Maritime Celts, Frisians and Saxons

Papers presented to
a conference at Oxford
in November 1988

Edited by Seán McGrail

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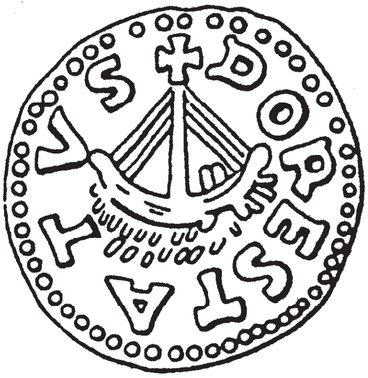

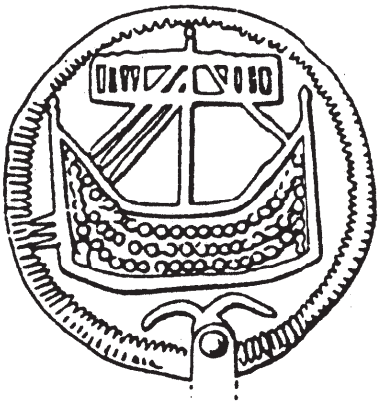

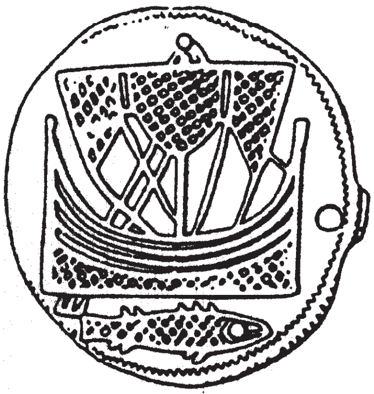

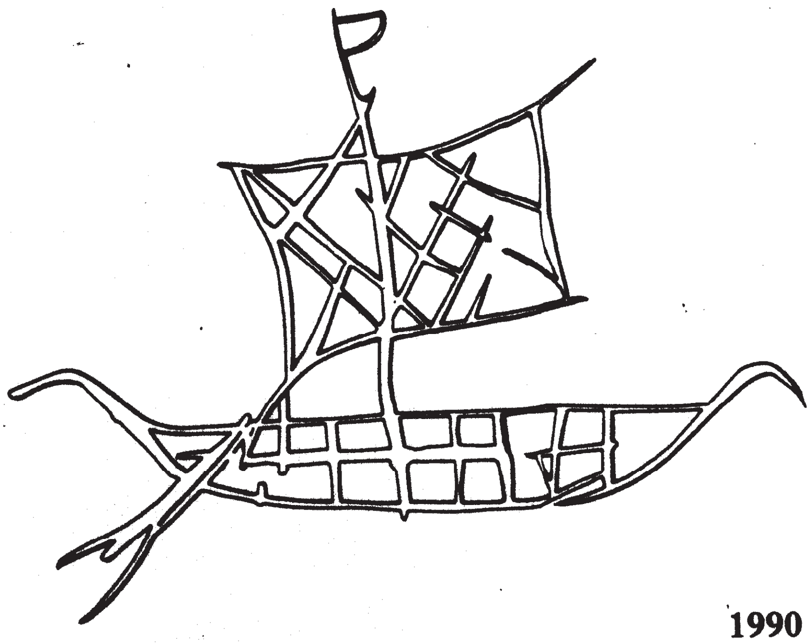

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Seàn McGrail

1990

Maritime Celts, Frisians and Saxons

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Contents

List of illustrations . . . vi

List of tables . . . vii

Contributors . . . vii

Editor s introduction . . . viii

1 Sea-level and coastline changes during the last 5000 years . . . 1
M J Tooley

2 Controls on coastal and sea-level changes and the application of archaeological-historical records to understanding recent patterns of sea-level movement . . . 17
J J N Devoy

3 Hengistbury Head: a late prehistoric haven . . . 27
B Cunliffe

4 Boats and boatmanship in the late prehistoric southern North Sea and Channel region . . . 32
S McGrail

5 The Romano-Celtic ship excavated at St Peter Port, Guernsey . . . 49
M Rule

6 The heritage of logboats and Gallo-Roman boats of Lake Neuchatel: technology and typology . . . 57
B Arnold

7 A re-assessment of Blackfriars 1 . . . 66
P Marsden

8 Barges of the Zwammerdam type and their building procedures . . . 75
M D de Weerd

9 The Romano-Celtic boats from Druten and Kapel Avezaath . . . 77
L Th Lehmann

10 Maritime traffic between the Rhine and Roman Britain: a preliminary note . . . 82
G Milne

11 On the use of the word Frisian in the 6th-10th centuries written sources: some interpretations . . . 85
S Lebecq

12 The Frisian monopoly of coastal transport in the 6th-8th centuries AD . . . 91
D Ellmers

13 The Channel from the 4th to the 7th centuries AD . . . 93
I Wood

14 Boats and ships of the Angles and Jutes . . . 98
O Crumlin-Pedersen

15 Pre-Viking traffic in the North Sea . . . 117
M 0 H Carver

16 A new boat burial from the Snape Anglo-Saxon cemetery, Suffolk . . . 126
W Filmer-Sankey

Index . . . 135

Illustrations

1.1 Distribution of unconsolidated sediments in lowland Britain
1.2 Coastline changes and sediment patterns in the Netherlands
1.3 Spatial and temporal pattern of sea-level index points in Britain
1.4 Crustal movement rates in Britain
1.5 Age-altitude graphs for south-east England
1.6 Probable medieval coastline of the Fenland and the Wash
1.7 Sea-level data from the Fenland
1.8 Romney Marsh in the Roman period
1.9 Map of Saxon Romney
1.10 Map of Broomhill Level
1.11 Stratigraphy in the vicinity of Broomhill Church
2.1 Holocene sea-level changes for south-east England
2.2 Land uplift and subsidence for north-west Europe
2.3 The coastline at Rye, Sussex
2.4 Factors involved in coastal sediment changes
2.5 Ocean-atmosphere influences on sea-level changes
2.6 Measurement of the geoid shape
2.7 Contour map of the earth s surface shape
2.8 Future sea-level rises
3.1 Map of Christchurch Harbour
3.2 Aerial photograph of Christchurch Harbour
3.3 Hengistbury Head: reconstruction of the 1st millennium BC landscape
3.4 Hengistbury Head: section through Rushy Piece
3.5 Hengistbury Head: the landing place at Rushy Piece
4.1 Exploded reconstruction drawing of the Hasholme logboat
4.2 Diagram of the Hasholme stern repair
4.3 Model of the Hasholme boat
4.4 The Broighter boat model
4.5 Map of south-east Ireland, south-west Britain and north-west France
4.6 A 17th century Irish sailing curach
4.7 The Althiburus *ponto* photograph
4.8 The Althiburus *ponto* drawing
4.9 Ship on a coin of the Atrebates
4.10 Ship engraving from Löddeköpinge
4.11 Ship on a coin of Cunobelin from Canterbury photograph
4.12 Ships on Cunobelin coins from Canterbury and Sheepen drawing
4.13 Early 20th century ship beached at St Ives, Cornwall
5.1 Map of St Peter Port Harbour, Guernsey
5.2 Details of fastenings
5.3 Nail pattern through a typical floor timber
5.4 Drawing of floor timber T51
5.5 Tripartite keel plank
5.6 Plan and sections of stern post
5.7 Reconstruction of the wreck
5.8 Plan of keel planks, planking and stern post
6.1 A cast of the Bevaix boat
6.2 Dendrochronological analysis of the Bevaix boat
6.3 Diagrams of planks in parent logs
6.4 Tool marks
6.5 Typology of Gallo-Roman boats
6.6 Yverdon 2 planking
6.7 Bevaix boat metric data
7.1 Blackfriars 1 plan and sections
7.2 Blackfriars 1 mast-step frame
7.3 Stages in the construction of Blackfriars 1
7.4 Sections through the fastenings
7.5 Boat and ship finds, 4th century BC - 4th century AD
9.1 Map showing Druten and Kapel-Avezaath
9.2 The Druten boat from west-northwest
9.3 Druten hypothetical reconstruction
9.4 The Kapel-Avezaath boat during excavation
10.1 Maritime traffic Rhine/Britain
11.1 Great Frisia during the Dark Ages
11.2 Frisian trade routes in the 7th-9th centuries
11.3 Ships on coins from Dorestad and Haithabu
14.1 Pre-Viking nautical sites
14.2 Plan of the Slusegard cemetery
14.3 Slusegåud grave boat No 1131
14.4 Slusegård grave boat No 1072
14.5 Gold boat models from Nors
14.6 Loading conditions for the two Slusegard boats
14.7 The Leck logboat
14.8 The Hasnæs logboat fragments
14.9 4th century iron nails and roves
14.10 Fragments of Nydam boat 1
14.11 Nydam boat 2 on display
14.12 Reconstruction drawing of Nydam boat 2
14.13 Fragments of Nydam boat 3
14.14 Oared boats on Gotland stones
14.15 The Alsodde steering oar
14.16 Fragments of the Gretstedbro ship
14.17 Frames from the Kongsgårde boat and Nydam boat 2
14.18 Sailing ships on Gotland stones
14.19 Engravings on a stone from Karlby
14.20 Drawing of the Karlby ship
14.21 A figurehead from Moerzeke-Mariekerke, Belgium
14.22 Distribution of different types of stem and stern posts in the 1st millennium AD
15.1 Distribution of iron clench nails in Britain
15.2 North Sea tidal streams and dominant winds
15.3 Travel times from Ipswich by land and by sea
15.4 Coastline near Sutton Hoo, with the 10 ft contour
16.1 Plans of the developing stain of the Snape boat grave
16.2 Photograph of the boat stain at level + 43
16.3 Vertical view of the east end of the boat stain
16.4 Diagram showing location of plans and sections
16.5 Plans and sections of the boat stain
16.6 Detail of east end of the boat stain at level + 53
16.7 Plan of the boat grave
16.8 Photograph of uppermost horn *in situ*

Tables

4.1 A theoretical assessment of the earliest use of types of water transport
4.2 Theoretical load carrying performance of two logboats
4.3 Theoretical cargo capacities of three planked boats
4.4 Techniques available to the late prehistoric boat builder
14.1 Dates of Danish boat finds

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Editor s introduction

Over the weekend of the 11th- 13th November 1988 a conference on *Maritime Celts, Frisians and Saxons* was held in the Department for External Studies, University of Oxford. The conference attracted 90 participants from countries bordering the North Sea and the Channel, from Sweden in the Baltic, from Ireland to the north of the south-west approaches, and from Switzerland at the headwaters of the Rhine. The participants included not only archaeologists and historians but also naval architects and specialists in sea-level studies.

The aim of the conference organisers was to promote discussion of the maritime and riverine aspects of the southern North Sea and Channel region from *c* 300 BC to *c* AD 800. During the earlier centuries of this period, the Atlantic seaboard routes between the Mediterranean and north-west Europe became more intensively used and were re-orientated as Iberia and Gaul, and then southern Britain, were absorbed into the Roman Empire. Although some of these western routes continued to be used in the post-Roman period, this was on a reduced scale, and the focus for maritime commercial activity appears to have shifted from the Channel region to the southern North Sea, in particular to the lower reaches of the Rhine and adjacent waters. But traders were not the only seafarers in the thousand years or so covered by this volume raiders, pirates, migrants, missionaries and fishermen also sailed these waters and those of the Channel and the Irish Sea.

The sixteen papers published here, revised versions of those given at the conference, deal with these seafarers and their vessels and the environment within which they used them, during this period of changing political and economic patterns. After two papers on sea-level and coastline changes an essential prerequisite to any maritime study the papers are arranged approximately in chronological order: two papers on the late prehistoric period; six on Romano-Celtic or Gallo-Roman times; and six on the Frisians, Saxons, Franks, Angles and Jutes of the Migration and early medieval periods.

Exercising my prerogative as editor, I wish to draw the reader s attention to two particular matters amongst the several important issues considered in this volume: the crucial position of the Romano-Celtic tradition in the study of the building and use of north-west European boats and ships; and the necessity for closer cooperation between archaeologists and environmentalists if a better understanding is to be gained of the conditions faced by late prehistoric and early medieval seafarers.

Several of the papers that follow consider the evidence for the types of ships and boats used at sea and on the main rivers of the region. It is not possible to present a full picture as we have only isolated pockets of evidence, widely spread in time and space, insufficient to describe the details of all types of shipping or to deduce technological relationships and lines of development from late prehistoric times to the early medieval period. It seems likely, however, that one of these pockets of evidence will prove to be a key element in future research into the origins of the principal types of medieval ship. The river boats and sea-going ships of the 2nd/3rd centuries AD Romano-Celtic tradition (Papers 5-9 in this volume) may well prove to be forerunners of the 6th-10th century Frisian vessels (Papers 11 and 12) and the later medieval cog and possibly the *hulc*. Futhermore, there are indications that this Romano-Celtic tradition may, itself, have been foreshadowed in the boats of the 1st century BC Veneti and, indeed, earlier Celtic planked boats (Papers 4 and 7).

Thus, from this Romano-Celtic tradition, we may in future be able to make progress both forwards and backwards in time. For any such studies to be firmly based it is essential, however , that those Romano-Celtic boats and ships that have already been excavated be published in as much detail as possible. Only in this way can the data base be enlarged sufficiently for regional, temporal and functional sub-groups to be recognised and the diagnostic traits of the mainstream tradition defined.

It has been said that the techniques used to build these Romano-Celtic vessels mark a radical technological shift from the building in shell sequence to building in the skeleton sequence, with the planking no longer edge-joined but fastened only to the framing. This may be so in a general way; however, there are certain apparent anomalies that require further discussion. Some of these boats do, in fact, have parts of their side planking edge-fastened (Pommeroeul 5, Zwammerdam 2, 6, and possible 4); this does not necessarily mean that the shell sequence had been used for parts of these vessels, but it is a strong pointer that such a possibility should be further investigated. Furthermore, at least three different methods were used to fasten this planking: overlapping planking, nailed (Zammerdam 2 and 6) with a possible relationship to proto-Viking clinker boatbuilding techniques: and flush-laid planking fastened either by draw-tongue joints (Zammerdam 6) probably related to the Mediterranean tradition or by obliquely driven spikes (Pommeroeul 5 and Zammerdam 6).

Some variation in practices used within a widespread tradition is to be expected, but the implications in this particular case cannot be fully understood until the Romano-Celtic boats now known, and any future finds, are comprehensively published. The re-assessment of Blackfriars 1 (Paper 7) and the preliminary publication of the St Peter Port wreck (Paper 6) are thus significant steps forward. Moreover, they underline the necessity for the full publication of such important boat finds as those from Pommeroeul, Belgium (de Boe & Hubert 1977; de Boe 1978).

Early maritime trade and early boat and ship operations cannot be understood without reference to the contemporary environment. Papers 1 and 2 in this volume demonstrate that there have been significant changes in sea-levels, river channels and coastlines in the past 10,000 years. These changes can be described only in very broad terms, except in rare places, such as the Netherlands, where palaeo-geographic maps have been drawn showing details of former coastlines and rivers at particular periods. For the other countries of the North Sea region there are insufficient high resolution temporal and spatial data on which such maps could be based, especially for the period covered by this volume. Archaeologists working in the maritime zone would thus do well to heed Dr Tooley s plea that they augment the meagre data base by including sea-level and related environmental changes amongst the matters to be investigated in their surveys and excavations.

I wish to thank the following colleagues in the Institute of Archaeology, University of Oxford: Mary Mills for typing the editorial content of this volume and amendments to several of the papers; Alison Wilkins for amendments and additions to some of the drawings; and Harry Edwards for additional photography.

Seán McGrail

References

de Boe, G, 1978 Roman boats from a small river harbour at Pommeroeul, Belgium, in du Plat Taylor, J, & Cleere, H, (eds), *Roman shipping and trade*, CBA Res Rep **24**, 22-30.

——, & Hubert, F, 1977 Une installation portuaire d'époque Romaine à Pommeroeul, *Archaeologia Belgica* **192**, 5-57.

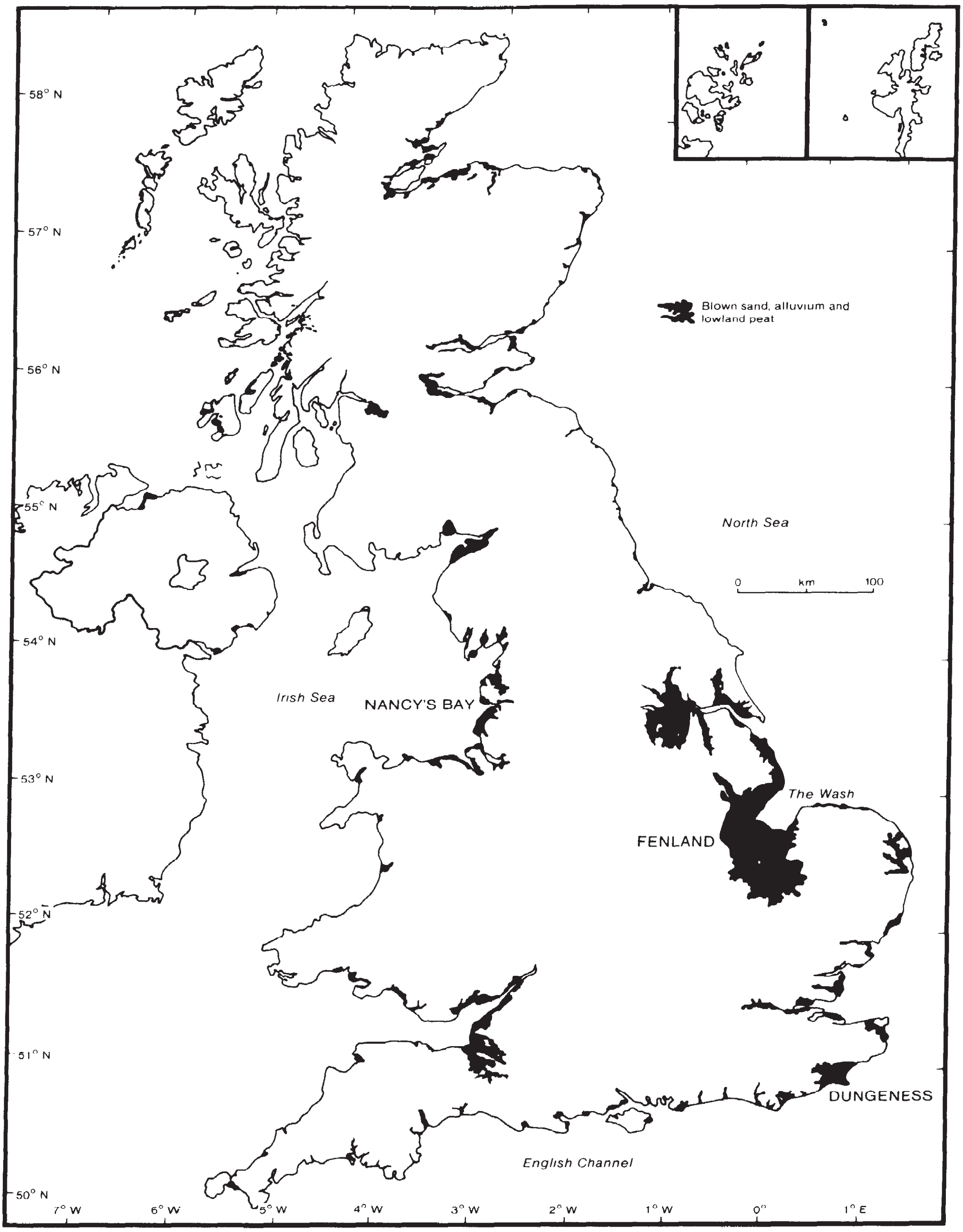


Figure 1.1 Coastal lowlands of the United Kingdom showing distribution of unconsolidated sediments— sand dunes, shingle, marine clays and silts, lowland peat (based on: International Quaternary Map of Europe, Sheet 6, Kobenhavn, 1:2,500,000, Hannover 1970; Quaternary Map of the United Kingdom, north and south,1:625,000, Institute of Geological Sciences; Atlas of Britain and Northern Ireland, p 18, Superficial deposits, 1:2,000,000). (Drawing: Author).

1 Sea-level and coastline changes during the last 5000 years

M J Tooley

Abstract

Sea-level and coastline changes during the last 5000 years are described, and attention is drawn to the lack of data for part of this period and the absence of palaeogeographic maps of the coastal lowlands of the United Kingdom, unlike the Netherlands. Rates of sea-level and land-level changes are presented for the United Kingdom as a context for a consideration of the sedimentary history of havens since the Late Iron Age. Examples are given from the coastal lowlands of the Fenland and Romney Marsh. The persistent nature of some havens during this period in the Fenland is contrasted with their ephemeral nature in Romney Marsh. The nature of sedimentation within the havens is considered in relationship to sea-level and land-level changes and local factors.

Attempts have been made in the past to show coastlines at different times during the Flandrian Age for some of the coastal lowlands of Britain. For example, in the 19th century, de Rance (1877) described the landward limit of grey marine clays in south-west Lancashire. In the Fenland, Godwin and Clifford (1938) drew on the detailed mapping of Skertchly (1877) to show the landward limits of the Fen Clay and Upper Silt. In the Somerset Levels, Kidson (1977) showed coastlines for 9000, 8000, 6000 and 4000 radiocarbon years bp, and in the Romney Marsh area, R D Green (1968) showed a degraded marine cliff as the marine limit at some unspecified period during the Flandrian Age. The Anglo-Saxon shore portrayed by Hill (1981) gives no more than an indication of some of the coastal lowlands: however, the coastal lowlands of Wales and of Scotland and the Teesside and Solway lowlands of England have been omitted. Furthermore, while a line on a small scale map may adequately represent a shoreline, on a large scale map (for example in Hill 1981, figs 19-22), a line for the coast fails to portray the complexity of coastal environments between low water mark and high water mark of spring tides (a space at present 5 km wide in the Ribble estuary of Lancashire and more than 18 km wide in Morecambe Bay). Nor can such a line indicate the nature of the area landward of the high water mark where there are brackish and freshwater flooded environments adjacent to creeks and drainage channels in the coastal lowlands. These environments provide not only food and raw materials, but also the means of communication in a network of channels, lagoons and havens. Figure 1.1 shows the distribution of some of the sand dunes, alluvium and lowland peat areas in Britain. This contains more information than Hill's maps, but even it is no clear guide to the position of coastlines at a particular time, nor does it indicate the nature and extent of the sedimentary environments — marine, brackish, fresh and terrestrial — associated with them.

Something of the extent and subtlety of the coastal zone is conveyed by the palaeogeographic maps of the Netherlands, in which a clear lithostratigraphic distinction is made between the tidal flat and lagoonal palaeoenvironments and the perimarine palaeoenvironment (Hageman 1969). In the former, alternating fresh and brackish water, organic sediments interdigitate dominantly inorganic sediments of marine origin. In the latter, alternating organic and inorganic sediments are of freshwater or terrestrial origin, but their extent and thickness is controlled by changes in sea-level in the tidal flat zone to seaward. The extent of these palaeoenvironments is considerable: the marine influence indirectly affected a coastal belt in the Netherlands up to 100 km wide.

The expansion and contraction of the Netherlands' tidal flat and lagoonal zone and of the area of fen peat at different times (Pens et al 1963) is clearly seen for two successive periods, 2300-2000 years BP (Fig 1.2A) and 1700-1250 BP (Fig 1.2 B). During the latter period, there was a marked expansion of the tidal flats, which allowed ships to pass along the Danish, German and Dutch coasts to the Rhine-Meuse delta, protected by coastal barriers and islands — in fact, a dilated Wadden Sea (Ehlers 1988).

In the United Kingdom, such Flandrian palaeogeographic maps do not yet exist, only maps and graphs of the spatial and temporal distribution of sea-level index points (Fig 1.3). The position of sea-level in the past can be represented on age-altitude graphs by index points, which are dated organic deposits showing marine tendencies during accumulation, and a measured altitude related to Ordnance Datum (OD). A former sea-level position cannot be pin-pointed given the existing methodological errors (Sherman 1982a), and an index point is better equipped with age and altitude errors as shown in Figures 1.5 and 1.7D. A sea-level band can be constructed (Fig 1.7E), following a well-established methodology of sea-level investigations (Tooley 1978a; b; Sherman 1982a; 1983; Sherman et al 1983).

A data base of sea-level index points with attributes of age and altitude errors can originate from stratigraphic investigations in coastal lowlands, such as those by Tooley (1978a) in north-west England, Sherman (1982a; 1986a; b) in the Fenland and Devoy (1979; 1980; 1982) and Jennings and Smyth (1982; 1985; 1987) in southern England. It can be enhanced with

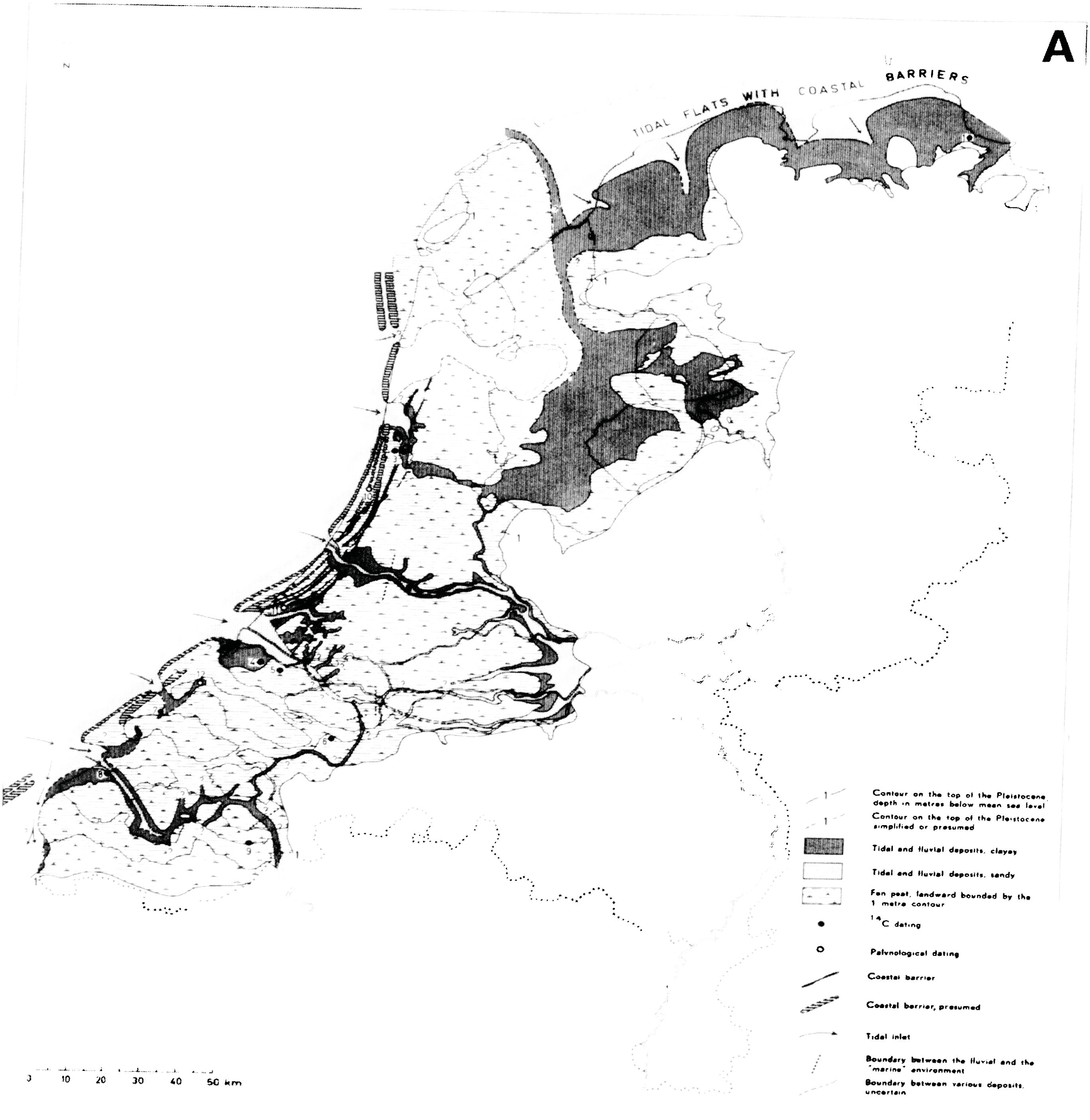
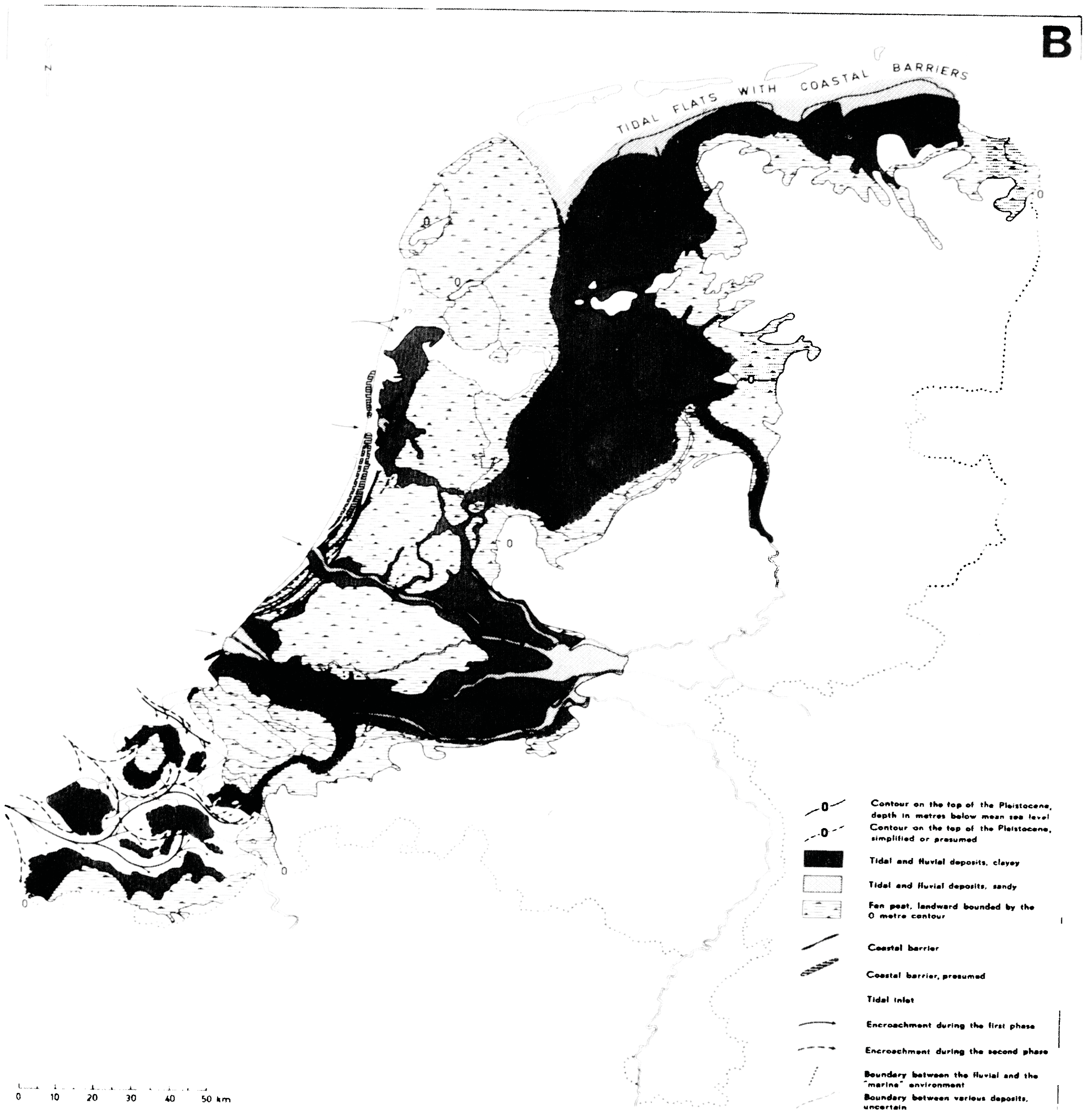


Figure 1.2 Coastline changes and sediment patterns in the Netherlands during the past 2300 years (Pons et al 1963): 2A coastal depositional environments, 2300-2000 BP; 2B coastal depositional environments, 1700-1250 BP. Revised maps for these periods have been described by Jelgersma et al (1979) and by Zagwijn (1986). (Maps: Editor: Koninklÿk nederlandsch geologisch-mijnbouwkundig genootschap).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Coastal barrier
Coastal barrier, presumed
Tidal inlet
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Encroachment during the second phase
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Boundary between various deposits, uncertain
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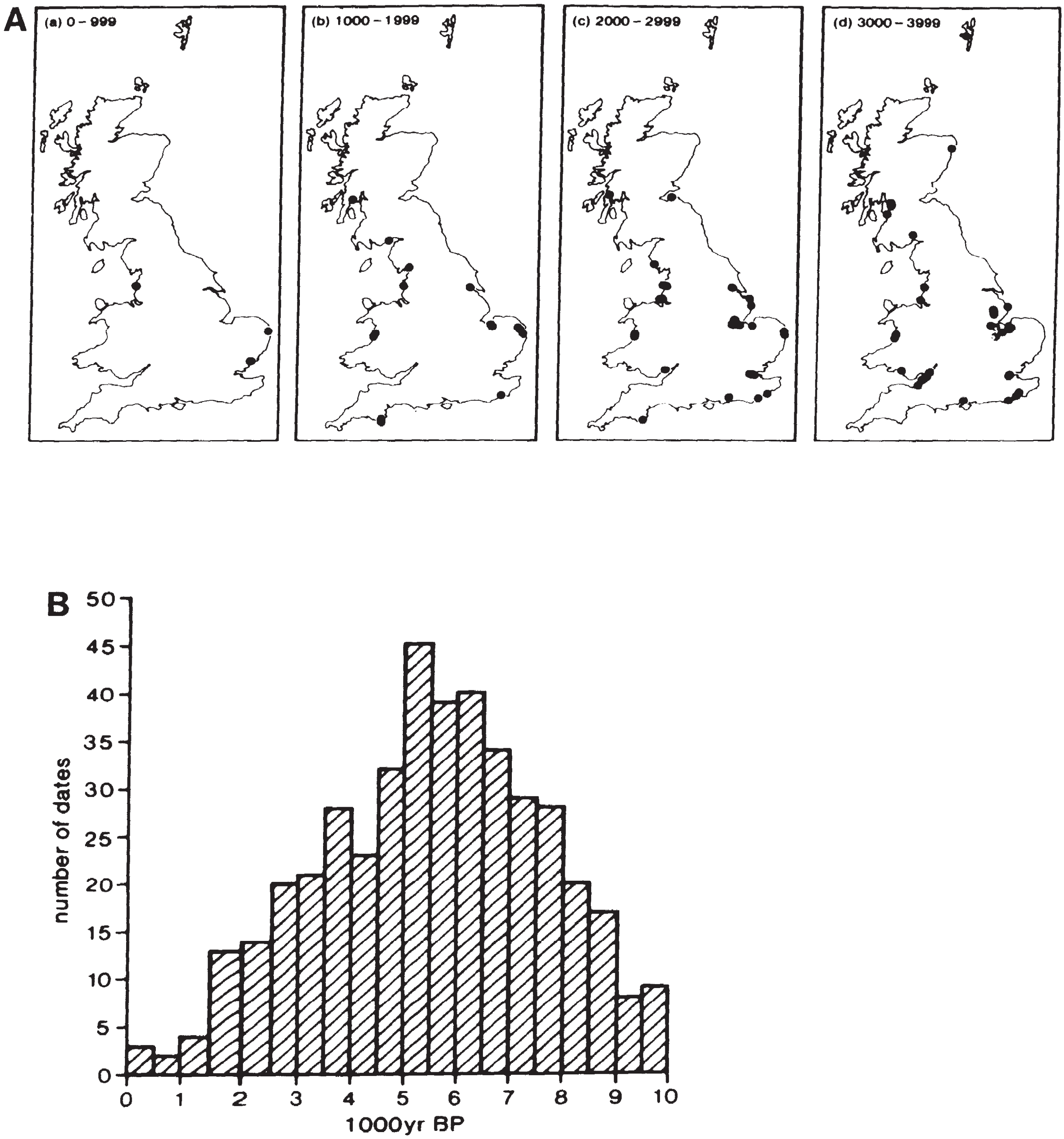

Figure 1.3 Spatial and temporal pattern of sea-level index points in the United Kingdom (Shennan 1989): 3A distribution of sites yielding sea-level index points from the present to 3999 radiocarbon years ago; 3B temporal pattern of Flandrian sea-level dates. (Diagram: Dr I Shennan and Longman Plc).

archaeological data from a coastal context (Flemming 1978-9; Masters & Flemming 1983). In Hampshire, Cunliffe (this volume) has demonstrated the existence of an Iron Age landing place on the south shore of Christchurch Harbour and this can be related to a contemporary sea-level. In Essex, Wilkinson and Murphy (1986) and Wilkinson et al (1988) have described sea-level and coastline changes in relation to the archaeological evidence from the Mesolithic to the Iron Age. De Brisay (1975) has described the saltmaking industry, manifest as the 'Red Hills' of Essex of Iron Age - Romano-British age, in relation to coastal trade and the changing Essex coastline.

The distributions of sea-level index points enhanced by coastal archaeological data are uneven, notwithstanding over 16 years of sea-level projects under the auspices of the International Geological Correlation Programme (IGCP), complementing projects of longer duration sponsored by the International Geographical Union and the International Union for Quaternary Research (Tooley 1987). At the end of IGCP Project 61 (sea-level movements during the last deglacial hemicycle) in 1982, some 782 sea-level data points had been tabulated for the United Kingdom (Tooley 1982a; b). At the end of IGCP Project 200 (Late Quarternary sea-level changes) in 1987, the sea-level data bank had risen to 915 records (Shennan 1989). Whilst there had been an improvement in the spatial distribution (with the exception of north and north-west Scotland, north Wales and much of the south coast), the temporal distribution remained similar. New dates came from the period 3-8000 bp, but the periods 0-3000 bp and 8-10,000 bp continued to have few dates (Fig 1.3B).

The period of particular interest in this volume — 300 BC to AD 800 — possesses very few dated indexed points, and their distribution is very uneven (Fig 1.3A). This makes it difficult to provide concrete facts on the coastlines, the havens, the lower courses of the rivers and the tidal regimes. It is hoped that, as an outcome of the Oxford conference and its proceedings, published in this volume, archaeologists will make a special effort to collect environmental data on sea-levels and coastlines whenever they work in the maritime zone — as, for example, was done during the excavation of the Hasholme logboat (Millett & McGrail 1987). Archaeological, palaeogeographical and historical data from the coastal lowlands for the past 2000 years need to be assembled and integrated to provide high resolution sea-level age-altitude graphs, rates of sea-level change graphs and coastline change maps.

Sea-level and land-level movements in Britain

The changing position of a coastline and the distribution and extent of coastal and near coastal environments are determined largely by sea-level and land-level movements. But, in addition, the supply and movement of sediments, and the wave, tidal and current regime and climate will affect the coastal morphology and the temporal and spatial patterns of accretion and erosion. These patterns will change as relative sea-level changes.

The most recent solution of the pattern of uplift and subsidence in Britain that will affect coastal processes has been calculated by Shennan (1989). It shows (Fig 1.4) current uplift rates of more than 1 mm/yr in north-west Britain compared with subsidence rates of more than -1.5 mm/yr in south-east Britain, based on an analysis of the IGCP sea-level radiocarbon data bank at Durham.

Because of differential land movements, sea-level changes registered by erosional and depositional records will vary spatially. In addition, all sea-level variates plotted on age-altitude graphs are subject to a range of errors, which should be indicated. Hence, a single line on an age-altitude graph is a poor summary of sea-level changes at a site. A more adequate summary is provided by error boxes for each variate, which can be resolved into sea-level bands (eg Shennan 1986a; b; Shennan & Tooley 1987; Tooley 1986). For south-east England Devoy (1982) employed 94 sea-level index points, for each one of which errors in altitude and age were estimated (Fig 1.5); the actual trace of sea-level (however defined) for each site specified will lie within the limits established by the error boxes. Clearly it is not possible, using the present methodology of sea-level investigations, to obtain an age and altitude resolution better than 100 radiocarbon years and 1 metre (Sherman 1982a),

In the absence of high resolution temporal and spatial data, only examples can be given of sea-level and coastal changes during the period 300 BC to AD 800 within the longer time context of the last 5000 years. Two examples will be considered from the coastal lowlands of the Lincolnshire Fen and Dungeness-Romney Marsh.

Tidal inlets in Lincolnshire

The Fenland of East Anglia within the counties of Lincolnshire and Cambridgeshire occupies the largest coastal lowland in Britain. The majority of the ground surface is at or below +5 m OD and, as the result of drainage and reclamation, extensive areas, such as the East Fen of Lincolnshire, lie below the zero altitude datum and, hence, some 4-5 m below the altitude at which the Highest Astronomical Tide intersects the coast. The ground surface of the Fenland is not a plane surface and slight, often imperceptible, changes of altitude bear witness to environmental changes that affected extensive areas, whether of a marine, brackish, freshwater or terrestrial nature. Great estuaries, such as the Welland-Glen estuary north-east of Spalding and the Great Ouse-Nene estuary north of Wisbech, as well as inlets such as Bicker Haven, Boston Haven and Wrangle Haven and the tidal creeks, rivers and tributaries that fed them, were the sites of havens and marked the lines of communication into and through the Fenland (Fig 1.6). They are preserved in the present landscape as distinctive soils, as the sites of saltern mounds and as upstanding meandering 'roddons' of silt and fine sand (Godwin 1938) as the adjacent ground surface declines in altitude from drainage and the consequential consolidation and wastage of peat.

Both Godwin (1938; 1978) and Salway (1970) have remarked on the geographical persistence of the great estuaries and rivers feeding them throughout much of the period covered by the Flandrian Age. Godwin (1978) explains this by the size of the catchment and the volume of discharge maintaining the river courses through the Fenland.

The first marine ingress was via the river channels and Sherman (1982a; 1986a; b) has described the stages of infill of the River Nene channel and shown that the first marine episode occurred some 6415 ± 185 (H-9263) bp at a measured altitude of c -8 m OD. Some four interruptions occurred in marine sedimentation, which ended here at 1845 ± 50 (SRR-1588) bp.

