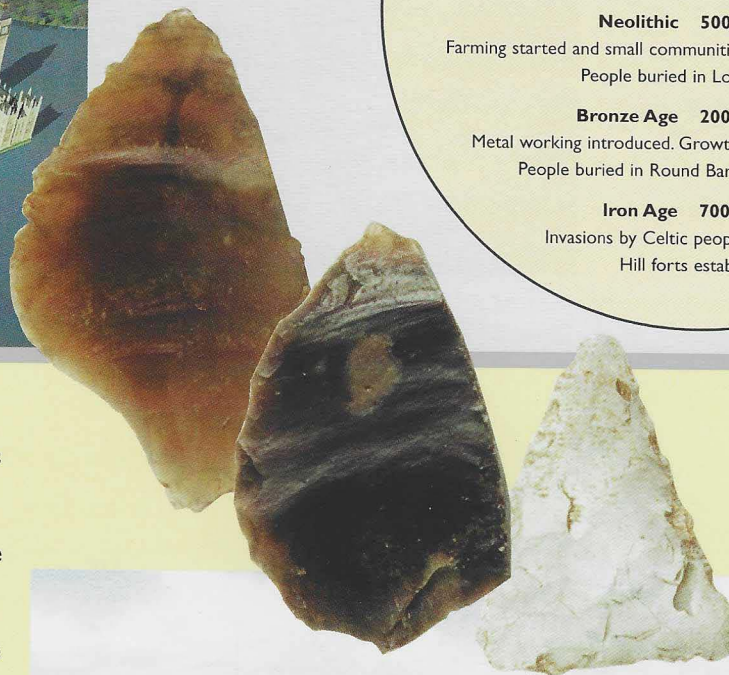
Farming started and small communities grew up. Stonehenge built.
People buried in Long Barrows

Bronze Age 2000–700 BC

Metal working introduced. Growth of contact with Europe.
People buried in Round Barrows and cremated

Iron Age 700 BC–AD 43

Invasions by Celtic people from Europe.
Hill forts established



Thorney Island lay between two branches of the River Tyburn which rose in Hampstead and flowed down to join the Thames at Westminster. ▶ The island appears to have been occupied from the very earliest times. A Neolithic leaf-shaped arrowhead and fragment of polished axe suggest that prehistoric man lived there. Late Bronze Age or Iron Age pottery has also been found on the site of the new Westminster station, along with evidence for a circular timber building. Similar pottery and flint flakes — the waste material from the making of flint tools — have also been recovered in New Palace Yard and under Parliament Square.



Dendrochronological dating

is based on the measurement of tree-ring sequences.

Trees lay down one ring per year, and so the number of rings in a tree represent the number of years a tree has been alive, i.e. a tree cut down in 1997 with 200 rings would have begun life in 1797. The pattern of rings is affected by climate and growing conditions, and it is possible to construct chronologies for different regions based on trees which have been cut down, old buildings and finally ancient timbers by cross-matching the beginning and end of sequences. Timbers which are found on archaeological sites have their ring-sequences measured and then matched against the established chronologies. If the patterns match, then the date the tree was cut down may be obtained.

If the bark is still on the timber, it is even possible to work out which season the tree was cut down in. This is by far the most accurate form of dating used in archaeology, and has contributed to the investigations of the Jubilee Line Extension Project

Seeds of horned pondweed would have been abundant on Thorney Island



Analysis of fluvial deposits — deposits laid down by flowing water, in this case the River Thames — show that during the Bronze Age the woodland cover was removed to make room for settlement and farming. Marginal areas by the water's edge were covered with aquatic plants.

Paw print of a dog on a Roman tile



◀ Fragments of Roman building material were found during work in Parliament Square and show that the Romans came to Westminster as well. Pieces of *opus signinum* — a type of cement floor used by the Romans — have been recovered, as have Roman bricks and tiles. Similar materials were found underneath the Abbey in the 19th and early 20th centuries, suggesting that substantial Roman buildings may have stood on the Island. Indeed, these building materials were often reused in the construction of later buildings, including both the Palace and Abbey at Westminster.



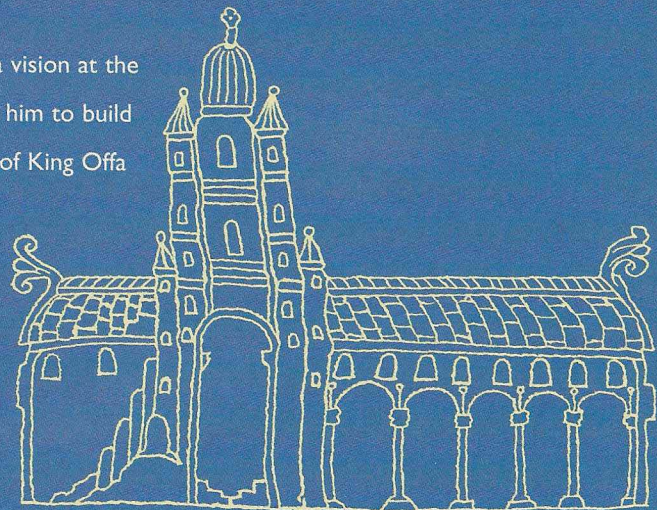
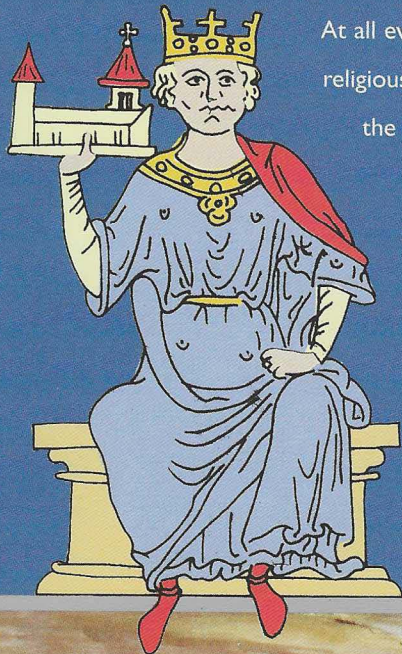
By the late Saxon period, about AD 1000, most of Thorney Island was regularly flooded and it may only have been the highest ground — the site of Westminster Abbey — that remained dry throughout. The timber and stone river walls were built not only for the purpose of reclaiming land from the river but also as a protection against the Thames. ◀

Saxon and Medieval Westminster

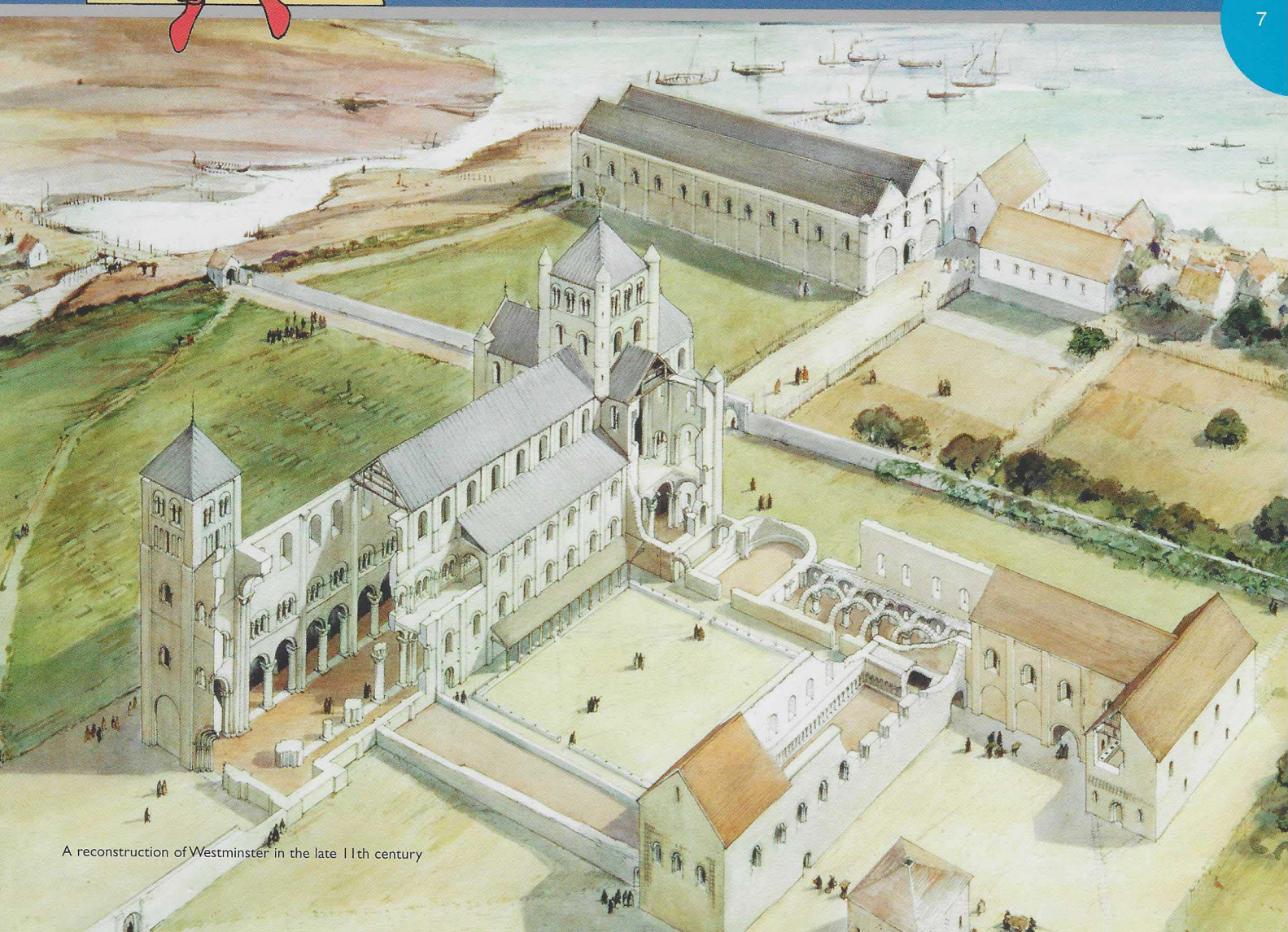
According to legend, St Peter appeared to King Sebert of the East Saxons in a vision at the consecration of Melitus as the first bishop of London in AD 604, and ordered him to build the first church on Thorney Island. A charter thought to date from the reign of King Offa in the 8th century describes the granting of land to 'St Peter and the needy people of God in Thorney in the terrible place which is called Westminster.'

King Edgar is supposed to have granted St Dunstan a charter to restore the Benedictine abbey there in AD 959.

At all events, there was certainly a large religious house on the site when Edward the Confessor became king in 1042.



- It was Edward who moved his royal palace to Westminster and started the rebuilding of the Abbey. The Abbey church was finished in 1065, and following the Norman Conquest William I was crowned there on Christmas Day 1066. Westminster Hall was built by William Rufus in 1097 as an extension of Edward's Palace and is one of the oldest surviving buildings in the area. In the 13th century, Henry III started a massive rebuilding programme on the Abbey that continued until the middle of the 16th century. The west towers were added in the 18th century by Nicholas Hawksmoor.



A reconstruction of Westminster in the late 11th century

The Abbey is situated on the highest ground on Thorney Island and its precincts originally extended under most of what is now Parliament Square. The precincts were entered by two main gates, one from Tothill Street in front of the western end of the Abbey and one from King Street which now lies under Parliament Square. King Street survived until the mid 19th century when government buildings were constructed on its site on the west side of Parliament Street, which itself was not laid out until the mid 18th century. Within the Abbey precincts lay a bell tower and a number of other buildings including houses for merchants attending the annual October fair. Part of one such house, found under the Square, had painted plaster walls and was entered by a door in the south wall. It was radically altered in the 14th century when partitions were constructed and hearths laid.



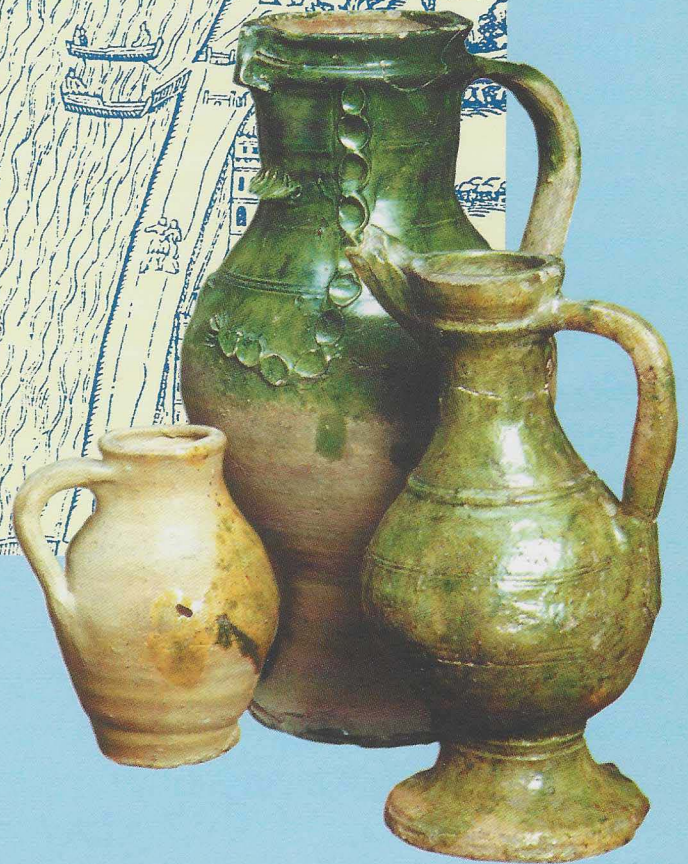
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To the east of the Abbey lay the Palace of Westminster. This was divided into three yards: Old Palace Yard lay at the south end and contained the Royal Apartments; ▲ New Palace Yard lay to the north of Westminster Hall, and the Green Yard lay between the two and adjacent to Westminster Hall. Each courtyard was entered by its own gate and there were water gates leading to jetties built out into the Thames. ◀ Parts of two of these gates have been found. The outer gate of New Palace Yard was built in 1287–9 and rebuilt in 1397–9.

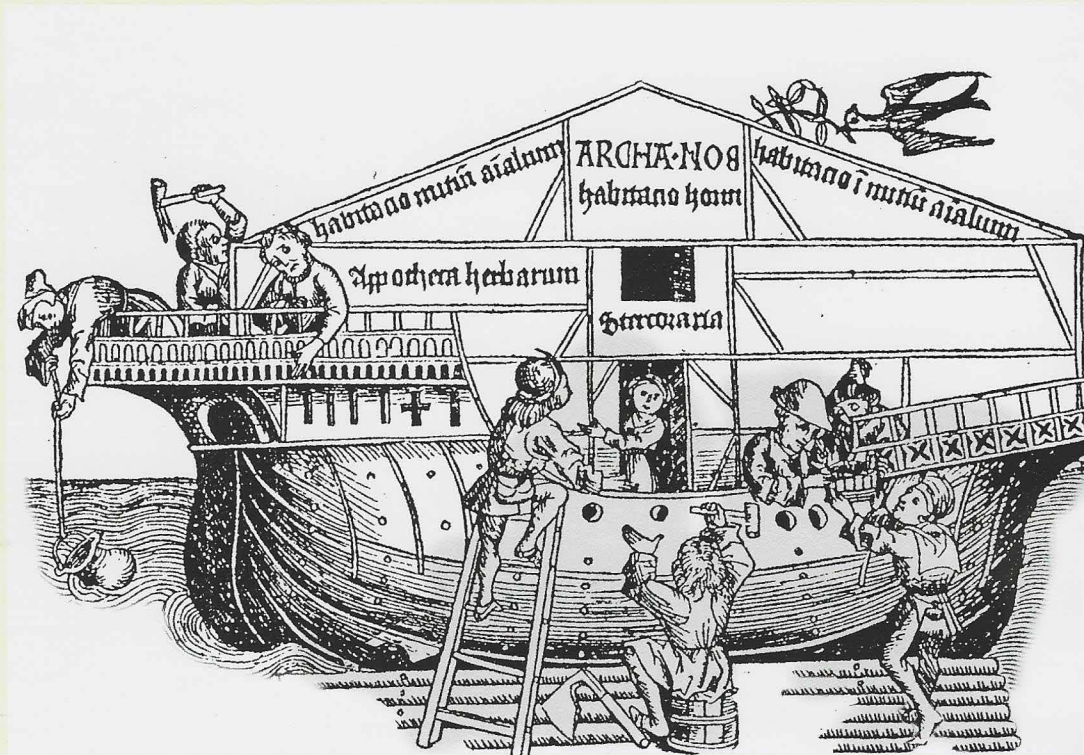


A 16th-century view of Westminster by Ralph Agas



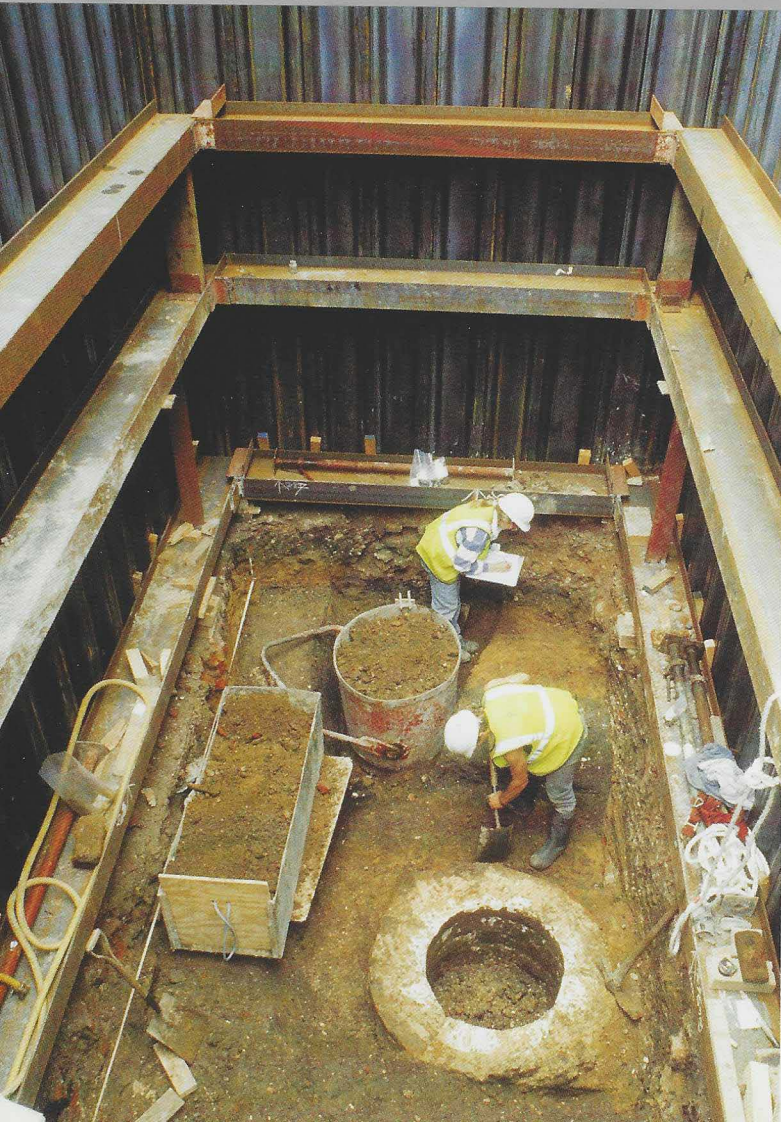
The corner of the earlier gate was found next to a stone building of similar date and featured a timber-lined cesspit containing some wooden plates. Some of the timbers were found to have been reused from a type of ship known as a 'cog'. ▼

The cesspit was filled in during the 14th century and a series of clay and stone floors laid over it. To the south of the building lay the yard surfaces of New Palace Yard. The stone boundary wall between New Palace Yard and the Green Yard was found in the south-eastern corner of Parliament Square. To its south lay a building with a stone floor. Excavations in a tunnel under St Margaret Street located the base of the gatehouse into the Green Yard, built in 1244–5 and laid on a raft of timber piles.

