Chapter 3: The development of the late Glacial and early to mid Holocene landscape

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Introduction

The geology and present topography of the study area

The Thames Valley has long been recognised as one of the most important regions for the British Quaternary record. Together with its extensions into the south Midlands, central Hertfordshire and southern Essex, the valley contains the longest and most complex series of Quaternary sediments outside of East Anglia (Gibbard 1985). The Middle Thames region extends from the Goring Gap in the west (a gorge-like valley, north-west of Reading) where the river cuts through the chalk sediments of the Chiltern Hills, to Rickmansworth in the north-east and central London in the east.

The region is characterised by three major geomorphological units. The southern part of the Middle Thames region is high ground, up to 120m above OD, consisting of Tertiary sands of the Bagshot Series characterised by open heaths and extensive pine forests. To the north east, the high ground comprises the Chalk of the Chilterns and the Tertiary Reading Beds. The second area stretches westwards from Windsor and consists of the gently undulating terrain of the Tertiary Lower London Clays. The third consists of the wide expanse of flat, relatively low-lying ground of the Thames Valley formed for the most part by river gravels and alluvium. At Windsor, a few kilometres downstream from the Eton Rowing Course, a Chalk inlier rises to prominence, forming Castle Hill.

The study area, which encompasses both the Eton Rowing Course and the Maidenhead, Windsor and Eton Flood Alleviation Scheme, lies about 40-50km west of central London on the north bank of the river Thames. The excavations (see Fig. 1.1) were largely situated on the gravel floodplain terrace deposits crossed by former palaeochannels incised in the late Glacial, some of which remained active into the historic period (Allen and Welsh 1996). The floodplain gravels belong to the Shepperton Terrace while the finer mineral and organic sediments filling the palaeochannels and their backswamps come under the broad heading of the Staines Alluvial Deposits (Gibbard 1985).

Previous archaeological and palaeoenvironmental knowledge

The palaeoenvironmental history of the Middle Thames is poorly understood, with only a few, though increasing, number of pollen diagrams available from the region. late Glacial and early Holocene pollen diagrams are available from Nazeing (Allison *et al.* 1952), Enfield Lock (Chambers *et al.* 1996), both in the Lea Valley, and Three Ways Wharf, Uxbridge, (Lewis *et al.* 1992; Lewis and Rackham 2011) in the Colne Valley. Detailed studies were undertaken of a range of biological remains from sediment sequences of early to late Holocene date at Runnymede Bridge, including pollen (Greig 1991; Scaife 2000), macroscopic plant remains (Greig 1991; Robinson 2000c), molluscs (Evans 1991; Evans 2000) and insects (Robinson 1991; Robinson 2000c). A small number of mid- to late-Holocene profiles are given in Greig (1992) for the London area. In the Lower Thames region pollen data exists from Silvertown (Wilkinson *et al.* 2000), Stonemarsh and Tilbury (Devoy 1979), Bramcote Green (Thomas and Rackham 1996) and Bryan Road (Sidell *et al.* 1995). In addition, work has been carried out in the Kennet Valley further upstream (Holyoak 1980; Collins 1994), and in the Upper Thames Valley (Day 1991; Parker 1995a, Parker 1995b; Parker and Anderson 1996; Parker 1997).

The development of the aims of the palaeoenvironmental analysis

Aerial photographs had indicated that nearly half of the Eton Rowing Course site consisted of palaeochannel and floodplain deposits (Plate 1.1), but the initial limited evaluations in 1987 and 1990 had not identified well-preserved environmental remains. Larger-scale evaluation in 1994 revealed well-preserved waterlogged remains in sequences of channel deposits more than 2m deep, including some likely to be of Mesolithic, Bronze Age and Iron Age date. There were also well-preserved occupation horizons within the alluvium that overlay backswamp deposits on the floodplain (Plates 3.1-3.3). Together these suggested the possibility of recovering an environmental sequence covering much of the Holocene, at least up to the Roman period. This became one of the principal aims of the

Plate 3.1 View of trenching in the backswamp deposits

Plate 3.3 Evaluation trench section showing the sequence of dark and lighter deposit horizons within the backswamp. The lowest dark deposit is peat. The upper deposits have concentrations of manganese, indicating former land-surfaces between phases of sterile alluvial accumulation. The uppermost landsurface included an early Bronze Age hearth.

palaeoenvironmental investigations, and Mark Robinson was asked to coordinated the environmental investigations. Structural waterlogged worked timbers were also found during the 1994 evaluation in three locations, and a second aim was to excavate any structures and recover information about woodland management in prehistory.

On the Maidenhead, Windsor and Eton Flood Alleviation Scheme extensive evaluation was carried out by Thames Valley Archaeological Services under the direction of Steve Ford, who persuaded Keith Lucas at Reading University to carry out pollen analyses upon sediments recovered from palaeochannel sequences. Subsequently, Phil Catherall, the Environment Agency's archaeologist, selected particular areas for excavation. During the excavations further palaeochannels were encountered and sampled, though few proved to contain well-preserved environmental remains.

The first season of excavations at the Eton Rowing Course in 1995 clarified the character of the site, exposing a substantial former channel of the Thames that was clearly active until the Roman period, in which lateral accretion and downcutting

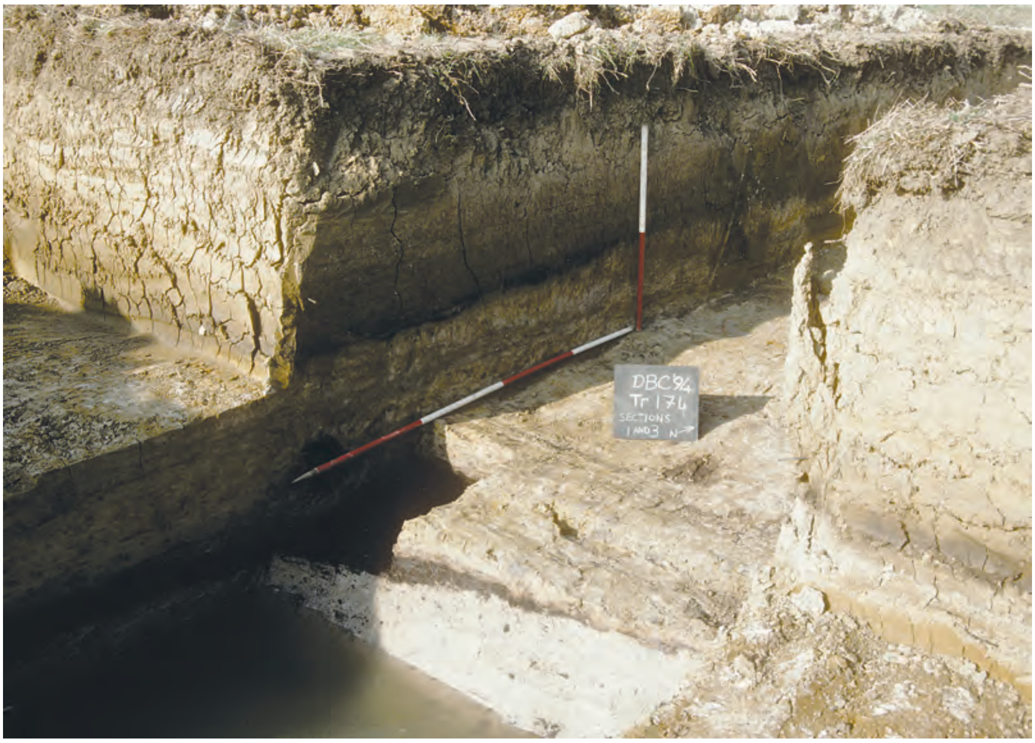


Plate 3.2 Detail of trenching in the backswamp deposits showing occupation horizon within the alluvium

Plate 3.4 View of machine excavation on the floodplain in Area Ex1, looking south from above the palaeochannel (not in picture). The hut in the background is close to the edge of the gravel terrace.

had preserved deposits dating from the early Neolithic period onwards. This channel ran through the middle of the site, and, on the western side of Basin R it was flanked on either side by a sequence of earlier deposits that represented the gradual silting up of backswamp deposits to form an alluvial floodplain behind a levee (Plates 3.4-6). These earlier deposits were present alongside the later and narrower former Thames channel throughout the site, but were only deep and well-preserved in a few areas, namely the north side of Basin R close to the gravel terrace Site F West, in the former Cress Brook channel (P) and in Inlet Z. The last two of these were channels that were largely infilled early in the Holocene.

The scope of the evaluations was deliberately wider than the areas required for the Rowing Course, exploring several alternative locations for associated repositories for spoil. The potential of the north part of Basin R, with its Mesolithic occupation site, resulted in the decision to leave it *in situ*, and the former Cress Brook channel was also outside the areas chosen for extraction. As a result, samples of some periods and from some parts of the site were restricted only to those retrieved in evaluation, not all of which were examined in the assessment.

In contrast, a large percentage of the former Thames channel crossing the site was extracted, providing numerous opportunities to examine and record the channel development. While, however, it would have been possible to examine any number of channel sequences in detail, one detailed sequence was considered sufficient to establish the environmental context for the human activity that was the primary focus of the archaeological investigations. A suitable sequence was obtained from Area 3 (Plate 3.7) – the first excavation across the complete width of the channel (dug in 1995) – which was supplemented by examination of

Plate 3.5 Detail of floodplain deposits which accumulated behind a levee in Area Ex1

Plate 3.6 View of levee from the early Neolithic channel to the north in Area Ex1

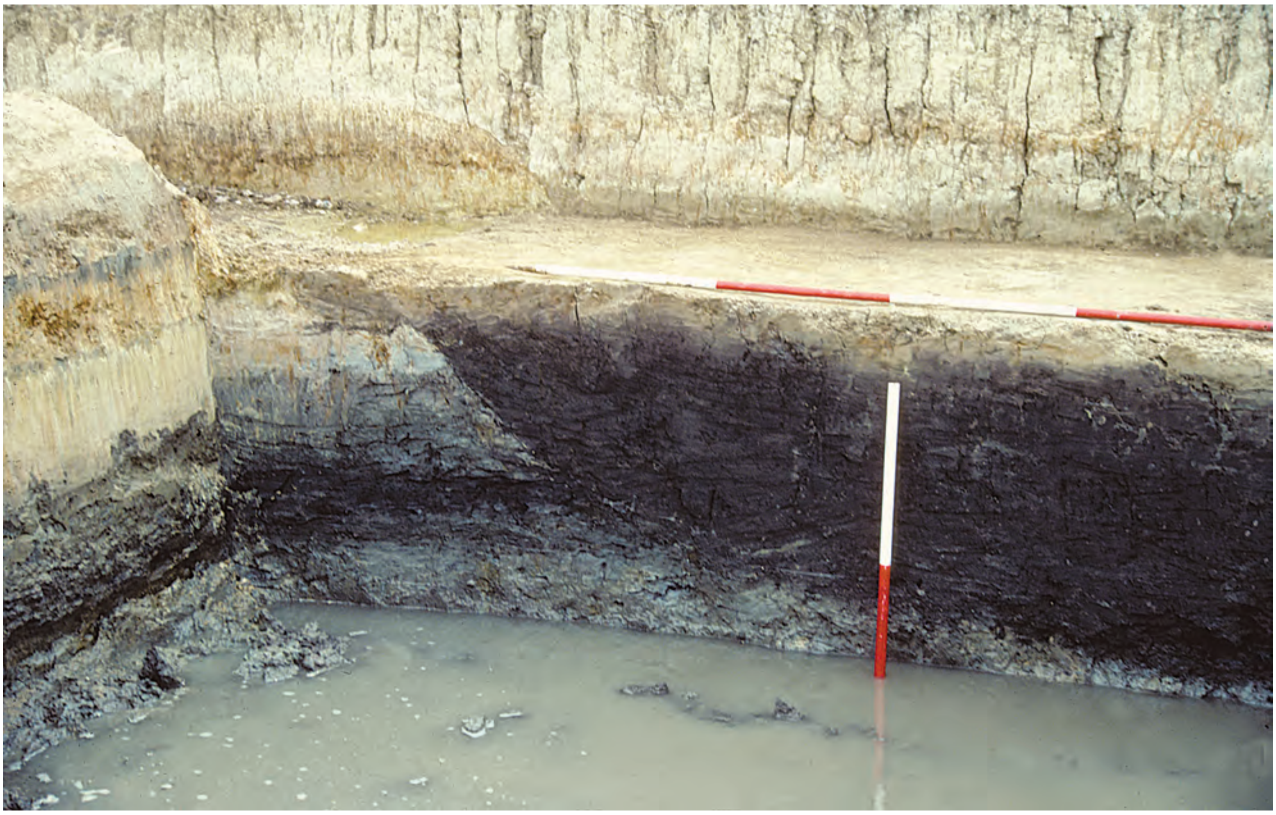


Plate 3.7 Section cut through channel deposits in Area 3, showing the Mesolithic sediments cut by the early Neolithic peat-filled channel edge, looking north-west

additional samples from Area 5, where the longest sequence of channel phases survived as a point-bar accumulation on the inside of a bend.

Additional sampling was also carried out in Area 15 on a backwater left by the blocking of a channel in Inlet Z, where another sequence of channel cuts, including one containing a deep layer of peat, was located in 1996. Sampling here was undertaken both because of the presence of likely early Holocene deposits, which had otherwise only been found in evaluation, because of the depth of preserved organic material, and because of the proximity of settlement of the later prehistoric period.

Due to the high water table, sampling of the complete depth of the deepest waterlogged deposits at the Eton Rowing Course was rarely possible (despite pumping). Even given the lateral accretion of deposit sequences in successive channel cuts, there may, therefore, be gaps due to the absence of the basal organic channel fills in all but the earliest channel cuts. There are thus gaps in the sequences obtained from the former Thames channel and from Inlet Z.

Beyond this, palaeoenvironmental investigations were limited to soils, remains from features and deposits on dry land directly associated with human activity.

