THE CONSUMPTION AND DISTRIBUTION OF ROMANO-BRITISH CERAMIC ROOFING MATERIALS IN CAMBRIDGESHIRE

By

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ABSTRACT

Roman ceramic roofing materials have been very much a 'Cinderella' topic in archaeology. The large quantities of broken tile often encountered on excavations of Roman buildings, have presented excavators with logistical problems. Views began to change during the latter half of the 20th century, as researchers recognised that useful information could be extracted from the study of ceramic roofing materials. The study of these materials in Cambridgeshire has been no further advanced than in many other parts of Britain.

There appeared to be very few Romano-British tile kilns recorded in the early stages of research for this dissertation. So where were the ceramic roofing materials being consumed in Cambridgeshire actually being produced?

To try to answer this question, I inspected and recorded examples of roofing tiles from a number of sources from both within and outside Cambridgeshire.

The results have not been entirely conclusive, although my study has added to the corpus of information on the distribution of shell-tempered products of the kilns at Harrold, Bedfordshire.

Word count: 9900.

TABLE OF CONTENTS

Illustrations

Tables

Abbreviations

BM	Higgins museum, Bedford
CAFG	Cambridge Archaeology Field Group
CAFU	Cambridge Field Archaeology Unit
CAU	Cambridge Archaeology Unit, University of Cambridge
CCC	Cambridgeshire County Council
CHER	Cambridgeshire Historic Environment Record
LA	Lincolnshire Archives
LHER	Lincolnshire Historic Environment Record
MAA	Museum of Archaeology and Anthropology, Cambridge
NM	Norris museum, St Ives, Cambridgeshire
OAE	Oxford Archaeology East (formerly CAFU)
PHER	Peterborough Historic Environment Record
VCH	Victoria County History

ACKNOWLEDGEMENTS

First of all, I must thank my dissertation supervisor Dr. Ian Whitbread, for agreeing to take on my project, offering much sound advice and encouragement. I am also grateful to Ian for putting me into contact with Dr. Philip Mills, who was always happy to comment on my ideas and questions about roof tiles. The staff of the Distance Learning unit at Leicester must be thanked too for guiding me through to the culmination of my undergraduate studies, not forgetting the administrators who had to deal with the awkward enquiries and questions.

A number of institutions and individuals deserve praise for providing hospitality and access to materials in their archives. These include Helen Giles curator at the Norris Museum St Ives, Cambridgeshire; Antony Lee, curator at Lincolnshire Archives; Imogen Gunn, senior curator at the Museum of Archaeology and Anthropology at the University of Cambridge; Liz Pieksma, curator at the Higgins Museum, Bedford; and Sally Croft, senior archaeologist with Cambridgeshire County Council, Historic Environment Record, for supplying information and arranging recovery of materials from 'Deep Store' in Cheshire.

I am also grateful to Dr. Sarah Poppy of Oxford Archaeology East (OAE) for providing copies of the reports on the CBM from excavations at Itter Crescent, Peterborough and Rectory Farm, Godmanchester. Also, thanks are due to Steven Macaulay and Stephen Wadeson of OAE for facilitating the provision of materials for study and to Carole Fletcher and Rob Atkins also of OAE, for advice on aspects of Cambridgeshire archaeology.

Thanks, must also go to my friends and colleagues of Cambridge Archaeology Field Group, who permitted and encouraged me to study Roman CBM from their archives and in particular Mike Coles and Terry Dymott for sharing their knowledge of Cambridgeshire archaeology.

Finally, but not least, I would like to thank my long-suffering wife Jenny for supporting me, while suffering the long lonely hours as I toiled over the keyboard or visited museums.

I could not have brought this dissertation to its conclusion without the contribution of all the above-mentioned. The inevitable errors and omissions, however, are solely the responsibility of myself.

1. Introduction

1.1 Ceramic Roofing Materials

Like many of the tokens indicative of the aspiration to high civilization, the Romans copied the use of ceramic roofing materials from Greece. Wikander (1990, 285-290) has discussed how the earliest ceramic roofing tiles noted in the Aegean, were probably those found at the sites of the temples at Corinth and Isthmia.

By the end of the seventh century B.C.E., the use of tiles had become more widespread throughout the Mediterranean. Flammable and less durable materials such as thatch, clay or wooden shingles began to be replaced by the more robust ceramic tiles.

Two types of ceramic roofing systems existed; Laconian, which comprised large concave pan tiles with convex cover tiles and Corinthian. This latter style utilised flat pan tiles with erect flanges along the upper edge and downward flanges along the lower edge, combined with pitched cover tiles. The tegula and imbrex, or Sicilian system developed from these earlier systems (Fig.1), appearing first on mainland Italy, before spreading around the Roman world (Mills 2005a, 21-22).

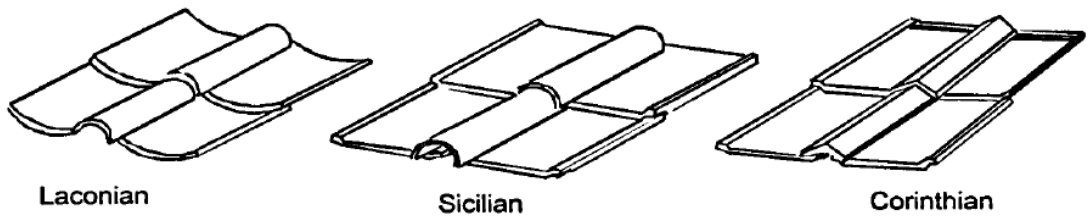


Fig.1. Early ceramic roofing systems. (After Mills 2005a, 21).

In Roman society, a tiled roof came to be seen as a mark of status. Indeed, a bronze tablet from Osuna (*Urso)* in Spain, containing chapters of the *lex coloniae Genetivae Iuliae*, details the requirement that a *decurione* (town councilor), of a colonia should own a property with a roof of at least 600 tiles, while for a coloni, a roof of at least 300 tiles is the requirement (Cooley and Salway 2012, 175). Further, one of the clauses on the inscribed bronze

plaque detailing the municipal laws of Tarentum, records that one of the requirements for a citizen to become a member of the *ordo decurionum* (town council), was to own a house with a roof of at least 1,500 Tiles (Hardy 1911, 107-8).

Dio Cassius (book 46, 31.3), writing on the war between Caesar and Antony, describes that when there was a need for finance, the senators of Rome were taxed at a rate of four *obols* for every tile on the roofs of houses which they either owned or were tenants in (Cary 1917, 63).

Although there is no evidence in Britain for the uptake of ceramic roofing products by the Iron Age population prior to the Roman conquest, a number of high-status buildings utilizing them, such as the palatial property at Fishbourne, appeared shortly after. Fishbourne it is suggested (Fulford 2008), may have been built for Cogidubnus, who as a client king, was supported by the early Roman administration.

Masonry buildings with tiled roofs would have been unaffordable for the average late Iron Age Britons, who would have continued to build their homes in the manner to which they were capable and accustomed. They may have viewed the architecture of the Romans as part of the imposition of a foreign culture upon themselves.

The production and consumption of ceramic building products in Britain appears to have initially at least, followed and have been controlled by the Roman military. The practice of stamping tiles for instance, had begun in Britain by the Roman army and navy from around 90-100 CE (Zienkiewicz *et. al.* 1993).

Beginning in the bridgehead area of the southeast, the appearance of Mediterranean style housing and official buildings slowly spread northwards and westwards, as more and more of the new province was brought within the control of the Roman administration. Initially, this would have taken the form of the standard structures found in the permanent forts as required by

the Legions stationed within them. As the Roman administration grew, ancillary buildings sprang up along the road networks, such as mansios (Hinman 1998) and mutatios or horse changing stations (Horton *et. al.* 1995).

Retiring veterans of the army were given parcels of land to farm and support themselves, leading to the spread of Roman style buildings across the province. The ad hoc accumulation of settlements around military sites grew into towns, whose more affluent members had larger villa type properties built in the surrounding countryside to better manage their agricultural estates. The apex of this later phase of building appears to have peaked in the late 3rd to early 4th centuries (Black 1994).

1.2 Research Questions

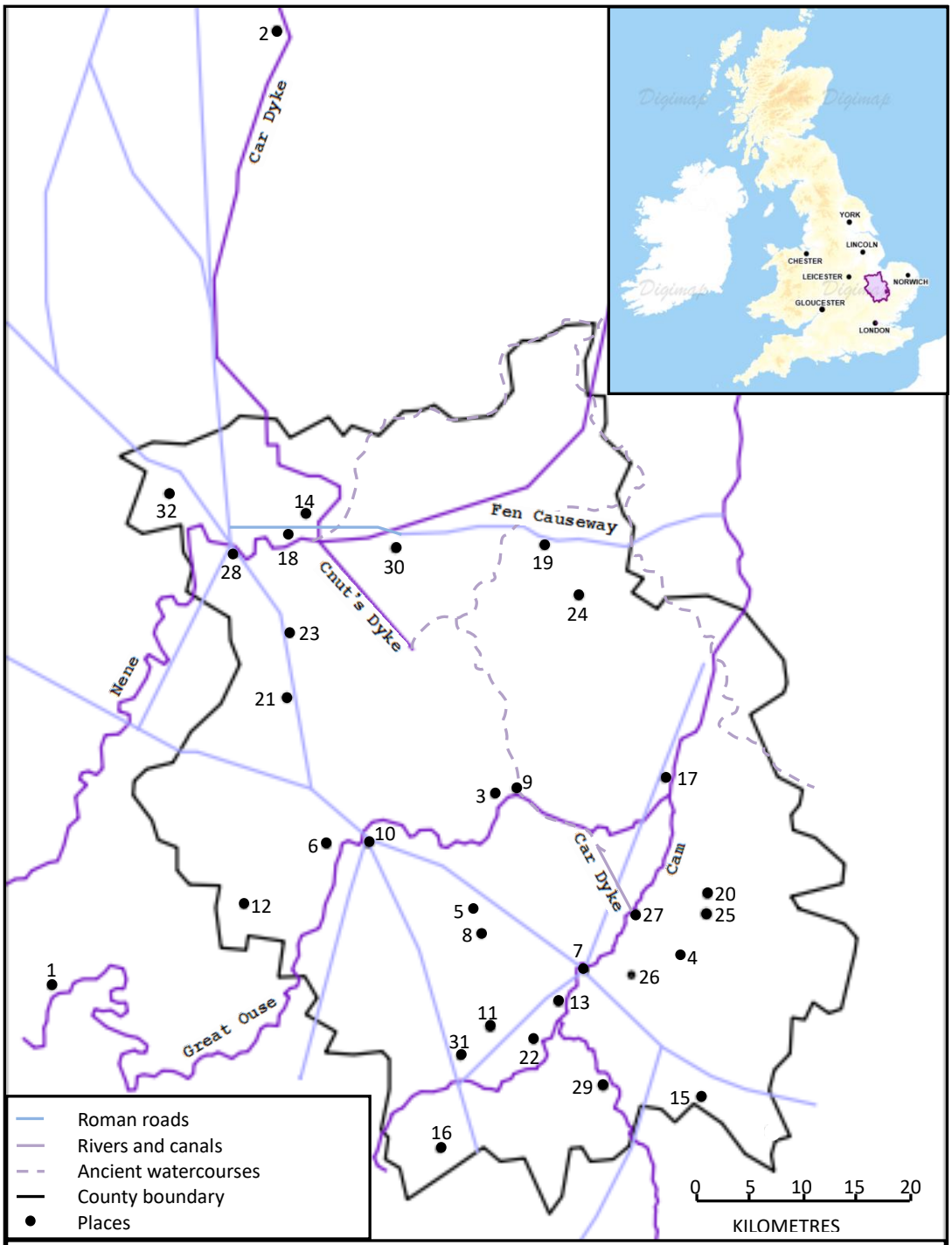
The apparent scarcity of Roman tile kilns in Cambridgeshire prompted one of the questions I have attempted to answer in this study: where were the ceramic roofing materials being consumed in Romano-British Cambridgeshire actually being produced? Were materials being traded into Cambridgeshire from major external production centres, or were tiles being produced in small-scale, archaeologically less visible enterprises perhaps in simple clamp kilns? Was there a mixture of these alternatives? Another avenue of my research would be to try to identify common features of tiles, which might indicate discreet manufacturing centres or travelling roofing specialists. Finally, I hoped to determine if the study of ceramic roofing materials could tell us anything about the people involved in their production.

Fig.2. Cambridgeshire location map.

1.3 The Study Area

The map of Fig.2 shows the county of Cambridgeshire in relation to some of the major British towns and cities with Roman origins.

Fig.3 shows the locations of sites referred to in this dissertation, along with the major Roman roads and courses of rivers and canals, including some of those watercourses, lost since Roman times.



1	Harrold (Beds)	2	Heckington (Lincs)	3	Bluntisham	4	Bottisham
5	Boxworth	6	Brampton	7	Cambridge	8	Childerley
9	Earith	10	Godmanchester	11	Gt Eversden	12	Gt Staughton
13	Haslingfield	14	Itter Crescent	15	Linton	16	Litlington
17	Little Thetford	18	Longthorpe	19	March	20	Reach
21	Sawtry	22	Shepreth	23	Stilton	24	Stonea
25	Swaffam Prior	26	Teversham	27	Waterbeach	28	Water Newton
29	Whittlesford	30	Whittlesey	31	Wimpole	32	Wittering

Fig.3. Places and features mentioned in the text.