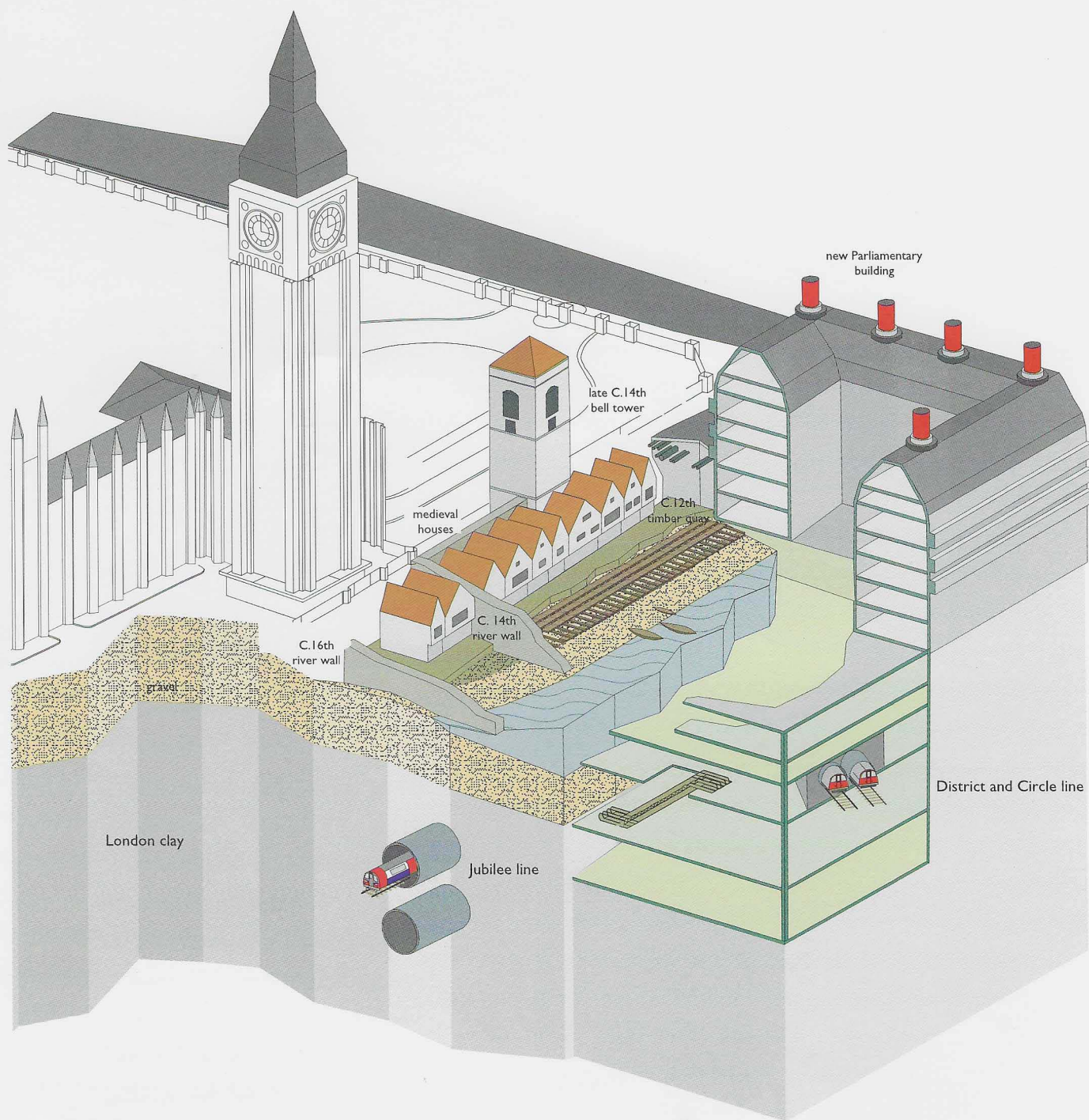


Along the north side of modern-day Bridge Street lay an east–west 12th-century quay at least 15m long. It had a timber floor and a stone wall fronting onto the Thames. This was probably the principal quay of the Palace until the 13th century when the land to its north was reclaimed. By the 14th century a new river wall was built still further out into the river, and additional land was reclaimed. It was on this land that the houses of the canons of the chapel of St Stephen were built. These fronted onto the river and backed onto the street named after them — Canon Row. Pits full of domestic rubbish were found in the back gardens of these houses, and a well contained two complete ceramic watering cans of the second half of the 16th century.

One of the houses was found to contain a large vaulted chalk drain which flowed out into the river. Under Bridge Street itself lay houses associated with the Woolstaple or wool market founded by Edward III in 1353, and substantial foundations running back from the river wall may have formed part of them or their replacements. The garden of one house contained a chalk well, ▼ and behind a chalk wall at the back ran a ditch which presumably drained into the Thames. The market itself lay in a courtyard which now lies beneath Parliament Street.

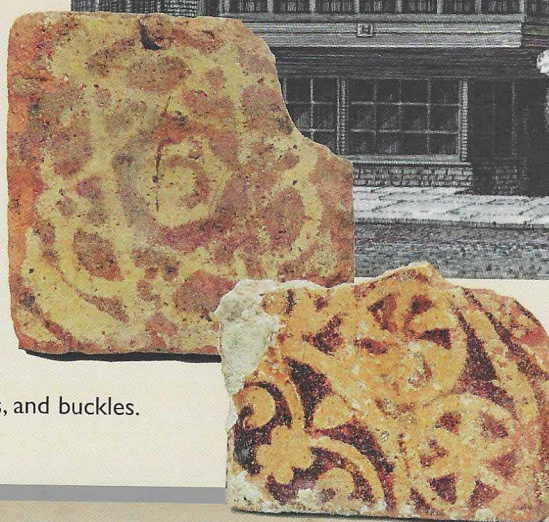
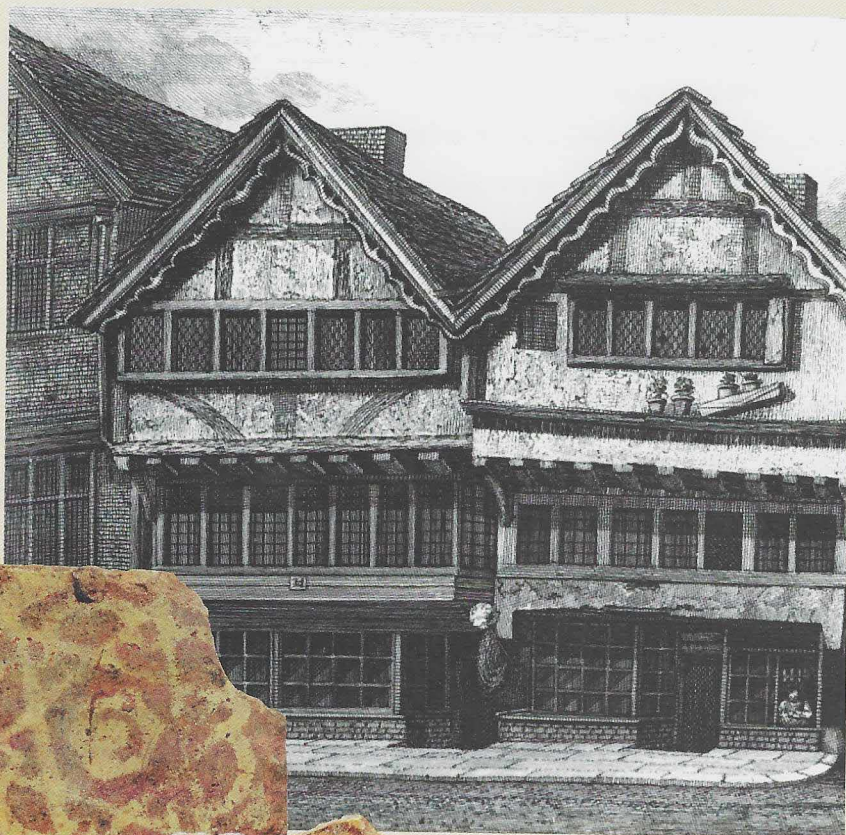


During the 11th and 12th centuries efforts were made to drain the marshy ground which had resulted from the flooding of the Island. Drainage ditches were dug across Parliament Square and the Thames foreshore, one of them revetted with timber posts and planks. A series of posts was set into the bed of the stream or ditch and may represent the foundations of a bridge leading into the Palace precincts. Radiocarbon dating of the timber suggests that it dates from between the middle of the 10th century and the end of the 11th century.



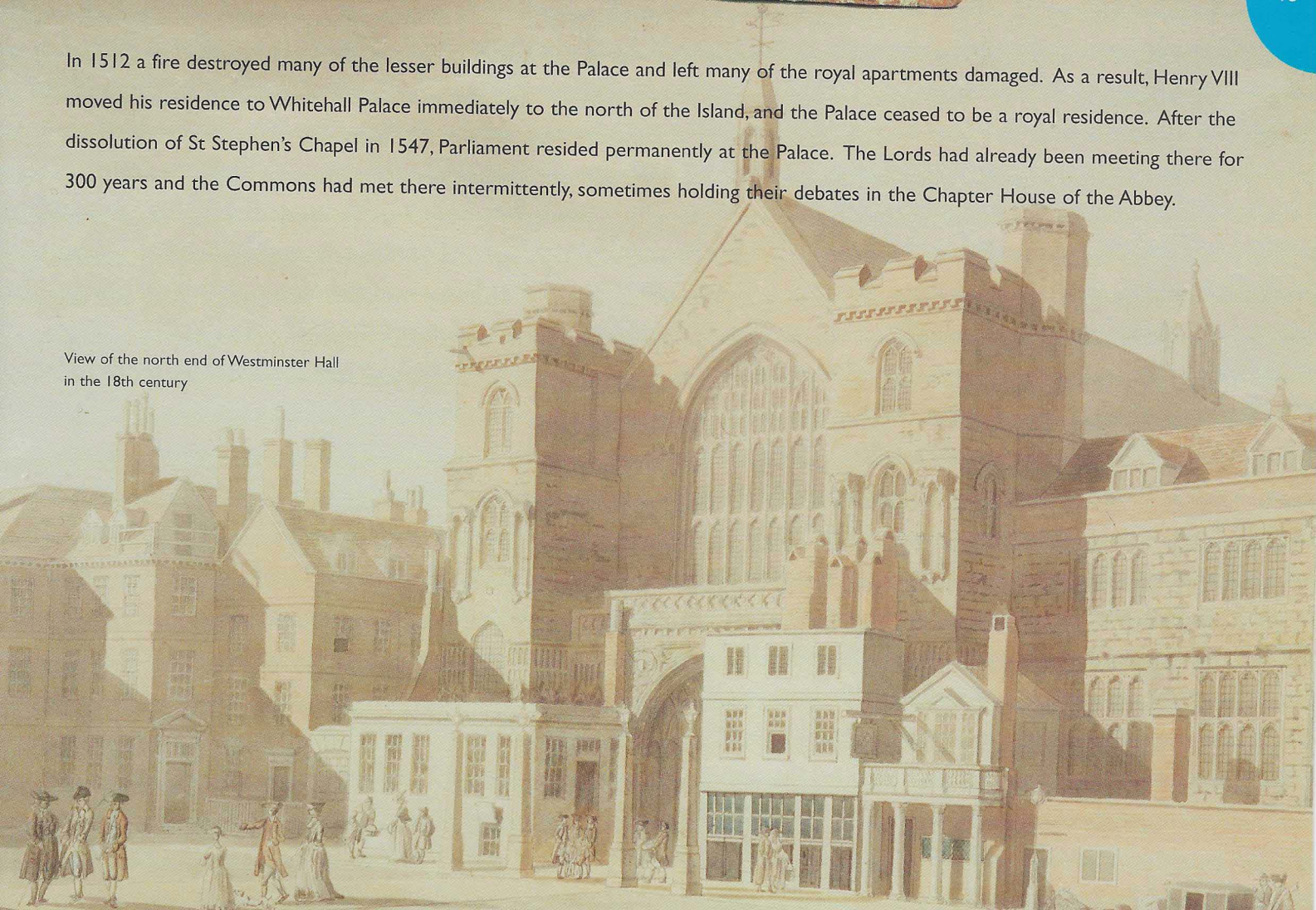
Medieval Westminster reconstructed alongside the modern buildings and the new station

Outside the precincts of the Abbey and Palace, the town of Westminster lay along the two main routes leading on to the Island: King Street and Tothill Street, the latter still leading west from the Abbey today. They were linked by a street known as Thieving Lane. The settlement along Tothill Street lay off the Island, on the far side of the bridge crossing to the Abbey precinct; while the settlement along King Street lay both on and off the island. By the medieval period the Tyburn took the form of a series of small streams on the north side, and on the south side had been partially diverted into a new ditch which served the Abbey mill. The houses along King Street ► on the west side possessed gardens which stretched at least 60m behind them and were separated from each other by ditches. The gardens were used to dispose of life's everyday debris; animal carcasses and broken pottery, for example, and other artefacts such as a ring, part of a jewellery chain, a mount from a horse harness, and buckles.

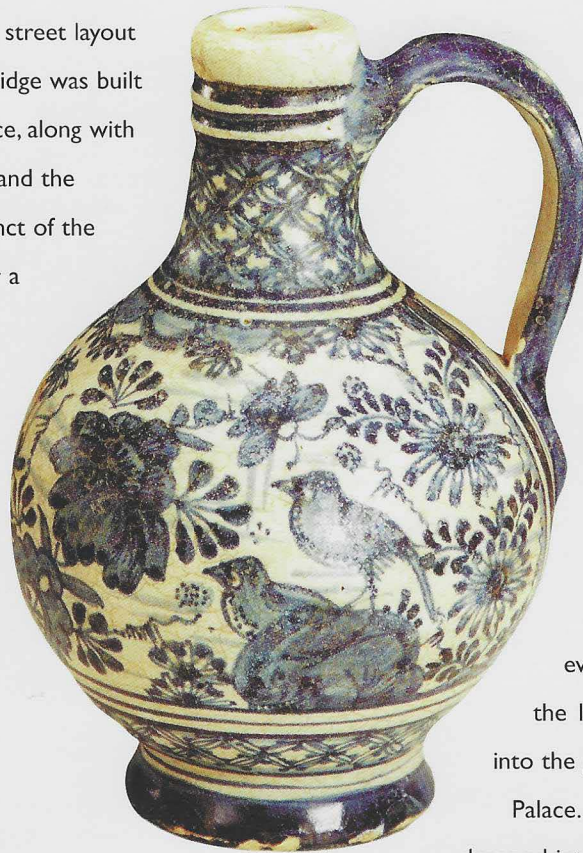


In 1512 a fire destroyed many of the lesser buildings at the Palace and left many of the royal apartments damaged. As a result, Henry VIII moved his residence to Whitehall Palace immediately to the north of the Island, and the Palace ceased to be a royal residence. After the dissolution of St Stephen's Chapel in 1547, Parliament resided permanently at the Palace. The Lords had already been meeting there for 300 years and the Commons had met there intermittently, sometimes holding their debates in the Chapter House of the Abbey.