Location of the principal samples

For the palaeoenvironmental analyses of the late Glacial and early Holocene landscape a series of sites were sampled (Fig. 3.1). From the Environment Agency Scheme these were Lot's Hole 3 and 66, and from the Eton Rowing Course the following: Inlet Z – 1501 (Area 15; Fig. 3.2), Mesolithic Basin R (Trench 167, layer 40; Fig. 3.6), Basin R floodplain tree-throw hole (Trench 46, layer 11; Fig. 3.6) and Area 3 columns 648, 658, 615 and 706 (Fig. 6.26). Supplementary information was obtained from Area 5 (Fig. 6.25), from Area Ex 1 (Figs 6.3 and 9.16), from evaluation trenches on the Eton Rowing Course in Basin W, along Channel G, in Channel P and at various points along the former Thames channel that were assessed for environmental remains by Mark Robinson. Significant dryland samples were those from the Rowing Course early Neolithic middens in Areas 6 and 10, late Neolithic pits with Grooved Ware in Area 16, and late Neolithic or early Bronze Age burnt spreads in Areas 11, 16 and 14. On the Environment Agency Scheme an early Neolithic pit (50189) at Lot's Hole contained charred plant remains, as did pit 50089 of probable Neolithic date at Marsh Lane East Site 2. A group of Peterborough Ware pits from Lake End Road West also contained charred plant remains, but radiocarbon dating indicated that whilst the hazelnuts were middle Neolithic, the cereals were intrusive from the Saxon occupation (Foreman *et al.* 2002, 54-5).

The chronological development of the environment is described in the following sections. Where the combined evidence from the two schemes is being compared with that from other sites or regions, the evidence is described as being 'at Dorney' for the sake of brevity.

The Mesolithic

Mesolithic sites

Large assemblages of struck flints of early Mesolithic date were found in three evaluation trenches (166, 180 and 173; Fig. 4.4) on the west edge of Basin R, with a few pieces from Trench 165 on the gravel terrace behind (Fig. 4.4). These suggest an area of occupation stretching for as much as 150m along the edge of the gravel terrace, and perhaps extending 50m back from the water's edge. Lenses of silt, gravel and organic silt interleaved with struck flints may indicate occupation of extended duration, although this could have resulted from the inwashing of artefactual material previously deposited close to the water's edge during or following periods of high rainfall. A radiocarbon date on an aurochs bone found on the same horizon as the principal flint concentration was indistinguishable from that on peat in Trench 167 adjacent, where burnt bulrush stems were also found. Other evidence for activity in the early Mesolithic period is slight, being confined to a small group of struck flints on the north-western edge of Channel N, and a few flints in a natural pingo on the gravel terrace midway between these two sites.

Later Mesolithic activity was of a different character, being largely represented by small numbers of microliths and other struck flints scattered widely along the edge of the former Thames channel, on the levee in Trench 169 and Area Ex3, on Gravel Island Site G, in Area 16, and Area 5. A possible hearth with some alder or hazel charcoal was found in Evaluation Trench 159. An antler mattock of later Mesolithic type was found close to the channel edge in Area Ex3, and a perforated stone macehead in Area 14. Tree-throw holes containing Mesolithic struck flints in larger numbers were found on the gravel terrace in Area Ex1, and on the floodplain. None of this suggests large-scale or long-lasting activity, but the ubiquity of the activity does indicate repeated use of the river's edge.

Mesolithic channel evolution and floodplain development

During the late Devensian there was extensive aggradation in the fluvial systems which is attributed to a reduction in the magnitude of peak discharge, and an increased supply of sediment gelifluced into channels from the surrounding higher ground. Annual runoff would have been concentrated during the spring thaw and a short summer. It has been suggested that the mean monthly temperature *c* 10,500 BP ranged between *c* 10°C and -17°C for summer and winter respectively (Atkinson *et al.* 1987). The aggradation of the flood-

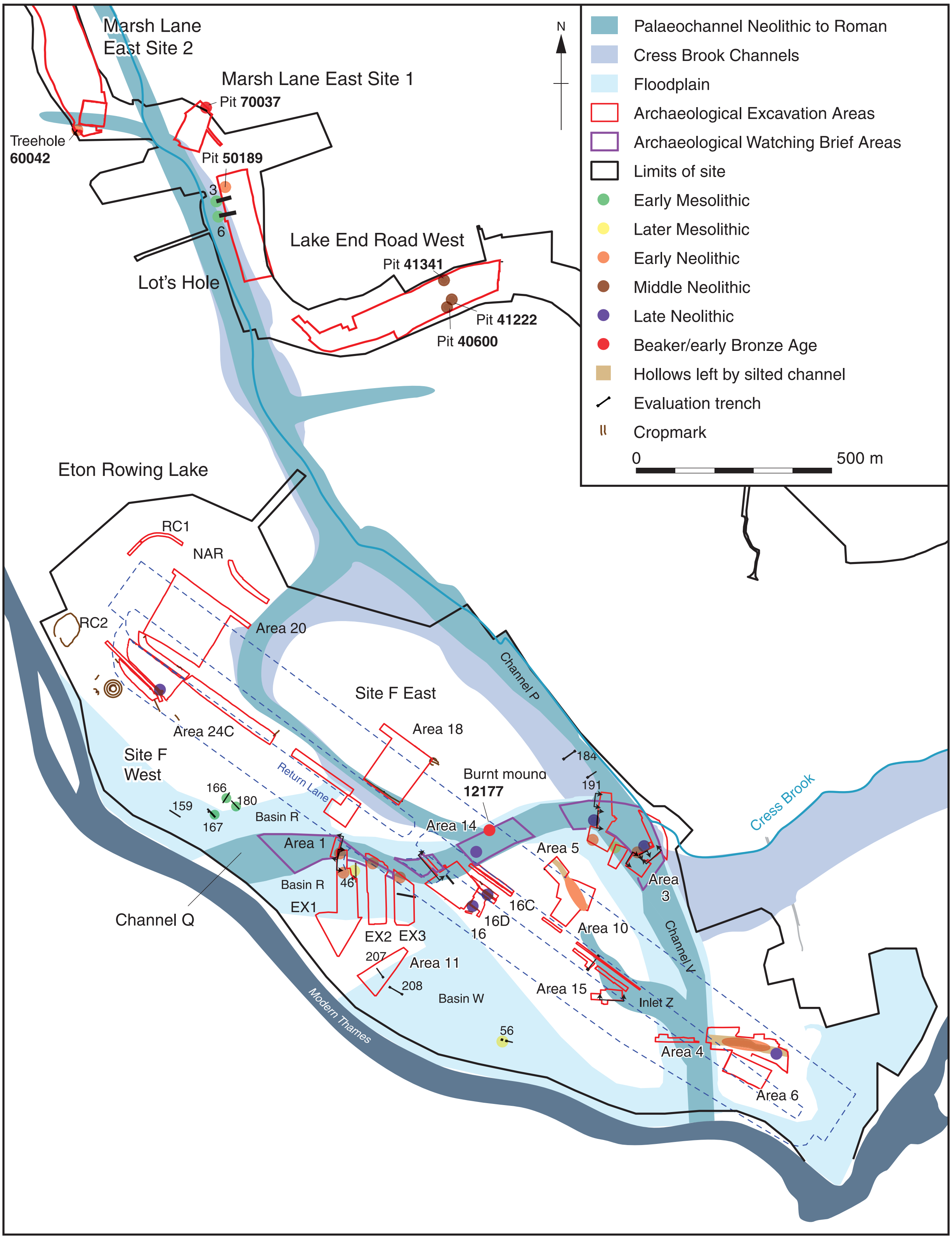


Fig. 3.1 Location of environmental samples and major sections

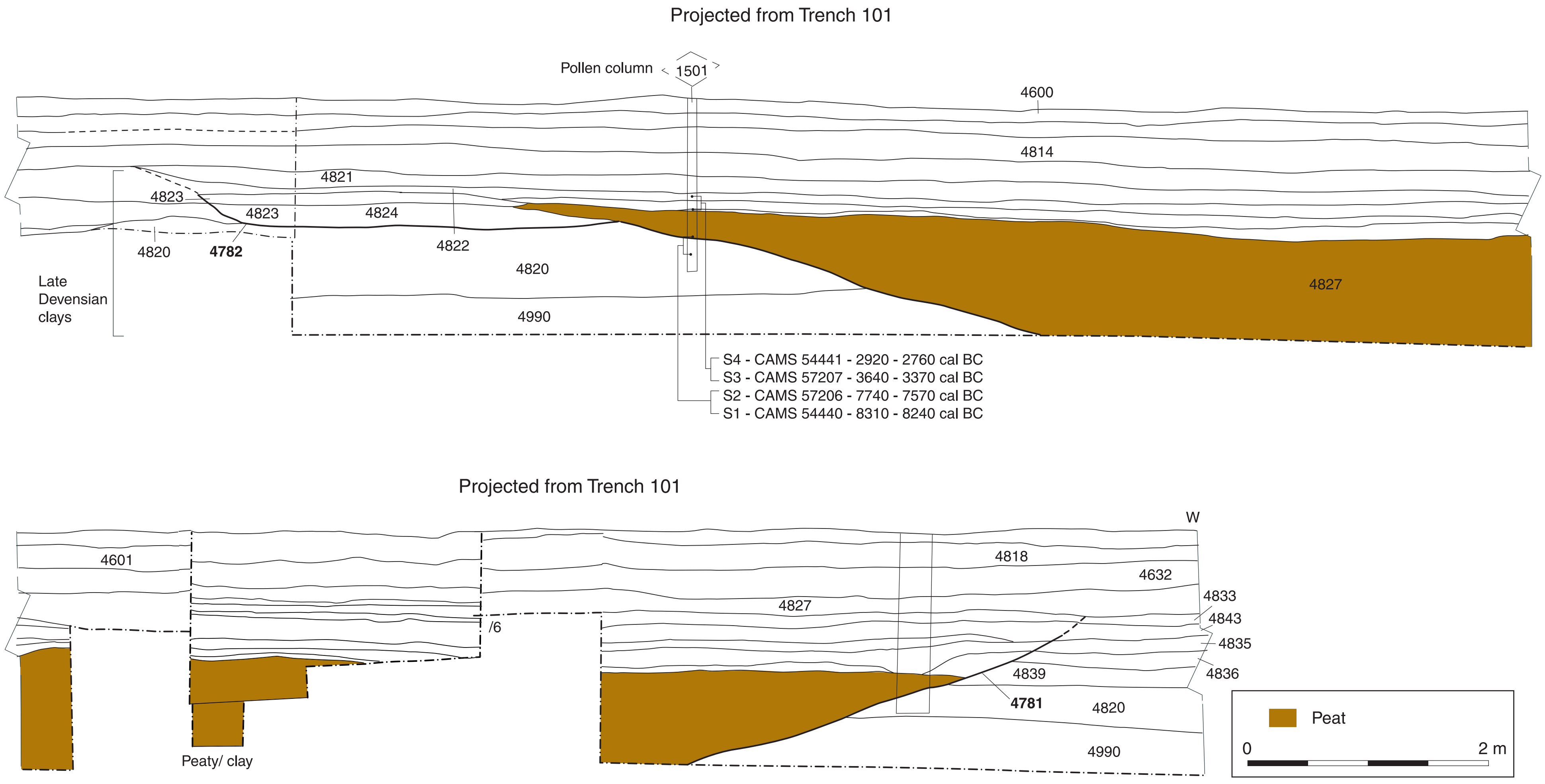


Fig. 3.2 Section across Inlet Z in Area 15

plain gravel terrace occurred under conditions of sheet flow and lateral migration of minor braided channels as would be appropriate to the late Devensian. There followed a transition to an anastomose system of multiple broad incised channels which are either extant or became filled with fine sediment. The pollen assemblage from fine sediment at the bottom of the Cress Brook channel at Lot's Hole was of late Glacial character with a basal age of 10670-10150 cal BC (AA-44401 (GU-9488): 10,490 ± 45 BP). Some channels became incised more deeply and more narrowly. This had the effect of isolating the other channels and former channel beds alongside the more deeply-incised channels as low-lying areas of floodplain.

Aerial photographs of the Eton Rowing Course site, together with the observations made during evaluation and excavation, show that there was a complex and relatively rapid development and abandonment of various channels during this period, a pattern that was probably also true for the surrounding area (Plate 1.1).

The late Devensian period concluded with an abrupt change to milder conditions associated with the northward migration of the North Atlantic oceanic polar front (Ruddiman and McIntyre 1981). This migrated between 35° and 55° N, almost immediately with a strong influx of warm Atlantic waters (Bard *et al.* 1987) with sea surface temperatures rising 9° C in less than 50 years (Koç and Jansen 1994).

Between 10-9 ka BP, a drastic change of climatic conditions occurred in the north Atlantic, with maximum solar radiation across the northern Hemisphere. At the start of the post-glacial (Holocene) many of the channels became cut off as the river became largely restricted by down-cutting and changes in the energy of the river system and sediment budget to a single channel. The abandoned palaeochannels gradually filled, first rapidly with sand and silt, and then more slowly with clay, as the velocity of flow decreased. Some of the sand may have been aeolian in origin (Keith-Lucas 1997). Such deposition reflects the river size resulting from hydrological change influenced by climatic modification. Later, organic sediments were deposited as the channels became choked with aquatic vegetation and the marginal reedbeds acted as filters for any further inorganic particles. Some calcium carbonate deposition was, however, occurring on plant stems.

Apart from minor episodes of sedimentation and cutting back, the channel system of the early Holocene remained extant until the Roman period. Lateral channel stabilisation had occurred before the end of the Devensian or at the start of the Holocene, levees being created along the margins of those channels which remained active. A radiocarbon date of 9220-8740 cal BC (OxA-9411: 9560±55 BP) was obtained on Cyperaceae seeds from the base of peat which had accumulated in a backswamp behind a levee in Basin R. Human activity began on the site at about this time with much flint-working debris along the edge of the backswamp (associated with animal bone including an aurochs bone dated to 9160-8740 cal BC (OxA-14088: 9540±45 BP) and was sealed by later alluvium.

Flow along the palaeochannel system on the route of the flood relief channel as reported at Lot's Hole and Marsh Lane East largely ceased between 10-9 ka BP. At Marsh Lane East peat that eventually supported *Quercus* carr filled the channel.

