Car Dyke
A Roman Canal at Waterbeach

Cambridgeshire
County Council

Car Dyke

A Roman Canal at Waterbeach

S P Macaulay MPhil (Cantab) PIFA
& T Reynolds PhD

1994
Revised 1996

Editor T Malim BA
Illustrator K Fox & S P Macaulay

Archaeological Field Unit
Cambridgeshire County Council
Fulbourn Community Centre
Haggis Gap, Fulbourn CB1 5HD
Tel. (01223) 881614

Report No 98 Car Dyke under site management

Photograph by C. Gait-Utime

Archaeological Field Unit

CONTENTS

LIST OF FIGURES

SUMMARY

In April 1993 a section through the Roman Car Dyke (or Old Tillage) at Waterbeach (SAM 3 TL 495 645) was excavated to provide information on which to base beneficial site management. The project was funded by English Heritage and the work was undertaken by Cambridgeshire County Council's Archaeological Field Unit. The results of the excavation support the original interpretation of the Car Dyke as a canal (20m wide and 4 metres deep), no date for construction was recovered, however the canal was abandoned sometime during the Antonine period (AD 140-180). There was a subsequent re-use probably in the 17th Century as a drain or catch-water, which has resulted in the removal of the upper (later Roman) layers of the Dyke, leaving only the truncated fills of the Roman canal. The immediate post-Roman, Saxon and medieval history of Car Dyke are therefore unknown at this point. These surviving deposits have however produced data relating to the original construction and use of the Dyke and it appears that in addition to the 17th Century dredging there was a later Roman re-cut when the Dyke's primary function changed to being used for drainage soon after its function as a canal fell into disuse. Environmental data supports this theory and suggests that changes in the contemporary local agricultural regime may coincide with the disuse of the canal. Excavation also revealed remains of the original land surface to the west of the Dyke preserved as a buried soil and showed that little now remains of the canal bank due to plough damage.

INTRODUCTION

Aims of the project

The Waterbeach section of the Car Dyke (SAM 3 TL 493 650-TL 496 641) survives as a 20m wide ditch over one mile long, with a depth of up to 2m. The monument is orientated north-south and runs south from Waterbeach towards the Cam. Originally it joined with the section that survives at Cottenham which would have linked the River Cam and the Old West River (Ouse) and may have been part of an extensive system of communications to York by way of the Ouse, Nene, and the Lincolnshire Car Dyke (Philips 1970).

The purpose of the excavation at Car Dyke were twofold:
i) to examine the function of the monument;
ii) to give data on which to base suitable management plans.

In addition to the formulation of management proposals for Car Dyke, it was hoped that excavation would allow us to understand the original use of the Dyke. All recent investigations into Car Dyke have centred around the Lincolnshire sections and it was felt that this excavation would provide a closer parallel to the section cut by Clark at Cottenham, Cambridgeshire (Clark 1949) when he confirmed the interpretation as a Roman Canal. Recent excavations in Lincolnshire however, have brought this function of the site into question (Simmons 1979, Thorpe & Zeffertt 1991).

The site was one of those included in the Monument Management Programme for Cambridgeshire and is one of the County Farms Public Access Sites, thus there was seen to be a need for an excavation to enhance the understanding of the monument and allow for better management. The present scheme of works proposed to set the agenda for managing the Waterbeach section of Car Dyke in the future.

The Monument Management recommendations (Malim 1990) proposed; removal of plough encroachment infill and rubbish, scrub control, tree management, improved public access and interpretation, and submission of the site into the Countryside

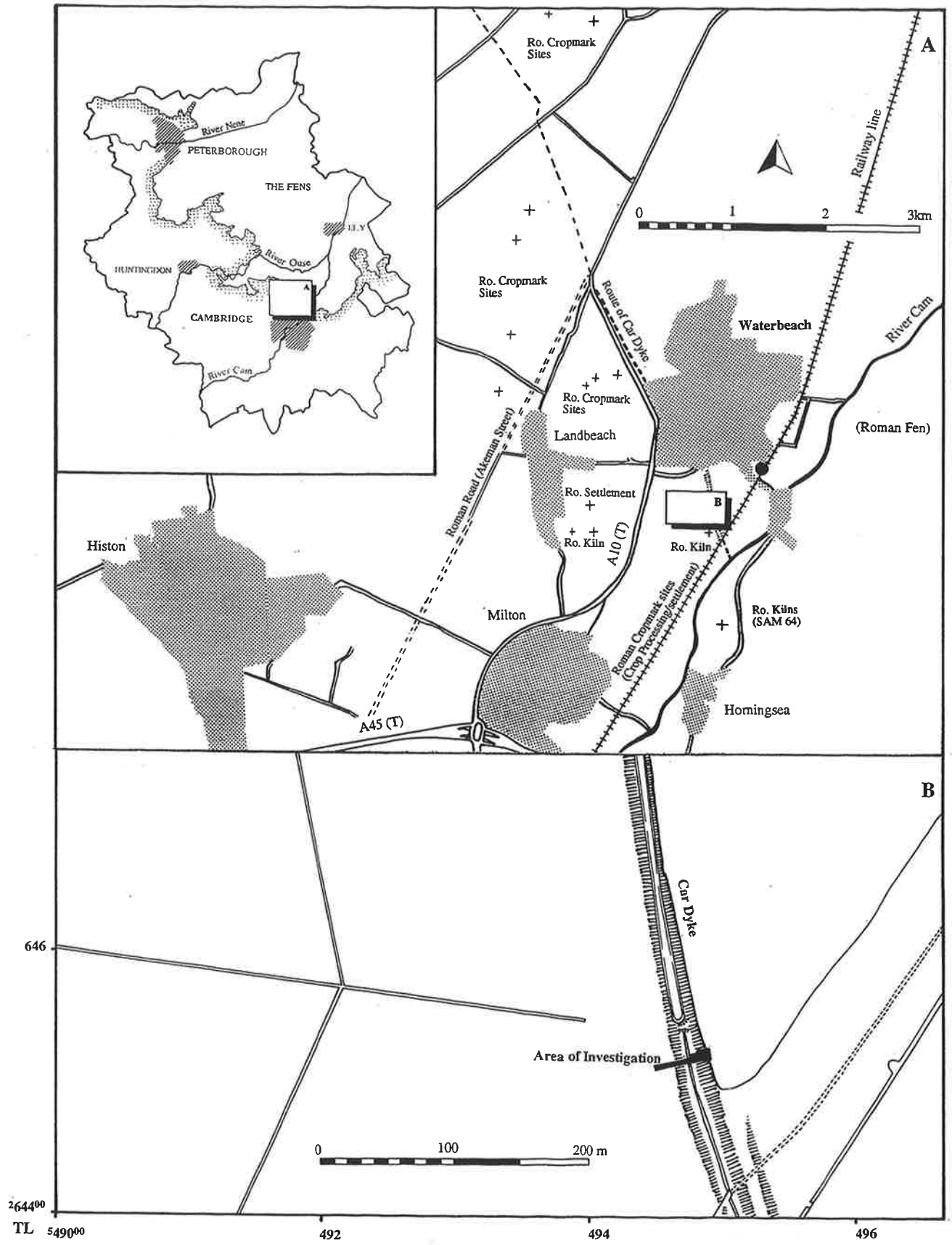

Figure 1 *- Waterbeach Car Dyke Location Map showing related Roman sites*

Stewardship Scheme. This would allow the environs of the site to be put into pasture, areas seeded for grass, with payments for management and provisions for educational access.

Additional aims of the project were as follows:

(a) To investigate the extent of plough damage to the monument and the degree of preservation of the site, so as to identify the appropriate level of earthwork reinstatement.

(b) To identify the original water-level and study the possibility of re-establishing this by removal of modern deposits.

(c) To examine the level of the water table and its effect on material preservation. Whether this level has dropped in recent times with the subsequent loss of preserved organic remains and what future effect any altering of the water level in the vicinity would have on the monument.

(d) To investigate phasing of the site and to retrieve material for dating purposes.

GEOLOGY AND TOPOGRAPHY

The site is situated in the valley of the Cam on Gault Clay with 1st Terrace River Gravels to the south. The site lies just to the north of the alluvial plain around the River Cam (5.53m O.D) and to the east of the gravels on which the Cottenham section of the Car Dyke is located.

ARCHAEOLOGICAL BACKGROUND

Introduction

Car Dyke is the name given to a series of Roman earthworks and cropmarks which run in an interrupted line from the River Cam at Waterbeach to the River Witham near Lincoln. It has two main sections which connect natural watercourses to form a continuous route, although there is debate as to whether all the 'Car Dyke' is a single monument or a series of locally important features and what it/their purpose was. It has been known to historians since Stukeley identified it in 1757. He interpreted it as a military canal to supply the army in Lincoln and York with cereals produced in the south. An alternative explanation for it is that it acted as a catch-water (Fox 1923; Hall 1985; Pryor 1978; Simmons 1975, 1979) and was an essential part of the drainage works undertaken by the Romans to produce an Imperial estate in the fens in the second century AD (Astbury 1973; Phillips 1970).

The monument runs some 122 km in length and has 10 scheduled sections totalling 33 km. It comprises a major channel of varying size and profile with banks which can occur on either or both sides. There are occasional gaps in the banks and in some places causeways appear to have been constructed across the channel. The monument is in varying states of preservation having suffered from infilling, ploughing, re-cutting and dredging. Roman artefact scatters occur in many places along the route and post-Roman/Anglo-Saxon remains are particularly well associated with the monument at its junction with the Cam at Waterbeach. Its construction and subsequent decay have had a profound effect on both drainage and transport along the fen edge, thus affecting the local development of these areas in later times. The monument has been used to define parish boundaries.

Place Name Evidence

The northern section at Peterborough and in Lincoln were known as Kari's Dyke in 1245 (Astbury 1958), probably after a local Danish landowner named Karr. Parts of the monument originally known as Car Dyke occur in Lincolnshire and north Cambridgeshire while the section between Waterbeach and the River Cam is more properly known as the Old Tillage. The latter has been known as such since as least 1235 (Reaney 1943) and is thought to derive from *Twilade*, a dialect word meaning to load, unload and go for a second load (Babington 1883). Ravensdale (1974) refers to the term *Car* to mean overgrown with marshes, reeds, shrubs, etc. but the existence of terms such as tillage suggest parts of the Dyke in Waterbeach and Landbeach were still operative in early medieval times.