The pattern and nature of sedimentation, including the infill of channels and estuaries, have been described by Godwin and others (Godwin 1940; 1978:

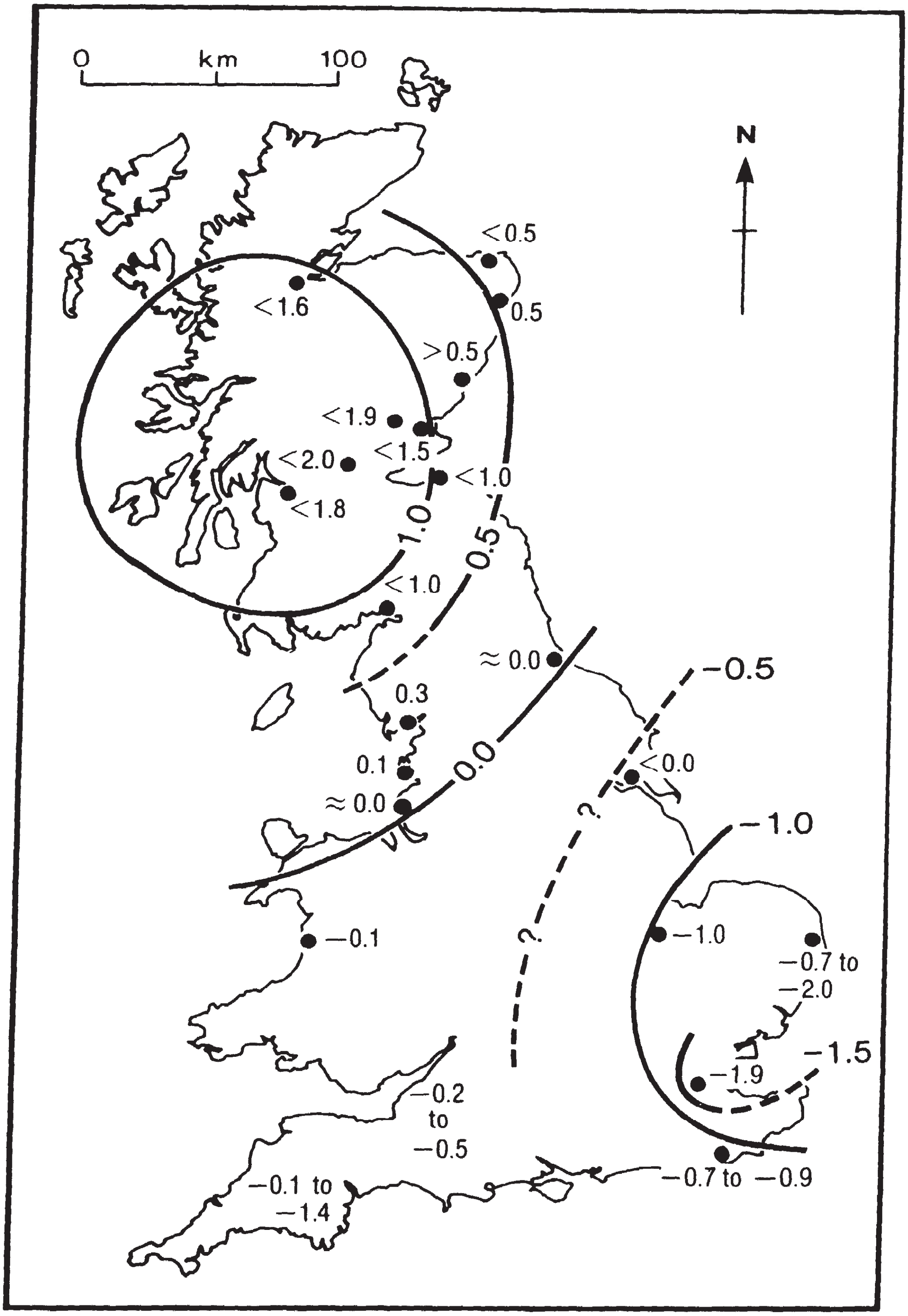

Figure 1.4 Map of Britain, showing estimated current rates of crustal movement, based on analysis of geological evidence (Shennan 1989). Units in mm/.yr. (Map: Dr I Shennan and Longman Plc).

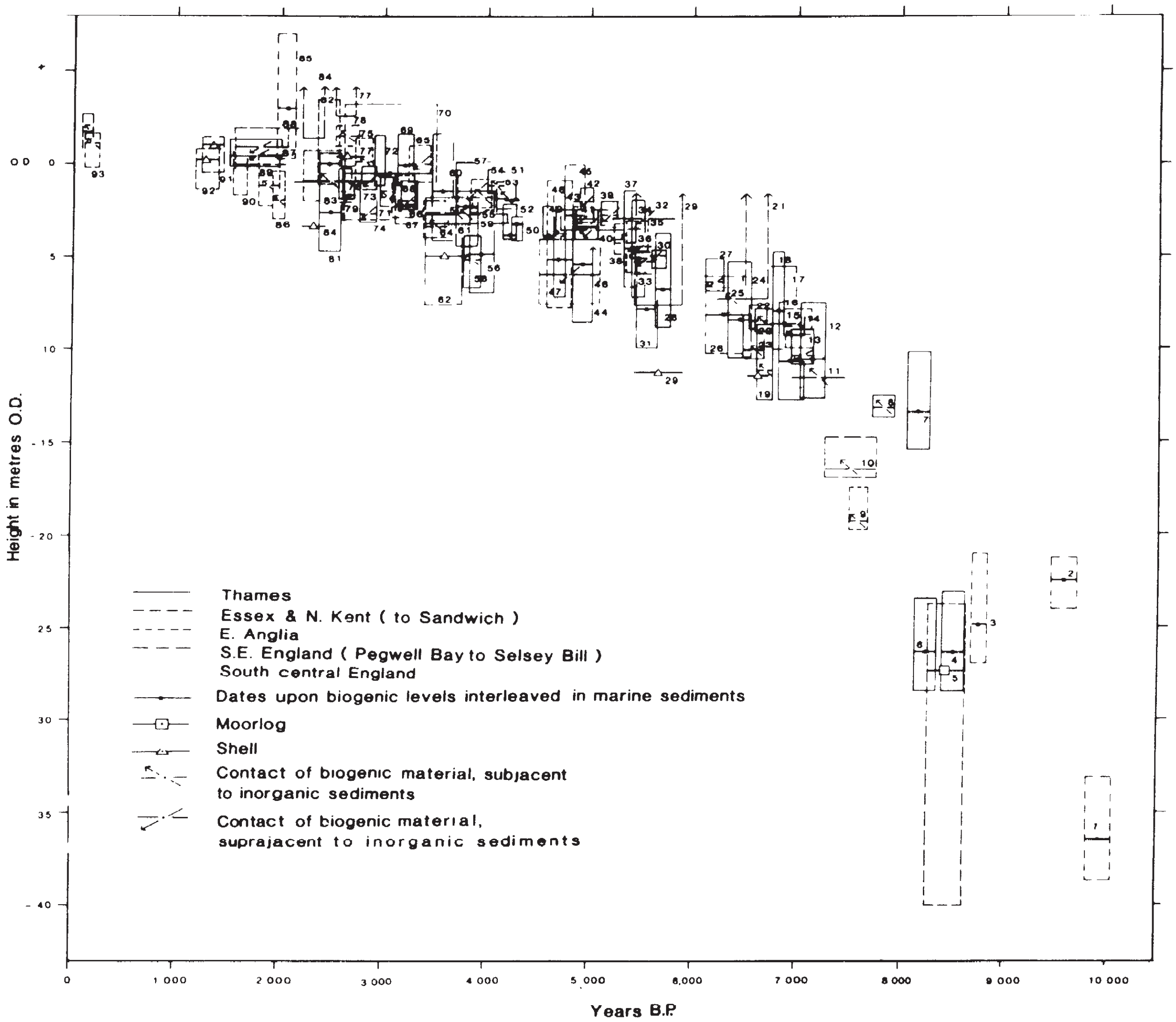

Figure 1.5 Age-altitude graph for south-east Britain, showing 94 sea-level index points with estimated errors for age and altitude (Devoy 1982). (Diagram: Dr R J N Devoy and the Geologists' Association).

Godwin & Clifford 1938; Willis 1961) as a relatively simple succession of Lower Peat, Fen Clay, Upper Peat and Upper Silt. This succession was retained by Gallois (1979) who described four lithostratigraphic subdivisions, roughly equivalent to those described by Godwin, and named the Lower Peat, the Barroway Drove Beds, the Nordelph Peat and the Terrington Reds. These schemes ignore the complexity of the Fenland stratigraphy as demonstrated by Skertchly in 1877 and further elaborated in southern Lincolnshire by Shennan (1980; 1982a; b; 1986a; b). Skertchly (1877,8) summarised the lithostratigraphy of the Fenland in the following way:

> There is no bed of peat constantly underlaid by Buttery Clay [Fen Clay], and, eastwards overlaid by marine silts, but the peat sometimes forms one bed twenty feet thick, and is sometimes largely intercalated with marine silts. There may be one, two, three, or even four peat beds within a few yards of each other, for the whole country was a debatable ground between land and sea, and when the one prevailed peat grew, and when the other had the mastery, silts were deposited.

Skertchly also described the infilling of the ancient estuary of the River Ouse and the interruptions in the succession of laminated sandy silts laid down under tidal conditions recorded along Popham's Eau. He concluded (1877, 145) that:

> ...the silting up of the old Ouse estuary was an intermittent action; that the surface of the estuary was intersected by numerous creeks, and that peat immediately commenced to grow when the salt water left any portion of the surface for a time.

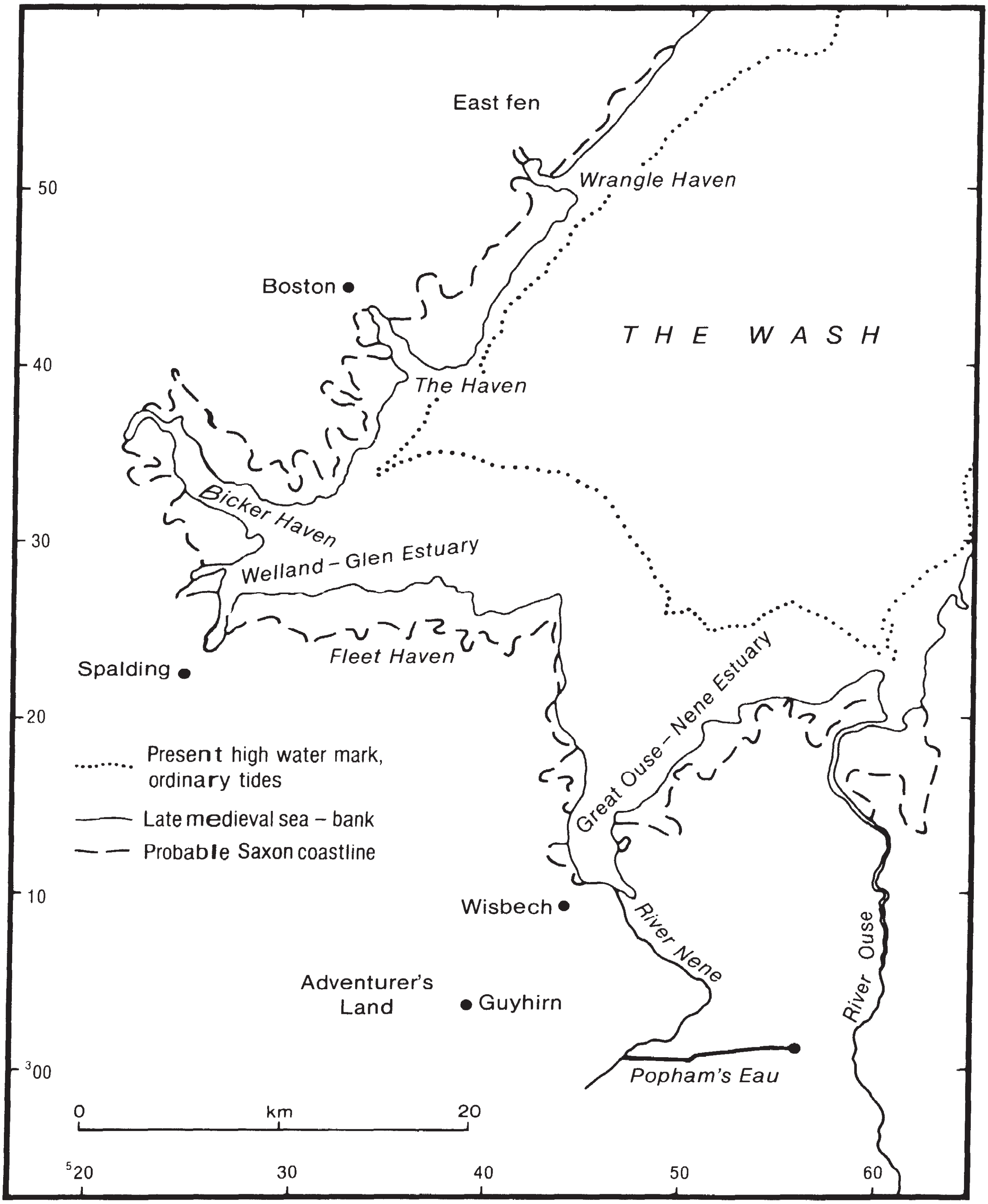

Figure 1.6 Map of Wash Fenlands, showing probable coastlines in Saxon and late medieval times (after Phillips 1970; H E Hallam 1965). (Map: Author).

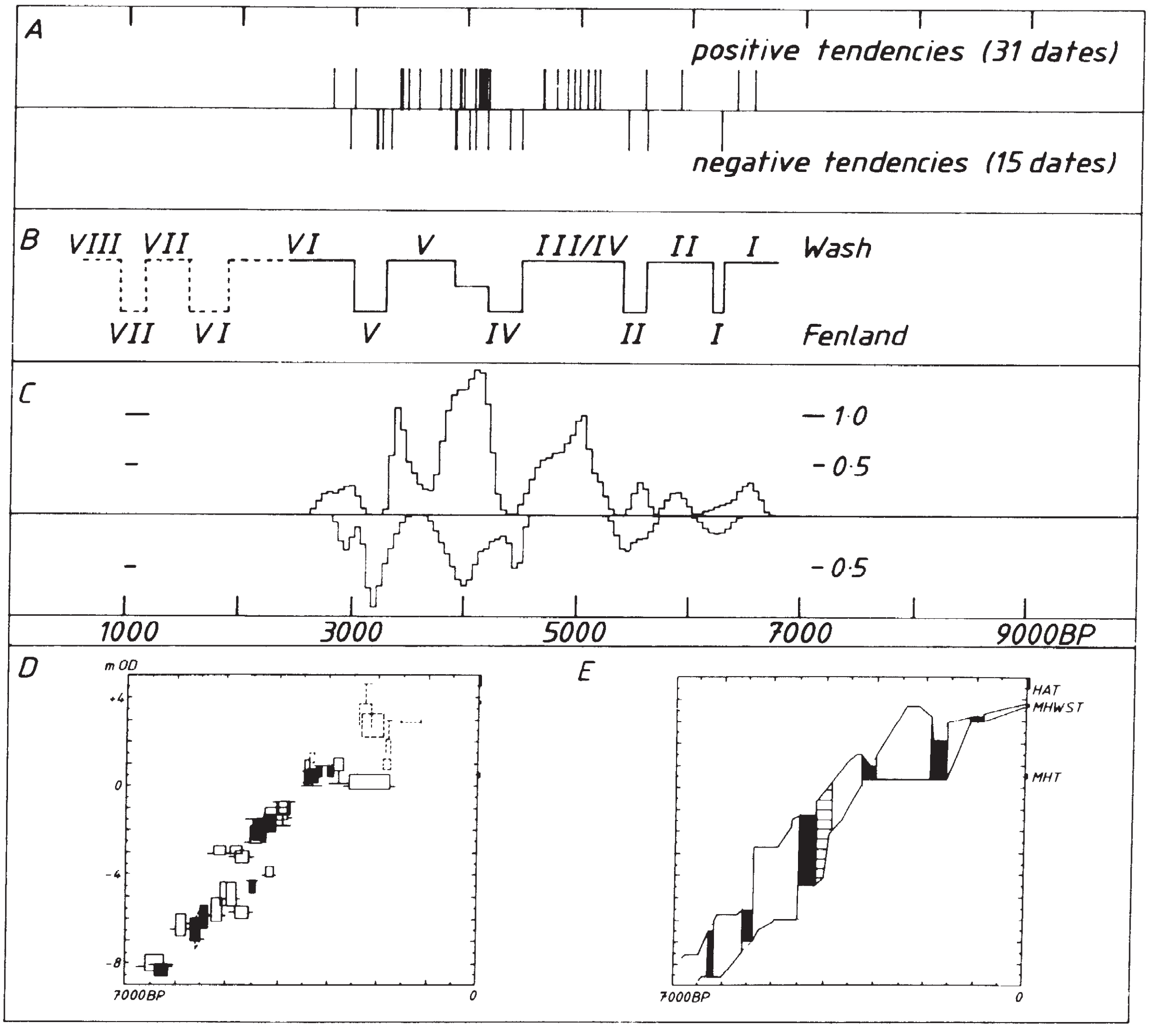

Figure 1.7 Sea-level data from the Fenland (Shennan 1982a) : A temporal distribution of 46 radiocarbon dates, showing positive and negative sea-level tendencies; B Wash/Fenland chronology, tentative after Wash VI and shown as a dashed line; C frequency histograms of radiocarbon dates given in 1.7A; D estimates of past levels of MHWST. Shaded error boxes represent negative tendencies. Dashed line boxes represent archaeological and morphological sea-level indicators; E possible sea-level band for the Fenland. (Drawing: Dr I Shennan and the Geologists' Association).

Furthermore, Skertchly drew attention to the variability of the environment, and the continual changes between freshwater and marine conditions both within areas and between areas of the Fenland, and these would have affected the opportunities for settlement and navigation.

Shennan (1982a; 1986 a; b) has also drawn attention to the variability of sedimentation within the Fenland and, employing stratigraphic, micro-palaeontological and radiometric techniques, has proposed a scheme of tendencies of sea-level movement and sea-level changes (Fig 1.7). The Wash stages are represented by marine sediments and record positive tendencies of sea-level movement; the Fenland stages are represented by freshwater or terrestrial deposits and record negative tendencies of sea-level movement. The chronology after Wash VI remains tentative; Fenland VI occurred c AD 50-c 400; Wash VII, c 400-c 800; Fenland VII, c 800-c 1000; and Wash VIII began c 1000. The tentative nature of these tendencies is due to the destruction of evidence by reclamation and agriculture, the construction of sea embankments and drainage canals and the difficulty of interpreting fragmentary sedimentary evidence in terms of sea-level changes and changes in water quality.

Evidence from archaeology and historical geography may also be employed to establish coastline changes and sea-level tendencies, and it is fortunate that, for the Fenlands, the evidence has been marshalled by Darby (1940a; b), Phillips (1970) and H E Hallam (1965), as it has for parts of the Netherlands by Louwe Kooijmans (1974; 1980). Figure 1.6, based on maps in Phillips (1970) and Hallam (1965), shows the probable Saxon coastline and the late medieval sea bank. Although the Iron Age and Romano-British coastlines around the Wash can only be approximated (Simmons 1977; 1980), S J Hallam (1970) has described the spreads

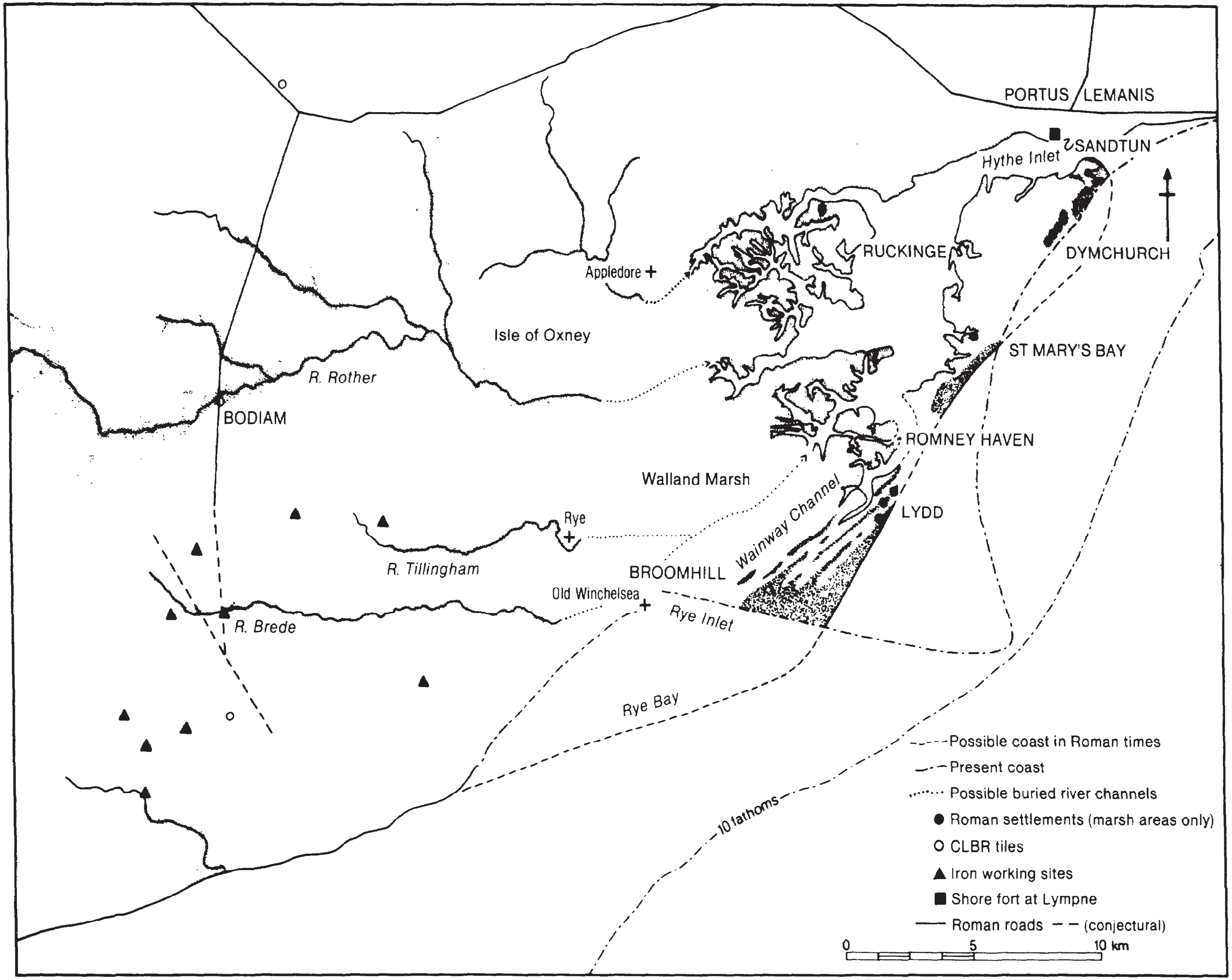

Figure 1.8 Map of Romney Marsh in the Roman period (Cunliffe 1988), with additional place names to show position of the three havens and sites mentioned in text. (Map: Professor B W Cunliffe and OUCA).

of Roman material at the heads of inlets or havens, such as Bicker Haven, and concluded that the Roman shore, like the Saxon shore, must have been highly indented, with settlements on levees adjacent to tidal creeks.

Settlement potentialities could have been enhanced both by drainage works and by saltmaking, as Skertchly (1877) described for Bicker Haven where, probably from Roman times until c AD 1600 (Healey 1975), salterns within the embankments of the haven added materially to ground altitudes, making reclamation possible. The 21.36 km^2 of the former Haven contains a distinctive soil developed on a sandy facies of the silt. In the Lincolnshire Marshes north of the Wash, Rudkin (1975) has described the extent of the spoil from saltmaking: hills composed of silt rise 4.6-6.1 m high and occupy up to 1.2 ha each. For this area between Humberston and Saltfleet, Pattison and Williamson (1986) have calculated that the saltern mounds cover 8.5 km^2 and contain c 23,000,000 m^3 of waste silt. Hence, the activities of man in the Fenland must be considered together with natural coastal sedimentation processes to explain the infilling of estuaries, havens and creeks from the Neolithic onwards.

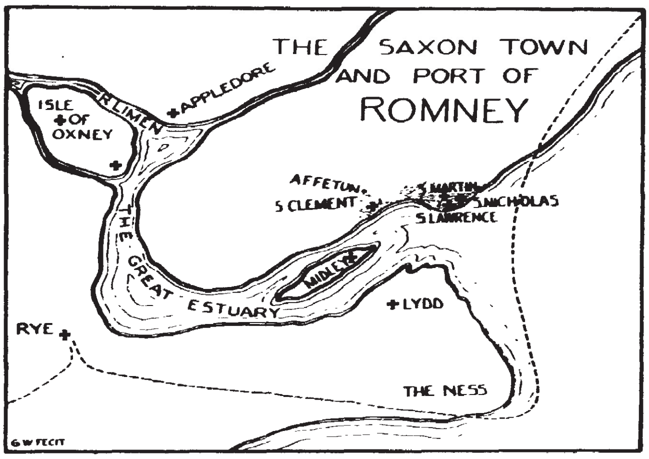

Figure 1.9 Map of Saxon Romney showing the haven between Lydd and Romney, and eyot of Midley in the Great Estuary (Ward 1952). (Map: Editor, Archaeologia Cantiana).

Tidal inlets in Kent

The proximity of south-east England to continental Europe bestowed particular advantages for trade to and from the estuaries and inlets of Essex, Kent and Sussex from the late prehistoric period (or earlier) until the present day. There are, for example, Roman harbour works and coastal forts at Reculver, Richborough, Sandwich and Lympne in Kent, and at Chichester and Pevensey in Sussex.

The importance of the Wantsum Channel, separating the Isle of Thanet from the rest of Kent during this and subsequent periods up to the 11th century, has been stressed by Hill (1981), who places it within a European context: 'the Wantsun Channel would appear to have been an important part of the sheltered waterway system that ran from Ribe in Denmark to Quentovic in northern Gaul, and from the Alps to the Thames' (Hill 1981, 14). In the Dungeness-Romney Marsh area, the record of geomorphological changes has been summarised by Eddison (1883), and the evolution has been considered in relationship to prehistoric and historic settlement by Cunliffe (1980). A considerable range of new data has been drawn together to illustrate aspects of the evolution, occupation and reclamation of Romney Marsh during the past 10,000 years and, particularly, during the past 5000 years (Eddison & Green 1988).

Attention will be directed here to the 27,000 ha of shingle, dunes and reclaimed marshland known as Romney Marsh and described by R H Barham in the Ingoldsby Legends as the 'fifth quarter of the globe'.

The viability of harbours on the coast and navigation along waterways across the marshes to the river valleys of the Rother and Brede that gave access to the resources of the Weald, depended on the volume of sediment from the rivers and from the English Channel and the rate of longshore drift (Fig 1.8). The incidence of storms and storm surges would affect not only the rate at which sediment was moved, but also the stability of tidal inlets. The opening and closing of tidal inlets would also affect water levels and the tidal range in Walland Marsh and Romney Marsh. Subsequently, engineering works, such as the embankments and sluices (including the Rhee Wall from Romney Haven towards Appledore), would have had a profound effect on discharges of water from the marshes and the scouring of navigational channels and havens.

All these factors must be set against long term processes, such as subsidence in southern Britain and sea-level changes. In south-east England, Shennan (1989) has calculated a subsidence rate of -0.85 mm/yr for the past 9000 years. At a higher level of resolution and, at the site scale, Tooley and Switsur (1988) have provisionally identified for the Romney Marsh area six periods of positive and six periods of negative tendencies of sea-level movement. Positive tendencies are associated with a dilation of marine sediments, alluviation and waterlogging, whereas negative tendencies are associated with channel scouring and erosion, coastline advance and drying of soils and peatlands. The relationship of these tendencies to the three inlets that are known to have served as havens at different times in the period since the late Iron Age has not been established but it is known that the most recent positive tendency of sea-level movement from 1830 ± 80 (SRR-2893) to 1550 ± 120 (NPL-25) bp on Romney Marsh coincides with the occupation of the Roman fort at Lympne.

C Green (1988) has summarised the record of these three successive marine inlets from the Romano-British period onwards. The first inlet at Hythe extended west as far as Port Lympne and became the Roman port of Portus Lemanis (Fig 1.8). Cunliffe (1980) has described the sheltered nature of the anchorage, protected by a sand dune immediately to the east, and by coastal shingle to the south-east enclosing an extensive lagoon, later to be infilled with clays and often fine sandy laminae, and reclaimed as Romney Marsh. Cunliffe (1980) has also speculated that bulk commodities, transported by river barges along tidal creeks and river channels from as far upstream on the River Rother as Bodiam, could be transshipped at Portus Lemanis to sea-going vessels. The nature of these creeks and channels on the marsh is conjectural, although Waller et al (1988) and Burrin (1988) have elucidated the age and nature of the infill of the valleys above the point where they debouch onto the marsh. It has been posited (for

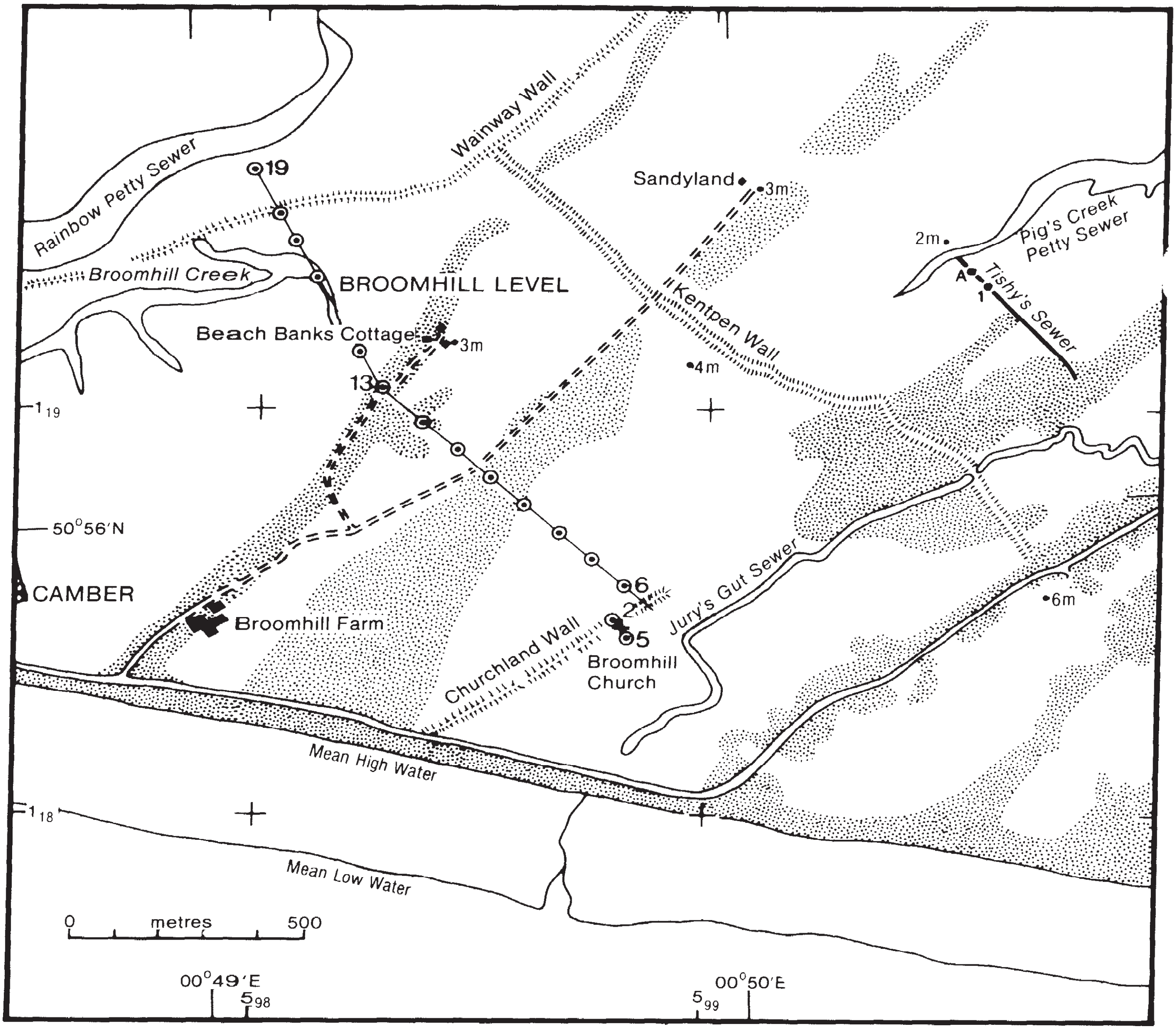

Figure 1.10 Map of Broomhill Level showing location of boreholes across level from site of Broomhill church to site of Wainway Channel, formerly the Great Estuary of the River Rother, now drained by Broomhill Creek and Rainbow Petty Sewer. Stipple indicates flint shingle at surface and subsurface, according to R D Green (1968). Borehole 18 lies at foot of Wainway Wall. (Drawing: Author).

example by R D Green 1968) that the River Rother flowed east at one stage in the evolution of Romney Marsh, north of the Isle of Oxney, past Appledore and into the Hythe Inlet, which it would have scoured. There is no field evidence for this during the Late Iron Age and Roman period, but it is worth noting, however, that earlier the valley of the Horsemarsh Sewer, east of Appledore, was a tidal inlet from 5500 ± 70 bp (Q 2647) until 5150 ± 70 bp (Q 2648) (Tooley & Switsur 1988), when the high water mark of spring tides was at c -3 m OD. The sea does not appear to have reached the mouth of this valley again until probably the beginning of the 3rd millennium BP at a recorded altitude close to OD, and may have remained there, connecting the tidal inlet at Hythe, until the abandonment of the fort at Lympne in the middle of the 4th century AD. At this time, the haven may have become choked by sediment or partially closed off by longshore drift of shingle or by the migration of the Rother estuary further south to Romney, or by a combination of all three. However, in a charter of AD 732, the site of the Roman port is identified as 'Huda's fleet' or tidal creek (Brooks 1988) and a grant of land for a saltern clearly indicates continuing marine conditions, although navigation from the east may not have been possible.

The second marine inlet, at Romney, may have been in existence by AD 741 and certainly existed by AD 920 (Brooks 1988). A possible estuary of the River

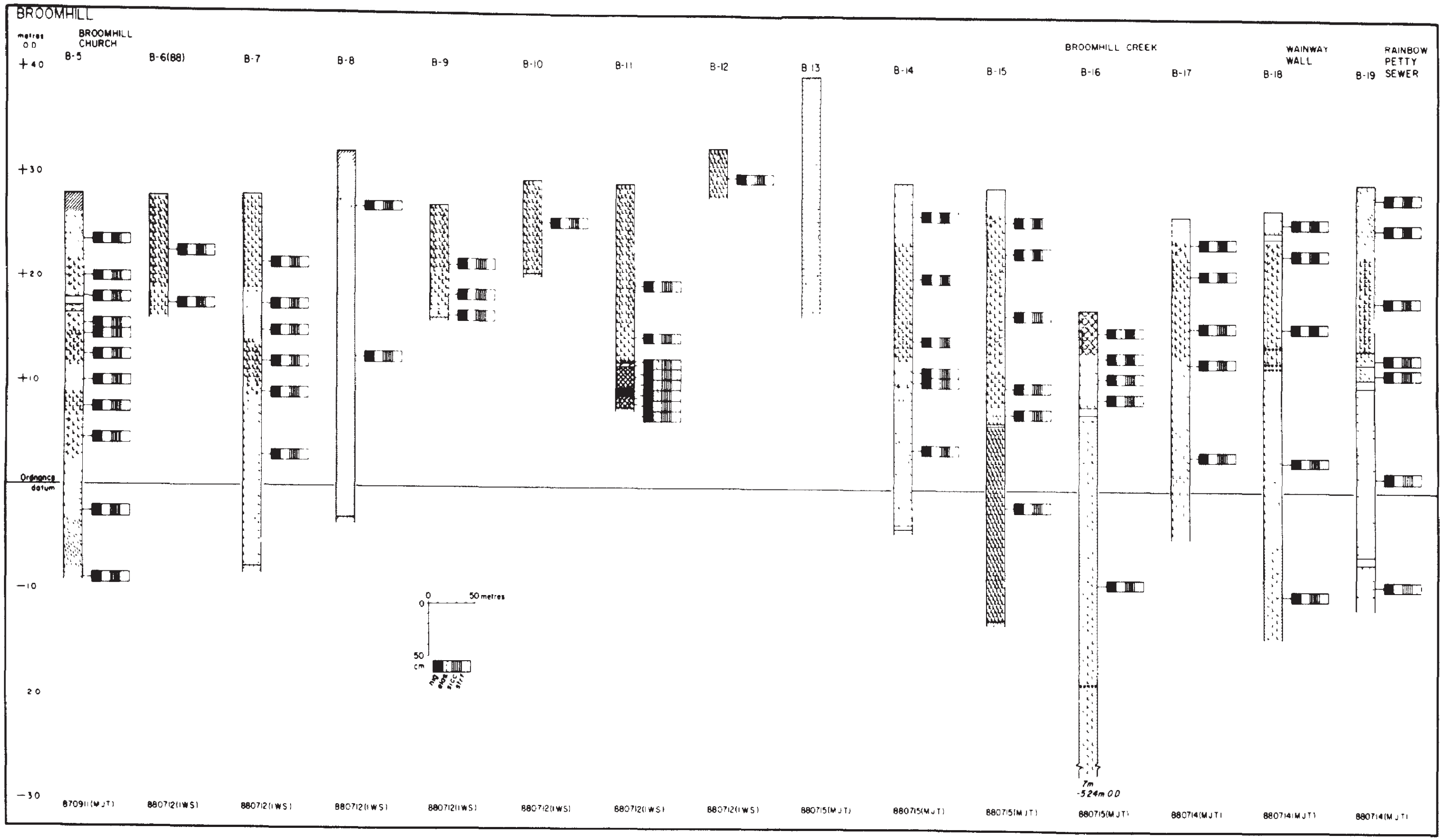

Figure 1.11 Stratigraphy at 100m intervals from Broomhill church to Rainbow Petty Sewer. Signatures and physical properties given according to scheme of Troels-Smith (1955). Drawing: Author).

Rother and the haven of Romney are shown on a map of Saxon Romney by Ward (1953), and reproduced here as Figure 1.9). This map shows two arms of the Rother (River Limen) uniting south-east of the Isle of Oxney and flowing first south, then east and north-east as a 'Great Estuary', before discharging into the sea between Lydd and Romney. Islands or eyots in the estuary included Midley (Tatton-Brown 1988; Fig 1.9). It has been posited that the River Rother impinged on the landward margin of the shingle north of Dungeness at a point where shingle was being eroded on the seaward side, resulting in a breach and creating a haven, for the scouring effect of the river would have been considerably enhanced from the shortening of its course. Spurn Point near the Humber and Aldeburgh in Suffolk provide contemporary analogies.

During the centuries succeeding AD 920, distributaries of the 'Great Estuary' of the River Rother silted up and, by the 11th century, it seems possible that the distributary east of Scotney and Midley was no longer navigable. R D Green's (1968) Creek Ridge number 1 may have been abandoned; the line of Creek Ridge number 2 was occupied by the river. By the early 12th century the River Rother had abandoned this course (Tatton-Brown 1988) and, probably by a similar process of impingement on the landward side of the shingle barrier and erosion on the seaward side, the river broke through in the Old Winchelsea area, incised a channel and created the third inlet and haven at Rye, which is maintained to the present day.

The fate of the 'Great Estuary' can be traced in both documentary and stratigraphic records. It continued to silt up, receiving water from Romney Haven in the north and Rye Haven in the south. Renamed the Water of Chene and, later, the Wainway Channel, the depth of water allowed lighters to transport goods towards Lydd as late as the 16th century (Gardiner 1988). At the northern end, the Haven of Romney was sustained by water discharged along a 7 mile long artificial channel known as the Rhee Wall, completed and in use from AD 1258 (Tatton-Brown 1988), with each of its three sections having a different history and function (Vollans 1988). Until the early years of the 15th century, the Rhee served the function of a ship canal linking Romney to Appledore, which also had access to the sea via the Appledore Water and the Rother estuary (Eddison 1988), passing Rye and entering Rye Bay — the third marine inlet. The post-16th century history of Romney Haven, contracted to Romney Hoy, has been traced by Eddison (1983).

A series of borings across part of the Wainway Channel (Fig 1.10, B-13, -19) shows the nature of the infill of the Great Estuary (Tooley 1989a). Clays, silts and fine sands are occasionally interrupted by layers of shells: Scrobicularia, Cardium and Hydrobia in B-16 and Scrobicularia in B-18. Some layers are coarsely laminated, bearing witness to a tidal flat type of sedimentation. On the south-east shore of the Great Estuary (Fig 1.9; Fig 1.11, B-14, -15) fine grain clastic sediments overlap coarse flint shingle that accumulated before 3410 ± 60 bp (Q-2651), a date on basal peat immediately above flinty shingle at Tishy's Sewer, Broomhill (Tooley & Switsur 1988). Gradients on the slope of the buried shingle between B-14 and B-15 are imperceptible, but there is an increase in gradient to more than 1:4 between B-15 and B-16, which may be close here to the axis of the Great Estuary. The maximum depth at which marine sediments were proved was -5.2 m OD.

The three inlets in the Romney Marsh area could also have been used as havens, one after the other, during the period from Roman times to the Middle Ages. The rapid rates of fine grained sedimentation in the tidal inlets and estuaries opens up the possibility that here is one of the greatest concentrations of buried harbour works and boats from the Roman period to the late Middle Ages. Clearly, it is important to undertake reconnaissance, archaeological and stratigraphic surveys in the area of Portus Lemanis and Huda's Fleet and in the area of Romney Haven and the 'Great Estuary' feeding it.

Conclusion

This comparison of two areas with havens during the period 300 BC - AD 800 has revealed contrasts: havens persisted in the Penland (indeed, they persisted for several thousands of years before the opening of this period) whereas in Kent and East Sussex they did not. Clearly these differences require corroboration and explanation.