View of the north end of Westminster Hall in the 18th century



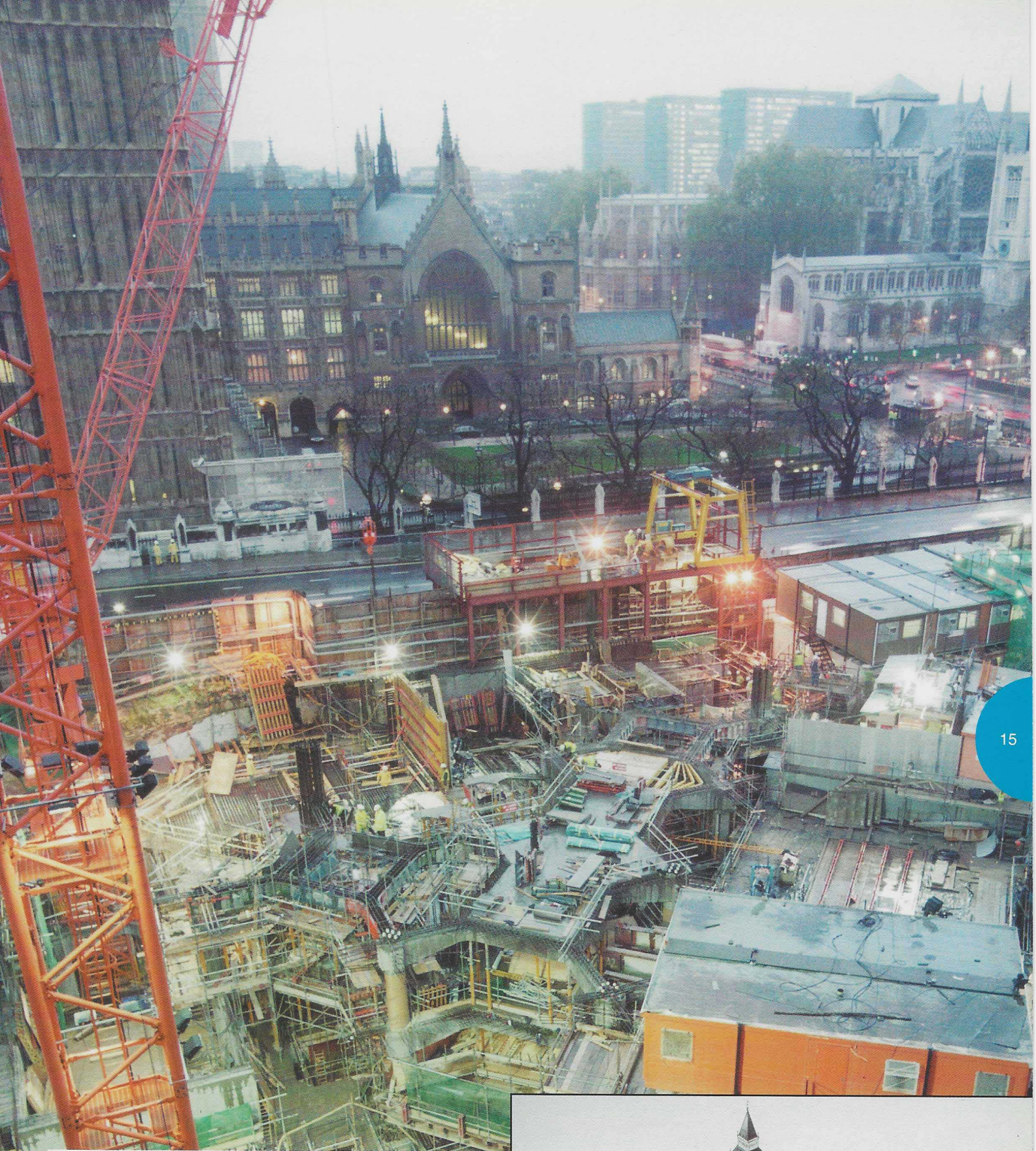
Many of the medieval buildings remained until the early 18th century, when the modern street layout began to emerge and Westminster Bridge was built in the 1740s. The gates into the palace, along with its bell tower, were then demolished and the streets widened. The northern precinct of the Abbey had already disappeared under a clutter of narrow streets during the preceding 150 years.



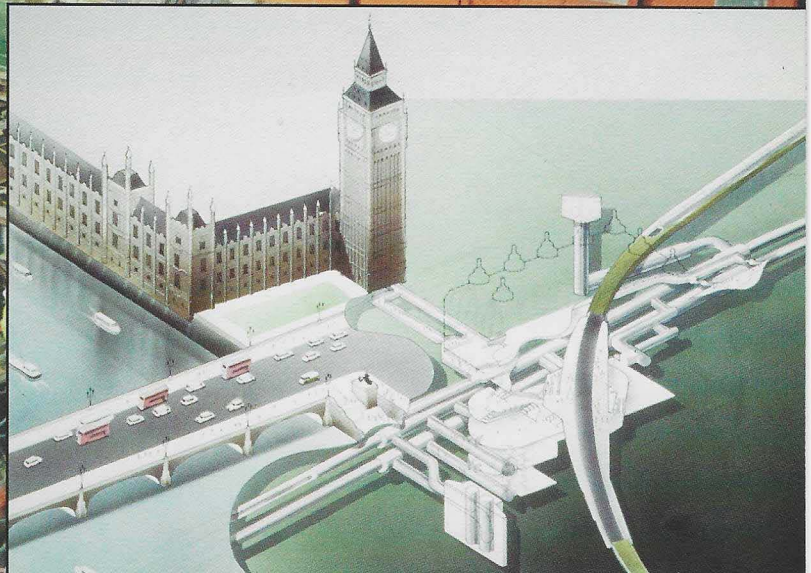
New and large houses were built during the later 16th and 17th centuries. A large brick built house was built on the north side of the market under modern day Parliament Street, replacing the old timber framed houses. The south end of the old merchant's house in the former Abbey precinct was rebuilt in about 1600, and a new brick hearth laid inside includes evidence of a spit set up over it. During the 17th century a brick well was inserted into the gatehouse into the Green Yard of the Palace. ◀ A delftware jug, dated 1627, was dropped into it at some time in the 17th century and survives complete.



The transformation of Westminster was completed during the 18th and 19th centuries. The rivers ceased to be visible (the Tyburn is now carried in a sewer), Whitehall Palace itself was abandoned as a royal residence and, along with King Street, was replaced by accommodation for the Ministries of State. In 1834 the Palace of Westminster was largely destroyed by fire, excepting Westminster Hall, St Stephen's Chapel and the cloisters. The remaining buildings were subsequently demolished to make way for the new Palace designed by Charles Barry and Augustus Pugin.



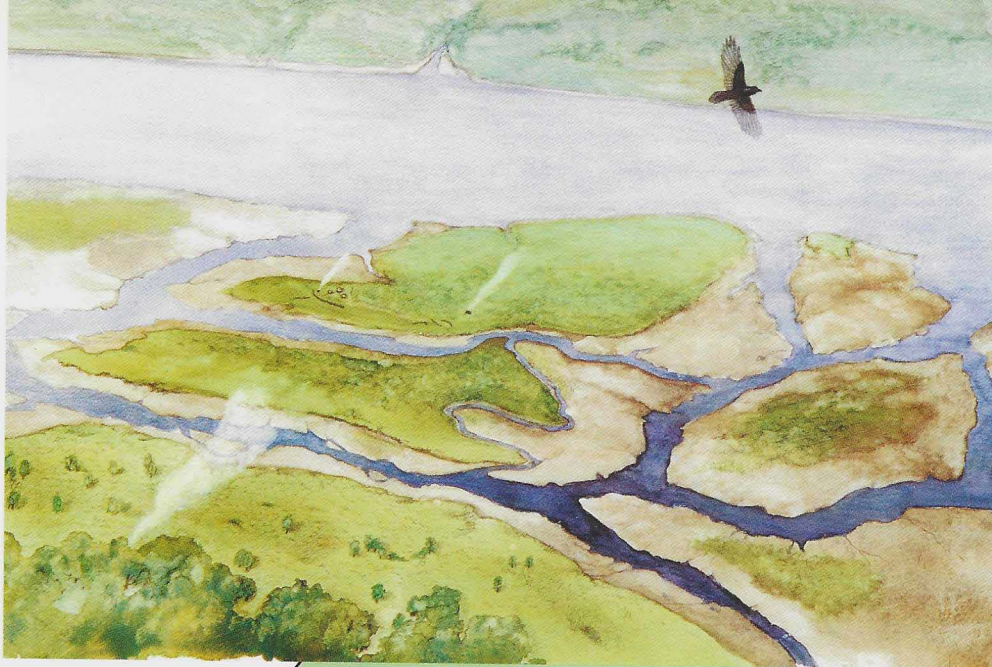
The construction of the Underground Station has given archaeologists from the Museum of London Archaeology Service the opportunity to uncover 5000 years of activity at Westminster within sight of the existing Palace of Westminster, part of which dates back 900 years. The new station will eventually be covered by new buildings to be used by MPs working in the Palace.



London Bridge



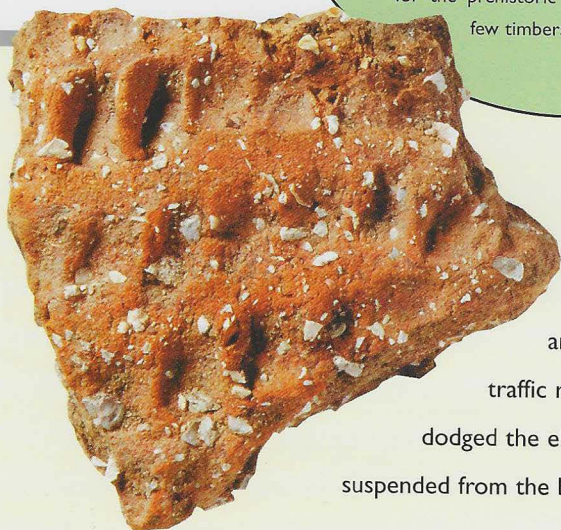
A new station for the Jubilee Line Extension has been constructed beneath London Bridge main line station. In addition, a major upgrade of the Northern line facilities has taken place here as part of the Jubilee Line Extension, raising standards of safety and comfort.



How Southwark looked before the Romans invaded

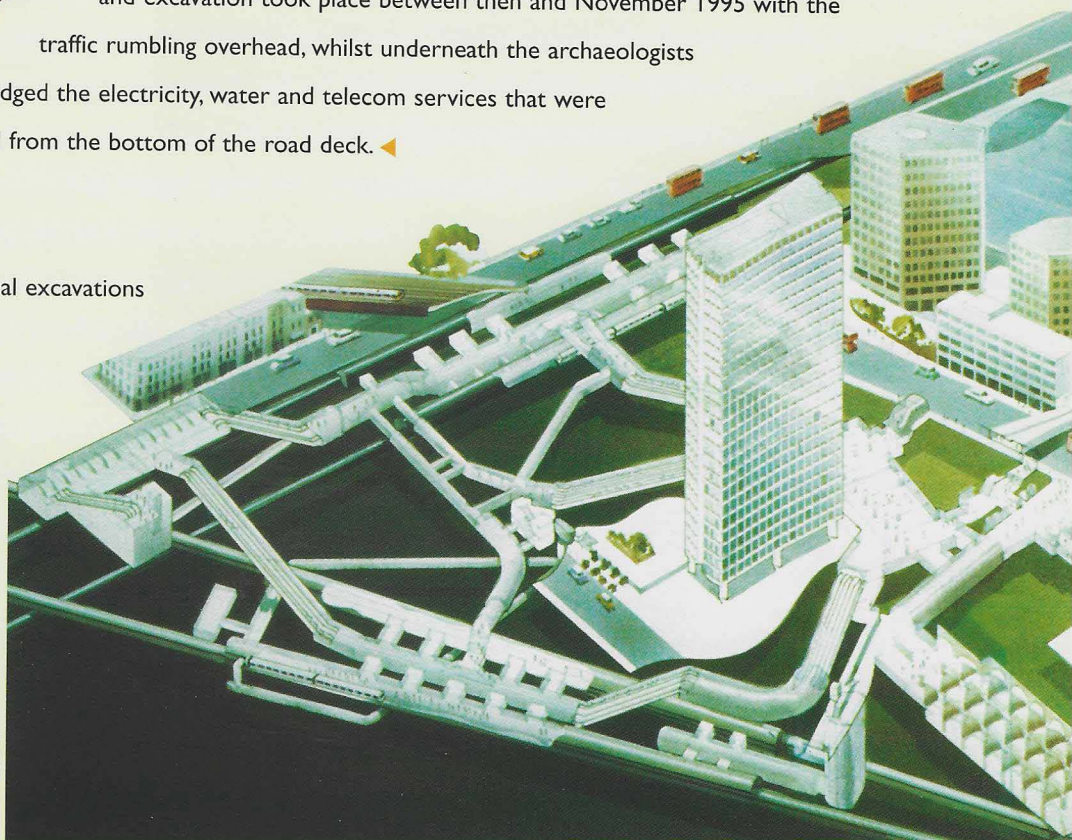
Radiocarbon Dating is based on the measurement of organic carbon found in ancient material recovered from archaeological sites. Several forms of carbon are present in living tissue and one of these, radiocarbon (or C14) decays at a known rate when the organism dies, whereas the other forms do not decay. Therefore by measuring the amount of C14, it is possible to establish when the organism died. Normally the date is obtained within a range to account for a margin of error. This can then be used to date archaeological strata and objects. Although it is not as accurate as dendrochronology, it is extremely useful for the prehistoric period when relatively few timbers are recovered.

Fragment of Neolithic pottery dating to 4500 BC



The largest excavation took place on the site of the new Northern line ticket hall. This is located directly beneath Borough High Street itself. Since the road could not be closed for the three-year construction programme, an artificial road deck was put in place at Easter 1995. The archaeological watching brief and excavation took place between then and November 1995 with the traffic rumbling overhead, whilst underneath the archaeologists dodged the electricity, water and telecom services that were suspended from the bottom of the road deck. ◀

Twenty-four other individual excavations took place in and around London Bridge, producing the largest body of new information about the past of Southwark for many years.

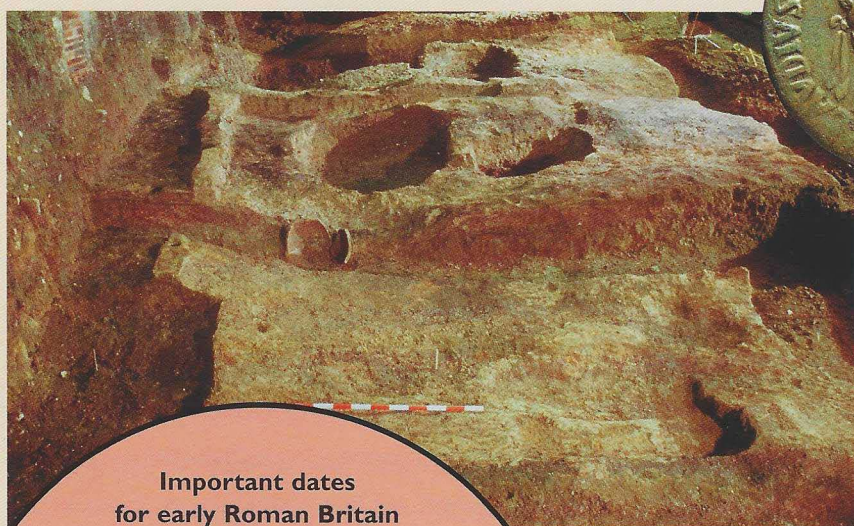


In prehistoric times, the natural ground level in the north Southwark area lay nearly ten metres (over thirty feet) below the level of the existing station concourse. The south bank of the Thames then comprised a series of low sand islands surrounded by braided channels and marshes. Whilst there is some evidence of limited prehistoric activity in the area, it was the Romans who first settled on these sand islands and it is the nearly two thousand years of continuous occupation since then that has raised the ground to its modern level.

Origins of Roman London

The generally accepted view is that Londinium was not founded in AD 43, the date of the invasion by the emperor Claudius, but in about AD 50. The extensive remains of clay-and-timber and masonry buildings dating to the period before AD 60 uncovered in the Jubilee Line Extension excavations will help to establish the precise origins and role of what has long been regarded as the poor relation of the main city north of the river.

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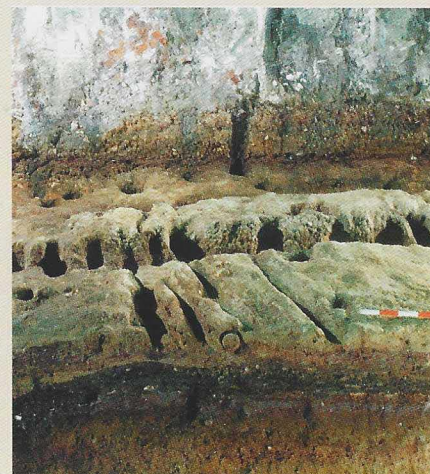
Certainly by AD 60 Southwark was a bustling settlement, and the Borough High Street excavation revealed houses made of

◀ timber and clay lining the main road that ran up to the first London Bridge. One of these houses may have been a blacksmith's workshop, judging from the hammerstone — the tiny waste metal fragments produced by beating hot metal — found there.

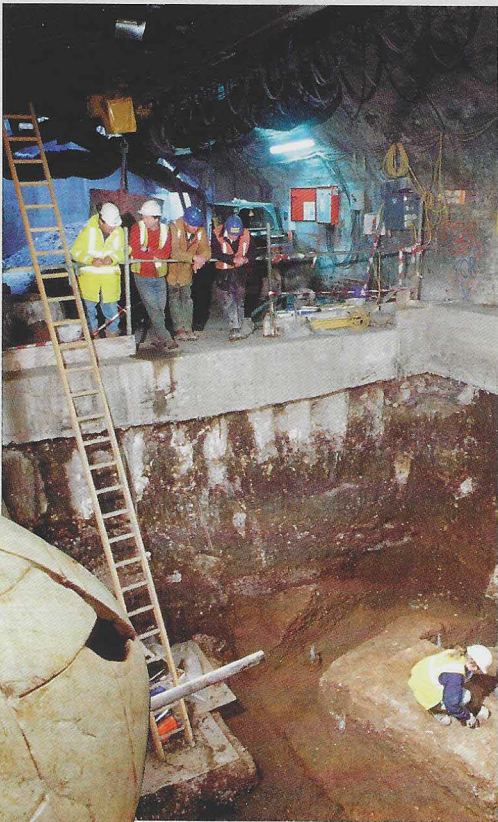
Important dates for early Roman Britain

- 55 BC Julius Caesar's first expedition
- 54 BC Julius Caesar's second expedition
- AD 43 Invasion by the Emperor Claudius
- c AD 50 Foundation of Londinium
- AD 60/61 Boudican Revolt destroys Londinium
- AD 122 Emperor Hadrian visits Britain.
Building of Hadrian's Wall started
- AD 143 Empire reaches its furthest limit with construction of Antonine Wall in Scotland
- AD 208-211 Emperor Septimius Severus bases Imperial Court in Britain
- AD 211 Emperor Septimius Severus dies in Eboracum (York)

There was already a street pattern emerging: two side roads running off the main road have been recorded, one with ruts made by carts and other vehicles (chariots?) still visible in it. ▶



Further to the east, a large masonry building was uncovered in excavations for an escalator shaft linking the Jubilee line ticket hall and the Northern line platforms. ▶ Large quantities of amphorae — Roman storage jars — were found. These amphorae have been identified as coming from many parts of the Roman empire: Spain, France and Italy itself, and suggest that this large building may have been a warehouse for storing such goods as wine, olives and figs, brought into Londinium by ship before being distributed throughout Britannia. Certainly the building is located close to the Roman waterfront to the east.



Roman amphora found under London Bridge Station

At least four rooms have been identified, one a sunken room with a concrete floor whose purpose is not yet clear.