Route *(Fig. 4)*

The route is well described elsewhere (Fowler 1932; Astbury 1958; Phillips 1970; Simmons 1975; Wilkes and Elrington 1978) and so will not be discussed in length here. There are two main sections of earthwork/cropmark: the southernmost running between the River Cam at Waterbeach and the Ouse at Earith, and the northern one running from the River Nene at Horsey (southeast of Peterborough) to the River Witham near Lincoln. There is a major gap in the route between the Earith and Horsey, and Astbury (1958) suggests that the missing section is 'lost' to a more modern waterway such as Conquest Lode or Whittlesea Dyke, whilst Cnut's Dyke is also a possibility. However, recent survey work has failed to locate such a watercourse (Hall and Coles 1994) and it is suggested that the main river systems of the Ouse and Nene were used for transport instead of an artificial water course through the Fens.

The southern section of Car Dyke can be seen to run from the Cam south of Waterbeach to join the Old West River at Lockspit Hall, north-east of Cottenham. It continues westwards by making use of the Old West along which many Roman finds have been identified until this tributary joined the Ouse at Earith (Fowler 1932; Philips 1970). To the east of Lockspit Hall the present course of the river (called the "Old West" or "Ouse") appears to be a late Post-Roman natural cut through dry land to join with the River Cam east of Stretham and thence together flowed north around the east of the isle of Ely (Fowler 1933; Worssam 1969).

Dating.

Excavations at Bullock's Haste, Cottenham (Clark 1949) yielded Belgic pottery sealed beneath one of the banks of the Car Dyke. These finds have been used to suggest a date of AD 50-60 for construction of the Dyke, while later first century pottery recovered from the basal silt of the channel could support this, but Hartley suggests this typological dating may need review in the light of more recent finds (Philips 1970). More recent sections through the Car Dyke have failed to provide further evidence for the date of its construction.

It has been suggested that the suppression of the Boudiccan revolt of AD 60-61 will have produced population movements into the fen area and also provided labour for the construction of works like Car Dyke (Phillips 1970; Potter 1965; Pryor 1978; Richmond 1955). This would fit with the evidence of pottery from Clark's excavations. However, evidence for initial occupation of the silt fen in Lincolnshire is mostly from the first half of the second century AD and excavations at Romano-British settlements near Car Dyke at Earith span the period from the first to the fourth centuries AD (White 1967). Pottery finds from later deposits dredged up from the channel of the Car Dyke at Bullocks Haste (Cottenham) broadly span these periods.

Car Dyke was certainly blocked at Cottenham after AD 375 for pottery of this date was found in a causeway deliberately constructed across the Dyke at Bullock's Haste (Clark

1949). Tebbutt (1957) however quotes Clark's data but suggests Car Dyke was abandoned at the end of the second century. The significance of the causeway for indicating the disuse of the canal is not clear. From constructional details observed by Simmons (1979) at a section of the Dyke in Lincolnshire causeways were always present, formed by leaving an upstanding baulk of natural gravel whilst digging out the Dyke channel. This is confirmed by later work (Thorpe and Zeffertt 1989).

Excavations by Lethbridge at Waterbeach in 1927 show the presence of Anglo-Saxon grubenhaus near to the Dyke, and that Anglo-Saxon pottery was discovered in the upper fills of the, by then, silted up Car Dyke (Lethbridge 1933). Pottery from this site included unabraded Romano-British sherds and it seems that this site is very early Anglo-Saxon. Hall (pers comm) suggests that the Old West to the south of the Isle of Ely was formed in the wetter environment of later Anglo-Saxon times, or most likely, during the medieval period.

A channel running from the centre of the medieval village of Cottenham links with the route of Car Dyke and its suggested use was to bring building stone to the village (Ravensdale 1974). This suggests that at least one stretch of the Dyke was functioning as a routeway into the medieval period or that the wetter conditions during the medieval period allowed Car Dyke to be re-used.

It seems that each part of Car Dyke has its own late Roman and later history, with some stretches remaining as dykes whilst others infilled.

Function.

There are two principal suggestions as to the function of the Car Dyke, and they are notable in that they reflect the geography of the worker's interest. The Southern Car Dyke, from the Cam to the Old West River and on to Earith has been interpreted as a logistical route for the Roman army linking up two of the major rivers of the region, and so create an access to the north (Fox 1923; Fowler 1932). Fowler states there was no Old West river between Stretham and Lockspit Hall, so Car Dyke formed the only link (see Fig 4). In the Lincolnshire section the prevailing interpretation has been that the Dyke served as a catch-water, diverting the seasonal increase in run-off into the nearest watercourses and preventing flooding in the Fenland (Simmons 1975). This is seen as a necessary part of the maintenance of the saltern industry which developed on the silt fen edge during the second century especially in Lincolnshire (Philips 1970). Both interpretations have been applied to the other respective part of the Car Dyke and also to other Roman waterways in the Fenland region (Potter 1966).

It is clear that neither interpretation has been as yet adequately refuted, although the recent sections excavated in Lincolnshire would emphasise the catch-water nature of the channel in that area, especially given the causeways blocking the route. Assuming Car Dyke had a transport function, the main suggestions for the goods transported upon it is corn (Darby 1983; Fox 1923) and building stone (Wilkes and Elrington 1978), but pottery is also likely to have been transported (a number of canal side kilns have been recorded), as would salted meat and the hides from animals slaughtered for transport. Dewhurst (1964) even suggests coal would have been imported from Nottingham and Derby along it, following the most logical route, although there is little definite evidence to support this theory.

The dimensions of Car Dyke, where known, are compatible with a transport function, if boats and barges such as those known from the Thames were being used (Mansfield 1966; Milne 1985; Wheeler 1950) In Cambridgeshire, excavation at Bullock's Haste (Clark 1949) and Earith (White 1967) and dredging of the channel has produced rich collections of pottery lacking in Lincolnshire (Philips 1970; Simmons 1975, 1979; Thorpe and Zeffertt 1989). There is also a notable association of kilns with the southern section of the Dyke (Cambridgeshire County Council SMR; Walker 1912;

Swan 1984), and another interesting association is a large number of querns found in fields along this part of it. These circumstantial pieces of evidence would seem to support an interpretation of the southern section of Car Dyke being that of a canal for transporting grain, flour and pottery.

For any effective explanation of the function of the monument, the surrounding landscape must be taken into account together with its relationships to other Roman settlements, roads and canals.

Research Priorities.

The first priority for any study of Car Dyke is to investigate a link between the two identified sections. Is Car Dyke a single monument of huge scale or two separate, but similar works?

There is a need for further dating to establish construction of the monument, particularly in Lincolnshire where direct artefactual associations are still lacking. The southern, Cambridgeshire, section also needs confirmation of the dating evidence, particularly a review of the pottery recovered by Clark, as Iron Age, Roman and Romano-British ceramic studies have developed further since the excavations at Bullock's Haste. Clearly associated assemblages of artefacts are needed to assist such re-examination of the dating evidence.

The dating for disuse of the monument is also obscure over most of the route, parts seem to have continued in use whilst others seemingly silted up during the Roman period. This is demonstrable even within the short stretch of the southern section of the Dyke, where Bullock's Haste excavations show the channel blocked and silted up by the end of the fourth century, grubenhausen at Waterbeach of early Saxon date, show it was fully silted by the fifth/sixth centuries. Whilst medieval channels running into it at Landbeach show a possible re-use by water traffic as late as this date. Place name evidence during Anglo-Saxon times suggests it was an active waterway and also suggests water traffic present in the Waterbeach/Landbeach areas in the medieval period. The various local factors contributing to its disuse or cleaning need to be identified in each local context.

Examination of the function for Car Dyke needs to be undertaken to understand its changing character in different locations. No exclusive single function should be ascribed for its full length and indeed it may have fulfilled more than one function for each section. Even if it did function as a canal, the seasonal run-off would be a factor that the engineers would have had to cope with. Excavations of channel-side settlements is needed to clarify their nature, certainly cereal processing and pottery manufacture were important activities between the Cam and the Old West River. Supplementary information about who was responsible for the channel's upkeep and associated sites may also derive from such additional excavations.

MANAGEMENT BACKGROUND

State of the Monument

Prior to 1993, despite being a Scheduled Ancient Monument (SAM 3), there was no management agreements for the Waterbeach section of Car Dyke. The site was in a general state of decay, suffering from plough encroachment and continued neglect. Along both sides of the Dyke ploughing too close to the canal had removed the visible remains of the banks which were noted by Cyril Fox and Fowler surviving as a low earthwork in a ploughed landscape, as late as 1923 (Fox 1923; Fowler 1932). The

damage however continues with ploughing also being responsible for pushing of soil over the edge of the Dyke obscuring the sides and profile of it.

The northern end of this part of Car Dyke, towards Cambridge Road, had had its western side pushed in and flattened for use as a vegetable patch and tipping has been taking place just to the south of this infilled section.

Along the length of the Car Dyke scrub growth was responsible for the cutting out of direct sun light which was resulting in soil erosion on the ditch sides. Movement down the base of the canal was also prevented by this thick undergrowth and the visual perception of the monument was being impaired. The large number of willows present were in a state of neglect with many dead trees blocking the channel. From a wildlife aspect this was not beneficial to birds or other mammals which would utilise scrub cover for nesting and breeding. Finally there had been a plantation of County Council funded trees along the western side of the Dyke and over the southern part of the canal which they had deliberately infilled during the early 1980's.

Management Proposals

Management proposals for Car Dyke at Waterbeach, have been in place since the monument was included in an archaeological survey of the Cambridgeshire County Farms Estate (Malim 1990). Subsequently the site has been entered into the Countryside Commission's Countryside Stewardship Scheme as a Historic Landscape. This has been possible with the alteration of County Farms tenancy agreements. The site is now one of Cambridgeshire County Farms Public Access Sites, a project started in 1992 aimed at promoting sites on the Farms Estate for public enjoyment and education.