The full development of woodland led to an abrupt decline in the loading of fluvial systems, a reduction of alluviation, and the development of a meandering system. The river formed stable channels with small discharge variation and limited bedload transport. Gradual backswamp sedimentation and extension of the floodplain were characteristic features of well-regulated low-relief environments. It has been suggested for the river Thames that the early to mid Holocene period was characterised as stable with little evidence for floodplain sedimentation (Wilkinson *et al.* 2000). Fluvial systems with similar dimensions have been observed elsewhere in southern England (eg from the river Gipping; Rose *et al.* 1980) but not the Upper Thames (Robinson and Lambrick 1984; Parker 1995a)

This view is supported at the Eton Rowing Course where there was little evidence of earlier Holocene sedimentation within those channels that continued to flow. The sorting of the floodplain terrace gravel by the action of the former Thames Channel Q had resulted in the creation of an armoured bed of larger pebbles that lay beneath fine sediments of Neolithic date. Much earlier Holocene overbank sedimentation, however, occurred in low-lying areas. Further episodes of sedimentation, especially of clay with a high marl content, occurred on levees. Backswamp peat accumulated rapidly until it reached the level of the permanent water table; thereafter, clay alluviation occurred on the floodplain (Basins R and W). A radiocarbon date of 5220-4940 cal BC (OxA-9412: 6130±45 BP) was obtained on waterlogged macroscopic plant remains from a tree-throw hole from towards the top of the clay alluvium on the floodplain in Area Ex1, although it is possible that the majority of the sedimentation had occurred during the first 1000 years of the Holocene.

The period from 8000 to 5000 BP is generally acknowledged to be the greatest period of post-glacial warmth, often referred to as the 'Climatic Optimum'. It is generally thought that aggradation in the fluvial systems of southern England halted. Many sites in Britain especially in the south, show either a slow down in the accumulation rates of sediments, often leading to compression in some profiles, or an 'Atlantic-hiatus' which has been attributed to stable conditions under maximal forest cover (Godwin 1975; Greig 1992). Lockwood (1979) has suggested that forest cover reduced runoff to rivers by as much as 50% when compared with present-day values. No late Mesolithic age channel sediments were found at the Eton Rowing Course perhaps supporting these suggestions. It should be borne in mind, however, that the samples from Area 15 in Inlet Z were taken at the side of the later palaeochannel cut, in order to obtain one sequence through the earlier and later channel phases, but did not reach the bottom of the later channel due to the high water table. The absence of late Mesolithic age channel sediments here may, therefore, be illusory.

Mesolithic environmental and vegetational sequence

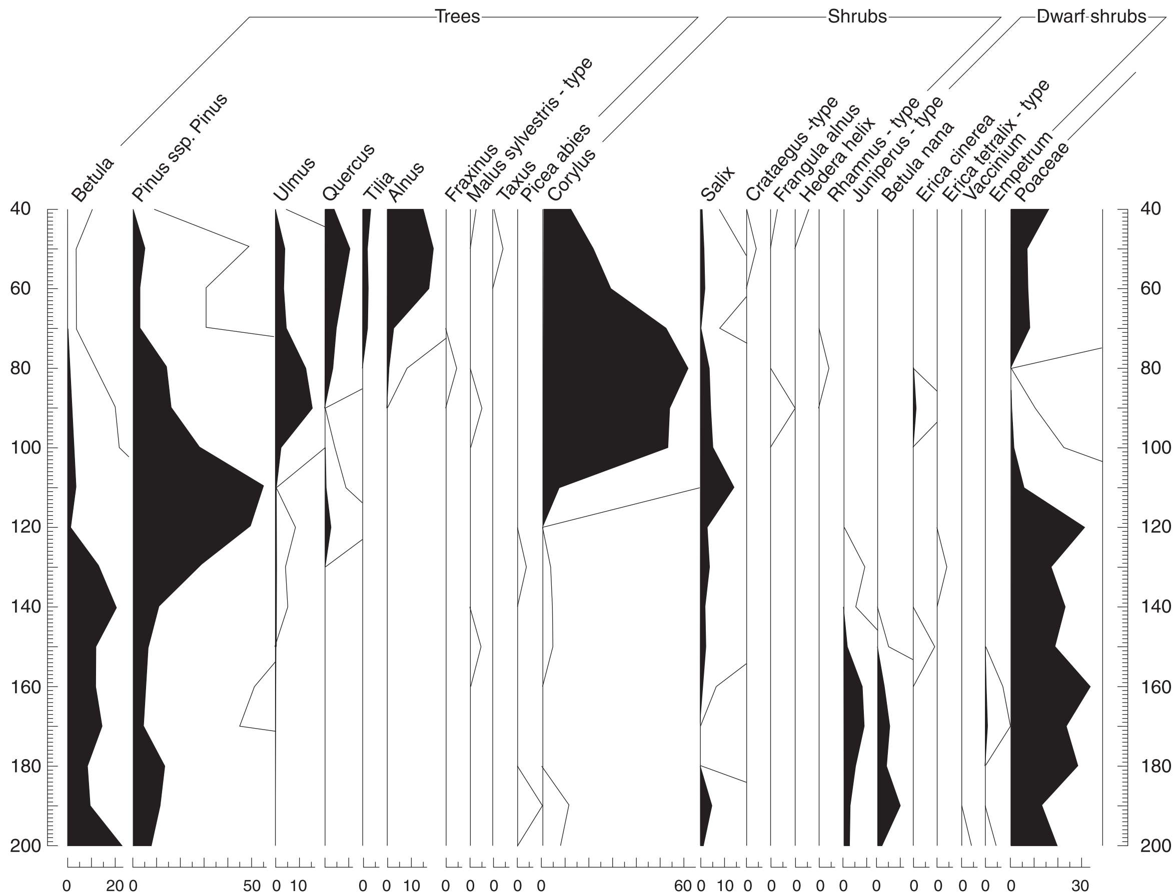
Over the past ten years there have been an increasing number of studies across the region which have revealed late Glacial and early Holocene pollen-rich sediments (for example, Moor Green, Staines Moor (Keith-Lucas 2000), Thames Valley Park, Reading (Keith- Lucas 1997), Uxbridge (Lewis *et al.* 1992; Lewis and Rackham 2011), Enfield Lock (Chambers *et al.* 1996) and Iver (Taylor unpubl.)).

At the end of the last glaciation, as sedimentation began in the palaeochannels, an open landscape existed with birch scrub, juniper-*empetrum* heath and dwarf arctic-alpine vegetation on the higher ground, and tall herb meadows, ruderal and aquatic communities in the low lying areas. At Lot's Hole 3, a basal date of 10670-10150 cal BC (AA-44401 (GU-9488): 10,490±75 BP) was measured. In the channels, *Isoetes*, which requires deep, clear water was present. In addition, there was standing, open water locally with floating leafed aquatics and surrounded by a *Carex*/*Equisetum* reedswamp.

At the Rowing Course, the early Holocene was represented by channel deposits in Area 15 (Inlet Z; 1501), Basin R, Basin W, the former Cress Brook Channel P and Area 3 (648 and 658). Pollen preservation from Inlet Z (1501) was good with the exception of the uppermost samples. The preservation in Area 3 was, however, much poorer. This is, perhaps, reflected in the difference in species richness between the two sites. The Area 3 samples from 648 and 658, for example, were generally poor, with a dominance of more resistant grains. A similar pattern was noted from Uxbridge (Lewis *et al.* 1992; Lewis and Rackham 2011). Therefore differential preservation may be an important consideration when interpreting these data. On the basis of the pollen diagrams and chronology, the profiles represent late Glacial and early Holocene times. The basal samples in 1501 (context 4820; Fig. 3.2) comprise grey clay of late Devensian age, with high frequencies of Gramineae and Cyperaceae, with smaller occurrences of Caryophyllaceae, Chenopodiaceae and *Rumex*, with low amounts of tree and shrub pollen. The high magnetic susceptibility reflects inwash of material from a sparsely vegetated area. The contact with the overlying organic sediment (4827) was sharp, suggesting an erosional contact and a hiatus in the Area 15 record. In 4820, the sediment decreases in particle size with a steady decline in sand content from 25% to 15% and an increase in clay and silt contents.

The pollen diagrams from Lot's Hole (Fig. 3.3) and Areas 15 (Fig. 3.4) and 3 (Fig. 3.5) reflect initial vegetation response to climatic amelioration, with taxa of bare and disturbed soils progressively succeeded by plants associated with more stable grasslands and scrub/woodlands. The early expansion of pioneer arboreal vegetation *c* 10 ka BP was by *Juniperus* and *Betula*. The character of the sediment supports the view of shallow open water with increasing open fen conditions, colonised by species of Cyperaceae and *Salix*. The presence of the pollen of *Typha* (as shown in the Area 3 pollen diagram) suggests marginal reedswamp. Birks (1986) has pointed out that a rise in summer temperatures during the early Holocene is confirmed by the presence of *Typha*. Therefore, tree distributions cannot have been in equilibrium with the climate for the first 1000-2000 years of the Holocene. Marginal woody vegetation is represented by the pollen of *Salix*, *Betula*, and *Corylus* along with macrofossil remains of *Populus*. The fairly high *Salix* pollen percentages (*c* 8%) would indicate considerable local willow scrub, probably in the vicinity of the fen. *Betula* would appear to have been a significant component of the vegetation during this stage, perhaps growing in damper hollows and less basic soils, and in carr woodland with *Salix*. *Salix* pollen is often poorly represented in such conditions (Birks 1973). There was still a fairly large grassland flora with Gramineae maintained at around 40-50%.

The isopollen curves of Huntley and Birks (1983) indicate that *Pinus* began to expand across southern England *c* 10,000 yr BP. At Silvertown, in the lower Thames region, the rise in *Pinus* was dated at 10,010±70 BP (Beta 93678; 9860-9300 cal BC), whilst at Iver, the expansion of *Pinus* was dated to 9350±90 BP (9110-8300 cal BC). At Dorney, *Pinus* began to expand *c* 10,000 yr BP. The large peak in Filicales fern spores at Dorney could result from preferential preservation *in situ*, since these are included with the pollen sum; thus, high numbers of fern spores affect the percentages of the other taxa in the diagram. Alternative interpretations include the possibilities that Filicales were an important component of the ground flora or that the peak indicates a phase of disturbance (eg burning and inwash). The arboreal taxa suggest that the surrounding areas would have been dominated by *Betula-Pinus-Corylus* woodland. The rise in *Corylus* was dated to 8750-8310 cal BC (AA-44399 (GU-9486): 9305±70 BP) at Lot's Hole and 8310-8240 cal BC (CAMS-54440: 9070±40 BP) at the Rowing Course. At Iver, this also occurred at 9260±100 BP (8740-8280 cal BC; the ages are indistinguishable when calibrated) but much later at Enfield Lock at 8200±80 BP (7460-7050 cal BC). This latter date would appear to be too late for the middle Thames region and should be viewed with some caution.


