WHITTLEWOOD PROJECT: PRELIMINARY RESULTS OF THE ENVIRONMENTAL ARCHAEOLOGICAL INVESTIGATIONS

N.P. Branch, M. Burn, C.P. Green, B. Silva, G.E. Swindle and E. Turton
Department of Geography, Royal Holloway University of London, Egham Hill, Egham, Surrey, TW20 0EX, UK

1.0 INTRODUCTION

This report summarises the findings of the preliminary environmental archaeological investigations conducted by Royal Holloway (University of London) Department of Geography as part of the Whittlewood research project (co-ordinated by the University of Leicester). At the initiation of the environmental archaeological component of the project, three broad research aims were formulated:

1. To quantify the effects of human induced landscape changes prior to 400 AD, in particular the nature and pattern of land-use during the Iron Age and Romano-British periods
2. To quantify the effects of human induced landscape changes between 400 - 1400 AD, in particular the nature and pattern of land-use
3. To quantify the effects of natural environmental changes between 800 BC – 1400 AD on the nature of land-use, in particular during the Iron Age climatic deterioration (c. 800 BC), the Medieval Warm Period (c. 1000 – 1300 AD) and Little Ice Age (c. 1300 – 1850 AD)

In order to achieve these aims, three mire basins (peat bogs) were selected within, or in close proximity to, the project area and core samples collected for laboratory analysis using a range of field methods, including mechanical and motorised coring:

1. Biddlesden 1 (NGR: SP 625 400)
2. Syresham 4 (NGR: SP 645 422)
3. Stow 1 (NGR: SP 668 370)

The field investigations demonstrated the presence of deeply stratified mineral and organic rich sediments and peat suitable for a range of laboratory analyses, in particular pollen analysis and radiocarbon dating. The preliminary results of this research are presented below.

2.0 LABORATORY METHODS

The lithostratigraphic descriptions of each core sample are presented in Tables 1, 3 and 5, and Figure 1 (all measurements are from the ground surface). The method used for describing the unconsolidated sediments and peat follows procedures outlined in Troels-Smith (1955). This involves providing a semi-quantitative description of the physical properties (e.g. colour), composition (e.g. gravel, sand, clay, silt, peat), lithostratigraphic unit boundaries (sharp or diffuse) and inclusions (e.g. artefacts) of each sedimentary unit. Pollen analysis of the Biddlesden 1, Syresham 4 and Stowe 1 sequences followed laboratory procedures developed at Royal Holloway Department of Geography, which were modified from Moore et al. (1991). The results, which are presented in Figures 2 and 3, and Table 7, are expressed as percentage of the total land pollen (i.e. pollen sum = trees, shrubs and herbs) and tabulated assessment data. Sub-samples of peat from Biddlesden 1, Syresham 4 and Stowe 1 were submitted to the University of Waikato (New Zealand) for radiocarbon dating. All age estimates were calibrated using OXCAL v. 3.5 (Bronk Ramsey, 1995 and 2001) using data from Stuiver *et al*., 1998. The results of the radiocarbon dating are presented in Tables 2, 4 and 6.

3.0 RESULTS OF THE INVESTIGATIONS AT BIDDLESDEN

The mire basin at Biddlesden is located in a long, narrow river valley draining towards the country estate of which it forms a part, and has been conserved by the landowner to increase local biodiversity. This is in contrast to several other basins located in the project area that had been heavily modified to enhance drainage or to create ponds. The basin was probably formed as a result of impeded drainage causing localised waterlogging and subsequent peat formation. A transect of exploratory core samples were recovered from the site to establish the area of greatest depth, and further core samples were obtained from this location for laboratory analysis (known as Biddlesden 1).

3.1 RESULTS OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND RADIOCARBON DATING

The composition of the basal sedimentary units at Biddlesden 1 (196-170cm; units 1, 2, 3, 4 and 5) is consistent with their deposition within, and on the margins of, a former river channel (palaeochannel). The sedimentary sequence consists of predominantly coarse mineral-rich sediments, probably overlying gravel. These sediments indicate deposition within a fluvial environment. This interpretation is confirmed by the presence of fine-grained sediments (clay and silt) that would have been deposited from a suspended sediment load. The sequence indicates pronounced variations in the energy of the fluvial system, with the fine-grained

sediments deposited in a virtually stationary ('low-energy') water body, while the coarse sediments represent a 'higher-energy' (fast flowing) water body. The mineral deposits have occasional fragments of organic detritus, representing either long-distance transportation of organic matter or *in situ* deposition of detritus from plants growing within, or on the margins of, an open water body. These sediments are typically found within a meandering river system, and represent the creation of point-bars, over-bank deposits (levées, crevasse-splay and floodplain deposits) and abandoned channel fills. The sequence indicates that during the process of lateral channel movement and accretion, bar formation (sand) was succeeded by finer sediment deposition (silt and clay) under progressively lower energy conditions.