The present-day county boundaries probably bear little resemblance to the land divisions in effect during the Romano-British period. Indeed, the county of Cambridgeshire only came into existence in the reign of Edward the Elder in 917 C.E. (Oosthuizen 1998, 85).

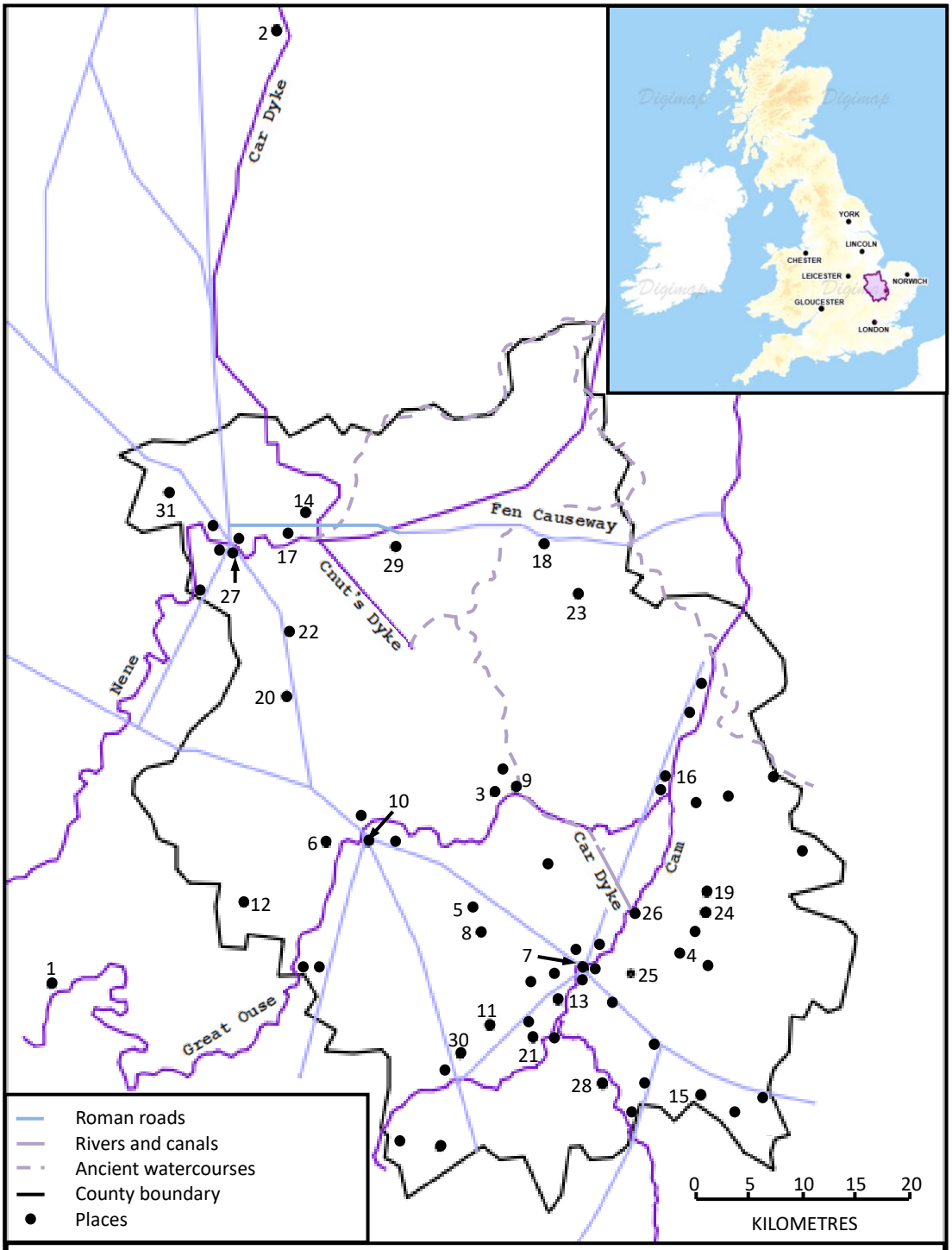
The modern county of Cambridgeshire, whose original northern boundary was the River Great Ouse, has been expanded to include the former minor county of Huntingdonshire as a district and the Greater Peterborough City Unitary Area.

1.4 Methods

The methods used in this study were largely metrical: recording the dimensions of tiles, their fabrics and inclusions and crucially the manner in which the tiles were formed. In particular, I have paid close attention to the flanges of tegulae from the point of view of how they were produced and incorporated into complete tiles. This avenue of research does not appear to have been pursued by many researchers in the field, with the notable exceptions of those who have carried out experimental production of tiles such as Ramos Sáinz (2003) and Warry (2006).

Custom recording sheets were designed to aid consistent data gathering (see appendix A). Photographs were taken of significant features and for the field walked material, permission was obtained from Cambridge Archaeology Field Group to create polished sections on selected items, to enable photomicrographs (50X magnification) to be taken. It was not possible however to carry out this procedure on museum specimens. Where the colour of fabrics was recorded, this was carried out in a consistent manner by reference to the Munsell Soil Color system.

1.5 Cambridgeshire Data Sources



1	Harrold(Beds)	2	Heckington(Lincs)	3	Bluntisham	4	Bottisham
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25	Teversham	26	Waterbeach	27	Water Newton	28	Whittlesford
29	Whittlesey	30	Wimpole	31	Wittering		

Fig.4. Roman CBM findspots and buildings. (Findspot data: Cambridgeshire Historic Environment Record).

I interrogated the Cambridgeshire Historic Environment Record (CHER), in order to discover sites within the county where Romano-British building materials have been found. These are distributed quite widely across the county, although generally they occur within close proximity to one of the major roman roads or the river valleys (Fig.4). However, a significant area of north and east Cambridgeshire is fenland and at times was relatively lightly settled during the Romano-British period due to episodes of flooding. Although buildings are evident through finds of occasional scatters of roofing tile, the houses were more ephemeral as they were wooden framed (Potter *et. al*. 1981).

A number of museums and institutions within Cambridgeshire were contacted and where online catalogues were not available, enquiries were initiated, in order to determine the extent of any Roman CBM held in their physical archives. Visits were then undertaken to those institutions which provided positive replies and data collected using the custom recording forms.

1.6 External Data Sources

In addition to studying assemblages of CBM from locations within Cambridgeshire, I also addressed some from outside the county, which might have thrown light on the longer distance trade in CBM during the Romano-British period.

1.6.1 Harrold, Bedfordshire

The distribution of heavily shell-gritted products, typical of the kilns at Harrold in Bedfordshire (Brown 1994), have been recorded throughout the south and southeast of England (Unger 2009). I hoped to learn more about the spread of these products into the east of England and how this might have been achieved. The Higgins museum, Bedford holds the archives from excavations in 1969-71.

1.6.2 Heckington, Lincolnshire

A number of Roman tile kilns were excavated at Heckington near Sleaford, Lincolnshire in 1970 (LHER 63586). The site is located

close to the Lincolnshire Car Dyke, and I studied material from these kilns at Lincolnshire Archives, in order to test whether any of their products might have been reaching Cambridgeshire.

1.7 Romans in Cambridgeshire

The earliest traces of a Roman presence within Cambridgeshire, in the decades following the invasion, are the appearance of forts at strategic control points. The remains of perhaps a first century fort have been found at Castle Hill, Cambridge, replacing an Iron Age hill fort (Taylor 2000, 77). The name Duroliponte has been settled on Cambridge, as the most likely candidate for the location found in the Antonine Itinerary, between Camborico (Hockwold-cum-Wilton, Norfolk) and Durobrivas (Water Newton) (Brown 1978, 4-5). Meaning something like 'walled town near the flowing water', it would be most appropriate, as it is the most convenient inland crossing point of the river Cam.

Another fort was located at Godmanchester (Durovigutum), controlling the Ermine Street crossing of the river Great Ouse. Like Duroliponte and Durobrivae, Durovigutum lay at a nodal point in the Romano-British communications network (Fig.3).

Settlement of the fens remained at a fairly low level, with the exception of the appearance of Roman style buildings on the fen islands at Stonea and March and at Grandford, where the Fen Causeway skirts around a possible early fort (Potter *et. al.* 1981, 87).

1.7.1 Fenland

The Fenlands stretch in an arc around the Wash, encompassing north-west Norfolk in the east, part of north Cambridgeshire in the centre and around the North Sea coast to south and south-east Lincolnshire. There is evidence from excavations; Flag Fen (Pryor 2004, 280-282), Must Farm (Knight 2012), The Fenland Survey (Hall and Coles 1988) and chance finds; The Isleham Hoard (Britton 1960), from around the Fenlands dating activity to the Bronze Age and before. However, by about 1300 B.C.E., the fenlands had become much

wetter and marshy (Fincham 2002, 8). Its inhabitants would have found greater difficulty accessing former resources, retreating to the higher and dryer land around its perimeter.

This situation persisted into the mid-to-late Iron Age, around 300 B.C.E., before human activity resumed in the deeper fens. Here it is initially noticeable only on the silt and gravel islands, such as Whittlesey, March, Stonea and Ely. Reoccupation and exploitation of the fens did not begin to occur more widely until after the Roman conquest, from around 50-100 C.E. (Fincham 2002, 8). From about 150 C.E., settlement began to increase as land was reclaimed by drainage works. This state of affairs continued into the third century, when serious flooding appears to have caused abandonment of some Fenland sites for a period of around fifty years.

The Fenland region has tentatively been viewed as an imperial estate. This is based largely it has to be said, on the discovery of the ***PVBLIC*** (RIB 230) inscription on a fragment of sandstone from Tort Field, Sawtry (Applebaum 1972, 31). Sawtry lies on the western edge of the Cambridgeshire fens on the Roman Ermine Street. Fincham (2002, 62) suggests it might mark the limit of influence of Durobrivae (Water Newton) a few kilometres to the north.

Direct access into the fens was limited: most of the Roman roads skirted around it. Apart from the rivers which ran through it to the Wash, the main route-way through the fens was the Fen Causeway. The western end of this route originated at Durobrivae, the town which grew up near the junction of Ermine Street and the river Nene. Durobrivae, or perhaps the nearby fort at Longthorpe, may have been ultimately where the authorities controlling the economy of the Fenlands were based.

1.7.2 Clay Farmlands and Chalk Uplands

The landscape of Cambridgeshire changes to the south and west, as Fenland gives way to the rising heavier clay farmland and chalk uplands, more suitable for sheep farming than arable. Villa

estates, such as those at Litlington (Wessex 2010) or Great Staughton (Greenfield *et. al.* 1994) are to be found in these parts of the county.

2. Literature Review

Early interest in Roman brick and tile concentrated on studies of manufacturers' marks (Pfeiffer *et. al.* 1905; Clifford 1955), mainly stamps of the Roman army and the navy. Due to the routinely vast quantities of brick and tile encountered on Roman sites, they have often been treated in a pragmatic manner, with highly selective retention policies being instigated (Wessex 2010). In this section I will review some of the work which has shown that the study of brick and tile has more to offer than epigraphic evidence alone.

2.1 Britain

Alan McWhirr's (1979), was the first detailed study of Romano-British brick and tile in the latter half of the 20th century. He catalogued all of the then known, or probable Roman brick and tile kilns in Britain and analysed modes of production and distribution.

The profile of research into Romano-British brick and tile was further enhanced by Gerald Brodribb's work (Brodribb 1987). The project which began by examining the masses of brick and tile from the bathhouse at Beauport Park, East Sussex, developed to cover material from more than 400 sites in Britain. Brodribb illustrates five different lower cutaway types (Brodribb 1987, 16), mostly knife cut, but does not mention the use of inserts in moulds.

Warry (2006a) has argued most cogently for a typology of roof tiles, tegulae, based on the lower cutaways of the flanges. Warry identifies five main types of cutaways, which he dates based on an analysis of stamps found on the tiles. The stamps included in the study are those of the Roman army legions. However, some researchers, (e.g. Mills 2014), have contended that the types of cutaways on tiles produced by civilian manufacturers, do not fit so well into Warry's typology. Warry's basic chronology may still be correct, albeit slightly modified (Warry 2006b, 263), but as Mills argues, there may be greater overlap in the transition between cutaway forms. Warry (2006b, 263-264) further argues for

a link between average tegula dimensions and cutaway form. This in itself he acknowledges, is not strong chronological evidence, however, he still affirms the validity of the cutaway typology.