Trees
Shrubs
Dwarf shrubs
Betula
Pinus ssp. Pinus
Ulmus
Quercus
Tilia
Alnus
Fraxinus
Malus sylvestris - type
Taxus
Picea abies
Corylus
Salix
Crataegus -type
Frangula alnus
Hedera helix
Rhamnus - type
Juniperus - type
Betula nana
Erica cinerea
Erica tetralix - type
Vaccinium
Empetrum
Poaceae
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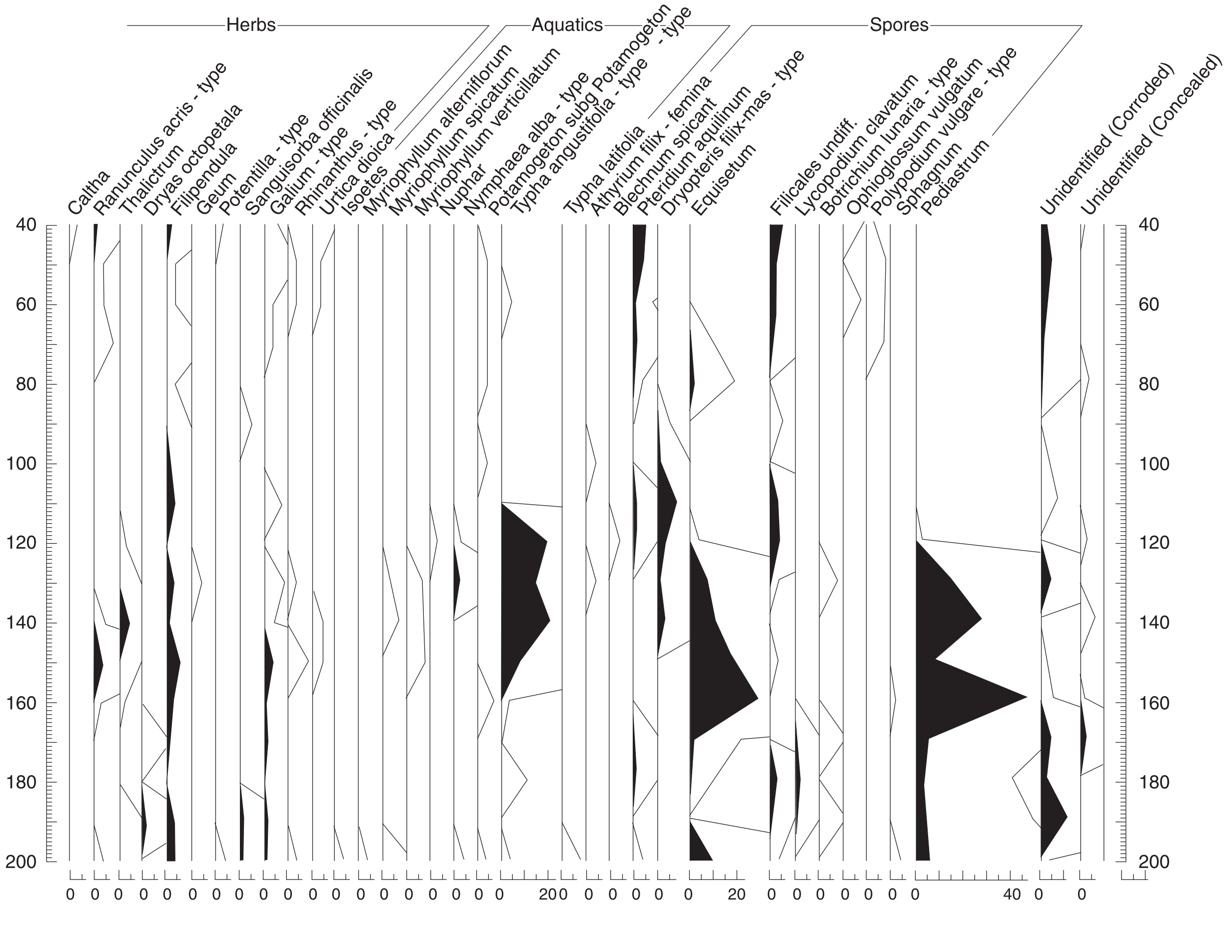
Herbs
Aquatics
Spores
Caltha
Ranunculus acris - type
Thalictrum
Dryas octopetala
Filipendula
Geum
Potentilla - type
Sanguisorba officinalis
Galium - type
Rhinanthus - type
Urtica dioica
Isoetes
Myriophyllum alterniflorum
Myriophyllum spicatum
Myriophyllum verticillatum
Nuphar
Nymphaea alba - type
Potamogeton subg Potamogeton
Typha angustifolia - type
Typha latifolia
Athyrium filix - femina
Blechnum spicant
Pteridium aquilinum
Dryopteris filix-mas - type
Equisetum
Filicales undiff.
Lycopodium clavatum
Botrichium lunaria - type
Ophioglossum vulgatum
Polypodium vulgare - type
Sphagnum
Pediastrum
Unidentified (Corroded)
Unidentified (Concealed)
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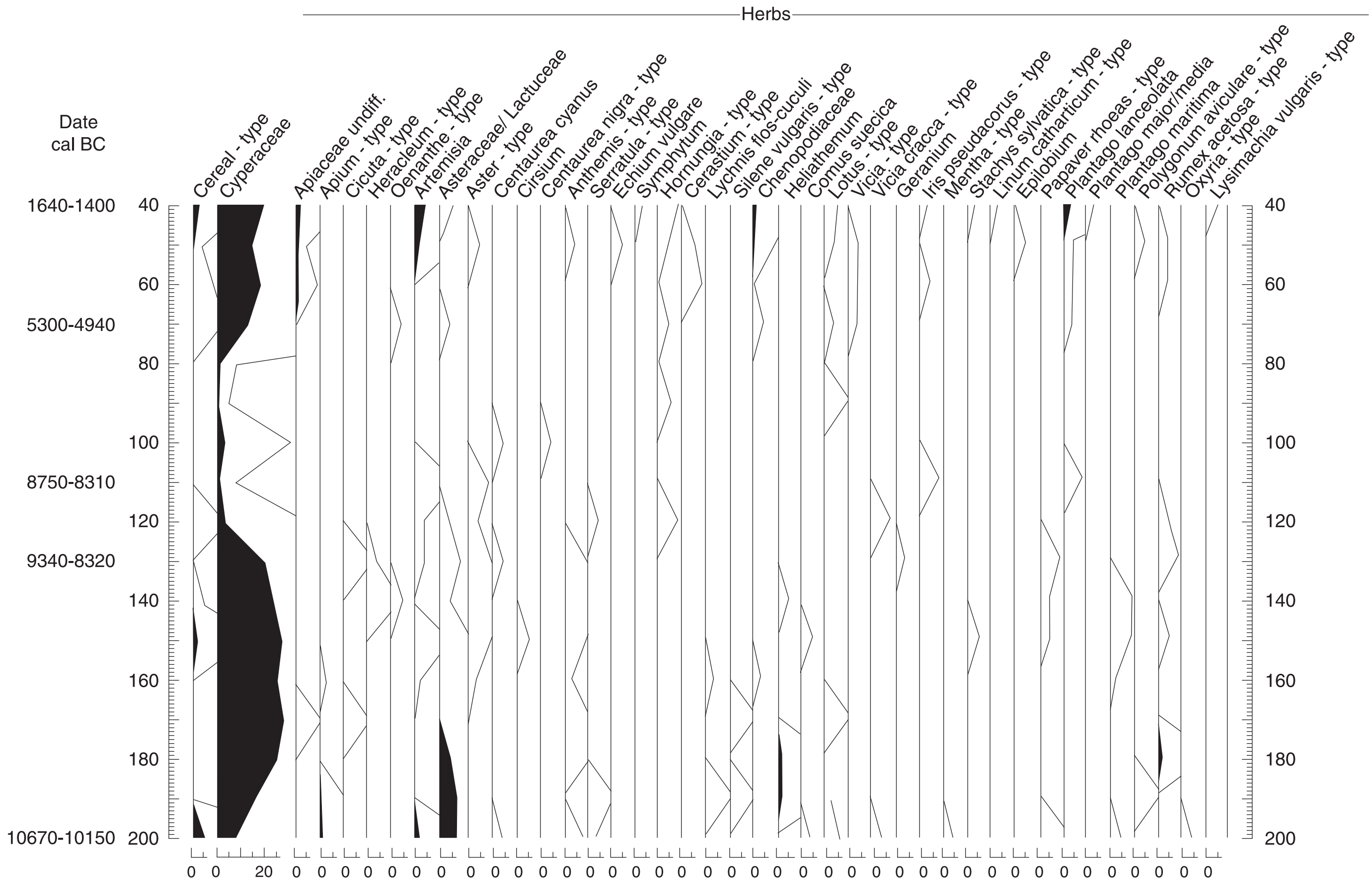

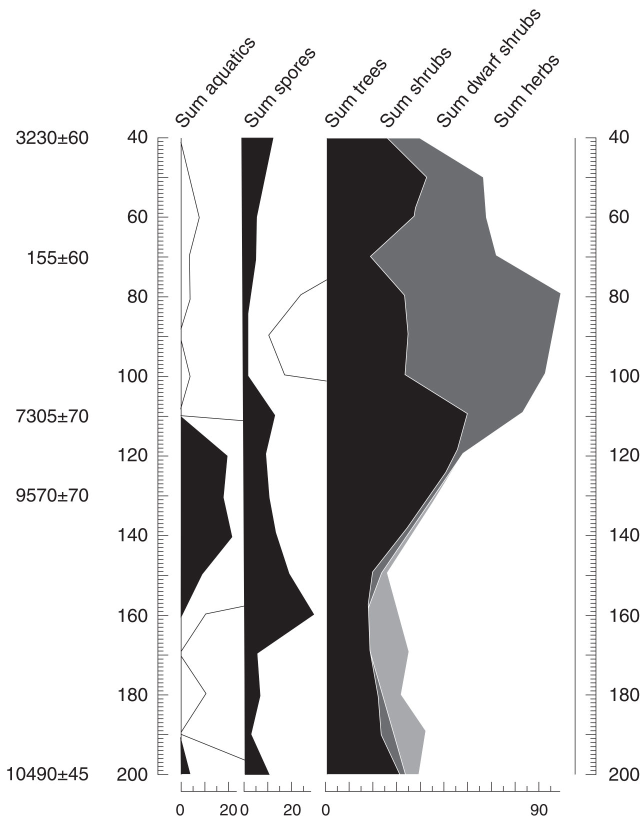

Fig. 3.3 (facing page and above) Lot's Hole, percentage pollen diagram

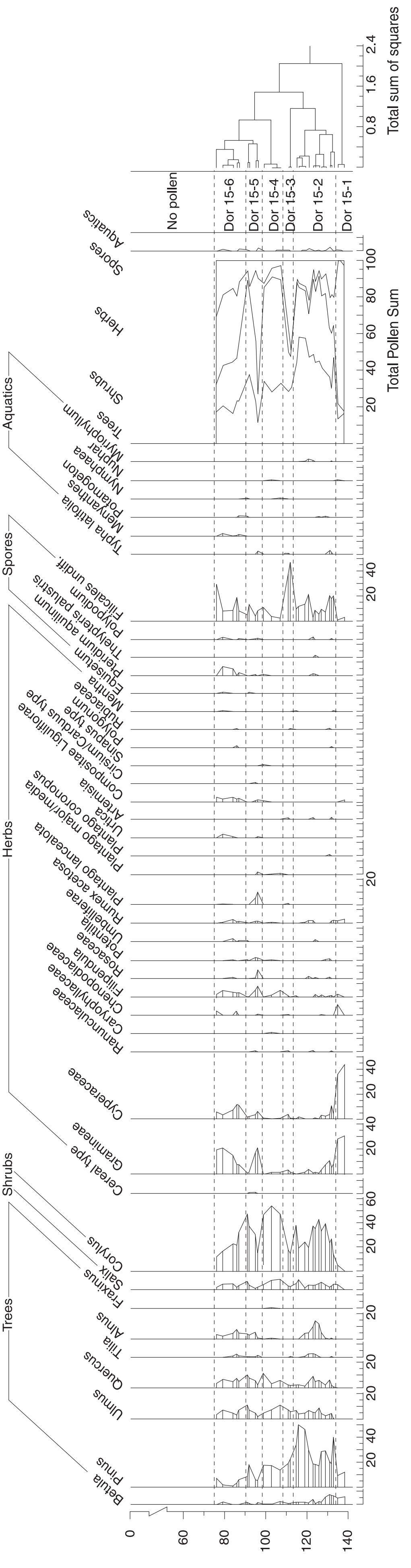

Fig. 3.4 Area 15, percentage pollen diagram

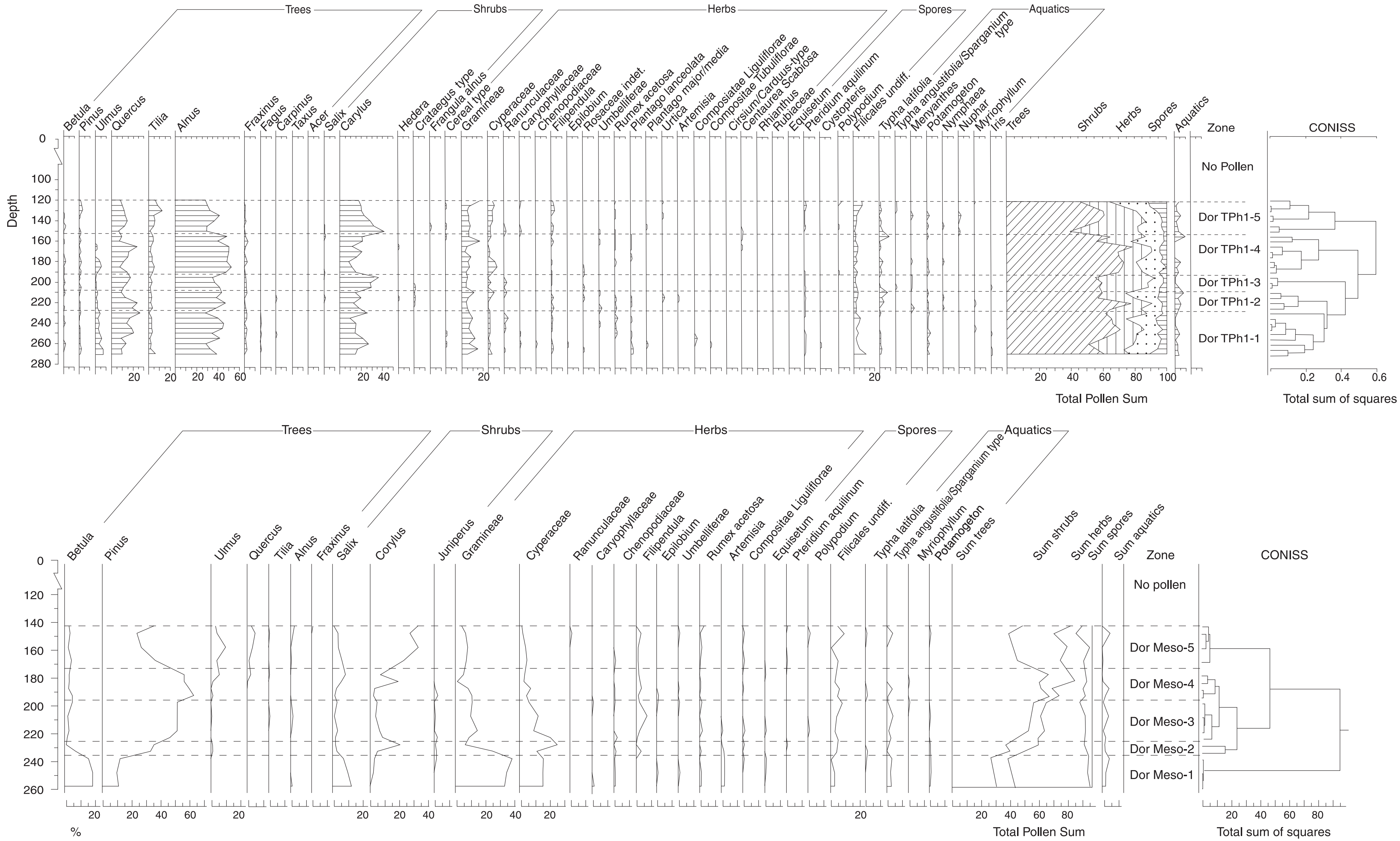

Fig. 3.5 Area 3, columns 615 and 706 (upper), and 648 and 658 (lower), percentage pollen diagram

It is, however, possible that birch-pine woodland persisted much later than elsewhere due to successful competition on poor substrates that excluded taxa such as *Corylus*. *Corylus* is usually an important if not co-dominant component of the vegetation in early post-glacial diagrams (Brown 1988). *Corylus* reaches levels of up to 50%. High levels of *Corylus* led A G Smith (1981) to suggest that humans promoted its expansion. However, his hypothesis was based on observations from North America and not *Corylus avellana* as found in north-west Europe. There is very little indication from the pollen curves at Dorney of major human disturbance. This view is supported by evidence from a number of other workers (Edwards 1982; Edwards and Ralston 1984). Thus, there is no support for the idea that hazel suggests a fire-climax community. There is, however, at Dorney some Mesolithic archaeological evidence for human activity on the site. Both at the Eton Rowing Course and at Lot's Hole there are charred stem fragments and seeds present amongst the macroscopic remains.

The earliest Coleopteran sample, dated to 9220-8740 cal BC (OxA-9411: 9560±55 BP), from the northern backswamp areas behind a levee in Basin R, contained no cold-faunal elements. Both Coleoptera and seeds suggested extensive reedswamp vegetation dominated by *Schoenoplectus lacustris* (true bulrush). The pollen added *Typha latifolia* (reedmace). Some charred stem fragments and seeds of *S. Lacustris* were present amongst the macroscopic remains. It is possible that dead reedswamp vegetation was burnt in winter in the Mesolithic, to facilitate fishing or encourage grazing animals. As has already been mentioned, a very similar radiocarbon date was obtained from the early Mesolithic lakeside site only 50m from this peat. In Area 3 the two peaks in magnetic susceptibility suggest inwash of sediment due to either unstable conditions or enhancement due to burning. The vegetation at this time was more combustible, being dominated by *Pinus*. Charred culm and leaf fragments of *Phragmites australis* (common reed) from the lakeside peat at the Star Carr Mesolithic settlement were interpreted as being derived from the deliberate burning of reed beds (Hather 1998). Episodes of burning were dated as occurring between 8750 BC and 8250 BC (Mellars and Dark 1998). In Inlet Z the basal channel organic layer (4827) contained abundant macrofossil remains of hazelnuts, although there was no direct evidence for their exploitation. The reduction in *Corylus* pollen frequencies was possibly due to the suppression of flowering by shading as the forest canopy developed.