The formation of peat (170-40cm; units 6-12) is of particular importance since this represents more terrestrial conditions. The presence of mineral sediments within the peat deposits between 170-110cm and 105-96cm suggests that either de-stabilisation of the surrounding slopes and subsequent erosion, or intermittent flooding of the peat surface from the nearby river, resulted in the deposition of sediments within the basin. The radiocarbon determinations obtained from the peat indicate that mire formation commenced 210 BC - 220 AD (Iron Age – Romano/British periods), and continued after 400-600 AD.

The renewal of mineral sediment deposition between 40-29cm (units13 and 14) may also be due to the causes listed above. However, on this occasion it was clearly more 'catastrophic' and resulted in a temporary cessation in peat formation. The age of this event (or events) is unknown, although the radiocarbon determination at 96-86cm indicates that it occurred sometime after 600 AD. Finally, the uppermost part of the sequence indicates further peat formation (units 15 and 16) and organic silt deposition (unit 17). The absence of mineral sediment in the former suggests that the surrounding landscape was probably relatively stable with no evidence for erosion. The latter reflects further de-stabilisation of the surrounding slopes or a renewal of flooding.

Table 1: Biddlesden 1 lithostratigraphic descriptions

Depth (cm)	Unit No	Description core sample 0 – 50 cm
0 – 10	17	Dark brown (10YR 3/3) organic silt (Ag4 Sh+); diffuse
10 – 22	16	Dark brown (10YR 3/3) herbaceous peat moderately humified ($Th^3$4, Humo 3); diffuse
22 – 29	15	Brown (10YR 4/3) herbaceous peat moderately humified ($Th^3$4, Humo 3); sharp
29 – 35	14	Grey (2.5Y 6/1) organic clayey silt (Ag3 As1 Sh+); sharp
35 – 40	13	Brown (10YR 4/3) organic silt (Ag4 Sh+); diffuse
40 – 45	12	Brown (10YR 4/3) herbaceous/moss peat moderately humified ($Th^3$3 $Tb^2$1, Humo 3); diffuse
45 – 50	11	Dark brown (10YR 3/3) herbaceous peat moderately humified ($Th^3$4, Humo 3)

Depth (cm)		Description core sample 40 – 90 cm
40 – 45	11	Brown (10YR 4/3) herbaceous/moss peat moderately humified ($Th^3$3 $Tb^2$1, Humo 3); diffuse
45 – 90	10	Dark brown (10YR 3/3) herbaceous peat moderately humified ($Th^3$4, Humo 3)
Depth (cm)		**Description core sample 80 – 130 cm**
80 – 96	10	Dark yellowish brown (10YR 4/4) herbaceous peat moderately humified ($Th^3$4, Humo3); sharp
96 – 105	9	Dark yellowish brown (10YR 4/4) herbaceous peat with silt moderately humified ($Th^3$4 Ag+, Humo 2/3); sharp
105 – 110	8	Dark brown (10YR 3/3) herbaceous peat moderately humified ($Th^2$4, Humo 2); sharp
110 – 130	7	Dark yellowish brown (10YR 4/4) herbaceous peat with silt highly to moderately humified ($Th^3$4 Ag+, Humo 2/3)
Depth (cm)		**Description core sample 120 – 170 cm**
120 – 126	7	Dark yellowish brown (10YR 4/4) herbaceous peat with silt highly humified ($Th^3$4 Ag+, Humo 3); sharp
126 – 170	6	Dark yellowish brown (10YR 4/4) herbaceous peat with silt moderately humified ($Th^2$4 Ag+, Humo 2)
Depth (cm)		**Description core sample 146 – 196 cm**
146 – 165	6	Dark yellowish brown (10YR 4/4) herbaceous peat moderately humified ($Th^2$4, Humo 2); sharp
165 – 174	5	Dark greyish brown (10YR 3/2) organic silt (Ag2 Dh2); diffuse
174 – 185	4	Brown (10YR 4/3) organic sandy silt, inclusions of charcoal at 180 cm; (Ag2 Ga1 Dh1); sharp
185 – 188	3	Dark grey silty sand (Ga3 Ag1); sharp
188 – 191	2	Dark greyish brown (10YR 3/2) clayey silt with fine sand and infrequent organic matter (Ag3 As1 Ga+ Sh+); sharp
191 – 196	1	Light yellowish grey (10YR 5/6) coarse sand (Ga4); inclusion of charcoal at 195cm

Table 2: Biddlesden 1 radiocarbon dating

Depth (cm)	Laboratory Code	Material Dated	Method	δ13C (‰)	Un-calibrated yrs BP	Calibrated yrs BC / AD (2 sigma)
86 - 96	Wk-13825	Peat	AMS	-28.6	1577 ±39	400 - 600 AD
156 - 165	Wk-13824	Peat	Standard Radiometric	-30.0	1998 ±80	210 BC - 220 AD

3.2 RESULTS OF THE POLLEN-STRATIGRAPHIC INVESTIGATION

The results of the pollen stratigraphic analysis have been divided into local pollen assemblage zones (BID 1 to BID 6) to provide a more convenient framework in which to describe and interpret the main changes in vegetation history occurring at the site.