Rare miniature Roman amphora from the 2nd century. It may have been used as a stopper or unguent jar



The Boudican rebellion

One of the most significant events in the early history of Londinium was its razing to the ground in AD 61 by Queen Boudica of the Iceni tribe, who were settled in East Anglia. After the death of King Prasutagus, who had become a client-king within the empire, the Roman provincial procurator, Decianus Catus, allowed the ancestral lands of the Iceni to be seized and his officials treated the royal family with ill-disguised rudeness and hostility. Prasutagus' widow, Boudica, objected to this treatment whereupon she was flogged and her daughters raped. Unsurprisingly this caused the Iceni to rise up in revolt and they were joined by the Trinovantes, the neighbouring tribe to the south.



After sacking Camulodunum (Colchester), Boudica marched on Londinium which was abandoned to its fate by the governor, Suetonius, in order to protect the rest of the province. The historian Tacitus described what happened:

'Undeflected by the prayers and tears of those who begged for his help, he [Suetonius] gave the signal to move, and took into his column any who could join it. Those who were unfit for war because of their sex, or too aged to go, or too fond of the place to abandon it, were butchered by the enemy. . . The Britons took no prisoners, sold no captives as slaves, and went in for none of the usual trading of war. They wasted no time in getting down to the bloody business of hanging, burning and crucifying.'



Statue of Boudica at Westminster Bridge



Recording the remains of a building destroyed in the fire

Tacitus estimated that 70,000 people died in Londinium, Camulodunum and Verulamium (St Albans) before the revolt was crushed and Boudica poisoned herself. Evidence of the revolt has long been known from the city north of the river but only inconclusive hints that the rebels crossed the river to Southwark had come to light before the Borough High Street excavation. Here, the earliest Roman buildings along the whole length of the site — some 60m — were sealed by a layer of fire debris indicating that a massive conflagration had swept along the Roman street. This layer has been dated at no earlier than AD 60 and no later than AD 70. While it is possible that there was another major fire in Southwark at the same time as the uprising of the Iceni, it is hard to avoid the obvious conclusion that Boudica was the responsible party.

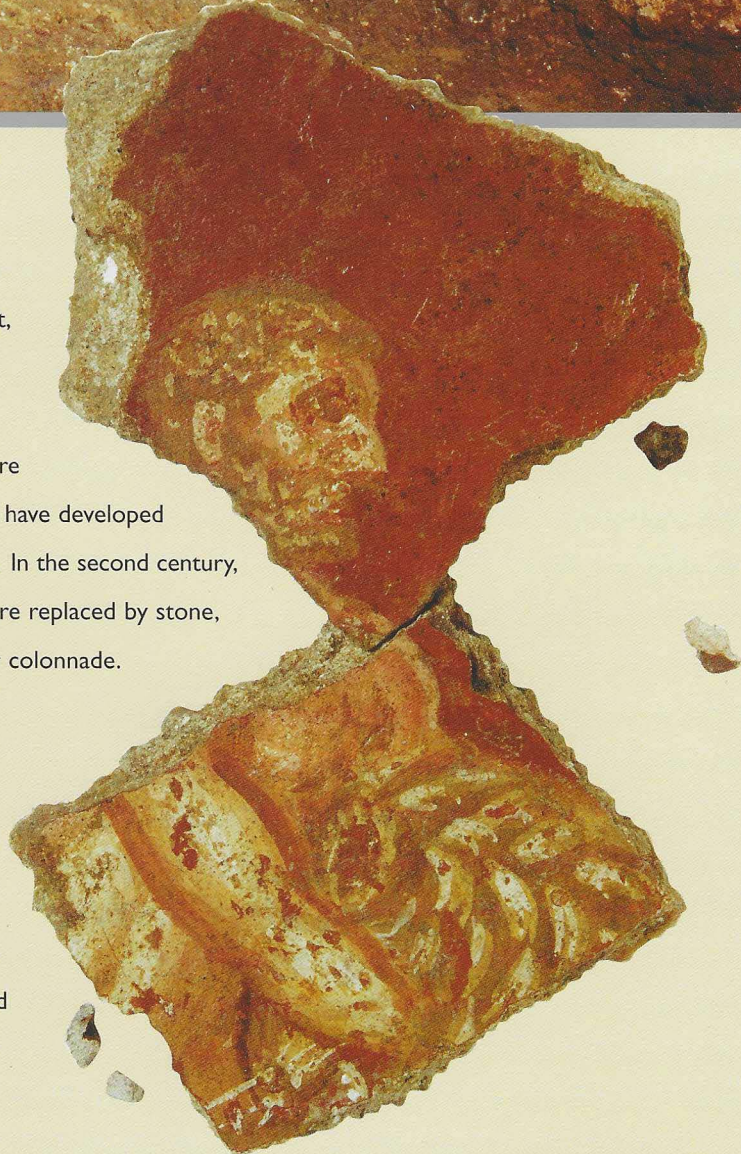
Rebuilding Roman Southwark

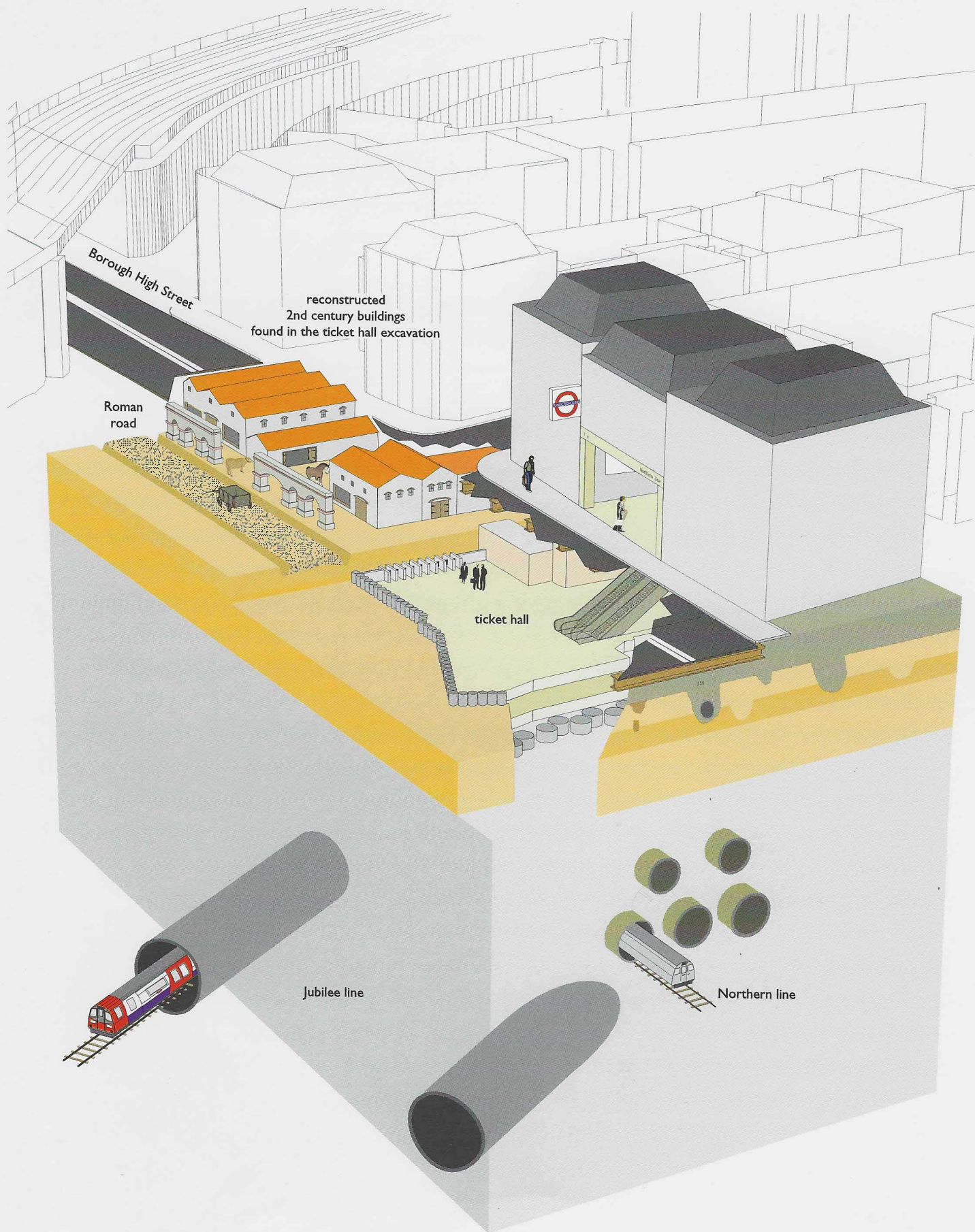


2nd century Roman building found under Borough High Street

After the fire, little time was wasted re-establishing the settlement. Some of the clay-and-timber buildings were simply rebuilt, though others were replaced by new stone structures. Intensive occupation continued alongside the main road. The side roads were relocated, and a pedestrian zone appears to have developed between the road and the building frontages. In the second century, as more of the clay-and-timber buildings were replaced by stone, this may have been covered by an arcade or colonnade.

Away from the main road larger and more prestigious masonry buildings were constructed. To the west, at the Redcross Way worksite, a large stone building was decorated with fine painted walls on which one scene showed a bearded man holding the head of a sheep, possibly a priest preparing an animal sacrifice and of mythological or religious significance. ►





Roman Southwark alongside the new Jubilee Line Extension entrance on Borough High Street



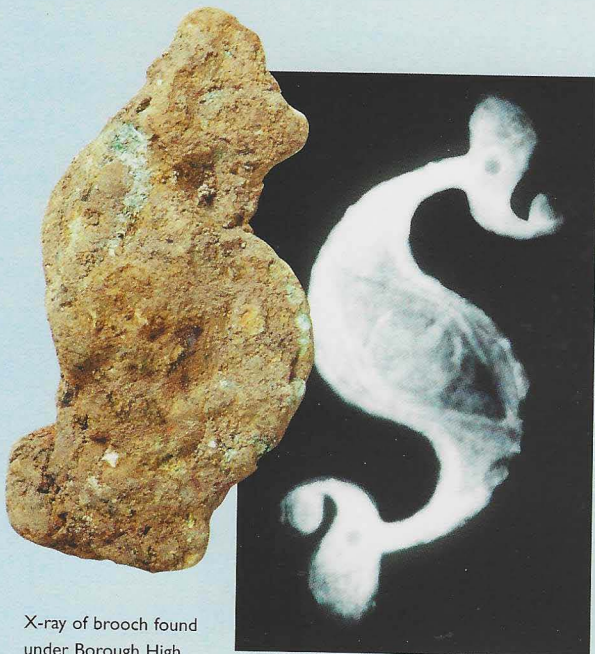
To the east, a mosaic floor uncovered underneath the railway arches would have formed part of the home of a patrician family, or an important public building. ▼

The possible warehouse building was replaced by more mundane clay-and-timber buildings, albeit ones with painted walls, perhaps suggesting that the focus of port activity had moved north of the river where new stone warehouses were built at the same time, in the later first century AD.

◀ By the end of the 2nd century, Roman Southwark occupied an area of at least 45 acres and probably had a population of at least three thousand. The settlement occupied the two main sand islands in the area and stretched as far south as the present Borough underground station. This is close to where Watling Street and Stane Street met and formed the single thoroughfare that ran along the line of Borough High Street to the Roman London Bridge. These were the two main Roman roads from the south coast, from Dubris (Dover) and from Noviomagus Regnorum (Chichester).



Everyday life in Roman Southwark



X-ray of brooch found under Borough High Street

Borough High Street Bakers

One building along the line of the road produced several large assemblages of charred cereal grain, with a small quantity of chaff and weed seeds. Large quantities are unusual, and suggest that large amounts of grain were being stored in this building before it burnt down. The cereals involved were wheat and barley. A quern stone was also found, and it seems possible that the grain was stored for use in the building, and it may have been a baker's shop. Alternatively, the grain could have been processed here before being sold as clean grain or flour. ▶



A high quality Roman pottery cup from the Borough High Street excavation. This type of pottery is called Samian ware, imported from Gaul (France)

The Jubilee line excavations have produced a wealth of information and artefacts that tell us about how the Romans lived. Crossing the Thames from the north, a traveller would have come across a bustling high street with shops lining the road.

Tiny droplets of metal indicate where a blacksmith had been shoeing horses and making metal objects for sale in his forge.

Hundreds of tiny charred grains of wheat fallen between the wooden floorboards of a house show where a baker had worked.

Large pits full of unwanted bone point to the presence of a butchers shop.

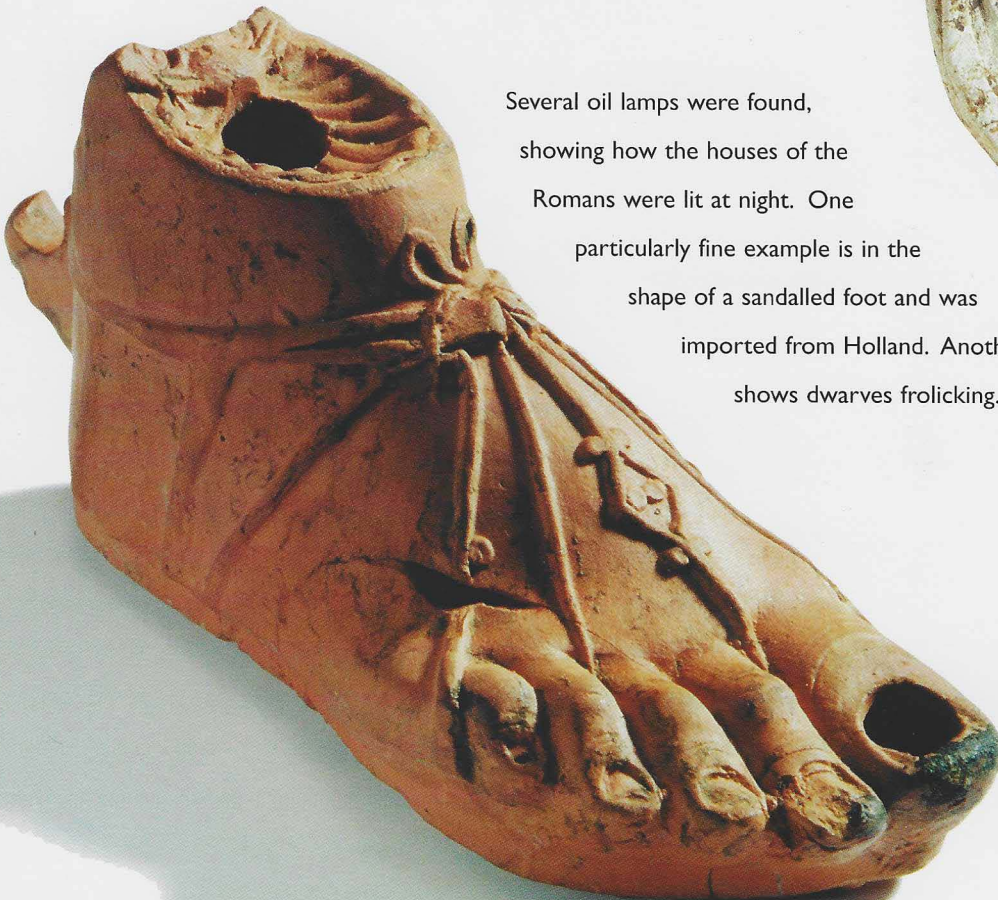
A series of masonry pier bases represent the foundations for a fine stone arcade under which shoppers would have strolled.



Large quantities of glass from bottles, bowls and beakers were found along with two gaming tokens. Fragments of armour and horse fittings attest to the presence of the military in Southwark, though to what extent is not yet clear.



Several oil lamps were found, showing how the houses of the Romans were lit at night. One particularly fine example is in the shape of a sandalled foot and was imported from Holland. Another shows dwarves frolicking.





Many fragments of brooches, worn by both men and women, were found as well as several bone hairpins. Two beads from a necklace were also recovered, as well as this bone handle for a knife.



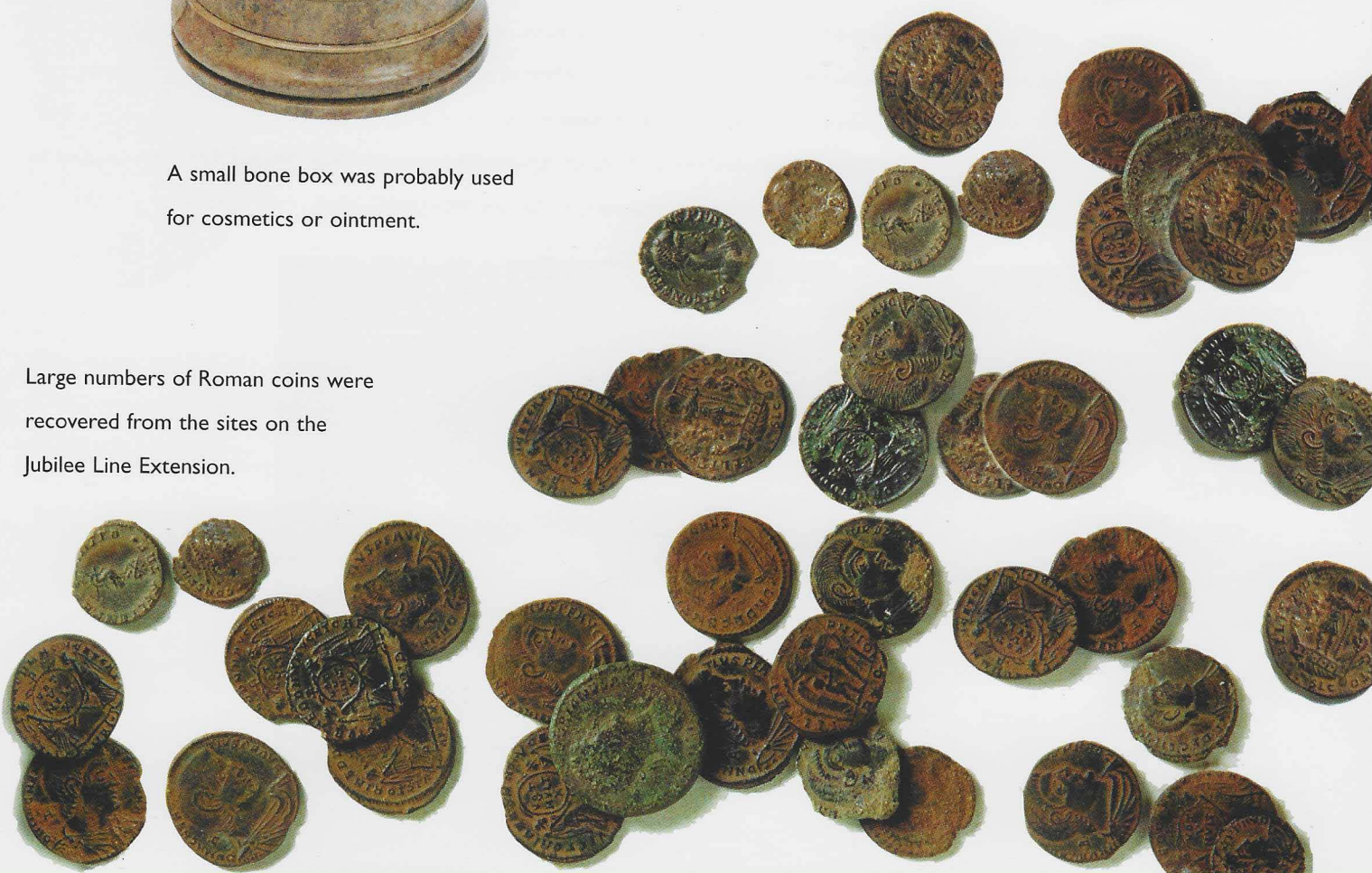
Stamp of Mercator, a 2nd century potter from Gaul



A small bone box was probably used for cosmetics or ointment.