There is a great need to link sea-level change data from tide gauges which cover, at best, the past 300 years, with the natural record of sea-level changes, which is well provided with chronological data for the period before 2500 bp. For the intervening period from c AD 1700 to c 500 BC (which includes the period covered by this volume) there is relatively little sea-level change data. Excavators working in the coastal lowlands should endeavour to investigate water-level and sea-level changes and thereby augment the meagre data base. The potential for such excavations on land sites in the coastal lowlands of Britain covering the past 2500 years is considerable. The havens of the Fenland and the three inlets on Romney Marsh at Hythe, Romney and Rye have been described, and each haven is an archive of sea-level changes and probably a graveyard of shipping.

Acknowledgements

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References

Brooks, N, 1988 Romney Marsh in the early Middle Ages, in Eddison & Green, (eds), 1988, 90-104.

Burrin, P J, 1988 The Holocene floodplain and alluvial deposits of the Rother valley and their bearing on the evolution of Romney Marsh, in Eddison & Green, (eds), 1988, 30-52.

Cunliffe, B W, 1980 The evolution of Romney Marsh: a preliminary statement, in Thompson, F H, (ed), *Archaeology and coastal change*, Soc Antiq London Occas Pap **ns 1**, 37-55.

——, 1988 Romney Marsh in the Roman period, in Eddison & Green, (eds), 1988, 83-7.

Darby, H C, 1940a *The drainage of the Fens*.

——, 1940b *The medieval Fenland*.

de Brisay, K, 1975 The Red Hills of Essex, in de Brisay, K, & Evans, K A, (eds), *Salt, the study of an ancient industry*, 5-10.

de Rance, C E, 1877 *The superficial geology of the country adjoining the coasts of south-west Lancashire* Memoirs Geol Survey England Wales.

Devoy, R J N, 1979 Flandrian sea level changes and vegetational history of the lower Thames estuary, *Phil Trans Roy Soc London* B **285**, 355-407.

——, 1980 Post-glacial environmental change and man in the Thames estuary: a synopsis, in Thompson, F H, (ed), *Archaeology and coastal change*, Soc Antiq London Occas Pap **ns 1**, 134-48.

——, 1982 Analysis of the geological evidence for Holocene sea-level movements in south-east England, in Greensmith, J T, & Tooley, M J, (eds), IGCP Project 61: sea-level movements during the last deglacial hemicycle (about 15,000 years), *Proc Geol Assoc* **93(1)**, 65-90.

Eddison, J, 1983 The evolution of the barrier beaches between Fairlight and Hythe, *Geog J* **149(1)**, 39-53.

——, 1988 'Drowned lands': changes in the course of the Rother and its estuary and associated drainage problems, 1635-1737, in Eddison & Green, (eds), 1988, 141-61.

——, & Green, C, (eds), 1988 *Romney Marsh: evolution, occupation, reclamation*, Oxford Univ Comm Archaeol Monog **24**.

Ehlers, J, 1988 *The morphdynamics of the Wadden Sea*.

Flemming, N C, 1979-80 Archaeological indicators of sea level, *Oceanis* **5**, 149-65.

Gallois, R W, 1979 Geological investigations for the Wash water storage scheme, *Rep Inst Geol Sci* **78/19**.

Gardiner M, 1988 Medieval settlement and society in the Broomhill area and excavations at Broomhill church, in Eddison & Green, (eds), 1988, 112-27.

Godwin, H, 1938 The origin of roddons, *Geog J* **91**, 241-50.

——, 1940 Studies in the post-glacial history of British vegetation. III Fenland pollen diagrams. IV Post-glacial changes of relative land- and sea-level in the English Fenland, *Phil Trans Roy Soc* **B 230 (570)**, 239-303.

——, 1978 *Fenland: its ancient past and uncertain future*.

——, & Clifford, M H, 1938 Studies in the post-glacial history of British vegetation. I Origin and stratigraphy of Fenland deposits in Southern Fenland, *Phil Trans Roy Soc* **B 229 (562)**, 323-406.

Green, C, 1988 Palaeogeography of marine inlets in the Romney Marsh area, in Eddison & Green, (eds), 1988, 167-74.

Green, R D, 1968 *Soils of Romney Marsh*, Soil Survey of Great Britain England Wales, Bull **4**.

Hageman, B P, 1969 Development of the western part of the Netherlands during the Holocene, *Geologie en Mijnbouw* **48(4)**, 373-88.

Hallam, H E, 1965 *Settlement and society: a study of the early agrarian history of South Lincolnshire*.

Hallam, S J, 1970 Settlement around the Wash, in Phillips, C W, (ed), 1970, 22-113.

Healey, R H, 1975 A medieval salt-making site in Bicker Haven, Lincolnshire, in de Brisay, K, & Evans, K A, (eds) 1975.

Hill, D, 1981 *An atlas of Anglo-Saxon England*.

Jelgersma, S, Oele, E, & Wiggers, A J, 1979 Depositional history and coastal development in the Netherlands and the adjacent North Sea since the Eemian, in Oele, E, Schuttenhelm, R T E, & Wiggers, A J, (eds), *The Quaternary history of the North Sea*, Acta Universitatis Uppsaliensis Symposia Universitatis Uppsaliensis Annum Quingentesimum Celebrantis **2**, 115-42.

Jennings, S,. & Smyth, C, 1982 A preliminary interpretation of coastal deposits from East Sussex, *Quat News* **37**, 12-19.

——, & ——, 1985 The origin and development of Langney Point: a study of Flandrian coastal and sea-level change, *Quat News* **45**, 12-22

——, & ——, 1987 Coastal sedimentation in East Sussex during the Holocene, in Carter, R W G, & Devoy, R J N, (eds), The hydrodynamic and sedimentary consequences of sea-level change, *Progress in Oceanography* **18(1-4)**, 205-41.

Kidson, C, 1977 The coast of south-west England, in Kidson, C, & Tooley, M J, (eds), *The Quaternary history of the Irish Sea*, Geol J Spec Issue **7**, 257-98.

Louwe Kooijmans, L P, 1974 *The Rhine/Meuse delta: four studies on its prehistoric occupation and Holocene geology*.

——, 1980 Archaeology and coastal change in the Netherlands, in Thompson, F H, (ed), *Archaeology and coastal change*, Soc Antiq London Occas Pap **ns 1**, 106-33.

Masters, P M, & Flemming, N C, (eds), 1983 *Quaternary coastlines and marine archaeology*.

Millett, M, & McGrail, S, 1987 The archaeology of the Hasholme Logboat, *Archaeol J* **144**, 69-155.

Mörner, N-A, 1987 Models of global sea-level changes, in Tooley & Shennan, (eds), 1987, 332-55.

Pattison, J, & Williamson, I T, 1986 The saltern mounds of north-east Lincolnshire, *Proc Yorkshire Geol Soc* **46(1)**, 77-9.

Phillips, C W, (ed), 1960 *The Fenland in Roman times*, Roy Geog Soc Res Ser **5**.

Pons, L J, Jelgersma, S, Wiggers, A J, & de Jong, J D, 1963 Evolution of the Netherlands coastal area during the Holocene, *Verhandelingen van het Koninklyk Nederlandsch Geologisch-mijnbouwkundig Genootschap* **21(2)**, 197-208.

Rudkin, E H, 1975 Medieval salt making in Lincolnshire, in de Brisay, K, & Evans, K A, (eds), 1975, 37-40.

Salway, P, 1970 The Roman Fenland, in Phillips, (ed), 1970, 1-21.

Shennan, I, 1980 *Flandrian sea-level changes in the Fenland*, unpubl PhD thesis, Univ Durham.

——, 1982a Interpretation of Flandrian sea-level data from the Fenland, England, *Proc Geol Assoc* **93**, 53-63.

——, 1982b Problems of correlating Flandrian sea-level changes and climate, in Harding, A F, (ed), *Climatic change in later prehistory*, 52-67.

——, 1983 Flandrian and late Devensian sea-level changes and crustal movements in England and Wales, in Smith, D E, & Dawson, A G, (eds), *Shorelines and isostasy*, Inst Brit Geog Spec Publ **16**, 255-83.

——, 1986a Flandrian sea-level changes in the Fenland I: the geographical setting and evidence of relative sea-level changes, *J Quat Sci* **1(2)**, 119-53.

——, 1986b Flandrian sea-level changes in the Fenland II: tendencies of sea-level movement, altitudinal changes, and local and regional factors, *J Quat Sci* **1(2)**, 155-79.

——, 1987 Holocene sea-level changes in the North Sea region, in Tooley & Shennan, (eds), 1987, 109-51.

——, 1989 Holocene crustal movements and sea-level changes in Great Britain, *J Quat Sci* **4(1)**, 77-89.

——, & Tooley, M J, 1987 Conspectus of fundamental and strategic research on sea-level changes, in Tooley & Shennan, (eds), 1987, 371-90.

——, ——, Davis, M J, & Haggart, B A, 1983 Analysis and interpretation of Holocene sea-level data, *Nature* **302 (5907)**, 404-6.

Simmons, B B, 1977 Ancient coastlines around the Wash, *South Lincolnshire Archaeol* **1**, 6-9.

——, 1980 Iron Age and Roman coasts around the Wash, in Thompson, F H, (ed), *Archaeology and coastal change*, Soc Antiq London Occas Pap **ns 1**, 56-73.

Skertchly, S B J, 1877 *The geology of the Fenland*, Memoirs Geol Survey England Wales.

Tatton-Brown, T, 1988 The topography of the Walland Marsh area between the eleventh and thirteenth centuries, in Eddison & Green, (eds), 1988, 105-11.

Tooley, M J, 1978a *Sea-level changes.*

——, 1978b Interpretation of Holocene sea-level changes, *Geolgiska Föreningens i Stockholm Förhandlingar* **100**, 203-12.

——, 1982a Sea-level changes in northern England, *Proc Geol Assoc* **93(1)**, 43-51.

2 Controls on coastal and sea-level changes and the application of archaeological-historical records to understanding recent patterns of sea-level movement

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Abstract

The paper provides an analysis of the environmental factors controlling the positions of the coastal zone over both long to short term timescales and, in particular, examines the nature of the interaction between changes in coastal position and water-level, or relative sea-level movement. Over approximately the last 2000 years relative sea-level is seen as having risen in height in many parts of north-west Europe by between 0.5-1.00 m to present day levels, with annual rates of rise today of 1-3 mm. Elsewhere, in areas formerly affected by ice loading, land uplift has led to patterns of relative sea-level fall. Interruptions to these trends, represented at the coast in the form of changes in coastal shape and its direction of movement, are seen as a result of the interaction of, for example, variations in climate, continental ice load/volume and melting, geoid shape, earth crustal mobility, land-ocean sediment budgets and human intervention. Ocean-atmosphere interaction forms an important element in controlling coastal position through time, particularly at short term timescales. 'Greenhouse' warming, storms and related climate impacts on the coast are discussed in this context. Conclusions are drawn about the contribution of archaeology as both a provider and consumer to sea-level-coastal data and of the subject's potential in helping the understanding of the broader controls upon coastline development.

The coastline, the zone of meeting between land and sea, is by definition a dynamic environment subject to major changes in form in both space and time. Yet, human societies have traditionally and world-wide chosen to be intimately linked with this zone, with some 25% of the world's population today living within ± 1.00 m of mean sea-level (Devoy 1987; Carter 1988). As the Celts, Frisians and Saxons, and other groups that have inhabited the shores of the shallow shelf sea areas of north-west Europe showed, the maritime environment has been of enormous importance to people historically in terms of communications, trade, technological-cultural development, art, as well as in belief and religious practice.

This concentration of human populations upon European, as well as upon other world coastlines has, in itself, had important consequences for the nature and pattern of coastal change. This may be seen in Europe in the progressive defining of coastal shape through the built environment and coastal engineering works since c AD 300, or earlier, in the raising of water-levels in estuaries and in widespread relative land submergence, as exemplified in the Thames estuary, parts of south-east England and the Netherlands.

This paper is designed to provide an introduction, therefore, at the level of the general reader, to the subject of sea-level and associated environmental changes. An understanding of such changes may be seen as a useful starting point to a consideration of how people have utilised maritime environments in the past. For, at the risk of being trivial, without the sea and its accompanying alterations in level and shape through time, it would not be possible to discuss the maritime nature of the Celtic, Frisian and Saxon peoples.

Coastal position and sea-level, c 500 BC - AD 1000

Over the broad time span covered by these peoples, relative sea-level (RSL) in most parts of north-west Europe has been rising (Fig 2.1); as it still is today in many parts of the region at rates of 1-3 mm per annum (Rossiter 1972; Emery 1980; Emery & Aubrey 1985), although some recent analyses of the data are more cautious in interpretation (Pirazzoli 1986; 1989; Pirazzoli et al 1988). The exact position of RSL and the coastline at particular times is often more difficult to determine at the local level, however, due to the lack both of precise regional models of sea-level behaviour (Greensmith & Tooley 1982; Shennan 1987) and detailed local data for coastlines. Nevertheless, it seems reasonable to suggest, on current evidence, that RSL. position in north-west Europe at c 2000 BP was probably in the order of 0.5-1.0 m below today's levels for Mean High Water Mark of Spring Tides (MHWST) at the open coast (Devoy 1987a; Tooley 1978).

In a sense an exception to this picture comes from those areas, such as Scandinavia, northern Britain and northern Ireland, which have experienced land uplift (isostatic rebound) since the end of the last glaciation (Fig 2.2). Although sea-surface levels continued to rise in these zones at similar rates to elsewhere in north-west Europe, the land, released from its former ice cover, has lifted here at a faster rate than ocean water-level has risen. This phenomenon has resulted in such coastlines recording a net relative fall of sea-level since c 4000 BC (Carter 1982; Smith & Dawson 1983).

This pattern of general RSL rise has not been without apparent interruption, however. During the

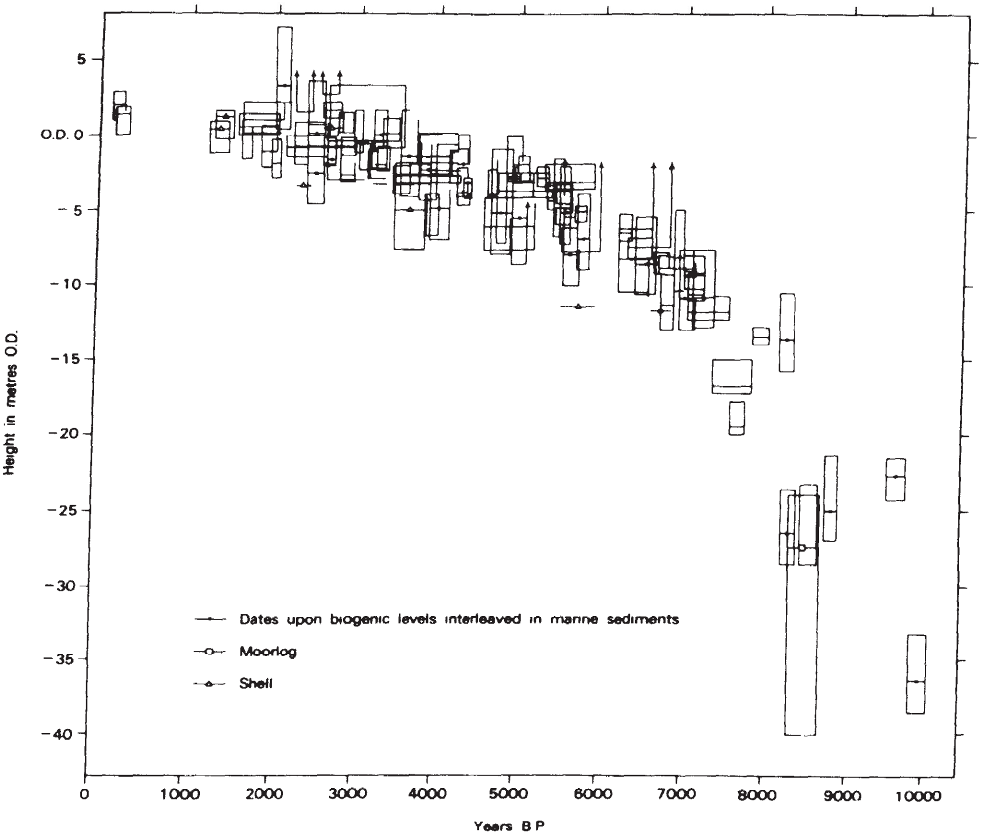

Figure 2.1 Pattern of Holocene relative sea-level changes from south-east England, defined by a time-altitude plot of sea-level indicators. 'Boxes' around indicators' positions show the amount of probable time and altitude error for each position. Plot is illustrative of the broad pattern of relative sea-level rise for MHWST experienced for coastlines in much of the North Sea region. (Diagram: Devoy 1987c, University College Cork).

period under discussion much archaeological and geological information exists for a prolonged phase of coastline building (progradation) between c AD 100-300. This may have resulted from a possible standstill in relative sea-level rise, or even a relative fall, and from variations in local sediment supply/river discharge factors (Devoy 1979; 1982; Shennan 1986). The subsequent flooding and eventual marine inundation of coastal zones such as the Fenland and the Thames estuary in Britain, or the Netherlands and parts of northern Germany post AD 300 is frequently referred to in archaeological and early sea-level literature as the 'Romano-British Transgression' (Godwin 1940; 1943; 1955; 1978). This time of coastal retreat and flooding may well have been facilitated by major storm events and it is probable that regional climate change had an important part to play in this pattern of sea-level behaviour. From this point in time onwards, sea-level and coastal data together record a pattern of continued marine inundation in many parts of the North Sea region; though evidence of local to more widespread phases of coastal advance, possibly incidental with climate changes, is also recorded (Tooley 1978; Lamb 1977a; 1977b; Shennan 1986).

In terms of the physical position of the coast, many of the lowland areas that are today situated well away from a direct marine influence represented the then coastline during the period under consideration. In Britain, as for elsewhere in Europe, there are many archaeologically and historically documented examples of such changes in coastal position (Devoy 1987a); as in London and the Kent-Essex marshes of the Thames (Devoy 1980; Nunn 1983; Bateman & Milne 1983; Wilkinson & Murphy 1986; 1987); the Rye-Dungeness area (Cunliffe 1980; Eddison & Green 1988); Chichester harbour and Christchurch Harbour of southern England. Many of the 'then' open coastal sites, navigable inlets and estuaries together formed ports, harbours or safe anchorages and were often associated with substantial human settlement. These sites have commonly become blocked and silted-up subsequently, leading to their abandonment or substantial decline as settlement locations (Fig 2.3).

Causes for these changes result from a variety of interrelated human and physical environmental factors (Fig 2.4) which may be summarised within five main themes:

(a) Human induced alterations to the coastal zone system. Of particular importance here, since the Roman period, has been the impact of large scale coastal engineering works; in progressively confining coastal inlets/embayments and in both defining and adding to coastal shape with embankments, jetties and harbour works. These

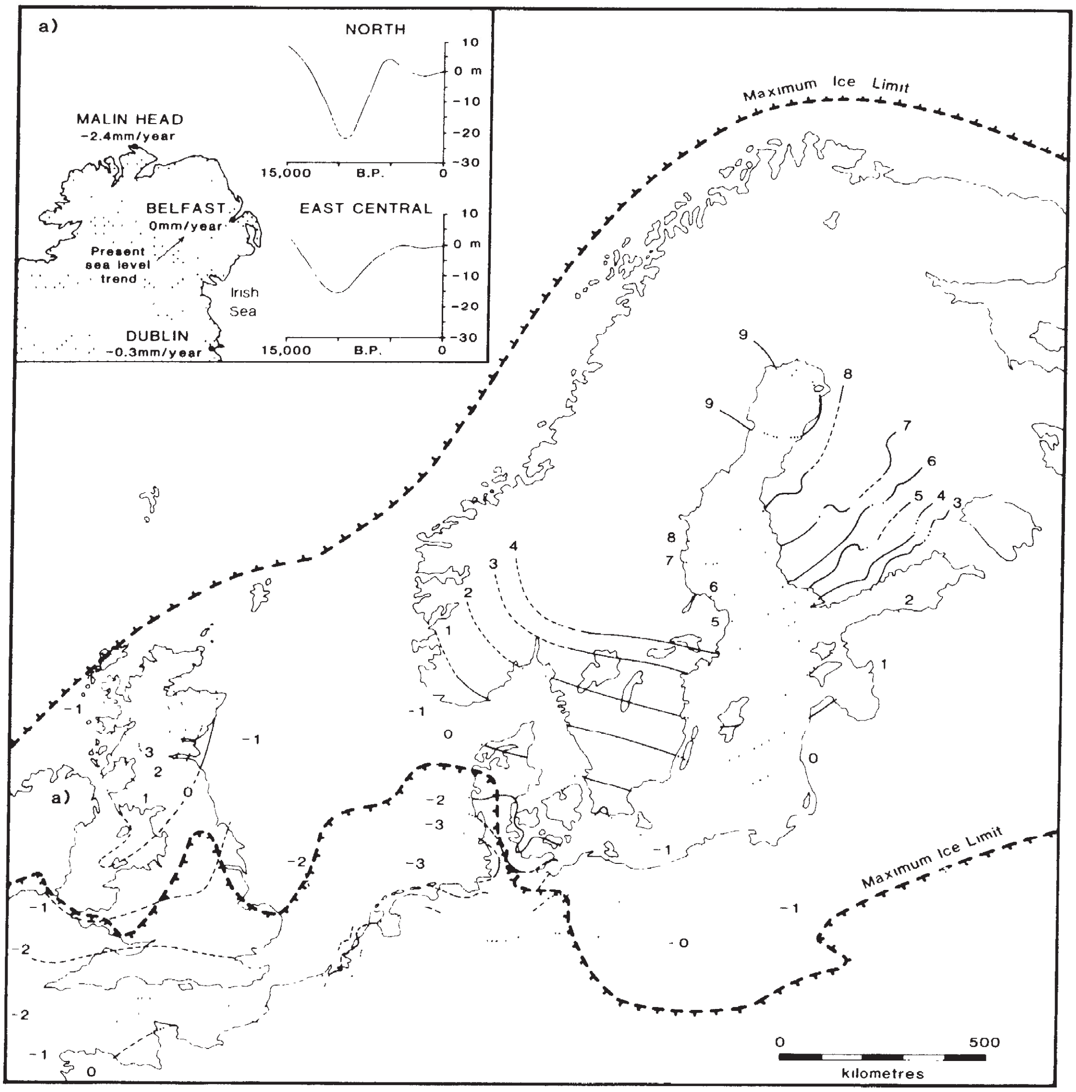

Figure 2.2 Present pattern of land uplift and subsidence for north-west Europe shown in mm per annum (after West 1977), Inset Figure 2a shows pattern of relative sea-level change in northern and eastern Ireland; zones of isostatic land uplift. (Diagram: Devoy 1987c, University College Cork).

changes have led to both variations in water level and sediment distribution.

A further traditionally invoked element has been variation of sediment supply to the coast, resulting from human alteration of land use practise. Deforestation and increased ploughing is often seen as having led historically to a greater release of sediment to the coast via the rivers and its subsequent accumulation at the shoreline. Equally, deforestation may cause hydrological changes with increased water run-off, concomitant with soil erosion and, therefore, sediment supply.

Although these factors are feasible as a cause of coastal change and have been shown to operate in contemporary settings (Hails 1977; Bird 1979; Gibb 1981), they have yet to be substantiated and proven as a widespread cause of coastal change/sediment supply in earlier situations. The sources of coastal sediments are too often a subject of conjecture only.

(b) Continued post-glacial sea-level rise, as a stimulus to the progressive landward shift of sediment to the coast, from material stored on the continental shelf.

(c) Coastal erosion leading to new sediment recruitment and changes in coastal configuration. Here the process of coastal erosion results in feedback between the consequent coastal shape/offshore bathymetry changes and sediment supply/distribution.

(d) Alterations in coastal processes consequent upon climate change, in terms of short to long term variations in wind/wave/water circulation patterns, again leading to an alteration of sediment supply or its removal at the coast.

Figure 2.3 Present coastline at Rye, Sussex. Coastal sediment accretion and river channel changes since c 1300 AD have 'stranded' former open harbour, A new channel cut by the River Rother through these coastal sediments is shown in foreground, together with the operation of oblique waves and alongshore, eastward sediment movement to Dungeness. (Photo: University College Cork).

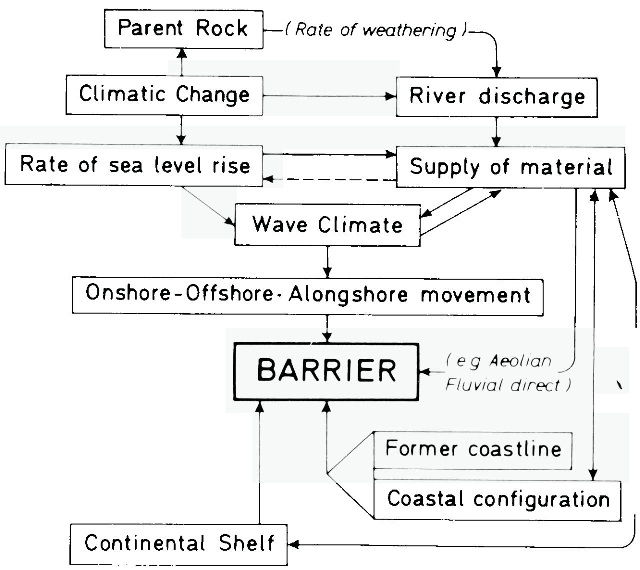

Figure 2.4 Elements of the physical environment conditioning changes in a coastal sediment system, such as a beach barrier environment. (Derived from Derbyshire et al 1981).

(e) The impact of major single or catastrophic events, such as storms or earthquake generated waves, in influencing a coastal system (Smith et al 1985; Smith 1988).

Readers are referred to Orford (1987), Carter (1987), Pethick (1984) and Hails & Carter (1975) for a more detailed discussion of these factors.

The ocean-atmosphere system and sea-level changes

Although coastal processes and dynamics are important in determining coastal position, variations in sea-level and related climate changes remain fundamental forcing factors in ultimately conditioning the broad parameters of coastal location.

'The oceans and atmosphere are inextricably linked; there is a continuous transfer of momentum, energy and matter at the ocean-atmosphere interface. The oceans absorb much of the solar radiation that penetrates the Earth's atmosphere and act as a heat reservoir, slowly heating up in summer and cooling in winter. The atmosphere in turn receives heat and most of its water content from the oceans. Changes in the atmosphere, therefore, are closely related to oceanic changes' and vice versa. (Stewart 1977)

There is a need, therefore, to examine the causes and past pattern of relative sea-level change, in order to help understanding about the movements of coastlines recorded in archaeological and historical data.

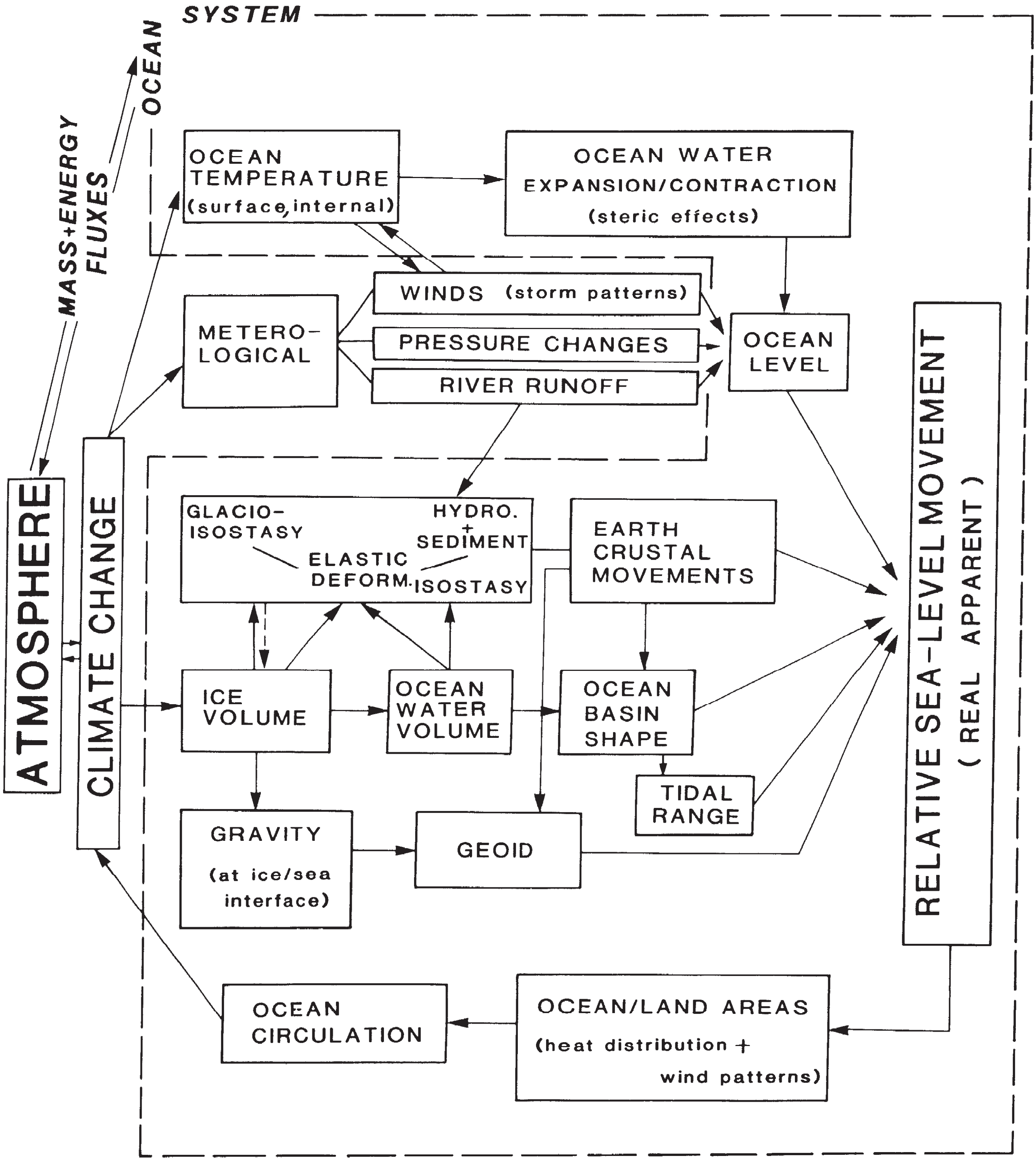

Figure 2.5 Components of ocean/atmosphere interaction responsible for relative sea-level changes at short to medium term timescales (hours to 1 million years). (Diagram: University College Cork).

Long term changes in sea-level

In assessing the factors responsible for influencing long term sea-level changes, two basic assumptions must be made. Firstly, the Earth has remained a 'fixed' size over approximately the last 600 million years and that, secondly, at the same time, the water volume of the oceans has also remained approximately constant (Devoy 1987b; c). On this basis, six main factors may be seen as potentially important in determining long term sea-level variations:

(a) Ocean water exchange with epicontinental seas.
(b) Change in shape of the ocean basins (ie through ocean ridge growth and decay, ocean spreading, sediment infill-loading factors.
(c) Mountain building — influencing basin shape.
(d) Variations in crustal heat flow — crustal thickening, thinning and ocean basin deepening.
(e) Geoid shape.
(f) Climate change.

The sixth factor 'climate change', has probably formed a pervasive influence on sea-level throughout earth history. Geological data relating to the long term history of the earth's crust show that for extensive phases of time (c 100 million years) global climate has been too warm to support the presence of polar ice caps (Hays & Pitman 1973; Mercer 1978; Nilsson 1983). Consequently, ocean levels relative to the land have been substantially higher than today's at these times. Although processes of continental drift, changing ocean basin shape, mountain building, earth crustal flexure and ocean circulation patterns have been the important direct determinants of land/sea position at such times (see Chappell 1987; Devoy 1987b; c; Tooley & Shennan 1987 for discussion), these factors have also contributed variably to changes in earth climate, and thus in a further additive way to relative sea-level change through this mechanism. During the Cretaceous warm, tropical seas spread over much of what is now Ireland and Britain, positioned at that time at c 30°N (Lovell 1977). Then global temperatures were 5-10°C warmer (than present day averages) and the world's oceans are estimated to have risen some + 350 m higher at maximum against the, then, continental land margins (Pitman 1978; Tissot 1979; Haq et al 1987).

At shorter timescales (< 1 million years) equally dramatic sea-level changes to those of the Cretaceous and earlier have also occurred, though of smaller vertical scale and not all in an upward direction. The onset of global cooling in Miocene times (5-25 million years) led to the re-establishment of the earth's ice caps (Mercer 1975) and the development of the 'Ice Age' (Quaternary). This change in climate and the resulting periodic growth of ice sheets on the land surface, led directly to a withdrawal of water from the oceans and a drop of global sea-levels. Although estimates vary as to the extent and duration of relative sea-level fall during these times of glacial cold (stadia lasting 60-70,000 years), geological evidence from submerged shoreline data from around the world's continental shelves, indicates that low levels of > -100 m present sea-level (psl) were attained at times (Bloom 1983; Devoy 1987a). It must be noted, however, that the areal pattern of low sea-level position probably varied greatly from one part of the world to another (Devoy 1987c).

Quaternary climate improvement and the re-establishment of times of global warmth in turn led to the return of water to the oceans from the melting ice (Fig 2.5). Again, evidence is not unequivocal as to the amount of regional/global relative sea-level shift during these interglacials, although it is clear that the net direction of sea-level movement for most coastlines has been upward. Exceptions occur in areas of former ice loading, such as northern Britain, Scandinavia or Canada, where the removal of the ice has resulted in land surface uplift in post-glacial time, generally at rates faster then water-level rise in the oceans. Geological data in the form of raised shorelines, for example, the shore platforms on the south coasts of Ireland and England, of western France and from the Maritime Provinces of Canada (Devoy 1983; 1987a) may suggest a maximal relative sea-level rise of c +4 to +6 m psl during the last and penultimate interglacials (Marshall & Thorn 1976; Mercer 1978). Crustal flexure/tectonic changes, however, often complicate this picture. Independent evidence from $\delta^{16/18}$O work (Shackleton 1987) suggests possibly a lower maximal ocean level rise of c +2 m psl for recent interglacial warmings.

The form of sea-surface behaviour during times of water return to the oceans is still unclear. Many sea-level researchers dealing with the most recent (Holocene, last 10,000 years) pattern of sea-level recovery feel that, despite significant regional and local anomalies, the dominant pattern has been one of an upward trending, oscillatory behaviour of the sea-surface. Rises in relative sea-level, at varying rates through time, have alternated with either sea-surface standstills, or real downward, negative sea-surface movements (Shennan 1987; Devoy 1987b). If real, climatic and atmospheric controls upon this behaviour, through changing patterns of storm intensity, cloud cover, precipitation, pressure systems and sun energy flux, have probably been significant (Fig 2.5). Periods of negative sea-level tendency in north-west Europe between c 4000-5000 BP and 1650-1850 BP, for example, or alternatively positive upward tendencies post c 1650 BP and, later, post c 750 BP (Shennan 1982; Shennan et al 1983) appear to match well with times of climate deterioration, in terms of global cooling in the first case, or more wet and stormy regional conditions in the other (Lamb 1977a; b).

A further complicating factor, much favoured by some sea-level researchers (Mörner 1987) as an explanation of relative sea-level variations through time is that of earth geoid change. Due to spatial, also possibly temporal, variations in the earth's density-

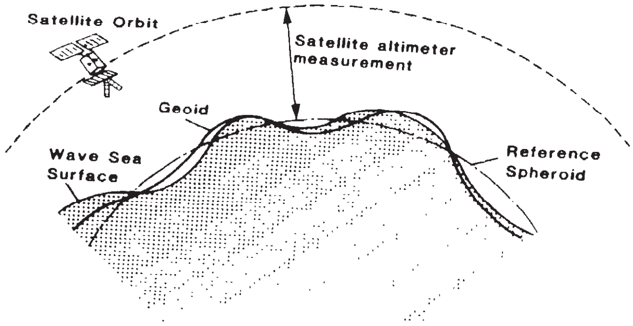

Figure 2.6 Measurement of geoid shape by satellite altimetry. Actual sea surface may be some distance (as much us 1-2 m) above or below the geoid surface due to action of waves, storms and tides. Vertical variations in geoid relief may be up to 200 m in height (see Fig 2.7 for details). (After Bearman 1989).

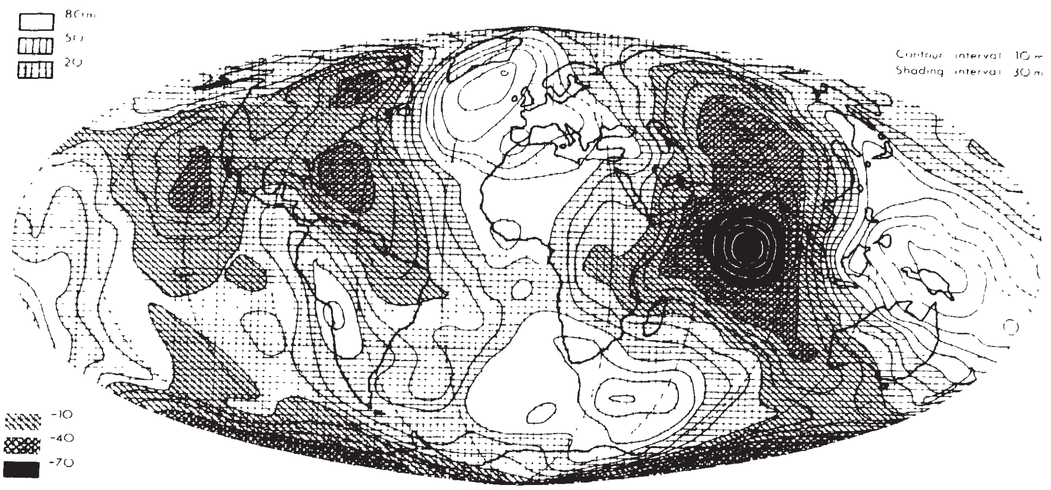

Figure 2.7 Contour map of the earth's surface shape based upon satellite measurement data — the geoid. (After Carey 1981)..

gravity field, the surface skin of the earth is distorted into a series of 'high and low relief' areas (Figs 2.6 and 2.7). The difference between 'high' and 'low' points may give a vertical 'relief' to the ocean surface of > 150 m. It has been postulated that these 'high' and 'low' points may migrate in time (even in timescale < 10,000 years), resulting in major changes in relative sea-level, and thus in coastal position. Such a proposition, though much discussed, has yet to be substantially proven.

Short term and contemporary changes

Storms certainly play an important role in temporarily increasing sea-levels significantly above normal tidal levels (Fig 2.5), especially where the conditions for storm surge prevail (ie the forcing of water by storm action into confined coastal configurations). These lead to major problems of coastal lowland flooding, as in London and Cork city or, alternatively, to coastal erosion and long term loss of land. In Bangladesh such storm surge induced, temporary increases in sea-surface level regularly cause very large losses in life (Southern 1979; Carter 1987; 1988) as, to a lesser extent, did the major 1953 storm in the southern North Sea region. Around the coasts of the British Isles normal storms on 'open' coasts regularly raise water levels 4-11 m above normal high water mark (HWM) positions.

Understanding of the mechanisms of sea-level change and their connection to climate forcings has led to the current concern about the future possible rises of global sea-levels, consequent upon the phenomenon of 'greenhouse' climate warming. Predictions from many informed science sources suggests that the effects of increasing CO_2 and accompanying 'greenhouse' gas levels in the atmosphere, for which the additive effects of ozone thinning must also now be calculated, will be to raise atmospheric temperatures globally by 1.5-4.5°C over the next 100 years approximately, for a doubling of atmospheric CO_2 levels (NAS 1979). Other scenarios are generally much worse (see Titus 1987 for review). This predicted level of increase in world temperature, at variable regional levels, appears to fit with the present observations of climate warming, showing rises of atmospheric temperature of c 0.4ºC since c AD 1880, coupled with CO_2 increase from 280/300 ppm in 1880 to 335 ppm in 1980 (Hansen et al 1981). Some earth scientists dispute these figures and the apparent close correlation between past 'greenhouse' gas emission and global temperature increases; pointing to the limited run of accurate data from temperature and 'greenhouse' gas observations, as well as to possible inaccuracies in methods of calculation (Pearman 1988).

If real, however, the effects of this global warming will be to accelerate the 'natural' post-glacial pattern of sea-level rise. Mercer (1978) suggested that melt-out of the West Antarctic ice sheet would lead possibly to a 5 m rise of sea-level in less than 100 years. As Clark and Lingle (1977) showed, the actual distribution of this water released on a rotating earth would not be uniform. The northern hemisphere would experience a rapid and initially disproportionately large part of this rise in respect to the southern hemisphere, before full global redistribution of water occurred. Subsequently, the glacial modelling work of Budd et al (1987) has demonstrated in their view that the effects of any 'greenhouse' induced melt of the West Antarctic ice sheet on sea-level are likely to be significant, but much lower than earlier anticipated, in the order of < 1 m maximum by c AD 2080 (Fig 2.8). Later studies (Warrick & Wigley 1988) of ocean/atmosphere interaction even suggest a global relative sea-level fall consequent upon climate warming and uptake of water into the atmosphere. These discussions, of course, only refer mainly to the effects of climate warming upon the West Antarctic ice mass rather than possible global ice melt. If this occurs at any significant level (ie melt from all glacier sources) then the sea-level rise scenarios will worsen (Meier 1984; Bindschadler 1985; Wigley & Koper 1987).