The transition from the Pre-Boreal to the Boreal is shown by the rapid rise in the abundance of *Corylus* and *Pinus* and by the fall in *Betula*. The surrounding woodland in this zone was probably *Pinus-Corylus* woodland. The peak in *Pinus* is high (up to 60% in Area 3 and 50% in Area 15 and 50% at Lot's Hole), and predates the rise in oak, as is common in south-eastern England (Bennett 1984) but not western Britain (Beales 1980; Barber and Twigger 1987). At Iver the maximum peak was 60% (Taylor unpubl.), at Uxbridge 70% (Lewis *et al.* 1992; Lewis and Rackham 2011) and at Enfield Lock 50% (Chambers *et al.* 1996). *Pinus* and *Corylus* dominated the early Mesolithic pollen record from an infilled palaeochannel on the floodplain at Faraday Road, Newbury in the Kennet Valley (Ellis *et al.* 2003). Drying out of the waterlogged areas with an initial colonisation by birch succeeded by pine provides a plausible explanation. It is probable that pine occupied areas previously devoid of extensive woodland. Permanent soil deterioration is unlikely with the later increase of plants on richer soils. Regionally, pine forest dominated on the acid-soils, with an understorey, including bracken, replacing the birch and juniper-*empetrum* heathland.

At *c* 9000 BP, *Betula* was out-competed by *Pinus* and excluded. *Corylus* could have spread faster than the deciduous thermophilous trees the refugia of which would have been further away (Deacon 1974). *Ulmus* and increasing *Quercus* would still have been restricted to higher and drier ground.

On the calcareous and neutral soils, woodland became dominated by *Quercus* and *Ulmus*. As *Quercus* and *Ulmus* produce less pollen than *Pinus*, this change in the arboreal sum may be seen as reflecting the competition and dominance of incoming thermophilous species. The ultimate dominance and expansion of these species may be seen as the result of changes in the conditions of the surrounding area. These changes probably included increasing soil stability, pedogenesis and freer drainage (Brown 1988). The decline in *Corylus* is accompanied by an increase in *Ulmus* possibly pointing to the replacement of hazel by elm on richer soils. The closing canopy would have lead to poorer flowering of hazel and a reduction in its pollen dispersal.

The few bones gave some indication of the mammalian fauna of the riverside woodland. It included aurochs, red deer, beaver and a species of vole. There was no evidence that any of them were ever hunted, although as an aurochs bone was found within the lakeside Mesolithic site, it is very likely that at least the aurochs and red deer were.

While there were later Mesolithic activity surfaces, including hearths, interstratified between the upper alluvial sediments on the floodplain, the occurrence of woodland snails in them suggested that any associated clearances were small. Evidence from riverine molluscs suggests that any habitation was temporary or seasonal.

An interesting feature of the early Holocene at Dorney is the early peak in *Alnus* (at 15% TLP) dated at 8310-8240 cal BC (CAMS-54440: 9070±40 BP), which later declines at 7740-7570 cal BC (CAMS-57206: 8610±50 BP). This predates the early Holocene expansion in *Alnus* into some areas of southern England at *c* 8200 BP – in the lower Thames estuary (Devoy 1979), the Isle of Wight (Scaife 1982) and

Poole Harbour (Haskins 1978) – by as much as 800 years. In the Upper Thames Valley, *Alnus* did not expand until 6800 BP (Day 1991; Parker 1995a). Brown (1988) argued that Alder was present, though not abundant, in southern England at the start of the Holocene, but only expanded later on. He argued that birch and willow had a competitive advantage over alder in the early Holocene that was later reversed as flood plain conditions changed. This, however, does not explain the results at Dorney. A similar early peak in alder, followed by a decline has also been found in London (Sidell pers. comm.). This expansion probably occurred in response to local changes in the water table, which allowed alder to expand into habitats that had either been too dry or wet due to local, site dependent factors such as hydrological thresholds, topography and climate.

The development of backswamp at Dorney probably promoted the early establishment of *Alnus*. The absence of early Holocene backswamp and migrational lag would account for the later establishment of alder in the Upper Thames Valley some 1500 years later. Fire has been suggested as a plausible mechanism for the spread of *Alnus* during the Holocene (McVean 1956; Chambers and Price 1985; Smith and Cloutman 1988). The widespread use of fire by hunter-gatherers and its hypothesised use in prehistory is well attested (Edwards 1988). Mesolithic disturbance and burning are seen as promoting catchment runoff and flushing on low ground (Moore 1986). The decline in *Alnus* may be due to the drying out of the backswamp areas as they became infilled and as greater woodland cover expanded, stabilising the landscape and reducing the amount of runoff. As the backswamp infilled this also favoured the expansion of *Salix* along with Cyperaceae, *Filipendula*, *Epilobium*, *Equisetum*, and *Typha*.

Organic sediments spanning the period from *c* 9000 to 7000 yr BP were absent from the channel sequences at the Eton Rowing Course. At Lot's Hole, however, a much compressed late Mesolithic sequence was present, supporting the above interpretation. A decline in *Pinus* at Lot's Hole was dated to 5300-4940 cal BC (AA-44398 (GU-9485): 6155±60 BP). At the Rowing Course, pollen, macroscopic plant remains and Coleoptera were recovered from a tree-throw hole in Trench 46, dated to 5220-4940 cal BC (OxA-9412: 6130±45 BP), which cut the backswamp sediments (Fig. 3.6; Plate 3.8). Similar evidence came from the floodplain in Trench 56 in Basin W. This evidence suggested that alder carr predominated on the low-lying areas of the site. One of the beetles, *Agelastica alni* (alder leaf beetle) is now extinct in Britain but was widespread in the alder woodlands which once prevailed in many river valleys during the late Mesolithic and Neolithic.

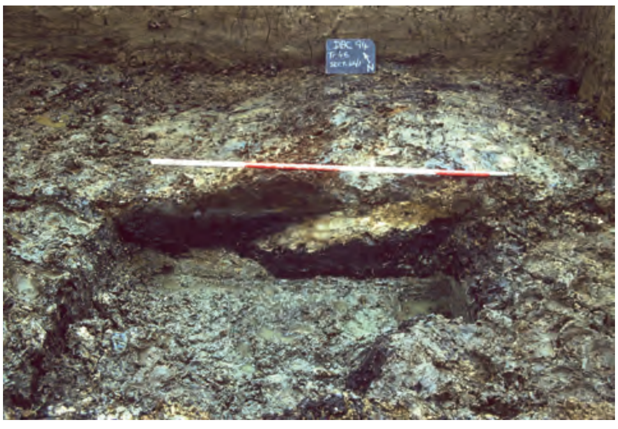

Plate 3.8 Tree-throw hole in Trench 46 containing later Mesolithic flints

The Neolithic

Neolithic sites

In the early Neolithic period evidence for human activity increases significantly across the local area. Evidence of repeated and relatively large-scale occupation was found in the form of middens in hollows in Areas 6 and 10 at the Eton Rowing Course, at Lake End Road West and at Amerden Lane West, while other sites of varying size were found on most of the excavated areas. A high density of monuments and other sites is also evident from cropmarks, fieldwalking and excavations in the surrounding area. Middle Neolithic activity is similarly widespread though less dense. In the late Neolithic and early Bronze Age, activity is also widely but thinly spread. Charred plant remains and animal bones were recovered from early Neolithic middens and tree-throw holes, from early, middle and late Neolithic pits, and from burnt spreads of later Neolithic and early Bronze Age date.

Although it is very likely that the former Thames channel crossing the Eton Rowing Course site was present throughout the Mesolithic, deposition and lateral movement is only evident from the early Neolithic onwards. Excavation of the channel in Areas Ex1-3 (Fig. 6.3), Area 1, Area 16, Area 5 (Fig. 6.25) and Area 3 (Fig. 6.26) provided waterlogged organic deposit sequences dating from the early Neolithic onwards. Neolithic peat deposits were also recovered from Inlet Z in Area 15. Only the deposits in Areas 3, 5 and Inlet Z were examined in detail.

Pollen

Four soil monolith sections (Columns 2334, 2335, 2336, 2337), all from buried soil profiles in a shallow hollow left by a late Devensian/early Flandrian palaeochannel in Area 6, were analysed the extent to which pollen was preserved. The hollow contained early Neolithic midden debris in soils of varying colour and composition. Soil and subsequently alluvial sediment continued to accumulate in the hollow after the Neolithic material had been deposited. Soils have in general received less atten-

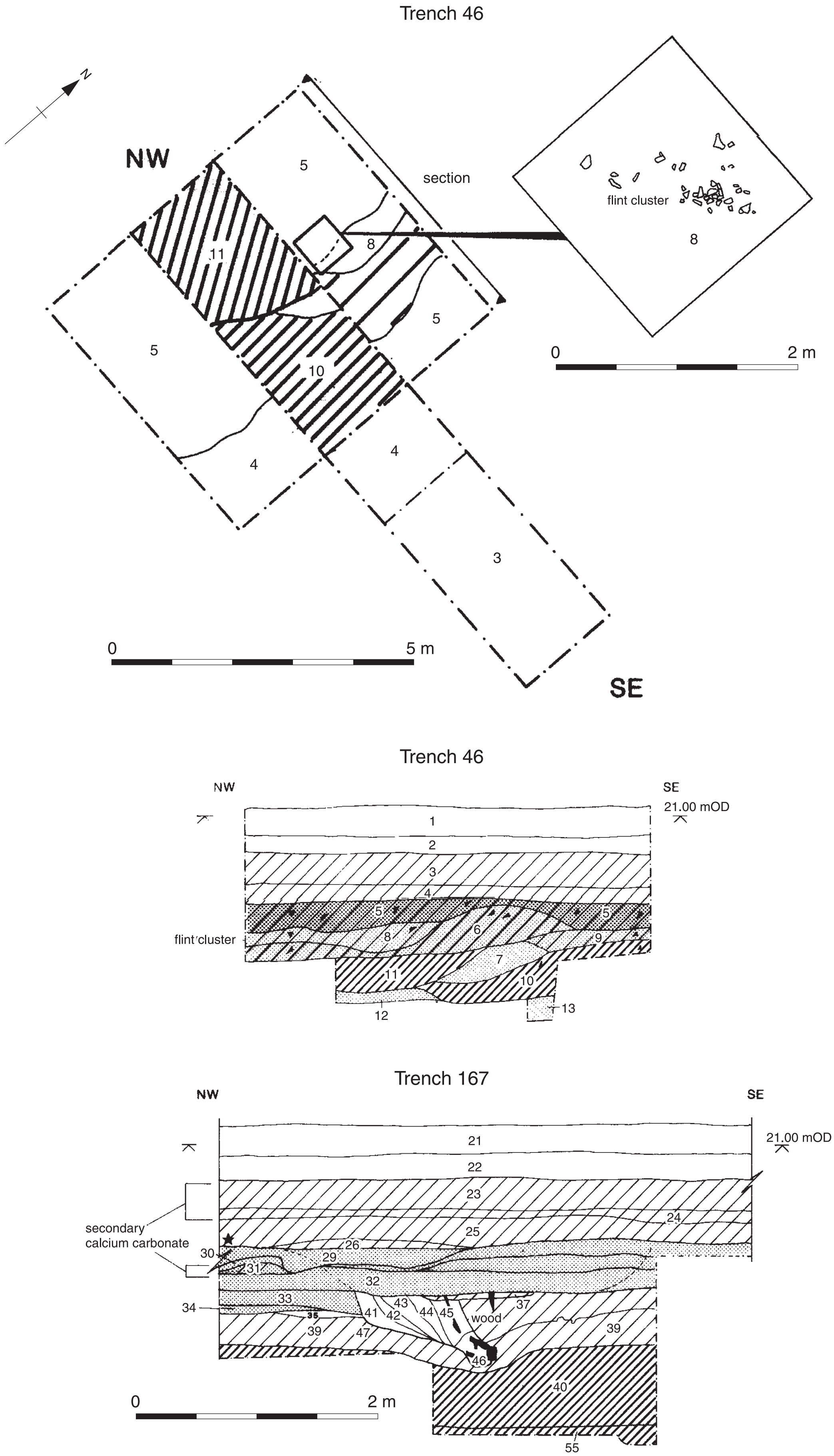

Fig. 3.6 Sections of Trenches 46 and 167, with a plan of the flint cluster in Trench 46

tion from palynologists than waterlogged materials because of the aerobic conditions and vertical mixing of the profile (especially with high populations of invertebrate detrivores) characteristic of them. In this case, pollen preservation was extremely poor in all samples, suggesting that biological decomposition and oxidation had been active. Only a few much-corroded Compositae pollen grains were found, as is characteristic of such conditions. These grains have very thick exines and are resistant to decay.

Charred plant remains

Area 6 midden

The area of the Area 6 midden was gridded and selected 2-metre and 4-metre squares were excavated and sampled for charred plant remains. There was some variation in the thickness of the midden material and some of it extended into tree-throw holes (Plate 3.9) but the results for the charred plant remains suggested it was all part of the same deposit.

There was charcoal from at least ten taxa of trees and shrubs, representing both woodland and scrub. The most numerous, both in terms of the quantity of remains and the number of samples in which they were present, were *Alnus glutinosa* (including some *Alnus/Corylus* type) and Maloideae (hawthorn, apple etc). *Fraxinus excelsior* and *Prunus* cf *spinosa* were also well represented. Charcoal of *Quercus* sp. was present in many of the samples but was not abundant. Other taxa included *Clematis vitalba*, *Ulmus* sp., *Corylus avellana* and, interestingly, *Fagus sylvatica*. *Fagus sylvatica* was represented by eight fragments from four contexts but radiocarbon dating suggested that this material was intrusive, one fragment being dated to cal AD 1440-1650 (OxA-9860: 346±35 BP) and a second to 2880-2460 cal BC (OxA-9926: 4075±65 BP).