The Stewardship Scheme provides grants for beneficial management, while protecting the 'natural' environment of the site, preventing the use of modern fertilisers and ensuring that the site is taken out of arable cultivation.

METHODOLOGY

A mechanical digger, using a 1.5m wide toothless ditching bucket, excavated a single trench, 55m long and 1.5m wide across the Car Dyke. This trench was widened and stepped to follow safety procedures and was cut through to the Gault Clay along its length. Steps were left to either side so that the Roman deposits could be excavated by hand. The trench was extended into the field to the west to investigate the survival of the bank and any buried soils. To the east remains of a bank had been noted by Tim Malim during survey work in 1989, but access to this land was not permitted by the tenant on this occasion.

Two pumps were in use at all times during the excavation and Royal Engineers of 39th Regiment sand bagged the water flow to the north and south of the site.

Roman layers were excavated by hand after establishing the profile by machine excavation. This profile was cleaned by hand, drawn, photographed and recorded using the standard Cambridgeshire County Council Archaeological Field Unit single context recording system. However the absence of ancient upper fills, the result of truncation, meant that only the two basal deposits were excavated in detail. The majority of artefact retrieval came from these two layers.

Investigation of buried soils, surviving bank, and features to the west of the Dyke were determined after their identification during machining, and these were also investigated by hand and recorded in detail.

Although English Heritage had not allowed the project design to include adequate provisions for environmental analysis, a sampling strategy was nevertheless envisaged. English Heritage specialists recorded the buried soil and collected a monolith from the basal fill [11 & 16] for macrofossil and mollusc analysis. Staff of Cambridgeshire Archaeology also collected monoliths for pollen analysis and took a sample core of the buried soil with the help of Cambridge University Department of Plant Sciences.

RESULTS

Trench Description

Machine excavation of over 4m in depth removed all layers onto the natural Gault Clay. It became apparent from the initial opening of the trench that there had been disturbance to the upper deposits, and the lack of Roman material from these layers suggested some truncation had occurred. From the information revealed in the exposed section it became apparent that there were seven identifiable phases of the monuments history.

Phase One A ditch (8) running near to the Dyke was revealed and sectioned (Fig 3). Cutting a poorly developed buried soil (9). This layer relates to the original land surface of the area which was sealed during the construction of Car Dyke. Both predate Car Dyke stratigraphically and pottery recovered close to the ditch from the buried soil is Iron Age in date. The axis of the ditch does not relate to the Dyke and would cut across it further to the south. A sample of the buried soil was removed for pollen and additional palaeoenvironmental analysis, however this has yet to be analysed and will form comparative material for other work in the vicinity.

Phase Two the construction of Car Dyke and the canal bank. The base of the cut [5] is flat with a wide central slot (20m wide and 2m deep) and sides which do not angle steeply (Fig 2). There is no surviving subsurface trace of the bank associated with the Dyke at this point, all that is recognisable is a slight rise in the land surface. The buried soil however testifies to the one time existence of the bank to which it owes its survival protected by the overburden.

Phase Three represents initial infilling of Car Dyke, originating from its use and providing the most accurate information available for its construction. The basal fills comprise yellow clay (2) and light grey/blue clay (16) and these include organic residue. These deposits, (along with (11), see Phase Five), form the only surviving Roman deposits (Fig 2). The basal deposit (16) was formed in conditions of rapid sediment accumulation (Appendix C), from free flowing well oxygenated water (Mollusc evidence from Appendix B). Nine sherds of Roman pottery were recovered from context (16) and four from context (2), all date to the Antonine period (AD 140-180). Whether these accurately date the monument's construction is open to question, more likely they represent deposition which occurred during the height of the canal's use. Pollen data suggests that at the time of deposition the surrounding area was dominated by grassland, few trees and pastoral and arable fields (Appendix C).

Phase Four a re-cut in the Roman period characterises a change in the use of the canal and potentially that of the surrounding landscape as seen from the pollen diagrams representing the top of context (16) continuing through into the fill of this cut (context 11) (see Appendix C). This later cut [18], appears to have been formed when the banks were more overgrown (Appendices B and C).

Phase Five is the fill of re-cut [18] which is represented by a light grey clay context (11). The higher pollen rain and the presence of some tree pollen hints at local scrub development of hazel and birch, in an open landscape still dominated by grass and herbs. There is still evidence for the continuation of cereal pollen and crop processing, and this may indicate that subsequent changes in the use of the Dyke may have had little effect for the local agricultural regimes. This deposit produced large quantities of (AD 140-180) pottery (117 sherds) the majority of which originate from local sources (Appendix A). It would appear that Phases Four and Five represent the disuse of the Car Dyke as a canal and a change of use as a drain or catch-water.

Phase Six the last active use for the Waterbeach Car Dyke is represented by a Post-Medieval re-cut [17] which has resulted in the truncation of part of the Roman profile and the loss of later Roman and post-Roman fills. Support for this phase comes from the accumulation of layers (1, 3, 4, 10 and 13), a mix of clay/silts which produced only a few sherds of re-deposited Roman pottery and Post-Medieval ceramics. Communication with David Hall regarding other canals in the Fenland Project (David Hall pers comm and Hall 1985b) with special reference to a test-bore through Car Dyke near Peterborough, indicates the observed sections are similar to other Post-Medieval recuts. Additionally there is evidence of the reuse of canals in the 17th-19th centuries throughout the Fens and Cambridgeshire (Fowler 1932). There is also the circumstantial evidence which is based upon negative evidence; ie the lack of any surviving later Roman fills.

Phase Seven the final phase is that of the in-filling and eventual abandonment of the monument from active use. The deposits represented by the grey/brown clay/silt deposits (3 and 10) and a dark grey/black humic clay/silt (4), form the fills of the Post-Medieval re-cut [17] and produced only two pieces of unstratified Roman pottery (collected while machining). Figure 2 also shows context (13) which represents the modern water channel which runs down the centre of Car Dyke. In addition to the modern 'in-filling' that has occurred in Car Dyke in recent years (see above State of the Monument), the site has been subject to general farm tipping as a result of its neglect and has had Cambridgeshire County Council grant-aided tree planting along its western side and inside the southern end. It is reported that even a WW2 Wellington Bomber has contributed to the modern in-filling of the monument!.

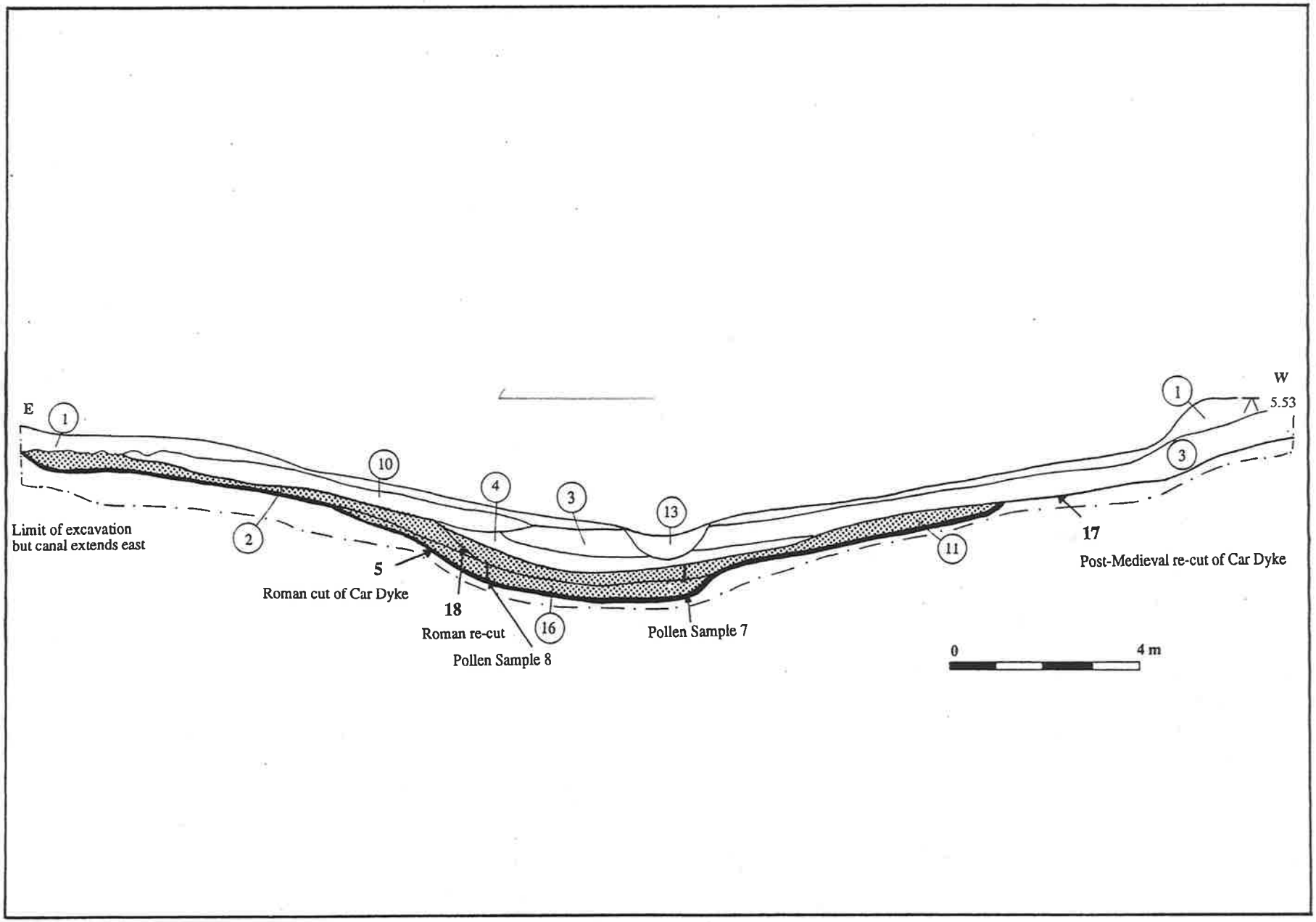

Figure 2 - North facing section of Car Dyke (stippling shows intact Roman layers)

Photograph by S.P. Macaulay

Plate 1 *- View of north facing section of Car Dyke*

Artefact and Sample Analysis

The Roman pottery from all deposits dates to the Antonine period AD 140-180. Most of the vessels represented are greywares from local kilns, such as Horningsea, while the fine wares generally come from the Nene Valley (Appendix A). The high percentage of local pottery supports the evidence for the proximity of other kilns in the immediate vicinity (see Fig. 1). There is a notable lack of later Roman pottery which might be attributed to the truncation of the upper fills during the Post-Medieval period. However, if later wares existed in upper Roman layers which had been removed during the 17th Century or after, this pottery should be found spread on the fields either side as a result of dredging (and modern ploughing), but it seems that there is little evidence for pottery of late Roman date found in the proximity of this part of Car Dyke.