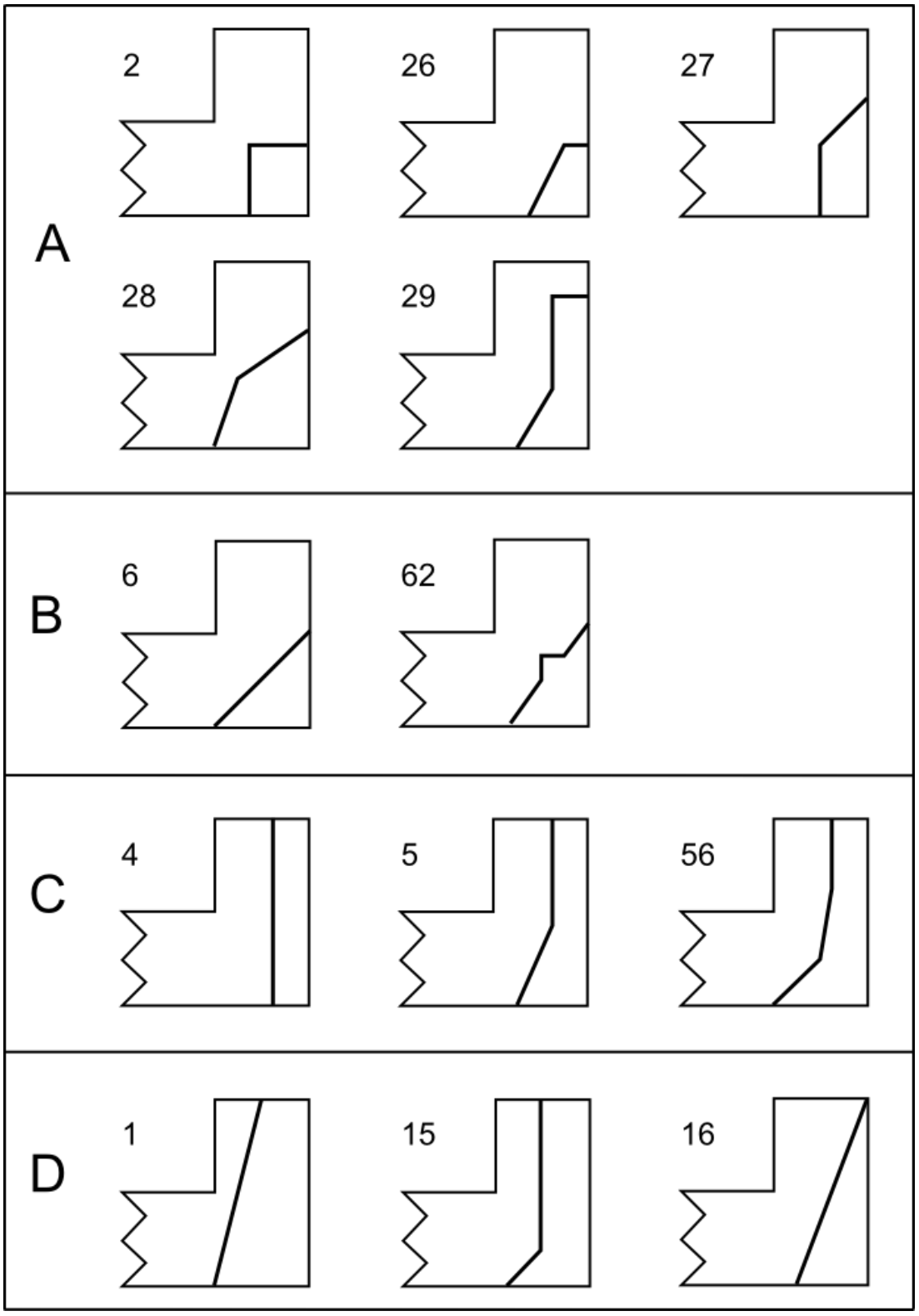


Fig.5. Lower cutaway groups. (Redrawn from Warry 2006a).

Philip Mills' Leicester PhD thesis examined the Mediterranean trade in Roman CBM (Mills 2005). This work demonstrated that CBM was a valued commodity in its own right, rather than merely being used as ballast for ships on return journeys. The type and colour of tiles may have been factors in identifying ethnicity in Beirut and Carthage, between Roman colonists and Indigenous inhabitants for example, or between Christian migrants and Orthodox Byzantines. Mills has carried out recent research on Romano-British ceramic building materials, including studies on tiles from sites in Cambridgeshire (Mills 2014).

2.2 Europe

A number of researchers have carried out investigations of Roman period tiles in several mainland European countries, to varying degrees of intensity and technicality.

One of the earliest studies was conducted by Jean Chauffin in the Bas Dauphiné region of France (Chauffin 1956). His survey compared the attributes of tegulae from a number of sites, from which he attempted to deduce a typology of the tiles, based on the profiles of their flanges. This was not conclusive; however, he did show that tiles with rounded flanges were in use over a much longer time span than those with square flanges.

Gabriel Manière investigated three Gallo-Roman tile kilns near Tritchot, in the municipality of Fousseret (Haute Garonne). Manière (1975, 210 fig.5), illustrates twenty-six different types of tegula flange profiles, in a rather poorly reproduced photograph (Fig.7). However, some of the examples appear very similar and it might have been possible to group some of them.

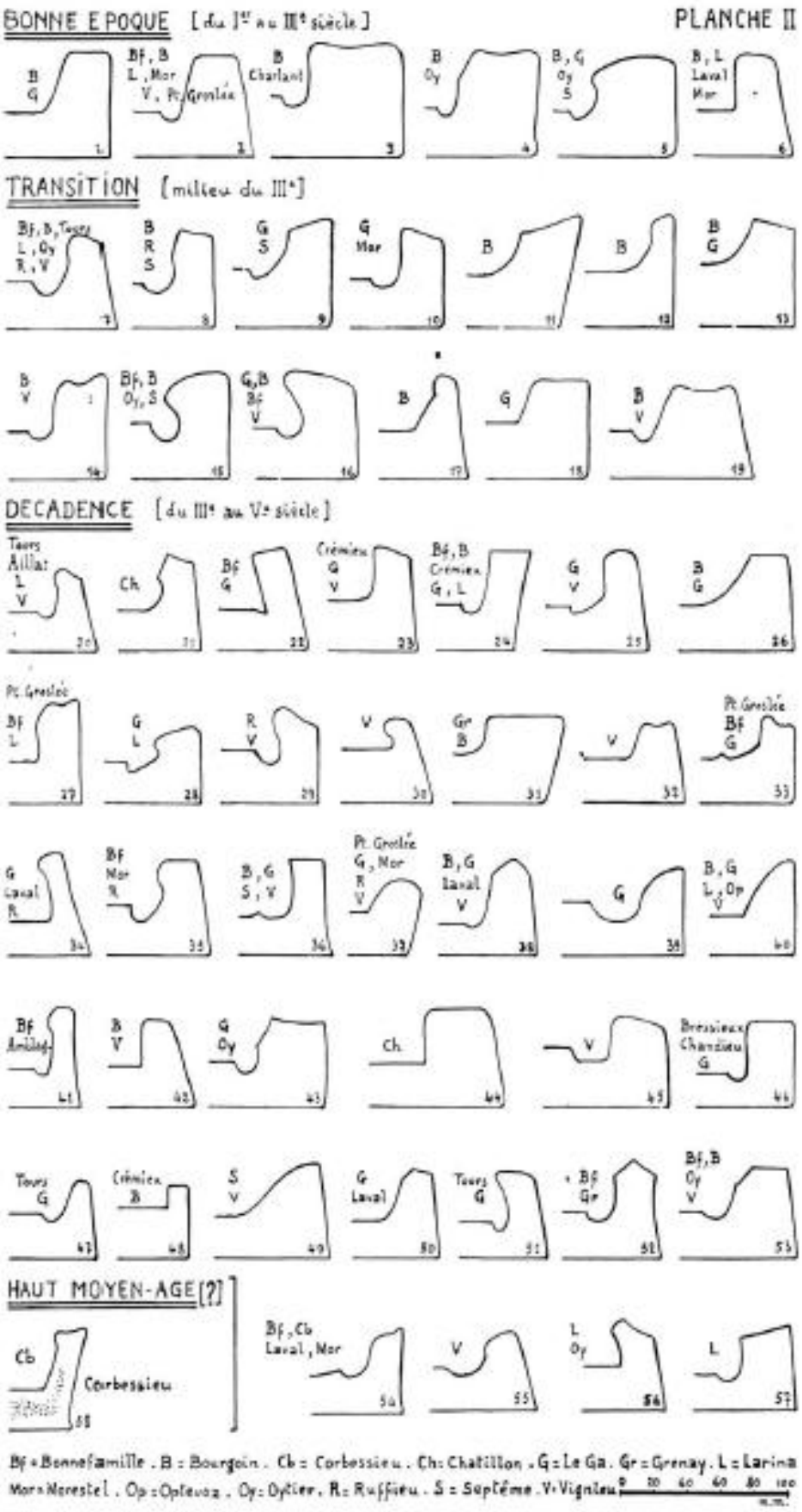


Fig.6. Tegulae flange profiles, Bas Dauphiné. (After Chauffin 1956, Plate II).

The diversity of tegulae profiles and cutaways at Tritchot, Manière observed, was typical of sites of the late Gallo-Roman period, rather than the more regular products of the earlier 'High Empire' period as found at Couladère (1975, 210).

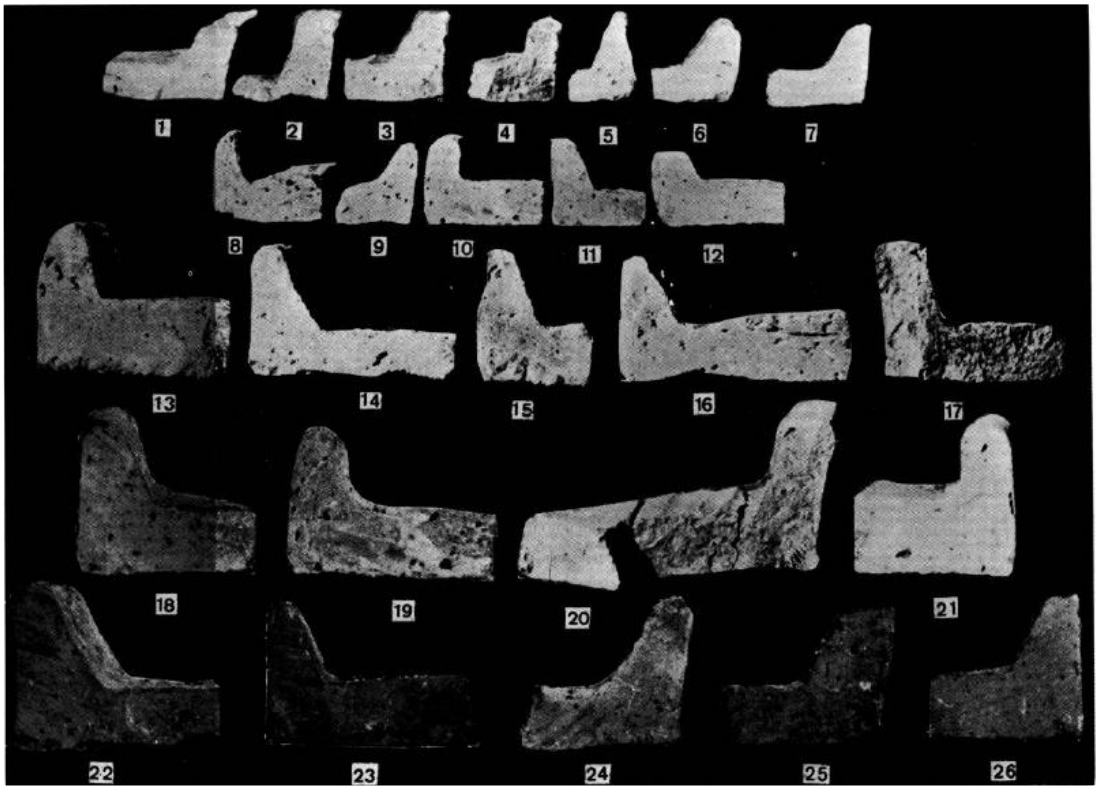


Fig.7. Tegulae flange profiles, Tritchot. (After Manière 1975).

Tiles from the Roman bath complex of San Juan de Maliaño, near Santander airport in northern Spain, were the focus of analytical study and experimental archaeology, undertaken by Maria Luisa Ramos Sáinz (2003).

The site was excavated between 1996-1998, revealing structures occupying an area of 15m by 14.5m. There had been two phases of construction. The first, dated to the second half of the first century C.E., comprised a rectangular building with two apses on its southern side. This building was enlarged to the north in the first half of the second century C.E., by the addition of a rectangular building, with an apse on its west facing side. The complex appeared to have remained in use until the late fourth, or early fifth centuries.

Ramos Sáinz has undertaken further work on Ibero-Roman roofing tiles in the Cantabria region. This was based on excavations in 2000 and archaeological monitoring in 2002–2003 at the first to fourth century C.E. colony of Castro Urdiales: Roman Flaviobriga.

The tiles studied were mainly broken fragments. However, one complete tegula and imbrex were recovered, enabling some comparisons to be made with examples from other locations.

With dimensions of 47.7cm long by 37.7cm wide and 2.9cm thick, the tegula weighed 9kg. Ramos Sáinz noted that it was slightly smaller than the dimensions given by Vitruvius for the bipedalis of about 59.4cm long by 44.5cm wide.