Apart from this ice melt component of 'greenhouse' warming, any increases in atmospheric temperatures will significantly affect ocean temperatures in time, leading to the commensurate expansion of the ocean water column (steric changes). Estimates of this effect in relation to contemporary climate warming indicates that a rise of ocean levels of 20-50 mm has taken place between 1880 and 1985 (Wigley & Roper 1987). Future climate warming along the lines predicted for CO_2 increases might account for a

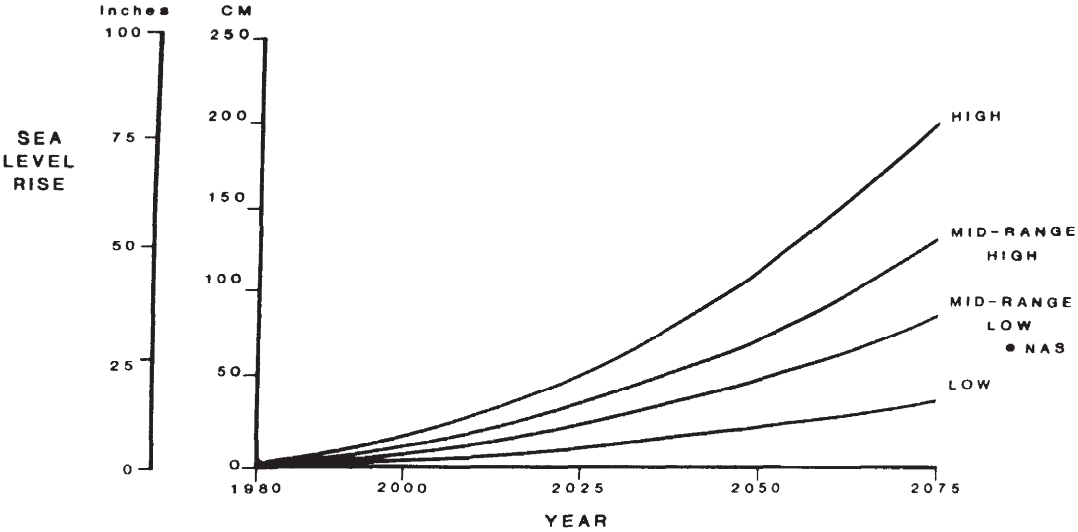

Figure 2.8 Global relative sea-level rise scenarios, derived from research studies undertaken in United States in early 1980s. (After Hoffmann et al 1983). Subsequent studies maintain the variability in the prediction of sea-level change.

further 40-80 mm vertical water level rise, though some scenarios of ocean water expansion indicate even higher levels of rise.

Although these steric effects on sea-level may seem large, the influence of ocean warming will also affect other elements of the ocean/atmosphere system, in particular weather patterns and ocean circulation. Increases in the often biologically devastating incursions of warm equatorial water into the southern Pacific region (El Niño), with accompanying regional temporary sea-level changes of ± 100-200 mm have been tentatively linked to this pattern of contemporary climate warming (Wyrtki & Nakahara 1984; Peltier 1987). Equally important, increasing storminess has been noted in the past 2-5 years from many parts of the world (eg north-west Europe and eastern Australia), as might be expected from the results of initial work on the atmospheric modelling of global warming (Pearman 1988). In terms of sea-level change, it has already been noted that storms are an important contributor to coastal flooding and erosion problems. Therefore, any increases in regional-global storminess, regardless of future long term, net vertical rises of ocean levels, will seriously increase our problems of coastal defence. For coastal dwellers in the lowlying continental margins of north-west Europe and for many of the world's population, with approximately 25% living within ± 1 m of mean sea-level, such storms may well prove disastrous.

Data sources and the contribution of archaeology

Following this discussion it is now possible to summarise the principal data sources upon which our 'understood' picture of RSL change and coastal position is based. These fall into four major categories:

(a) Geological — derived from stratigraphic, sedimentary studies and fossil indicators of former water levels.

(b) Historical sources — maps and other documentary information.

(c) Archaeological — buried material.

(d) Contemporary observations — through satellite remote sensing, tide-gauge monitoring of water levels.

The value of archaeological data as a source of RSL information and its subsequent interpretation is potentially asignificant one. Its role may be seen in terms of its being both a consumer and also a producer of data. As a consumer, archaeology has used RSL and related shoreline information to help test hypotheses about proposed events, lifestyles and physiographic reconstructions of environments at particular times. In a related field of social-anthropological explanation, for example, in the behaviour and movements of peoples about the earth using possible land bridge routes or in the development of trading patterns, sea-level data is again used to test explanations (Devoy 1985; Flood 1986).

Conversely, archaeology can be a producer of information. Louwe-Kooijmans (1974) demonstrated the potential value of using modern positions and former settlement sites in reconstructing former shorelines. Equally, a wealth of other data has potential for use here, in the form of buried boats or wharf locations, for example, as other papers in this volume discuss. The range of data may be such that detailed reconstructions of coastal configurations may be attempted based on archaeological and historical data alone, as in the case of the Fenland (Simmons 1980) and many other sites in Britain (Thompson 1980). Alternatively, the range of archaeological information available, such as specific coastal position/water level indicators to less precise, but intriguing, 'remembered' information, as in Australia (Flood 1986) or Scandinavia and Canada (Devoy 1987a), can provide a valuable test upon geological reconstructions.

The major problem in all detailed RSL reconstructions is the need for precise data, particularly if the work is to be further used in modelling or related attempts at fundamental understanding of environmental processes and earth functioning. Accurate index points of RSL position, in terms of their height, time and the environment represented are required (Plassche 1986). A valuable plus for archaeological data exists here. For whilst providing information about age, either accurately or through provision of material for radiometric dating, or more crudely though relative chronologies, archaeology may also provide important contextural information showing how a site and environment changed over time. Unfortunately, accurate height information, or the significance of a find/site for specific sea-level position within the coastal zone from archaeological sources, has hitherto frequently been all to dubious. The important points remaining, however, are that archaeological information can provide complementary data to an otherwise all too exclusively used range of geological data types. Further, such information may be particularly helpful in elucidating the latest phases in relative sea-level recovery over the last 2000 years; a time of increasing significance for the study of contemporary ocean/atmosphere responses.

References

Bateman, N, & Milne, G, 1983 A Roman harbour in London, *Britannia* **14**, 208-9.

Bearman, G, (ed), 1989 *The ocean basins: their structure and evolution.*

Bindschadler, R, 1985 Contribution of the Greenland ice cap to changing sea level, in Meier, M F, (ed), *Glaciers, ice sheets and sea level*, 80-91.

Bird, E C F, 1979 Coastal processes, in Gregory, K J & Walling, D E (eds), *Man and environmental process*, 82-101.

Bloom, A L, 1983 Sea-level and coastal morphology through the Late Wisconsin glacial maximum, in Porter, S C, (ed), *Late Quaternary environments of the United States, Vol 1: the late Pleistocene*, 215-29.

Budd, W F, McInnes, B J, Jenssen, D, & Smith, I N, 1987 Modelling the response of the West Antarctic ice sheet to a climatic warming, in van der Veen, C J, & Oerlemans, J, (eds), *Dynamics of the West Antarctic ice sheet*, 321-58.

Carey, W S, 1981 Causes of sea-level oscillations, *Proc Roy Soc Vict* **92**, 13-17.

Carter, R W G, 1982 Sea-level changes in Northern Ireland, *Proc Geol Assoc* **93**, 7-23.

——, 1987 Man's response to a sea-level change, in Devoy, (ed), 1987c, 464-98.

——, 1988 *Coastal environments.*

Chappell, J, 1987 Ocean volume changes and the history of sea water, in Devoy, (ed), 1987c, 33-58.

Clark, J A, & Lingle, C S, 1977 Future sea-level changes due to West Antarctic ice sheet fluctuations, *Nature* **269**, 206-9.

Cunliffe, B W, 1980 The evolution of Romney Marsh: a preliminary statement, in Thompson, (ed) 1980, 37-55.

Derbyshire, E, Gregory, K J, & Hails, J R, 1981 Coastal processes, in Derbyshire, E, Gregory, K J, & Hails, J R, *Geomorphological processes.*

Devoy, R N J, 1979 Flandrian sea-level changes and the vegetational history of the lower Thames estuary, *Phil Trans Roy Soc London B* **285**, 355-410.

——, 1980 Post-glacial environmental change and Man in the Thames estuary: a synopsis, in Thompson, (ed) 1980, 134-48.

——, 1982 Analysis of the geological evidence for Holocene relative sea-level movements in south-east England, *Proc Geol Assoc* **9**, 65-90.

——, 1983 Late Quaternary shorelines in Ireland: an assessment of their implications for isostatic land movement and relative sea-level changes, in Smith & Dawson, (eds) 1983, 227-54.

——, 1985 The problems of a Late Quaternary landbridge between Britain and Ireland, *Quat Sci Rev* **4**, 43-58.

——, 1987a Sea-level changes during the Holocene: the North Atlantic and Arctic oceans, in Devoy, (ed), 1987c, 294-347.

——, 1987b Introduction: first principles and the scope of seasurface studies, in Devoy, (ed), 1987c, 1-30.

——, (ed), 1987c *Sea surface studies: a global view.*

Eddison, J, & Green, C, (eds), 1988 *Romney Marsh: Evolution, occupation and reclamation*, Oxford Univ Comm Archaeol Monog **24**.

Emery, K O, 1980, Relative sea-levels from the tide-gauge records, *Proc Nat Acad Sci USA* **77**, 6968-72.

——, & Aubrey, D G 1985 Glacial rebound and relative sea-levels in Europe from the tide-gauge records, *Tectonophysics* **120**, 239-55.

Flood, J, 1986 *Archaeology of the Dreamtime.*

Gibb, J G, 1981 Coastal hazard zone mapping as a planning technique for Waiapu County, east coast, North Island, New Zealand, *Water Soil Technol Publ* **21**, 1-63.

Godwin, H, 1940 Studies of the post-glacial history of British vegetation III. Fenland pollen diagrams, IV. Post-glacial changes of relative land- and sea-level in the English Fenland, *Phil Trans Roy Soc London B* **230**, 239-303.

——, 1943 Coastal peat beds of the British Isles and North Sea, *J Ecol* **31**, 199-247.

——, 1955 Studies of the post-glacial history of British vegetation VIII. The Meare Pool region of the Somerset Levels, *Phil Trans Roy Soc London B* **239**, 161-90.

——, 1978 *Fenland: its ancient past and uncertain future.*

Greensmith, J T, & Tooley, M J, (eds), 1982 IGPC Project 61, Sea-level movements during the post-deglacial hemicycle (about 15,000 years), *Proc Geol Assoc* **93**, 1-125.

Hails, J R, (ed), 1977 *Applied geomorphology.*

——, & Carr, A P, (eds), 1975 *Nearshore sediment dynamics and sedimentation.*

Hansen, J, Johnson, D, Lacis, A, Lebedeff, F, Lee, P, Rind, D, & Russell, G, 1981 Climate impact of increasing atmospheric carbon dioxide, *Science* **213**, 957-66.

Haq, B V, Hardenbol, J, & Vail, P R, 1987 Chronology of fluctuating sea-levels since the Triassic, *Science* **235**, 1156-67.

Hays, J D, & Pitman, W C III, 1973 Lithospheric plate motion, sea-level changes, climatic and ecological consequences, *Nature* **246**, 18-22.

Hoffman, J S, Keyes, D, & Titus, J G, 1983 *Projecting future sea-level rise*, 2nd Rev Edu Govt Printing Office, Washington DC.

Lamb, H, 1977a The Late Quaternary history of the climate of the British Isels, in Shottan, F W, (ed), *British Quaternary Studies*, 283-98.

——, 1977b *Climate: present, past and future, Vol 2.*

Louwe-Kooijmans, L P, 1974 The Rhine/Meuse delta: four studies in its prehistoric occupation and Holocene geology, *Analecta Praehistorica Leidensia* 7.

——, 1980 Archaeology and coastal change in the Netherlands, in Thompson, (ed), 1980, 106-33.

Lovell, J P B, 1977 *The British Isles through geological time.*

Marshall, J F, & Thom, B G, 1976 The sea-level in the last interglacial, *Nature* **263**, 120-1.

Meier, M F, 1984 Contribution of small glaciers to global sea-level, *Science* **226**, 1418-21.

Mercer, J H, 1975 in van Zinderen Bakker, E M, (ed), *Palaeoecology of Africa and of the surrounding islands and Antarctica* **8**, 85-114.

——, 1978 West Antarctic ice sheet and CO^2 greenhouse effect: a threat of disaster, *Nature* **271**, 321-5.

Mörner, N-A, 1987 Pre-Quaternary long term changes in sea-level, in Devoy, (ed) 1987c, 233-41.

NAS (National Academy of Sciences), 1979 *Understanding climate change.*

Nilsson, T, 1983 *The Pleistocene: geology and life in the Quaternary ice age.*

Nunn, P D, 1983 The development of the River Thames in central London during the Flandrian, *Trans Inst Brit Geog* **ns 8**, 187-213.

Orford, J, 1987 Coastal processes: the coastal response to sea-level variation, in Devoy, (ed) 1987c, 415-63.

Pearman, I, 1988 *Greenhouse: planning for climate change.*

Peltier, W R, 1987 Mechanisms of relative sea-level change and the geophysiscal responses to ice-water loading, in Devoy, (ed) 1987c, 57-94.

Pethick, J S, 1984 *An introduction to coastal geomorphology.*

Pirazzoli, P A, 1986 Secular trends of relative sea-level (RSL) changes indicated by tide-gauge records, *J Coastal Research* **S1 (1)**, 1-26.

——, 1989 Recent sea-level changes in the North Atlantic, in Scott, D B, Pirazzoli, P A, & Honig, C A, *Late Quaternary sea-level correlation and applications.*

——, Grant, D R, & Wentworth, P, 1988 Trends of relative sea-level change: past, present and future, *XII International INQUA Congress, Ottawa, 1987, special session 18, 'Global change'.*

Pitman, W C III, 1978 Relationships between estuary and stratigraphic sequences of passive margins, *Bull Geol Soc Amer* **89**, 1389-1403.

Plassche, van de O, (ed), 1986 *Sea-level research: a manual for the collection and evaluation of data.*

Rossiter, J R, 1972 Sea-level observations and their secular variation, *Phil Trans Roy Soc London A* **272**, 131-9.

Shackleton, N J, 1987 Oxygen isotopes, ice volume and sea-level, *Quat Sci Rev* **6**, 183-90.

Shennan, I, 1982 Problems of correlating Flandrian sea-level changes and climate, in Harding, A F, (ed), *Climate change and later prehistory*, 52-67.

——, 1986 Flandrian sea-level changes in the Fenland, I and II, *J Quat Sci* **1**, 119-79.

——, 1987 Global analysis and correlation for sea-level data, in Devoy, (ed) 1987c, 198-230.

——, Tooley, M J, Davis, M J, & Haggart, B A, 1983 Analysis and interpretation of Holocene sea-level data, *Nature* **302**, 404-6.

Simmons, B B, 1980 Iron Age and Roman coasts around the Wash, in Thompson, (ed), 1980, 56-73.

Smith, D E, 1988 A Holocene Tsunami in the North Sea, *Abstracts Int Geog Union, 26th Congress, Sydney, Vol 2*, 554.

——, Cullingford, R A, & Haggart, B A, 1985 A major coastal flood during the Holocene in eastern Scotland, *Eiszeitalter u Gegenwart* **35**, 109-18.

——, & Dawson, A G, (eds) 1983 *Shorelines and isostasy.*

Southern, R L, 1979 The global socio-economic impact on tropical cyclones, *Australian Meteor Mag* **27**, 175-95.

Stewart, J, (ed), 1977 *Oceanography: introduction to the oceans.*

Thompson, F H, 1980 *Archaeology and coastal change*, Soc Antiq London Occas Pap **ns 1**.

Tissot, B, 1979 Effects on prolific petroleum source rocks and major coal deposits caused by sea-level changes, *Nature* **277**, 463-5.

Titus, J G, 1987 The greenhouse effect, rising sea-level and society's response, in Devoy, (ed) 1987c, 499-528.

Tooley, M J, 1978 *Sea-level changes in north-west England during the Flandrian stage.*

——. & Shennan, I, 1987 *Sea-level changes.*

Warrick, R A, & Wigley, T M L, 1988 *Proceedings of the international workshop on climate change, sea-level, severe tropical storms and associated impacts, University of East Anglia, 1987.*

West, R G, 1977 *Pleistocene geology and biology.*

Wigley, T M L, & Roger, S C B, 1987 Thermal expansion of sea water associated with global warming, *Nature* **330**, 127-31.

Wilkinson, T J, & Murphy, P, 1986 Archaeological survey of an intertidal zone: the submerged landscape of the Essex coast, England, *J Field Archaeol* **13**, 177-94.

——, & ——, 1987 *The Hullbridge Basin Survey, interim report 7.*

Wyrtki, K & Nakahara, S, 1984 *Monthly maps of sea-level anomalies in the Pacific, 1975-81.*

3 Hengistbury Head: a late prehistoric haven

Barry Cunliffe

Abstract

Hengistbury Head in Dorset is admirably sited: outer approaches are protected by a reef and the inner harbour (Christchurch Harbour) is sheltered by the headland itself. Its shelving gravel beaches provide suitable moorings. Moreover, the harbour is linked by two major rivers, the Stour and the Avon, to the productive heartland of Wessex.

The site was occupied from time to time throughout the prehistoric period. In the 1st century BC it became a centre for maritime trade, taking on all the attributes of a port-of-trade. A recent campaign of excavations concentrated on the main settlements and on one of the harbour areas; details of harbour works came to light and much environmental evidence.

Of the many fine harbours along the Solent shore of Britain attractive to prehistoric sailors, Christchurch Harbour is one of the best endowed. Today it is a large expanse of shallow, almost land-locked water protected by the ridge of Hengistbury Head from the predominantly south-west winds and currents and scoured by the flow of the two Wessex rivers, the Avon and the Stour (Figs 3.1 and 3.2). The headland is a prominent feature immediately recognisable from the sea and equally easy to locate from further off since it lies on a deep bay midway between the headlands of Ballard Point and The Needles.

That Hengistbury was attractive in prehistoric times has long been evident from the Bronze Age barrow cemetery straggling along the ridge but its importance in the late Iron Age was not established until J P Bushe-Fox carried out a rescue excavation on the north-facing shore in 1911-12 (Bushe-Fox 1915). After an initial burst of interest the archaeological world seems to have forgotten the site until David Peacock drew attention to the exceptional collection of Dressel 1A amphorae contained in the old collection (Peacock 1971). A thorough re-study of the surviving artefacts by the present writer left little doubt that Hengistbury had been a major port on an extensive trading network throughout much of the 1st century BC (Cunliffe 1978; 1982).

Hengistbury was clearly a key site in any attempt to assess the effects of long-distance trade on the socio-economic system of south-eastern Britain in the century or so before the Roman invasion of AD 43. It called for a reassessment based on sound stratigraphical evidence: with this in mind a programme of limited excavation was mounted from 1979-1987. The aims of the project were:

a) to examine part of the settlement area to provide stratified material and a context within which to assess the older collections;
b) to define the range of settlement structures;
c) to evaluate the economy and overseas contacts of the community;
d) to obtain environmental data;
e) to explore aspects of the maritime use of the site in the prehistoric period.

The first three aims were rapidly achieved in the excavation of 1979-84 and have been reported on in full (Cunliffe 1987). The last two were accomplished with rather more discomfort in 1985-7 and are yet to receive full publication.

Hengistbury as a port-of-trade

The archaeological record showed that an extensive settlement had existed along the north shore of the headland overlooking the sheltered waters of Christchurch Harbour. At the beginning of the 1st century BC the settlement expanded rapidly and activity intensified but after the middle of the century gradual decline set in until, by the Roman period, most of the old settlement area had been reduced to farmland. During the early 1st century BC Hengistbury was receiving cargoes of exotic products from the south along the Atlantic sea-ways. Most evident archaeologically were quantities of wine amphorae coming ultimately from northern Italy, a considerable variety of fine pottery from Armorica, blocks of raw purple and yellow glass, figs from the Mediterranean, and there was, no doubt, a range of other commodities no longer recognisable in the archaeological record. In return, raw materials were brought to Hengistbury from far afield in Britain for refinement and ultimately for export. The easiest to recognise were metals, iron, copper, tin, lead, silver and gold. Salt cake and Kimmeridge shale armlets were also in evidence. In addition there is some evidence for the stockpiling of corn from the Wessex chalkland and even tenuous evidence for the amassing of cattle for export, either on the hoof or as salt meat and hides. When compared with Strabo's list of desirable exports from Britain at about this time the only two items not accounted for at Hengistbury are slaves and hunting dogs, neither of which would be easy to identify under normal archaeological conditions.

The evidence for trade is difficult to quantify but is sufficient to suggest that ships of various kinds must have frequented the harbour, ranging from river craft plying the Wessex rivers to sea-going ships capable of making coastal journeys to the West Country or crossing the Channel to the ports of the north Breton coast.

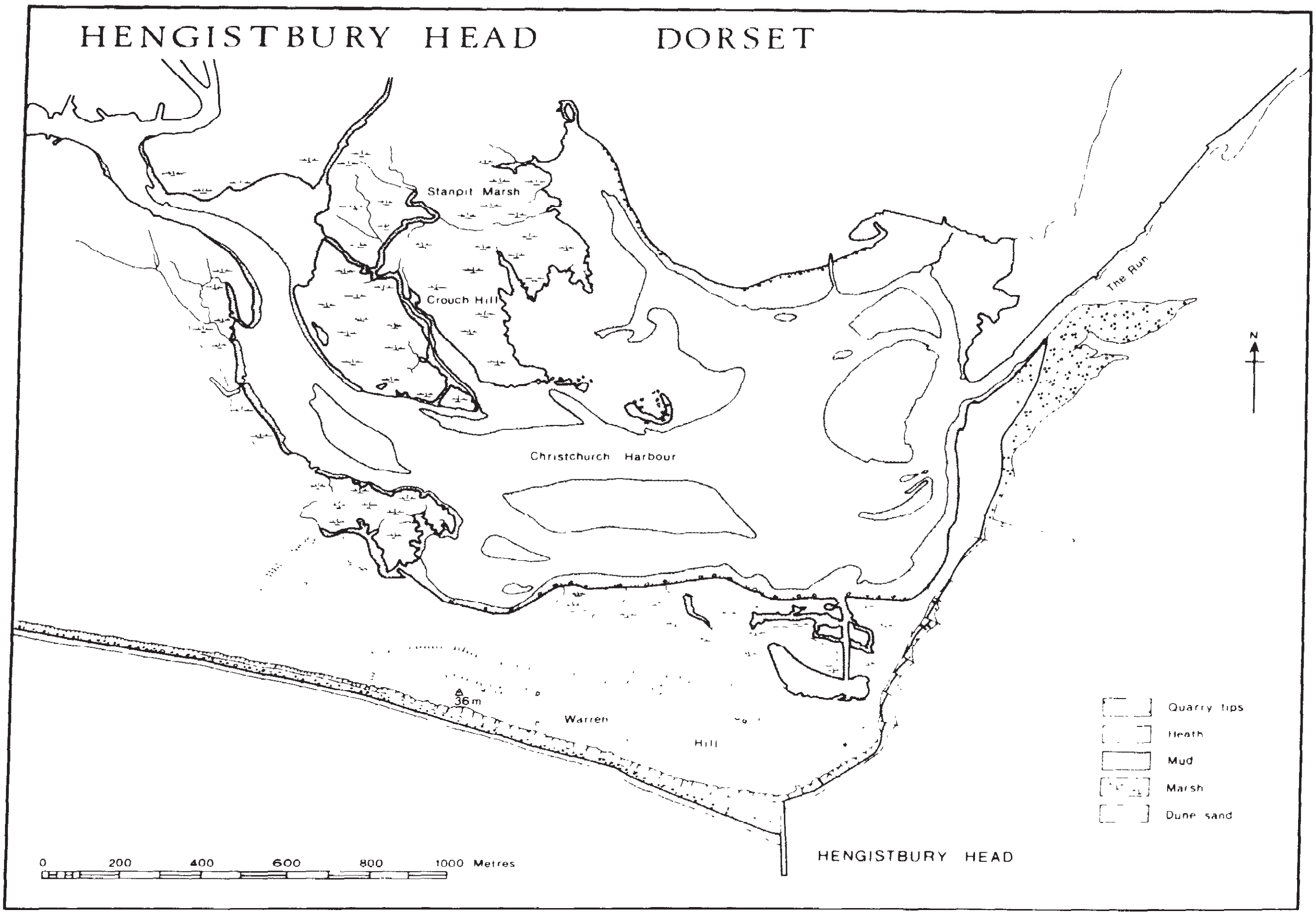

Figure 3.1 Christchurch Harbour, Dorset, with Hengistbury Head to the south. (Map: Institute of Archaeology, Oxford).

Evidently some provision must have been made for landing at the headland settlement: the last three years of the campaign were dedicated to the examination of this problem.

Land forms

Crucial to any understanding of the Iron Age use of the headland is the question of the original form of the landscape. Essentially there have been three processes at work sculpting its present shape: massive erosion along the southern seaward side of the head; long shore drift depositing the eroded material in a spit across the harbour mouth; and the accumulation of marsh deposits on the sheltered shore within the harbour. To add to the complexity of the situation minor changes in sea-level introduce another variable which can significantly alter the rate of change of sedimentation. To assess these processes a detailed programme of environmental work was undertaken under the direction of Dr Michael Tooley and the comments offered below represent a preliminary summary of our findings. Some modification in matters of detail can be expected as the results of the various scientific analyses become available.

Figure 3.3 offers a tentative reconstruction of the headland as it is thought to have been in the late Iron Age. Coastal erosion, particularly in the last 200 years, has dramatically reduced the land mass to about half its original size but the greatest interest from the point of view of this paper lies in the character of the sheltered north shore. Simply stated, three massive gravel bars can be distinguished rooted to the headland but thrusting out into the harbour. These are composed of well-rounded flint pebbles sometimes of considerable size and rise to heights of in excess of 2 m from the bedrock base. The simplest explanation for them is that they were created under riverine conditions in the Pleistocene, perhaps by the proto Bourne/Stour/Avon as it flowed to join the Solent river (Cunliffe 1987, 117). By the Iron Age they were ancient features of the landscape. For ease of reference the bars have been given names based on local topographic features (Fig 3.3).

Each gravel bar protected an inlet. Between Barrow bar and Barnfield bar the inlet was narrow and it was here that the main area excavation was carried out. The essential conclusions from the point of view of the present discussion were that the sea-level had dropped by about 0.6 m during the 1st millennium BC exposing

Figure 3.2 Aerial photograph of Christchurch Harbour from the east. (Photo: K Hoskin).

the sandy base of the inlet, some 20 m wide, which was colonised by the Iron Age settlement.

At the east end of the headland the situation was very different. Limekiln bar extended outwards some 230 m from the land and was met by a complex of other sand and gravel bars, possibly of more recent age, formed as cuspate spits building back westwards from the extreme north-east corner of the promontory. The exact geomorphology of this fascinating area has yet to be studied in detail but it is clear that by the late Iron Age a continuous barrier extended from Limekiln bar to the gravel spit enclosing a large expanse of marshland in which a peat bog had formed.

Thus neither Barnfield inlet, nor the Salthurns, provided a suitable haven. Rushy Piece on the other hand, between Barnfield bar and Limekiln bar, was altogether different and it was here that detailed investigation brought to light evidence of the Iron Age harbour works.

The landing place at Rushy Piece

Rushy Piece, as its name implies, is a low-lying area of reed swamp lying between the two gravel bars and cut off from the present harbour by a low beach of gravel. Excavation was made hazardous by the high and persistent water table but around the fringes conventional excavation was possible while, in the centre, trial pits dug by hand or by machine were sufficient to establish stratigraphy. In addition, probing enabled the surface of the uppermost gravel spreads to be plotted.

The essential stratigraphy is summarised in Figure 3.4. The profile of an early beach was established overlaid by blue grey alluvium with an upper surface at between 0.4 and 1.2 m below present OD. This was the situation c 100 BC when the harbour was established. Two structural phases can be distinguished. In the first an area of the alluvium and part of the old beach was dug away, presumably to create a deep water approach, and the material removed was dumped along the upper edge of the inlet. This was then sealed with a varying thickness of redeposited gravel, quarried from the nearby gravel bars, creating a hard, which projected seaward along the southern edge of the inlet. From the north-west edge of the hard the gravel sloped evenly down to the deep water cut.

The intention of the harbour works is clear enough — to create a landing place where boats could approach

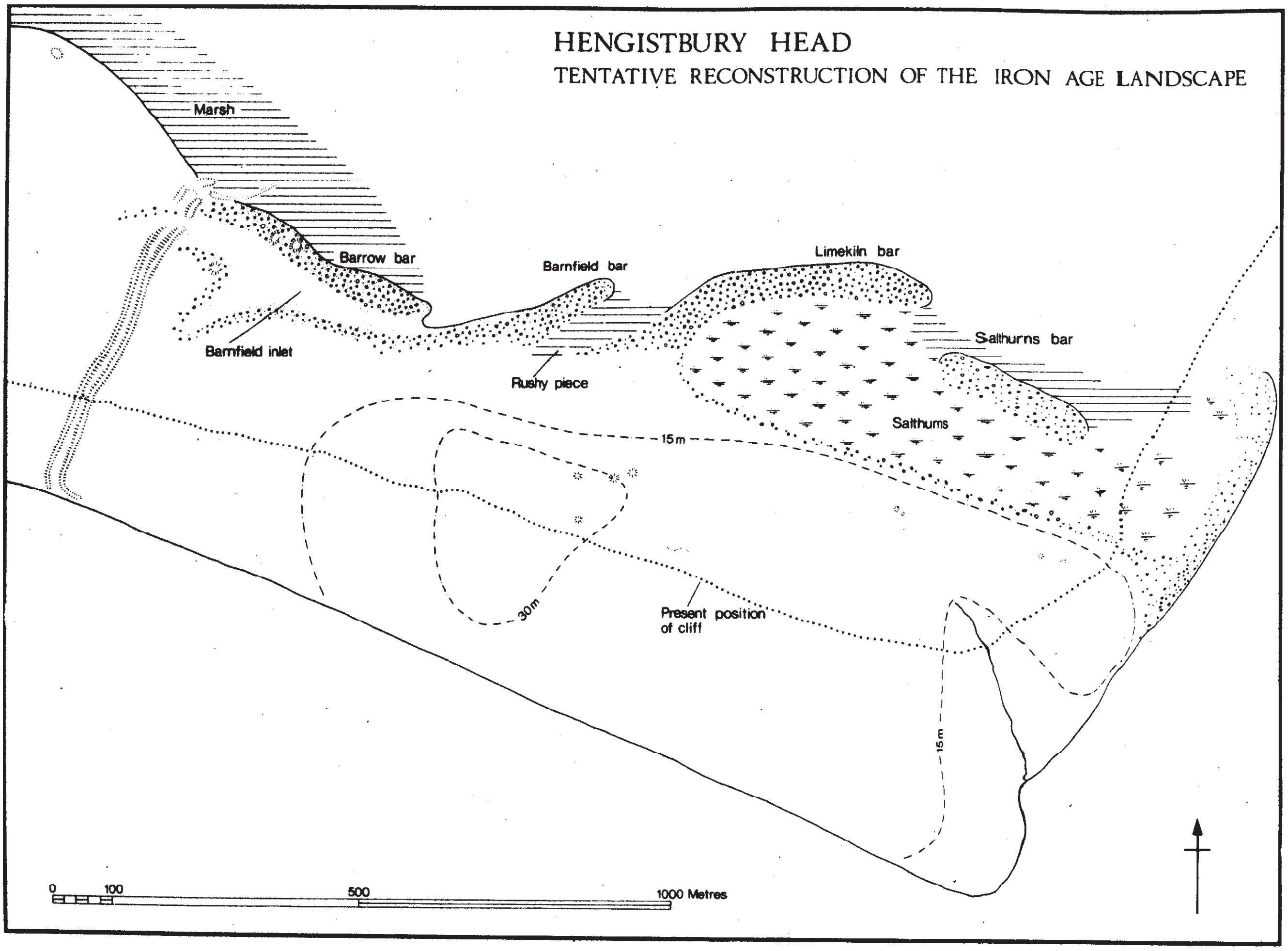

Figure 3.3 Hengistbury Head: tentative reconstruction of the 1st millennium BC geomorphology. (Drawing: Institute of Archaeology, Oxford).

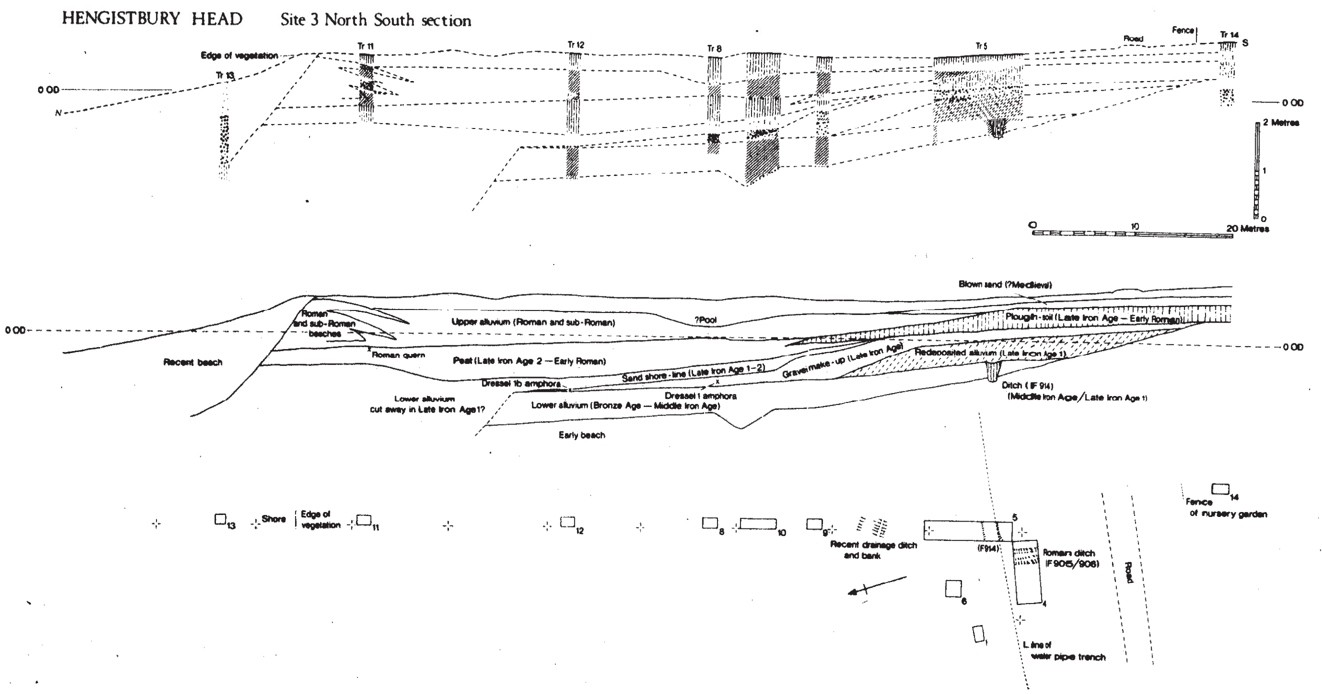

Figure 3.4 Section through Rushy Piece. Note exaggeration of vertical scale. (Drawing: Institute of Archaeology, Oxford).

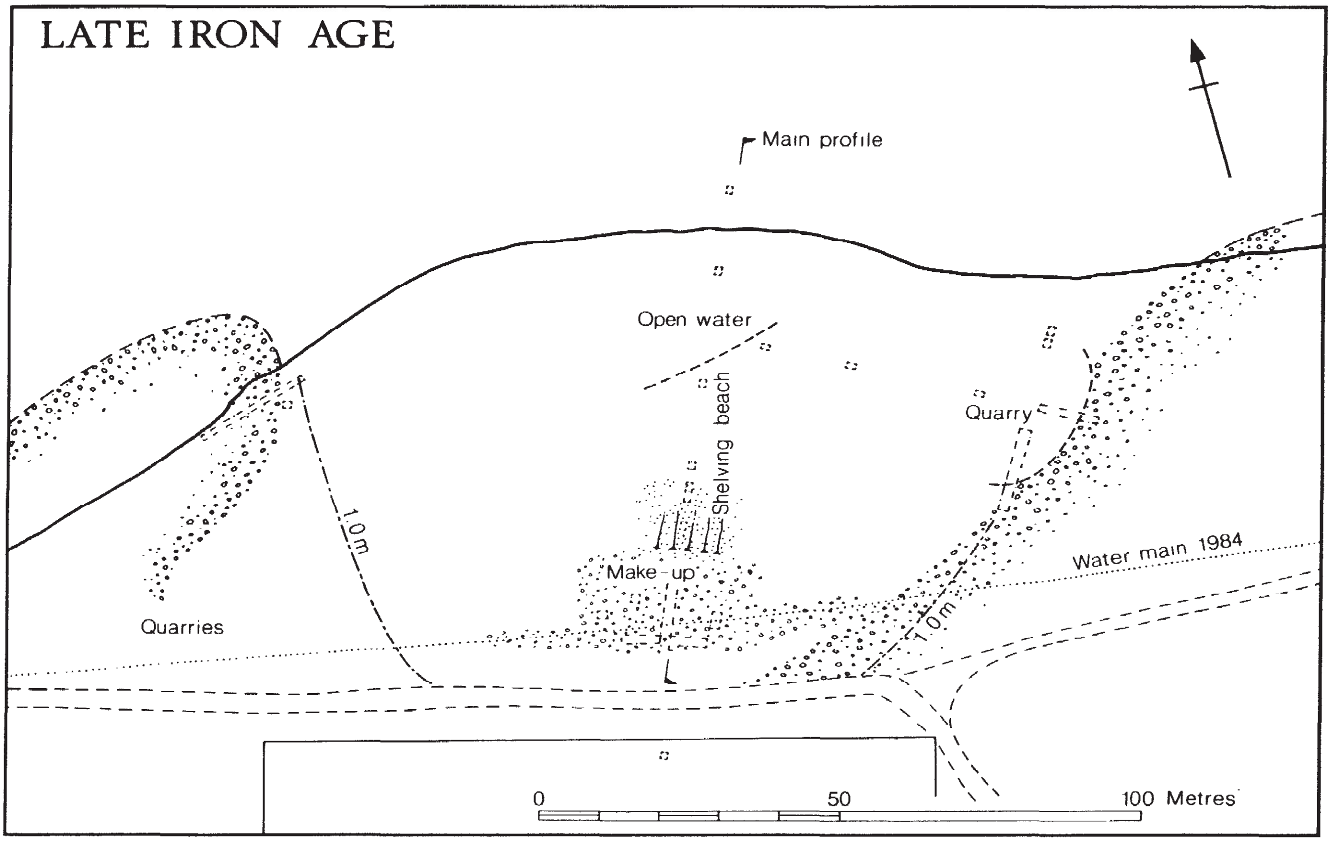

Figure 3.5 Landing place at Rushy Piece. (Drawing: Institute of Archaeology, Oxford).

close inshore protected from any swell or scend in the main harbour and where they could be beached on a hard and their cargo loaded and unloaded. What is impressive is the very considerable expenditure of energy invested in creating the gravel hard involving the quarrying and movement of many hundreds of tons of gravel (Fig 3.5).

At the time when the harbour was in use in the late Iron Age mean sea-level would have been no more than 0.5 m below present OD but subsequently conditions changed. The most likely explanation is that changes in sea-level led to the creation of a new gravel bar across the entrance to the landing place creating an area of stagnant water where the old landing place and hard once were. The result was that peat grew above the earlier remains while on the slightly drier ground to the south arable fields were laid out. Later, in the late or sub Roman period, a rise in sea-level breached the barrier and the area once more turned into alluvial flats covered at high tide. Throughout this period and subsequently beach formation continued. A slight lowering of sea-level in the medieval period allowed the formation of a peat marsh once more.

Implications

What emerges from this brief summary of an Iron Age haven at Hengistbury is that Iron Age harbours with man-made landing places once existed and can be discovered by normal archaeological methods. Clues to their whereabouts are best provided by artefact assemblages incorporating imported material. Once a potential site has been identified a combined archaeological/geomorphological approach is demanded since the archaeological levels are likely to be inextricably bound up with natural stratigraphy consequent upon sea-level change.

That more Iron Age ports exist around the coasts of Britain is certain and it can only be a matter of time before some of them are discovered.

References

Bushe-Fox, J P, 1915 *Excavations at Hengistbury Head, Hampshire in 1911-12*, Soc Antiq London Res Rep 3.

Cunliffe, B, 1978 *Hengistbury Head.*

——, 1982 Britain, the Veneti and Beyond, *Oxford J Archaeol* 1.1, 39-68.

——, 1987 *Hengistbury Head, Dorset. Volume 1: the prehistoric and Roman settlement, 3500 BC-AD 500*, Oxford Univ Comm Archaeol Monog 13.

Peacock, D P S, 1971 Roman amphorae in pre-Roman Britain, in Jesson, M, & Hill, D, (eds), *The Iron Age and its hill-forts*, 161-88.

4 Boats and boatmanship in the late prehistoric southern North Sea and Channel region

Seán McGrail

Abstract

Evidence for the use of water transport in the southern North Sea and Channel region during the period c 300 BC to c AD 50 is evaluated and boat types, building methods, means of propulsion, and likely performance are described. An attempt is made to build upon earlier work by Ellmers and to identify the characteristics of the Celtic tradition of planked boat and shipbuilding. Methods of navigation, trade routes, harbours and landing places are also discussed, and it is concluded that, well before 300 BC, seamen of north-west France, south-west Britain and south-east Ireland used sail, and were capable of open sea navigation out of sight of land.

Water transport

Theoretical investigations, based upon:

(a) the identification of the materials, tools and techniques required to build the various forms of water transport and

(b) the determination of the earliest appearance in the archaeological record of these characteristics — albeit not in a nautical context

indicate that, by the end of the Neolithic, some 2000 years before the period under consideration, almost all the types of float, raft and boat known to Man could have been built in north-west Europe (Table 4.1). The only types of water transport which became technologically possible after the Neolithic, and are therefore not listed in Table 4.1, are:

(i) bundle boats — for which there is no known tradition outside Arabia

(ii) complex bark boats — for which there is no known tradition in north-west Europe, apart from some minor and late evidence from Finland

(iii) complex plank boats — of which there are indeed examples in the Bronze Age of north-west Europe (see below).

Floats and rafts

No matter how structurally seaworthy they might have been, floats and rafts are unlikely to have been used at sea in early north-west Europe because of the relatively cold sea temperature which, when combined with exposure to wind, can soon lead to hypothermia (McGrail 1987,5). On the other hand it does seem likely that some of the floats and rafts listed in Table 4.1 were used on lakes and rivers in this region.