Environmental analysis of selected deposits unsurprisingly indicate the presence of aquatic plants, while macrofossils of wetland and terrestrial herbs were also present. Mollusc shells were very common, the assemblages characteristic of a large body of well oxygenated water. The environmental assessment produced the type of flora and fauna to be expected in and around a canal (Appendix B).

Two monoliths were taken for pollen analysis; sample 8 was taken from the base of the Car Dyke deposits within context 16; sample 7 while coming from a similar elevation represents a higher stratigraphic position, the basal part of sample 7 is within context 16, but the upper extends into context 11. The pollen diagrams therefore correlate so that the changing environment is related to the changing use of the Dyke (final paragraphs Appendix C).

The brief assessment of basal deposits for pollen has made it possible to make some general observations (taken from Appendix C). The dominant signal in the pollen record is that from herbs, and particular grasses. This assemblage is characteristic of open, partially disturbed grassland and tall-herb communities. Arable activity is indicated by the consistent presence of *Hordeum* type (barley) pollen. Therefore it is likely that at the time of deposition, pastoral and arable fields surrounded Car Dyke. It appears that this was essentially a tree-less environment, with the exception of *Salix* (willow) and *Alnus* (alder) growing in marshy locations fringing the Dyke itself. The remaining arboreal taxa probably represent distant woodland with *Quercus* (oak), *Corylus* (hazel), *Ulmus* (elm), *Betula* (birch) and other trees. At the top of sample 7 arboreal pollen reached frequencies of 20%. This could be interpreted as local hazel and birch scrub development, with an increase in local oak.

The Dyke itself would have been fringed by *Cyperaceae* (sedges), *Typha latifolia* (greater reedmace), *Sparganium* spp. (bur-reeds) and *Lysimachia* sp. (loosestrife). Other aquatic plants such as *Myriophyllum spicatum* (milfoil), *Nuphar lutea* (yellow water-lily) and *Potamogeton* sp. (broad leaved pond-weed) were also present. There was a peak in pollen concentration in sample 7 between 10 and 20 cm, marked by a broad stratigraphic change, probably indicating a slower sediment accumulation rate in still water at the time.

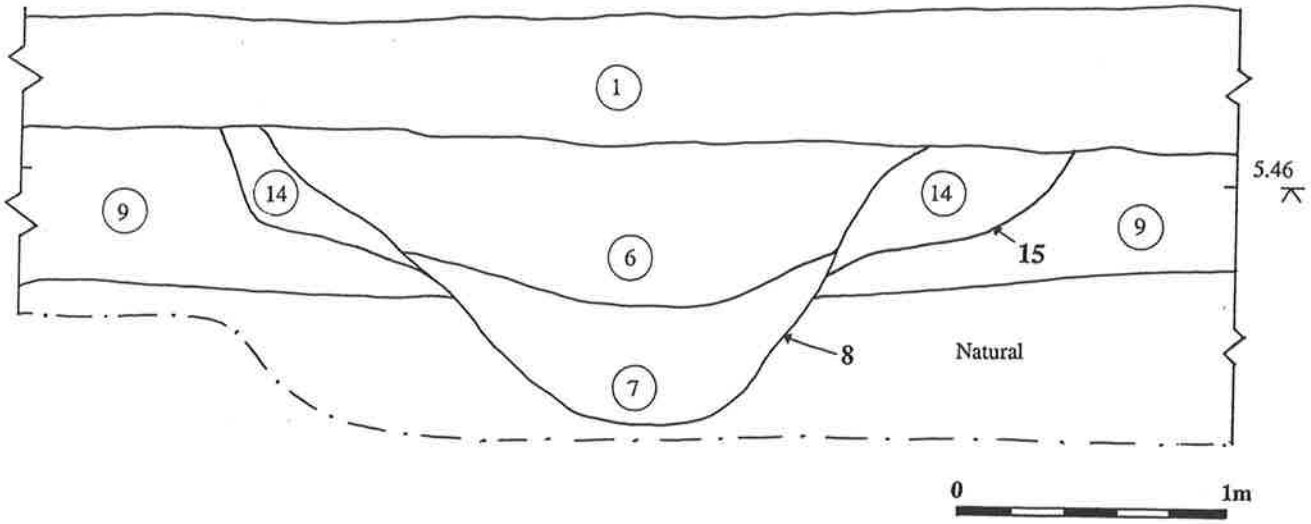

Figure 3 - North facing section of Iron Age Ditch [8/15] and Buried Soil [9]

Photograph by A. Taylor

***Plate 2** - Countryside Management Team at Car Dyke*

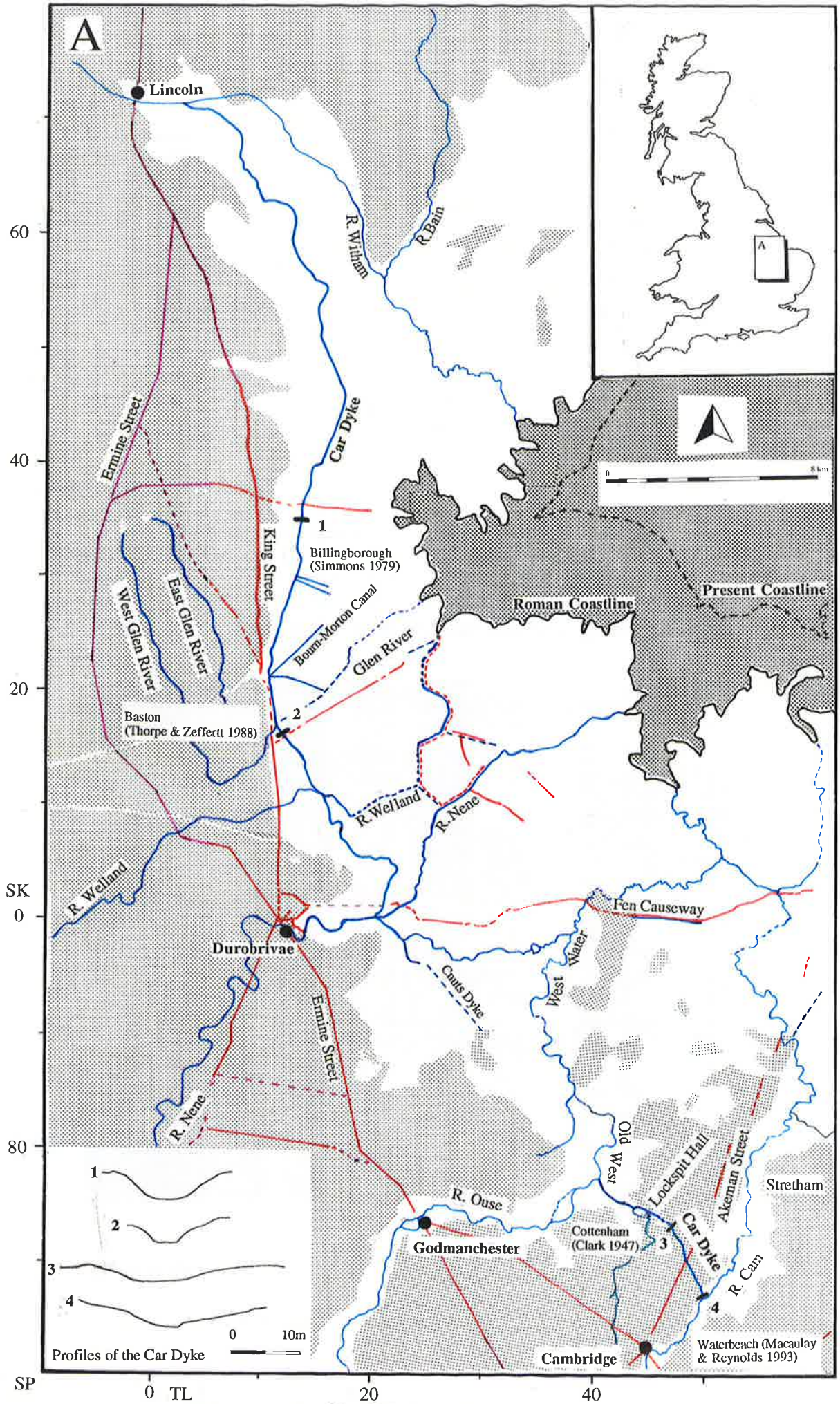

Figure 4 *- Route of Car Dyke from Waterbeach to Lincoln, stippling represents upland and islands (After Philips 1970 with additional data)*

DISCUSSION

Although only a single trench was cut across the Car Dyke at Waterbeach, the results have provided the first clear picture of the function of the southern section of Car Dyke since Clark's excavation at Cottenham in 1947. The similarities of the Waterbeach and Cottenham sections, compared to the Lincolnshire sections, suggest that there are at least two separate monuments currently called 'Car Dyke' (Fig 4). The functions appear to be firstly as a canal in the south, and secondly as a drainage or catch-water ditch in the north of the County and in Lincolnshire.