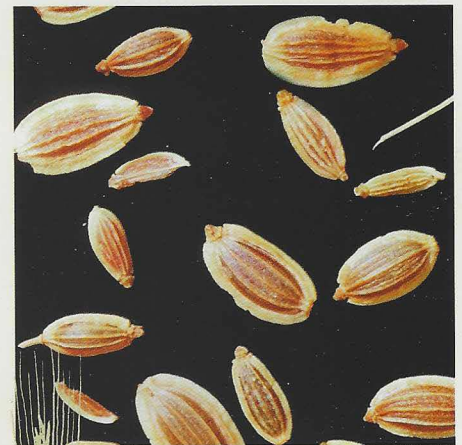
The pottery that has been found will show what the citizens ate off, drank from and cooked in, and sometimes it will even be possible to say who made the dishes as the Roman potters often stamped a maker's mark on their wares.

Large numbers of Roman coins were recovered from the sites on the Jubilee Line Extension.





Large quantities of animal bone were found which will yield information on what the Roman diet was like. It appears that cattle, sheep and pigs were the most common sources of meat, though one building produced deer bones which were a rarity and an indication of high status. The seeds of the plants that have been recovered will also tell us a lot — wheat was plentiful and barley was also present.



Borough High Street butcher's shop

A very large quantity of animal bones was recovered from a sequence of 1st to 4th-century buildings and structures. The evidence suggests a possible use for one of these buildings. Concentrated amounts of cattle bones were found in dump deposits situated both within and adjacent to this structure. In one of these dumps the cattle bones were almost entirely composed of skull and lower limb parts, while in each of the remaining dumps the assemblages are composed of heavily butchered upper limb fragments. Thus there is clear evidence for the major division of the carcass into the meat-rich and meat-poor parts, as well as consistent evidence for the efficient removal of meat (mainly using the cleaver) from the meat-rich parts. From this evidence it can be assumed that this building was very likely a butcher's shop, where animals were (probably) killed and jointed, and the meat sold.

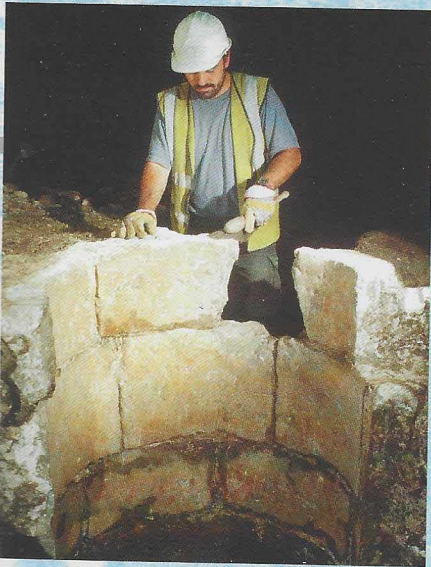
All these finds give an insight into the daily life of Roman Southwark, while the Jubilee line sites that revealed Roman graves will provide information about Roman funerary practices. Analysis of the bones will enable the age at death to be determined, as well as the sex of individual skeletons. Certain diseases affect the bones, so that it may be possible to determine the cause of death. These graves all belong to the later Roman period, when the settlement appears to have contracted. Areas that once used to be occupied by buildings were now used for burials.



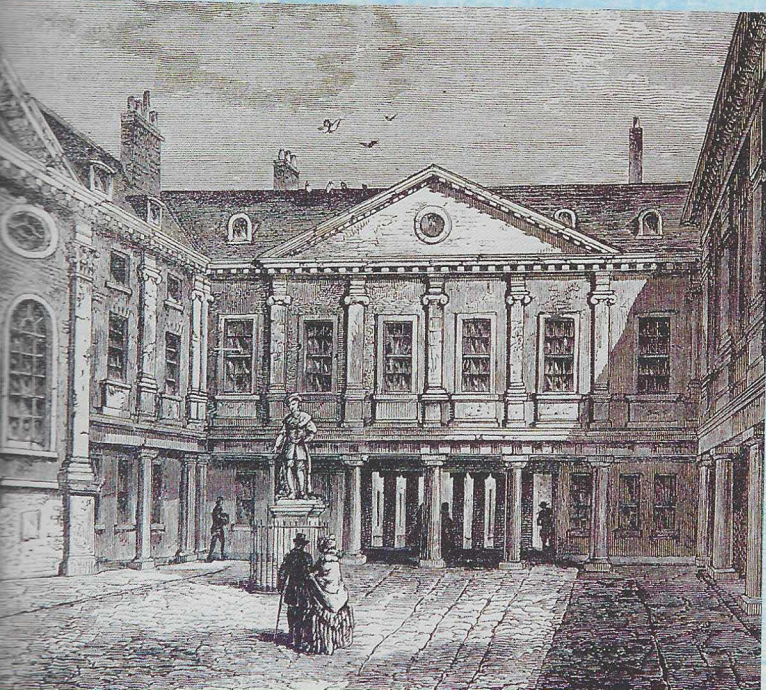
St Thomas's Hospital

London Bridge station occupies the site of the old St Thomas's Hospital, which was demolished in the 1850s to make way for the railway, except for the south range which is now occupied by the Post Office. The hospital moved to its current location on the south bank opposite the Houses of Parliament. The original hospital was founded in the 1170s as part of the priory of St Mary Overy, whose church was the predecessor of Southwark cathedral. The hospital moved to the east side of Borough High Street after a fire in the 13th century.

Unfortunately, most of the old hospital remains were destroyed in the 1850s, but the Jubilee line excavations at London Bridge station have revealed some information about both the hospital and other medieval and later buildings that surrounded it. A fine 17th-century stone well ▼ found in the Borough High Street excavation may have stood in front of the main gates of the hospital, and was perhaps provided for the public. Underpinning works on London Bridge Street revealed a medieval masonry wall and post-medieval brick walls and floors that were certainly part of the hospital complex but still need further analysis to determine their function within the hospital precinct.



St Thomas's Hospital courtyard in 1840



Several post-medieval skeletons from a ventilation shaft just off Joiner Street may have been part of a cemetery attached to the hospital for those patients who did not recover.

Nearer Tooley Street remains have been found of what was probably the London town house of the Prior of Lewes in Sussex. Many senior clergymen and religious houses owned imposing properties in London as bases for the politicking that was as much a part of the medieval church as religion. William fitzStephen, writing in the 12th century, noted that:

'Almost all bishops, abbots and magnates of England had lordly habitations whither they repair and wherein they make lavish outlay, when summoned to the City ... to councils and great assemblies'

▲ When the railway was built a fine vaulted stone undercroft was revealed very close to these remains and would have been part of the same town house.

Alehouses and Taverns

East of Joiner Street foundations were recorded of what may have been the Crown Brewhouse, one of the many taverns for which Southwark was famous. Borough High Street was described in the seventeenth century as 'a continued ale house with not a shop to be seen.' On London Bridge Street the stableyard of the Swan with Two Necks Inn was uncovered.



Early 15th-century
Canterbury souvenir badge

The excavations on Borough High Street revealed the foundations and brick cellars of a series of these premises including the Bull Tavern, the Peacock, which was owned in 1329 by Ralph le Brewer, and the Ostrich Feather. Chaucer's famous Tabard Inn, from which the Pilgrims set out for Canterbury, lay further to the south along the High Street.

Southwark's popularity stemmed from its position on the south side of London Bridge, so that those arriving at London late at night, or wishing to leave early in the morning, could do so when the main gates of the City north of the river were shut.



View towards London Bridge in the 19th century

- Inn** – a place to lodge travellers and their horses
- Tavern** – a drinking house that sold wine
- Alehouse** – a small drinking house that sold ale and beer but not wine
- Brewhouse** – a large establishment that brewed its own beer
- Victuallers** – cross between a butcher and grocer
- Tipler** – a person who ran an alehouse



Records do indicate other occupations along Borough High Street, though one tenement whose foundations were uncovered was owned in 1555 by Alexander Gray, a girdler and doublet maker. Among his lodgers that year were the Widow Knyghtlye, a bakeress, and 'Mother' Bowtye, a tippler.

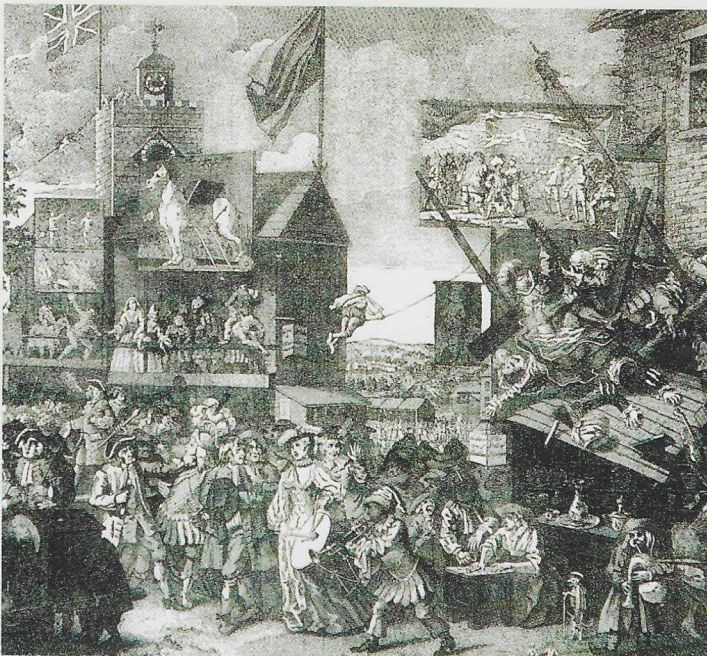
St Saviours Burial Ground, Redcross Way

The Jubilee Line Extension worksite at Redcross Way was located above a large post-medieval cemetery. The MoLAS excavation concentrated on an area where an electricity sub-station was to be located to supply power for the new line. One hundred and sixty skeletons were removed from the burial ground and are currently being studied prior to re-burial. A few of the burials were still clothed and the coffins usually survived as well. Study of these skeletons will provide invaluable information about the poorer part of Southwark's population in the 19th century.

The exact date for the first interment in the burial ground is uncertain, but the early to middle 17th century seems probable. The site appears not to have been consecrated. One alleged reason for this is that the land was held leasehold from the bishop of Winchester and by custom only freehold land could be consecrated. Another was put forward in *The Annals of St Mary Overy*: 'The women inhabiting these houses are said not to have been allowed Christian burial unless reconciled to the church before their death and there is an unconsecrated burial ground known as the Cross Bones at the corner of Redcross Street, formerly called the Single Woman's burial ground, which is said to have been used for this purpose.'



These women were the prostitutes who lived in the 'stews' (brothels) of Bankside, and for that reason the graveyard was allegedly placed far from the parish church itself. However there is no evidence that this was a graveyard either solely, or even at all, for prostitutes, but it was certainly used for the burial of paupers and rapidly became 'crowded to excess'. In 1791 St Saviour's wished to move its charity school to the site from Montague Close, near to the Cathedral, but the proposal provoked controversy on the grounds that the works would disturb the graves of relatives and friends of local people. On further investigation it was also discovered that the ground was never consecrated.



Walker in his 1839 *Gatherings from Graveyards* states that 'The poor ground, called "Cross Bones", in Red Cross Street, Union Street, Borough, also belongs to this parish. The greater portion of this ground has not been opened for some time past, in consequence of its very crowded state; the remaining part, however, is still used for interments, many of the poor Irish are buried in it. Two charity schools, one for boys and the other for girls, are built at the west end, in Union Street, the back parts of which run into this ground.'

The burial ground was closed by an order in council in 1853 and passed out of ecclesiastical control in 1862.

Stratford

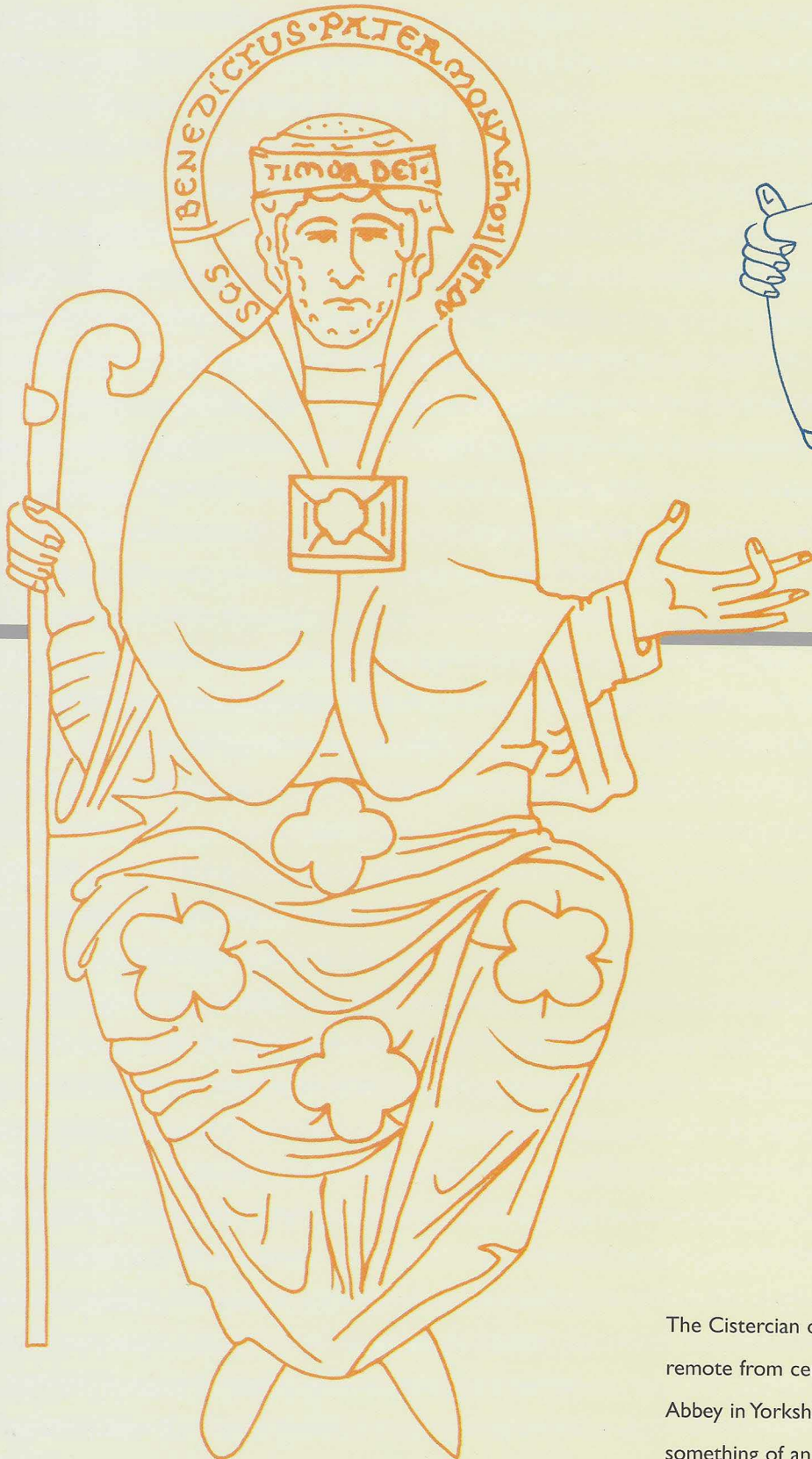
The Jubilee Line Extension will end at the new Stratford station and a depot for the trains is located nearby. Excavations on these works were carried out by both the Newham Museum Service and the Oxford Archaeological Unit between 1991 and 1994.

The topography of Stratford comprised low gravel islands surrounded by marsh. It lay on the route of the main Roman road running east from London to Chelmsford and Colchester. The excavations revealed evidence of prehistoric activity on the site, most notably an Iron Age settlement, including two horse burials which may be evidence of sacrificial rites. The remains of a Roman farm were also found, presumably located close to the main road, though no trace of that was discovered.

Stratford itself is not recorded until the second half of the 11th century, after the Norman Conquest, and gained in importance in the following century after Queen Matilda built one bridge over the River Lea at Bow, and another over its tributary the Channelsea at Stratford. She also raised the road above the marshes on a causeway along what is now Stratford High Street. However it was the founding of the great Cistercian abbey of St Mary Stratford Langthorne that put Stratford on the map.