No ancient floats have survived but there is some evidence for rafts. The earliest excavated log rafts are the two from 2nd century AD Strasbourg noted by Ellmers (1972, 106, figs 83, 84), but there are 1st century BC references to their use on the River Rhine (Caesar Bello Gallico, 1.12,6.35). Earlier use on this and similar rivers seems likely. Bundle rafts have not been excavated, but they have been used in the recent past on inland waters in Ireland and elsewhere (McGrail 1987,163), and early use seems likely wherever reeds were available. Thus, the little evidence there is, suggests that, in the late Iron Age, rafts of logs and of reed bundles and a variety of floats could have been used on inland waters in the lands bordering the southern North Sea and the Channel.

Boats

The evidence for boats is more promising, as there is evidence for logboats (dugout canoes), hide boats and plank boats from before, and actually in, the period under discussion.

Logboats

Logboats have been discovered in Britain, Ireland, France, Belgium, the Netherlands, Germany, and Denmark (Ellmers 1973, McGrail 1978; Rieck & Crumlin-Pedersen 1988), but only about half of the 60 or so that have been well documented are dated to the prehistoric period (Booth 1984; Rieck & Crumlin-Pedersen 1988). Of these, five are from the late Iron Age of the southern North Sea region: Hasholme, c 300 BC (Millett & McGrail 1987); Shapwick, 2305 ± 120 bp (Q-357); Poole, 2245±50 bp (Q-821); Holme Pierrepont 1, 2180±110 bp (Birm-132); and Loch Arthur/Lotus, 2050±80 bp (SRR-403). This is a very limited number on which to base conclusions; nevertheless it seems likely that, wherever there were sizeable trees, simple logboats would have been built and used on inland waters for hunting, fishing, fowling, reed gathering and as ferries of men and of cargo. In some cases these logboats may have carried armed men, as seen in the Roos Carr, north Humberside, models (Sheppard 1901; 1902), recently dated to 2460 ± 70 bp (OXA-1718).

Simple logboats may be modified in several ways to give them the extra transverse stability and freeboard required to become usable at sea. The parent log, providing it is of a suitable timber species, may be expanded, normally after heat treatment, to give greater beam at the waterline and hence increased stability (McGrail 1978, 38-41). Or logboats may be fitted with stabilisers (a sort of close-in outrigger) which also increases their effective beam (ibid, 51-4). A third way of increasing stability is by pairing two logboats side-by-side (ibid, 44-51). Additional freeboard may be obtained by extending logboats vertically by adding one or more strakes of planking to the sides of the basic boat (ibid, 41-3). There is, in fact, no evidence in any of the north-western European logboats dated to pre-Roman

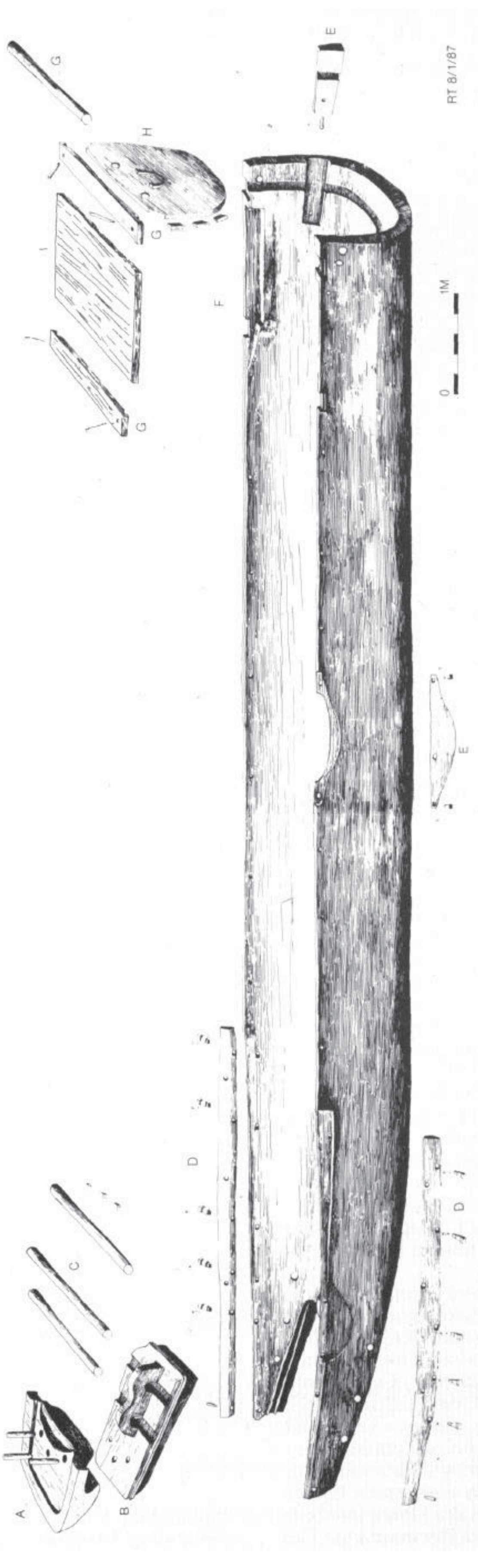

Figure 4.1 Exploded reconstruction drawing of the Hasholme logboat of c300 BC: A. upper bow with treenails; B. lower bow; C. transverse timbers with wedges; D. washstrakes with treenails and keys; E. repairs with treenails and keys; F. shelves; G. beam-ties with treenails; H. transom with wedges; I. hypothetical deck. (Drawing: National Maritime Museum).

Table 4.1 A theoretical assessment of the earliest technological stage that certain types of water transport could have been used in north-west Europe

Technological stage	Water transport	At sea or on inland waters
Palaeolithic	log float	inland waters
	bundle float	inland waters
	hide float	inland waters
	simple log raft	inland waters
	simple hide-float raft	inland waters, but no known tradition
	simple bark boat	inland waters, but no known tradition
	simple hide boat	inland waters
Mesolithic	complex log raft	inland waters
	multiple hide-float raft	inland waters, but no known tradition
	bundle raft	inland waters
	simple log boat	inland waters
	multiple-hide boat	at sea and on inland waters
	basket boat	at sea and on inland waters, but no known tradition
Neolithic	pot float	inland waters, but no known tradition
	pot-float raft	inland waters, but no known tradition
	complex log boats	at sea and on inland waters
	simple plank boats	inland waters

Notes: 1. For definition of types see McGrail 1985c; 1987a, 4-11.
2. For sources of technological evidence see McGrail, 1981, 12; 1987 53-4, 85-7, 96-7, 171-2, 185-7, 191.

times of expansion, or of stabilisers, or of pairing. Thus it seems unlikely, on present evidence, that logboats were used at sea in prehistoric times.

It is generally agreed that comparisons of theoretical cargo capacity are best made when boats (and not just logboats) are loaded to a waterline where 2/5 of the boat's height of sides is freeboard (McGrail 1987, 198-201; 1988, 38). The waterline (2/5 freeboard or 3/5 draft) is the one given for a fully loaded vessel in chapter 166 of the medieval Icelandic Law Code, Grågås (Morcken 1980). Table 4.2 gives comparative figures for two late Iron Age logboats from Poole in Dorset and Hasholme, north Humberside. It can be seen that the Poole logboat, with a draft of only 0.30 m, could readily have used the natural harbour at Poole and the lower reaches of the rivers Frome, Piddle and Sherford, carrying nearly 1 tonne of cargo with a crew of four paddlers (McGrail 1978). The Hasholme logboat, operating in the River Humber, its creeks and tributaries, could have carried over 5 tonnes of cargo with a crew of five (McGrail 1988). Logboats could evidently make a significant contribution to economic and social life in the late Iron Age.

The Hasholme boat is a large and complex logboat and therefore may not be typical of those generally in use in the late prehistoric period (Millett & McGrail 1987). Nevertheless, the techniques used to build her illustrate the high standard of woodworking that Celts could achieve in a region which was not necessarily in the forefront of technology in those times. The boat measured 12.78 x 1.40 x 1.25 m and her parent log was c 800 years old and over 13 m in height, with a lower girth of at least 5.40 m (1.72 m or c 6 ft in diameter). Figure 4.1, an exploded diagram, shows that the Hasholme boat had a two-part bow as an extension to the main log. The lower bow was fastened to the log by a cleat and transverse timber assemblage showing affinities with the Ferriby sewn-plank boats of the 2nd millennium BC (Wright 1976; 1985) and that from Brigg of the mid 1st millennium BC (McGrail 1981b; 1985a). Washstrakes were fastened to the fore part of the main hull by treenails locked in position by keys or cotters (as were the repairs at the stern (Fig 4.2) and on the port side); and three large vertical treenails, 60 mm in diameter, locked bottom, sides, washstrakes and bow elements together. At the stern she had a separate transom wedged in a groove, and three beam ties clamped the

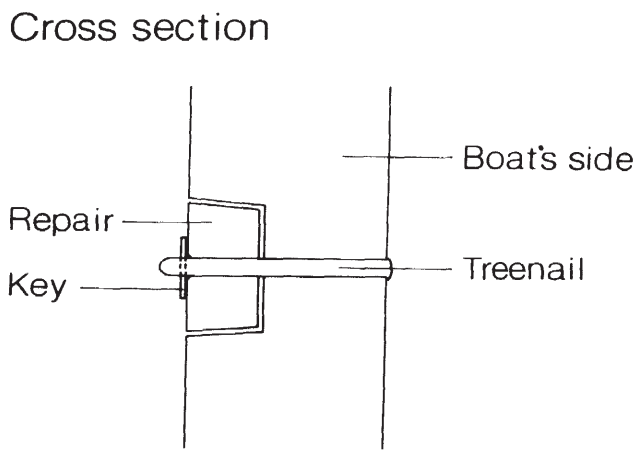

Figure 4.2 Diagram of repair to stern of Hasholme boat. (Drawing: Institute of Archaeology, Oxford).

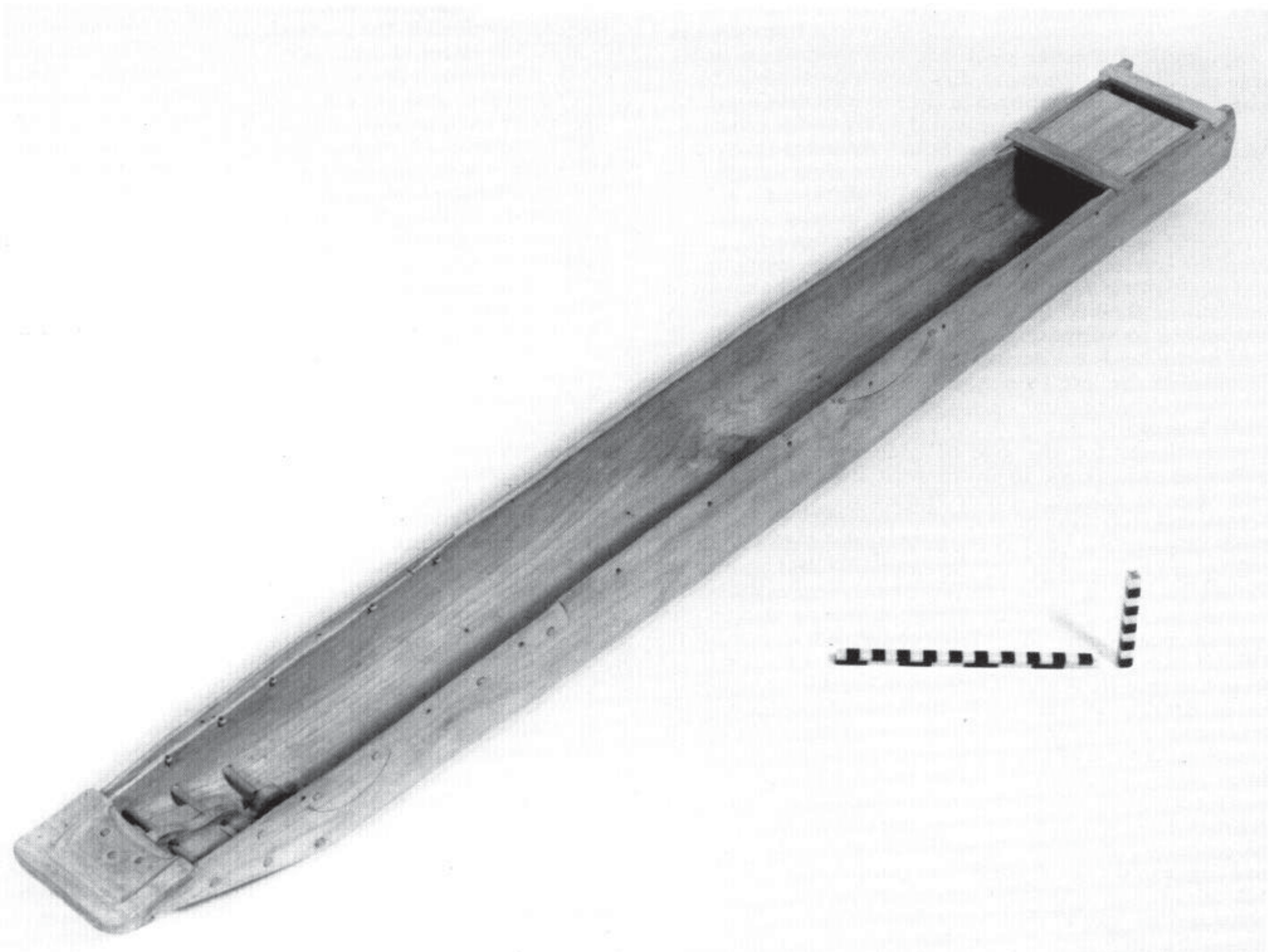

Figure 4.3 1:10 scale model of reconstructed Hasholme boat. (Photo: Institute of Archaeology, Oxford).

Table 4.2 Theoretical load carrying performance of the logboats from Poole and Hasholme

Boat	Description	Draft (m)	Freeboard (m)	%[1]	Deadweight[2] (kg)	Deadweight[3] coefficient
Poole	Light displacement (862 kg)	0.19	0.31	38	—	—
Hasholme	Light displacement (4398 kg)	0.38	0.87	30	—	—
Poole	Maximum men (2 plus 16)	0.30	0.20	60	1080	0.56
Hasholme	Maximum men (2 plus 18)	0.46	0.79	37	1200	0.21
Poole	4 men plus 898 kg peat[4]	0.30	0.20	60	1102	0.55
Hasholme	5 men plus 5502 kg peat[4]	0.75	0.50	60	5802	0.57

Notes: 1. Ratio of draft to maximum height of sides expressed as a %. It is considered that the 60% values are best for comparison of boats as cargo carriers (McGrail 1988).
2. Weight of cargo and crew
3. Deadweight/Displacement. A measure of ability of boats to carry cargo, in particular high density, low stowage factor, loads.
4. Alternatively, materials of greater bulk density (eg grain, meat, timber, iron or stone) may be carried, resulting in increased stability.

sides of the boat firmly against this transom, thus making the stern watertight. Also shown in Figure 4.1 is a hypothetical quarter deck for two steersmen using large paddles; it is thought that such a deck could have rested on the shelves found in the sternsheets (Fig 4.3).

In several parts of the world today — for example, Pakistan (Greenhill 1971) or South America (Edwards 1965) — logboats are used in the same river systems as planked boats. Logboats fit into a different cultural context from planked boats, being usually found in peripheral regions; they are generally preferred to plank boats for economic reasons. Thus it is not surprising to find prehistoric logboats in the River Humber, where prehistoric planked boats were also used, and it seems reasonable to suppose that both types were similarly used in the lands bordering the southern North Sea and Channel in the late Iron Age.

Hide boats

The evidence for the use of hide boats (sometimes known as skin boats) in north-west Europe before the Iron Age is meagre: antler fragments from Husum, Schleswig-Holstein, of doubtful provenance (Ellmers 1984); a so-called boat grave at Dalgety, Fife (Watkins 1980); rock carvings in Scandinavia and northern Russia, including some which probably represent boats, though there are differing views on dating and on the type of boat depicted (Marstrander 1963; Johnstone 1972; Coles & Harding 1979, 317); a small shale bowl from Caergwrle, Wales (Denford & Farrell 1980; Green et al 1980), which it is difficult to demonstrate represents a boat (except in a symbolic way) let alone to identify the type of boat; and some minute gold models from Nors, Denmark (Muller 1886) which do have a more obvious boat-like form (see Fig 14.5) and which Johnstone (1980,126) believes represent Bronze Age hide boats, but which Crumlin-Pedersen (this volume) has suggested may represent expanded logboats of the 5th/6th century AD. This is not to imply that hide boats were not used, for they were technologically possible from the Mesolithic, but the evidence available at present is thin. However, in the Iron Age and the Roman period there is more substantial evidence, although no actual hide boat has yet been found, apart from a 'coracle-like vessel' with a human skeleton found near the River Ancholme at South Ferriby, South Humberside, and thought by Sheppard (1926) to be of Roman date — the remains no longer exist.

A small gold model from Broighter, County Derry, Ireland, dated to the 1st century BC (Farrell & Penny 1975) originally had nine rowing thwarts with associated oars in grommets on each side, and there are also three poles for propelling the boat in the shallows (Fig 4.4). A yard on a mast stepped through a hole in the central thwart indicates that this boat could also be sailed, probably using a square sail of aspect ratio between 0.75 and 1.38, depending on where on the mast the yard was positioned. She was steered by a steering oar over the quarter and had a four-hook grapnel anchor. From the general shape and the proportions of this model it seems likely that it represents a sea-going hide boat of the curach type.

There are several references by Roman authors (1st century BC - 3rd century AD) to the contemporary use of hide boats on inland waters and at sea off north-west Europe (Caesar, Bello Civili, 1.54; Pliny, 7.206; Lucan, Pharsalia 4, 130-8; Solinus, Polyhistor 23). Two other references are important because they contain information from much earlier sources. Pliny (4, 104), writing in the 1st century AD and quoting from an early 3rd century BC history by Timaeus, states that Britons involved in the tin trade used boats with a withy framework covered with sewn hides (vitilibus navigiis corio circumsatis; see also Pliny Nat Hist 34, 156). In his 4th century AD poem, Ora Maritima, Avienus preserved extracts from an early periplus which Hawkes (1977, 19) and others date to the 6th century BC, before the time when the Cathaginians are known to have prevented Greek ships passing through the Strait of Gibraltar. Periploi were originally oral aids to coastal pilotage for mariners and traders, and the Massaliote periplus quoted by Avienus describes the main features of a voyage southbound along the western coast of Atlantic Europe and then along the northern shores of the Mediterranean to Massilia (Marseilles). There are undoubted difficulties in interpreting the names of people and places mentioned, difficulties increased by the apparent interpolation of extraneous matter — for example, Himilco of Carthage's description of a windless, tideless, seaweed-strewn sea (Murphy 1977, line 117-29, 380-9, 406-16). Nevertheless, the main elements of the description are clear, even if some details remain ambiguous. The information of relevance to the present discussion — those lines dealing with seafarers who lived in the vicinity of a headland Oestrymnin — may best be presented by paraphrasing and interpreting Murphy's translation (1977):

> The hardy and industrious peoples of the islands and coasts of the lands around Ushant or Ouessant [ie the predecessors of the Veneti, Osismii and Coriosolites] were heavily involved in maritime trade, much of it in tin and lead. They used hide boats (netisque cumbis) on these oceanic voyages. [Lines 94-107]
> From Ushant/Ouessant it is two-days' sail to Ireland [see Fig 4.5; a two-day voyage requires an average of c 5 kts made good — which is not impossible] and Albion [Britain] is sighted on this voyage. [Lines 108-112]
> Merchants from Tartessus [a harbour in the Gulf of Cadiz, south-west Spain], from Carthage, and from the vicinity of the Pillars of Hercules [Strait of Gibraltar] sailed to the Ushant/Ouessant region to trade. [Lines 113-116]

Thus, from at least the early Iron Age, hide boats were used on sea-going trading voyages in the western Channel and the north Bay of Biscay region.

Caesar (Bello Civili, 1.54) states that British hide boats had keels, and this is sometimes thought to have been a mistake as 20th century Irish and Welsh curachs and coracles do not have them, and only certain types (eg those from County Kerry) have a central lath which is broader than other laths in the framework. However, Adomonnan in his 6th/7th century AD Vita St Columbae (Anderson & Anderson 1961) and other medieval authors (Marcus 1953-4, 315) refer to curachs with keels, and a late 17th century drawing by Captain Philips, now in the Pepys Library, Magdalene College, Cambridge, shows a large Irish sailing curach with prominent keel and stem (Fig 4.6). It seems very possible that Iron Age sea-going hide boats similarly had keels and stems.

Philip's 'Wilde Irish' curach also has a woven wickerwork hull inside the hide (as has a 19th century Scottish curach now in Elgin Museum; Fenton 1976), and not the unwoven, fastened-lath framework of recent curachs. Descriptions by Caesar (Bello Civili, 1.54), Lucan (Pharsalia 4, 136-8), Pliny (Nat Hist 7, 205-6; 34,

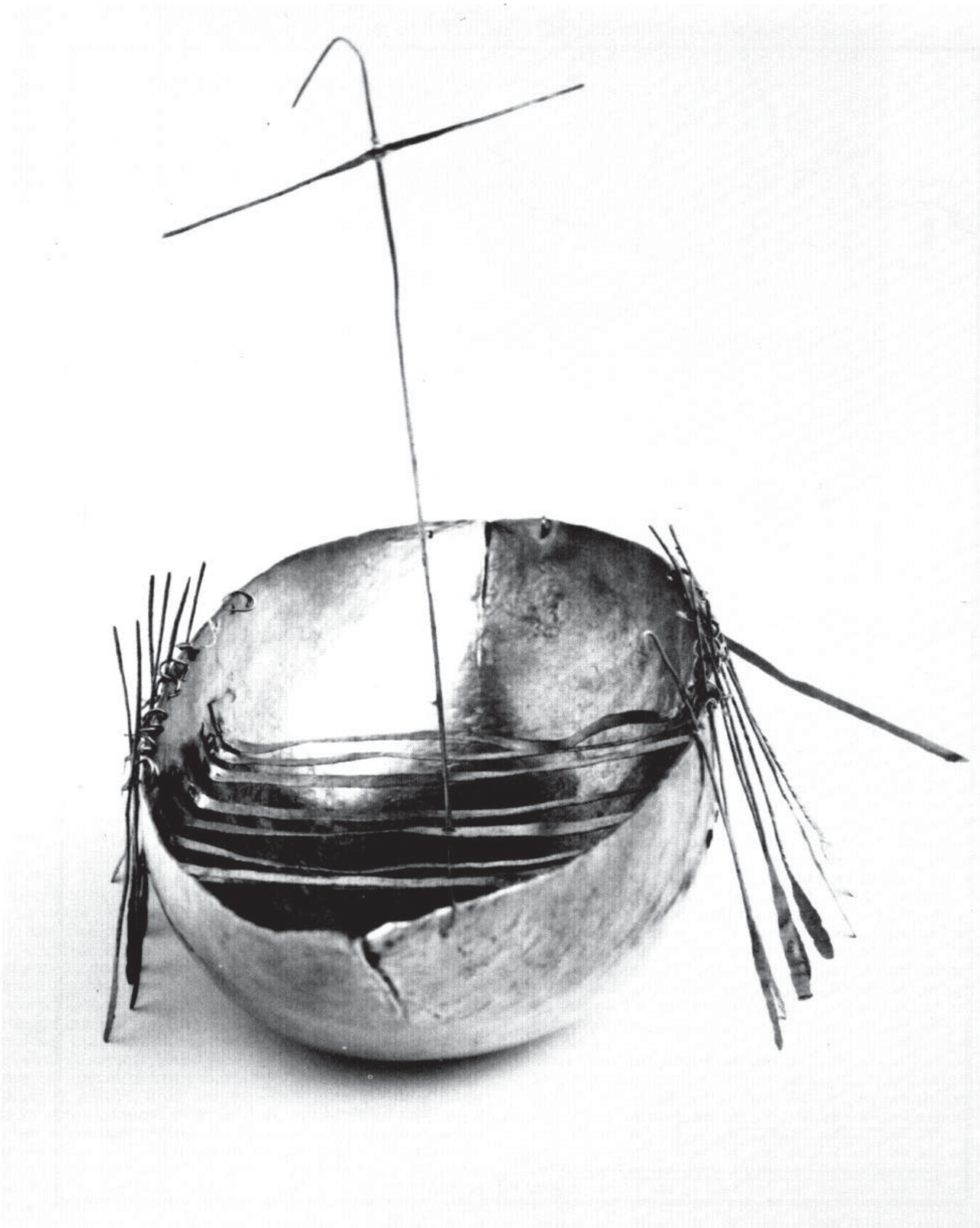

Figure 4.4 Small gold model boat of 1st century BC from Broighter, Co Derry, Ireland. (Photo: National Museum of Ireland).

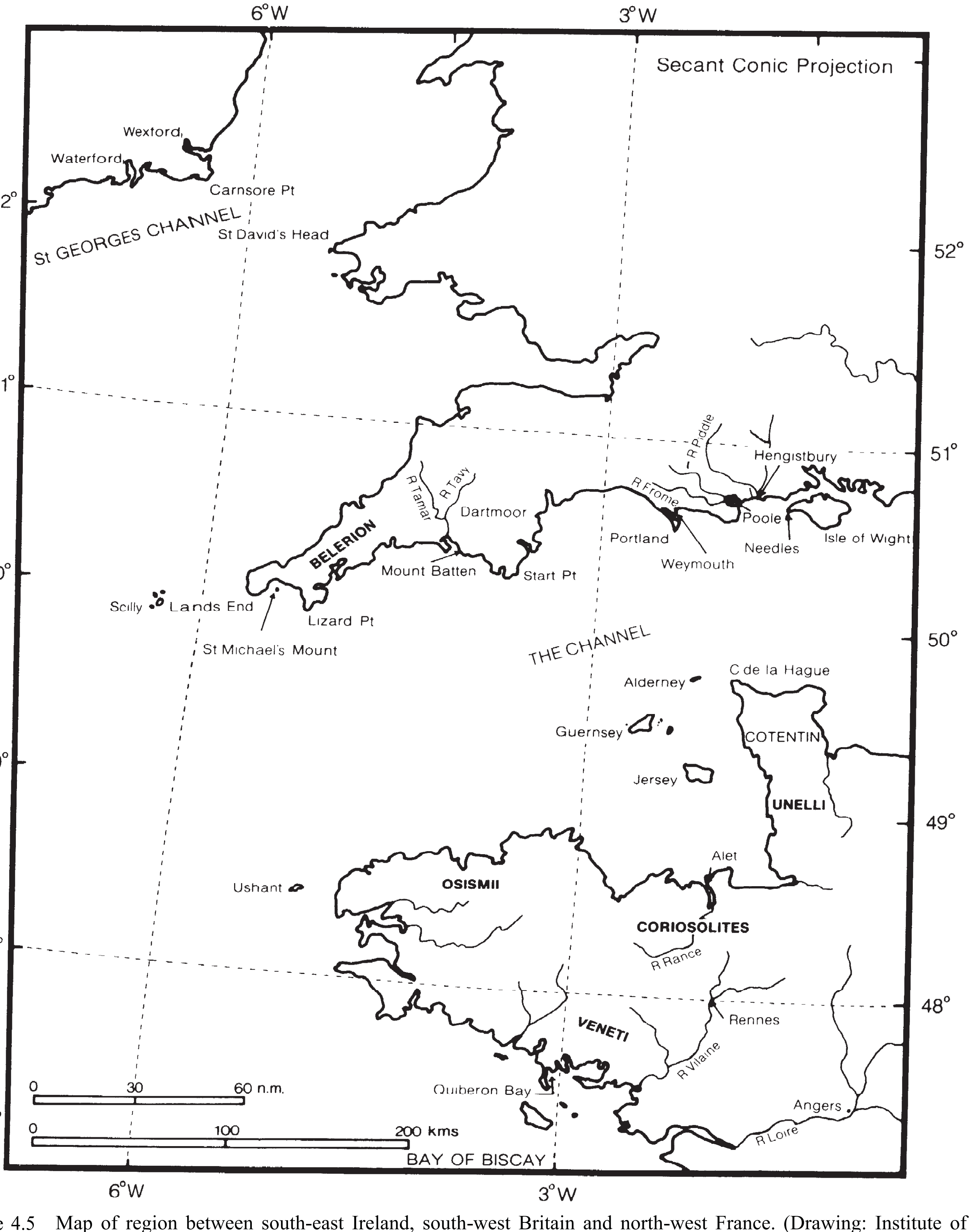

Figure 4.5 Map of region between south-east Ireland, south-west Britain and north-west France. (Drawing: Institute of Archaeology, Oxford).

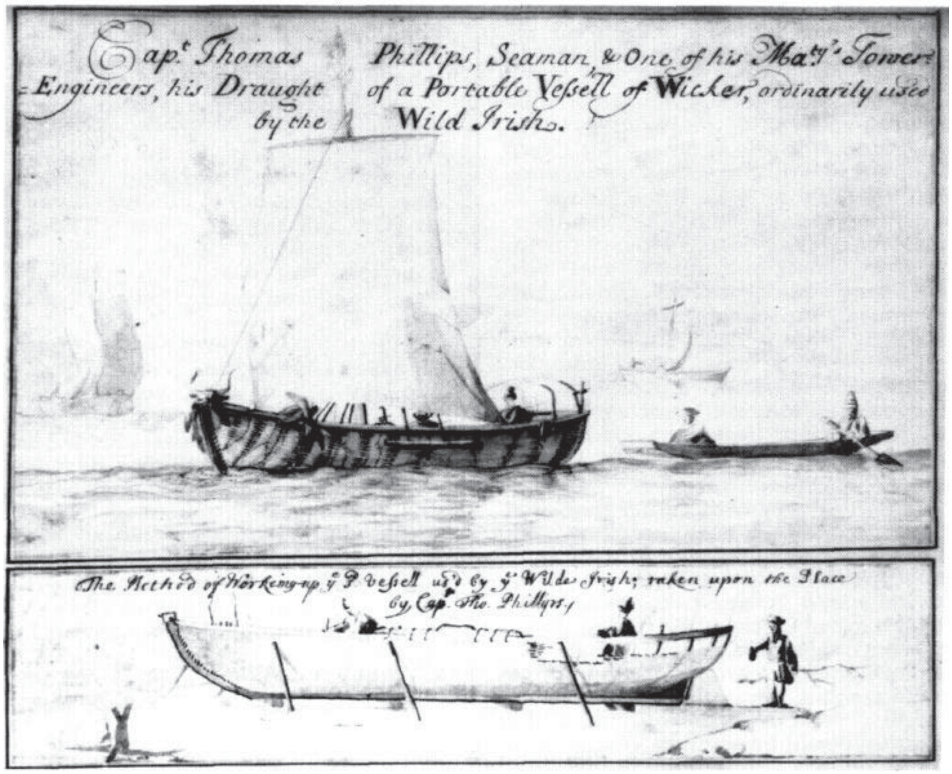

Figure 4.6 Captain Phillips' late 17th century drawing of curachs. (Photo: Pepys Library, Magdalene College, Cambridge).

156) and Dio Cassus (48, 18-19) strongly suggest that the framework of early British and Irish hide boats also was a woven wickerwork. It seems likely that these boats, which were probably the most important type in prehistoric north-west European waters for exploration, trade and fishing, were similar in form to the 20th century Siberian baidara or the Inuit umiac (McGrail 1987, 173-87) of the circumpolar zone (themselves not unlike the Broighter model); and in size say, 11.0 x 1.75 x 0.60 m. These late Iron Age hide boats were probably propelled by a single square sail, or by oars in foul winds, and steered by a steering oar over the quarter as we see on the Broighter model.

Hide boats fit well into an environment with exposed coasts, where there are few large trees but a good supply of hides from land or sea animals, and where life can be sustained by animal husbandry and by sea fishing and hunting— a 'crofter' economy. They are quickly built, are cheap when compared to a plank boat of similar capacity, and are readily repaired. Hide boats can be operated from almost any shore from informal landing places, and are excellent surf boats. Their lightweight structure is buoyant, giving good freeboard even when loaded; thus in general terms they are more seaworthy and seakindly than equivalent plank boats. The woven framework is resilient and energy absorbent, yet it holds the shape of the boat and gives strength to the hull for least weight. Although Severin's Brendan may not have been an authentic replica of a prehistoric sea-going hide boat, her trials did demonstrate that such a boat had good seakeeping qualities and was generally reliable (Severin 1978).

There are some disadvantages to these boats: the hide cover, which is relatively easily holed contributes little to strength, and thus boats are limited in length to c 12 m (or possibly 18 m; McGrail 1987, 184); thus they could never have been enlarged into ships. The lightness of the structure and consequent good freeboard also mean reduced resistance to leeway (despite having a protruding keel and the use of a steering oar), thus windward performance may not be as good as that of a comparable planked boat. Nevertheless, in certain physical environments and economic conditions, the hide boat has advantages and is preferred to the planked boat, and there is every reason to believe that they were widely used in the early southern North Sea and Channel region, both sea-going types and others more suitable for inland waters, even though in certain parts of that region the planked boat was also known and used (see below).

Bronze Age planked boats

Despite the apparent dominance of hide boats as sea-going craft in the early Iron Age of the southern North Sea and Channel region, the future was to lie — as in the rest of the world — with the planked boat which, of all the boat types, was the one that could be successfully developed into a ship. There are five planked boats from north-west Europe dated to the Bronze Age: three finds from North Ferriby, North Humberside, dated to the 2nd millennium BC (Wright 1976; 1985); the planked boat from Brigg, South Humberside, of the mid 1st millennium BC (McGrail 1981b; 1985a); and the boat from Hjortspring, Als, southern Denmark, dated to c

Table 4.3 Theoretical cargo capacities of the plank boats from North Ferriby, Brigg and Hjortspring

Boat		Draft (m)	Freeboard (m)	%[1]	Deadweight[1] (kg)	Deadweight[1] coefficient
Ferriby	1	0.30	0.36	45	3000	0.54
		0.40	0.26	61	5500	0.52
Brigg	2	0.25[2]	0.09	74	1540	0.23
		0.46[3]	0.09	84	7160	0.57
Hjortspring		0.31	0.39	44	2110	0.80

Notes: 1. See notes 1, 2 and 3 in Table 4.2.
2. Side height of 0.34 m.
3. Side height of 0.55 m.

350 BC (Rosenberg 1937). These boats were all sewn-plank boats, no iron fastenings were used, and they were all suitable for river and estuary work rather than open sea voyages, the Brigg 'raft' of box-like form being especially suited to upstream work. The Ferriby boats with their high length/breadth ratio (c 6:1) were evidently built with speed in mind, essential when crossing the tidal Humber estuary. Estimates of the cargo capacity of these three boats are given in Table 4.3, although these figures are not directly comparable as they have not been calculated at similar waterlines.

None of these boats had any evidence for sailing or rowing (the earliest evidence in north-west Europe of oared propulsion is on the small gold model from Durrnberg of the 5th century BC; Ellmers 1978), and it must be assumed that they would have been propelled and steered, by paddles, which were indeed found with the Hjortspring boat.

The Brigg 'raft' is keel-less: Ferriby boat 1, on the other hand, has a keel, in the sense that the central longitudinal member of the bottom is of greater scantlings than the remainder of the bottom planking, but it is not a very prominent one and may be best classified as a 'thin-plank' keel (McGrail 1987, 112-13). There are suggestions, however, that, in addition to the Ferriby/Brigg type of planked boat, there were also boats with prominent keels and stems in early Britain: the Bronze Age boat-shaped log coffin from Loose Howe, North Yorkshire (Elgee & Elgee 1949) has a pseudo-keel and stem; and the Iron Age logboat from Poole, Dorset has a pseudo-stem. Such features are non-functional on a logboat and thus must have been copied from a planked boat, or possibly a hide boat.

Early Iron Age planked boats

Table 4.4 attempts to summarise the range of boatbuilding techniques available to late prehistoric man in north-west Europe, based on the evidence from boat-shaped coffins, logboats, hide boats and planked boats. Thus, at the beginning of the period under review, some or all of these techniques could have been used to build the planked boats of the southern North Sea region. Whether there were in fact early Iron Age planked boats with these features remains to be

Table 4.4 Techniques available to the late prehistoric boatbuilders of north-west Europe

Shape	● flat-bottomed (Ferriby, Brigg)
	● round-hulled (Hjortspring, Logboats)
Sequence	● shell (Ferriby, Brigg, Hjortspring)
	● skeleton (Hideboats)
Ends	● with stems (Loose Howe, Poole)
	● with stems plus protrusion (Hjortspring)
	● without stems (Ferriby, Brigg)
Keels	● with prominent keel (Loose Howe)
	● without keel (Brigg, Hjortspring)
	● with 'low-profile' keel (Ferriby)
Planking	● overlapping but superficially flush-laid (Ferriby, Brigg, Hasholme)
	● overlapping clinker-style (Hjortspring)
Caulking	● moss (Ferriby, Brigg, Hasholme)
	● hide (Poole)
Fastenings	● sewn (Ferriby, Brigg, Hjortspring)
	● cleats with transverse timbers (Ferriby, Brigg, Hasholme)
	● locked treenails (Hasholme)
	● metal (Holme-Pierrepont 1)
Occuli	● boat's eyes (Logboats from Brigg, Loch Arthur, Hasholme and the Roos Carr model)

Sources: Wright 1976; 1985; McGrail 1981b; 1985a; Rosenberg 1937; Elgee 1949; McGrail 1978; Millett & McGrail 1987.

demonstrated by excavation, and whether such hypothetical boats were used at sea, in addition to hide boats, or were restricted to lakes, rivers and estuaries, as were their only known Bronze Age predecessors, must remain an open question for the present.

Later Iron Age planked boats

The early Iron Age planked boat is therefore conjectural, but towards the end of the Iron Age, in the 1st century BC and the early 1st century AD, the sea-going plank boat becomes more tangible as there is documentary and iconographic (but not excavated) evidence for them in the Channel region.

The Veneti boats

Caesar (Bello Gallico, 3.13) and Strabo (4.4.1) have left descriptions of the sea-going boats of the Veneti, a sub-group of the Belgae of north-west France (Fig 4.5). These vessels were solidly built with high bow and stern, and bottoms that were flatter than those of the Roman ships, enabling them to sail closer inshore and to take the ground readily in tidal waters. These Celtic craft were more seaworthy than Caesar's ships, yet not so fast. Most, if not all, of these differences are to be expected when sail-propelled Channel trading vessels are compared with oared warships which, although they may have been built on the River Loire (Bello Gallico, 3.9) were undoubtedly to a Mediterranean specification. Other points made by Caesar and Strabo may be more diagnostic of the late Iron Age, Celtic boatbuilding tradition.

The Veneti ships had oak planking — presumably (at least superficially) flush-laid, otherwise the difference from the Classical tradition would have been noted. This planking was caulked with what is usually translated as 'seaweed' but which may have been moss (E V Wright, pers comm) or even reeds (harundines) which Pliny (Nat Hist, 16.158), of the 1st century AD, tells us was used by the Belgae to caulk seams 'where it held better than glue and was more reliable than pitch'. The Veneti boats' thwartships timbers (transtra — which should probably be translated as 'frames' or 'floor timbers' rather than 'crossbeams') were c 1 ft or 0.30 m thick (pedalibus in altitudinem) and were fastened by iron nails (ferreis digiti), a thumb or 1 inch (25 mm) in diameter. Caesar tells us these ships were propelled by leather sails but he gives no description of mast, yard or standing and running rigging, except for a passing reference to ropes (funes) which fastened the yard to the mast. There is also no mention of the steering arrangements and so, perhaps, it may be concluded that it was by side rudder, generally similar to those used in Classical ships. Caesar does, on the other hand, tell us that the Veneti used iron chains with their anchors — these chains were probably forerunners to cables of organic material and similar to the 6.5 m iron chain found with a 1st century AD iron anchor at Bulbury, Dorset, some 2-3 miles up the River Shelford from Poole Harbour (Cunliffe 1972).

Caesar (Bello Gallico, 3.8) and Strabo (Geog, 4.4.1) also describe the seafaring activities of the Veneti, how they had numerous ships and exercised authority over coastal traffic by making 'almost all' pay tribute. In the theory and practice of seamanship they had no equal, and they regularly sailed to an emporium in Britain,

The distribution of Veneti gold coins (Galliou 1977) indicates that the Veneti, from their territory in Morbihan, were active up the River Loire beyond Angers, along the rivers Auine and Elorn, and as far as Rennes on the River Vilaine (Fig 4.5). On the other hand, they are not well documented in the archaeological record of Britain but, as Cunliffe (1982, 43-5) and Langouët (1984) have pointed out, the Coriosolites are, in both coins and pottery. The latest distribution maps of early amphorae finds (Galliou 1984; Fitzpatrick 1985) seem to reflect a coastal trade from the Garonne and the Loire to Ushant, with the possibility thence of a direct crossing Ushant/Lizard or a coastal route to Alet, the Coriosolites' emporium. Galliou (1977; 1984,28) has pointed out the possibility of an overland route between Quiberon Bay and Alet via the rivers Vilaine and Rance, with a portage between headwaters. Early amphorae have also been found in the Cotentin peninsular and the Channel Islands suggesting the involvements of the Unelli/Venelli in this cross-Channel trade.

Although Caesar creates an impression of the unique maritime power of the Veneti, his statement that 'almost all' paid them tribute, implies that there were other Celts independently involved in trading voyages. In their fight against Caesar the Veneti were helped, not only by British auxiliaries, but also by most of the tribes of coastal Armorica and Belgic Gaul, from the Osismii near Ushant to the Manapii at the mouth of the Rhine, except for the Coriosolites of the Brittany Côte du Nord and the Venelli/Unelli of the Cotentin peninsula (Bello Gallico, 3.9). Documentary and archaeological evidence thus tend to suggest that, although the Veneti may have specialised in trading voyages along the Atlantic coast from the Loire to near Ushant and across the western Channel route to Britain (and possibly to Ireland as their predecessors had done in hide boats 500 years earlier), the Coriosolites and Venelli/Unelli used the mid-Channel route, Mediterranean goods having been brought to Alet and the Cotentin peninsula for trans-shipment, despite the Veneti 'monopoly'.