It is likely there may be more than a single explanation for the function of the monument not just as a whole but in local areas as well. It has been hypothesised that the southern section of the Car Dyke may have been used to connect the Cam to the Ouse at a time when there was no natural watercourse going all the way from Stretham to Earith (Fowler 1932). It is quite possible to theorise that there was a dual purpose involved when the Dyke was constructed. There is a vital need to excavate channel-side settlements, especially as, since the completion of our work at Waterbeach there has been evidence recorded to indicate the presence of pottery kilns near to the site, and our environmental data which suggests that changes in local agricultural practices are apparent in the palaeoenvironmental reconstructions from Car Dyke (Appendix C). It might be that local pottery production and the duration of this industrial activity has a more direct bearing on the function and life span of the Car Dyke as a canal than has previously been thought.

The results of this work at the Waterbeach Car Dyke contrasts with the results of work carried out on the northern sections in Lincolnshire. Excavation revealed the profile of the Waterbeach Car Dyke to be that of a wide shallow channel with gently sloping sides and a wide central slot. Although the upper fills were truncated, there remained basal Roman deposits which confirm the existing shape (deposits (2) and (11)) as part of the original construction. Profiles of the southern Car Dyke differ greatly from its northern counterpart (Fig 4). The sections at Baston and Billingborough suggest the profile and character of a drain or catch-water (supported by archaeological data), whilst the Cottenham and Waterbeach stretches suggest the shape of a canal. Comparisons with the Bourn-Morton canal, Lincolnshire, investigated in the Fenland Management Project, revealed a profile closer to the Baston and Billingborough sections (13m wide by 3m deep with a re-cut 7m wide by 1.5m deep Tom Lane pers. comm). The large quantities of pottery recovered from the excavation at Waterbeach contrasts with the paucity of such data from all sections of the Dyke excavated in Lincolnshire (Simmons 1979, Thorpe & Zefferett 1989). In addition to this there needs to be a review of the pottery recovered by Clark at Cottenham, in the light of recent developments in the field of Iron Age and Roman ceramic studies since 1949.

The state of preservation of the monument is varied. There remains little trace of any bank to either side of the monument, although there are some remains further to the south along the eastern edge. A buried soil survives and has been preserved by the removal of this strip of land from arable cultivation. The preservation of Roman deposits is adequate given that the basal fills are sealed by a protecting series of layers of Post-Medieval origin. The base of Car Dyke retains standing water for most of the year which helps to preserve the organic deposits. The site still remains an important reservoir of data despite the truncation of the upper fills and must be considered of particular value for studies not only of the Dyke itself and Roman canals in general but also for palaeoenvironmental reconstruction along the southern fen edge.

MANAGEMENT IMPLICATIONS

The extent of damage caused by continued ploughing, particularly that which has encroached onto the margins of the Dyke, has resulted in the destruction of any remains external to he original Dyke, such as canal banks. There only remains a slight rise to the west, the results of the spreading out of the material. This area is now out of the plough and seeded for grass with a hedge established along the western perimeter. Ploughing close to the edge of the Dyke has also resulted in the pushing of material to form an overhang in several locations. However plans to reinstate any earthwork feature of the monument have been rejected as too expensive and unnecessary because it still survives as a linear feature in the landscape.

An aim of the project was to assess the survival of deposits, particularly those of a waterlogged nature. Additionally the work aimed to investigate whether there had been any loss of preserved organic remains as a result of changing water levels and what future effects any activities which may alter the water table would have on the monument. Finally, the possibility of removing modern silt was to be investigated with the aim of increasing the level of standing water in the monument to add to the setting of the site.

The removal of the most recent silting of the monument was discussed. The purpose of this was to aid public presentation of the monument and to help preserve deposits by encouraging waterlogging. However there appears to be little need for the removal of any upper silts, as the Post-Medieval re-cut has removed the upper Roman and later fills of the Dyke. Any removal of silt would only reinstate the 17th Century catch-water profile, which is not substantially different from the present profile. The site exists today as a substantial ditch which, while not always waterlogged, does hold standing water for most of the year. The fact that the upper Roman layers have been removed means that only the lower basal deposits are Roman in date. The state of preservation in waterlogged conditions is adequate at present. However, there would be no room for any lowering of this level as this would expose the upper deposit [2] which spreads along the sides (Fig 2).

The information retrieved from the excavation has allowed informed recommendations to be made on the management of Car Dyke at Waterbeach. The site now has Public access, educational information and worksheets have been produced. The site does not require any silt dredging, and interpretation boards will be erected.

The Countryside Commission Stewardship Scheme provides grants for the management of the site, while protecting the natural environment, preventing the use of modern fertilisers and ensuring that the site is taken out of arable cultivation. Grants have been made available for scrub management, pollarding of willows, hedge planting, grass seeding and access.

Recommendations

It is recommended that the eastern side of Car Dyke should also be entered into the Countryside Stewardship Scheme. At present this land is also owned by Cambridgeshire County Council County Farms Estate, however any future changes in the tenancy agreement should include provisions for access to the rest of the site as a minimum requirement and that ploughing should cease close to the monument.

For the correct management of the monument (its survival, condition, setting, access and interpretation) any substantial local disturbances should be discouraged. In particular any activities which may affect the local water-table must be avoided. To this must also be added the consideration of the monument in its local environment. The function and

history of Car Dyke relates directly to its surroundings, while information stored in the monument pertains to these local developments. Existing contemporary archaeological features may contribute to the fuller understanding of the monument, in particular local Roman kilns, industrial sites and potential settlements.

CONCLUSIONS

The conclusions which can be drawn from the excavation in conjunction with the subsequent environmental analysis of deposits, indicate that the Waterbeach Car Dyke was originally constructed as a canal. The shape in profile determined from the stratigraphic sequence suggests this function, while the later re-cuts show that the Dykes function changed over time and was reused as a catch-water, probably immediately after ceasing to be a canal during the Antonine period (AD 140-180), and then again in the Post-Medieval period. This fits with similar findings from work near Peterborough which has a 17th Century re-use of the Car Dyke as a drain (David Hall pers comm).

Environmental pollen data tentatively supports this theory (Appendix C), while the molluscan information similarly points towards the function of the Car Dyke being first that of a canal which is reused as a catch-water (Appendix B).

Basal deposit [16] appears to have been the initial fill of Car Dyke, which seems to have been laid down fairly rapidly. A few sherds of pottery from the Antonine period (AD 140-180) were recovered (which may have been intrusive from higher levels) and the environmental data retrieved differed from the later deposits, charting the changes in the local environment over a fairly short period of time (Appendix C).

The suggestion that the canal may have changed function in the Roman period, represented by the formation of [11], is supported by the re-cut and subsequent alteration of Car Dyke's profile coupled with the much higher pottery concentration in this layer and definable changes in the palaeoenvironmental sequence gauged from this deposit (Appendix B and Appendix C). This sees the banks of Car Dyke becoming overgrown with localised scrub development coinciding with its disuse as a canal.

The range in pottery dates tells us little on the duration of the monument given the destruction of the upper fills, however this may have been short given the pottery range recovered from the basal deposits, which all fall within the Antonine period (AD 140-180). While the shape of the Dyke at Waterbeach links the site to the Cottenham section, constructed AD 50-60 (see chapter 2 Dating), pottery retrieved only suggests a date for abandonment during the Antonine period (AD 140-180).

9 ACKNOWLEDGEMENTS

The authors would like to thank English Heritage for funding the project and Cambridgeshire County Farms Estate for accommodating the works. We would like to thank Mr Smart, the tenant, for allowing us access. The Cambridge Regional College Countryside Management Team for their clearance of scrub on the excavated area and the Royal Engineers of 39th Regiment for all their help sand-bagging, erecting viewing platforms and advice. The Parish Council for their involvement and interest especially Mr Shipp, Mr Sabberton and Duncan Mackay. Philip Walker, Peter Murphy, David Hall and Steve Boreham for their specialist advice. Tim Malim, Helen Paterson and Alison Taylor whose knowledge of the site was invaluable. Finally the archaeological team of Richard Heawood, Karen Fox, Ken Welsh and Tom.

10 BIBLIOGRAPHY

Astbury, A.K. 1958. The Black Fens. The Golden Head Press Ltd, Cambridge.

Babington, C.C. 1883. Ancient Cambridgeshire. Octavo Series PCAS XXIX 1851-1897.

Clark, J.G.D. 1949. *Report on Excavations of the Cambridgeshire Car Dyke 1947.* Antiquaries Journal 29: 145-163.

Darby, H.C. 1983. The Changing Fenland. University Press Cambridge.

Dewhurst, P.C. 1964. *'Wool Street, Cambridgeshire'.* Proc. Cambridge Antiq. Soc LVI & LVII; 42-60

Fowler, G. 1932. *'Fenland Waterways, Past and Present. South Level District.'* Proc. Cambridge Antiq. Soc XXXIII: 108-128 (Part I) & XXXIV: 17-33 (Part II).

Fox, C. 1923. The Archaeology of the Cambridgeshire Region. University Press Cambridge.

Hall, D. 1985a. 'Cambridgeshire' In R.J. Silvester (ed) Fenland Research Vol 2: 46-49.

Hall, D. 1985b. The Fenland Project, No.2 Fenland Landscapes and Settlement between Peterborough and March. East Anglian Archaeology Report No.35, 1987.

Hall, D. & Coles, J. 1994. Fenland Survey. English Heritage, Billington Press Ltd.

Hartley, B.R. 1970. *The Dating of the Cambridgeshire Car Dyke.* in Phillips (ed). The Fenland in Roman Times. R.G.S Research Series No.5, 126.

Lethbridge, T.C. 1933 *'Huts of the Anglo-Saxon period'* Proc. Cambridge Antiq. Soc XXXIII: 133-151

Lethbridge, T.C. 1935 *'The Car Dyke, the Cambridgeshire Ditches and the Anglo-Saxons'* Proc. Cambridge Antiq. Soc XXXV: 90-96

Lethbridge, T.C. 1957. *'The Riddle of the Dykes'* PCAS LI: 1-7

Malim, T. 1990. Archaeology on the Cambridgeshire County Farms Estate. Cambridgeshire County Council.

Mansfield, R. 1965. The Roman City of London, G Benn Ltd, Cambridge.

Milne, G. 1985. The Roman Port of London. Batsford London.