Stratford Langthorne Abbey

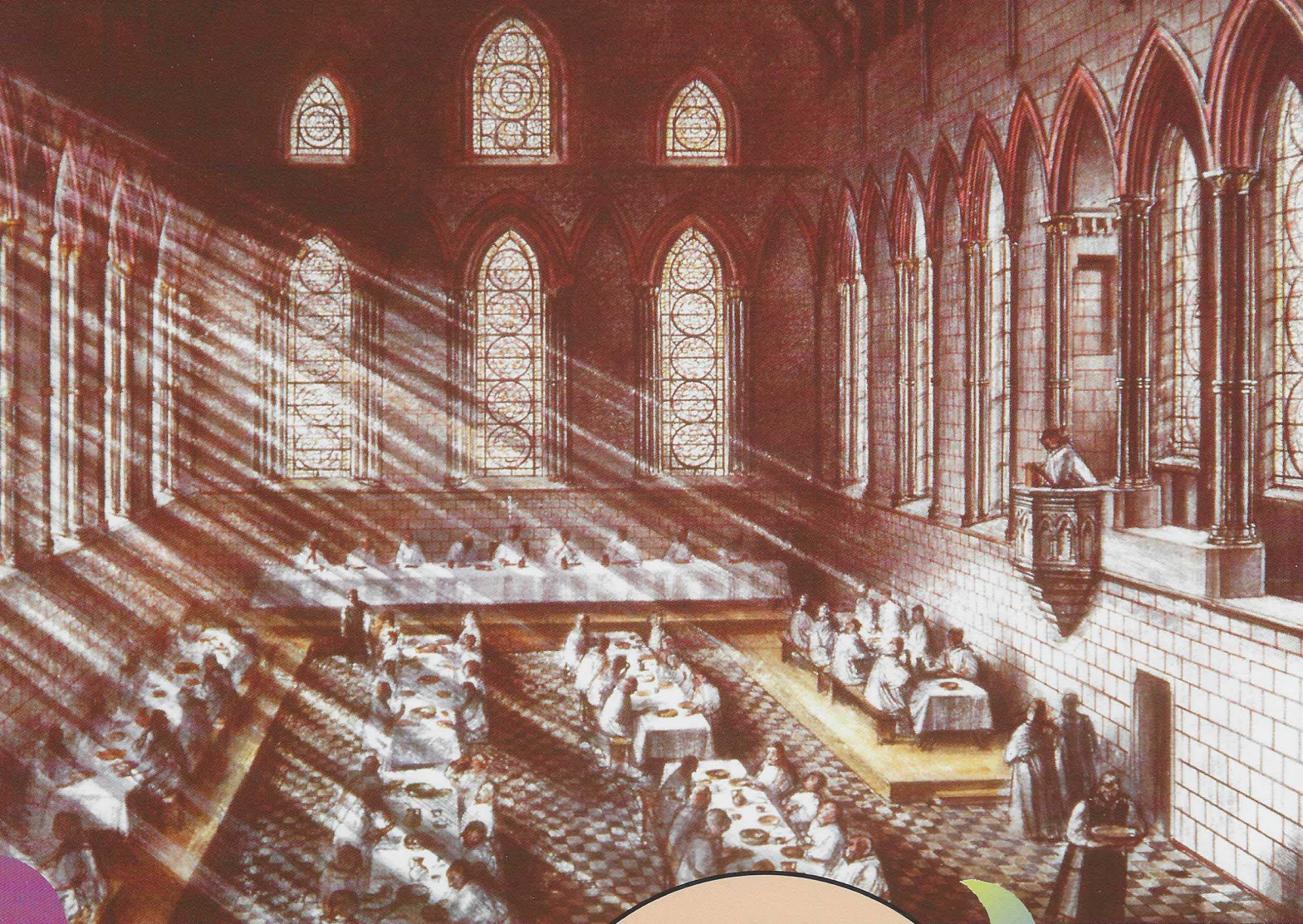
The abbey was founded in 1135 by William de Montfichet as a house of the French Savignacs. The Savignacs were a religious order dedicated to restoring the rule of St Benedict to its original simplicity, and in 1147 submitted to the Cistercians who shared their ideals.



St Benedict who lived in the 6th century



The Cistercian order generally chose isolated locations remote from centres of population, such as Fountains Abbey in Yorkshire. Stratford Langthorne was something of an exception in this respect in view of its proximity to London, but conformed to normal Cistercian practice in its dedication to the Virgin.



The rule of St Benedict divided the day into eight offices, or services; matins, which took place at night and the other seven, lauds, prime, terce, sext, none, vespers and compline, day-time offices. Thus much of the day was spent in the abbey church in formal acts of worship, and on feast days there was little time for anything else. The Cistercians reacted against this formality and ostentatious displays of wealth of the kind seen in richly decorated vestments, and jewel-studded chalices and candlesticks. They amended the daily timetable to allow greater time for study and private prayer so as to enhance the individual's personal spiritual journey through life.

The offices of the day

Matins – the night office. Originally 2 am

Lauds – the first of the canonical hours.

Morning prayer

Prime – the first hour of the day. Sunrise

Terce – the third hour of the day. About 9 am

Sext – the sixth hour of the day. About 12 noon

Nones – the ninth hour of the day. About 3pm

Vespers – the sixth of the canonical hours.

Evensong

Compline – the last of the canonical hours. Bedtime

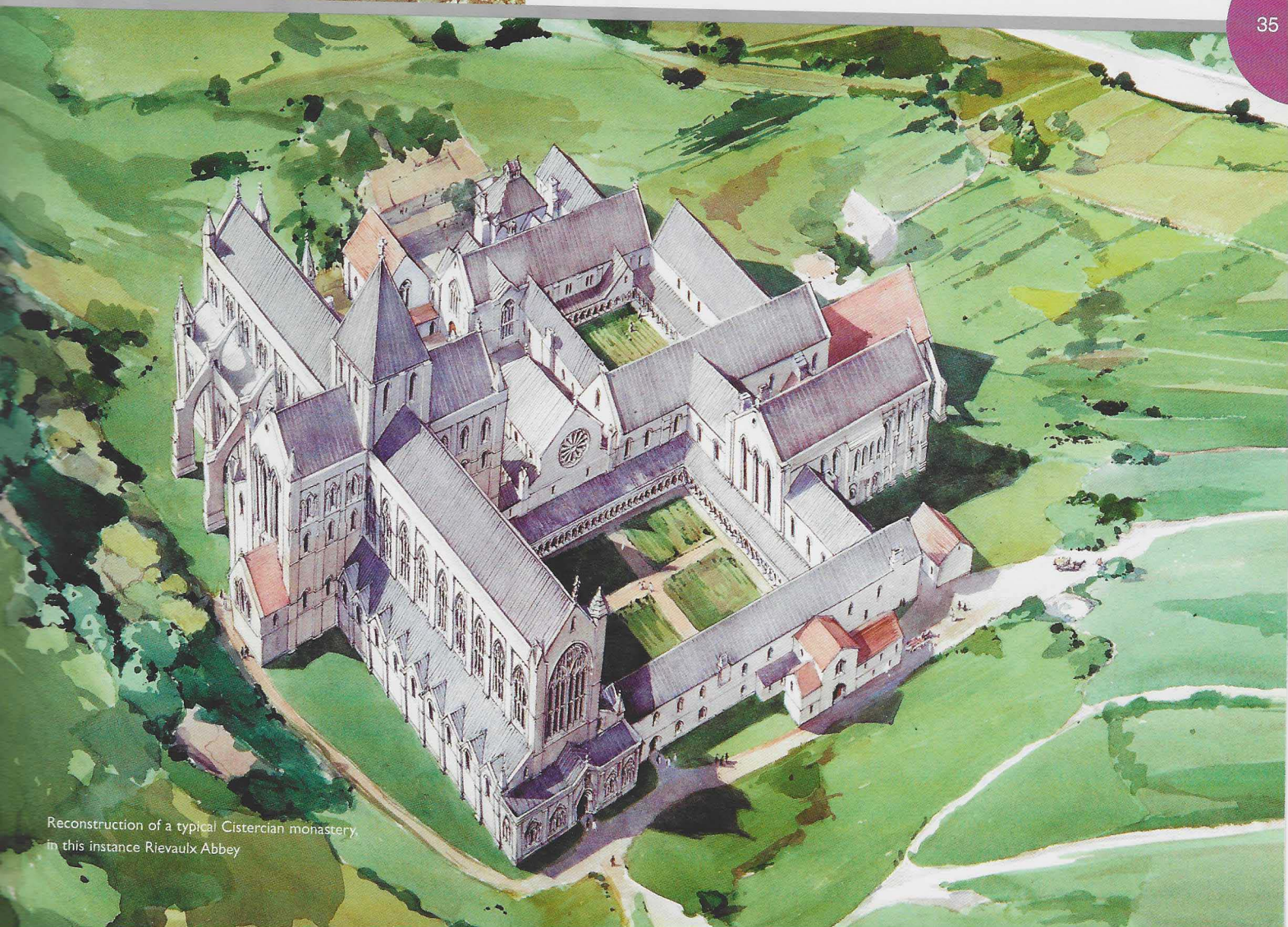
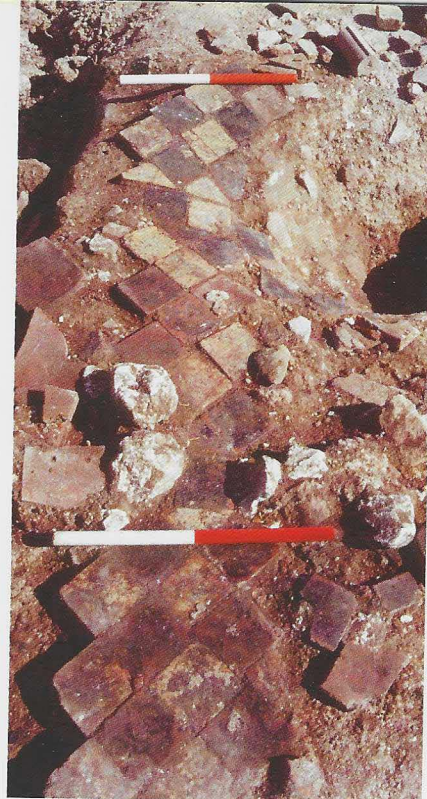
However the success of this return to simplicity inevitably resulted in the accumulation of great wealth as rich benefactors left large sums of money to the order. Stratford Langthorne became one of the richest houses of the Cistercian order, occupying twenty acres of land that were granted after the conquest of 1066 to Robert Gernon, a Norman knight and grandfather of the abbey's founder, William de Montfichet.

The monastery at Stratford

The Jubilee Line Extension excavations at Stratford revealed large stretches of the monastic precinct. The east end of the later stone-built abbey church was uncovered. Inside the church was a series of mortar and chalk floors, and occasionally small areas of patterned

tilled floor survived. ▶ Several separate chapels within the church were identified.

However a monastery was not just a church but a community, and the remains of many of the buildings associated with the life of the community were excavated as well. These included the infirmary, where the monks were treated when sick, and the cloister which consisted of a central open garden surrounded by a covered walkway around which the monks processed. A long stretch of the abbey's great drain was also uncovered. ◀



Reconstruction of a typical Cistercian monastery, in this instance Rievaulx Abbey

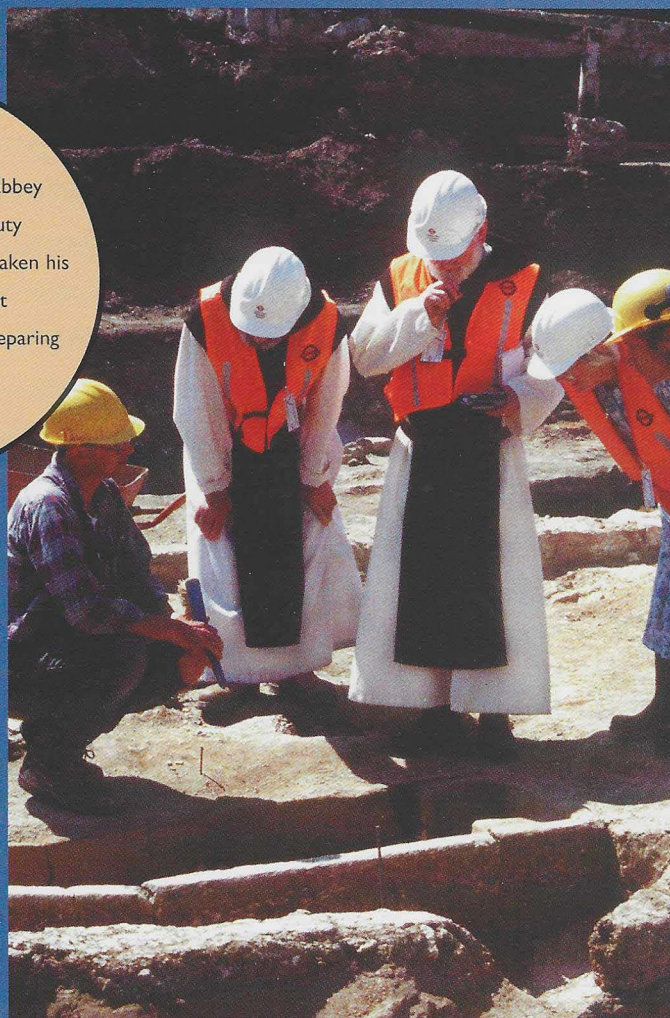
Abbot – the head of the abbey

Prior – the abbot's deputy

Brother – a monk who has taken his vows but is not a priest

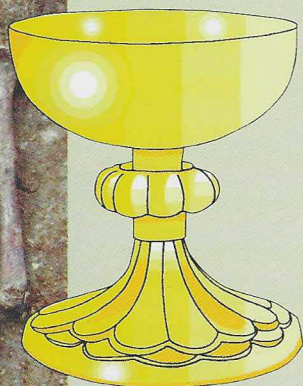
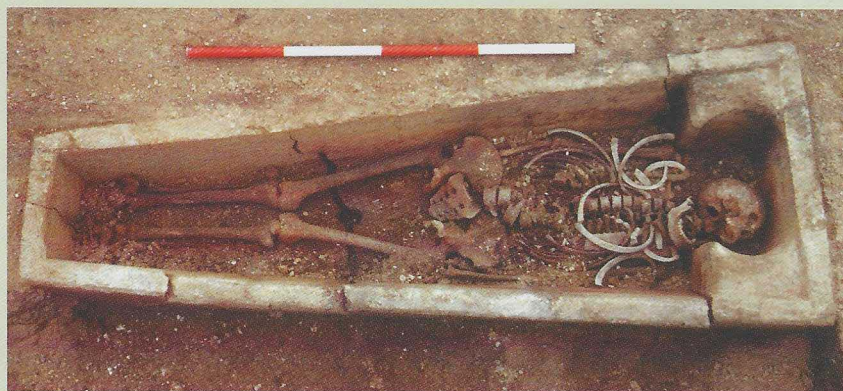
Novice – a monk who is preparing to taken his vows

Cistercians of the Strict Observance (from Mount St Bernard Abbey, Leicestershire) return to Stratford Langthorne Abbey after a 450 year absence



Inside the church several graves were found. Burial here was an honour usually reserved for important benefactors of the abbey and their families. The burial of a child only about nineteen months old was probably from such a family. Burials were generally simple affairs in wooden coffins, but two were of a particularly high status. The first, located in the north transept, was in a stone coffin (below), and the second consisted of a wooden coffin placed in a stone cyst with iron furniture also deposited in it. Stone coffins in particular were beyond the means of most families. It is known that Humphrey de Bohun, earl of Hereford and Essex, was buried in the abbey in 1336, and in 1392 daily masses were said for William de Tetlynghbury who was buried by the altar of the Holy Cross.

The members of the community themselves were not buried in the church. The abbot and other leading officials would be buried in the chapter house or cloister walk. The other monks had their own cemetery to the east of the church, while a further graveyard was set aside for ordinary lay people who did not qualify for burial in the church.



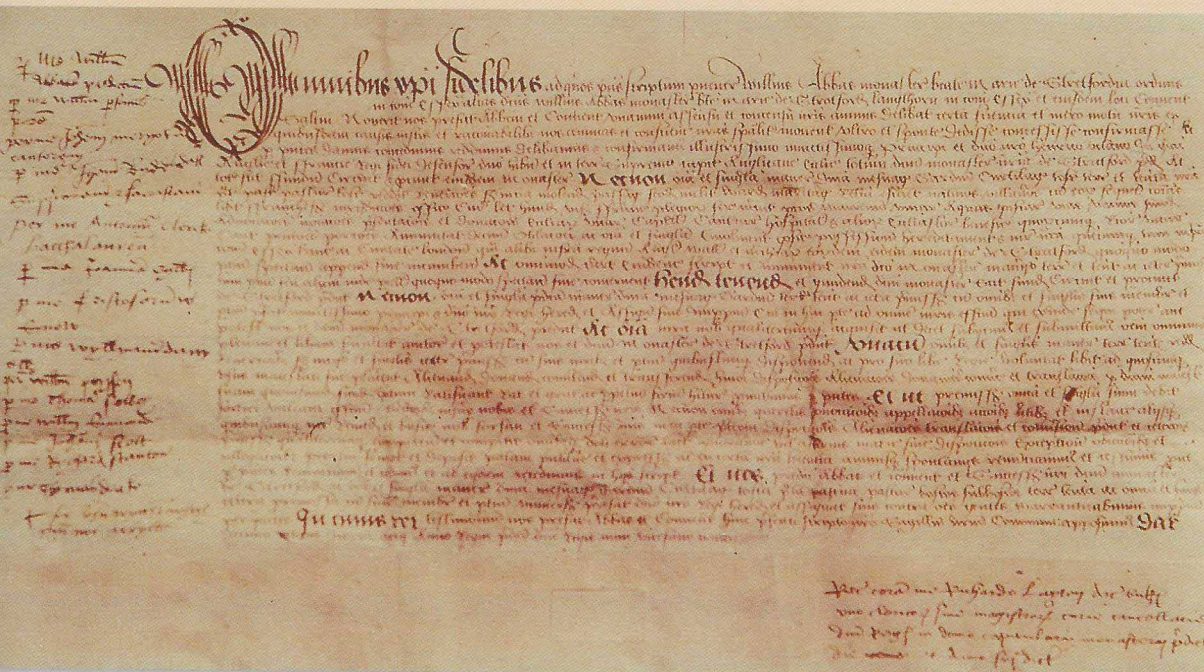
A total of 683 skeletons were excavated, including many from an area that probably formed part of the monks' graveyard. These discoveries will provide a virtually unrivalled opportunity for studying the inhabitants of the monastery throughout its life. Most of the monks were buried in simple shrouds, though there were a few wooden caskets and two high-status lead coffins. ◀ Two of the monks were buried with chalices and one with a patten, the small plate used at communion, indicating that they were also priests. Other burials from the lay community's cemetery were also recorded.

The Dissolution and afterwards

The life of St Mary's Stratford Langthorne as a monastic community ended on 29 March 1538 when it was closed as part of Henry VIII's dissolution of the monasteries. The last abbot was William Huddlestone, elected in 1524. The dissolution was not caused simply by Henry's quarrel with the Pope over his divorce from Katherine of Aragon, but was part of a wider rejection of Catholicism and foreign interference.