The Castro Urdiales tegula was compared with tegulae from the first century C.E. to second century thermal spring site of Labitolosa in Huesca (Ramos Sáinz 1999, 263-275), and the hot springs at Maliaño, which dates to between the second half of the first century C.E. and the end of the third century. The example from Labitolosa measured 56cm x 33cm x 4.1cm, while that from Maliaño was 46.2cm x 35.5cm x 2.3cm. The tiles from Cantabria were noted to be similar to those of Huesca, dating to the third to fourth centuries C.E., while that from Labitolosa was first century C.E. to the mid second century.

Further comparisons were drawn with tegulae from Salelles d'Aude (Narbonne), where Laubenhaimer had excavated a pottery and ceramic building materials manufacturing works. Tiles were identified as being produced during two periods. In the first century C.E. the tiles had dimensions of 60cm x 44.5cm x 3.1cm and weighed 16kg, while those of the second century measured 53cm x 41.3cm x 3.2cm, weighing 10kg. The inference thus drawn, was that tiles became smaller and lighter over time.

Ramos Sáinz noted that as with the efforts of Chauffin (1956) and Cardoso (1971), attempts to produce a typology of tiles based on their flange metrics had proven difficult. This it was suggested

was due to the lack of available complete tiles. What was clear however, was that there were two types of flange forms on tiles from Maliaño. Those with a more rounded profile were found with thicker tiles of 2.7cm, while those with a square profile were associated with thinner tiles of 1.9cm.

Referring to Chauffin (1956), Ramos Sáinz noted that the prevalence of rounded section flanges from the Bas Dauphiné sites ranged over a long period, from the first century C.E. to the eighth century. The square section flanges were placed in the first century C.E. to the second century by Chauffin. To test this preposition, samples of Maliaño tiles with both types of flange profiles, were subjected to thermoluminescence analysis. Surprisingly, this produced dates in the second half of the third century C.E. for both tile types.

Signatures, the markings made on tiles by fingers or the use of tools, came in a wide variety of forms on the Cantabrian tiles. Although most commonly tiles were found not to be marked, Ramos Sáinz (Fig.8) noted nine different types of signatures on those which were. Most of the markings appeared on the upper surfaces of tiles; in the form of circles, arcs, lines, and figure-of-eight designs. However, three types of marks appeared on the underside of tiles: parallel diagonal lines, sometimes in crossed groups and figure-of-eight designs.

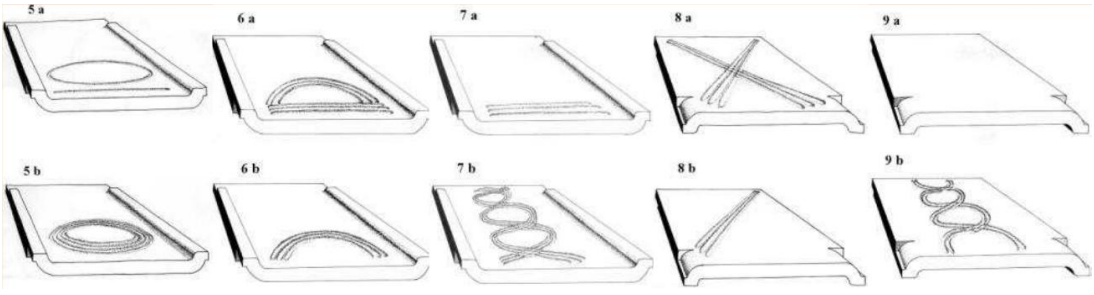


Fig.8. 'Signatures' on tegulae from Maliaño. (After Ramos Sáinz 2003, Figs.5-9)

The markings on imbrices were similarly diverse (Fig.9). Multiple longitudinal markings appeared on the upper, visible surfaces of a few tiles, while wavy lines also occurred. Markings on the undersides of imbrices were a more common feature and exhibited

greater diversity. They include groups of 'S' curves, including overlapped groups, longitudinal linear lines, transverse lines near one end and groups curving from one end to the other.

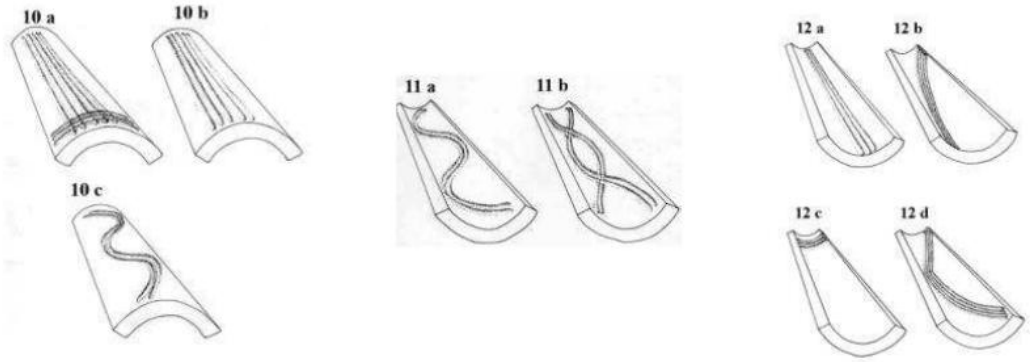


Fig.9. 'Signatures' on imbrices from Maliaño. (After Ramos Sáinz 2003, Figs.10-12)

The marks were considered to provide a degree of security against the tiles being displaced in strong winds by increasing friction (Ramos Sáinz 2003). That imbrices were found to be more often carrying such markings, it was suggested, was because they were lighter than tegulae and therefore more easily lifted.

Further analysis of finger made markings on the Maliaño tiles, attempted to determine who might have been creating them by measuring their width (Ramos Sáinz 2003, Table 3a). These ranged from 0.4cm (5%) up to 0.8cm (20%), with 0.6cm (60%) being the most common. It was suggested that the majority of the marks could have been produced by children, or females.

Consideration was given to the fact that freshly made marks in wet clay would have been a little wider prior to shrinkage in the firing process. Figures of 1.0cm for 6-year-old children, 1.5cm for 9 year-olds, 1.3-1.5cm for adult females and 1.6-2.2cm for adult males were given.

Experimental archaeology is described by Ramos Sáinz, namely the reconstruction of a section of roofing, using the tegula and imbrex system. The beds of the tegulae were formed in simple four-sided moulds. Flanges were then manufactured, utilising strips of clay cut to length to allow for the cutaways. The undersides of the

flanges and mating areas on the beds were then roughened and clay slip applied in order to assist adhesion. Additional thin strips of clay were then applied to strengthen the joints. The results were described as being successful with no failures being evident after firing of the tiles (Ramos Sáinz 2003).

Antonio Cardoso (1971 202) considered that holes were made after firing in tiles which were intended for the bottom row of a roof. These would be secured by nails or wooden pegs. He gives an alternative method for how tiles may have been prevented from slipping off the roof. This involved the lower cutaways, sitting over nails in the supporting laths underneath (Fig.10). Signatures and signs on the upper surfaces of tiles Cardoso suggests, were to assist the roofers in correctly placing them on the roof (1971, 203).

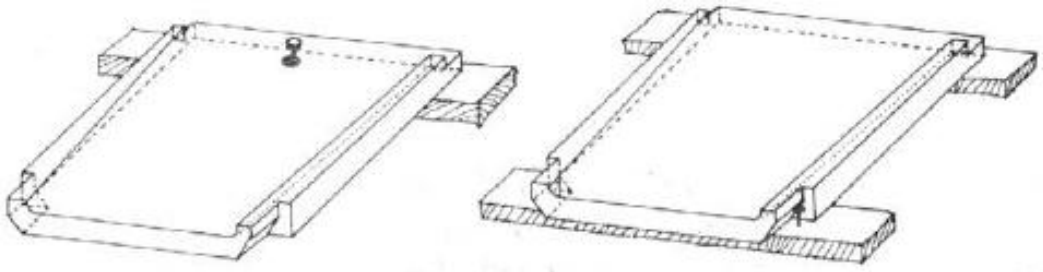


Fig.10. Alternative methods for securing tegulae on a roof. (After Cardoso 1971, Fig.1.)

3. Transport Routes Within Cambridgeshire

In the following sections, I will discuss the various methods by which heavy goods, such as brick and tile, could have been moved around the Cambridgeshire region during the Romano-British period, and how these might have influenced the choices of building materials seen in the archaeological record today.

3.1 Roads

Cambridgeshire was well served by roads during the Romano-British period (Fig.2). Some of these may have been based on pre-existing track ways in use by Britons at the time of the invasion. However, the Roman administration soon built new roads, initially to facilitate the rapid deployment of the army, and then later the network was developed to aid the bureaucracy and trade.

Some evidence for long distance trade along the road network, comes from the roads themselves. Coal was used as a source of fuel in Roman Britain and has been found on a number of sites in Cambridgeshire; Barnack, Buckden, Car Dyke, Littleport, Maxey, Orton Longueville and Water Newton (Dearne and Branigan 1995). However, there are no local sources of coal in the county. Excavations investigating the construction of the road now known as Worsted (wool) street, running south from Cambridge towards Colchester, found a layer of coal in its makeup. Browne (1978, 69) suggests that it may have originated in Nottinghamshire or South Derbyshire. Smith (1997, 318-319) however, commenting on its analysis, proposes sources in Warwickshire.

Either location would have been accessible by the Roman road system, for transport by packhorse perhaps. Watling Street passes close by coal measures in Warwickshire, at Dordon for instance.

Worsted Street, running south from Cambridge was part of the route coined *Via Devana* by antiquarians. It was considered to have linked Colchester with the Roman town at Chester (*Deva*) and was traced as far as Leicester on the known Roman roads. In 1994, the Leicestershire Museums Service (Peter Liddle *pers. comm.*),

announced the discovery of a possible continuation of the *Via Devana*. From Leicester, this passed through Leicestershire and Derbyshire, to meet the Wall to Derby Road (*Rykneild Street*) after crossing the river Trent. Coal is well known to outcrop in the Northwest Leicestershire and South Derbyshire coalfield, through which this road would have passed and may be a good candidate for one of the sources of the coal found in Cambridgeshire.

3.2 Waterways

Although the system of roads within Cambridgeshire and Britain as a whole, both those newly built ones and existing prehistoric routes adapted and improved by the Roman administration permitted the relatively rapid movement of personnel and goods, they may not have been suitable for the long distance movement of heavy products such as ceramic building materials. Indeed, Roman law may have restricted the maximum weight that could be carried by wagons. The best evidence for this though is the *De Curso Publico Codex Theodosianus*. This collection of laws, however, was published between 429-438 C.E., long after the Roman architectural high point in Britain (Hornblower *et. al.* 2012). For transporting larger loads though, water born routes may still have been the preferable option.

3.2.1 Rivers

There are three major river systems within Cambridgeshire (Fig.2). The river Nene arises in Northamptonshire to the west of Cambridgeshire and flows northwards mainly. At Wansford, the Nene turns eastwards and flows through the well-known lower Nene valley pottery manufacturing region. Pottery kilns were located at Sibson, Stibbington, Wansford and Castor.

The town of Durobrivae was located close to the Nene and the crossing point of Ermine Street at Water Newton. The river now flows through the modern city of Peterborough and on past another Romano-British pottery manufacturing area at Stanground.

Most of the Nene's flow was canalised away to the Wash during various episodes of fenland drainage. However, a relic of part of its course can still be found, curving south and westwards around Farcet, before meandering around Yaxley and Stilton Fens. From here it proceeded via Ramsey before heading north towards the Fenland island settlements of March and Ely, before reaching the Wash at Sutton Bridge.

The river Great Ouse flows into Cambridgeshire from Northamptonshire. Flowing northwards from Bedford, it takes a more easterly route, passing through St. Neots, then north-eastwards to Huntingdon and Godmanchester, then on through St. Ives. The Great Ouse continues eastwards towards Soham and is joined by the river Cam near Little Thetford. It then turns northwards through Ely and Littleport before heading for the Wash at Kings Lynn. A quantity of tiles and other building materials were found in the Great Ouse at St Ives, which may represent a lost cargo (Phillips 1970, 189).

The river Cam originates near Ashwell in Hertfordshire as the Rhee. It flows northwards through Cambridgeshire to be joined by the Granta near Grantchester, thence continuing through Cambridge itself. Still flowing northwards, the Cam passes the regionally important Romano-British pottery manufacturing area at Horningsea, then on to join the Great Ouse.

Both the Nene and Cam were tidal waterways far inland and would have given the region outlets for coastal trade.

3.2.2 Lodes

These water features, essentially canals or canalised existing waterways, are characteristic of the Fenland region. Although many were undoubtedly constructed after the Romano-British period, there is evidence for some to have been constructed and in use, during this period (Salway 1970, 11). They connected often remote inland sites to the major arterial waterways, enabling the supply

of goods and materials into and out of these communities, where transport by road may have been inconvenient or prohibitive.

3.2.3 The Car Dyke

There been much debate about the purpose of this remarkable feature of the Romano-British landscape. Salway (1970, 11) notes that in 1757, William Stukeley proposed that the Car Dyke was built as an integral part of the Roman transport network. Stukeley suggested it was a means for moving grain produced in the fens, northwards to supply the Roman army.