A total of 97 cereal grains, 53 hazel nutshell fragments, four stones of wild fruit and two weed seeds were recovered by flotation from a total of 967 litres of soil. The identifiable cereal grains were almost all of *Triticum* sp., mostly *T. dicoccum* (emmer wheat) although there were also three short free-threshing grains of *Triticum turgidum* or *aestivum* (rivet or bread-type wheat). There was a very slight presence of hulled *Hordeum* sp. (hulled barley). Cereal chaff was absent. In addition to the nutshell fragments of *Corylus avellana* (hazel), there were also some stones of *Prunus spinosa* (sloe) and *Crataegus* sp. (hawthorn). Although it was noted above that the *Fagus* charcoal was intrusive, an early Neolithic radiocarbon date of 3950-3660 cal BC (OxA-9890: 4995±40 BP) was obtained on a charred hazel nutshell, and four radiocarbon dates, all between 3800 and 3630 cal BC (OxA-9889: 4935±40 BP; OxA-9819: 4925±40 BP; OxA-9891: 4910± 40 BP and OxA-9859: 4895±50) were obtained on charred grains of *T. dicoccum* from the midden.

Plate 3.9 Tree-throw hole in the Area 6 hollow, part-excavated, looking west, and showing midden debris filling the open half

Area 10 Midden and other sites

A second area where midden debris had accumulated in the top of a hollow left by a palaeochannel was situated in Area 10. Concentrations of charred remains were low but the charcoal included *Fraxinus excelsior*, *Quercus* sp. and Maloideae. There were also a very few nutshell fragments of *Corylus avellana* and cereal grains including *Triticum dicoccum*. Considerable numbers of nutshells of *Corylus avellana* were found in early and middle Neolithic pits along the Flood Alleviation Scheme, particularly at Lake End Road West.

The late Neolithic and early Bronze Age

Late Neolithic and early Bronze Age site activity

Pits of late Neolithic date were found in Area 16 and Area 24 at the Eton Rowing Course, and pits of probable Beaker date in Area 24. Beaker pottery was also found in the hollow in Area 10 on the gravel terrace, and a spread of Beaker and early Bronze Age pottery was found on the edge of the floodplain close to the gravel terrace in Areas Ex1 and Ex2, associated with flint clusters and evidence of burning. Large fragments from early Bronze Age vessels were found further north on the floodplain closer to the former Thames channel. A hearth of early Bronze Age date was found on the floodplain on the north side of Basin R in Trench 159, and further Beaker and early Bronze Age sherds in Evaluation Trenches H and J in Site F East. A Beaker sherd was recovered from Area 15, along with a variety of flint tools including a barbed and tanged arrowhead, and an early Bronze Age sherd and another barbed and tanged arrowhead, together with a scatter of struck flint probably of similar date, were recovered from Area 4. Extensive burnt deposits, probably indicative of clearance, have been found at the Eton Rowing Course in Areas Ex1, Area 16, Area 14 and Area 11.

A spread of round barrows of late Neolithic/ early Bronze Age date was found along the two schemes, and many more are known as cropmarks in the surrounding landscape. Although few have been excavated, they demonstrate the growing number of monuments in the local landscape.

Charred plant remains

Areas 16, 16D and 24 pits

Charcoal was identified from three late Neolithic pits in Areas 16, 16D and 24. *Alnus glutinosa* predominated in the pits (13650 and 16023) in Areas 16 and 16D while *Quercus* sp. predominated in the pit in Area 24. There was also a strong presence of species of thorn, particularly Maloideae but also *Prunus* cf *spinosa* and *Rhamnus catharticus*. Food-plant remains were found in the pit in Area 16, the most numerous items being nutshell fragments of *Corylus avellana* but some cereal grain including *Triticum dicoccum* was also present.

Areas WB and 16 burnt mounds

Late Neolithic and Beaker burnt mound deposits were found on the bank of the palaeochannel in Area 16 (Figs. 8.3-4), and (covering a length of 20m or more on the opposite bank) in Area 14. Charcoal from layer 12812 gave a radiocarbon date of 2900-2620 cal BC (OxA-10226: 4190±45 BP), while charcoal from layer 12177 gave a date of 2570-2280 cal BC (OxA-10227: 3920±40 BP). Both contained much charcoal of *Alnus glutinosa*. Maloideae charcoal was also well represented in both of them. Charcoal of *Quercus* sp. was present but not abundant.

Area 11 burnt mound

Much charcoal of *Fagus sylvatica* was present in a 'burnt mound' deposit (10700) in Area 11 (Plate 3.10; Fig. 9.19), and an early Bronze Age radiocarbon date of 2200-1930 cal BC (OxA-10228: 3666±40 BP) was obtained on it. The deposit also contained charcoal from other trees and shrubs, particularly *Alnus glutinosa*. An earlier, late Neolithic date for *Fagus sylvatica* was obtained from the Area 6 midden (see above).

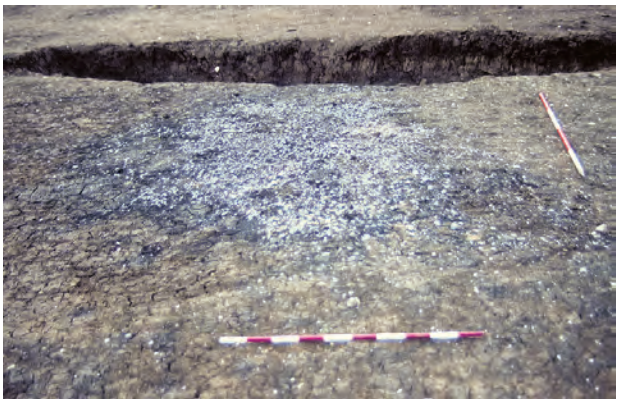

Plate 3.10 Burnt mound deposit 10700 in Area 11

Area 6 tree-throw hole 5382

A sample from a Neolithic to early Bronze Age tree-throw hole contained some cereal grains including *Triticum* cf *dicoccum* and tubers of *Arrhenatherum elatius* ssp. *bulbosum*. *A. elatius* is a grass of ungrazed grassland.

Marsh Lane East Site 2

An early Bronze Age cremation pit (70037) from the centre of a ring ditch on this site produced only charcoal of *Quercus* sp., implying the deliberate selection of this species for use in the cremation pyre.

Neolithic and Bronze Age channel evolution

The switch to an oceanic climate with increased rainfall at the start of the Atlantic climatic period caused an increase in flow rates in streams and rivers. This appears to have re-activated the flow in many of the palaeochannels, frequently resulting in the truncation of sediments. This has been well documented across southern Britain with notable examples including the Ouse Valley, Sussex (Scaife and Burrin 1983) and the Kennet Valley (Collins 1994).

From about 5200 BP (around the start of the Neolithic) onwards, the pattern of activity shown by the former Thames channel changed. There were episodes of bank sedimentation and erosion which tended to occur on the southern side of the channel. The last episode of erosion perhaps belonged to the late Bronze Age (see Area 3). The movement of the channel was restricted to a relatively narrow zone. There was no large-scale development of meanders or channel avulsion. These sediments mostly comprised calcareous organic silts and sands, with much broken shell and tufa or carbonate encrustations.

The rich aquatic fauna and flora from the Neolithic and early Bronze Age channel sediments suggest that the Thames was a well-vegetated river carrying unpolluted well-oxygenated water. The most numerous of the aquatic molluscs such as *Bithynia tentaculata* and *B. leachii* require clean flowing water (or large lakes). One of the water snails, *Gyraulus acronicus,* is restricted to the Thames drainage system. The most abundant aquatic beetles, the Elmidae, have similar requirements, clinging to stones and aquatic plants. Most of them, if they occur at all in the Thames at present, are restricted to weir outflows and fast-flowing tributary streams. Two of them, *Stenelmis canaliculata* and *Macronychus quadrituberculatus*, are now extinct in the Thames. Two more water beetles from the Neolithic and early Bronze Age sediments, *Helophorus arvernicus* and *Helichus substriatus*, no longer occur in the Thames. The caddis cases were mostly of *Ithytrichia* sp., which requires running water. The occurrence of the freshwater limpet *Ancylus fluviatilis* suggests that the channel had a stable stone bed in places. The beetle *Macronychus*

Plate 3.11 Photograph of the early Neolithic phase channel in Area Ex2, showing the trunk of an oak tree that was growing on the levee fallen at right angles into the channel

quadrituberculatus has larvae which feed on decaying submerged wood (Freude *et al.* 1979, 294; Olmi 1976, 209). Wood was present in the channel both from fallen trees and beaver lodges.

Some lengths of the channel were sufficiently slowly flowing for floating-leaved plants such as *Nymphaea alba* (white water lily), *Nuphar lutea* (yellow water lily) and *Potamogeton* spp. (pondweed) to become established. These plants were represented both by their seeds and by phytophagous beetles, *Donacia crassipes* feeding on the water lilies and *D. versicolorea* feeding on the pondweed. A tall emergent community of *Schoenoplectus lacustris* (true bulrush) probably grew towards the margins of the channel. This plant was indicated by seeds and the beetle *D. impressa* for which it is the only host plant. The presence of some *Phragmites australis* (common reed) was suggested by the beetle *D. clavipes*. The marginal vegetation probably slowed the flow of water sufficiently for beetles such as *Hydrobius fuscipes* and *Ochthebius minimus*. There were some seeds from plants of shallow water and bankside mud such as *Alisma* sp. (water plantain), *Myosotis aquaticum* (water chickweed), *Oenanthe aquatica* gp. (water Plantain) and *Rorippa* cf *palustris* (marsh yellow cress). The occurrence of the beetle *Aphthona nonstriata* indicates the presence of *Iris pseudacorus* (yellow flag). There were also some beetles of waterside mud such as *Dyschirius globosus*. However, the macroscopic plant and invertebrate remains gave no evidence for extensive riverside marshes or fens. In this respect the Neolithic river differed strongly from the early Mesolithic river. While there would undoubtedly have been some areas of seasonally exposed mud, there seems mostly to have been a relatively abrupt transition between aquatic and terrestrial habitats. Where the bank was stable, it probably supported *Urtica dioica* (stinging nettle) and *Lythrum salicaria* (purple loosestrife), and where the bank was eroding, short-lived plants such as Bra*ssica rapa* ssp. *sylvestris* (wild turnip) probably colonised.

The excavation of lengths of the Thames palaeochannel in Areas Ex1-3, 1, 3 and 5 provided an interesting opportunity to view a Neolithic channel in plan. One of the Neolithic episodes of erosion resulted in the undermining of *Quercus* (oak) trees that had been growing along the bank, causing them to topple into the channel (Plate 3.11). Much of the edge of the channel had logjams of

Plate 3.12 Beaver-gnawed branch showing characteristic tooth-marks on the facets

Plate 3.13 Photograph of the early Neolithic channel in Area Ex3, showing wood spread along the channel edge

driftwood, including mature trees. In places, tall *Fraxinus excelsior* (ash) trees had fallen onto them from the bank. These obstructions were rapidly covered with organic sediment and thus preserved.

Human activity continued in the area throughout the Neolithic and early Bronze Age. No evidence of felling was noted amongst the trees in the river although unfortunately few were examined for axe marks. However, much beaver-gnawed wood, including probable lodge structures in Areas Ex1 and Ex3, along with the skeleton of a beaver, were found in the channel (Plates 3.12-14). Beaver food caches were also found in Ex3 and perhaps in Area 5 (Plates 3.15-16). The activities of the beavers did not completely block the flow along the Thames palaeochannel but it is likely that they influenced patterns of sedimentation and erosion within it. Beaver activity in the smaller channels perhaps included damming them to create pools and could even have resulted in channels becoming cut off from the Thames. Beavers are likely to have influenced the composition of marginal woodland with their feeding. They are believed to favour the bark of *Salix* spp.(willow) and *Populus* spp. (poplars) over *Alnus glutinosa* (alder; Coles 2006, 5). At the Eton Rowing Course, however, the favoured species appear to have been *Ulmus* (elm) and *Fraxinus excelsior* (ash). It is likely that beavers were active throughout the length of the Thames during the Neolithic and early Bronze Age. A bundle of beaver-gnawed twigs of early Bronze Age date was found at Runnymede (Coles 2006, 96-7; Robinson in Morigi *et al.* 2011, 184).

Plate 3.14 Photograph of partial exposure of tangled trunks and logs at the edge of the channel in Area Ex3, probably the remains of a beaver lodge

Plate 3.15 Detail showing large trunk with small beaver-gnawn branches adjacent, presumably representing a food cache or store

Plate 3.16 Detail of the gnawed ends of two of the small branches

The results from Dorney give a very similar picture of the Neolithic and early Bronze Age environment of a major channel of the Thames to that from a channel of similar age at Runnymede (Needham 1991). It is likely that the river was of such a character along much of its length.

The Neolithic and early Bronze Age landscape

At the start of the Neolithic there was a period of deep channel incision in Area 3 and re-activation of the channel in Area 15 with renewed sedimentation in both areas. The pollen flora was dominated by a woodland assemblage, with high frequencies of *Alnus* sp. and *Corylus* sp., along with *Quercus* sp., *Ulmus* sp. and a little *Tilia* sp. (lime). This is more apparent in Area 15 than in Area 3. Both spectra show a decrease in arboreal taxa and increase in non arboreal pollen. A similar picture is shown at Lot's Hole. In both Areas 3 and 15 the onset of incision and sedimentation occurred at approximately 5000 BP. In Area 15 Inlet Z (1501) sedimentation was slow with a compressed sequence, whilst in Area 3, the channel (samples 706 and 615) was characterised by rapid infill, 1.5m of sedimentation occurring in 600 radiocarbon years compared with 0.25m in 1000 years in Area 15. The channel in Area 3 is characterised by shell-rich, carbonate silts.

In Area 15, the high *Pinus* and *Ulmus* values plus *Quercus* and Filicales are possibly due to incision into older channel sediments with some reworking. There are much lower frequencies of alder suggesting a much drier location, the selective removal of alder in this area, or a closer proximity to surviving woodland elements. Area 15 was not part of a major channel at this stage, and reactivation of the channel is likely to have resulted from local runoff from the terrace draining into the main palaeochannel downstream over a period of time.