196-165cm, Local Pollen Assemblage Zone BID 1: *Pinus, Castanea*

This zone is characterised by the dominance of *Pinus sylvestris* (scots pine; 80% declining to 20%) with *Castanea sativa* (sweet chestnut; 8%), *Alnus glutinosa* (alder; 10%), *Fagus sylvatica* (beech; 3%), *Betula* (e.g. *B. pendula*, silver birch; 1%) and *Tilia* (e.g. *T. cordata*,

small leaved lime; 1%). The shrub pollen record includes *Corylus* type (e.g. *C. avellana*, hazel; 9%). The non-arboreal pollen assemblage includes Cyperaceae (sedge family; 26%), Poaceae (grass family; 21%), Asteroideae/Cardueae (daisy sub-family; 11%), Lactuceae (daisy sub-family; 15%) and *Plantago lanceolata* (ribwort plantain; 9%). The aquatic and spore taxa are dominated by *Sphagnum* (bog moss; 50%) and *Polypodium vulgare* (polypody fern; 21%). Microscopic charred particles are present throughout the lower part of the zone.

165-120cm, Local Pollen Assemblage Zone BID 2: Poaceae, Cyperaceae, *Cereale*

This zone is characterised by the dominance of Poaceae (27%) with Cyperaceae (45%), and a range of herbaceous taxa including Apiaceae (carrot family; 10%), Asteroideae/Cardueae (5%), *Chenopodium* type (e.g. *C. album*, fat hen; 6%), *Filipendula* (e.g. *F. ulmaria*, meadowsweet; 6%) and *Plantago lanceolata* (7%). *Cereale* (cereal) pollen is present throughout the zone (c. 5%). The tree and shrub pollen taxa are represented by low percentage values of *Betula, Pinus* and *Corylus* type. The aquatic and spore taxa include *Littorella uniflora* (shoreweed; 8%) and *Polypodium* (5%). Microscopic charred particles are present throughout the upper part of the zone.

120-95cm, Local Pollen Assemblage Zone BID 3: Herbaceous taxa

This zone is characterised by the dominance of Cyperaceae (70%) with Poaceae (10%), *Filipendula* (10%) and *Plantago lanceolata* (5%). The tree and shrub pollen taxa are represented by low percentage values of *Betula, Pinus*, *Quercus* (e.g. *Q. robur*, pedunculate oak), *Corylus* type and *Salix* (e.g. *S. alba*, white willow). The aquatic and spore taxa include *Littorella uniflora* (5%), *Myriophyllum spicatum* (spiked water milfoil; 1%), *Potamogeton* (pondweed; 6%) and *Polypodium* (3%). Microscopic charred particles are present throughout the zone.

95-70cm, Local Pollen Assemblage Zone BID 4: *Pinus*, Herbaceous taxa

This zone is characterised by the dominance of Poaceae (32%) with Cyperaceae (15% and *Pinus* (10%). Tree and shrub pollen taxa are represented by low percentage values of *Betula, Tilia* and *Salix*. Herbaceous taxa include Asteroideae/Cardueae (10%), *Chenopodium* type (4%), Lactuceae (26%), *Plantago lanceolata* (2%) and *Ranunculus* type (e.g. *R. repens*, creeping buttercup; 2%). The aquatic and spore taxa are poorly represented but include *Littorella uniflora* (1%), and *Polypodium* (10%). Microscopic charred particles are present throughout the zone.

70-35cm, Local Pollen Assemblage Zone BID 5: Cyperaceae, Herbaceous taxa

This zone is characterised by the dominance of Cyperaceae (60%) with Poaceae (33%). Tree and shrub pollen taxa are poorly represented (*Betula, Pinus*) with the exception of *Juniperus communis* (juniper; 12%), *Quercus* (2%) and *Corylus* type (2%). Herbaceous taxa include Asteroideae/Cardueae (15%), Brassicaceae (cabbage family; 8%) and *Plantago lanceolata* (5%). The aquatic and spore taxa are poorly represented but include *Polypodium* (40%) and *Dryopteris* type (e.g. *D. filix-mas*, male fern; 6%). Microscopic charred particles are present throughout the zone.

35-0cm, Local Pollen Assemblage Zone BID 6: *Pinus*, Poaceae, Herbaceous taxa

This zone is characterised by the dominance of *Pinus* (21%) and Poaceae (29%). Tree and shrub pollen taxa include *Alnus* (6%), *Betula* (1%), *Fraxinus* (*F. excelsior*, ash; 1%), *Quercus* (3%), *Tilia* (1%) and *Corylus* type (1%). Herbaceous taxa include Asteroideae/Cardueae (19%), *Filipendula* (4%), Lactuceae (20%), *Plantago lanceolata* (6%) and *Cereale* type (1%). The aquatic and spore taxa are poorly represented but include *Polypodium* (30%) and *Dryopteris* type (7%). Microscopic charred particles are present throughout the zone.