There are two sections, which today have come to be known by a common name. The Lincolnshire section originates near Washingborough to the south-east of Lincoln and runs generally southwards. Simmons and Cope-Faulkner (2004, 1) suggest that it may originally have reached Lincoln itself. It follows the eastern contours at the base of the Lincolnshire limestone ridge, to eventually reach the Peterborough area, where it probably connected with the river Nene.

Most recently, this section has been viewed as a complex of linked catch-water drains, part of a system similar to the Dutch *Ringvart* water management systems (Simmons and Cope-Faulkner 2004, 1). This relies on a secondary dyke and seabank, seawards of the inland channel. The two features would be linked by cross-streams or rivers controlled by sluices. Water could then be stored in the main dykes, to be released along the cross-streams when the tides allowed. In the central Lincolnshire section, the second main dyke could have been a drain known as the *Midfendic*, which runs roughly parallel to the Car Dyke. (Fig.11) Its purpose may have been to protect or reclaim land where salt production took place (Potter *et. al.* 1981, 106-112).

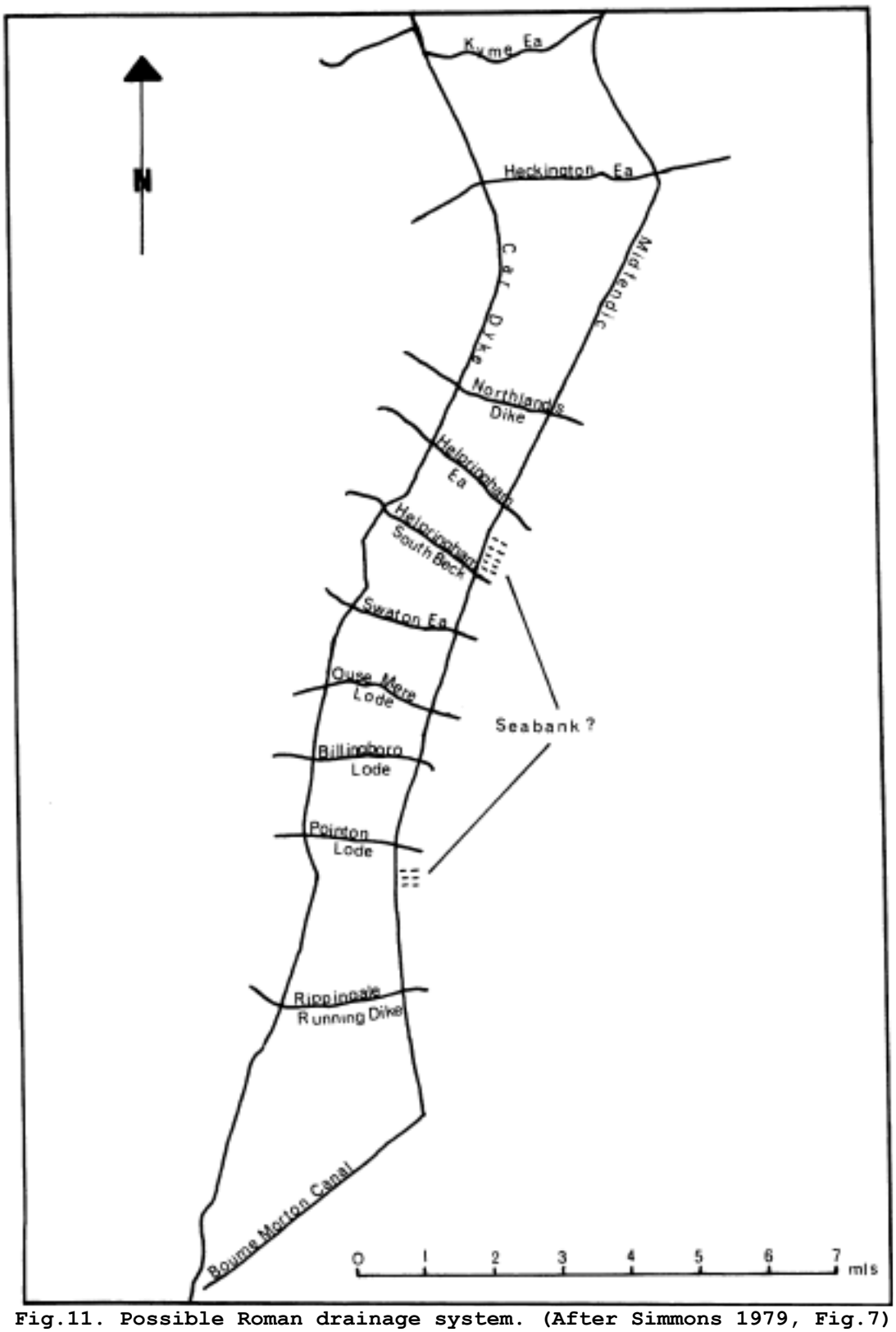


Fig.11. Possible Roman drainage system. (After Simmons 1979, Fig.7)

This would most likely have been an imperially controlled industry, who would have had the resources to carry out major civil engineering projects such as the Car Dyke.

The argument for the Lincolnshire Car Dyke to have been a continuously navigable waterway, has been made redundant recent excavations of Roman roads which cross the Car Dyke at Dowsby and Billingborough. Here it was demonstrated that the roads were led across the dyke on deposits which were undisturbed, thus highlighting the fact that the Lincolnshire Car Dyke never had been a continuous single feature (Simmons 1979, 187-190).

Sections of Car Dyke could have been used for local movement of goods. Close by the Car Dyke at Eye near Peterborough, a large quantity of tiles was found. It has been suggested that this could have been a depot with associated wharfage (Phillips 1970, 272).

Fig.12. The Car Dyke at Newborough near Peterborough (Photo:Author)

The second section of waterway known as the Car Dyke, is to be found in Cambridgeshire. Here it once connected an extinct branch of the river Great Ouse, with the river Cam at Waterbeach. Located nearby at Horningsea, was an important regional pottery industry, which Mills (2014, 450) suggests was also producing some roofing tile.

Another artificial waterway known as Cnut's Dyke, connected the Nene to another extinct river branch. It is not completely clear however, whether there was a continuous route between the Cam and Nene via the watercourses in the Roman period. What is clear, is that the Cambridgeshire region was well served by watercourses in the Romano-British period, providing alternative means of moving bulky and heavy materials.

4. Tile kilns

4.1 Cambridgeshire

Only two definite Romano-British tile kilns appear within the CHER database; one at Little Thetford discovered in 1995 (Hinman 1995) and the other at Stilton in 2006 (Wessex 2006). The author is aware however, of a further small tile kiln which was excavated at Boxworth in 2003 (Terry Dymott *pers. comm.*).

The city of Peterborough HER (PHER 50605) holds details of a tile kiln which was located at Wittering in the very north of Cambridgeshire, while another tile kiln was discovered during recent excavations at Itter Crescent, Peterborough (OAE 2013).

One of the aims of this dissertation, was to explore whether the apparently limited number of Roman-British tile kilns recorded for Cambridgeshire is a true representation of the industry in the county. We should perhaps examine whether the situation in Cambridgeshire is typical of Britain as a whole or is anomalous.

The map in Fig 13 below, based on data gathered in 2005, is a Google Maps plot of tile kilns compiled from data on the Archaeology Data Service website by Phil Mills.

There are a number of clear concentrations of kiln sites. The largest covers the south-east corner of England, largely along a north-east/south-west alignment, from Ipswich, through Colchester, London to the Isle of White. A second less well-defined grouping follows a similar north-east/south-west alignment. This runs from Lincoln, through Leicester, Warwickshire and Gloucester to the Bristol/Bath area. The regions to the north appear to be more uniformly, if lightly, populated with tile kilns.

Fig.13 Plot of Roman tile kilns in Britain. (After Mills 2005b).

Caution needs to be exercised in assessing the density of sites, as some of the pins on Mills' map represent multiple kilns on the same overall site. It may also be the case that the data reflects where development has taken place leading to the discovery of kilns. However, Cambridgeshire appears to reside in a relatively lightly populated zone between the two major groupings. What might have given rise to this situation?

As discussed previously, the area around the Wash was less densely settled in the Roman period, or at least the earlier part of it.

Buildings appear to have been of a more modest character, perhaps the residences of bailiffs, tending the estates and industrial interests of landowners living in urban centres (ref). Reeds would have been in plentiful supply in the fens, providing thatch for roofs, although small scatters of tile do occur. This of course only addresses the situation in the East of England. A large swathe between the two major kiln groupings, with the exceptions of the Piddington/Harrold and Wittering/Stilton/Little Thetford groups, appears devoid of tile kilns.

The northernmost of the two major groupings of tile kilns, encompasses several major Romano-British garrisons and administrative centres: Cirencester, Gloucester, Leicester and Lincoln. Coincidently or not, this grouping mirrors the Fosse Way, a major cross-country routeway. Perhaps this is a clue to the tilemaking industry being under imperial control along the two axes of influence. The industry was originally at least, controlled by the military, and that later, civilian contractors could have been employed to take over production (Brodribb 1979; Warry 2010).

The following is a gazetteer of the known tile kilns in Cambridgeshire, with a description of some of the fabrics and tile types discovered during excavations.

4.1.1 Boxworth

A tile kiln was found during the Boxworth 'Big Dig' excavations in 2003 (Connor and Taylor 2007). It was a small rectangular one measuring approximately 1.2m by 1.2m (Fig.14).

4.1.2 Itter Crescent, Peterborough

Itter Crescent was a large Iron Age to Roman villa site. It is situated in what is now the Walton suburb, to the north of Peterborough and was excavated in 2010-2012.

Fig.14. Boxworth tile kiln partly excavated. (Photo: T. Dymott)

There is evidence of Iron Age activity on the site, with the villa being built in the second century. The property appears to have been abandoned in the fourth century, following which much of the stone walls were robbed out. A small stone-built tile kiln was located to the west of the main villa buildings (Henley and Pickstone 2012).

4.1.3 Watson's Lane, Little Thetford

A brick and tile kiln was discovered during excavations at the Watson's Lane site by the Cambridgeshire Archaeological Unit in 1995 (Fig.15). The remains of eight round houses were located at what appears to have been an industrial area. Roman activity occurred mainly between the second and third centuries, with abandonment taking place in the fourth century (Lucas and Hinman 1996).

4.1.4 Stilton Fen

Channel 4 Television's Time Team conducted excavations at Stilton Fen in 2006 (Wessex 2006). The site is located on a small island

of slightly higher ground, near the junction of two waterways.

Fig.15 Little Thetford tile kiln. (Photo: http://www.littlethetford.org/images/cowslipd.jpg)

Within the apparently industrial settlement, several kilns were discovered. One of these (Structure 190), was interpreted as a tile kiln. The tile kiln was observed to be a rectangular one. Although it was not fully excavated, it was classified as a Brampton type (square or oblong).

4.1.5 Wittering

(PHER 50605). The excavation of what was thought to be a mausoleum in 1994-1995, after the chance find of a decapitated burial by the farmer, revealed a tile kiln. The tegulae and pilae built structure comprised a stokehole which was 4.5m long, 4m wide and 1m deep, cut into the limestone bedrock. The firing chamber had a central flue, with eight cross-flues to each side and the whole structure appears to have been enclosed within a massive shelter, supported by six posts of approximately 0.3m diameter.

4.2 Regional Tile Kilns

In this section I will introduce some of the sites with tile kilns, whose products might have been traded into Cambridgeshire, by road or water.

4.2.1 Harrold, Bedfordshire

The kilns at Harrold, Bedfordshire, are well known regionally at least, for their shell-tempered wares (Unger 2009). Their products, both pottery and tiles are found on sites in Cambridgeshire. It seemed appropriate therefore to include them in this study, in order to more confidently identify their products and to better understand the distribution and trading patterns of Romano-British CBM in the county.

The kilns were located on a gentle slope, approximately 800m west of the river Great Ouse and perhaps within 3km of a Roman road between Irchester, some 11km to the north and the Great Ouse valley.

Excavations were undertaken between 1968 and 1971, revealing a total of nine kilns. Most of the kilns were identified as producing pottery, although tiles were found in the backfill and structures of some. One kiln (kiln 7) was of a rectangular form, which was identified as most likely being a tile kiln (Brown 1994).

There appears to have been two major eras of ceramic production at Harrold: the 2nd century C.E. and the late 3rd/early 4th centuries

C.E. As Brown suggests (1994, 106), this may just be the response to changing demand. However, the majority of tile making seems to have taken place in the latter era.

Harrold products are found widely across the south and southeast of England. Sophie Unger (2009) in discussing the changing fashions in the building practices of Roman London has highlighted the distribution of Harrold ceramic building products, and particularly their appearance on sites in London.

4.2.2 Heckington, Lincolnshire

A number of tile kilns were located to the southeast of Lincoln, close to the Lincolnshire Car Dyke at Heckington (Simmons 1994). The study of tiles from these kilns has been included in this survey, to test whether or not they could have been traded into Cambridgeshire, via the Roman road system, or perhaps the Car Dyke itself. Phil Mills (*pers. comm.*) has reported noting tiles with a similar blue/brown finish, like an example from Great Eversden (Fig.16), from a number of sites along the Car Dyke.