Several attempts have been made to put flesh on the skeleton of Caesar's description of the Veneti vessels. Creston (1956; 1961) thought that they must have been like the early 20th century sinagot (Le Yacht 601 (14.9.89), 310-11) of the Gulf of Morbihan, whilst Beaudouin (1975, 104) saw similarities with a 19th century boat from Brest, the lanvéoc (Paris 1882, pl 38). Others have seen aspects of Caesar's descriptions in the Romano-Celtic boats of the 2nd-3rd century AD, and there are more similarities here than in the earlier speculations (see papers by Rule, Arnold, Marsden and Lehmann in this volume).

The ponto

Johnstone (1980,87-8) and, following him, Weatherhill (1985) have suggested further consideration should be given to the ponto, a view first expressed by Jal (1848, 1201) and then by de la Ronciere & Clerc-Rampel(l934, 2-3). Some six years after Caesar had first encountered the Veneti ships he mentions in his book on the Civil War (Bello Civili 3.29) pontones quod est genus navium Gallicarum, a 'kind of Gallic craft' known as a ponto, which was a navis oneraria, capable of transporting troops, and possibly horses. This ponto probably had a reputation as a reliable sailing ship for Antony left thirty of them at Lissus in north-west Greece so that Caesar might use them to pursue Pompey (Bello Civili 3.40).

Johnstone (1980, 87-8) has drawn attention to a ponto named and depicted on a mosaic from a cross-shaped floor in the frigidarium of the Maison des Muses at Althiburus (Mediena), Tunis, now in the Bardo Museum. This mosaic, dated to the second half of the 3rd century AD but probably copied from an earlier source, has illustrations of nearly 30 ships and boats named in Latin and sometimes in Greek (Dunbabin

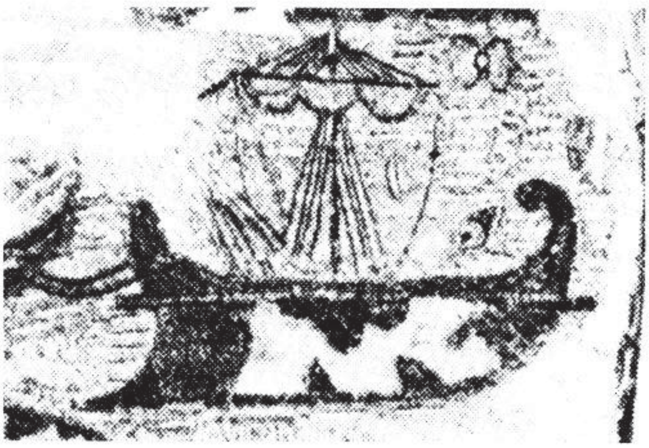

Figure 4.7 A ponto on 3rd century AD mosaic from Maison des Muses at Althiburus, Tunisia. (Photo: Bardo Museum, Tunis).

1978, 24, 127, 136, pl 122). The ponto (Fig 4.7 and 4.8), which is being towed by a boat of similar form, appears to be a ship of some size, with a relatively deep hull (length/depth = 3.36). The sheerline is generally parallel to the keel except at the ends where it rises sharply and, at the stern, curves forward. There appears to be a wale or rubbing strake below the sheer. She was propelled by a square sail (aspect ratio of c 1) on a mast stepped near amidships which is supported by shrouds. The yard, on which the sail is furled, has several lifts to the mast-head, and braces from the yard arms to the deck. Other rigging leads to a now-obliterated, sharply angled mast which probably had an artemon sail over the bows. There is a rudder on the port quarter which may be one of a pair.

Stem projections

This appears to be a representation of a ship 'high and dry' rather than afloat, thus the lowest part of the hull visible may be taken to be the keel which meets the curved stem in a projecting forefoot. Projections of various forms may be seen, for example, on the prehistoric Hjortspring boat (Rosenberg 1937); on late Bronze Age and early Iron Age Scandinavian rock carvings (Christensen 1972, 162); on 1st century BC

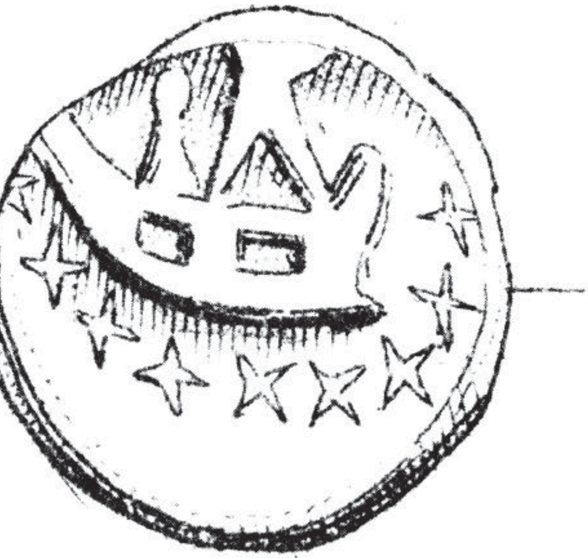

Figure 4.9 Drawing of ship on gold coin of 1st century BC Atrebates in Cabinet des Medailles, Paris. (After Muret et Charbouillett 1889, pl 35, coin 8611).

coins of the Continental Atrebates (Fig 4.9); on British coins of the early 1st century AD (see below); on a Gallo-Roman bronze model river boat from Blessey near the source of the River Seine (Johnstone 1980, fig 12.5); on several late 3rd century AD coins of Allectus (Marsden 1964; Dove 1971); and on an engraved stone from Löddeköpinge, Sweden, tentatively dated to the 9th century AD (Rieck & Crumlin-Pedersen 1988, 131, 143) (Fig 4.10). They are also found in the Mediterranean region; on Minoan engravings of c 2000 BC (Casson 1971, fig 36); on 7th century BC boat models and engravings from Italy (Bonino 1975); on the 3rd century BC Punic shipwreck from Marsala (Basch & Frost 1975); and on the 1st century BC Madrague de Giens wreck (Tchernia et al 1978); on lst/2nd century mosaics at Ostia (Basch 1983, fig 1); on a mosaic of the 1st century AD at Magdala (Raban 1988); see also Casson (1971, figs 30, 137, 140, 145, 191). They have been known in the 20th century on boats of the Celebes (Hornell 1946, 210, fig 39); in Lake Victoria (Worthington 1933); Siberia (Brindley 1919/20); and in Oceania and the Indian Ocean (Hale 1980, 126). These projections are thus wide-ranging in time and space.

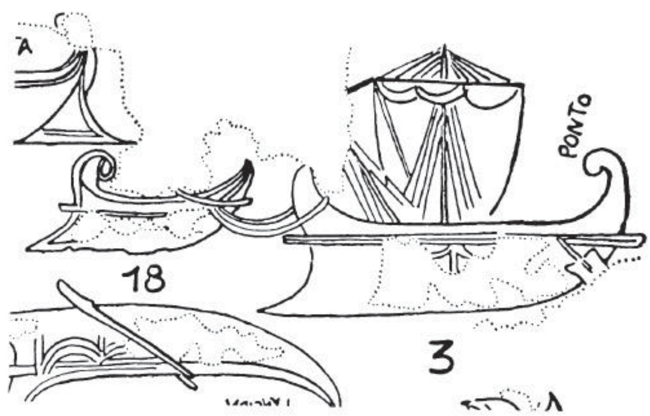

Figure 4.8 Drawing of the Althiburus ponto and tug. (After Gauckler 1905, pls 9 and 10).

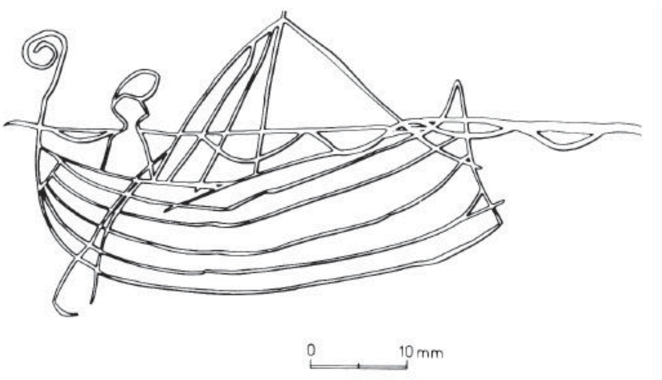

Figure 4.10 Drawing of 9th century engraving found at Löddeköppinge, Skane. (After Rieck & Crumlin-Pedesen 1988, 143).

Only rarely do they represent rams, which are only practicable at the waterline of an oared fighting vessel. There are a number of other reasons why boats may have such projections:

(i) for use when beaching bows first when the protrusion prevents the bows digging in,

(ii) to increase speed potential, by increasing the waterline length, by reducing resistance or drag due to the cancellation of the bow wave, and by fairing an otherwise blunt bow,

(iii) to improve windward performance by increasing the lateral plane area thus increasing resistance to leeway,

(iv) to improve steering characteristics (Mudie 1986, 53),

(v) in a short, steep sea it is said to be effective in keeping up a boat's head (Worthington 1933, 161), or,

(vi) as a structural solution to the problem of making a strong, watertight joint between keel and stem by running the keel beyond the stem and supporting the latter by an external knee.

Ships on Celtic coins

The representation of boats with stem projections, nearest in time and place to Caesar's Veneti, are the one on the 1st century BC Atrebates gold coin (Fig 4.9) and those on two bronze coins of Cunobelin (Figs 4.11 and 4.12). The Atrebatic depiction is stylistic and little more than the fact that this is a relatively deep boat with a bow projection can be deduced. The coins from Canterbury and Sheepen, which were issued by Cunobelin of the Trinovantes/Catuvellauni during the period 20-43 AD (van Arsdell 1989, 408, cat no 1989-1, pl 51), show more details.

Figure 4.11 Early 1st century AD bronze coin of Cunobelin from Canterbury. Scale 2:1 (Photo: Canterbury Archaeological Trust).

There are problems in interpreting representations on coins: the engraver is constrained by the shape and size of the coin; he may be drawing something from outside his own experience and the model he uses may be taken from another culture and/or another age; the representation may be stylised and details may be difficult to interpret; and boats are generally represented by a longitudinal elevation whereas transverse sections are needed if worthwhile estimates of performance are to be made. The difficulties here have been well described by Coates (1987). Even when it is certain that the representation is of a boat or ship, it is difficult to be certain about the precise type depicted. Marsden (this volume) has, for example, raised the question of whether the boats depicted on the two Cunobelin coins may be representations of Classical vessels in view of the fact that on the reverse of both coins there is a copy of a Classical motif, a standing winged Victory. However, there are other instances of Celtic and Classical art forms appearing on the same coin, for example, early 1st century AD silver coins of Verica of the Atrebates/Regni (van Arsdell 1989, 164, cat no 506-1) has a bull of Augustus on the obverse and a Celtic deity on the reverse (Andrew Burnett, pers comm).

Moreover, there is reason to believe that Cunobelin was indeed in the political, economic and geographic position as leader of the Trinovantes/Catuvellauni to use his own ships in the cross-Channel trade, the main axis of which had, by this time, moved from the western and central Channel to the eastern crossings linking the Rhine mouth and Belgic Gaul with the Thames and the Essex Stour, Blackwater and Colne (Cunliffe 1982, 52-3; van Arsdell 1989, 393). Furthermore, it is not possible to suggest a Classical representation of a sailing vessel with the group of features shown on the Cunobelin coins from which they might have been copied. It seems not unreasonable, then, to consider the alternative hypothesis that the engraver depicted a ship type that he knew, and that these are representations of a ship of the Trinovantes/Catuvellauni which Cunobelin recognised as a prime support to his political prestige which was based on cross-Channel trade, as suggested by Muckelroy et al (1978).

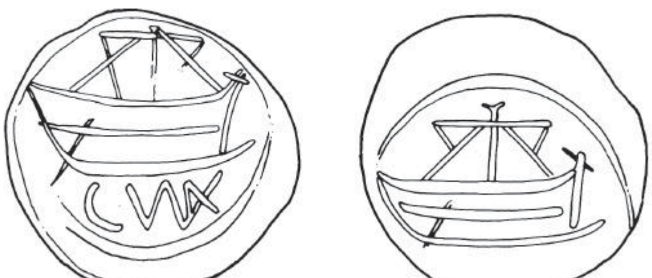

Figure 4.12 Drawing of the Cunobelin coins from Canterbury (left) and Sheepen near Colchester (right). Scale 2:1. (Drawing: Institute of Archaeology, Oxford).

The ship on the Canterbury bronze coin (Fig 4.11) has a relatively deep hull (L/d = 3.2), comparable with that of the Althiburus ponto. The sheer line is generally parallel to the keel except at the ends where it rises, especially at the bows. She was propelled by a square sail (aspect ratio of c 0.70) on a mast stepped just forward of amidships, which is supported by forestay and backstay. The mast is cut short at the edge of this coin, but on the coin from Sheepen (Fig 4.12) there appears to be a feature at the mast head. The yard is depicted fore and aft, as is often the case on coins, and there appear to be braces from the yard-arms (or possibly these lines depict the sail). There is a transverse spar at the head of the fore stem (also on the Sheepen coin) which may represent a cleat for securing a bowline to the weather leach of the sail, thereby improving windward performance, or it may be a lead for an anchor cable; it seems too low to be the yard for an artemon sail.

This appears to be a representation of a ship 'high and dry' rather than afloat, thus the lowest horizontal line is the keel which displays some rocker or longitudinal curvature. As in the Althiburus ponto, the keel meets the fore stem (here straight rather than curved) in a projecting forefoot. The near-horizontal lines half-way down the hull may represent a wale, or possible the waterline. A side rudder appears to be depicted to the left of the coin, is, on the starboard quarter of the vessel.

The coin from the River Colne at Sheepen, near Colchester, was found by an anonymous metal detector in 1980 and is now in the British Museum (1981/12/34/1). The boat depicted is generally similar to that from Canterbury but is not from the same die as certain proportions and measurements are different: the L/d is 3.5; the yard/mast ratio is c 0.76 (compared with 0.64); the square sail would have had an aspect ratio of c 0.48; and the rise in sheer at the bow is not abrupt, being similar to the stern.

The ships depicted on these two coins, with their distinctive sheerline, were evidently designed to be seaworthy craft. Furthermore, the possibility that they were fitted with bowlines and with braces suggests that attempts had been made to make them weatherly, as does the projecting forefoot, for (as with the ponto) this was not a beaching aid. In (near) tide-less seas, as in the Mediterranean, beaching by running a boat ashore is often practicable, but in tidal zones, as in the Channel, an alternative and frequently better method is to let the boat or ship take the ground on a falling (ebb) tide and at about half-tide, thus avoiding being neaped (stranded above the high water mark). The rockered keel of the Cunobelin ships (in longitudinal section the keel has a slight rise away from midships) would have been a useful characteristic when beached, for it would facilitate re-floating on the rising (flood) tide. If these Cunobelin ships had a waterline beam in proportion to their depth of hull they would have been stable, seaworthy ships of good cargo capacity, but not outstanding for speed. These characteristics, together with their weatherliness and their ability to operate from informal landing places, were necessary in cross-Channel trade; they also match aspects of Caesar's description of the Veneti craft.

The ponto, the Celtic coin ships and the boats of the Veneti

Interpretation is obviously limited by the nature and quality of these representations; nevertheless it is possible to recognise that the Althiburus ponto and the Cunobelin ship have certain features in common:

(i) they both (and the Atrebates coin) have relatively deep hulls, suggesting a cargo carrying function,
(ii) the main mast is stepped near amidships in a position suitable for a square sail; the method of slinging the yards from their mid-points provides support for this hypothesis,
(iii) the ponto has braces; the Cunobelin ship probably has them,
(iv) the ponto has wales; the Cunobelin ship probably has them,
(v) both (and the Atrebates coin) have stem projections.

The differences may also be listed:

(i) whereas both sheerlines rise markedly at the ends, the ponto's after post is incurving in stylus fashion (Casson 1971, 66-8),
(ii) neither ship has a high aspect ratio sail, but the ponto's ratio is greater (1 compared with 0.70/0.50),
(iii) the ponto's yard is supported by lifts,
(iv) the Cunobelin ship's sail may have had a bowline to taughten its leading edge when close to the wind,
(v) the ponto has an artemon as an auxiliary sail,
(vi) the ponto mast is supported by shrouds whereas the Cunobelin mast has stays. This may not be especially significant as shrouds and stays together on a representation hide detail and the two craftsmen may have chosen to omit one or the other for clarity,
(vii) both have side rudders but the ponto may have had two,
(viii) the ponto keel is straight and its stem is curved, whereas the Cunobelin ship has a rockered keel and a straight stem.

Caesar's and Strabo's descriptions undoubtedly refer to a type of Celtic sea-going cargo ship used in the Channel and the northern region of the Bay of Biscay in the 1st century BC. Whether this was the ponto subsequently mentioned by Caesar seems likely but is not certain. We cannot, however, precisely equate the 1st century BC ponto of Caesar with the 3rd (possibly 2nd) century AD ponto of Althiburus, for it is well-known for ship types to change over time, both in form and in function, although the same name continues in use - for example, the punt, the barge and the hulc. On the other hand, Caesar was evidently impressed by the capabilities of the Veneti cargo ships and it is not unlikely that he requisitioned some for his own fleet. Such a vessel would need some modification for use in Mediterranean waters and it is likely that there would be some introduction of Classical techniques and practices. Gains in general shipbuilding knowledge and competence are also likely to have occurred with the passage of time. Thus an artemon sail and paired side rudders could have been fitted, as we see on the Althiburus ponto, to increase manoeuvrability and improve steering. The introduction of the head sail would have necessitated the moving aft of the mainmast towards the centre of the waterline length. The use of an oared tug to tow the Althiburus ponto suggests not only the use of harbours rather than informal landing places, but also an increase in size of ship. Large ships require larger masts and yards and heavier yards require lifts to be fitted. Other changes in the rigging and the addition of an incurving stern suggest there may have been less requirement in the 2nd/3rd century Mediterranean to sail close-hauled and more time spent with a following wind and sea. The use of formal harbours where the vessel could berth alongside a waterfront implies not only that a rockered keel was no longer essential but also that the ponto stem projection was not to assist in beaching but more probably to improve the hydrodynamics of the hull.

The Celtic tradition of boat- and shipbuilding

As is often the case in a proto-historic period, there are problems in attempting to conflate archaeological and documentary evidence and to identify archaeological entities with historical facts. Nevertheless, there is sufficient overlap in the several forms of evidence considered above to advance as a working hypothesis that, in Caesar's descriptions of the Veneti craft and of the Gallic ponto, in the ships depicted on the Atrebates and Cunobelin coins, and in the ponto on the Althiburus mosaic, we can see different aspects of a boatbuilding tradition indigenous to the southern North sea and Channel region, which changed somewhat over time and was adapted for several functions, including use in the Mediterranean. A boat- or shipbuilding tradition is a broad concept and there is no requirement that all vessels built in that tradition, even at any one time, should be identical. Such variability may be due to differences in function or in operating environments, or to local preferences, or to technological progress. In any one planked boat or ship tradition, for example, the Viking or the Classical, we may expect to find river barges, ferries and coastal fishing boats as well as fighting vessels and ocean-going cargo ships. A tradition is identified, and may be recognised, by a general continuity in time and space and by a set of diagnostic attributes which are more likely to be technological characteristics than morphological features. Shape (per se) has a relatively minor part to play in defining traditions as it is itself generally determined by the function the vessel is to undertake and by the operating environment. Only in the case of an innovation in shape, or in the case of a tradition with a very limited range of functions and operating environments, may this attribute make a significant contribution towards defining a specific tradition.

There is, to date, no excavated ship or boat of the 1st century BC southern North Sea and Channel region to give support to this working hypothesis or, alternatively, to cause it to be questioned. There are, however, a dozen or more boats of the 2nd/3rd century AD, from the Thames estuary, the Rhine region and Guernsey which have distinctive boatbuilding features generally known as Romano-Celtic or Gallo-Roman (du Plat Taylor & Cleere 1978; McGrail 1981a, 23-4; papers by Rule; Arnold; Marsden; de Weerd; and Lehmann, this volume).

Some characteristics of these Romano-Celtic craft, the heavy floor timbers, the massive nails, and possibly the caulking (Arnold 1977), reflect aspects of Caesar's description of the Veneti ships. The majority of these vessels are river barges but two of them, St Peter Port, Guernsey and Blackfriars 1, London, are clearly estuary vessels and probably sea-going, although their lack of, a prominent keel would have limited their operational performances. The mast steps of these two are approximately one-third the waterline length from the bow, an ideal position for a towing mast for bank towage, but not so for a mast with a square sail (McGrail 1987, 216-8). It may by that these two vessels were two-masted and the second mast step has not been found, but this seems unlikely. Another possibility is that they were dumb-lighters towed by larger ships or oared boats. An alternative hypothesis is that these vessels were fitted with a single fore-and-aft sail, such as a sprit or lugsail, which would need to be stepped forward of amidships. Ellmers (1969, pl 16; 1975, fig 8; 1978, fig 3) has suggested that representations of Romano-Celtic river boats of the 2nd/3rd century AD on a mosaic at Bad Kreuznach and on a gravestone from Junkerath depict leather lugsails with battens. It may thus be that Celtic lugsails began to be used in the 2nd century AD, replacing earlier square sails.

The working hypothesis formulated above may now be extended to include the evidence from the Rhine, Thames and Guernsey vessels of the 2nd-3rd centuries AD. The hypothesis then is that there was a Celtic tradition of plank boat and shipbuilding extending from before the 1st century BC to after the 3rd century AD. The diagnostic attributes of this tradition may tentatively be identified as the use of a form of the skeleton sequence of building, with planking that was generally not edge-joined, but fastened to heavy floor timbers and side timbers by large iron nails clenched by turning the point through 180° so that the nails became J-shaped, and with a distinctive caulking between the strakes (see Rule; Arnold; Marsden; and Lehmann, this volume). The use of leather sails may also be a distinguishing feature. A stem projection may be typical of some of them but not characteristic of the entire tradition.

The majority of the Romano-Celtic vessels so far excavated have a flat-bottomed transverse section with hard chines; but this need not be a diagnostic attribute of the Celtic tradition, rather a requirement of their function as river barges. The exceptions are the Blackfriars 1 and St Peter Port wrecks which have bottoms which are flattish in the floors with rounded chines. Such a transverse section would indeed be flatter than those of Caesar's fighting ships and would ensure good cargo capacity, give the necessary transverse stability, and enable the vessels to sit upright on the beach for loading and unloading. The fact that these two vessels did not have prominent keels need not preclude other (as yet unknown) sea-going vessels of the Celtic tradition having them, and it can be seen from Table 4.1 that such a feature was within the technological inheritance of late prehistoric north-west Europe. A hull form with a prominent keel does not prevent a vessel taking the ground; Figure 4.13 shows a 100 ton ketch of

Figure 4.13 The coasting ketch Charlotte discharging cargo on the beach at St Ives, Cornwall, c 1908. (Photo: Gillis Collection).

round-hull form with prominent keel beached for cargo unloading at St Ives, Cornwall. The transverse sections of medieval cogs, which are also known to have been beached (Ellmers 1979, fig 1.6; Crumlin-Pedersen 1979, fig 2.12), are not unlike those of the Blackfriars 1 and St Peter Port vessels, except that the former have a more prominent keel.

The foregoing hypothetical description of the Celtic building tradition is based on three descriptive passages, four representations, and a dozen or so boat finds. When more evidence comes to light, especially wrecks from the period 200 BC - AD 500, it may become clearer whether this is indeed one tradition, what the distinctive characteristics are, how the tradition changed over time, and how it was adapted to build vessels for different functions and for use in different environments. Such studies should also increase our understanding of the early history of the medieval cog (Fliedner 1964; Crumlin-Pedersen 1965; Ellmers 1979): they may also throw some light on the early history of skeleton building.

Trade routes and navigation

The seaborne distribution of stone within the British Isles in the Neolithic period (Flanagan 1975; Cummins & Clough 1988, maps 1, 2, 3, 6, 9, 10, 11, 12, 16) and the cross-Channel metal trade in the Middle Bronze Age (Muckleroy 1981) indicate a long established seafaring tradition in Britain, Ireland and France. Their successors in the later Bronze and early Iron Age were thus able to respond to the overseas demands for tin. Subsequently in the late Iron Age cross-Channel trade was in insular gold, iron and other metals, grain, cattle, hides, slaves and hunting dogs (Strabo, 4.5.2; Cunliffe 1988a, 98-104, 145-9) and the import of Mediterranean produced goods such as wine, figs, glass and pottery.

Four or five cross-Channel routes between the Continent and Britain may be identified from excavated and documentary evidence as having been used in the 1st century BC, and probably earlier (McGrail 1983a). It seems likely that the open sea route from Ireland to the Continent was from Carnsore Point, Wexford to the vicinity of Scilly (both lie approximately on longitude 6¼° W); and then from Lizard Point to the vicinity of Ushant (both on c 5¼° W), this leg also being the westernmost of the probable Britain/Continent routes (Fig 4.5). The likely maximum speed made good on these two legs can hardly have been more than 5 kts: at this speed and with the requirement to take departure from, say, Carnsore Point or Lizard Point in daylight and to make a landfall[1] at Scilly or Ushant also in daylight, there would have been a period of at least 10 hours out of sight of land even in midsummer. Thus for such open sea voyages deep-sea navigational techniques were necessary, in addition to the skills of coastal pilotage (McGrail 1983, 314-9).

As similar voyages — on the evidence of the Massaliote Periplus (see above) — were undertaken in the 6th century BC, Iron Age seamen must have been capable of ocean navigation from those times, or even earlier. Furthermore, it seems likely that such voyages were undertaken primarily by sail rather than under oars (although this method must remain a possibility). If this proposition is accepted, then the date for the earliest use of indigenous sail in the waters of north-west Europe is put back to c 600 BC, half a millennium earlier than the Broighter boat model's mast and yard and the sails of the Veneti ships described by Caesar (Bello Gallici 3.13) and by Strabo (Geog 4.4.1).

Harbours and landing places

The sea routes discussed above are based on the evidence of Classical authors (McGrail 1983a) and on excavated sites and artefacts, leading to the identification of natural harbours with river access to the interior. Excavated evidence has shown that, by the late Bronze Age, sites within certain harbours, as for example at Mount Batten within Plymouth Sound (Cunliffe 1988b), had became the prehistoric equivalent of ports. But these were not ports with built-up waterfronts as were to be found in the Classical world at that time (Casson 1971, 361-70). The indigenous hide and (later) wooden boats and ships of the southern North Sea and Channel region (even those that were ocean-going) used informal landing places adjacent to the settlement, workshops and trading areas which comprised the 'port'. Here they were beached by taking the ground on a falling tide or they were anchored or moored in the shallows and their goods unloaded by wading men or into smaller boats (logboats?) or into horse-drawn carts (Ellmers 1985, 25-30), as still happens in certain parts of the world today (McGrail 1981c; 1985b).

With few, if any, fixed structures the precise sites of early landing places may be difficult to identify archaeologically but there are certain characteristics which may help in the search for them (McGrail 1983b, 34-41). One such landing place has recently been identified at Hengistbury Head within Christchurch Harbour by the recognition of a man-made gravel hard close to the site of a 1st century BC international trading place (Cunliffe, this volume).

In the late 4th century BC Pytheas sailed from Massalia to explore the northern sea and bring back commercial and navigational information (Hawkes 1977; 1984). Pytheas' subsequent book is now lost, but Strabo (Geog, passim) of the 1st century BC and Pliny (Nat Hist 4, 102-4) of the 1st century AD, quote from him and from Timaeus of the 3rd century BC, and from these several accounts it is deduced (Hawkes 1977; 1984) that Pytheas probably made a landfall at Belerion (Lands End in Cornwall), followed by a landing somewhere in the south-west peninsula, where he was told that tin, mined nearby, was taken by hide boat to Mictis, an island some six days' sail up the Channel (ie, to the east), where it was made available to foreign merchants. It is generally agreed that this emporium was probably on or near the Isle of Wight (Vectis in later times), The practice of using an island or a promontory as a mart or entrepot has been, and is, widespread: on such isolated and readily defended sites traders can be segregated, protected and supervised, justice dispensed and tolls imposed (McGrail 1983a, 311-3).

Diodorus (5.22.1-4) of the 1st century BC mentions an island Ictis connected at low water to the British mainland by a causeway where tin, mined in the Belerion peninsula, was brought in wagons for foreign merchants to buy and transport to the Mediterranean via Gaul. Sixteen or more places have been suggested for the location of Ictis (Maxwell 1972): the two considered most likely being the island of St Michael's Mount, Cornwall and the peninsula of Mount Batten on the eastern side of Plymouth Sound (Cunliffe 1983; 1988b; Hawkes 1984). A major difficulty is to establish whether either site in the 1st century BC would have been an island which dried at low water leaving a (natural) causeway to the mainland. St Michael's Mount has scarcely been investigated archaeologically, but there are a number of finds from Mount Batten which indicate that it was prominent in international seaborne trade from the 4th century BC until just before the Roman Conquest (Cunliffe 1988b). Access may readily be gained from Mount Batten by rivers Tavy and Tamar to tin and copper deposits on Dartmoor and around Callington. These minerals would thus almost certainly have been brought to Mount Batten by boats, although other material to be exported could have been brought by wagon. Wagons could also have been used to load and unload ships anchored or moored in the shallows off both Mount Batten and St Michael's Mount. An alternative interpretation of Diodorus' causeway might be that it was a hard of the Hengistbury type which dried at low tide, and on which boats were beached.

There are other natural havens on the south coast of Britain, for example in Poole Harbour and in Weymouth Bay (Cunliffe 1982,46), with some evidence for use as international 'ports'. On the east coast recent excavations at the 1st century BC/AD site at Redcliff on the northern shores of the River Humber have also revealed evidence for international trade, although it is not yet clear whether this was by a direct or an indirect route (Crowther et al forthcoming). It seems likely that a similar site or sites remain to be found in the River Thames near the head of tidal waters. Excavations at Bordeaux on the River Gironde (Debord & Gauthier 1979) and at Alet near St Malo, Brittany (Langouet 1984) have revealed further evidence for an international trade which linked Atlantic north-west Europe, especially the southern North Sea and the Channel region with the Mediterranean. There must be numerous smaller sites with landing places, associated with local coastal and river traffic, remaining to be discovered.

Endnote

1 The meaning of 'landfall' is sometimes misunderstood. In this paper it means the sighting and identification of a prominent coastal feature, usually when at some considerable distance from it.

References

Anderson, A O, & Anderson M O (eds), 1961 *Adomnan's life of St Columba*.

Arnold, B, 1977 Some remarks on caulking in Celtic boat construction and its evolution in areas lying north-west of the alpine arc, *Int J Naut Archaeol* **6**, 293-97.

Basch, L, 1983 Bow and stern appendages in the ancient Mediterranean, *Mar Mirror* **69**, 395-412.

——, & Frost, H, 1975 Another Punic wreck in Scicily: its ram, *Int J Naut Archaeol* **4**, 201-28.

Beaudouin, F. 1975 *Bateaux des côtes de France*.

Bonino, M, 1975 Picene ships of the 7th century BC engraved at Novilara (Pesaro, Italy), *Int J Naut Archaeol* **4**, 11-20.

Booth, B, 1984 Handlist of maritime radiocarbon dates, *Int J Naut Archaeol* **13**, 189-204.

Brindley, H H, 1919/20 Notes on the boats of Siberia, *Mar Mirror* **5**, 66-72, 101-7, 130-42, 184-7; **6**, 15-18, 187.

Casson, L, 1971 *Ships and seamanship in the ancient world* (1986 ed).

Christensen, A E, 1972 *Boats of the North*.

Coates, J F, 1987 Interpretation of ancient ship representations, *Mar Mirror* **73**, 197.

Coles, J M, & Harding, A F, 1979 *The Bronze Age in Europe*.

Creston, R Y, 1956 Considerations techniques sur la flotte des Vénètes et des Romains, *Annales de Bretagne* **63**.

——, 1961 Les navires des Vénètes, *Actes du 11e Congrès International d'Archéologie Sous-marine*, 369-80.

Crowther, D, Willis, S, & Creighton, J, forthcoming Topography and archaeology of Redcliff, in Crowther, D R, & Ellis, S, (eds), *Humber and its environs in history and prehistory*.

Crumlin-Pedersen, O, 1965 Cog-kogge-Kaag, *Handels og Sjøfartsmuseum pa Kronberg Arbog*, 81-144.

——, 1979 Danish cog-finds, in McGrail, S, (ed), *Archaeology of medieval ships and harbours*, Brit Archaeol Rep **S66**, 17-34.

Cummins, W A, & Clough, T H McK, 1988 *Stone axe studies volume 2*, CBA Res Rep **67**.

Cunliffe, B W, 1972 Late Iron Age metalwork from Bulbury, Dorset, *Antiq J* **52**, 293-308.

——, 1982 Britain, the Veneti and beyond, *Oxford J Archaeol* **1**, 39-68.

——, 1983 Ictis: is it here?, *Oxford J Archaeol* **2**, 123-6.

——, 1988a *Greeks, Romans and barbarians: spheres of interaction*.

——, 1988b *Mount Batten, Plymouth*, Oxford Univ Comm Archaeol **26**.

de la Roncière, C & Clerc-Rampel, G, 1934 *Histoire de la marine française*.

Debord, P, & Gauthier, M, 1979 Bordeaux — la fouille de l'Ilot St Christoly, *Dossier Aquitaine*, 36-9.

Denford, G T, & Farrell, A W, 1980 Caergwrle bowl, *Int J Naut Archaeol* **9**, 183-92.

Dove, C E, 1971 First British navy, *Antiquity*, **45**, 15-20.

Dunbabin, K M D, 1978 *Mosaics of Roman North Africa*.

du Plat Taylor, J, & Cleere, H, (eds), 1978 *Roman shipping and trade*, CBA Res Rep **24**.

Edwards, C R, 1965 Aboriginal watercraft on the Pacific coast of South America, *Ibero-Americáná* **4**.

Elgee, H W, & Elgee F, 1949 An Early Bronze Age burial in a boat-shaped wooden coffin from north-east Yorkshire, *Proc Prehist Soc* **15**, 87-106.

Ellmers, D, 1969 Keltischer Shiffbau, *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* **16**, 73-122.

——, 1972 *Frühmittelalterliche Handelsschiffahrt in Mittel und Nordeurope*.

——, 1973 Kultbarken, fahren, Fischerboote vorgeschichtliche Einbaüme in Niedersachsen, *Die Kunde* **ns 24**, 23-62.

——, 1975 Antriebstechniken Germanischer Schiffe im 1 Jahrtausend N CHR, *Deutsches Schiffahrtsarchiv* **1**, 79-90.

——, 1978 Shipping on the Rhine during the Roman period, in du Plat Taylor, & Cleere, (eds), 1978, 1-14.

——, 1979 Cog of Bremen and related boats, in McGrail, S, (ed), *Archaeology of medieval ships and harbours*, Brit Archaeol Rep **S66**, 1-15.

——, 1984 Earliest evidence for skin boats in Palaeolithic Europe, in McGrail, S, (ed), *Aspects of maritime archaeology and ethnography*, Nat Marit Mus Monog, 41-85.

——, 1985 Loading and unloading ships using a horse and cart standing in the water, in Herteig, (ed), 1985, 25-31.
Farrell, A W, & Penny, S, 1975 Broighter boat: a re-assessment, *Irish Archaeol Res Forum* **2.2**, 15-26.
Fenton, A, 1976 Curragh in Scotland, *Scot Stud* **16**, 61-81.
Fitzpatrick, A, 1985 Distribution of Dressel 1 amphorae in north-west Europe, *Oxford J Archaeol* **4**, 305-40.
Flanagan, L N W, 1975 Ships and shipping in pre-Viking Ireland, *Cultura Maritima* **1**, 3-8.
Fliedner, S, 1964 *Die Bremer Kogge*.
Frost, H, 1976 Punic ship, *Notizie Degli Scavi* **30**, supplement.
Galliou, P, 1977 Les monnaies et les amphores, in Problèmes de navigation en Manche Occidentale a l'èpoque romaine, *Caesarodunum* **12**, 496-9.
——, 1984 Days of wine and roses?, in MacReady & Thompson, (eds), 1984, 24-36.
Gauckler, P, 1905 Un catalogue figuré de la battellerie gréco-romaine. La mosaíque à Althiburus, *Monuments et Mémoires publies par l'Academie Inscriptions et Belles-Lettres*.
Green, H S, Smith, A H V, Young, B R, & Harrison, R K, 1980 Caergwrle bowl: its composition, geological source and archaeological significance, *Rep Inst Geol Sci* **80.1**, 26-30.
Greenhill, B, 1971 *Boats and boatmen of Pakistan*.
Hale, J R, 1980 Plank-built in the Bronze Age, *Antiquity* **54**, 118-27.
Hawkes, C F C, 1977 *Pytheas*, 8th J L Myres Memorial Lecture.
——, 1984 Ictis disentangled and the British tin trade, *Oxford J Archaeol* **3**, 211-33.
Herteig, A E, (ed), 1985 *Conference on waterfront archaeology* **2**.
Hornell, J, 1946 *Water transport*, (republ 1970).
Jal, A, 1848 *Glossaire Nautique*.
Johnstone, P, 1972 Bronze Age sea trial, *Antiquity* **46**, 269-74.
——, 1980 *Seacraft of Prehistory* (2nd ed 1988).
Langouët, L, 1984 Alet and the cross-Channel trade, in Macready & Thompson, (eds), 1984, 67-77.
McGrail, S, 1978 *Logboats of England and Wales*, Brit Archaeol Rep **51**.
——, 1981a *Rafts, boats and ships*.
——, (ed), 1981b *Brigg 'raft' and her prehistoric environment*, Brit Archaeol Rep **89**.
——, 1981c Medieval boats, ships and landing places, in Milne, G, & Hobley, B, (eds), *Waterfront archaeology in Britain and northern Europe*, CBA Res Rep **41**, 17-23.
——, 1983a Cross-channel seamanship and navigation in the late 1st millennium BC, *Oxford J Archaeol* **2**, 299-337.
——, 1983b Interpretation of archaeological evidence for maritime structures, in Annis, P, (ed), *Sea Studies*, Nat Marit Mus Monog, 33-46.
——, 1985a Brigg 'raft' — problems in reconstruction and in the assessment of performance, in McGrail, S, & Kentley, E, (eds), *Sewn plank boats*, Brit Archaeol Rep **S276**, 165-94.
——, 1985b Early landing places, in Herteig, (ed), 1985, 12-18.
——, 1985c Towards a classification of water transport, *World Archaeol* **16**, 289-303.
——, 1987 *Ancient boats in north-west Europe*.
——, 1988 Assessing the performance of an ancient boat — the Hasholme logboat, *Oxford J Archaeol* 7, 35-46.
Macready, S, & Thompson, F H, (eds), 1984 *Cross-Channel trade between Gaul and Britain in the pre-Roman Iron Age*, Soc Antiq London Occas Pap **n ser 4**.
Marcus, G J, 1953-4 Factors in early Celtic navigation, *Etudes Celtique* **6**, 312-27.
Marsden, P, 1964 Warships on Roman coins *Mar Mirror* **50**, 260.
Marstrander, S, 1963 *Ostfolds Jordbruksristninger:* Skjeberg 2 vols.
Maxwell, I S, 1972 Location of Ictis, *J Roy Inst Cornwall* **6**, 293-319.
Millett, M, & McGrail, S, 1987 Archaeology of the Hasholme logboat, *Archaeol J* **144**, 69-155.
Morcken, R, 1980 *Langskip, Knarr og Kogge*.
Muckelroy, K, 1981 Middle Bronze Age trade between Britain and Europe: a maritime perspective, *Proc Prehist Soc* **47**, 275-97.
——, Haselgrove, C, & Nash, D, 1978 A pre-Roman coin from Canterbury and the ship represented on it, *Proc Prehist Soc* **44**, 439-44.
Mudie, C, 1986 Designing replica boats, in Crumlin-Pedersen, O, & Vinner, M, (eds), *Sailing into the past*, 38-59.
Muller, S, 1886 Votivfund fra Sten-og Bronzealderen, *Aarbøger for Nordisk Oldkyndighed og Historie*.
Muret, & Charbouillet, 1888 *Cabinet des Mèdailles à Paris*.
Murphy, J P, 1977 *Rufus Festus Avienus Ora Maritima*.
Paris, F E, 1882 *Souvenirs de marine conservés*.
Prins, A J H, 1987 *Sewn boats*.
Raban, A, 1988 Boat from Migdal Nania and the anchorages of the Sea of Galilee from the time of Jesus, *Int J Naut Archaeol* **17**, 311-29.
Reick, F, & Crumlin-Pedersen, O, 1988 *Boade fra Danmarks Oldtid*.
Rosenberg, G, 1937 *Hjortspring fundet*.
Severin, T, 1978 *Brendan voyage*.
Sheppard, T, 1901 Notes on the ancient model of a boat and warrior crew found at Roos in Holderness, *Trans East Riding Antiq Soc* **9**, 62-74.
——, 1902 Additional notes on the Roos Carr images, *Trans East Riding Antiq Soc* **10**, 76-9.
——, 1926 Roman remains in north Lincolnshire, *Trans East Riding Antiq Soc* **25**, 170-4.
Tchernia, A, Pomey, P, & Hosnard, A, 1978 L'Epave Romain de la Madrague de Giens, *Gallia*, 34th supple.
Watkins, T, 1980 Prehistoric coracle in Fife, *Int J Naut Archaeol* **9**, 277-86.
Weatherhill, C, 1985 Ships of the Veneti — a fresh look at the Iron Age tin ships, *Cornish Archaeol* **24**, 163-9.
Worthington, E B, 1933 Primitive craft of the central African lakes, *Mar Mirror* **19**, 146-63.
Wright, E V, 1976 *North Ferriby boats*, Nat Marit Mus Monog **23**.
——, 1985 North Ferriby boats — a revised basis for reconstruction, in McGrail & Kentley, (eds), 1985, 105-44.

5 The Romano-Celtic ship excavated at St Peter Port, Guernsey

Margaret Rule

Abstract

The remains of a single masted sailing vessel which sank at the end of the 3rd century AD were recovered from the Harbour entrance in St Peter Port, Guernsey, Channel Islands, in 1984-6.

The ship was a minimum of 22.21 m long at the waterline and it was preserved to a maximum width of 4.5 m at a height of 0.6 m above the keel. It was constructed entirely of oak, with a tripartite keel plank and strakes secured to the floor timbers and side-frames with J-shaped, large iron nails. There were no carpentered joints in the structure.