3.3 INTERPRETATION OF THE DATA FROM BIDDLESDEN

196-165cm, Local Pollen Assemblage Zone BID 1 (units 1 to 5)

Although the pollen concentration is poor in this basal zone, during the earliest phase of sedimentation within the basin the pollen record indicates that pine woodland dominated the landscape surrounding Biddlesden. In addition to the pine woodland, there is evidence for the presence of beech, birch and lime, probably forming open mixed deciduous woodland with hazel shrubland. Areas of the basin had already been colonised by *Sphagnum* moss; the main peat-forming plant of many mires and characteristic of wet surface conditions typically found on predominantly rain-fed, low nutrient status (ombrotrophic) bogs. The presence of alder, sedge and polypody pollen suggests that damp woodland colonised the edge of the basin. During this zone, a decline in the natural woodland cover is indicated by the pollen data and its replacement firstly by grassland and then sweet chestnut woodland. The presence of microscopic charred particles indicates that this event coincided with burning of the vegetation cover. These data suggest that the removal of woodland may be attributed to anthropogenic activities associated with sweet chestnut cultivation (planting and woodland management), probably from the Roman period onwards. The radiocarbon date of 210 BC - 220 AD from the base of zone BID 2, and pollen stratigraphic records from across Europe (Branch, 1999) supports this interpretation.

165-120cm, Local Pollen Assemblage Zone BID 2 (units 6 and 7)

The pollen record from zone BID 2 indicates that the landscape around Biddlesden was predominantly open in character, being dominated by grassland (e.g. meadow and pasture) and cultivated fields containing cereals (*Triticum* / *Hordeum* type; wheat / barley). The poor representation of arboreal pollen indicates that only isolated woodland existed in the area. The pollen record also suggests that a significant change in the basin hydrology occurred at this time with the transition to peat formation and the creation of open pools of water that were colonised by various aquatic plants. This evidence is supported by the lithostratigraphic descriptions, which also indicate deposition of mineral sediment within the basin. The cause of this event remains to be fully elucidated, but the evidence suggests that cereal cultivation and burning by human groups near to the site may have led to accelerated erosion and increased surface runoff. The radiocarbon determination from the base of zone BID 2, together with the pollen data from zone BID 1, suggests that this event occurred during the 1^{st}-2^{nd} centuries AD.

120-95cm, Local Pollen Assemblage Zone BID 3 (units 8 and 9)

The pollen record from zone BID 3 indicates that the landscape around Biddlesden was open in character, with only isolated woodland consisting of birch, pine and oak. The mire basin consisted of peat and bodies of open water containing shoreweed, spiked water milfoil and pondweed, fringed with willow, sedges, grasses and meadowsweet. The absences of direct pollen-stratigraphic indicators of anthropogenic activity (e.g. cereals) are surprising, and may suggest that the landscape was either abandoned or that agricultural activities were mainly concerned with animal husbandry. The single radiocarbon date from the base of zone BID 4 indicates that this change in land-use during zone BID 3 predates the end of the Roman period (c. 400 AD).

95-70cm, Local Pollen Assemblage Zone BID 4 (unit 10)

Pollen zone BID 4 indicates that pine re-colonised the landscape at Biddlesden between 400-600 AD, although the percentage values are considerably lower than those recorded during zone BID 1. This suggests that the landscape was open in character and dominated by grassland. There are no direct pollen-stratigraphic indicators of human activities, although the presence of pine may indicate woodland management rather than natural re-colonisation of abandoned areas. The almost complete absence of pollen indicators of open water suggests that the bodies of open water that formed at Biddlesden during zones BID 2 and BID 3 probably became in-filled, resulting in further peat formation. The edge of the mire basin was probably colonised by sedges, creeping buttercup, and damp woodland consisting of willow and polypody.

70-35cm, Local Pollen Assemblage Zone BID 5 (units 11-14)

The pollen record for zone BID 5 indicates that the landscape was predominantly open in character with the exception of the uppermost part of the zone, which indicates that juniper briefly colonised the area sometime after 400-600 AD. This event is unusual since juniper only occurs in significant quantities in British pollen-stratigraphic sequences during the Devensian late glacial (14,000-10,000 years ago), being indicative of cold climatic conditions, and occasionally from buried soils associated with historic period ornamental gardens. Although a relationship between the presence of juniper and a colder climate during the Medieval / post-Medieval period is possible (i.e. Little Ice Age), it is also likely that the tree was deliberately planted. Evidence possibly supporting the former interpretation may be found in the lithostratigraphic descriptions (units 13 and 14), which note an increase in mineral sediment within the basin, perhaps as a response to accelerated erosion. However, until further pollen stratigraphic data is available for the region as a whole this interpretation should be treated with caution.