Tiles from the Heckington kilns were examined at the Lincolnshire Archives. Their fabrics are generally of a mid to light orange (5YR/6/8-10YR/7/6), being reasonably well made with occasionally slightly reduced cores. The upper surfaces of the flanges and beds of the tiles show signs of being wiped or scraped smooth. The outer faces of the flanges and parts of the lower cutaways appear to have been sanded, indicating the use of a mould in their manufacture.

Fig.16 Tile fragment from Great Eversden (GE01). (Photo: Author)

A block would have been incorporated into the mould to produce the vertical component of the cutaways. The cutaways were then completed by several knife cuts, producing a coarse curve.

There are many examples among the Heckington tile assemblage of a single loop 'signature', in the form of a '6' or '9' (Fig.17) shape. Equally numerous are the imprints of dog paws, large ones, up to 70mm across (Fig.18), one of which almost completely penetrates the tile on which it occurs.

Fig.17 Loop sign and fingerprints. (10mm grids) Fig.18 Paw prints. (Photos: Author)

5. Survey of Roman Roofing Tiles in Cambridgeshire

For this survey of Roman roofing tiles, I have attempted to extract evidence contained within the characteristics of the tiles, in order to try to establish whether there are any common features in their production.

Site ID	Site Name	Archiving Body
BL	BLUNTISHAM	NM
BP	BRAMPTON	CCC
BT	BOTTISHAM	CCC
CA	CAMBRIDGE, ARBURY VILLA	MAA
CG	CAMBRIDGE, GLOUCESTER TERRACE	MAA
CH	CHILDERLEY	CAFG
EA	EARITH	NM
EV	EXNING VILLA	MAA
GE	GREAT EVERSDEN	CAFG
GP	GODMANCHESTER, PINFOLD LANE	MAA
GR	GODMANCHESTER, RECTORY FARM	OAE
GS	GREAT STAUGHTON VILLA	MAA
HA	HARROLD, BEDFORDSHIRE	BM
HC	HASLINGFIELD, CANTELUPE FARM	CAFG
HK	HECKINGTON, LINCOLNSHIRE	LA
HR	HASLINGFIELD, RIVER FARM	CAFG
IC	ITTER CRESCENT	OAE
LV	LINTON VILLA	CCC
RV	REACH VILLA	CAFG
RV	REACH VILLA	CAFG
SH	SHEPRETH	MAA
SP	SWAFFAM PRIOR	CCC
SS	SAWTRY, STOCKING CLOSE	NM
ST	SAWTRY, TORT HILL	NM
TV	TEVERSHAM VILLA	CCC
WB	WATERBEACH	OAE
WH	WHITTLESFORD	MAA
WM	WIMPOLE	CCC
WN	WATER NEWTON	NM

Table 1. Sites referred to in this survey.

It should be noted however, that it has not been possible to conduct an exhaustive survey of roofing tiles from all sites in Cambridgeshire. Those which have been studied, represent a cross section of site types and collection methods. Although material from field walking is unstratified, as everything found is usually retained for assessment, it is probably more representative of sites than that from museum collections, for instance. Typically,

these institutions only retain items which exhibit distinctive features.

On commercial and research excavations, materials are largely processed on site, with diagnostic items retained and the remainder usually deposited on site (Wessex 2010).

The first point to note is the wide variety in roofing tiles, principally tegulae, not only between sites across the county, but also on individual sites. This is perhaps not so surprising, given that Roman style housing was in vogue for perhaps 350 years. Villa estates growing in wealth would have been extended over time, especially as families expanded and repairs would have probably taken place at frequent intervals.

5.1 Fabrics

There is currently no definitive county-wide catalogue of CBM fabric types in Cambridgeshire. Several organisations, such as the Cambridge Archaeological Unit of the University of Cambridge and Oxford Archaeology East use their own classification systems (Anderson 2013, 1-2).

For the Itter Crescent excavations, Anderson identified thirteen fabrics. Most of these are common fabrics which could be expected to be found on Cambridgeshire sites, but also included are unusual types such as the shell-tempered and white-fired fabrics, thought to originate from Harrold in Bedfordshire (Brown 1994).

The fabrics from Great Eversden and Reach, are typical of the types found in Cambridgeshire. They are largely sandy or fine silty types, with varying amounts of inclusions of quartz grit and pebbles, ferruginous and calcitic particles. Most are uniformly well-fired in a range of fully oxidized red/orange colours, although a number have reduced cores. More rarely occurring are pink shell-tempered fabrics, which are typical of those found with origins to the west of Cambridgeshire, perhaps from Harrold (Brown 1994), or the Milton Keynes/Towcester area (Zeepvat 1987). One very square section

tegula flange is in a very sandy beige coloured fabric, whose origin is as yet undetermined.

The colouration of some tiles from Great Eversden is most unusual. The surface finish is a deep blue/brown, with a chocolate brown core. Phil Mills (*pers. comm.*), reports seeing similar examples from a number of sites along the Lincolnshire Car Dyke. John Hefferan (2008), writing about tiles recovered from a Roman villa site at Goring-on-Sea, suggests that a blue/brown surface colouration can result from low firing temperatures in the kiln.

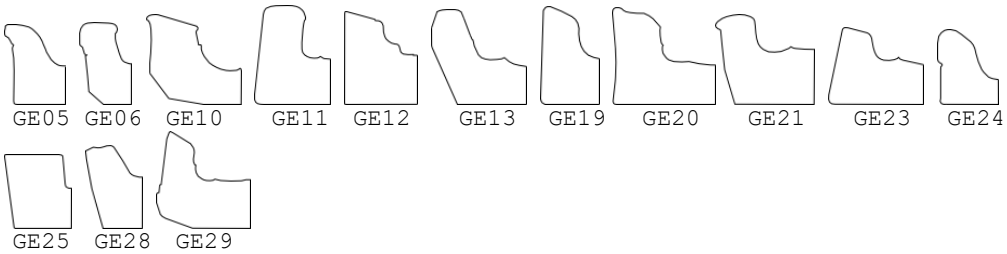
5.2 Forms

The variation in tegulae profiles from Great Eversden and Reach villa sites (Fig 19), show as much variety as those from some of the continental European sites, such as Tritchot (Fig.7) or San Maliaño (Fig.8).

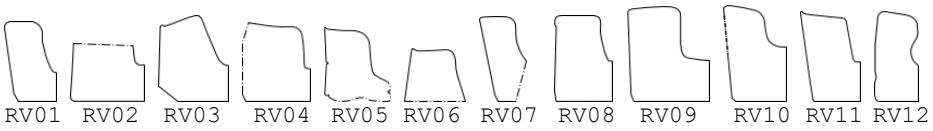
A feature common to many of the Cambridgeshire tile fragments examined, was the application of knife trimming to the outer bottom corner, and occasionally the outer top corner of tegulae flanges. This operation may have been carried out in order to clean up overspill of clay. Material may have squeezed between joints in moulds or underneath them, or where clay had been squeezed over the top of moulds following smoothing (Warry 2006a, 10).

Several of the tegulae flanges from Great Eversden (GE05, GE10, GE21) have lips on the top outer edges, indicating that the flanges may have been smoothed while still in a mould and clay has squeezed over the top, a trait shared with Harrold (HA02). Four Great Eversden flanges (10, 12, 20, 29) have double finger smoothing channels on the inner flange faces, a feature shared with Arbury villa (CA01), Haslingfield (HC08) and Sawtry (SS03).

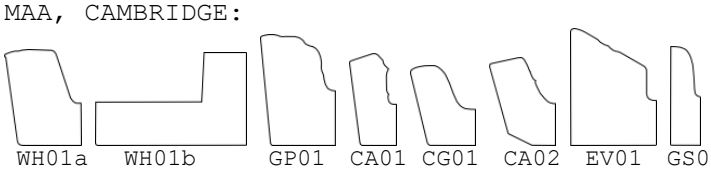
GREAT EVERSDEN:



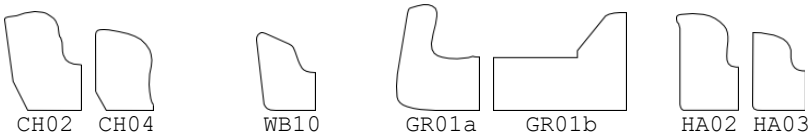
REACH VILLA:



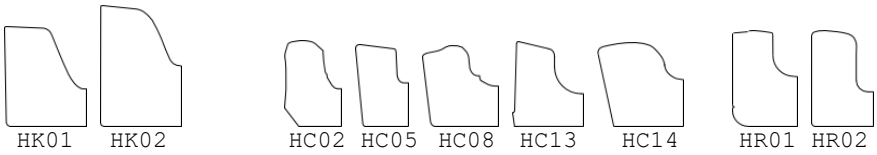
MAA, CAMBRIDGE:



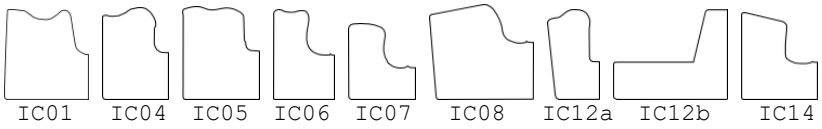
CHILDERLEY: WATERBEACH: GODMANCHESTER: HARROLD



HECKINGTON: HASLINGFIELD CANTELUPE FARM: RIVER FARM:



OAE, ITTER CRESCENT PETERBOROUGH:



NORRIS MUSEUM, ST IVES:

CAMBRIDGESHIRE COUNTY COUNCIL:

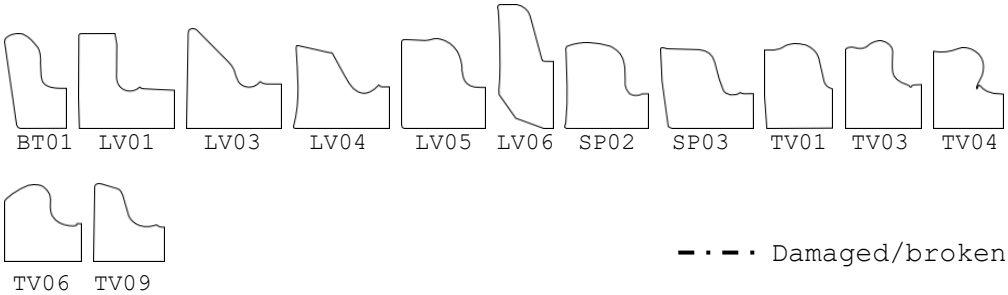


Fig.19 Tegulae flange profiles. (Scale 1:4)

Many of the tile fragments from Reach villa are worn and abraded. Four of the tegulae flanges have lips on the top outer edge (03, 05, 06, 11), indicating that they may have been smoothed against the inside face of a mould.

A feature common to tegulae from Itter Crescent (IC01, 04, 05, 06, 12), Sawtry (SS01, 02) and Teversham (TV01, 03, 04) is a pronounced finger channel along the top of the flanges. These may be purely decorative touches or may be the result of smoothing out the join between strips of clay.

Many of the flanges examined have a very perpendicular outer face, which might be expected if they were produced in a simple box mould. Some of them have and inward, or outward slope though.

A small number of the flanges have sloping inner or outer faces. An inner face which sloped outwards, would clearly allow greater clearance with its covering imbrex, however, some inner faces slope inwards. These deviations from the perpendicular, could have been due to accidents during the manufacturing process, during mishandling, drying or during firing in the kiln.

If tegulae were being manufactured in rigid, perpendicular moulds, an inordinate number of moulds would be required for any reasonable sized roof if the tiles were allowed to dry before being removed from their moulds. The alternative would involve moulds with detachable sides, or perhaps even rigid moulds with sloping sides. This would make it easier to remove a wet tile from the mould by either lifting the mould up of the tile on its baseboard, or by tipping the tile out. There would be much less suction and friction between mould and wet clay with a mould with sloping sides, than one with perpendicular sides.

Cutaways are another distinctive feature of tegulae. These were formed in the flanges of tiles prior to firing, and their purpose was meant to aid meshing when tiles were overlaid to form waterproof joints. Warry (2006 7-37) has discussed different techniques by

which the cutaways might have been formed. Some of these are dependent on the types of moulds used to produce the tiles.

With a conventional four-sided mould used to produce a tile with upstanding flanges, the upper cutaways may have been knife-cut. Alternatively, they may have been formed by the use of a taut wire, perhaps that used when shaping the body of the tile. This would have been held across the width of the tile to cut both flanges simultaneously. Either technique usually leaves tell-tale marks in the unfired clay. All of the upper cutaways observed in this study had been knife cut.

Warry (2006a, 4) identified thirteen lower cutaway types, which he arranged into five groups (Fig.5). He argues for a chronological transition from group A to group D, on the grounds of technological refinement and simplification of the production process (Warry 2006a, 44). Also noted are tiles with lower cutaways designated in a group R, as regional variants. None of this latter group were observed in this study.

A step-change in roofing technology is asserted by Warry, with tegulae exhibiting type C cutaways. The period when these tiles appear, is linked to the rapid expansion of building projects. Tiles with type D cutaways, represent the end of urban development, while R type cutaways are found in a number of regional traditions.