The vessel burned to the waterline and sank in 4-5 m of water sometime shortly after AD 285.

The site

The wreck lay in 5 m water (Below Chart Datum) at the side of the channel into the Harbour entrance (Fig 5.1). The seabed around the site was soft muddy sand and there was little or no colonisation of the site by marine animals or plants. There were no natural hazards in the area for either divers or the wreck, but the frequency of commercial shipping movements through the Harbour entrance demanded the utmost vigilance on the part of the Dive Marshal.

The site was discovered in 1982 by Richard Keen, a professional diver and amateur archaeologist who recorded what was visible at that time, and reported it to the Island authorities and professional archaeologists. The wreck structure had been exposed by the thrust from propellors of large vessels ('prop wash') but, at that time, there was no evidence to suggest its importance. In 1984 further exposure of the wreck occurred and it became clear that the integrity of the hull was being destroyed. A portion of a timber, displaced from the hull earlier that year, had been dated by radiocarbon analysis to 1840 ± 80 BP (HAR-6135) and Roman pottery and tile had been noticed exposed on the seabed and protruding from the layer of pitch which capped the structure.

Excavation

A rescue excavation was organised by the Guernsey Maritime Trust in November 1984 to record the structure and its contents and recover as much as possible of the ship for study, conservation and display.

On low water springs the propellors of passing ships occasionally appear to have touched the wreck itself, and heavily weighted lifting trays were easily displaced and scattered if they were left on site. In these circumstances it was decided to limit the time taken to record both the structure and the finds on the seabed to the absolute minimum. A framework was constructed over the wreck to support the divers' bodies above the archaeological deposits, but this was not used for accurate survey. Discrete numbered tags were placed on the structure and measured plans, sketches and photographs were made of all timbers in situ with their associated tags. Finds within the ship were only removed after their context had been recorded. Unstratified objects recovered from around the wreck were identified individually, with unique numbers signifying their location within the area where they were found. The layer of solidified pitch which concealed and preserved most of the stratified material was broken up using hammers and chisels, endeavouring to retain the relationship of the lumps to each other, and to the area of the hull where they were found. As this layer was removed the structure of the hull became inherently unstable. The work had to be paced to ensure that removal of the pitch and the stratified sediments did not leave large areas exposed and unrecorded when the weather finally deteriorated at the end of November 1984 and further excavation that year became impossible.

During the following winter 16 tons of sandbags were placed over the structure covering an area c 6 x 6 m. These had to be monitored and replaced several times after winter storms. The excavation and recovery of the stern structure was completed in April 1985. Recovery of the loose timbers, displaced from the wreck prior to the excavation, continued until August 1987.

The ship

The ship was constructed entirely of oak (Quercus sp) with edge-to-edge planks fastened to floor timbers and side-frames with long iron nails. All the longitudinal seams were caulked with oak or willow shavings and moss was used to effect a seal between the cone shaped heads of the nails and the planks (Figs 5.2 and 5.3). There were no carpentered joints within the ship; simple butt joints were secured by fastening a third timber over the joint. Thus joints in hull planking occurred where a side-frame or floor timber overlay them, and the inherently weak joint between the keel plank and the stern post was accomplished by securing a carefully rebated floor timber over the junction of the two (Fig 5.4). This apparently weak structure at the stern and the bow would have allowed for the easy replacement of a damaged stem or stern post with the minimum disruption of the keel and floors.

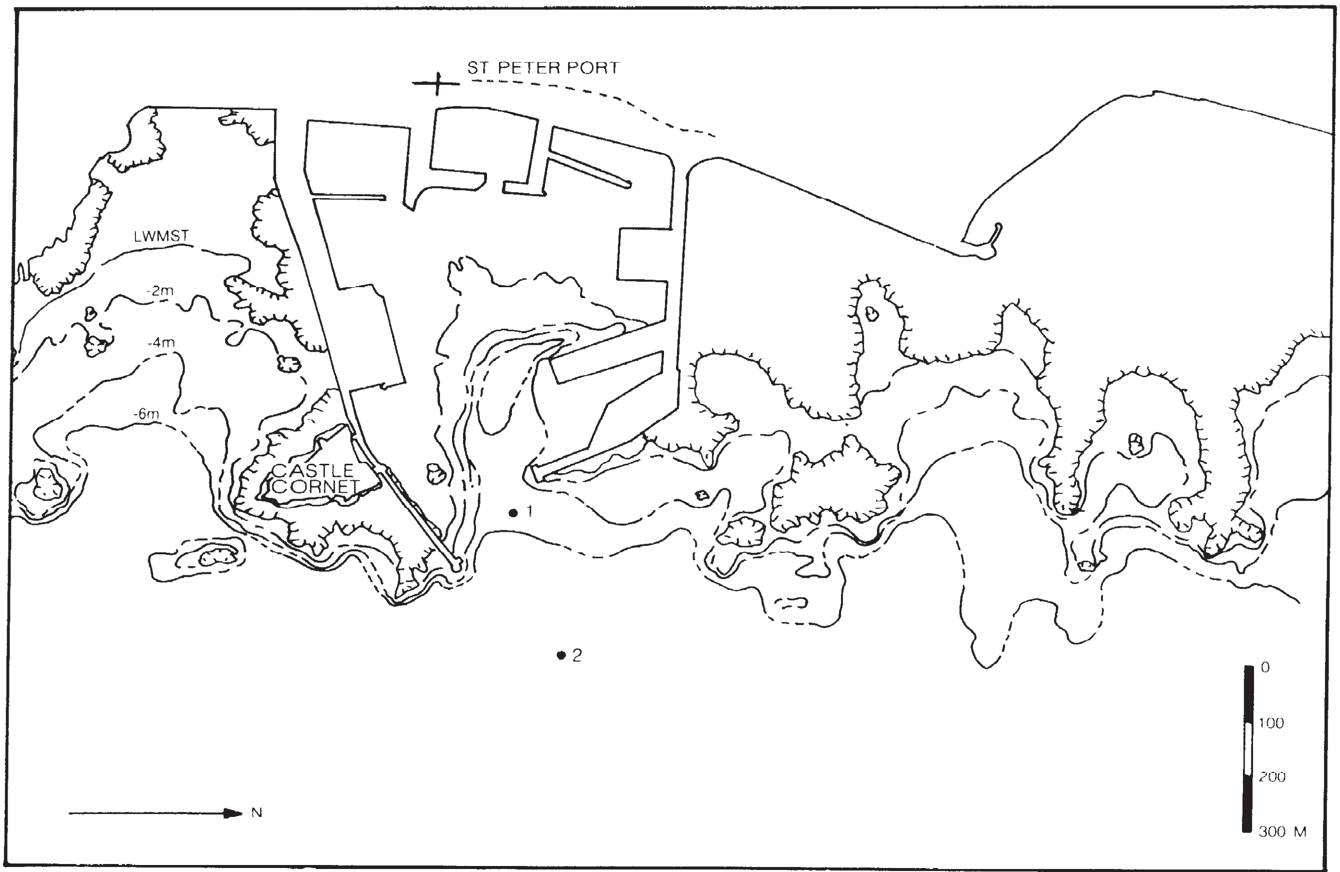

Figure 5.1 St Peter Port Harbour: 1. site of late 3rd century wreck; 2. site of early 2nd century wreck material. (Map: Author).

There was no evidence for a steering oar, or quarter rudder, nor was any part of the mast, yard or sails found apart from a few fragmentary cringles found in the bilges. These, however, could have been part of a sailcloth being used as a tarpaulin on the ship's last voyage. No anchor was found; any useful items of this nature would have been easily salvaged after the ship sank.

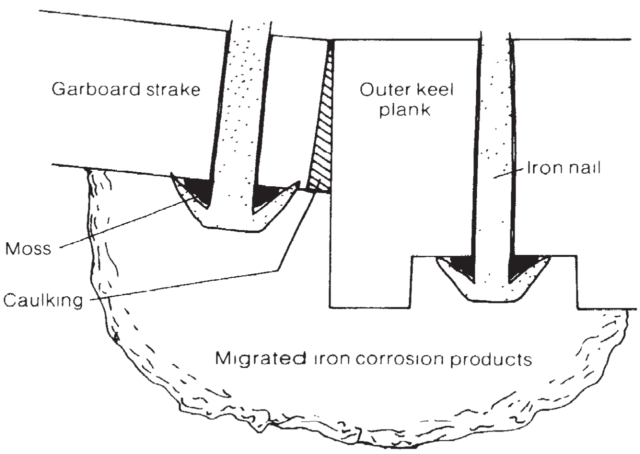

Figure 5.2 Detail of iron nail fastenings showing rebate in keel plank, caulking material between plank seams and moss beneath conical heads of nails. (Diagram: Author).

The evidence of a fragmentary mast partner suggests that the ship may have been decked but no ballast or cargo was found which could be related to the main hold within the ship. When she caught fire and burned to the waterline it appears that the main hold was empty. This is one reason why the forward two thirds of the ship was so easily destroyed when it was exposed to prop wash.

A specialised floor timber (T49) at the stern was fashioned with a lateral ridge and two small sockets for vertical posts c 0.10 m square. These provided support for a lightweight partition which divided a small cabin at the stern from the main hold. This compartment was provided with a hearth, cooking equipment and sufficient utensils for a crew of at least three people. Blocks of pitch and barrels found in the hold at the stern may be part of a cargo which was totally destroyed by fire in the forward end of the boat, but the absence of ballast suggests that the main hold was empty when the ship sank. There is no evidence to suggest that the hold was lined with fixed boards or ceiling planking, but fragments of charred lightweight planking may have been part of a detached framework of bottom boards. The hull planking exposed between the frames is charred in many places, suggesting exposure to the main force of the flames for a period of time before the ship sank.

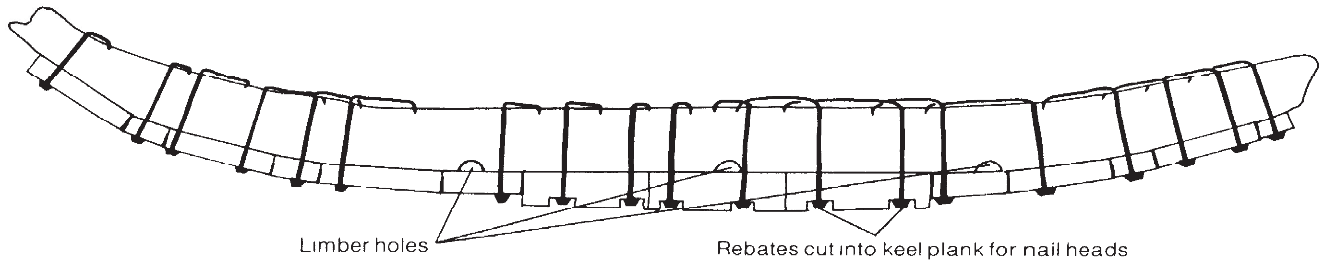

Figure 5.3 Pattern of clenched iron nails securing keel planks and outer hull planks to floor timbers. (Diagram: Author).

The ship sank in shallow water and, if we accept that the sea level was probably 2 m lower than at present on this site, it follows that the wreck would have been a bare 2 m below the surface on a low spring tide. It would have been easy to salvage useful timbers such as the steering oars or the anchors, and it would have been equally easy for the crew to swim ashore when the ship caught fire. Any perishable cargo would have been destroyed in the fire and livestock could have escaped with the crew.

The original work programme included a topographical survey of the Harbour in order to determine the original Roman shore line. Regrettably, dredging operations in 1985 removed most of the modern and post-Roman silts and this research is in abeyance for the present. Investigation of other sites where wreck debris has been found may add further evidence for the commercial and possible military exploitation of the fine natural anchorage between Guernsey and Herm during the first four centuries AD.

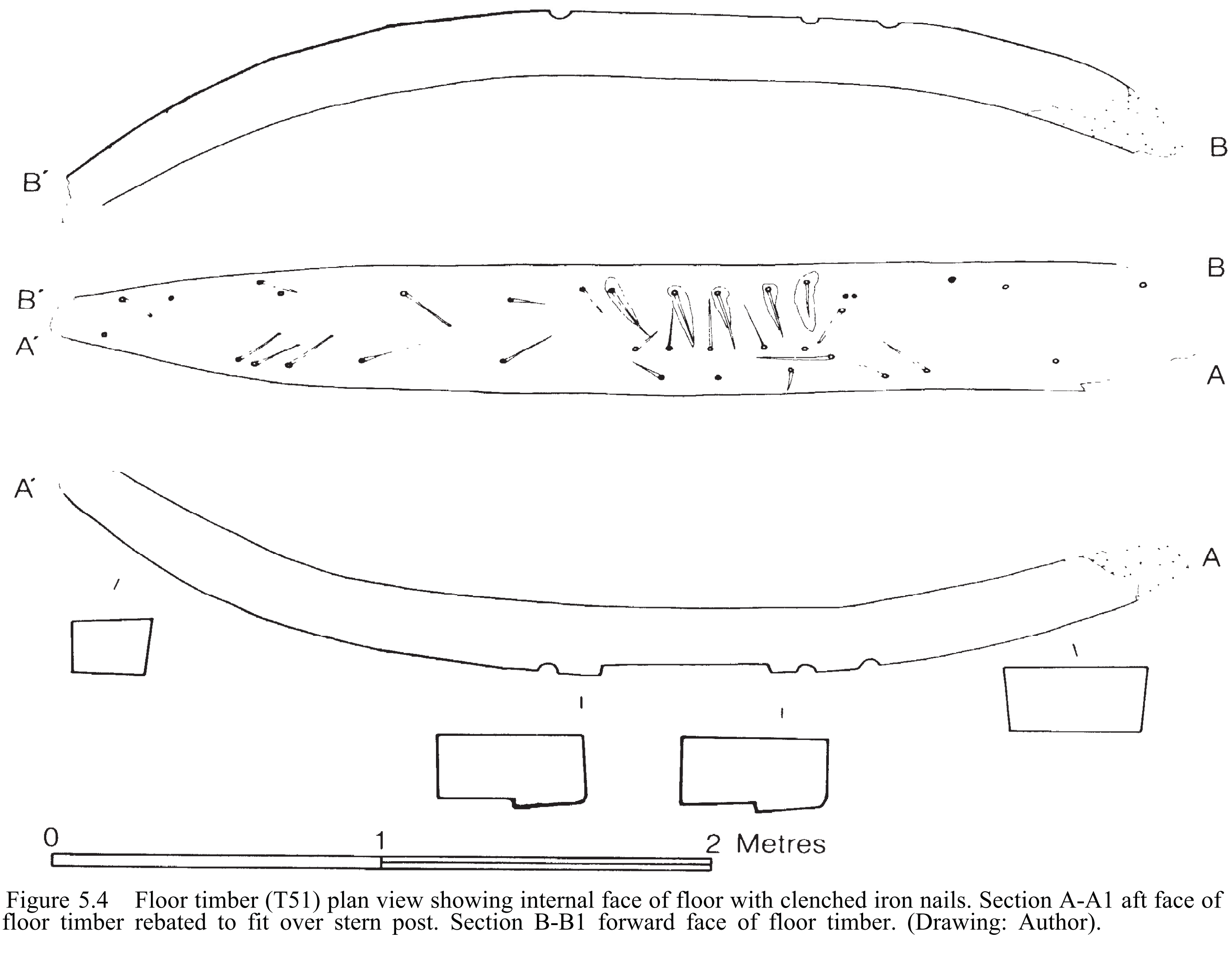

Figure 5.4 Floor timber (T51) plan view showing internal face of floor with clenched iron nails. Section A-A1 aft face of floor timber rebated to fit over stern post. Section B-B1 forward face of floor timber. (Drawing: Author).

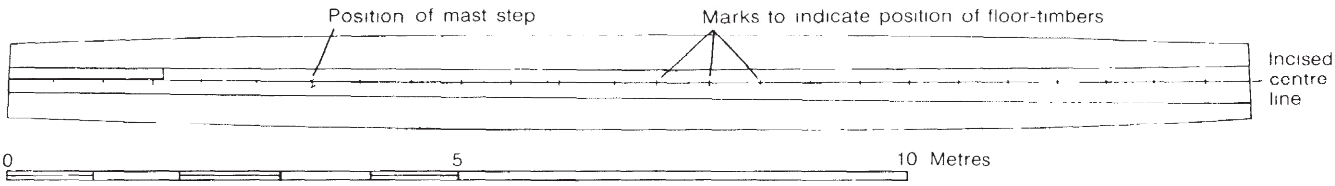

Figure 5.5 Tripartite keel plank. (Drawing: Author).

The timbers of the ship

The keel plank

The strongest and heaviest element in the hull is the tripartite keel plank (Fig 5.5). It is constructed of three timbers lying alongside each other, each one 14.05 m long and 0.12 m thick. The maximum width of the three timbers together is 1.21 m. They were secured to the overlying floor timbers with large iron nails clenched by turning through 180° (see below). There is no evidence of temporary battens to hold the elements of the keel plank in position while the holes for the nails were drilled.

The central plank is scored with an incised line which marks the centreline of the vessel, and a series of blind nail holes on the same alignment suggest that a setting out line was used to mark the desired position of the centreline before it was cut into the surface of the wood. At intervals along this line, an incised slash cut across the centreline marks the position of each of the floor timbers. The mean interval between these marks is 0.56 m, ie, 22.95 uncia, just one uncia short of two pedes monetales (0.59 m) suggesting that the mean interval between the floor timbers, centreline to centreline, was intended to be two Roman feet. Where the necessity for a wide floor timber breaks this pattern, the centreline to centreline spacing of the three adjacent floor timbers is adjusted so that the average of two adjacent measurements is 0.56 m. This suggests that the workman setting out the lines was either aware of the dimensions of the floors and was acting under specific instructions or he was, by setting out the marks, controlling the design of the hull and ensuring that the ship builders were following a preconceived design. At a distance of one quarter of the length of the keel, measured from the bow, the centreline is marked with an 'I' to indicate the position of a wide, thick floor timber rebated to provide a step for the mast.

The stern post

The stern post (Fig 5.6) was more than 3.73 m long and asymmetrical along all its axes. It was rectangular in section where it butted against the keel plank but it was roughly adzed to shape throughout its length to accommodate the floor timbers and the stealer planks. Its thickness diminished from 0.19 m to 0.10 m as it rose up from its junction with the keel while its width tapered irregularly from 0.48 m to 0.26 m. The floors which overlay the stern post are rebated to fit over it and they have two limber holes (Fig 5.4). Crudely tapered rebates or champhers are cut into each side of the stern post to allow a small stealer plank to lap over the edge of the post. As the post rises upwards it becomes an inboard structure. We were unable to record how this arrangement terminated, as the extreme end of the stern post had been removed at some time in the past. The drill marks where the timber had been cut were fresh and uneroded and it is possible that this 'demolition' occurred in the recent past, possibly as late as the Second World War.

Floor timbers

There were a minimum of 38, and possibly as many as 42 floor timbers in the ship. Twenty-two of these were recovered reasonably intact and their position in the ship can be demonstrated with confidence. Seven floor timbers were found in situ at the stern and the position of

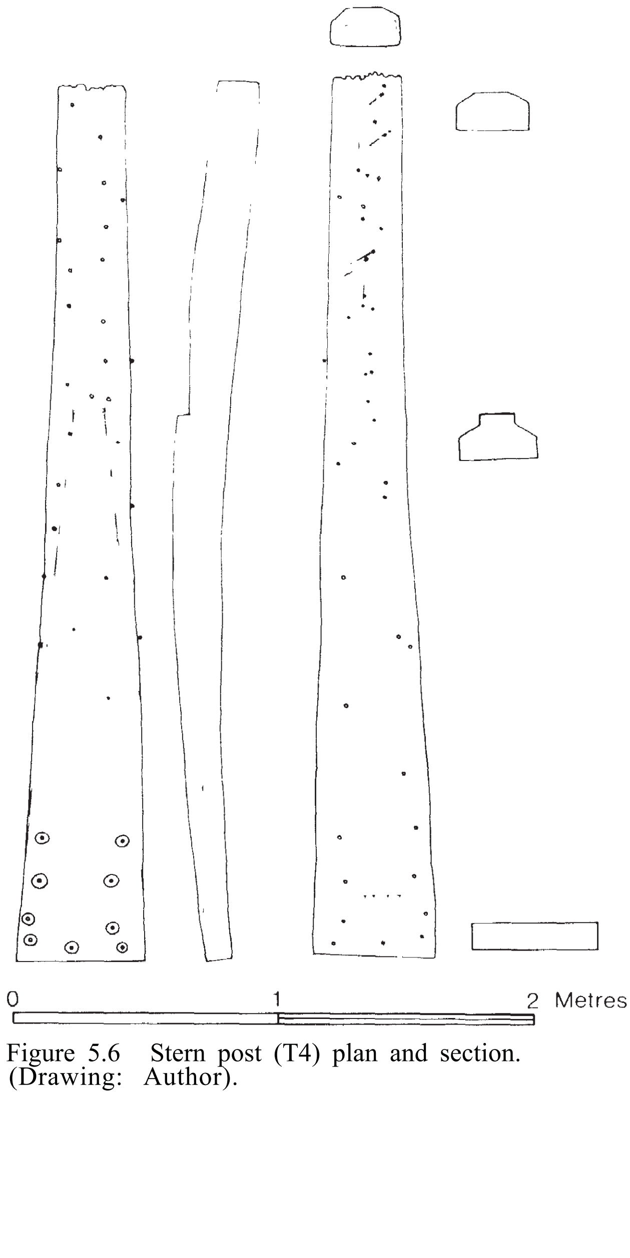

Figure 5.6 Stern post (T4) plan and section. (Drawing: Author).

the remaining 16 can be deduced from a careful examination of the nail holes in the keel planks (Fig 5.7).

All of the floor timbers had been cut to shape with an adze from a sawn baulk of oak. Saw marks, adze marks and sap wood survive, and the carpentry of the timbers will form part of a detailed report. All the floor timbers were rectangular in section as they crossed the bottom of the hull. Their section then diminished and became more square as they curved upwards. The outer face of the floor timbers were sometimes dressed with an adze in a series of flat facets or faces to receive the strakes. Floortimbers overlying the keel have three limber holes whereas those which overlie the stern post below the waterline have two.

Planks

All of the planks (Fig 5.8), including the keel plank, were cut tangentially from a baulk of oak using a saw. This may have been done on a trestle, but considering the weights involved, (the centre element of the keel plank alone weighed some 700 kg when cut to shape) it would seem to be more sensible to cut these timbers over a pit using rollers to bring the timber baulk into position. Traces of saw cuts are visible on the inboard and outboard faces as well as the internal edges of the planks wherever the surface survives. The undersurface of the keel plank was worn during the life of the vessel, presumably as a result of being beached or grounded at low tide. Most of the timbers which were scattered on the seabed before recovery are so degraded by gribble (Limnoria sp) that the surface evidence has been totally destroyed.

Side-frames

The remains of four futtocks or side-frames were found in situ. The grain of the timber follows the shape of the frame, but too little survives to allow extrapolation of the curve of the frame above the eroded top of the adjacent floor timbers. The frames were secured to the planks with iron nails driven through pre-drilled holes in the strakes and turned through 180° into the inside face of the frame.

Some of the holes in the strakes missed the frame they were intended to secure. These unwanted, misplaced holes were plugged with a wooden dowel driven in from the outside. It is clear that the hull was planked up to the level of the tops of the floor timbers before the side-frames were inserted. Whether skeleton or shell construction continued above this height cannot be deduced from the evidence which survives. The position of missing side-frames can be surmised from a careful study of nail holes in the strakes.

Hull fastenings

The timbers of the ship were fastened together with iron nails driven through pre-drilled holes. Recesses were cut into the outer face of the keel planks to house the heads of the nails and protect them when the boat was beached (Fig 5.2). On the remainder of the hull the heads were allowed to remain proud of the wood. In every case moss had been used to effect a watertight seal between nail head and planking.

The keel nails were hammered home with great thoroughness, and often the conical head of the nail bit into the timber, compressing the wood into the head of the nail. This was not the case with the nails securing the strakes to the floor and side timbers, where the head of the nail sometimes barely penetrated the loosely twisted rove of moss. In a few cases the nail was driven through a treenail (cf Blackfriars 1; Marsden, this volume). Whether this was to check a split in the timber is uncertain.

As most of the iron work in the wreck had completely corroded away, silicon rubber was used to make casts of the lost iron nails which were then drawn. The nails passing through the strakes and frames varied from 0.32-0.69 m in length, with a mean of 0.48 m. Nails securing the keel plank to the floors measured 0.41-0.79 m in length, with a mean of 0.57 m. The maximum thickness any nail had to penetrate, excluding the mast step was c 0.33 m and all the nails were turned over on the inboard face of the timber and turned again to ensure that the point of the nail was embedded in the face of the timber. The nails were generally circular in section with a diameter c 22 mm at the head diminishing to 12-18 mm by the time it had passed through the timber. The last 20-40 mm of the tip of the nail is sometimes square in section.

The sequence of construction

(1) Timbers were selected, felled and possibly seasoned. (It is possible that dendrochronology will suggest a date of felling and a provenance for the timber used to build the ship).

(2) The timber was cut into baulks, sawn and dressed to shape.

(3) Keel planks were assembled and the centreline was marked out. They were either supported on stocks or placed on logs and rolled over a pit.

(4) The floor timbers were placed in position on the keel planks at predetermined intervals according to their size and function.

(5) Holes for the nails were drilled from the inside through the floor timbers and the keel planks.

(6) Rebates were cut in the outer face of the keel plank to house the heads of the nails.

(7) Nails were driven through keel planks and floors from the outside, taking care to secure a grommet of moss (Polytrichum sp) beneath the head of the nail as it was driven into the rebate.

(8) The emergent tip of the nail was turned over onto the inner face of the floor timber and then driven back into the face of the timber.

(9) The stern post (? and the stem) were offered into position and held in place with timber shores.

(10) The keel plank was dressed to fit flush with the inner face of the stern post and the floor timber (T 51, Fig 5.4) was fitted over the butt joint and secured in place with iron nails. The next three frames aft were secured to the stern post.

(11) The hull was then planked up to the top of the floor timbers. The ‘wedge’ shape of the stealer planks suggests that they were fitted after the other strakes were secured in position.

(12) Fastening holes bored through the upper strakes were drilled before the side-frames were placed in position and secured with iron nails. In some cases misplaced predrilled holes were plugged with dowels.

(13) The two stern frames, T56 and T57, were placed in position and secured after the shell of planking had been completed.

(14) There is no direct evidence for the construction technique above this point, but it would have been possible to secure the side-frames temporarily with transverse and

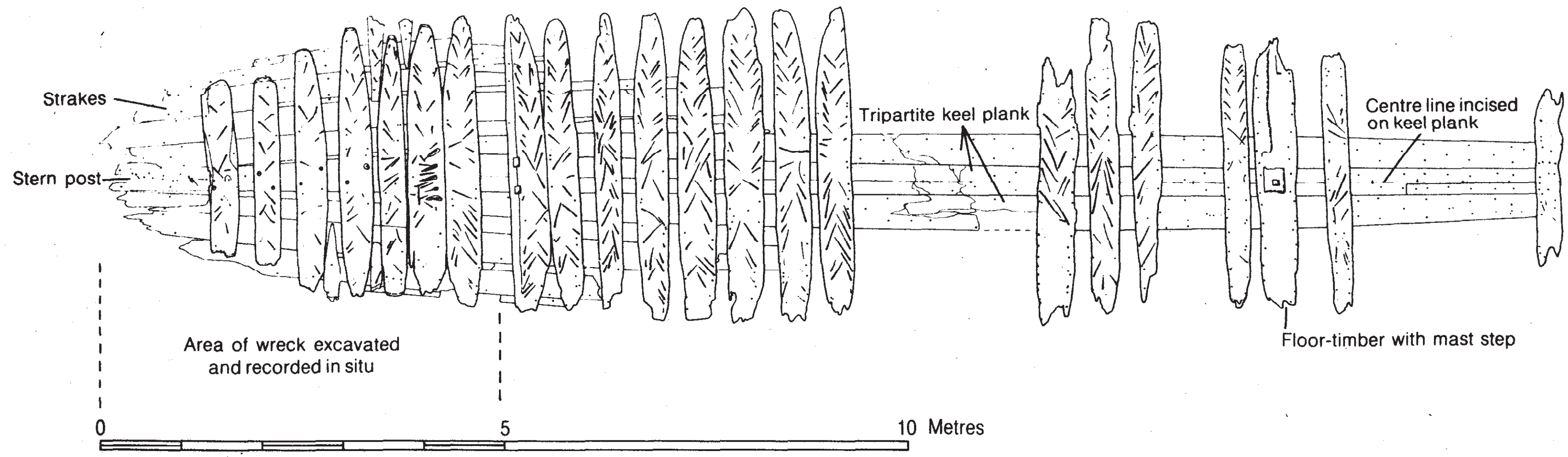

Figure 5.7 Reconstruction of wreck based on timbers recovered in situ at stern and loose timbers recoveredfrom the Harbour after the forward end of the vessel was destroyed in 1984. (Drawing: Author).

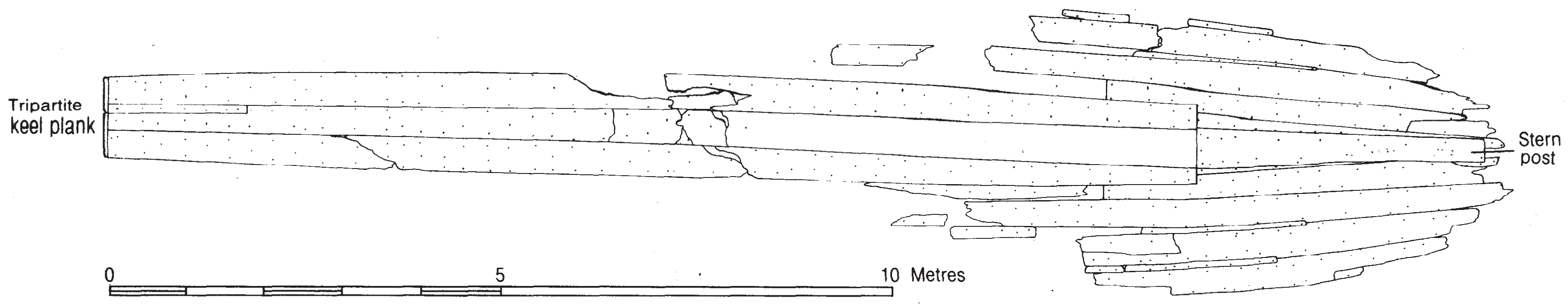

Figure 5.8 Plan of outer hull planking, stern post and keel planks. (Drawing: Author).

longitudinal battens, and complete the framework up to the gunwale before continuing to plank the hull.

The finds

The bilge at the stern contained stratified objects and cultural environmental debris. This material has been studied in detail and it forms part of the archaeological report (in prep). Only the significant dating material will be commented on in this report.

Pottery

A group of stratified pottery found in the stern of the vessel may be interpreted as the domestic equipment of the crew. The group dates from the late 3rd century (AD 250-300) and it includes Rhenish ware as well as Ceramique l'Eponge bowls. The sources of the pottery represent the trade routes of the period; Algeria, Spain, western France, Dorset and the Rhineland.

The pottery included: Three amphorae; three double-handled flagons; one single-handled flagon; one beaker; one cup; two fine flanged bowls; one coarse flanged bowl; three cooking pots; one dish; one mortar. (Other domestic items include a quern and a finely turned cup of maple wood).

Other pottery found unstratified around the site, including samian from eastern Gaul and Black Burnished ware from the Thames Estuary may not derive from this wreck. It should be noted that recent underwater fieldwork is revealing a spread of anchorage debris from a wide date range; these finds will be the subject of a separate report (Monaghan forthcoming).

The coins

The loss of the ship can be securely dated by 80 coins which were found within or immediately adjacent to the wreck. All were in stratified deposits. They fall into two main groups. Firstly, a group of 2nd century regular issues dating AD 117-200. These coins are all well worn, in low relief with the minimum of detail, and they were clearly in circulation for a long time before they were lost. The second group of 74 coins are all Antoniniani dating from the late 3rd century. These coins are the subject of detailed reports by J A Davies and which will be part of the full archaeological report which will be published by Guernsey Museum.

In the absence of later issues it is suggested that the group was lost sometime in the early 280s. The coins were found in two 'clusters' at the stern of the ship and they probably represent the contents of a purse or box.

The context of the wreck

In the early years of the Christian era the requirements of a mariner crossing the Channel were similar to today, including a safe, sheltered anchorage in a south-westerly storm and a plentiful supply of fresh water.

The problems of coastal navigation in these waters, without benefit of compass and using only the stars, landmarks and a sounding lead, have been discussed elsewhere (McGrail 1983, 299).

The identification of Guernsey as the source of water-worn boulders of horneblende-quartz-diorite used in the 1st century building levels at Fishbourne in Sussex, (Cunliffe 1971) and the discovery of imported terra nigra pottery at the Tranquesous in St Saviour's parish in 1977 (Burns 1977), quickened the interest of fieldworkers in the Bailiwick.

Underwater finds by divers and trawlermen suggested that the waters between Guernsey and Herm had been used as an anchorage or haven during the Roman occupation of Britain. In November 1977, Richard Keen, a Guernsey professional diver and amateur archaeologist, discovered a group of amphorae dating from the late 1st/early 2nd century AD, in 17 m of water just outside the entrance to the modern harbour (Keen 1979). Although no evidence of a hull structure has been seen on this site the close association of the amphorae with each other, and their alignment in the seabed suggest that they are more likely to be associated with a wreck than to be unrelated anchorage debris. The site remains undisturbed and protected by legislation.

The recent excavation of store buildings at La Plaiderie in St Peter Port (Burns pers comm, publication forthcoming), suggests that there was a developed harbour in the town throughout the 2nd and 3rd centuries, and evidence of Gaulish pottery and New Forest ware found on this site indicates the continued use of trade routes established before the conquest of Britain. The sheltered channel between Guernsey and Herm would have been a welcome haven for sailing vessels in the past, just as it is today, and the hazards of a cross Channel voyage from the port at Alet on the River Rance to the ports between Selsey Bill and Dorset have been well defined (McGrail 1983). Any mariner attempting to pass west of Guernsey to avoid the reef at the Casquettes, or making for the route between Guernsey and Jersey, would have increased confidence and a better chance of survival if he had knowledge of the natural haven and plentiful fresh water provided in the anchorage at St Peter Port.

Evidence is lacking for an economy in Guernsey capable of producing a surplus for export, but it is hoped that future fieldwork in the island will throw new light on the social and economic structure of the rural settlement which must have flourished behind the facade of the Harbour.

It is tempting to speculate on the possible military importance of a secure natural harbour at the end of the 3rd century when continuing unrest and piracy necessitated the construction of new forts at Portchester, Hampshire and at the mouth of the Seine and the Somme (Cunliffe 1986).

If the signal station constructed at the Nunnery on Alderney (Johnstone 1981) can be dated to this period then the prospect of another similar station being established on Guernsey becomes more feasible. But this is speculation; there is no direct evidence to suggest that the St Peter Port wreck had any function other than as a merchant vessel.

Acknowledgements

I am grateful to the following: Volunteers from the Blue Dolphin Sub Aqua Club who were responsible for on-site surveillance during the Winter months and who provided invaluable on-site support to the team of diving archaeologists. Jon Adams, Alex Hildred, Chris Dobbs, Adrian Barak, Ian Oxley and Nick Rule, all members of the original Mary Rose team who were at various times responsible for the underwater survey and excavation. Martin Dean who was seconded from the National Maritime Museum to assist with the recovery. David Gibbins, University of Cambridge who, amongst other things, established the work room and undertook the documentation of finds. Richard Keen who provided essential services underwater, undertook most of the underwater photography and recorded anchorage debris recovered in recent years by divers and by trawlers. Dr Jason Monaghan who assisted in the recording of the finds and the timbers from the wreck in detail, and who will publish a report on the anchorage debris in The Proceedings of the Societe Guernsaisse. Dr Mark Jones who also assisted in the post-excavation research. The National Maritime Museum for arranging for the radiocarbon dating to be done at Harwell.

References

Burns, R B, 1977 The Late Iron Age Site at the Tranquesous, St Saviours, Guernsey, *Trans Soc Guernsiaise* **20**, 188-218.

Cunliffe, B, 1971 *Excavations at Fishbourne. Vol II: the finds*, Res Rep Soc Antiq London **27**.

——, (ed), 1986 The first eight thousand years, 7000 BC—AD 1000, in Jamieson, A G, (ed), *A people of the sea*, 3-18.

Johnstone, D E, 1981 *The Channel Islands: an archaeological guide*.

McGrail, S, 1983 Cross-Channel seamanship and navigation in the late first millennium BC, *Oxford J Archaeol* **2**, 299-337.

Monaghan, J, forthcoming Pottery from the St Peter Port wreck site, *Trans Soc Guernsiaise*.

6 The heritage of logboats and Gallo-Roman boats of Lake Neuchâtel: technology and typology

Béat Arnold

Abstract

Ethnological studies such as those undertaken by F Beaudouin (1970) on the Adour with its chaland monoxyle assemblé, those of W Rudolf (1966) in Pomerania with the Bodenschalenboot of Rostock or the Blockstevenboot of Gratz on the Oder, and those of T Itkonen (1942) in Finland have made it possible to trace close parallels between certain boats and their common ancestor: the logboat or dugout canoe fashioned out of a single tree trunk.

The basic principle in all these cases consists of beginning with a voluminous mass of wood from which the carpenters carve or sculpt the desired shape of the finished product.

In the case of the Gallo-Roman boats of Lake Neuchâtel, the most spectacular element remains the bilge strake or chine girder[1] planking which ensures the transition from the flat bottom to the sides. The transverse section of this element is more or less L or C shaped.

Two aspects are dealt with in detail. The first deals with the fashioning of the planking of the Bevaix boat, which naturally leads to the second, a discussion of certain typological characteristics of these boats based upon their geometry.

Fashioning the planking of the Bevaix boat

Since 1985, during the period in which 'rescue' archaeological excavation was restricted. we undertook the process of 'preserving' the Bevaix boat, finally opting to make a cast of each plank; the original pieces were then put into large boxes filled with lacustrine and immersed in the lake for posterity (Fig 6.1).

The Bevaix boat had been temporarily stored in great tanks of water since its excavation more than 10 years before. The casting created an opportunity to undertake a new and detailed analysis of it.

For technical reasons inherent in the rescue operation of 1973, the large sheathing planks were cut into 1.8-2.0 m pieces. The multiple transverse sections obtained in this way proved essential for understanding the fashioning techniques of the various plankings, and optimal for dendrochronological analysis. The Bevaix boat was built with oaks felled in AD 182 (Fig 6.2).

The most remarkable conclusion, however, is the fact that all the planking was carved out of tree trunks, like logboats: the carpenters knew exactly where each piece they carved was to be placed and the shape it needed to have, in three dimensions (Fig 6.3), except plank A (and probably D) which was secondarily bent with heat (Fig 6.3A).

This three dimensional conceptualisation of the various planking elements and their fashioning by carving certain amounts of material out of the trunks (becoming veritable sculptures) shows that we are still quite close to the techniques used in making logboats. Here, however, an even more remarkable mastery of volume is achieved. The perfect illustration of this is the Yverdon 2 boat, discovered in 1984.

Let us recall (Arnold 1974; 1978; 1980) that the bottom planking of the Bevaix boat is essentially made up of four boards arranged diagonally along the bottom; the beginning of the first (A) constitutes the bow and the end of the fourth (D), the stern. These two pieces are rather similar: in both cases the stump (or butt) end of an oak tree trunk was used, ie, the widest part out of which to carve the raised extremity. On the other hand, a considerable mass of wood was carved away to obtain the longitudinal curve, and the plank was finally bent by heating a small portion of its length.

Planks E and F, which fill the space between the four parallel bottom planks (A, B, C, D) and the bilge strakes, were also carved out of oak trunks.

The B and C planking, however, was derived from the tangential cutting of large oak trunks, which yielded exceptionally wide, flat boards. Although marks left by a pit-sawyer were identified in two spots, all the finishing work was done with axes and adzes. Lastly, in the case of plank B, a main branch was used to follow the curved part of the bow (Fig 6.3).

To carve the four bilge planks (two each side), the carpenters used a whole oak trunk each time and not a trunk split in half lengthwise as one could be led to believe by a single transverse section (Arnold 1980, fig 11).

The basic tools used to fashion this boat still remain the axe and the adze. At least three categories of blades can be distinguished:

1) series of narrow, rectilinear blades, 64-70 mm wide,
2) a wide, slightly arched blade at least 100-110 mm wide (this tool was used tangentially, as only one edge of the blade could sometimes be observed, never both; Fig 6.4A),
3) a concave blade, belonging exclusively to an adze which was designed to carve, among other things, a groove on each side of the bottom of the boat to channel any water to the lowest point.

It can also be pointed out that, in the first case, certain marks in the rough-hewn underside of some frames were indubitably made by an adze with a narrow

Figure 6.1 Casting of the Gallo-Roman Bevaix boat: 2.2 tons of polyurethane (Ureol 6426). (Photo: Yves André).

rectilinear blade. Traces of a pit-saw were also observed at some places on planks and frames (Fig 6.4B).

To complete the set of tools used in building this boat, we can also mention the frequent use of a hand-saw for adjusting the edges of the planking. A bevel, creating a space to introduce the caulking, was carved afterwards with an axe in the starboard edge of each plank. Finally, an auger with a spoon-bit (diameter 16-18 mm) was used to bore holes for round wooden pegs designed to hold the planking temporarily together while in the building yard, but also to prepare for the nails which were driven from the outside through the narrowest frames to prevent them from splitting.

As far as plank C and bilge plank H are concerned, these are recycled pieces. For the former, little square pegs used to plug the holes left by torn-out nails indicate that at least two series of frames had been previously used. The dendrochronological analysis shows that this plank C could have been carved, at the most, 20 years earlier; the lack of precision is due to the total absence of sapwood on this plank. Bilge plank H, discovered during a dive in 1980, also shows traces of recycling; round extra pegs used for an earlier assemblages, and small square pegs.

In conclusion, we note that only by cutting the long planks into pieces can the techniques used to carve them be recognised through clear and precise observation; a method of analysis which is quite out of keeping with museum objectives which generally take priority.