35-0cm, Local Pollen Assemblage Zone BID 6 (units 15-17)

Zone BID 6 provides unequivocal evidence for anthropogenic activity at Biddlesden, suggesting the formation of a culturally modified landscape. The evidence is threefold: (1) the rise in pine pollen values indicating probable management of pine woodland; (2) the presence of *Cereale* pollen indicating the cultivation of cereals in nearby fields (*Triticum / Hordeum*), and (3) the presence of high concentrations of microscopic charred particles indicating burning of vegetation. The timing of this transition is presently unknown, although it undoubtedly occurred sometime after 600 AD. During zone BID 6 the mire basin was colonised by damp woodland, dominated by alder, polypody and meadowsweet.

4.0 RESULTS OF THE INVESTIGATIONS AT SYRESHAM

4.1 RESULTS OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND RADIOCARBON DATING

The composition of the basal sedimentary unit at Syresham 4 (150-145.5cm; unit 1) is consistent with its deposition on the margins of a former river channel (palaeochannel). The unit consists of coarse mineral-rich sediments, probably overlying gravel, indicating deposition within a fluvial environment. This interpretation is confirmed by the presence of fine-grained sediments that would have been deposited from a suspended sediment load. The initiation of peat formation between 145.5 and 86.5cm (unit 2) would have resulted in more stable, terrestrial conditions at the site. The radiocarbon determination for this event

indicates that it occurred between 7070 and 6690 BC. Several pronounced changes in sedimentation occurred at the site with the deposition of mineral-rich sediments between 86.5-71cm (units 3 and 4) suggesting destabilisation of the surrounding slopes and erosion. The radiocarbon determination for these events indicates that they commenced between 2580 and 2270 BC. A period of peat formation (71-14.5cm; units 5 and 6) succeeded these events suggesting the formation of terrestrial conditions on the mire surface. The radiocarbon determination for this event indicates that it commenced between 800 and 480 BC. The presence of mineral sediment within the peat indicates intermittent destabilisation of the surrounding slopes and further erosion.

Table 3: Syresham 4 lithostratigraphic descriptions

Depth (cm)	Unit No	Description
0 – 14.5	7	Dark brown root zone (10YR 3/3); diffuse
14.5 – 68	6	Dark brown (10YR 3/3) herbaceous/wood peat with silt ($Th^{2}2$ $Tl^{1}2$ Ag1); diffuse
68 – 71	5	Black (10YR 2/1) highly humified wood peat ($T1^{4}4$); diffuse
71 – 83	4	Very dark greyish brown (10YR 3/2) silty clay with wood (As2 Ag1); diffuse
83 - 86.5	3	Very dark greyish brown (10YR 3/2) organic clay (As2 Dh1); diffuse
86.5 - 145.5	2	Black (10YR 2/1) highly humified wood peat ($T1^{4}4$); diffuse
145.5 – 150	1	Light yellowish brown (10YR 6/4) sandy silty clay (As2 Ag1 Ga1)

Table 4: Syresham 4 radiocarbon dating

Depth (cm)	Laboratory Code	Material Dated	Method	δ13C (‰)	Un-calibrated yrs BP	Calibrated yrs BC / AD (2 sigma)
60 - 70	Wk-13822	Peat	Standard Radiometric	-28.7	2519 ±69	800 - 480 BC
80 - 90	Wk-13823	Peat	Standard Radiometric	-28.9	3927 ±58	2580 - 2270 BC
130 - 140	Wk-13821	Peat	Standard Radiometric	-29.1	7989 ±59	7070 - 6690 BC

4.2 RESULTS OF THE POLLEN-STRATIGRAPHIC INVESTIGATION

A pollen-stratigraphical assessment of the entire sequence indicated that the preservation and concentration of pollen grains and spores below 72cm was very poor. This is undoubtedly due to the slow rate of peat accumulation resulting in the oxidation of pollen grains and spores. For this reason, the pollen analysis was focussed on the upper 72cm of the sequence. The analysis indicated that open alder and willow ‘carr’ woodland dominated the local vegetation cover. The adjacent dry land consisted of open mixed deciduous woodland, dominated by hazel with some oak, lime, elm, ash, birch and possibly pine. The presence of sweet chestnut pollen is clearly very important and indicates local growth of this tree within managed woodland. The diverse assemblage of non-arboreal pollen provides

further evidence for the open character of the vegetation cover. Perhaps the most significant find is the presence of cereal pollen. Although the concentration of cereal pollen is very low, it nevertheless suggests that cultivation was taking place in close proximity to the mire basin.

4.3 INTERPRETATION OF THE DATA FROM SYRESHAM

The pollen-stratigraphic and sedimentary data from Syresham 4 indicates the presence of open landscape with isolated trees. The evidence for anthropogenic activity from 800-480 BC, and probably before, is unequivocal and indicates both woodland management of sweet chestnut and cereal cultivation. The timing of the sweet chestnut cultivation is particularly important since this tree is equated with the Roman-British period. Therefore, the uppermost part of the sequence from Syresham 4 (56-0cm) is most probably Roman and post Roman in age. The absence of sweet chestnut and cereal cultivation in the sample at 48cm is interesting and may be due to abandonment of the area or a change in agricultural practices.