The arboreal taxa are generally high with *Quercus*, *Ulmus*, *Tilia* and *Fraxinus* comprising the regional woodland. *Tilia* would have been more abundant in areas with base-rich, well-drained soils. During the mid-Holocene (Neolithic) *Alnus* was well-established, forming dense woodland on the floodplain region at Dorney. The presence of suitable damp soils would seem the most important factor affecting its distribution in the region. Brown (1988) has suggested that lime is intolerant of waterlogging. It must be noted that *Tilia* has durable resistant grains (cf Havinga 1967; 1971) and thus, there is a danger of selective preservation especially in small sites (Bradshaw 1981). The possible under-representation is probably due to poor dispersal rather than low pollen productivity (Godwin 1975).

Locally, *Alnus* largely replaced *Salix* and *Corylus*, though these persisted along with *Frangula alnus*. The presence of *Polypodium* (an epiphyte in wet woodlands) in the Dorney sequences suggests dense, damp woodland elements on the floodplain areas.

There was probably dense alder woodland over much of the floodplain (alder forming up to 50% of the total pollen sum in Area 3), an interpretation confirmed by the presence of numerous seeds, female catkins etc of *A. glutinosa*. Plant macrofossil remains tend to be rich throughout profile Dor TPh1 (Area 3), especially fruits and catkin scales of *Alnus glutinosa*. At Lot's Hole *Alnus* wood was also found in the sediments. Closed alder woodland had probably shaded out willow swamp.

The macroscopic plant and invertebrate remains from Area 3 at Dorney enable a more detailed picture to be built up of the floodplain woodland. The continued presence of the beetle *Agelastica alni* and the occurrence of other alder-feeding insects such as the weevil *Rhynchaenus testaceus* support the botanical evidence for alder woodland. The paucity of remains of other shrubs, particularly nuts of *Corylus avellana* (hazel) suggest that the woodland was sufficiently dense to prevent the establishment of much of an understorey. The herbaceous flora of the woodland floor was probably sparse with, for example, low-growing plants of *Moehringia trinervia* (three-nerved sandwort) on soil that was only sparsely vegetated. However, it must be stressed that, unlike the Mesolithic period, the floodplain vegetation comprised alder woodland growing on a mineral soil, not alder carr growing on fen peat. Indeed, as the fallen oak tree in the channel showed, there were some trees less tolerant of waterlogged conditions growing on the floodplain.

There was similar evidence from Runnymede for the development of alder woodland on the floodplain alongside a channel of the Thames by the Neolithic period (Greig 1991). A full woodland insect fauna was present at Dorney but Runnymede had a greater range of woodland beetles dependent on very old, moribund trees and dead wood that are now very rare or extinct in Britain. A similar picture has emerged for the Upper Thames, with alder woodland on the floodplain at Buscot Lock in the late Neolithic (Robinson and Wilson 1987). Closed alder woodland was also detected on the floodplain of the river Windrush in the Mesolithic and at Sparham Fen (Parker 1995a).

Tilia and *Quercus* pollen remain relatively high during this period, indicating *Tilia*- and *Quercus*-dominated woodland, as both are poor pollen dispersers. *Tilia* is considerably under-represented in modern pollen spectra (Andersen 1973) and its importance at Dorney is difficult to assess. *Tilia* pollen reaches up 10%, which is quite high when compared to the rest of Britain. It is probable that it was a more significant component than its pollen percentages suggest. The paucity of macroscopic remains of trees other than *Alnus* implies that they were growing in areas more remote from the channel at the Rowing Course than the alder woodland. It is likely that mixed oak-lime woodland with a hazel understorey grew on the Shepperton Terrace and other higher ground. Although *Fagus* (beech) charcoal in the early Neolithic midden in Area 6 was probably intrusive, fragments gave a late Neolithic date of 2880-2460 cal BC (OxA-9926: 4075±65 BP), and securely stratified *Fagus* charcoal from the 'burnt mound' in Area 11 was dated to 2200-1930 cal BC (OxA-10228: 3666±40 BP) in the early Bronze Age. *Fagus* was probably a minor component of the woodland, especially where the soil was well drained and shallow. It should also be noted that there is an increase of thermophilous trees other than *Alnus* such as *Fraxinus*, *Carpinus* and *Fagus*. The continuous curve for *Fraxinus*, considering its under-representation in the pollen record, points to local presence in forest openings on better soils, on wet mineral soils or streamsides (Beales 1980; Godwin 1975). There was a slight presence of *Quercus*, *Fraxinus* and *Corylus* amongst the waterlogged macroscopic plant remains, and their occurrence was also suggested by some of the phytophagous Coleoptera.

The pollen sequences from Dorney appear narrowly to post-date the Elm Decline, which generally occurs *c* 5100 yr BP (see Parker *et al.* 2002 for a full account of the *Ulmus* decline). The *Ulmus* decline has been recognised from a number of sites in the London region (eg Tilbury, Crossness, Stonemarsh, Broadness, Bryan Road, Silvertown, and Bramcote Green; Branch *et al.* 2005). It has been suggested that at this time the climate in Britain became more continental in nature (Parker *et al.* 2002). Branch *et al.* (2005) noted changes in stratigraphy and vegetation cover at Bramcote Green and Hornchurch Marshes that implied reduced moisture levels.

Around 10% of the terrestrial Coleoptera from the Area 3 sequence fell into Species Group 4 – wood and tree-dependent species. Such a value, combined with the evidence from the other insect remains for the occurrence of a balanced woodland fauna possibly reflected a catchment with at least half, possibly more, woodland cover. The transition between zones Dor 15-4 and Dor 15-5 in profile 1501 from Area 15 shows a disturbance phase with a marked decrease in arboreal and tree pollen types and an expansion of non-arboreal types, especially Gramineae, *Filipendula*, *Plantago lanceolata*, Rosaceae and *Potentilla*. An example of *Scolytus scolytus* (elm bark beetle) was found in the sample dated to 3660-3510 cal BC (CAMS-57208: 4800±40 BP). Remains of *S. scolytus* has also been found at Hampstead Heath below the elm decline horizon. *S. scolytus* is the modern host carrier of the ascomycete fungus *Ophiostoma ulmi* which causes Dutch Elm disease. It has been suggested that this disease was the cause of the Elm Decline. Whilst *S. scolytus* may have been a key component of the mid-Holocene *Ulmus* decline it is possible that some degree of prehistoric land clearance was a prerequisite for the beetle to spread rapidly across the landscape.

The peak in disturbance in profile 1501 was dated to 3640-3370 cal BC (CAMS-57207: 4730±40 BP; context 4822). This event is much less apparent in Area 3 where the dominance of alder dilutes the effects of any disturbance, but this also suggests that the clearance episode was localised and restricted to the drier ground. Further disturbance and clearance occurred between 2900-2630 cal BC (CAMS-57209: 4200±40 BP).

This pollen evidence suggests clearance for the grazing of domesticated animals. There is little or no sign of arable cultivation in the pollen sequences, although, as already stated, four charred cereal grains from Area 6 have been dated to between 3800-3630 cal BC.

All three insect assemblages from the 5th millennium BP sequence at Area 3 showed evidence for grassland and the presence of domestic animals. Species Group 11 – beetles with larvae that feed on the roots of grassland plants – such as *Phyllopertha horticola*, *Agrypnus murinus* and *Agriotes* spp. formed around 5% of the terrestrial Coleoptera. These beetles do not usually occur under woodland conditions where the tree cover is sufficient to shade out young vegetation on the woodland floor and indeed were absent from the Mesolithic samples. Their abundance in Neolithic samples from Area 3 was at a level which suggested that at least a quarter of the catchment was grassland. There was also a significant component of beetles from Species Group 3 – weevils which feed on clovers and vetches. They are favoured by hay meadow conditions but also flourish on other grassland which is not being heavily grazed. They included *Sitona* cf *hispidulus*, *S. puncticollis* and *Apion* spp. The grass-feeding leaf beetle *Crepidodera ferruginea* was also present.

Although there was pollen from a range of grassland plants, the waterlogged seeds only included a small grassland element. This was possibly because the main open areas were some distance from the river channel. However, potential members of the grassland community represented by seeds included *Ranunculus* cf *repens* (buttercup), *Lychnis flos-cuculi* (ragged robin), *Filipendula ulmaria* (meadowsweet), *Potentilla reptans* (creeping cinquefoil), *Rumex conglomeratus* (sharp dock) and *Prunella vulgaris* (selfheal). Some seeds of possible weeds of cultivation were also present including *Brassica rapa* ssp. *sylvestris* (wild turnip), *Stellaria media* (chickweed), *Chenopodium album* (fat hen) and *Atriplex* spp. (orache). However, they could also have been growing on other disturbed-ground habitats including eroding river banks.

The scarabaeoid dung beetles of Species Group 2, which are favoured by the droppings of domestic animals, averaged about 8% of the terrestrial Coleoptera. One of them, *Onthophagus nutans*, is now extinct in Britain. Some of the various beetles of more general foul organic material of Species Group 7 could have also been associated with animal droppings, but others are likely to have lived in riverside accumulations of decaying plant debris etc. The concentrations of dung beetles were sufficiently high to suggest continuous grazing of domestic animals in the vicinity of the Thames at Dorney throughout the period represented by the sediment sequence.

Some light-demanding thorn scrub was suggested by seeds of *Rhamnus catharticus* (purging buckthorn) from the palaeochannel sediments. The charcoal, however, gave much more evidence of thorn scrub fringing the open areas. Charcoal of Maloideae (hawthorn, apple etc) was abundant in the early Neolithic midden in Area 6, while there was a strong presence of charcoal of Maloideae, *Prunus* cf *spinosa* (sloe) and *R. catharticus* in the late Neolithic pits of Areas 16, 16D and 24. These shrubs would have been able to resist the grazing pressure of domestic animals.

The results from the Neolithic palaeochannel sediments at Dorney present a very similar picture to those from a similarly wide range of biological evidence from a Neolithic palaeochannel at Runnymede (Greig 1991; Robinson 1991). Both suggested dense alder woodland on the floodplain and mixed deciduous woodland including oak and lime on higher ground. Likewise, both gave evidence for an open component to the landscape with grazing by domestic animals. However, there were differences between them. Runnymede had a greater range of old woodland beetles dependent on very old moribund trees and dead wood that are now very rare or extinct in Britain, suggesting a somewhat different character to the woodland. The proportions of wood and tree-dependent Coleoptera and of scarabaeoid dung beetles were higher at Dorney, suggesting that although there was perhaps a greater degree of tree cover, there was also more grazing by domestic animals. However, both areas probably had Neolithic landscapes that were mosaics of old woodland, clearances which were being grazed and included limited cultivation, and abandoned clearances with developing woodland. There was no evidence from either site for progressive clearance during the Neolithic. As new areas were cleared so former clearings were becoming colonised by secondary woodland.

The uppermost layer of mineral alluvium overlying the Neolithic organic channel sediment yielded an age of *c* 2400-1400 BC (OXosl-968b: 3900±500 BP, see Appendix 6). The later phase channels in Area 5 and the uppermost levels in the Lot's Hole sequence show a progressive decline in woodland across the floodplain environment when compared with the Neolithic channels. There is evidence for more general woodland clearance, and local woodland clearance cannot be ruled out. Burnt spreads and horizons at the Eton Rowing Course occur in the late Neolithic, the late Neolithic/Beaker period and in the early Bronze Age. The deposits and their dates are: Area 16 layer 12812, with a date range of 2900-2620 cal BC (OxA-10226: 4190±45 BP), Area 14 layer 12177, dated to 2570-2280 cal BC (OxA-10227: 3920±40 BP) and Area 11 layer 11400, dated to 2200-1930 cal BC (OxA-10228: 3666±40 BP). The rise of arable agriculture is evident with indicators including cereal and weeds of disturbed soils such as Chenopodiaceae, *Artemisia*, *Anthemis t.*, *Plantago major/media* and *Polygonum*. The earlier presence of cereal type pollen may, however, reflect the presence of wild grasses such as *Glyceria maxima* with pollen grains sufficiently large enough to qualify as cereal type.

Floodplain grasslands are represented by Gramineae, Cyperaceae, Compositae Liguliflorae, Compositae Tubuliflorae, *Plantago lanceolata*, Ranunculaceae, Rubiaceae and *Rhinanthus*. Some of the taller growing herbs may reflect floodplain pastures which were left ungrazed through the summer to provide hay or foggage later in the season. Thus, the high frequencies of Gramineae pollen (unlikely in a heavily grazed pasture) and the presence of Umbelliferae and *Rhinanthus* are suggestive of grassland that was not being grazed heavily.

Similar results were given by molluscs from early Bronze Age alluvium overlying the Neolithic organic channel sediments in Area 3. The main terrestrial snail was *Vallonia pulchella* which, along with *Carychium* sp., suggests tall grasses alongside the channel.

Neolithic and early Bronze Age agriculture and the procurement of biological resources

Neolithic

Radiocarbon dates of 3950-3660 cal BC (OxA-9890: 4995±40 BP) on a charred hazel nutshell and 3800-3640 cal BC (OxA-9889: 4935±40 BP) on a charred grain of emmer wheat from the early Neolithic midden at Area 6 showed that the collection of food plants and the cultivation of crops co-existed almost from the start of the Neolithic. The food-plant remains from this midden fell into the typical Neolithic pattern in which cereals were being cultivated but wild food plants, particularly hazelnuts were also being collected (Moffett *et al*. 1989; Robinson 2000a). Somewhat similar results were given by the midden in Area 10 although the concentration of remains was very much lower. A late Neolithic pit in Area 16 likewise contained hazel nutshell fragments and a little cereal grain. The cereals, *Triticum dicoccum* (emmer wheat), free-threshing *Triticum* sp. (rivet or bread wheat) and hulled *Hordeum* sp. (hulled barley), and the gathered nuts and fruit, *Corylus avellana* (hazel), *Prunus spinosa* (sloe) and *Crataegus* sp. (hawthorn) are the familiar range recorded from other Neolithic settlements (Moffett *et al.* 1989).

Wheat and barley scatter little pollen to the wind so it is unsurprising that the location of the cultivation plots was not detected by any of the pollen sequences from the palaeochannels. The cereals could readily have been grown in small clearings on the Shepperton Terrace including some of the islands. The pollen results confirmed the local availability of hazel.