Phillips, C.W.(ed) 1970. The Fenland in Roman Times. RGS Research Series No.5: 126

Potter, T. 1966. *'The Roman Pottery from Coldham Camp and its Affinities'* Proc. Cambridge Antiq. Soc LVIII: 12-37

Pryor, A. 1978. The Car Dyke Durobrivae: A Review of Nene Valley Arch. No.6: 24, 25.

Ravensdale, J.R. 1974. Liable to Flood. University Press Cambridge.

Reaney, P.H. 1943. 'The Place-names of Cambridgeshire and the Isle of Ely'. Cambridge University Press.

Seale, R.S. 1975. Soils of the Ely District. Harpendon.

Simmons, B.B. 1975. The Lincolnshire Car Dyke. The Car Dyke Research Group Publication No.1

Simmons, B.B. 1979. *'The Lincolnshire Car Dyke: Navigation of Drainage?'.* Britannia Vol.10: 183-196.

Swan, V.G. 1984. The Pottery Kilns of Roman Britain, RCHM, HM Stationery Office, London.

Tebbutt, C.F. 1957. *'A Belgic and Roman Farm at Wyboston, Bedfordshire'* Proc. Cambridge Antiq. Soc L: 75-84

Thorpe, R. & Zeffertt, T. 1989. Excavation of the Lincolnshire Car Dyke, Baston. Fenland Research No.6.

Walker, F.G. 1912. *'Roman Pottery Kilns at Horningsea'*. Proc. Cambridge Antiq. Soc XX: 14-69

Worssam, B.C. 1969. Geology of the County around Cambridge. HMSO, London.

Wheeler, R.E.M. 1950. London in Roman Times. London Museum Catalogues No.3

White, D.A. 1967. *'Excavations on a Romano-British Settlement on the Fenland Edge at Earith, Hunts'* Proc. Cambridge Antiq. Soc LX: 7-17.

Wilkes, J.J. & Elrington, C.L 1978 'Roman Cambridgeshire' A History of the County of Cambridgeshire and the Isle of Ely Vol VII, University Press Oxford.

Appendix A

Roman Pottery from the Excavations at Car Dyke 1993

G Lucas

Contexts

003 flared neck greyware jar, micaceous buff amphora fragment.
009 small, abraded coarseware sherds, possibly prehistoric.
011 large-medium, fairly unabraded sherds; sandy, burnished blue-grey-slipped ware, mostly cordoned jars, some with burnished wavy lines between grooving; other greywares, including a chamfered beaded bowl and combed storage jars, one with oblique finger impressions along base, all reminiscent of Horningsea wares. Large white-slipped combed bowl. Bilobed jar with shoulder grooving similar to types from Verulamium. Square-rimmed buff shell-tempered jar with two shoulder grooves. Nene valley brown-colour-coated vessels, including folded beaker and globular beaker, fine greyware globular beaker with metallic grey colour-coat and compass inscribed circles and another folded beaker with tall upright rim in a similar fabric. Rim of Samian cup, internally grooved, another sherd of Samian or early Imitation Samian in fine pink fabric with matt red-brown slip, possibly Dr.30. Nene Valley Mortaria fragment.
016 medium-large, fairly unabraded sherds; sandy greywares, including cordoned jar.

Discussion

Most of the pottery comes from context 011, and consists of fairly large unabraded sherds; most of the vessels represented are greywares from fairly local kilns, such as Horningsea, and consist of cordoned jars showing a good deal of use wear in many cases, in the form of abrasion and burning. An unusual thick-walled combed bowl, is also of some interest, and search for parallels would be of some value. Some of the larger vessel fragments also have black residues attached to the interior. One base had been trimmed to a disc with possibly a central perforation, and two body sherds were also noticed to have been possibly shaped into discs. Finewares were present in a reasonable quantity, mostly from the Nene Valley. The overall date range of the pottery assemblage points to the Antonine period, i.e.. c.AD 140- 180 AD, and seems fairly consistent with few or no residuals.

Given both the state of pottery and range of forms and wares, the Car Dyke assemblage represents an extremely useful collection of early Roman pottery from the Fen Edge, and would warrant further attention, particularly given its provenance. In comparison with the material collected from the 1947 excavations (Clark 1949), the dates presented here vary somewhat, especially the upper fills where Clark retrieved 3rd century pottery; no pottery of later than Antonine was recovered in 1993 upper Roman levels. This lack of later Roman pottery may be due to a truncation of upper Roman levels by Post-Medieval re-cuts, unlike Clark's section which had peat formation . However, Clark's basal silt covered a range of late 1st to the end of the 2nd century AD, which comes closer to this assemblage, though it is not as well-defined chronologically. The reason for this may relate to the fact that Clark's lower layer had few and sparsely distributed sherds, much like the lowest level from the present excavation, representing a longer duration of accumulation. the upper Roman layers from both the 1947 and 1993 excavations produced an abundant amount of densely distributed pottery, and both may be part of a localised and/or single act of dumping. If so, it would account for the difference in dates. Whatever the case, it seems certain that more work needs to be carried out to evaluate the dating discrepancy between the two sites, and it may mean a re-evaluation of the 1949 results.

Appendix B

The Car Dyke, Waterbeach, Cambridgeshire (WATCD 92)

Assessment of soils, sediments and macrofossils

Peter Murphy, Centre of East Anglian Studies, UEA, Norwich

Introduction

A section was cut across the Roman canal, the Car Dyke, by Stephen Macaulay and Tim Reynolds for Cambridgeshire Archaeology in April 1993 as part of the Cambridgeshire County Council Monument Management Programme. The aims were to provide data relevant to the management of the monument and to confirm or refute its Roman origin. It was found that, though the dyke had been re-cut in the 17th century as a drain, truncated basal fills with 2nd century pottery survived. These were wet organic shelly clays. West of the dyke a buried soil survived beneath the remains of a dykeside bank.

The buried soil

0-25cm	A_p. Greyish-brown clay loam; slightly stony; small blocky peds; straw, modern roots; sharp boundary.
25-50cm	Light greyish-brown clay loam; virtually stoneless; fibrous roots; well-defined blocky peds; yellowish-brown mottles; sharp boundary.
50-51cm	Discontinuous yellowish-brown sandy clay loam with small angular flints; sharp boundary.
51-75cm	Light brown clay loam; virtually stoneless; reddish-brown mottles; merging boundary.
75-90cm	(?A horizon of buried soil). Greyish-brown clay loam; rare small flints; reddish-brown mottles; merging boundary.
90-115cm	Yellowish-brown clay loam; virtually stoneless; reddish-brown mottles and black flecks; merging boundary.
115cm+	Gault Clay. Very firm grey clay.

This buried soil is sealed beneath *c*75cm of bank make-up. It is thus relatively well protected, though from a management viewpoint ploughing should clearly be discouraged to avoid further degradation of the surviving bank.

The basal canal fills

50cm monoliths were taken from contexts 11 and 16 (Fig 2) for both pollen and macrofossil analysis (samples 5,6,7 and 8) with bulk samples from 11 and 16 (samples 3 and 4). These latter samples had been processed in a bulk sieving/flotation tank, using 0.5mm meshes. The sediments were as follows:

Sample 5. Context 11.

0-12cm	Very dark brown firm moist organic clay; sharp boundary.
12-50cm	Greyish-brown firm moist shelly organic clay.

Sample 6. Context 16.

0-50cm	Light grey firm moist clay; shelly with some bone fragments.

Macrofossils

It was decided to retain samples 5 and 6 intact but to assess the flots and residues from bulk samples 3 and 4 to give a general idea of the macrofossils present.

Plant remains from these samples, noted during scanning, are listed in Table 1. There seemed to be few differences between the assemblages from the two samples: both included a mixture of macrofossils from aquatics, reedswamp, wetland and grassland herbs, weeds, shrubs/trees and a little charred plant material. Unsurprisingly, aquatic plants were well represented. Macrofossils of wetland and terrestrial herbs were also present, no doubt deriving from bankside vegetation. Salix (willow) capsules and Sambucus seeds were relatively common in 11, rather less so in 16, perhaps indicating more overgrown banks in the later phase. The sparse charred material must relate to crop processing somewhere in the catchment.

Mollusc shells were very abundant (Table 2), freshwater species predominating. The assemblages, again unsurprisingly, were characteristic of a large body of well oxygenated water with muddy banks. Land snails occurred sporadically. Beetle remains were well preserved but not common. Other arthropod remains included ostracods and caddis larval cases made of shell fragments.

From this assessment it appeared that the macrofossils represented very much the type of flora and fauna to be expected in and around a canal, and they did not seem to provide any significant information on the surrounding landscape. In these circumstances detailed analysis was not recommended.

Conclusions

At this stage full analysis of the samples cannot be recommended, though they may prove useful for comparative purposes. Information from a single point along the canal is of limited value for interpreting the wider Roman landscape. Taking a longer-term view, a research programme involving sampling at multiple sites along the canal would be much more informative and interpretable, in terms of separating regional and local inputs of micro- and macrofossils. Such a project is not envisaged at present and it is therefore particularly important that the water table in the basal canal sediments should be maintained to prevent degradation of biological remains. Any activity near the dyke likely to affect water levels should be discouraged, or at least monitored. The buried soil beneath the bank similarly needs protection from plough damage.

Aquatics

Alismataceae (embryos)
Nasturtium officinale R.Br.
Nymphaea alba L.
Oenanthe sp.
Ranunculus subg. *Babrachium*
Ceratophyllum demersum L
Nuphar lutea (L) Sm.
Nymphoides peltata (S.G.Gmelin) Kuntze
Potamogeton spp.

Reedswamp, wetland and grassland herbs

cf *Apium* sp.
Cladium mariscus (L) Pohl.
Lycopus europaeus L.
Prunella vulgaris L.
Scutellaria sp.
Carex spp.
Eleocharis palustris/uniglumis
Mentha arvensis/aquatica
Ranunculus acris/repens/bulbosus
Sparganium sp.

Weeds

Aethusa cynapium L.
Brassica sp.
Conium maculatum L.
Polygonum aviculare agg.
Rumex sp.
Stellaria media -type
Atriplex sp.
Cirsium/Carduus sp.
Picris sp.
Polygonum sp.
Rumex acetosella agg.
Urtica dioica L.