5.0 RESULTS OF THE INVESTIGATIONS AT STOWE

The mire basin at Stowe is located in a short, narrow tributary river valley draining towards the main river valley and country estate of which it forms a part, and has been conserved by the landowner to increase local biodiversity. The basin was probably formed as a result of impeded drainage causing localised waterlogging and subsequent peat formation. A transect of exploratory core samples were recovered from the site to establish the area of greatest depth, and further core samples were obtained from this location for laboratory analysis (known as Stowe 1).

5.1 RESULTS OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND RADIOCARBON DATING

The composition of the basal sedimentary units at Stowe 1 (180-120cm; units 1-3) is consistent with their deposition within, and on the margins of, a former river / stream channel (palaeochannel). The sedimentary sequence consists of predominantly coarse mineral-rich sediments. These sediments indicate deposition within a fluvial environment. This interpretation is confirmed by the presence of fine-grained sediments (clay and silt) that would have been deposited from a suspended sediment load. The sequence indicates pronounced variations in the energy of the fluvial system, with the fine-grained sediments deposited in a virtually stationary (‘low-energy’) water body, while the coarse sediments represent a ‘higher-energy’ (fast flowing) water body.). The results of the radiocarbon determinations indicate that organic sedimentation prior to peat formation commenced 600 BC – 390 BC. This sequence is succeeded by peat formation between 120-86cm (units 4 and 5), and mineral sediment deposition (86-0cm; units 6-9). The radiocarbon determination

indicates that peat formation occurred shortly before 1160-1290 AD. The mineral sediments suggest de-stabilisation and erosion of the surrounding slopes. The phase of peat formation suggests stabilisation of the slopes and the formation of semi-terrestrial conditions on the mire surface.

Table 5: Stowe 1 lithostratigraphic descriptions

Depth (cm)	**Unit No**	**Description core sample 0 – 50cm**
0 – 36	9	Very dark brown (10YR 2/2) organic sandy silt (Ag3 Ga1 Sh+); diffuse
36 – 50	8	Brown (10YR 4/3) organic sandy silt with some gravel (Ag2 Ga1 Gg1 Sh+)
Depth (cm)		**Description core sample 40 – 90cm**
40 – 64	8	Brown (10YR 4/3) organic sandy silt with some gravel (Ag2 Ga1 Gg1 Sh+); sharp
64 – 68	7	Black (10YR 2/1) decayed root; sharp
68 – 86	6	Dark brown (10YR 3/3) organic clayey silt (Ag2 As2 Sh+); sharp
86 – 90	5	Very dark brown (10YR 2/2) herbaceous peat moderately humified and silt ($Th^2$3 Ag1) Humo 2
Depth (cm)		**Description core sample 80 – 130cm**
80 – 100	5	Very dark brown (10YR 2/2) moderately humified herbaceous peat and silt ($Th^2$3 Ag1) Humo 2; diffuse
100 – 120	4	Brown (10YR 4/3) herbaceous peat moderately humified and silt ($Th^2$3 Ag1) Humo 2; diffuse
120 – 130	3	Very dark greyish brown (10YR 3/2) organic silt + gravel (Ag3 Ga1 Sh+); diffuse
Depth (cm)		**Description core sample 120 – 170cm**
120 – 130	3	Very dark greyish brown (10YR 3/2) organic silt + gravel (Ag3 Ga1 Sh+); diffuse
130 – 146	2	Dark brown (10YR 3/3) organic clayey silt (Ag2 As2 Ga+ Gg+); sharp
146 – 170	1	Grey (2.5Y 6/1) silty clay with gravel (Ag2 As2 Gg+)
Depth (cm)		**Description core sample 130 – 180cm**
130 – 146	2	Dark brown (10YR 3/3) organic clayey silt (Ag2 As2 Ga+ Gg+); Mollusca; sharp
146 – 180	1	Grey (2.5Y 6/1) clayey silt with gravel (Ag2 As 2 Gg+); Brick

Table 6: Stowe 1 radiocarbon dating

Depth (cm)	**Laboratory Code**	**Material Dated**	**Method**	**δ13C (‰)**	**Un-calibrated yrs BP**	**Calibrated yrs BC / AD (2 sigma)**
90 - 100	Wk-13819	Peat	AMS	-30.0	800 ±38	1160 - 1290 AD
136 - 146	Wk-13820	Organic sediment	AMS	-29.1	2417 ±40	600 BC – 390 BC

5.2 RESULTS OF THE POLLEN-STRATIGRAPHIC INVESTIGATION AND INTERPRETATION OF THE DATA

The pollen assessment conducted on the core samples from Stowe indicates the presence of moderately well preserved pollen grains and spores that are suitable for detailed analysis

(currently being completed by B. Silva). The basal part of the sequence (180-120cm) indicates the presence of alder and willow woodland, as well as *Sphagnum* bog formation, sometime before 600-390 BC. The dry land vegetation consisted of isolated pine woodland and grassland. Following the transition to peat formation (1160-1290 AD), the pollen grains and spores are better preserved, probably because of the waterlogged anaerobic conditions. The range of taxa identified indicates two broad vegetation communities:

1. Wetland dominated by bog moss
2. Dry land dominated by grassland

The absence of high arboreal pollen content within the record suggests that much of the natural woodland cover of the area had been removed probably as a consequence of human activities. However, in the absence of direct pollen stratigraphic indicators of human activity e.g. cereal pollen, the precise nature of the land-use practices remains unclear. The cessation of peat formation and the deposition of mineral sediments between 80-0cm mark a significant change in the environmental history of the site. These sediments undoubtedly reflect destabilisation of the surrounding slopes, possibly as a consequence of human activities, sometime after 1160-1290 AD. Unfortunately, the pollen record does not provide unequivocal support for this interpretation due to the absence of indicators of human impact other the presence of disturbed ground plant taxa, such as ribwort plantain.

Table 7: Stowe 1 pollen assessment

Depth (cm)	Main pollen taxa	Common name
3-4	Chenopodium type	E.g. Fat hen
7-8	Quercus Pinus	Oak Pine
11-12	Poaceae Brassicaceae	Grass family Cabbage family
15-16	Poaceae Brassicaceae	Grass family Cabbage family
27-28	Brassicaceae Plantago lanceolata	Cabbage family Ribwort plantain
31-32	Aster type Artemisia Brassicaceae Plantago lanceolata Lactuceae	Daisy family Mugwort Cabbage family Ribwort plantain Daisy family
43-44	Chenopodium type Plantago lanceolata Poaceae Aster type Fagus Pinus Ulmus	E.g. Fat hen Ribwort plantain Grass family Daisy family Beech Pine Elm
51-52	Lactuceae Plantago lanceolata	Daisy family e.g. dandelion Ribwort plantain

	Alnus Poaceae Brassicaceae	Alder Grass family Cabbage family
79-80	Poaceae Plantago lanceolata Brassicaceae Pinus Calluna	Grass family Ribwort plantain Cabbage family Pine Heather
91-92	Calluna Juniperus Poaceae Pinus	Heather Juniper Grass Pine
95-96	Sphagnum Brassicaceae Poaceae Lactuceae	Bog moss Cabbage family Grass family Daisy family e.g. dandelion
99-100	Pinus Caryophyllaceae Corylus type Cyperaceae	Pine Campion family E.g. Hazel Sedge family
107-108	Poaceae Apiaceae Lactuceae Chenopodium type Cyperaceae Ligustrum Pteridium	Grass family Carrot family Daisy family E.g. fat hen Sedge family Privet Bracken fern
111-112	Poaceae Cyperaceae	Grass family Sedge family
123-124	Poaceae Lactuceae Apiaceae Centaurea scabiosa	Grass family Daisy family e.g. dandelion Carrot family Greater knapweed
135-136	Poaceae Cyperaceae Centaurea scabiosa Lactuceae Filicales Alnus Pinus	Grass family Sedge family Greater knapweed Daisy family Fern Alder Pine
139-140	Pinus Sphagnum	Pine Bog moss
147-148	Filicales Pinus Pteridium	Fern Pine Bracken fern
155-156	Sphagnum Plantago lanceolata Aster type Alnus	Bog moss Ribwort plantain Daisy family Alder
167-168	Alnus Caryophyllaceae Salix	Alder Campion family Willow
171-172	Pinus	Pine
175-176	Poaceae	Grass family
179-180	Calluna Poaceae	Heather Grass family

6.0 DISCUSSION

At the initiation of the environmental archaeological project three broad research aims were formulated. These will now be discussed in the light of the preliminary results from Biddlesden, Syresham and Stowe.

To quantify the effects of human induced landscape changes prior to 400 AD, in particular the nature and pattern of land-use during the Iron Age and Romano-British periods

The environmental archaeological records from Biddlesden and Stowe indicate that prior to 400 AD natural pine woodland together with beech, birch and lime, and hazel shrubland, dominated the surrounding landscape. This mixed coniferous – deciduous woodland cover declined during the early stages of the site formation and was replaced by grassland and sweet chestnut woodland. This significant change in the landscape has been attributed to human activity involving burning, woodland clearance, creation of grassland and finally woodland management. The short phase of sweet chestnut cultivation is surprising and the duration of the activity is unknown. However, based upon studies of Iron Age and Roman sweet chestnut cultivation in other parts of Europe, it is highly likely that the event commenced sometime during the early Roman period. Evidence in support of this interpretation has been provided by the Syresham record, which also indicates sweet chestnut cultivation together with cereal cultivation. Following the cessation of sweet chestnut cultivation, the landscape was once again dominated by grassland, possibly meadow or pasture, and also cultivated fields containing cereals (*Triticum* / *Hordeum* type; wheat / barley). These changes may have resulted in increased surface weathering and erosion causing mineral sediments to enter the Biddlesden basin. Although the timing of this phase in the landscape history of Biddlesden is unknown, it is highly likely to have occurred sometime during the 1st-2nd centuries AD. In contrast, it is interesting to note that following the abandonment of sweet chestnut cultivation at Syresham, there is no clear evidence for anthropogenic activity. This suggests that during this time, the landscape of the project area was a mosaic of land-use practices. Finally, the record from Biddlesden indicates that during the period immediately prior to the end of Roman occupation (possibly the 3rd-4th centuries AD), cereal cultivation ceased in the area. It is unknown whether this occurred as a consequence of landscape abandonment or simply that agricultural activities were concerned with animal husbandry.