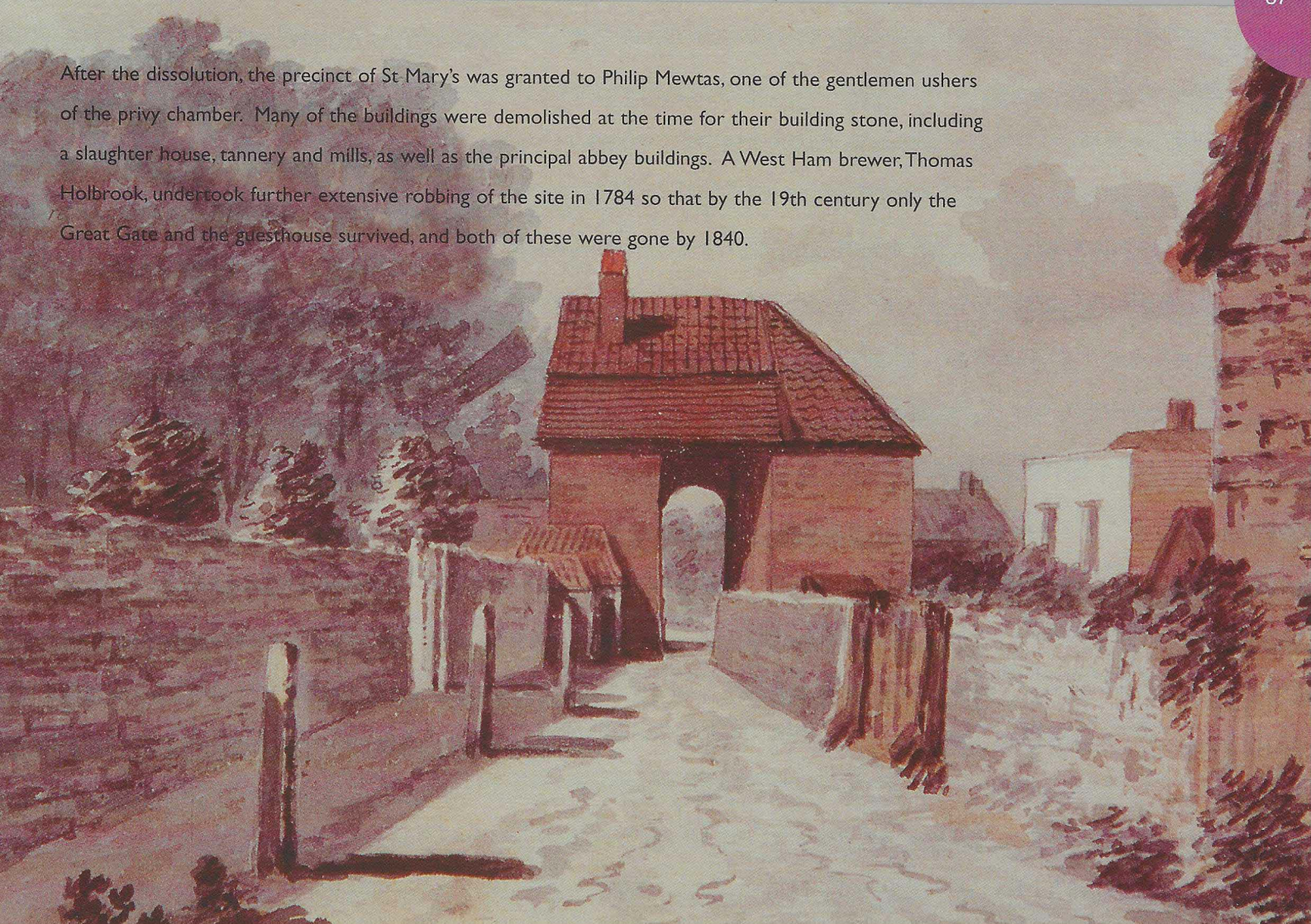
Moreover, Henry's chief minister, Thomas Cromwell, had his eyes on the great wealth of the monasteries,

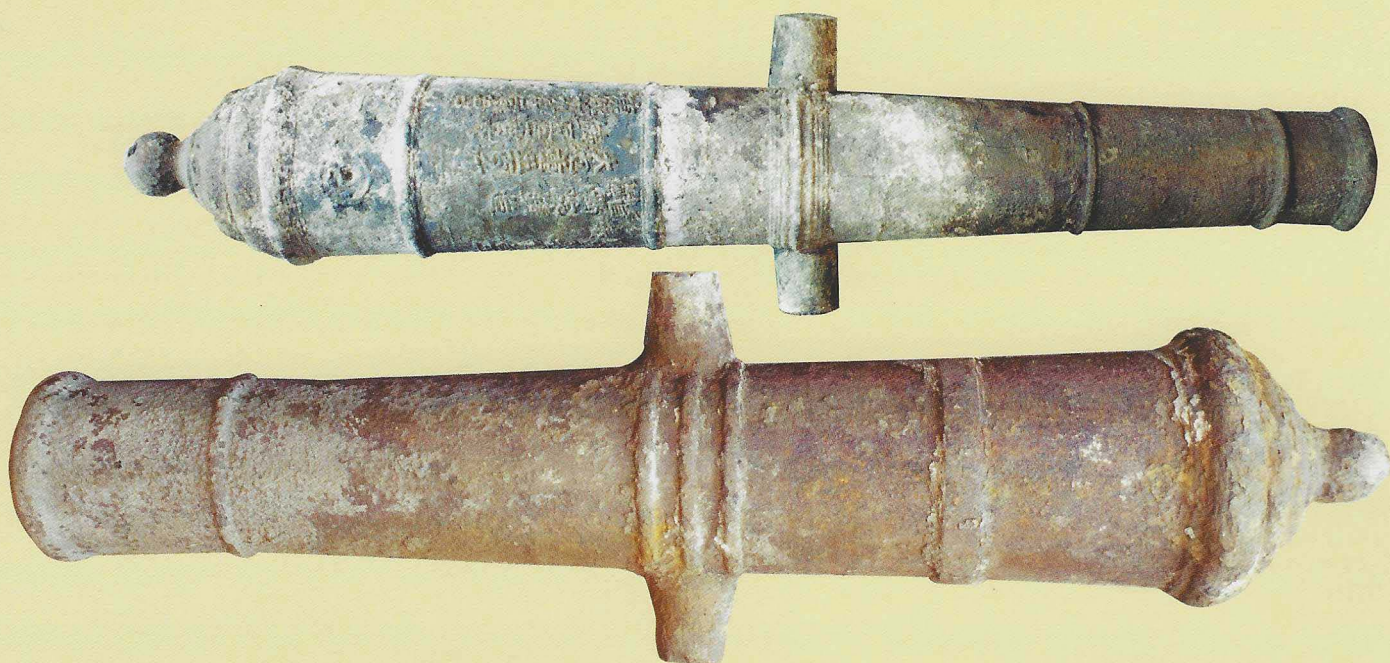
and the poor standards of behaviour of some of them gave him an opportunity to act against them.



The deed by which the buildings and property of the Abbey were surrendered after 400 years

After the dissolution, the precinct of St Mary's was granted to Philip Mewtas, one of the gentlemen ushers of the privy chamber. Many of the buildings were demolished at the time for their building stone, including a slaughter house, tannery and mills, as well as the principal abbey buildings. A West Ham brewer, Thomas Holbrook, undertook further extensive robbing of the site in 1784 so that by the 19th century only the Great Gate and the guesthouse survived, and both of these were gone by 1840.





One spectacular find was of a Chinese cannon from the 17th century. How it ended up in Stratford is a mystery. It may have been booty or ship's ballast, or for melting down. The inscription reads:

'The provincial officer of Guangdong, under [the order of] The Governor General and Provincial Governor, cast great cannon, weight 500 jin, [1 jin = 1-1.3 lbs] the caster Lu Qi-you, Kangxi 19th [29th?] year, 2nd month auspicious day.'

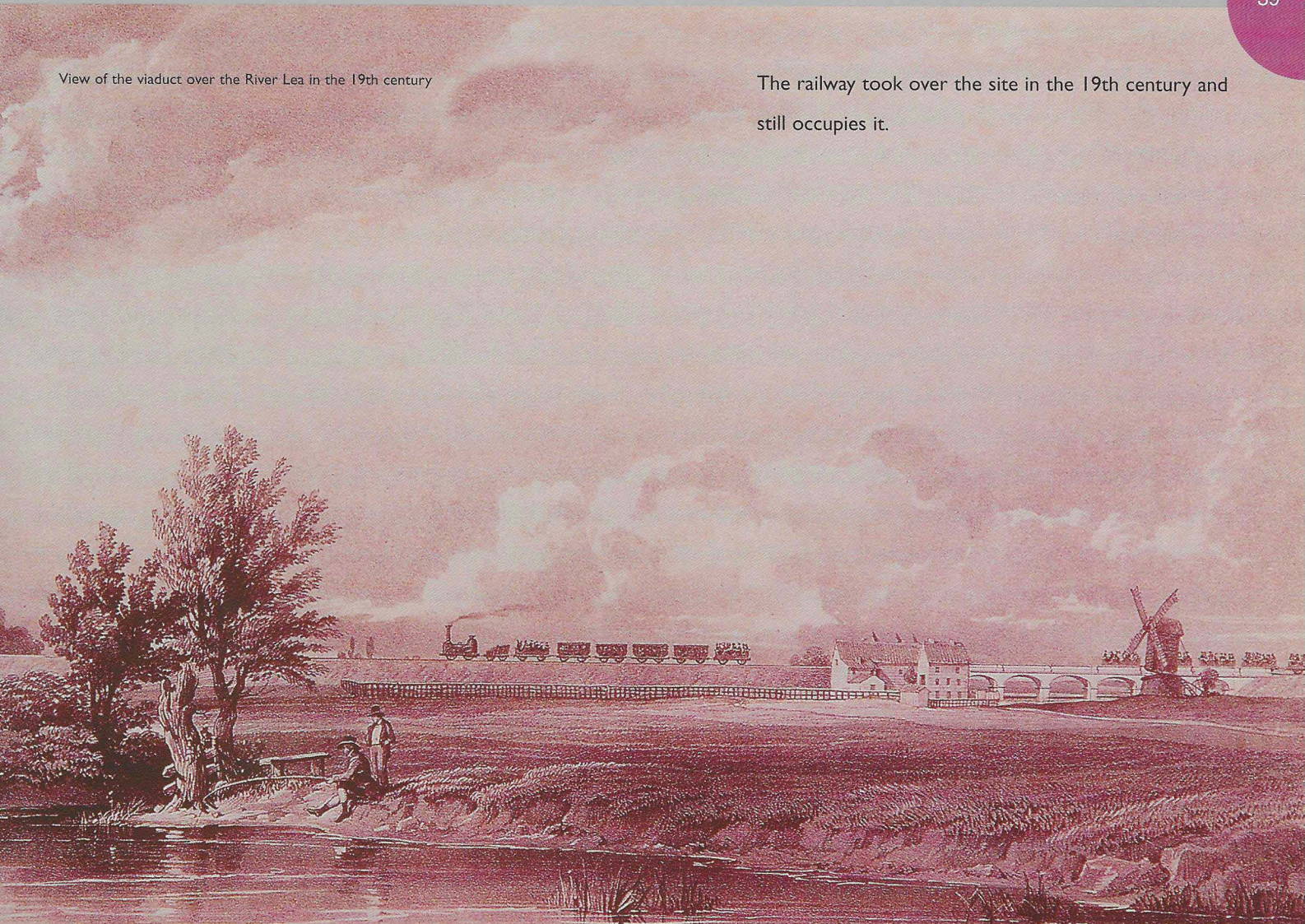
The emperor Kangxi reigned from 1662 to 1722 so his nineteenth year would be 1680; the twenty-ninth would be 1690.

廣東都使司王
泰
撫院鑄造
大炮重五百斤
鑄匠呂德茂
康熙十九年二月吉日



As London expanded, industry was attracted to the Stratford area and the site was used for calico, and later silk, printing. Remains of the West Ham Abbey print works were uncovered in the excavations and included tanks stained with the dye used in the process. The Carpenters' Company also owned land at Stratford; their guild was established around 1271 and its purpose was to control those aspects of the building industry in London in which carpenters were involved, as well as being a religious, social and charitable association. The Company bought 63 acres of land at Stratford in 1769 and regularly added to it over the next century, in the latter part of which it built houses there. During the archaeological investigation at Stratford Station a stone bearing the Company's coat of arms was uncovered, one of four which marked the corners of its estate. ◀

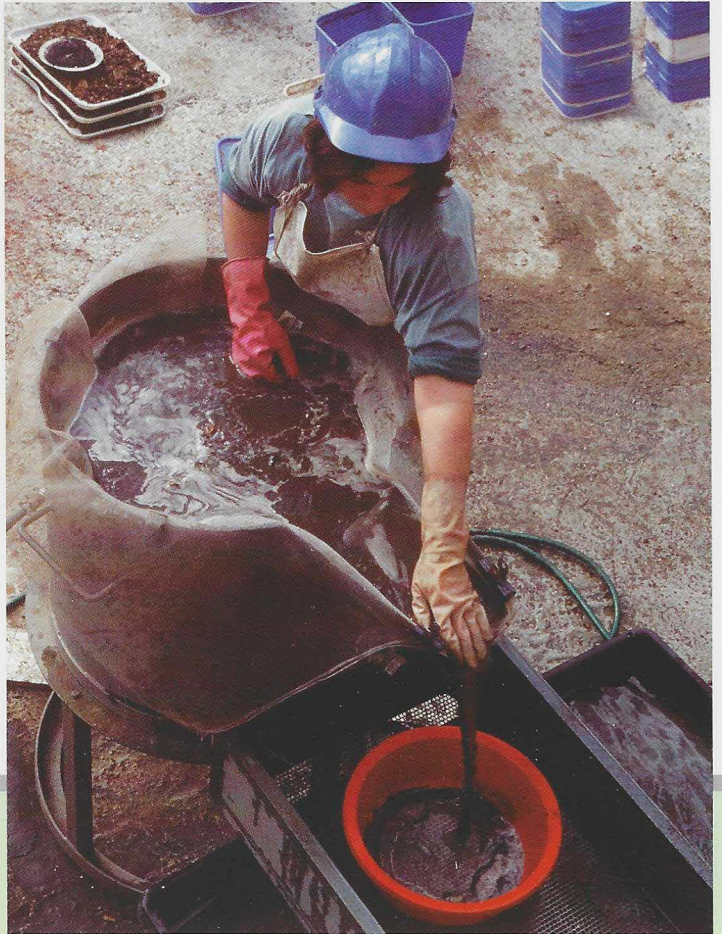
View of the viaduct over the River Lea in the 19th century



The railway took over the site in the 19th century and still occupies it.

Jubilee Line Extension Palaeoenvironmental Project

The idea behind the Palaeoenvironmental Research Project is to look at the history of the River Thames over the last ten thousand years. Following the end of the last Ice Age, about ten thousand years ago, the glaciers that covered much of northern Europe melted, discharging enormous quantities of water into the rivers and oceans. This had a huge effect on the Thames, which, being tidal, was affected by the sea and the rivers that drain into the upper Thames Valley. Consequently, the people living in the Thames valley since the Mesolithic period were affected by rising water levels and the expansion of the river across the floodplain, as well as an improving climate.



By studying the changes to the river which have taken place along the route of the Jubilee Line Extension, we are establishing

exactly what took place, and how this affected the environment and the population. A record of these changes is left in the sediments which have been deposited by the river. These are found on archaeological

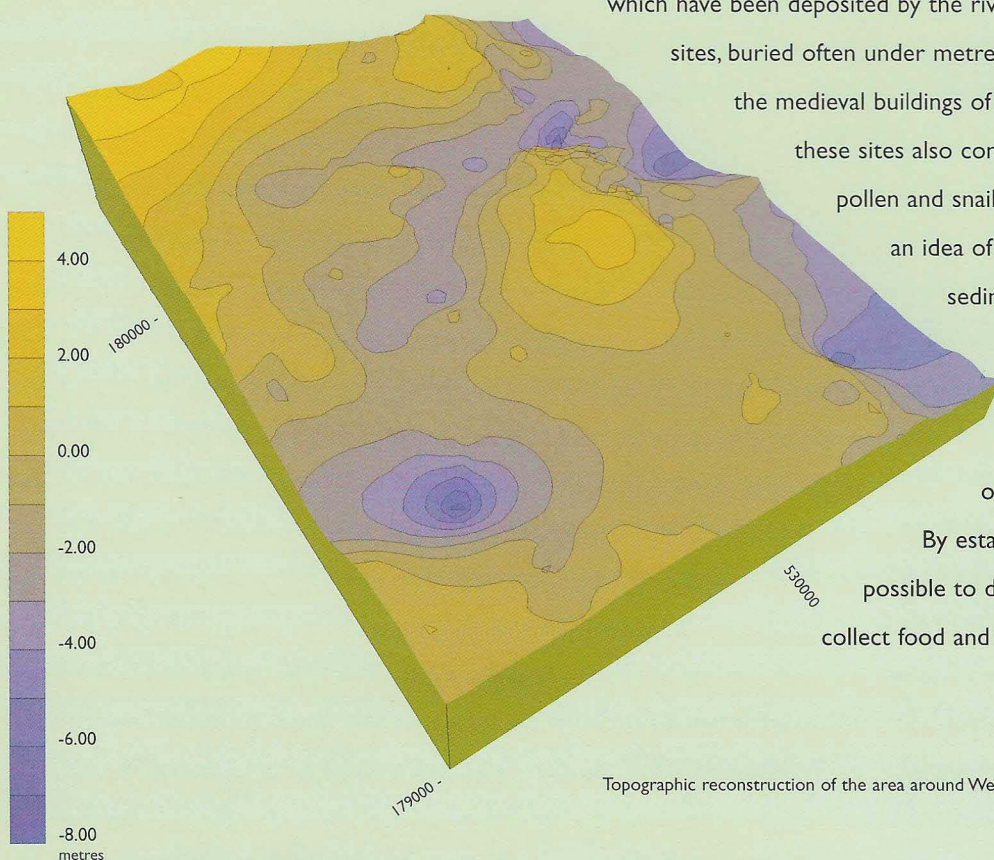
sites, buried often under metres of later archaeological deposits, such as the medieval buildings of Westminster. The sediments found on

these sites also contain plant and animal remains, such as pollen and snail shells. These are being examined to gain

an idea of the local environment at the time the sediments were laid down. This information can

be used to reconstruct the landscape in the different areas being studied, for instance, the type of vegetation on the foreshore and adjacent land.