A total of 27 lower cutaways were identified amongst the tiles and tile fragments examined in this survey. Their proportions can be seen in Table 2 below.

TYPE	WARRY DATE RANGE	n	%	MILLS DATE RANGE
A	40-120	1?	3.7	90-280
B	100-180	7	25.9	71-410
C	160-180	16	59.3	200-410
D	240-380	3	11.1	3rd-4th C.
R	4th C.	0		4th C.

Table 2. Date ranges for lower cutaway types.

Only one of the tile fragments examined, that from Swaffam Prior (SP03), had a lower cutaway which could have been of Warry type A. This may have been formed by the flange being pinched between thumb and finger, although the finish was quite smooth and could have been accomplished by the use of a gouge. It was, however, not entirely clear if this feature was situated near the end of the tile and may have been caused during poor handling of the soft tile.

Table 3 below lists the cutaways by type and includes the dimensions of flange height (H), width (W) and bed thickness where it merges into the flange (T).

5.3 Signatures

A number of writers, such as McWhirr and Viner (1978) Brodribb (1979), have suggested that marks made on bricks and tiles with fingers or tools may have been 'signature' marks, identifying individual tile makers. Havas (2007) suggested that they may have been used as apotropaic devices. The exact purpose of signatures is still not entirely clear, and they may have no more than a decorative function.

Not all such marks, however, would have been visible when the tiles were laid and overlapped, and in some cases, the marks were made on the undersides of tiles. Ramos Sáinz (2003) concluded that in these cases, the markings may have helped to key tiles when cemented together, or to increase the frictional grip when laid on the roof.

Relatively few of the tiles and tile fragments which I inspected in the course of researching this dissertation topic, exhibited humanly made signature marks. Those which were noted, were mainly found in the museum collections, where such features have led to them being disproportionately retained. Far fewer were found among the field walked assemblages which represent a more random sample of albeit fragmentary tiles.

Tile ID	Where Held	Flange		Bed	Trimmed	Lower Cutaway	
		Width (W) mm	Height (H) mm	Thick (T) mm		Warry Type	Mould/Cut
SP03	CCC	29	24	18	T	A?	?
GP01	MAA	30	29	29		B6	C
GE02	CAFG	19	26	21	T	B6	C
GE03	CAFG	26	18	19		B6	C
GE06	CAFG	18	21	22	T	B6	C?
GE10	CAFG	26	29	18	T	B6	C?
GE13	CAFG	26	30	20		B6	C?
RV03	CAFG	32	26	19	T	B6	C?
BT01	CCC	18	29	21		C4	M
HA02	BM	26	28	23		C4	M
HA03	BM	20	20	21		C4	M
LV04	CCC	28	22	21		C4	M
CA02	MAA	21	24	22		C5	C
EV01	MAA	40	38	24		C5	C
GE25	CAFG	30	18	21		C5	C
IC01	OAE	38	24	24		C5	M
IC03	OAE	32	27	23		C5	M
IC04	OAE	27	24	25		C5	M
IC05	OAE	32	25	24		C5	M
SS01	NM	21	32	24		C5	C
SS02	NM	23	25	25		C5	C
TV01	CCC	33	24	21	T	C5	C
HK01	LA	34	33	20		C56	M
HK02	LA	38	32	32		C56	M
WH01	MAA	29	28	22		D16	C
CH02	CAFG	27	28	24	T	D5	M
CH04	CAFG	29	43	N/A		D5	M

Table 3. Lower cutaways by Warry types A-D.

In view of the work of Ramos Sáinz carried out in Spain, as discussed in section 2, it may be instructive to assess the signatures found on tiles in this survey. From this, it may be possible to determine, as Ramos Sáinz did, to what extent age and gender played a part in the production of tile.

Table 4 below lists those tiles and tile fragments which were found to carry signature marks, along with the width of the marks and additional information. Where multiple curved finger marks occur, the outermost one with the greater radius is listed first.

ITEM ID	TILE TYPE	DIMENSIONS (mm)				NOTES
		OUTER	2nd	3rd	4th	
BL02	Tegula	9	9			loops 7mm apart
GE01	Tegula	12	10			partial curves blue/brown tile
GE08	Tegula	6-7	6-7			top loops of 'heart' possibly stick drawn
GE15	Imbrex	13	13			longitudinal linear
GP01	Tegula	6-7	6-7			concentric from lower edge, 8mm apart
HA02	Tegula	6-7	6-7			partial semicircles, converge towards lower edge
HC06	Tile?	12				34-35mm thick brick/tile?
HC12	Tegula	6	8			partial semicircles, converge towards lower edge
HK01	Tegula	7	?	?		partial semicircles from lower edge, 2 faint
HK03	Tegula	11-17				'6' or '9' loop, tapering
HK04	Tegula	12				partial '6/9' loop, max dim, tapering
HK05	Tegula	11-16				partial semicircle, tapering, faint, near lower edge
HK06	Tegula	13				'6/9' loop and fingertips (54mm across four)
IC01	Tegula	9	8	14	8	complete semicircles at lower edge
LV01	Imbrex	8	8			longitudinal linear, separated by 10mm
SH01	½ Wall	8	8			linear, diagonally from edge, 145mm long
SP01	Tegula	10				open '6/9' loop, max dim, tapering
SS01	Tegula	10				partial semicircle near lower edge
ST01	Tegula	9	9			broken, 2 linear? separated by 3mm
TV02	Imbrex	11	8	8		longitudinal linear, separated by 2mm

Table 4. Dimensions of finger 'signatures' found on tiles.

Caution should be exercised when attempting to draw conclusions from the width of finger signatures. Some of the examples listed in table 4, particularly those from field walked assemblages, are eroded. The width and depth of a finger mark will depend on the force applied and the consistency of the clay. A heavily impressed mark made by a child could be wider than a lightly made adult one. However, generally speaking, a mark left by an adult finger, should be wider but shallower than that left by a child's finger.

Another factor which must be considered, is that of shrinkage during the drying and firing processes. Brodribb (1987) suggested that tiles may have shrunk by as much as 10%, as did Peter Warry (2006) In the report on the assessment of finger marks from Maliaño? (Ramos

Sáinz 2003), a figure of 10% is apparent (Table 5). This is the value which I have adopted in my analysis.

TYPE OF PERSON	WIDTH OF INDEX, MIDDLE AND RING FINGERS	PRINTS LEFT IN RAW CLAY
Child of 3 yrs	1.1cm/1.1cm/1.0cm	1.1cm/1.0cm/1.1cm
Child of 6 yrs	1.1cm/1.1cm/1.0cm	1.3cm/1.3cm/1.1cm
Child of 6 yrs	1.1cm/1.1cm/1.1cm	1.2cm/1.3cm/1.3cm
Child of 6 yrs	1.3cm/1.3cm/1.3cm	1.3cm/1.4cm/1.4cm
Child of 6 yrs	1.1cm/1.2cm/1.1cm	1.2cm/1.2cm/1.3cm
Child of 6 yrs	1.0cm/1.3cm/1.2cm	1.0cm/1.4cm/1.0cm
Child of 9 yrs	1.2cm/1.3cm/1.1cm	1.0cm/1.5cm/1.0cm
Child of 10 yrs	1.1cm/1.2cm/1.1cm	1.2cm/1.4cm/1.0cm
Child of 12 yrs	1.1cm/1.1cm/1.0cm	1.2cm/1.3cm/1.1cm
Woman of 23 yrs	1.2cm/1.3cm/1.1cm	1.3cm/1.4cm/1.3cm
Woman of 23 yrs	1.5cm/1.5cm/1.4cm	1.5cm/1.6cm/1.4cm
Woman of 24 yrs	1.2cm/1.3cm/1.1cm	1.3cm/1.4cm/1.3cm
Woman of 25 yrs	1.4cm/1.5cm/1.3cm	1.4cm/1.5cm/1.4cm
Woman of 26 yrs	1.4cm/1.5cm/1.3cm	1.5cm/1.6cm/1.4cm
Woman of 28 yrs	1.5cm/1.5cm/1.5cm	1.4cm/1.7cm/1.4cm
Woman of 35 yrs	1.5cm/1.5cm/1.4cm	1.1cm/1.4cm/1.1cm
Man of 40 yrs	1.5cm/1.5cm/1.5cm	1.6cm/1.7cm/1.7cm
Man of 42 yrs	1.8cm/1.7cm/1.7cm	1.8cm/2.0cm/1.7cm
Man of 43 yrs	2.1cm/1.9cm/1.8cm	2.2cm/2.0cm/1.9cm

Table 5. Finger widths and prints made in wet clay. (After Ramos Sáinz 2003, Table 3a)

As fingers may not have been pressed to full depth into the clay, the width of single marks could be misleading unless some means of calibrating them is devised. Where three or more finger marks have been made together, we can be more confident that the space between the ridges more accurately reflects the true width of the fingers.

The most useful example in this survey then is IC01. This is an almost complete tegula recovered during the Itter Crescent villa excavations. It was almost certainly produced in one of the kilns at Harrold in Bedfordshire, by comparison with examples of tiles inspected at the Higgins Museum, Bedford.

By multiplying the figures in table 4 for IC01 by 10% with a little rounding, we arrive at values of 10, 9, 16 and 9 millimetres, respectively. By comparison with Ramos Sáinz's results and measurements of my own fingers, which are far from fleshy, we may

deduce that the finger marks were made by an adolescent male, or perhaps an adult female.

It is not clear whether the four loops on IC01 were made altogether as it might be too uncomfortable for a tilemaker to bring all four fingertips together. It would have been much easier to use the middle three fingers, but then the fourth loop would have to have been made separately afterwards, perhaps using the track of the outer loop as a guide.

Five of the tile fragments (25%) carry marks in the range of 6-7mm wide. These were almost certainly made by preadolescents. It would appear that all ages were involved in the tilemaking process. This may have occurred in family groups as implied by the three fragments from Great Eversden (GE01, GE08, GE15)

5.4 Harrold type shell-tempered fabrics

The map of Figure 20, shows the distribution of Harrold type shell tempered fabrics in Cambridgeshire, identified during this survey. To instill confidence that these fabrics were coming from a common source, polished sections from a number of examples were prepared, and examined at 50x magnification (Fig.21). The photomicrographs reveal that the samples are all quite similar and appear to correspond with the description of Harrold type shell tempered fabrics (ROB SH), as noted by Tomber and Dore (1998).

Although the overall number of sites is quite small, the distribution indicates three groupings. It could be argued that these reflect the reliance of the trade in Harrold type fabrics, on the Cambridgeshire river systems.

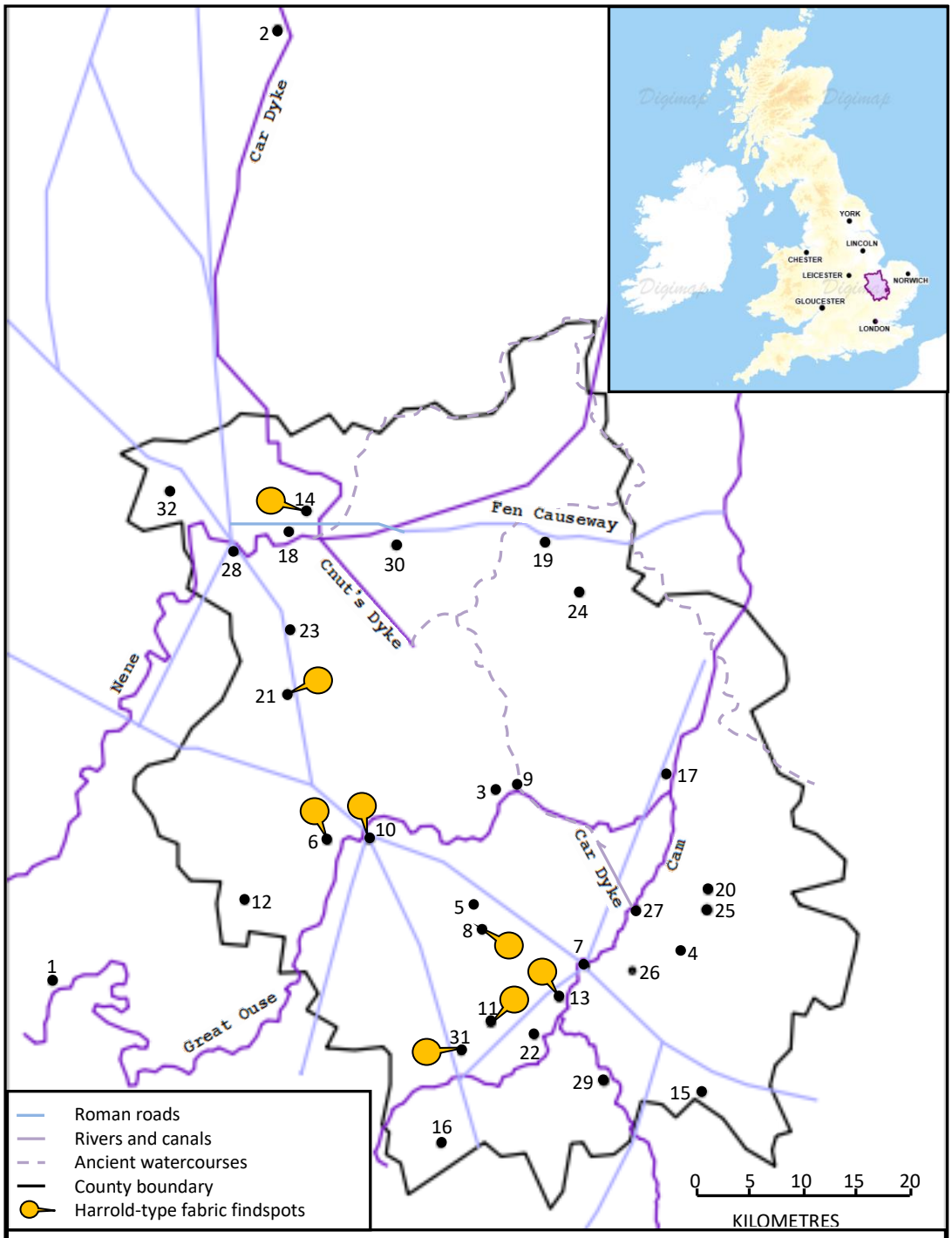
The northernmost group comprises tiles from Itter Crescent, Peterborough and Sawtry, Stocking Close. These sites could have been supplied via the river Nene, one of its tributaries or perhaps the Cambridgeshire Car Dyke.