To quantify the effects of human induced environmental changes on the landscape between 400-1400 AD, in particular the nature and pattern of land-use

During the immediate post-Roman period, the environmental archaeological records from Biddlesden indicate that pine re-colonised the landscape, although the vegetation cover remained predominantly open in character and dominated by grassland. The absence of unequivocal evidence for human activities suggests that the re-colonisation occurred as a consequence of natural vegetation succession, rather than woodland management. A decline in this woodland cover and further evidence for the expansion of grassland suggests that human activities became more intensive and extensive. These activities led to the creation of a mosaic of land-use activities, probably during the later historic periods, including management of pine woodland and the cultivation of cereals in nearby fields (*Triticum / Hordeum*). This evidence is broadly supported by the results from Stowe, which suggest accelerated erosion and landscape degradation sometime after 1160-1290 AD.

To quantify the effects of natural environmental changes from 800 BC to 1400 AD on the nature of land-use, in particular during the Iron Age climatic deterioration (c. 800 BC), the Medieval Warm Period (c. 1000 – 1300 AD) and Little Ice Age (c. 1300 – 1850 AD)

The environmental archaeological records from Biddlesden indicate that sometime after 400-600 AD juniper colonised an otherwise open landscape composed of grassland and isolated woodland. This event may be due to a well-recorded deterioration in climate known as the Little Ice Age, which occurred in Britain between 1300 and 1850 AD, and was characterised by dramatic fluctuations in temperature and precipitation resulting in drought, famine and flooding. At this stage in the environmental archaeological investigations this correlation is highly speculative and must be treated with caution. However, unless juniper was deliberately planted, it is difficult to understand why it would colonise this area unless it was in response to unusual environmental conditions.

In conclusion, the environmental archaeological investigations at Biddlesden, Syresham and Stowe have demonstrated the potential of these sequences for reconstructing changes in the landscape of the project area. Further work on these sites, and others within the project area, will be conducted prior to submission of the final report in August 2005.

7.0 REFERENCES

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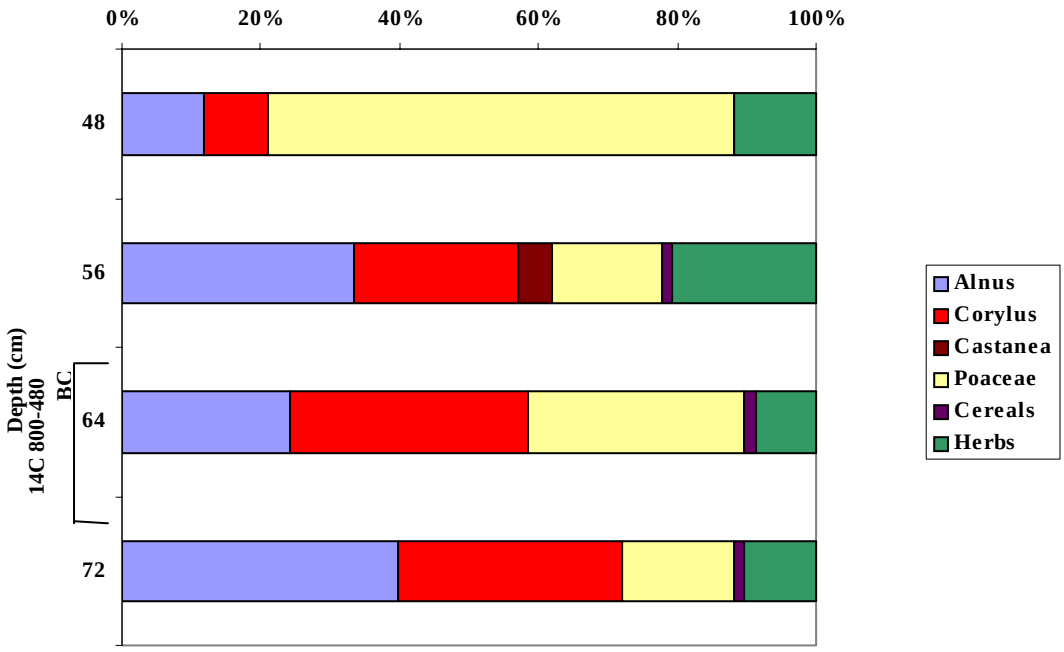

Figure 3: Selected taxa percentage pollen diagram from Syresham 4