By establishing where the dry land was, it is possible to define where people could live and collect food and other material, such as building timber.



Topographic reconstruction of the area around Westminster

Recovery of samples

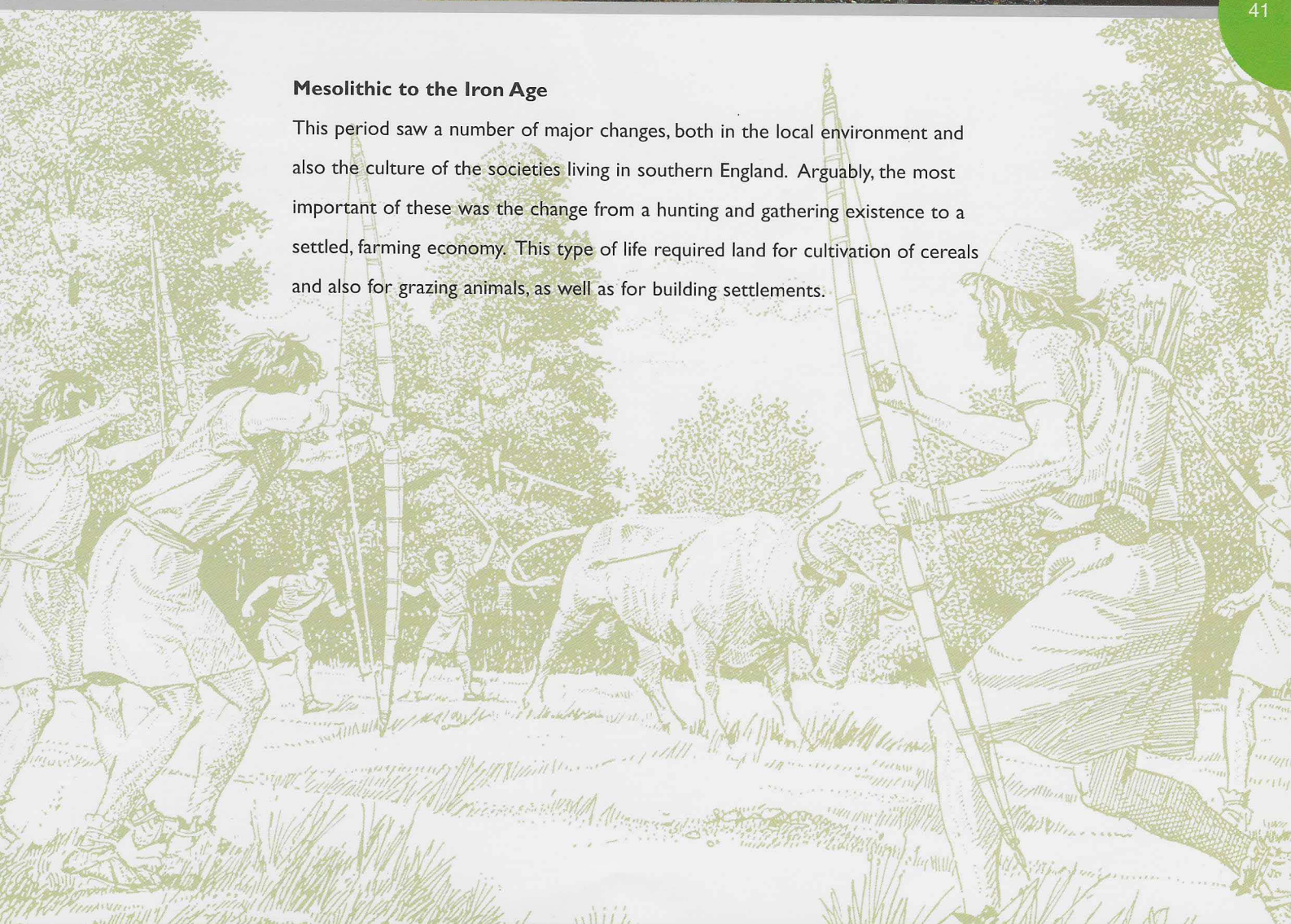
Samples were collected for this project from a number of sites along the route of the line, mainly from the development of Westminster and Southwark Underground stations. These were mainly taken from the sequences of sediment which had accumulated on the sites. By collecting undisturbed blocks (monoliths), these samples can be used for several types of analysis.

Additionally, small samples were taken in order to date the sequences. These were submitted to radiocarbon measurement (see above).



Mesolithic to the Iron Age

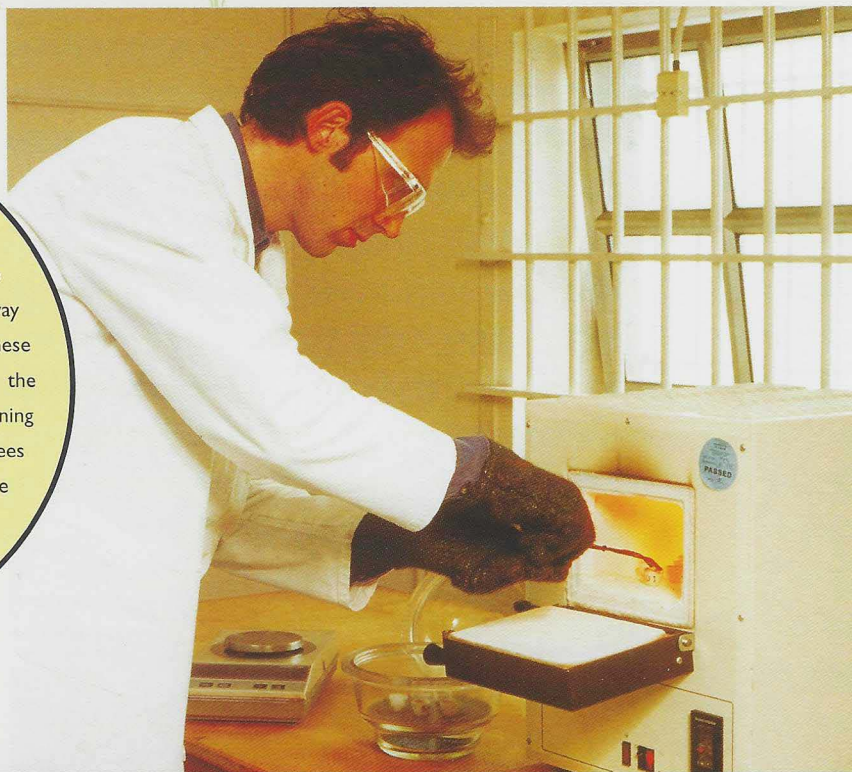
This period saw a number of major changes, both in the local environment and also the culture of the societies living in southern England. Arguably, the most important of these was the change from a hunting and gathering existence to a settled, farming economy. This type of life required land for cultivation of cereals and also for grazing animals, as well as for building settlements.



Preliminary work on samples from this period indicates local woodland, probably on the higher ground away from the foreshore, with boggy conditions towards the river. The trees making up the woodlands included oak, elm, ash, hazel and native lime. Several types of wet, river margin environments were represented, with species such as alder and reedmace.

Sedimentary analysis

A series of techniques has been applied to the monoliths, in order to characterize the way the sediments accumulated on the sites. These include X-raying the samples, distinguishing the size of the grains, i.e. sand and pebbles, and burning the sediment at temperatures of 500 degrees centigrade and higher to establish the proportions of organic content.



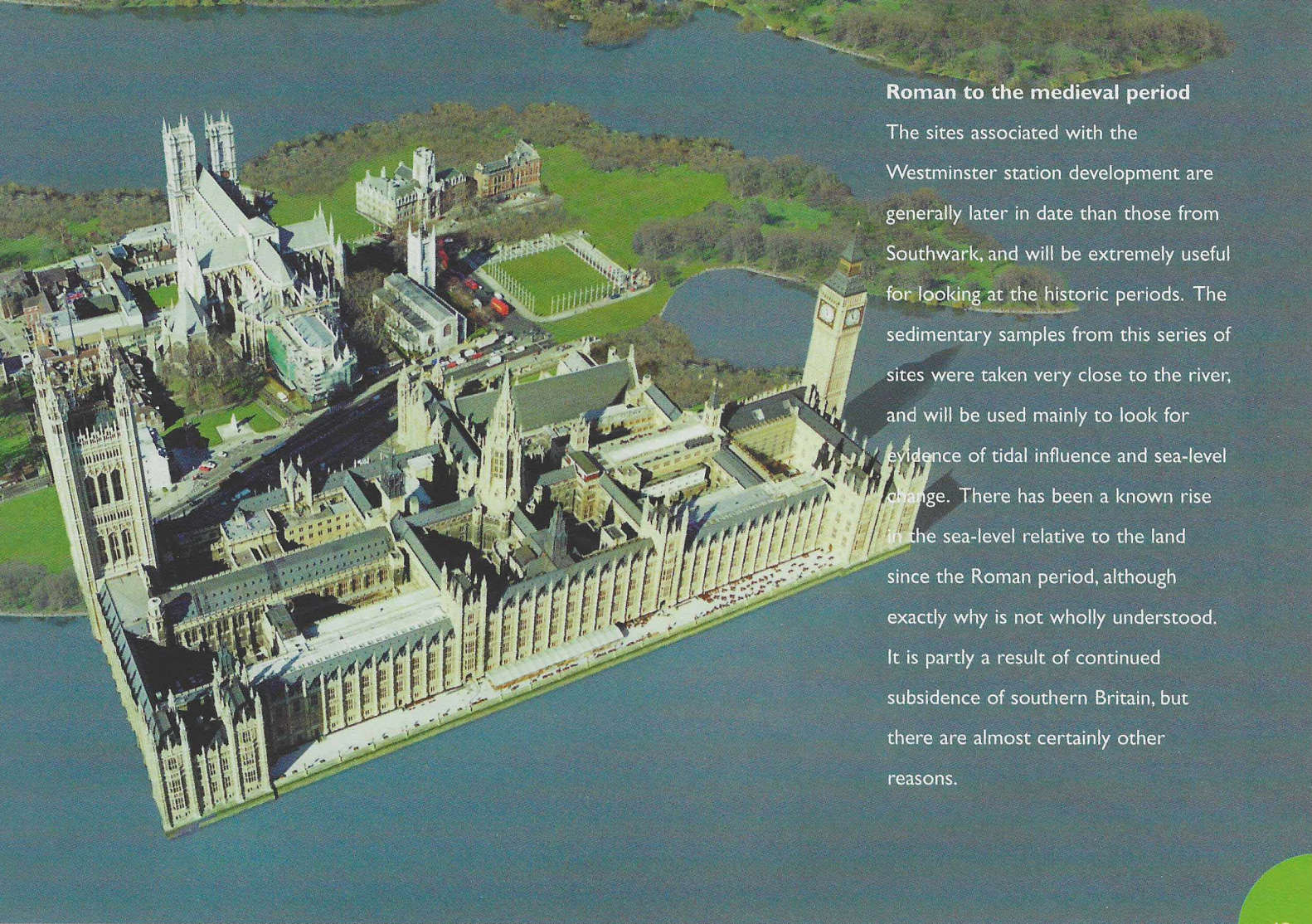
A decline in tree species matched by an increase in herbaceous plants suggests that the landscape was gradually cleared. This would have taken place as people made space for settlement and farm land. Currently, this is thought to have taken place in the Bronze Age, c 2000 BC although further dating is needed to refine the picture for London. The woodland was probably cleared, in part at least to create fields for cereal cultivation.

Much of the evidence for this comes from the area of Southwark Underground Station, and Canada Water.

Pollen analysis

Small samples have been taken from the monoliths throughout each sequence to characterize the vegetation in the local area. The sediment is removed, leaving a solution which contains any pollen grains present. These are then identified at magnifications of 1000 times. The groups of species found in each sample are then used to build up a picture of the environment at known time periods, eg mixed deciduous woodland in the Neolithic period in Southwark. It can also be used to identify human activity which has a broad effect, such as removing the ancient woodland to make more room for agriculture and settlement.

This is practically impossible to detect on the actual archaeological sites.



Roman to the medieval period

The sites associated with the Westminster station development are generally later in date than those from Southwark, and will be extremely useful for looking at the historic periods. The sedimentary samples from this series of sites were taken very close to the river, and will be used mainly to look for evidence of tidal influence and sea-level change. There has been a known rise in the sea-level relative to the land since the Roman period, although exactly why is not wholly understood. It is partly a result of continued subsidence of southern Britain, but there are almost certainly other reasons.

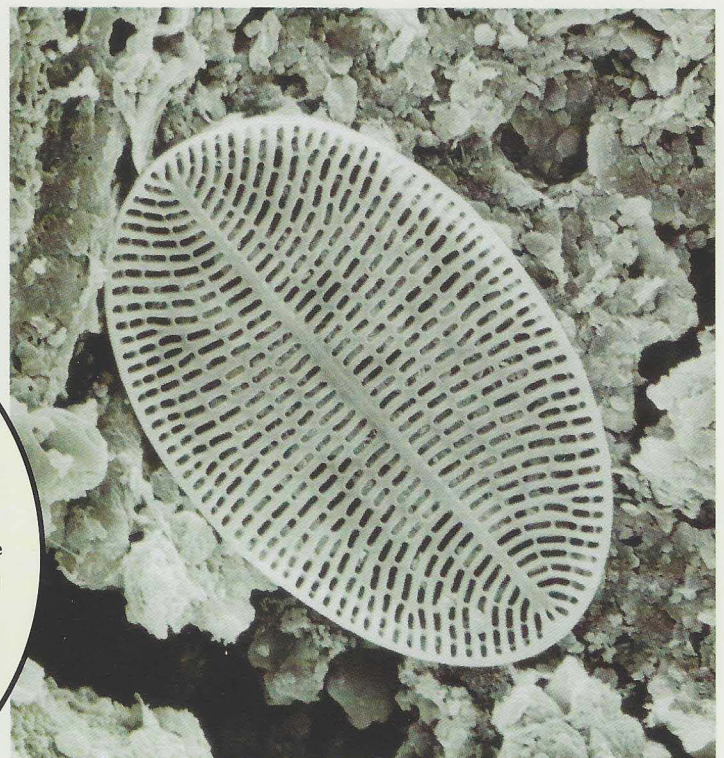
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The diatom evidence should establish whether sea-level itself was rising, and whether the tide reached Westminster. The pollen indicates that cereal cultivation continued into the historic period in this area, indeed, the presence of rye from Westminster supports the picture of farming development. Unfortunately, the picture becomes unclear with the medieval period. This is a result of the increasing urbanisation; many species of plant are brought into the area, such as herbs and medicinal plants which do not grow locally. However, pollen from such plants is deposited, and it is very hard

to get a clear idea of the landscape. It is at this period that this project will end.

Diatom analysis

Samples are treated in much the same way as for pollen extraction: the diatom valves are from unicellular algae which live in water. Different species live in varying conditions, i.e. salt water or fresh water. The groups of species in each sample are used to establish what types of water were present, and so establish the relationship of the site to the Thames. This provides information on past tide levels which in turn indicates, for instance, how far upstream boats could have easily travelled.



Acknowledgements

MoLAS would like to thank everyone involved with the Jubilee Line Extension Project and London Underground Limited for enabling the successful integration of archaeology with this most complex infrastructure project. Special thanks are due to:

London Underground Ltd: Denis Tunnicliffe (Managing Director),
Jubilee Line Extension Project: Hugh Doherty (Project Director),
Marcus Karakashian (Senior Supervising Engineer),
Paul Chapman (Divisional Quantity Surveyor)

JLEP Westminster: Mike Jenkins

JLEP Southwark: Chris Field & Martin Gamble

JLEP Stratford: Peter Humphreys & Peter Arthey

JLEP Public Relations: Richard Humphries & Alistair Siddons

JLEP Contractors: Steve Miell (Costain-TaylorWoodrow Joint Venture),

Mark Lewington (Balfour Beatty-Amec Joint Venture),

Dave Wilkinson (Oxford Archaeological Unit),

Pat Wilkinson & Ken MacGowan (Newham Museum Service)

London Borough of Southwark: John Dillon

Greater London Archaeology Advisory Service: Jez Reeve &
Dominic Perring

In addition the authors would like to thank Bill Clowes, Rob Weatherston, Brian Devlin, Mike Harvey, Karen Crabtree, John O'Connor, Barry Mathers, Dave Wass, Brendan Hunt & Steve Fallace

For further information:

MUSEUM OF LONDON ARCHAEOLOGY SERVICE

Walker House, 87 Queen Victoria Street, London EC4V 4AB

Archaeology Project Managers Mike Hutchinson & Al Green

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Text James Drummond-Murray, Chris Thomas & Jane Sidell,
with Adrian Miles

Digital imaging Andy Chopping

Design & typesetting Tracy Wellman

Photography Andy Chopping, Maggie Cox & Edwin Baker

Artwork Helen Jones & Jeannette van der Post

Editorial support Tony Dyson

Credits for other photographs and illustrations:

English Heritage Photographic Library p34 (reconstruction of the refectory at Rievaulx Abbey by Alan Sorrell), 35 (reconstruction of Rievaulx Abbey looking south by Terry Ball)

Jubilee Line Extension Project p1 (trackwork at Redcross Way; Hugh Doherty), 3 (Jubilee Line Extension), 6 (Westminster station looking east), 15 (work at Westminster; isometric view by Duncan Lamb), 17 (isometric view by Duncan Lamb), 32 (work at Stratford)

Museum of London p5 (looking south towards Southwark in c30 BC), 8 (Westminster Hall in the 17th century), 13 (medieval houses in King Street; north entrance to Westminster Hall c1760), 18 (Roman London by Peter Froste), 20 (Boudican rebellion by Alan Sorrell), 41 (prehistoric hunting)

Newham Museum Service p35 (excavations at Stratford – tiled floor; drain), 36 (excavations at Stratford – visiting Cistercian monks; coffin burial; burial with chalice), 37 (deed of surrender of Stratford Langthorne Abbey; the Great Gate in 1731 by Francis Grose), 39 (Stratford viaduct in the early 19th century)

Westminster Abbey Library p7 (Norman Westminster reconstruction by Terry Ball) *courtesy of the Dean and Chapter of Westminster*

Nigel Cameron p43 (diatom)

JLE won the 1994/5 BUSINESS COMMITMENT TO THE ENVIRONMENTAL MANAGEMENT SYSTEMS AWARD – of which archaeology was a major part.

BRITISH ARCHAEOLOGICAL AWARDS 1996: JLE was nominated for the Virgin Group Award for the best presentation of an archaeological project to the public.