Another group is clustered in and around Godmanchester

(Copplestone and Neal n.d.). The river Great Ouse could have been utilised to reach these sites, although some overland transport may have been required.

The third and southernmost group of sites are located in and around Cambridge (Duroliponte). For these, the river Cam itself could have been the natural choice of transportation route.

The alternative option would have been the movement of produce by the road system. However, if the Theodosian codex limiting the weight of road vehicles was operating throughout the empire and restating already existing laws, then river-born trade in goods may have been the only option for large and bulky objects such as roofing tiles.



1	Harrold(Beds)	2	Heckington(Lincs)	3	Bluntisham	4	Bottisham
5	Boxworth	6	Brampton	7	Cambridge	8	Childerley
9	Earith	10	Godmanchester	11	Gt Eversden	12	Gt Staughton
13	Haslingfield	14	Itter Crescent	15	Linton	16	Litlington
17	Little Thetford	18	Longthorpe	19	March	20	Reach
21	Sawtry	22	Shepreth	23	Stilton	24	Stonea
25	Swaffam Prior	26	Teversham	27	Horningsea	28	Water Newton
29	Whittlesford	30	Whittlesey	31	Wimpole	32	Wittering

Fig.20 Distribution of Harrold-type products from this survey.

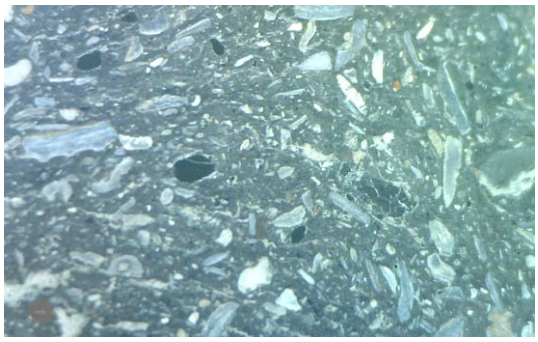


Fig.21a Childerley (CH03)

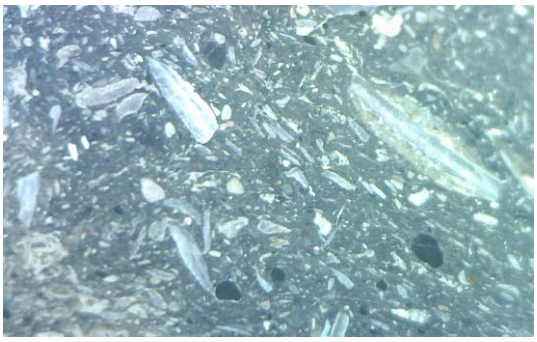


Fig.21b Childerley (CH04)

Fig.21c Haslingfield (HC03)

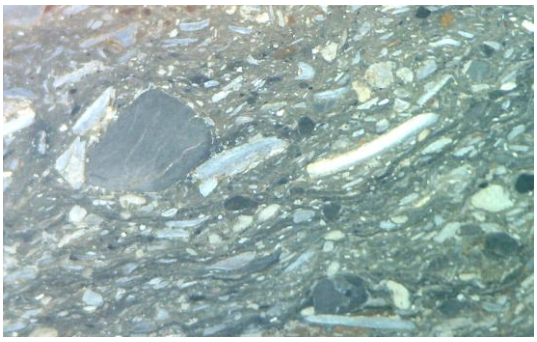


Fig.21d Haslingfield (HC04)

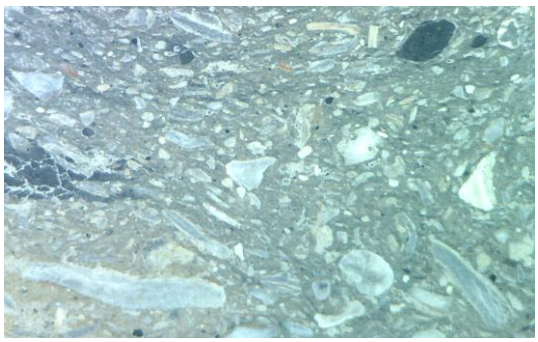


Fig.21e Great Eversden (GE25)

Fig.21a-e Photomicrographs of examples of Harrold-type shell-tempered fabrics. 50x magnification, 3mm field of view. (Photos: Author)

5.5 Other Markings

Several writers (Brodribb 1987, Warry 2006a) report marks inscribed on the edges of tiles sometimes called 'tally' marks. These have been interpreted as batch or production marks; however, they do not appear on all complete tiles which have been examined. None of the tiles or tile fragments examined in this survey exhibited such marks.

Other marks which are commonly found on tiles, are those left by animals. Animal prints such as pigs, sheep and goats have been taken as evidence for tilemaking to have been undertaken in a agricultural setting. It was a seasonal activity and could have been undertaken during slack periods in the agricultural cycle on farms.

A number of paw prints were noted on tile fragments in this survey. The most common were those of dogs. A pair of what appeared to be cat paw prints were noted side-by-side near the edge of tile fragment GE22 (Fig.22), where it had apparently jumped onto the tile.

Cat and dog paw prints may indicate that some tilemaking took place in domestic situations. However, some of the dog paw prints on tiles from Heckington (Fig 18) were up to 75-80mm across the pads: hardly lapdogs! In view of the ubiquity of dog paw prints on tiles generally, perhaps we might consider that these apparently freely roaming animals were guard dogs. Presumably, theft and vandalism would have been as prevalent as they are today!

Far from being the mundane objects that they are in the modern world, in Roman times, roofing tiles would have been valuable commodities. Phil Mills (pers. comm.) estimates that a tegula would have cost in the region of £50 by today's value and his work in the Mediterranean (Mills 2005a) shows that they were traded widely.

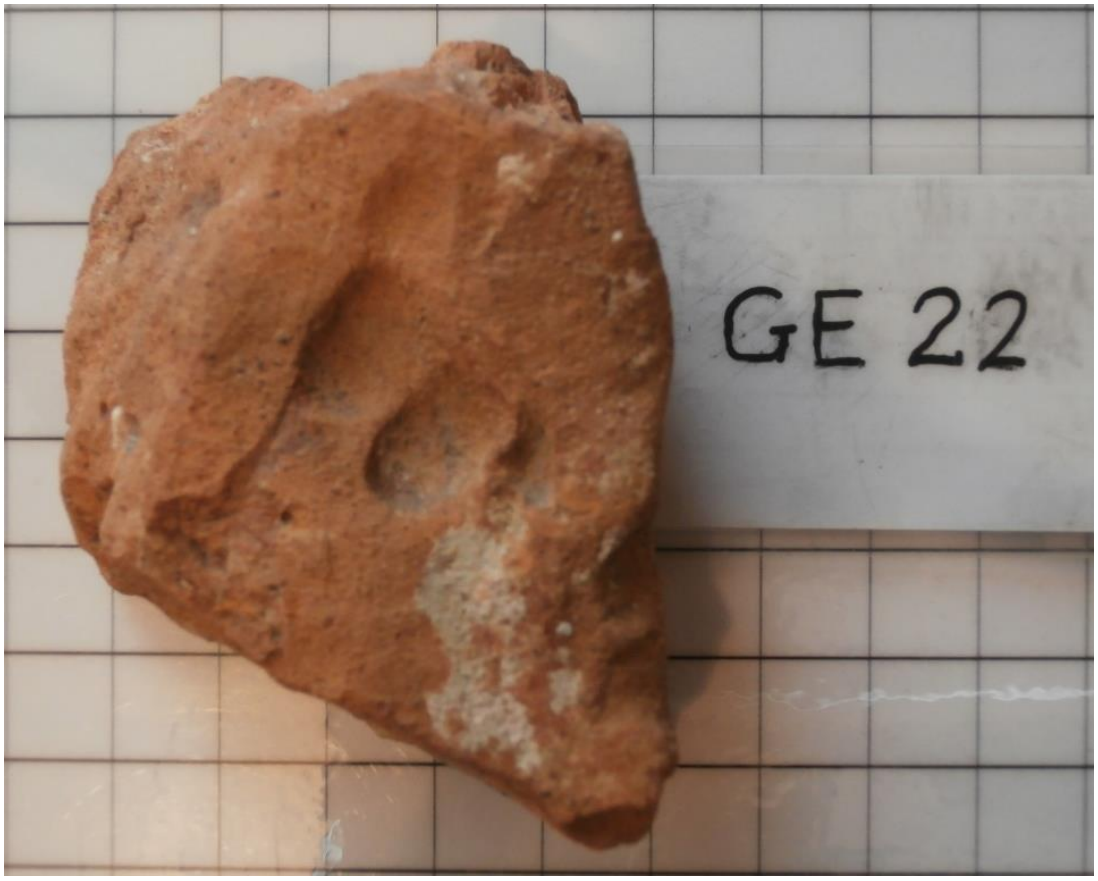


Fig.22 Cat prints on a Great Eversden tile fragment. (Photo: Author)

6. Conclusions

The outcomes of this survey of Romano-British ceramic roofing materials in Cambridgeshire have not been entirely conclusive, although, a number of strong strands of evidence have emerged which perhaps point towards future research.

I did not find any conclusive evidence to suggest that CBM were being imported into the Cambridgeshire region from the kilns at Heckington, Lincolnshire. However, Phil Mill's comments on the unusually coloured tiles he had observed at sites near the Car Dyke should be kept in mind, especially in view of the fact that I have noted similar examples from Great Eversden. The effects observed could have been due to conditions in kilns and may be more common than expected. Alternatively, the colouring could have been due to the methods or materials employed by itinerant tilemakers.

Although my sample Harrold-type shell-tempered products was quite small, it did demonstrate that their eastern trading limit was aligned on the three main urban centres in Roman Cambridgeshire, with none observed in the less prosperous Fenland areas.

Roman Cambridgeshire as well provisioned with transport routes. As well as having some of the major Roman roads passing through the county, as discussed in section 3, the rivers and waterways undoubtedly had a major role. The as yet, sometimes enigmatic Car Dyke may have had an important function in the transport of heavy loads. Sections of it, however, were clearly multi-functional, acting as part of the drainage system for the Fenlands.

The results of the analysis of finger signatures on Cambridgeshire tiles revealed that persons of all ages were involved in tilemaking. This could still have been occurring in industrial settings, although it could help to explain why so few tile kilns have been recorded in Cambridgeshire. Small-scale, family group production may have taken place utilising low technology such as clamp firing. These methods would probably leave little evidence in the archaeological record.

A third possibility to consider, is that pottery kilns were also being used to produce brick and tile. Romano-British pottery kilns are found quite widely throughout the county, so a lack of suitable clay was probably not a factor also.

7. Further work

Future studies of Romano-British ceramic building materials in Cambridgeshire would benefit from including materials from a much wider range of sites. It was not possible to gain access to material from a number of sites that it had originally been planned to. These include the kiln sites at Stilton Fen, Wittering and Boxworth.

Wider study of finger signatures across Cambridgeshire, could help to show if the age demographics of persons is consistent county wide and on a larger scale, how this compares with other areas of Britain.

More detailed analysis of fabrics by the use of thin sections or chemical inclusion fingerprinting, could help to identify common sources of clays.

APPENDIX A:

1. CBM DRAWING SHEET
2. CBM RECORDING SHEET
3. CBM PHOTOGRAPHY RECORDING SHEET

CBM DRAWING SHEET

DATE:		SOURCE:		ACC.CODE:		ID:		N°:	

ATTRIBUTES	
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	
M	
N	
O	
P	

NOTES:

KEY: - - - - - - UNCLEAR OR HIDDEN DETAIL -·-·-·-·- BROKEN OR DAMAGED

CBM PHOTOGRAPH RECORDING SHEET

DATE:	SOURCE:	ACC.CODE:	ID:	N°:	NOTES:

CBM RECORDING SHEET

DATE:	SOURCE:	ACC.CODE:	ID:	N°:	WEIGHT:	NOTES:

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