Shrubs/trees

Rosa sp (thorns)
Sambucus nigra L.
Salix sp (capsules)

Others

Twigs
Charcoal fragments
Charred *Bromus* caryopses.
Rhizomes
Charred cereal grain fragments

Table 1: Plant macrofossils from contexts 11 and 16.
Taxa are represented by fruits or seeds unless otherwise indicated.

Freshwater molluscs

Valvata cristata (Müller)
Bithynia tentaculata (Linné)
Lymnaea truncatula (Müller)
Lymnaea peregra (Müller)
Planorbis carinatus (Müller)
Anisus cf *leucostoma* (Millet)
Gyraulus albus (Müller)
Planorbarius comeus (Linné)
Pisidium spp.
Valvata piscinalis (Müller)
Aplexa hypnorum (Linné)
Lymnaea glabra (Müller)
Planorbis planorbis (Linné)
Anisus vortex (Linné)
Bathyomphalus contortus (Linné)
Hippeutis complanatus (Linné)
Unionidae (fragments)

Marsh/land snails

Carychium sp.
Cochlicopa sp.
Pupilla muscorum (Linné)
Zonitidae indet.
Trichia hispida group
Succinea sp(p)
Vertigo pygmaea (Draparnaud)
Vallonia costata (Müller)
Cecllioides acicula (Müller)

Arthropods

Ostracods
Caddis larval cases
Beetles

Table 2: Animal macrofossils from contexts 11 and 16.

Appendix C

Car Dyke - Report on the preparation and assessment of pollen samples (Includes Second Report)

S. Boreham
Subdepartment of Quaternary Research
Department of Plant Sciences, University of Cambridge
Downing Street, Cambridge CB2 3EA

Introduction

In early October 1993 two 50cm long monoliths from Car Dyke (samples 7 and 8) were provided by Cambridgeshire Archaeology, for sampling and preparation for pollen analysis The monoliths were two separate samples from different faces in a section through Car Dyke. Sample 8 was almost entirely from the lowest stratigraphic unit in the channel-fill; context 16. Sample 7 was slightly higher in the sequence and straddled the boundary between context 16 and context 11. The monoliths have been described, samples have been taken, and a number of these have been prepared for pollen analysis. A brief assessment of the pollen types present, and the abundance of fossil pollen has been made.

Sediment description and sampling

Following examination of both samples, a description of the stratigraphic units present was made. Pollen samples were taken with a calibrated 1cm^3 brass volumetric sampler, and stored in sealed glass vials prior to preparation. A description of the sediments, and the sampling regime used appears below;

Sample 8 - monolith

Top	Description	Troels-Smith
0 - 6cm	Grey organic clay and silt with shell debris	As2 Ag1 Ld1
6 - 50cm	Grey clay and silt with shell debris	As3 Ag1
Base		

Pollen samples were taken at 5cm intervals between 5cm and 45cm yielding nine samples in total.

Sample 7 - monolith

Top	Description	Troels-Smith
0 - 5cm	Grey organic clay and silt	As2 Ag1 Ld1
5 - 17cm	Brown-grey organic clay silt	As1 Ag1 Ld2
17 - 21cm	Grey organic clay	As3 Ld1
21 - 25cm	Grey shelly organic clay	As2 Ld1 test. mol.1
25 - 52cm	Grey organic clay and silt with shell debris	As2 Ag1 Ld1
Base		

Pollen samples were taken at 5cm intervals between 5cm and 50cm yielding ten samples in total.

Pollen preparation and assessment

It was decided to originally prepare ten of the nineteen samples taken from the two monoliths for pollen and there after analyse the remainder. In each monolith these samples were from 5, 15, 25, 35 and 45cm respectively initially, followed by the remaining samples. The samples were prepared for pollen analysis using the standard chemical technique. This involves treating the samples with hydrochloric acid, sodium

hydroxide, hydrofluoric acid, and an acetolysis mixture, before staining with safranin, and mounting in silicone fluid. An exotic spike of 13911 *Lycopodium* spores per cm^3 was added to each sample to allow the calculation of pollen concentration if desired. The prepared pollen samples were assessed using a high-power binocular microscope at x400 magnification. The aim of the assessment was to describe the commonest pollen types encountered, gauge the abundance of fossil pollen, calculate its likely concentration, and estimate the volume of counting work for a competent palynologist.

Tables showing the abundance of the various pollen types encountered appear below;

Sample 8

	Samples								
	5cm	10cm	15cm	20cm	25cm	30cm	35cm	40cm	45cm
Traverses	1	1	1	1	1	1	1	1	1
Taxa									
Pinus			1						
Quercus	1	1	1	2		1		1	
Alnus				1					
Corylus	1			1					
Hedera			1						
Gramineae	6	9	12	9	17	10	9	8	5
Cereals	1	2		1	2	1		2	
Cyperaceae		1			2				
Centuriea type		1							
Caryophyllaceae				1					
Filipendula		1							
Plantago lanc	1	1		2					
Rosaceae						1			
Rumex sp		1				1			
Umbelliferae		1				1	3	3	
Filicales	1	3	2	1	1	1	1		1
Potamogeton	1						1		1
Sparganium type		6				2		1	
Exotic	7	10	6	10	9	14	5	6	9
Sum of pollen & spores - aquatics	**11**	**20**	**16**	**18**	**23**	**23**	**15**	**14**	**6**
Fossil pollen conc. x 10^3 per cm^3	21.9	27.8	37.1	25.0	35.6	22.9	41.7	34.8	9.3

Sample 7 (Report one)

	Samples				
	5cm	15cm	25cm	35cm	45cm
Traverses	1	1	1	1	1
Taxa					
Ulmus	1				
Quercus	1	1		1	1
Alnus		2			
Corylus	2	1	3	1	
Salix		1			
Hedera		1			
Gramineae	9	15	10	6	12
Cyperaceae	1	1			
Compositae (tub.)	2	2			
Chenopodiaceae	1	1			
Filipendula		1			
Plantago lanc			1	1	
Rosaceae	1	1			
Rumex sp			1		
Urtica				1	
Filicales	5	4	4	2	3
Potamogeton		1			
Typha lat.		1			
Exotic	7	3	9	4	3
Sum of pollen and spores - aquatics	**21**	**30**	**20**	**14**	**17**
Fossil pollen conc. x 10^3 per cm^3	41.7	139	30.9	48.7	78.8

Interpretation of pollen encountered

The brief assessment of pollen types seen in the samples is hardly a basis for detailed palaeocological reconstruction. However it is possible to make some general observations. During the deposition of the minerogenic basal stratigraphic unit in sample 8 (context 16) it would seem that the pollen rain was dominated by grass and herbs. There were apparently few trees, and the presence of cereal pollen hints at the agriculture. The low pollen concentrations could be due to rapid sediment accumulation, poor pollen production, poor pollen preservation, or all three. The more organic sediments at the top of sample 8 are possibly from context 2, and those throughout sample 7 apparently belong to both context 11 and 16. These deposits generally had higher pollen concentrations, and the presence of some tree pollen hints at local scrub development in an open landscape still dominated by grass and herbs.

Sample 7 (cont)

	Samples					
	10cm	12.5cm	20cm	30cm	40cm	50cm
Traverses	1	1	1	1	1	1
Taxa						
Betula	2	1				
Quercus	1	1				
Alnus	1					
Corlyus		1				
Salix	1		1	1		
Gramineae	8	13	10	11	3	3
Cereals	1					
Cyperaceae		1				
Compositae (tub.)	2	4	2		1	
Artemisia		1				
Compositae (lig.)	1				1	
Chenopodiaceae			1		1	
Plantago lanc	1	3		2	1	
Rumex sp.		1				1
Umbelliferae		1				
Filicales	1	4	4	3	2	2
Sparganium type	1	1	2	2		
Exotic	3	4	12	8	5	7
Sum of pollen and spores - aquatics	**19**	**30**	**19**	**17**	**9**	**6**
Fossil pollen conc. x 10^3 per cm^3	88.1	104.3	22.0	29.6	25.0	11.9

Description of the pollen diagrams

In broad terms the two pollen diagrams are similar in many respects. The main feature is the dominance of herb pollen, and particularly that of Gramineae (grasses). In addition the diversity and abundance of the various herbaceous taxa are similar in both. Apart from grasses, other herbs well represented in the pollen record include Cyperaceae (sedges), Umbelliferae, *Plantagon lanceolata* (ribwort plantain) and various Compositae. Notably, *Hordeum* type (cereal) pollen was also present at frequencies of up to 5%. In contrast arboreal taxa occur at low frequencies, with *Corylus* (hazel), *Quercus* (oak) and *Salix* (willow) represented throughout. Arboreal pollen reaches a maximum of 20% at the top of sample 7.

Palaeoenvironmental reconstruction

The dominant signal in the pollen record, as previously stated, is that from herbs, and particular grasses. This assemblage is characteristic of open, partially disturbed grassland and tall-herb communities. Arable activity is indicated by the consistent presence of *Hordeum* (barley) type (cereal) pollen. Therefore it is likely that at the time of deposition, pastoral and arable fields surrounded Car Dyke. It appears that this was essentially a tree-less environment, with the exception of *Salix* (willow) and *Alnus* (alder) growing in marshy locations of fringing the dyke itself. The remaining arboreal taxa probably represent distant woodland with *Quercus* (oak), *Corylus* (hazel), *Ulmus* (elm), *Betula* (birch) and other trees. However, *Pinus* (pine) pollen is known to be far-travelled, and so is of little significance at low frequencies. At the top of sample 7 arboreal pollen reached frequences of 20%. This could be interpreted as local hazel and birch scrub development, with an increase in local oak.

The Dyke itself would have been fringed by *Cyperaceae* (sedges), *Typha latifolia* (greater reedmace), *Sparganium* spp. (bur-reeds) and *Lysimachia* sp. (loosestrife). Other aquatic plants such as *Myriophyllum spicatum* (milfoil), *Nuphar lutea* (yellow water-lily) and *Potamogeton* sp. (broad leaved pond-weed) were also present. The low proportion of Pre-Pleistocene pollen and spore types re-worked from the bedrock indicate a small but continuous input from a mineral catchment. Concentrations of fossil pollen ranged between 15000 and 100000 grains per cm^3. There was a peak in pollen concentration in sample 7 between 10 and 20 cm, marked by a broad stratigraphic change, probably indicating a slower sediment accumulation rate in still water at the time.