Much of the charcoal was of *Alnus glutinosa* (alder) suggesting that the floodplain woodland was one of the main sources of fuel. Lesser quantities of other woodland trees including *Fraxinus excelsior* (ash) and *Quercus* sp. (oak) were also exploited. The occurrence of charcoal of Maloideae (hawthorn, apple etc), *Prunus* cf *spinosa* (sloe) and *Rhamnus catharticus* (purging buckthorn) was

Plate 3.17 Views of a bear bone fragment from Area Ex2 alongside a modern specimen from an Alaskan brown bear (© Natural History Museum)

perhaps the result of thorn scrub encroaching on open areas being cut back and added to the fuel.

The bones of domestic animals were vastly in the majority in the early Neolithic, and thus domestic cattle, followed by sheep and goats, and then by pigs, must have provided the main source of meat and other animal products (see Appendix 3). Cattle were most numerous, and isotope studies elsewhere have shown that some Neolithic cattle had high levels of fungi in their diet, consistent with their having been woodland browsers. Although isotopic analysis of a Neolithic pig at the Rowing Course suggested similarly high levels of fungi, the isotopic levels of the Eton Neolithic cattle did not show any such indicators (Stevens *et al.* 2012), although the sample of bones studied was admittedly small. It is, however, likely that some woodland was opened up to provide browsing as the first stage of clearance.

The presence of sheep implies some relatively short-turfed unshaded grassland, and in the early Neolithic over a quarter of the animal bones were of sheep (and possibly goats). The relative abundance of sheep, and the lower numbers of pigs, suggest that animal husbandry was not entirely dominated by the use of woodlands, and that grassland clearings were an important part of the early Neolithic landscape, as the Area 3 insect assemblages suggest. It is even possible that the early Neolithic pig bones all belong to wild pigs, though more probably some were domesticated.

Plate 3.18 Partial pig skeleton recovered on the western bank of palaeochannel

Other wild animals were certainly being exploited, including aurochs, red deer and roe deer. Despite the greater size of aurochsen and red deer compared to domestic cattle, it is considered unlikely that they contributed more than 10% of the meat in the early Neolithic diet. All of these wild species could have lived in the woodland of the Dorney area, and both wild and domesticated pigs probably spent much of their lives rootling in woodland. An unusual discovery on the floodplain in Area Ex2 was part of the scapula of a brown bear (Plate 3.17). This was found on the alluvial floodplain, and is not radiocarbon dated, but stratigraphically appears to belong in the early Neolithic horizon, rather than in the later Mesolithic. The scapula is that of a large individual, similar to Alaskan brown bears nowadays, and indicates that large carnivores, as well as large herbivores, were still present in the vicinity during this period.

The Neolithic environmental evidence is not comprehensive enough to distinguish clear changes within the 4th millennium BC, but it may be noted that the much smaller animal bone assemblage of middle Neolithic date from Area 6 at the Eton Rowing Course has a very different composition, including a much larger proportion of wild species, particularly deer. The low proportion of remains from domestic animals is in contrast to finds from the middle Neolithic at nearby Runnymede, where only five red deer, all antler pieces, were found, in a sample of 407 identified bones (Done 1991).

Sheep and goats became less common at the Rowing Course in the middle Neolithic, and even rarer in the late Neolithic, while pigs became the second most numerous species, with bones forming over 25% of the late Neolithic assemblage (Plate 3.18). Charred cereals were also much less commonly recovered in the middle and late Neolithic periods. At the very least, this evidence supports the view that considerable woodland persisted in the local area throughout the middle and late Neolithic, and may even have increased in extent. This is in line with the environmental evidence from Runnymede for the later Neolithic (Robinson in Morigi *et al.* 2011, 184), and for the middle Neolithic with that from Daisy Banks Fen near Radley in the Upper Thames Valley (*ibid*., 183).

The middle Neolithic bones from the Rowing Course, together with the other indicators, may indicate less dense occupation than at Runnymede. The assemblage sizes for the middle and late Neolithic are, however, small, and the interpretation of material from dryland or floodplain archaeological features (like these at Dorney) is much less straightforward than that of environmental data from the palaeochannels, as what is deposited can be highly influenced by cultural factors. There is

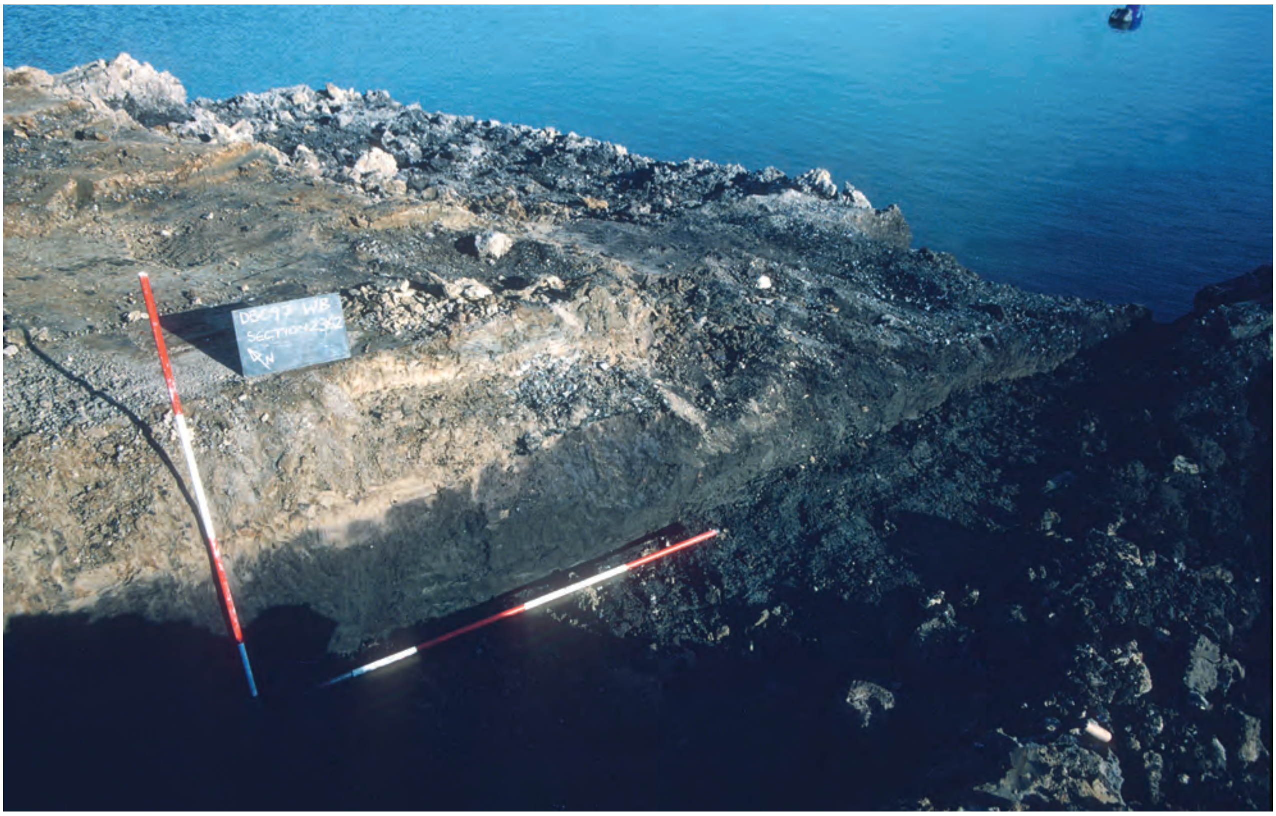

Plate 3.19 Burnt flint deposit 12177 on the western bank of palaeochannel

evidence for further clearances along the edge of the Thames palaeochannel in Areas 3 and 16 in the late Neolithic.

Early Bronze Age

Few early Bronze Age food-plant remains were found but remains from a tree-throw hole in Area 6 of late Neolithic to early Bronze Age date showed that *T. dicoccum* remained in cultivation. It is uncertain whether the gathering of hazelnuts remained a major activity. The *Alnus* woodland continued as an important source of fuel. However, *Fagus sylvatica* (beech) was one of the main types of charcoal from an extensive area of clearance incorporating a 'burnt mound' in Area 11 perhaps suggesting it was necessary to exploit woodland further afield to obtain sufficient fuel.

The early Bronze Age landscape was more open than that of the Neolithic, and it is thought likely that there was less dependence on woodland grazing. Indeed, the occurrence of carbonised tubers of *Arrhenatherum elatius* ssp. *bulbosum* (onion couch grass) in Area 6 suggests that there was open land which was neither being cultivated nor heavily grazed. Further clearances of Beaker-period and early Bronze Age date, represented by extensive burnt mound deposits, occurred on the west bank of the palaeochannel in Area 14 and on the edge of the gravel terrace in Area 11 where it dipped onto the floodplain (Plate 3.19; see also Plate 3.10) Another similar deposit was found on the terrace edge during evaluation (Trench 181; Plate 3.20). This was not radiocarbon dated, but is also likely to have belonged to this period.

Among the small assemblage of animal bones ascribed to this period, sheep are better-represented than in the late Neolithic, and horse may also appear for the first time. The dating of these bones is not entirely certain, but they are consistent with the opening up of the landscape suggested by the other environmental indicators.

Conclusions

The hydrological and vegetational changes that occurred at Dorney in the late Devensian and the transition to the Holocene were the results of the abrupt climatic amelioration that concluded the Devensian, with sea surface temperatures rising 9º C in less than 50 years (Koç Karpuz and Jansen 199w). A transition from unstable minor braided channels to multiple broad incised channels also occurred in the Upper Thames Valley towards the end of the late Devensian (Robinson and Lambrick 1984; Parker 1995a). More recent work on the Upper Thames at Yarnton has similarly shown some broad channels were subsequently isolated by downcutting at the end of the late Devensian. The Holocene regime of simplification of a multiple channel system by silting and of lateral channel stability are also features of the Upper Thames Valley (Robinson

Plate 3.20 Burnt mound deposit spilling from the edge of the gravel terrace onto the floodplain in evaluation Trench 181

1992, 198). However, there was no early Holocene formation of backswamp on the lowest parts of the floodplain of the Upper Thames. There the floodplain remained dry and above ordinary flood levels until at least the late Bronze Age, with flooding not becoming widespread until the middle Iron Age (Robinson and Lambrick 1984; Robinson 1992, 200-1). The other site on the Middle Thames where a palaeochannel sequence has been studied in detail is downstream at Runnymede Bridge (Needham 1991; 1992), where horizontally-bedded Mesolithic marl and clay alluvium were perhaps analogous to the backswamp sediments at Dorney.

It is possible that most of the alluviation which filled the backswamp at Dorney occurred within the first 1000 years of the start of the Holocene, before the development of dense woodland throughout the catchment had fully stabilised Pleistocene sediments. There followed perhaps 4000 years of much-reduced sedimentation. The change of channel activity from around 5200 BP, with episodes of erosion and sedimentation, imply occasions of greatly increased flow. It is tempting to link this to Neolithic and Bronze Age clearance activity. However, it must be noted that a major component of the sediments deposited was calcium carbonate that had entered the drainage system in solution, rather than sediment that had been eroded from soil exposed by prehistoric agriculture. In contrast, the sediments associated with the bridges and later deposits at Dorney (see Volume 2) are likely to have had an origin at least in part related to human activity in the catchment. The Runnymede sequence also showed episodes of Neolithic and Bronze Age channel sedimentation and erosion (Needham 1991; 1992). There was evidence for a major flood event at Runnymede some time after 3500 BP which deposited a layer of dense gravel over parts of the site. It has not been possible to correlate this event with any of the episodes of erosion and sedimentation recorded from the Eton Rowing Course, which all appear to have been less extreme. A mid-channel sandbank was, however, present, extending from Area 1 downstream to Area 14 (Plate 3.21), and one of the trees found embedded within it was dated by radiocarbon to 2880-2480 cal BC (BM-3125: 4090±50 BP). This suggests that a major erosive event of some kind had occurred sometime in the late Neolithic.

Much of the vegetational sequence for Dorney during the first half of the Holocene was unexceptional (Birks 1986), being determined by the rate of arrival of more competitive tree species following the abrupt climatic amelioration and soil maturation. The only evidence for possible pre-Neolithic human interference with the vegetation was the burning of reedswamp vegetation in the early Mesolithic. However, the early peak of *Alnus* sp. (alder) *c* 9100 BP followed by disappearance *c* 500 radiocarbon years later, only to return as the predominant tree on the floodplain in the mid Holocene is of particular interest. Brown (1988) has presented evidence that *Alnus* sp. was present, although not abundant, in southern England from the start of the Holocene but that it only began a major expansion on floodplains at or after 8000 BP. He argued that *Betula* spp. and *Salix* spp. had a competitive advantage over *Alnus glutinosa* in the early Holocene that was later reversed as floodplain conditions changed. This, however, does not

Plate 3.21 Sandbank in Area 1

explain the events at Dorney. A similar early peak in *Alnus* sp. pollen, followed by a decline has been found in London (Sidell pers. comm.). Dorney also provided early evidence for the presence of *Fagus sylvatica* (beech) with a radiocarbon date on charcoal confirming its occurrence in the early Bronze Age.

The pollen and insect evidence for Neolithic activity against a background which retained much of its original tree cover is similar to that from Runnymede (Greig 1991; Robinson 1991). Of particular interest was the discovery of the early Neolithic middens and contemporaneous waterlogged sediments in the palaeochannels. While there was plenty of evidence from the pollen for local sources of the hazelnuts that were found charred in the middens, there was scant pollen evidence for the cultivation plots of the cereal grain that was also found charred.

Cereal cultivation is likely to have occurred on a very small scale but, although charred hazelnuts usually outnumber cereal grains on sites with evidence for settlement, the use of cereal was a usual part of the Neolithic economy (Moffett *et al.* 1989; Robinson 2000a). While cereals would have needed a fully cleared area for their cultivation, cattle and pigs can be grazed under partly wooded conditions. It has been argued that the Coleopteran evidence from some Neolithic sites where there was both a high proportion of wood and tree-dependent Coleoptera and Scarabaeoidea dung beetles reflected the herding of domestic animals in woodland (Robinson 2000b). Domestic animals are thought likely to have been grazed in woodland as well as open areas at both Dorney and Runnymede.

The occurrence of the small early Bronze Age barrow cemeteries along with limited pollen and insect evidence suggested that clearance became progressively more extensive and that there were some permanent open areas. However, a background of woodland remained and there was even less evidence than from the Neolithic for cereal cultivation, although the carbonised remains confirmed that at least some cereals were being grown.