Correlation of the diagrams

The sample 8 monolith was taken at the base of the Car Dyke deposits within context 16. It appears that although sample 7 was taken at a similar elevation, several metres to the west of sample 8, it represents a higher stratigraphic position. The basal part of sample 7 is within context 16, but the upper extends into context 11. Using the stratigraphy of the monoliths alone, it is tempting to correlate the grey organic clay and silt at the tops of sample 8, with a unit of similar lithology at the base of sample 7. If one relies on this premise, then the pollen diagram from sample 8 could lead upwards into that from sample 7. However, a gap or overlap in the profiles would be a strong possibility. This seems plausible if the frequences of various taxa, and the concentrations of fossil pollen are considered.

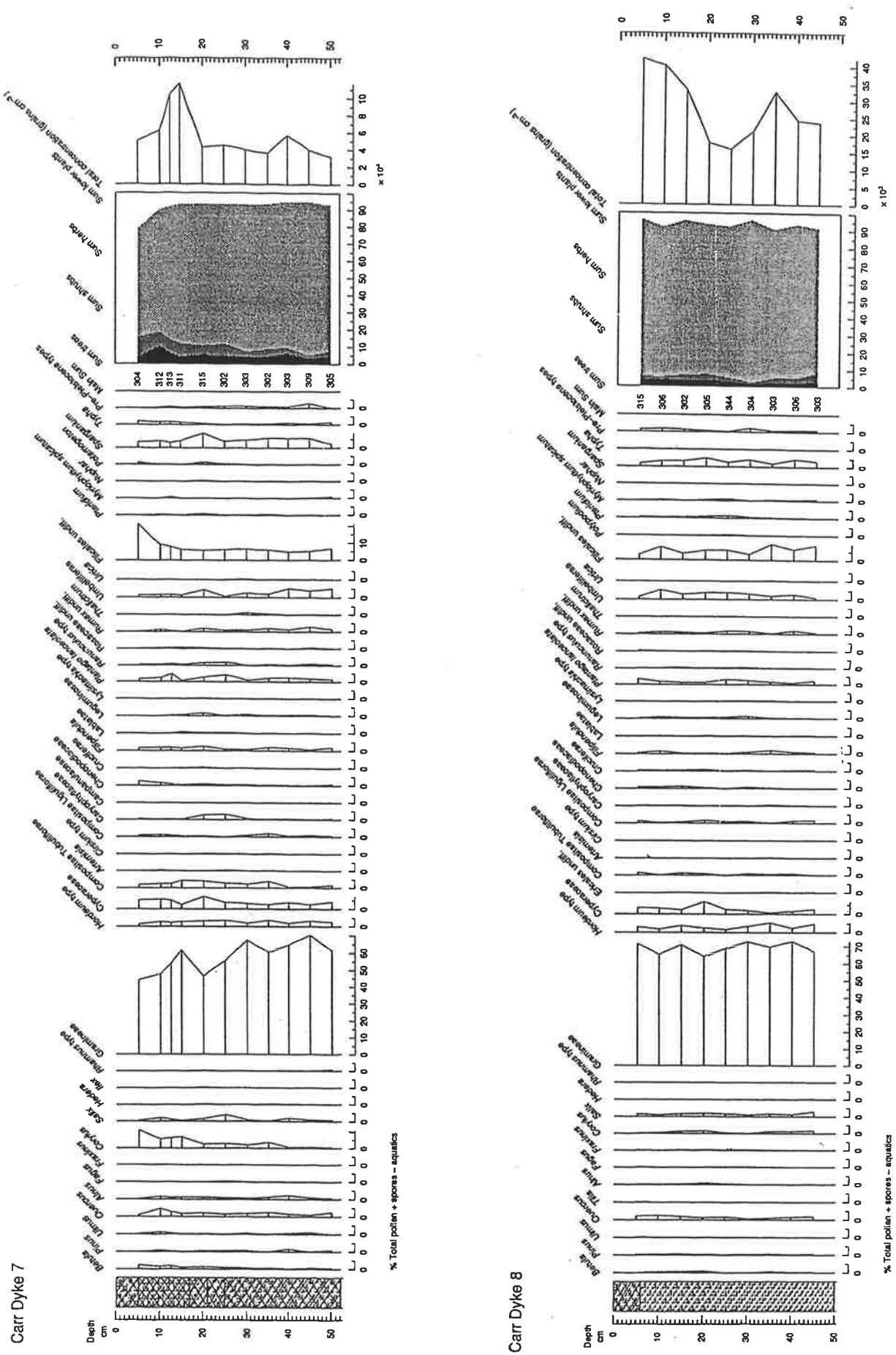

Figure - Pollen diagrams for Sample 7 and Sample 8

Appendix D

WAT CD 1993 Context List

Ctx. No.	Description	Nature	Finds	Above	Below
001	Topsoil	Dark grey/brown Clayey/silt		002,003 010,013	
002	Ro. Dyke fill	Dark yellow/brown Clay	Ro. pottery(4) Fe nail	012,016	001,004, 010,011
003	P/med dyke fill	Grey/mid-brown Clayey/silt	Ro. pottery(2)	004,011,012	001,010, 013
004	P/med dyke fill	Dark black/grey Clayey/silt		002,011	003,010, 013
005	Cut of Car Dyke	Roman Canal? cut by 017			
006	Ditch fill	Mid-grey clay		007	001
007	Ditch fill	Dark brown/grey clay		008	006
008	Cut of ditch	Drainage? (West of CD)			
009	Buried soil	Mid-brown clay	Preh pottery(5)	012	006,007, 014
010	P/med ditch fill	Grey/brown clayey/silt		002,011,016	
011	Ro. dyke fill	Light grey clay	Ro. pottery(117) Animal Bone(7) Wood(7), Shell(5) Charcoal(2)	012,016	002,003, 004,010
012	Natural	Blue Gault clay			002,003, 011,016
013	Modern water channel	Disturbed fills		003,004	001
014	Ditch fill (cut by 008)	Grey/brown clay		009	006,007
015	Cut	Ditch cut by 008			
016	Ro. dyke basal fill	Grey/blue clay	Ro. pottery(9) Burnt flint Sheep jaw	012	002,011
017	Cut of P/med dyke	Cuts 005			
018	Cut? Ro. re-cut of Car Dyke				

GLOSSARY OF ARCHAEOLOGICAL TERMS

Anglo-Saxon The period dating between the withdrawal of the Roman legions in 410 and the Norman invasion of 1066. Within this period several ethnic groups from northern Europe vied for control of the British Isles, including the Angles, Saxons, Jutes, Danes, and Norwegians. The latter two groups are collectively known as the Vikings and became involved in British politics from the eighth century, later than the others. The Vikings were successful in occupying a large part of the north and Midlands of England, before providing a King (Cnut) for the whole of England. For most of this time England was divided up into several kingdoms until Saxon resistance to Viking incursions led to the unification of England under Aethelstan and Alfred.

Artefact Any object made by people. Generally, this word is used for finds such as pottery, stone tools, or metal objects, but it can be used in a much wider context in that the landscape we have today is a product of human activity and is thus an artefact itself.

Cropmarks Archaeological features below the ploughsoil can affect the growth of sensitive crops through moisture retention or loss. For example, the growth of cereal crops over buried ditches or pits will encourage rapid growth leading to tall, dark coloured plants, whereas walls and roads will lead to stunting and faster yellowing of the crop. These discrepancies in crop growth can be easily detected from the air, and by taking photographs the cropmark patterns can be plotted onto maps and given provisional interpretation.

Earthworks Archaeological features that are still extant above the ground as banks and ditches, platforms, roads, ponds, canals, etc. They were either constructed of soil or became covered by it later, leaving the archaeology showing in relief.

Enclosures: An area defined by a continuous surrounding ditch. These may be enclosures around human settlements, fields, or paddocks for stock. Rectilinear enclosures are ones with straight sides and corners, whilst curvilinear enclosures are ones with rounded sides.

Fieldwalking. Technique of archaeological survey. Walking over ploughed and weathered soil, an experienced observer can collect many ancient artefacts, and by plotting the distribution of such find spots on maps an idea of the use of the landscape can be built up for each period of the past.

Geophysical Survey. Investigation of changes occurring in the magnetic and electrical characteristics of the soil, which can often be induced by human activity.

Iron Age. Prehistoric period c. 700 BC - AD 43 when iron was used extensively for tools and weapons. The period traditionally ends with the Roman invasions of AD 43 but in fact there was a considerable time of adjustment after this date when the Iron Age way of life continued with little change from Roman influence.

Medieval. Historic period that begins with William the Conqueror's invasion in 1066. Post-Medieval is generally considered to date from 1500.

Modern The period since modern industrialisation, roughly corresponding to 1800 onwards.

Natural The local subsoil that is unaltered, in nature and location, by human action.

Post-Medieval This period is generally considered to date from 1500, and is not used for dates after about 1800.

Roman. Historic period AD 43 - 410 when much of Britain was part of the Roman empire. The term Romano-British is now widely used to describe the people of this period, as few were Roman themselves, but they were a provincial manifestation of the empire developing in a unique way. AD 410 was the date the legions were withdrawn, but the Romano-British culture continued for some time into the 5th century in tandem with Anglo-Saxon migration.

Stratigraphy: Order and relative position of strata. Deposits in archaeological sites will be layered one on top of another, with the highest layer being the latest being the latest deposits, thus giving a chronological relationship to the layers and the artefacts within them. Features (such as ditches, pits, or walls) cut through these layers will obviously date to later events, and will in turn contain their own discrete sequence of deposits. On the other hand features that have been covered by layers are obviously earlier than the deposition of those layers that seal them.

Archaeological Field Unit
Fulbourn Community Centre
Haggis Gap
Fulbourn
Cambridge CB1 5HD
Tel. (01223) 881614

Cambridgeshire
County Council
Education,
Libraries & Heritage
COMMUNITY SERVICES DIVISION