At Bevaix, the planks were carved according to the form they were to have in the finished boat. This demanded, on the part of the carpenters, a very precise knowledge of the ultimate shape of the boat and the

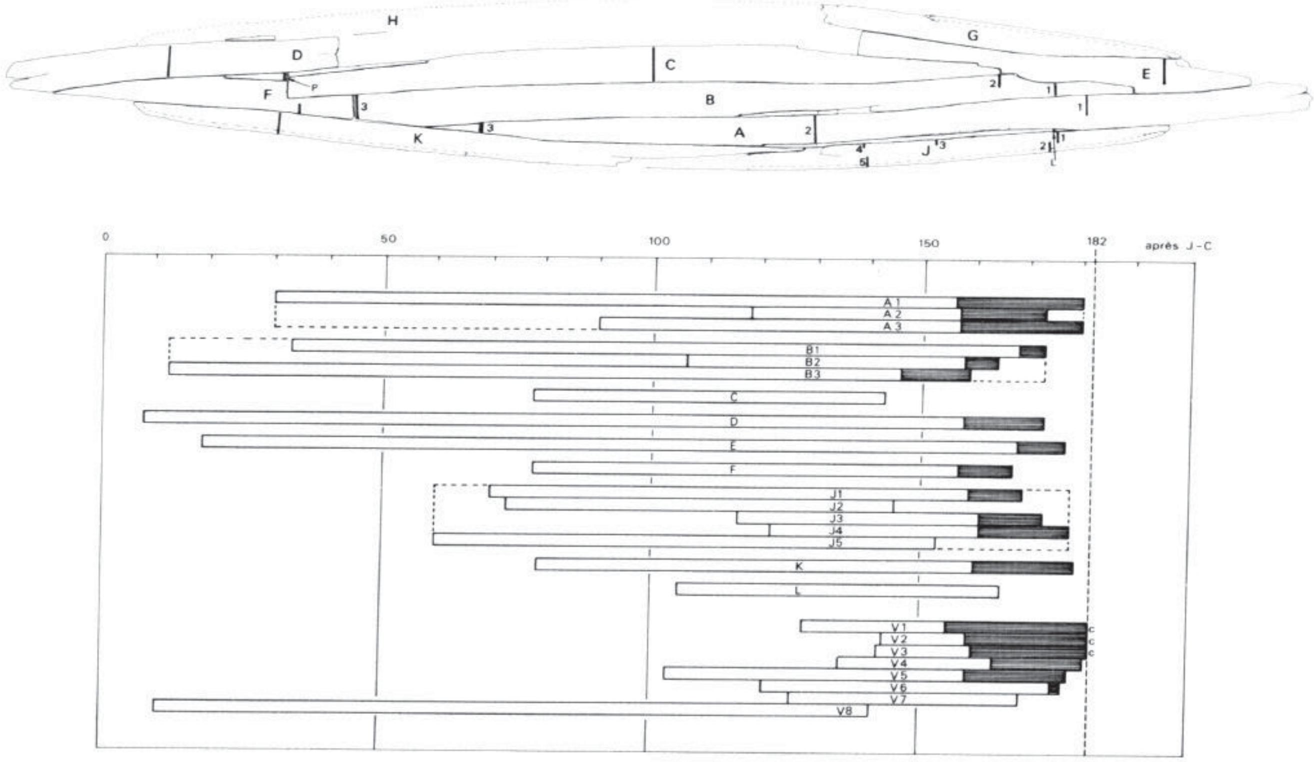

Figure 6.2 Dendrochronological analysis (by H Egger) established that the Bevaix boat was constructed with trees cut in AD 182. V. frames. (Diagrams: Author).

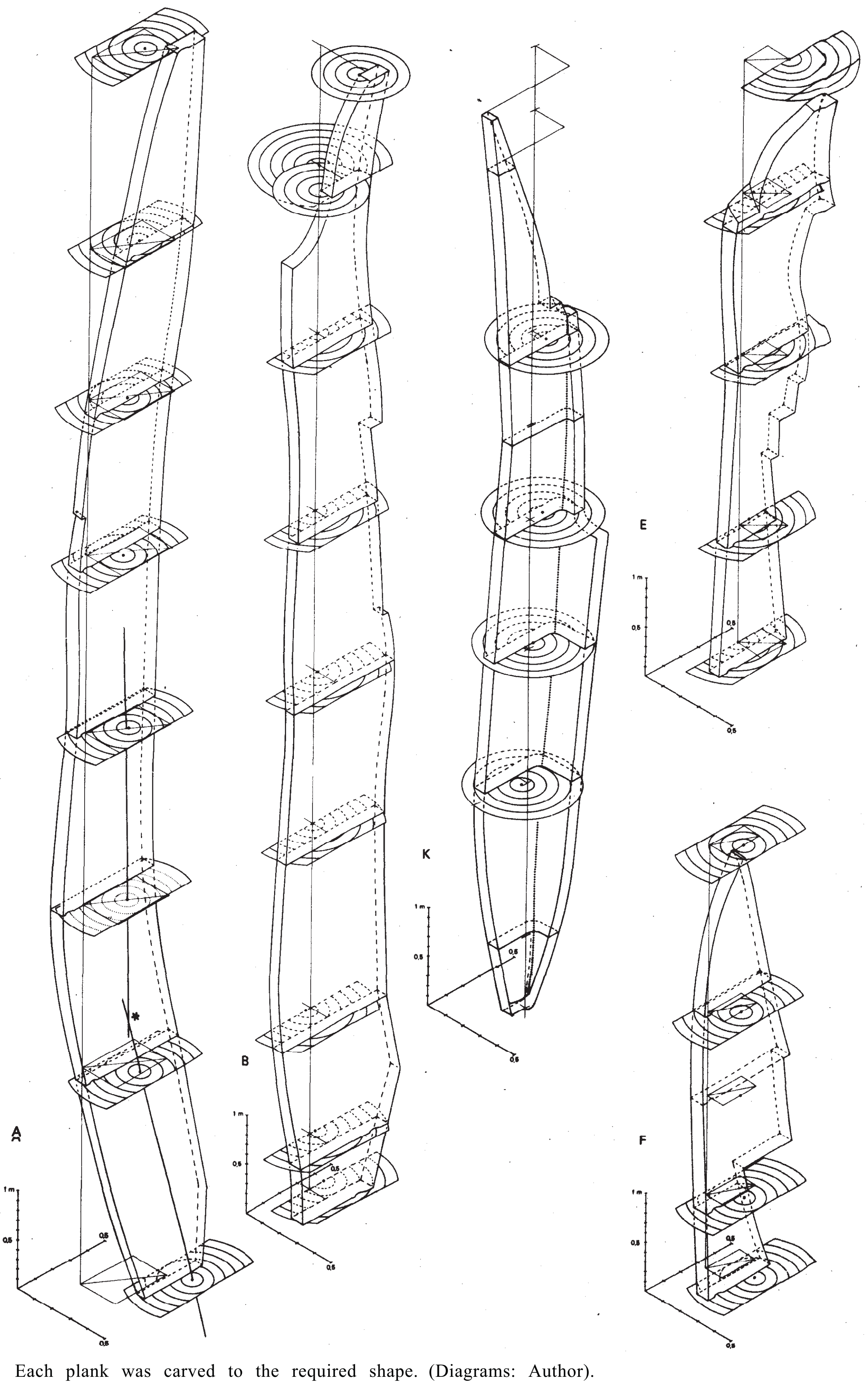

Figure 6.3 Each plank was carved to the required shape. (Diagrams: Author).

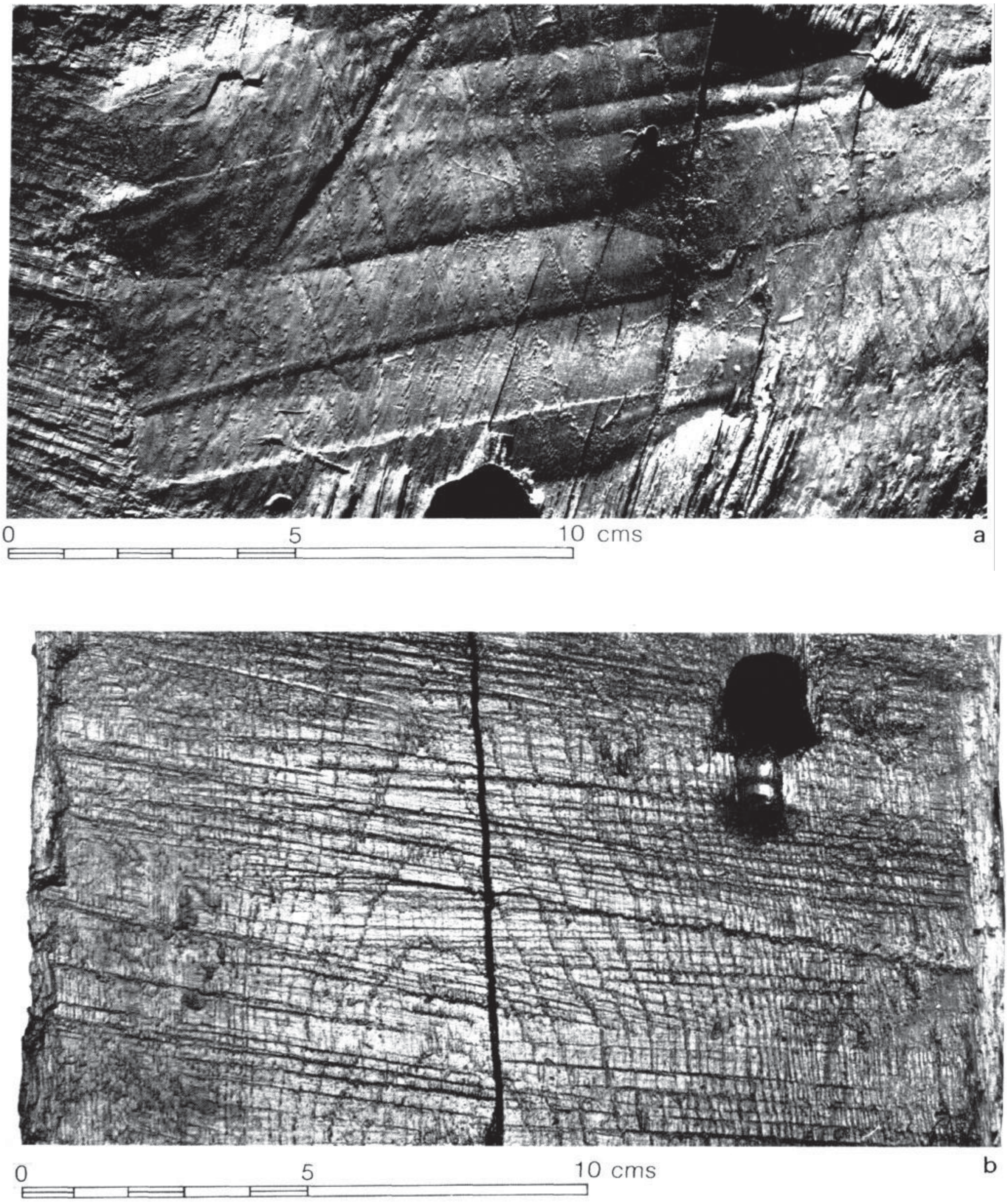

Figure 6.4 a. Traces of a wide blade, slightly arched. Scale 1:1. b. Traces of a pit-saw. Scale 1:1. (Photos: Yves André).

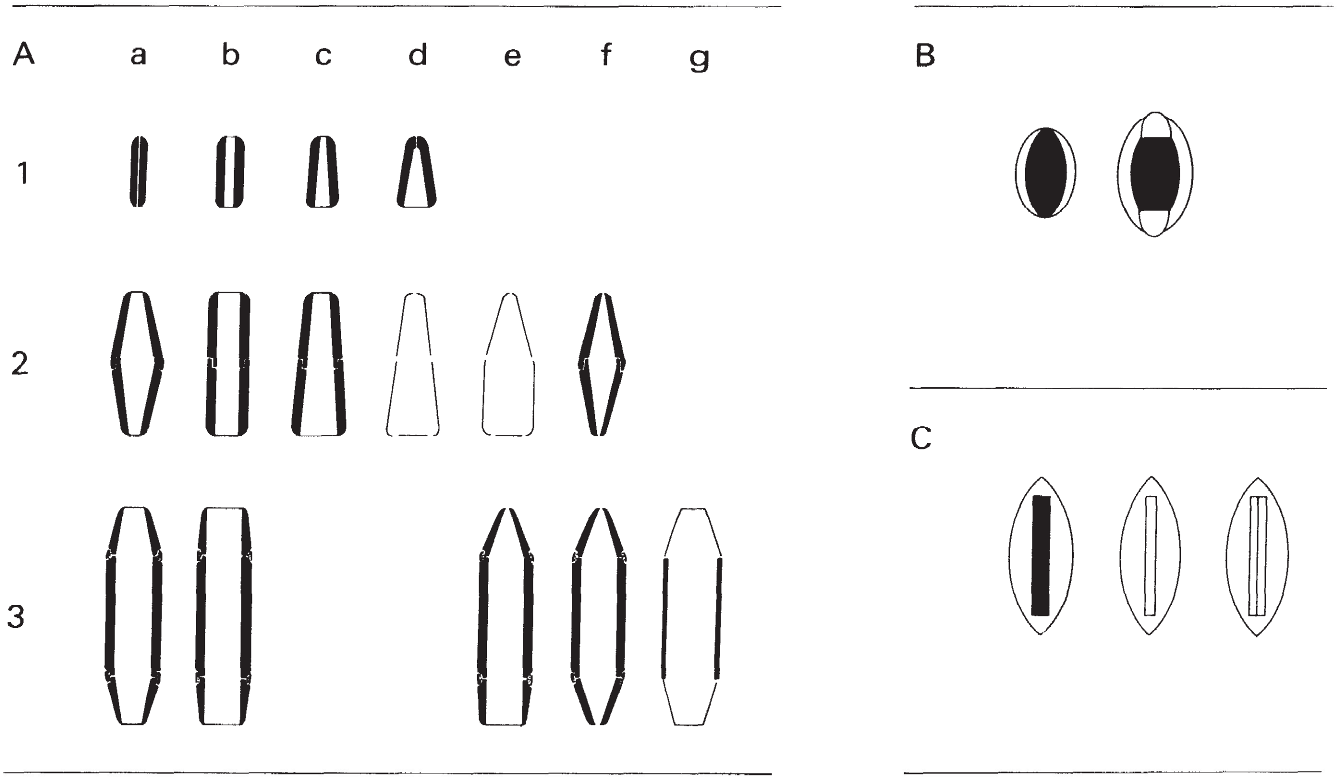

Figure 6.5 Typology of the Gallo-Roman boats and especially the polygonal ones (A). This latter group may be sub-divided with regard to the number of pieces per bilge-strake: 1. rectangular; 2. hexagonal; 3. octagonal. (Diagrams: Author).

exact spot where each carved piece was to be inserted.

In this context, and in opposition to the boat of Zwammerdam 2 (de Weerd 1987; see below and Fig 6.7), it is apparent that no standardisation of preliminary carving of the planks was possible. Here we remain very close to the carving techniques of logboats and to the Celtic or pre-Celtic traditions.

Towards a typology of Gallo-Roman boats

Various attempts at classification have already been proposed for Gallo-Roman boats (Marsden 1976; Lehmann 1987; but also Ellmers 1984). They do not, however, take sufficiently into account the constraints imposed on a boatbuilder by the size and shape of the trees available to him. Logs are the essential limiting factor, ensuring the boat's rigidity (like a keel), while also inducing the principal lines of the boat's shape and size.

These constraints due to the raw material are actually the same as those present in logboats where the bottom, for example, chosen to be made from a certain part of the cross-section of the trunk, directly influences the shape of the sides (Arnold 1976, fig 4; 1980, fig 3). They are also the same as those that caused carpenters to change from the logboat to the plank boat in order to obtain boats longer than 12-15 m and capable of loading more than 3-5 tons.

Three groups of plank boats can be distinguished on the basis of the limiting element of the logboat (Fig 6.5).

The polygonal barques (box-shaped) make up a first group (A). These belong to the 'bottom-based construction type'. The bilge strakes correspond to this fundamental element, and the length of the boat as well as its shape depend on the number of pieces used.

The second group (B) comprises boats with the bottom, carved from a single vast piece of wood, in the shape of a spoon (Velsen; Utrecht-Waterstraat), sometimes complemented at the extremities by the addition of other pieces (Utrecht). The dimensions of these boats and any developments towards shapes of large dimensions, remain very limited. Only Zwammerdam 3 1973 (2nd-3rd century; de Weerd 1977, pl 14/l) can be attributed to this group which is, above all, illustrated by medieval boats: Velsen 1974 (11th-12th century; Vlek 1987); Utrecht-Waterstraat 1974 (12th century; Hoekstra 1975; Vlek 1987); and Utrecht 1930 (11th century; Vlek 1987).

The third group (C) is characterised by boats of an often slender shape, constructed either on a massive axial element or on two axial planks which are thicker than the rest of the planking. Examples of the former are the Mainz 1, 3 and 9 boats 1982 (4th century; Höckmann 1982), but we could also name the modern Bodenschalenboot of Rostock (Rudolph 1966, pl 2). An example of the latter is the Blackfriars 1 boat of the 2nd century (Marsden 1966; this volume).

Polygonal boats

The shapes of the polygonal boats, regardless of the number of pieces per bilge strake or chine-girder, vary

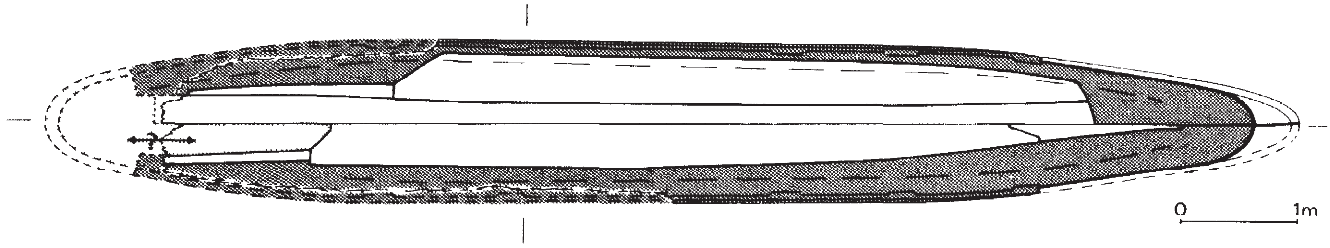

Figure 6.6 Planking of Yverdon 2, 1984: polygonal boat of rectangular type developed into a triangle (A1d). (Drawing: Author).

only slightly (Fig 6.5A). The basic shape (a) is rectangular with one piece per bilge strake, hexagonal with two, octagonal with three; this shape can be reduced to a rectangle (b), a trapeze (c), a triangle (d), a pentagon (e) or a bi-point (f).

Rectangular base type (A1a): no boat of this shape has yet been found for the Gallo-Roman period, but they existed in various places in Europe at the end of the 19th century and at the beginning of the 20th century.

Rectangular type developed into a trapeze (A1b): the medieval boats of Meinerswijk 1976 (Reinders 1983, pl 21-37) and Krefeld 1973 (Dammann 1974, 5).

Rectangular type developed into a triangle (A1d): Yverdon 2 1984, 3rd/4th century (Fig 6.6; Weidmann & Klausener 1985).

Hexagonal type (A2a) : Bevaix 1970, 2nd century (Arnold 1974; 1978; 1980; Egloff 1974).

Hexagonal type reduced to a rectangle (A2b) : probably Yverdon 1 1971, 1st century AD (Weidmann & Kaenel 1974; Arnold 1978, 59), Pommeroeul barge 1 1975, 2nd century (de Boe & Hubert 1977, figs 32 & 35), and Woerden 1978, 4th century (Haalebos 1987).

Hexagonal type reduced to a trapeze (A2c) : probably Druten 1973, 2nd/3rd century (Lehmann 1978), even though the published plans render such an analysis difficult.

Octagonal type (A3a) : Zwammerdam 4 1974, 2nd-3rd century (de Weerd 1977, 192-3, pl 16/1).

Octagonal type reduced to a rectangle (A3b): Zwammerdam 6 1974 2nd-3rd century (de Weerd 1977, pls 7/2 & 8/2).

Octagonal type reduced to a hexagon (A3f): Zwammerdam 2 1973, 2nd-3rd century (de Weerd 1987, fig 3.3B).

Lastly, before the plank boat without carved bilge strakes, we can also mention cases such as the grande galupe on the Adour of the 20th century (Beaudouin 1970, figs 20 & 21), where the elements are reduced to the minimum and are only present in the central part of the bilge (g).

Fashioning the extremities

Unfortunately, in many cases, the extremities of these vessels either were not preserved over time or were not recorded fully. In some cases however, a few propositions can be drawn from published photographs.

In the first case, the bilge planks are joined and constitute, in themselves, the extremities; perhaps surmounted by a breast-hook (Yverdon 2).

In the second case may be included extremities consisting of a single massive piece of wood. Several types can be identified, but the most remarkable is that of Woerden (Haalebos 1987, fig 41). Among the modern boats can be mentioned the chaland monoxyle assemblé from the Adour (Beaudouin 1970) or the Blockstevenboot of Gratz on the Oder (Rudolph 1966, fig 27, pl 5).

The floor planking can also be carved in such a way as to meet the top of the extremity (eg Bevaix; Arnold 1974). Considering the constraints in shape due to the tree trunk, this implies that these boats are not very high-sided.

Finally, the planking can have a fissure between the bottom and an extremity; this fissure can be shaped in a zig-zag (eg Pommeroeul barge 1; de Boe & Hubert 1977, fig 36). Similar joining is manifested near the stern of Yverdon 1 (Arnold 1978, 59).

The presence of a stem has as yet only been ascertained in group C (Mainz 1, 3 and 9 and Blackfriars 1).

Other parameters

The analysis of other parameters such as techniques of assembling the side planking (either clinker or carvel (flush-laid) built), the pattern of the framing (eg pairs of frames in L shape), the mast-steps (essentially transverse), and also the caulking (Arnold 1977) allow us to continue these typological approaches. Although these parameters have but little influence upon the general line of the boat, they have a marked tendency to persist. Thus, it is probably with their help that the ensembles or regional groups can be identified.

Evidence for standardised measurements

De Weerd (1988) has tried, from a consideration of the planks of Zwammerdam 2 as well as the arrangement of the frames of different Gallo-Roman boats, to demonstrate the presence of a standardised unit of measure, ie, pedes monetales (PM = 0.296 m). Without delving here to the very root of the problem, it nonetheless seems essential to draw attention to the following points: ships may only be considered which have been well preserved, restored or not too deformed; have been the subject of meticulous drawings; and have been published at a reasonable scale (for example, 1:50). One must also know the extent of the variation of the dimensions discerned in order to determine, by their comparison, if the results are compatible with the use of a precise measurement (for example, 296 mm).

Moreover, the use of the extremities of the surviving remains as points of reference for measurement is doubtfully valid if these do not correspond either to the extremities of the ship in the underparts of the hull at the time of its construction, or to a major functional element of the vessel. It is thus dangerous to use the value of the standardised unit that is sought to be established in order to reconstruct one or

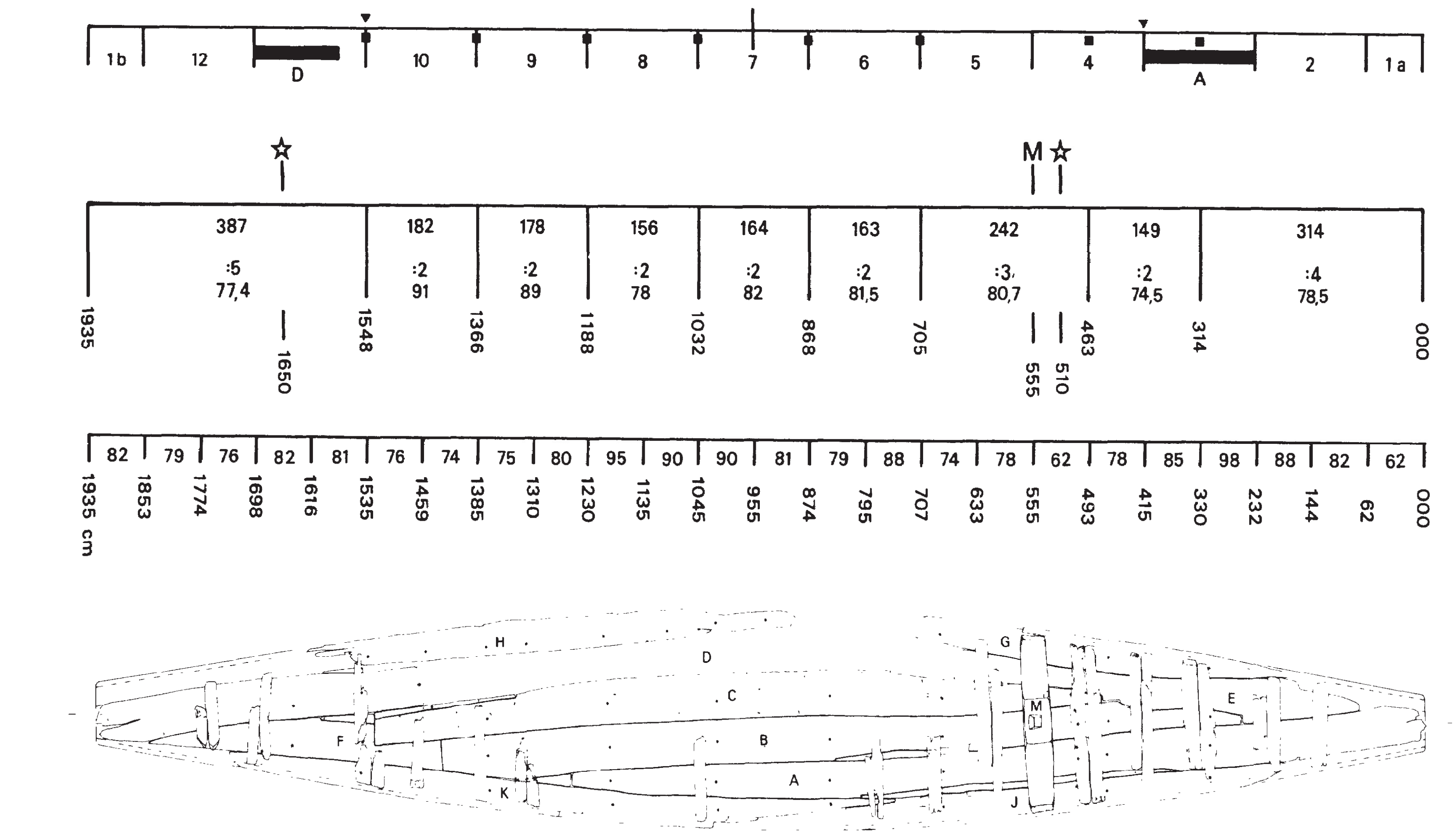

Figure 6.7 Metric data Bevaix boat (after restoration). ■ location of the row of rounded wooden pegs; ▼ – ▼ horizontal floor; A, D, bent area of plank A and perhaps D. (Diagram: Author).

both missing extremities, and subsequently use this or that position to prove the application of that measure in the construction of the boat.

In the case of the Gallo-Roman boat of Bevaix, it is only valid to use measurements of the distances between a pair of frames in the absence of numerous destroyed frames (Fig 6.7). These results and those obtained on the basis of the beams forming the stocks at the building site (as indicated by rows of round treenails) do not constitute any proof for the use of any system of precise measurement when making and positioning the diverse elements of the boat: the distances obtained vary widely from 0.74-0.90 m (in fact, 0.81 ± 0.06 m). This value, being between 2.5-3 PM, can therefore have no simple relationship with the PM. Reliance on the Bevaix boat to prove the use of PM in ship and boat construction seems to us ill-justified (de Weerd 1988, fig 142).

As for the interpretation of the boat Yverdon 1 (de Weerd 1988, fig 143), it is even more problematic, given the small portion of the boat that is preserved. This holds true even more so when taking into account the presence of secondarily added frames (Arnold 1978, 159, Fig C/R), with a mean distance between two pairs of frames being 0.92 ± 0.06 m).

Conclusion

The Gallo-Roman boats known to date can be classified into three groups: polygonal boats; boats with a dugout bottom; boats set on a massive axial plank. These groups are characterised by their origin in the logboat tradition: one or more planks are obtained by carving successive amounts of material out of a massive piece of oak.

By their number and arrangement, the sculptured bilge strakes limit the dimensions of the boat — at the same time they constitute the essential element ensuring its rigidity — and directly influence its general shape.

An analysis of several transverse sections (1.8-2.0 m in length) sliced through the large sheathing planks of the Bevaix boat, built in AD 182, demonstrates that these planks were carved from massive pieces, if not whole trunks, in order to obtained the desired longitudinal profile. One, or possibly two, was secondarily bent by heating a small portion of the plank, The carpenters, therefore, must have known very precisely where each carved piece was to go, not only in plan, but also in elevation, which effectively excludes a standardised pre-cutting of the oak trunks into planks. This three-dimensional conceptualisation of each plank of a given boat is remarkably well illustrated by the Yverdon 2 boat.

There is no statistically-valid evidence for the use of Roman standard units of measurement in either the Bevaix or Yverdon 1 boats.

Footnote

1 Bilge strakes or chine-girders may also be known as transition strakes.

Acknowledgements

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References

Arnold, B, 1974 La barque gallo-romaine de la baie de Bevaix (lac du Neuchâtel, Suisse), *Cahiers d'archeologie subaquatique* **3**, 133-50.

——, 1976 La pirogue d'Auvernier Nord 1975 (Bronze final). Contribution à la technologie des pirogues monoxyles préhistoriques, *Cahiers d'archéologie subaquatique* **5**, 75-84.

——, 1977 Some remarks on caulking in Celtic boat construction and its evolution in area lying northwest of the Alpine arc, *Int J Naut Archaeol* **6**, 293-7.

——, 1978 Les barques celtiques d'Abbeville, de Bevaix et d'Yverdon, *Archéologia* **118**, 52-60.

——, 1980 Navigation sur la lac de Neuchâtel: une esquisse à travers le temps, *Helvetia Archaeologica* **11, (43-4)**, 178-95.

——, 1983 Les dernières pirogues monoxyles de Suisse centrale, *Helvetia Archaeologica* **14 (55-6)**, 271-86.

——, 1985 Navigation et construction navale sur les lacs suisses au Bronze final, *Helvetia Archaeologica* **16, (63-4)**, 91-117.

Beaudouin, F, 1970 *Les bateaux de l'Adour. Genèse d'une architecture antique.*

Boe, G, & Hubert, F, 1977 Une installation portuaire d'époque romaine à Pommeroeul, *Archaeologica Belgica* **192**, 5-57.

Crumlin-Pedersen, O, 1972 Skin or wood? A study of the origin of the Scandinavian plank-boat, in Hasslöf, O, *Ships and shipyards, sailors and fishermen. Introduction to maritime ethnology*, 208-34.

Dammann, W, 1974 Rheinschiffe aus Krefeld und Zwammerdam, *Das Logbuch* **10/1**, 4-10.

de Weerd, M D, 1977 Römerzeitliche Transportschiffe und Einbäume aus Nigram Pullum/Zwammerdam (Z-H), in *Studien zu den Militargrenzen Roms II, Bonner Jahrbuch Beiheft* **38**, 187-98.

——, 1987 Maatvoering in pedes monetales en andere neiuwigheden bij de bouw van de zogenaamde keltische rijnaken van Zwammerdam, *Flevobericht* **280**, 15-23.

——, 1988 *Schepen voor Zwammerdam. Bouwwijze en herkomst van enkele vaartuigtypen in West- en Middeneuropa uit de Romeinse tijd en de Middeleeuwen in archeologisch perspectief.*

Egloff, M, 1974 La barque de Bevaix, épave gallo-romaine du lac de Neuchâtel, *Helvetia Archaeologica* **5 (19-20)**, 82-91.

Ellmers, D, 1972 Frühmittelalterliche Handelsschiffahrt in Mittel- und Nordeuropa, *Offa* **28**.

——, 1984 Punt, barge or pram — is there one tradition or several?, in McGrail, S, (ed), *Aspects of maritime archaeology and ethnography*, Nat Mar Mus Monog, 153-72.

Haalebos, J K, 1987 Een romeins schip te Woerden, *Flevobericht* **280**, 25-8.

Höckmann, O, 1982 Spätrömische Schiffsfunde in Mainz, *Archäologisches Korrespondenzblatt* **12**, 231-50.

Hoekstra, T J, 1974 Notes and news. Netherlands. Utrecht, *Int J Naut Archaeol* **4**, 390-2.

Itkonen, T I, 1941 *Suomen ruuhet. 1-, 2-, 3- ja monipuiset seka lautaruuhet kivikaudesta vuoteen 1940*, Kansatieteelinen Arkisto **5/1**.

Lehmann, L Th, 1978 The flat-bottomed Roman boat from Druten, Netherlands, *Int J Naut Archaeol* 7, 259-67.

——, 1987 Constructieverschillen in Romeinse platbodems, *Flevobericht* **280**, 29-31.

Marsden, P, 1966 *A ship of the Roman period from Blackfriars in the City of London.*

——, 1976 A boat of the Roman period found at Bruges, Belgium, in 1899, and related types, *Int J Naut Archaeol* **5**, 23-55.

Reinders, H R, 1983 Drie middeleeuwse rivierschepen gevonden bij Meinerswijk (Arnhem) opgravingsverslagen 5, 6 en 7, *Flevobericht* **221**.

Rudolph, W, 1966 *Handbuch der volkstumlichen Boote im ostlichen Neiderdeutschland, Institut für deutsche Volkskunde* **41**.

Vlek, R, 1987 *Medieval Utrecht boat*, Brit Archaeol Rep **S382**.

Weidmann, D, & Kaenel, G, 1974 La barque romaine d'Yverdon, *Helvetia Archaeologica* **5** **(19-20)**, 66-81.

——, & Klausener, M, 1985 Un canot gallo-romain à Yverdon-les-Bains, *Archéologie Suisse* **8**, 8-14.

7 A re-assessment of Blackfriars Ship 1

Peter Marsden

Abstract

The New Guys House and Blackfriars ship 1 vessels found in London are two of the three known Romano-Celtic vessels from Britain. The latter was a sea-going ship with constructional characteristics similar to those of the Bruges boat, also Roman, found in 1899. They were built with flush-laid planking fastened to the frame by large iron nails clenched in a distinctive manner, and the mast-step was cut into a frame with medial ridges. It is likely that the Blackfriars type of ship was similar to that used by the Veneti of north-west Gaul, but it is argued that it is unlikely that coins of Cunobelin depict these native ships. It is suggested that the Blackfriars ship may have been built on the Rhine or the Thames.

Introduction

Of the three Romano-Celtic vessels found in Britain, two were found in London and date from the latter half of the 2nd century AD. Discovered in 1959 and 1962, they were, respectively, a river barge abandoned in an ancient creek at New Guy's House, near London Bridge, Southwark, and a sea-going merchant ship sunk in the bed of the River Thames at Blackfriars, City of London (Blackfriars ship 1). They were the first Romano-Celtic vessels to be studied in detail in Europe. Another sea-going vessel has been found recently off Guernsey, Channel Isles, to add considerable new information about the form and construction of at least the Blackfriars type of vessel (see Rule, this volume).

Little was known of the significance of the Blackfriars and New Guy's House vessels at the time of their publication (Marsden 1965; 1967). However, it did seem that they were of a Celtic shipbuilding tradition, and that the former appeared to resemble Caesar's description of the ships of the Veneti, a Celtic tribe in north-west Gaul. Subsequently, other vessels were found in the inland waters of central and northern Europe which not only show that there was a considerable variety of form and construction in the Romano-Celtic tradition, but also show that they were unlike contemporary Mediterranean and Scandinavian ship construction (McGrail 1981, 24-5, 30-1). It is now possible to assess the London finds in the wider context of later discoveries (McGrail 1981, 22-4). Moreover, as facilities for archaeological examination have improved since 1962, the parts of the original ships that were preserved have been subjected to more detailed study, particularly dendrochronological analysis, to establish how the ships were constructed, and where and when they might have been built. Furthermore, the discovery of contemporary waterfronts and trade goods in Roman London (Milne 1985) have made it possible to assess how the ships might have been used (Marsden in prep).

Of the British finds, Blackfriars ship 1 was most intact, and a partial reconstruction is possible. Furthermore, following the discovery that the Bruges boat, found in 1899, originally had a mast-step timber similar to that in Blackfriars ship 1 (Crumlin-Pedersen 1965, 99) it is now clear that that vessel too was of Blackfriars type, and it seems likely that it was capable of sailing at sea. Its surviving timbers were recorded at the National Scheepvaartmuseum in Antwerp, and a radiocarbon date of the 2nd century AD obtained (HAR-472). Since details of its construction are very similar to other features in the Blackfriars ship, it seems likely that major features that survived in the Bruges boat are a useful guide to missing parts of the Blackfriars ship.

Originally pointed at both ends (Fig 7.1), the Blackfriars ship had a flat bottom, and instead of a keel it had two broad central planks alongside one another, each about 0.66 m wide and 0.076 m thick, which were held to massive floor timbers by iron nails clenched by turning through 180°. The outer bottom planks were 0.05 m thick, as were the side planks which were held to side frames by similar nails. The midships part of the vessel was originally lined with a ceiling of oak planks, 0.025 m thick, forming the hold. Just forward of this, and about one-third of the length of the vessel from the bow, was the mast-step. This rectangular socket lay in the central part of a floor timber, which had medial ridges extending along the centre of its upper surface (Fig 7.2).

Building sequence

There are difficulties in reconstructing the building sequence of the ship, for the function of some features cannot be explained. For example, small holes filled with pegs in the planking fragments may be the remains of a system of temporary fastenings used during the building process. That fittings of this type were used during the construction of at least some Romano-Celtic vessels is shown by the barge from Bevaix, Switzerland (Arnold 1978, 33-4 and this volume, also Rule, this volume).

Before the ship could be built it was necessary to convert logs into frames and planks. The floor timber frames were hewn from substantial logs, and the side-frames were cut from grown timbers of the appropriate shape. The planks had been tangentially cut by adze, axe or, more likely, by very large saws, as shown in a Roman tombstone relief from Gaul (Meiggs 1982, fig 14d). This tombstone depicts two men sawing a large log raised upon a trestle, and the saw, a long blade with a handle at each end, was held by one man below the log and one man above. There is some evidence to indicate that

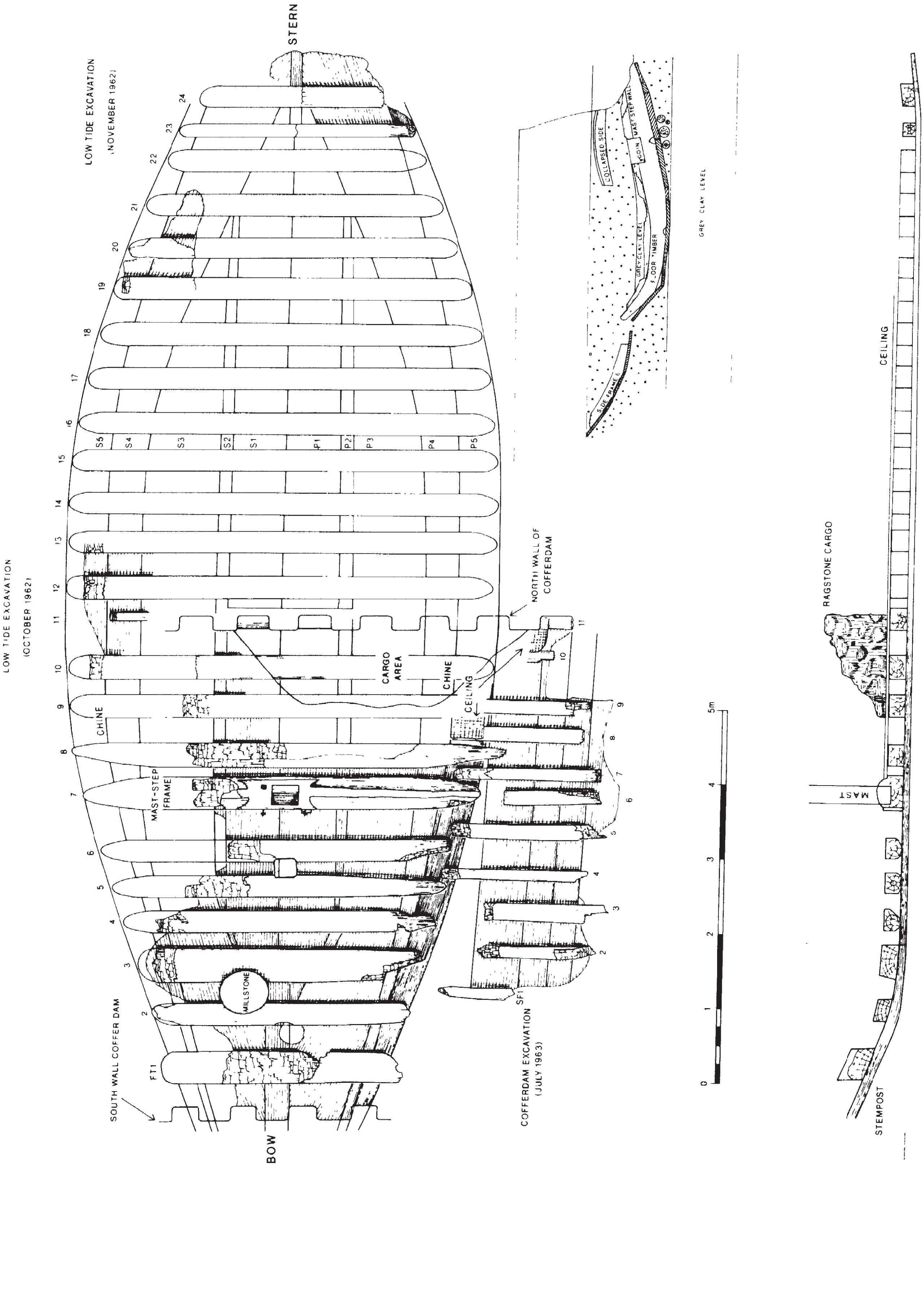

Figure 7.1 Plan of Blackfriars ship 1, 2nd century AD. (Drawing: Museum of London).

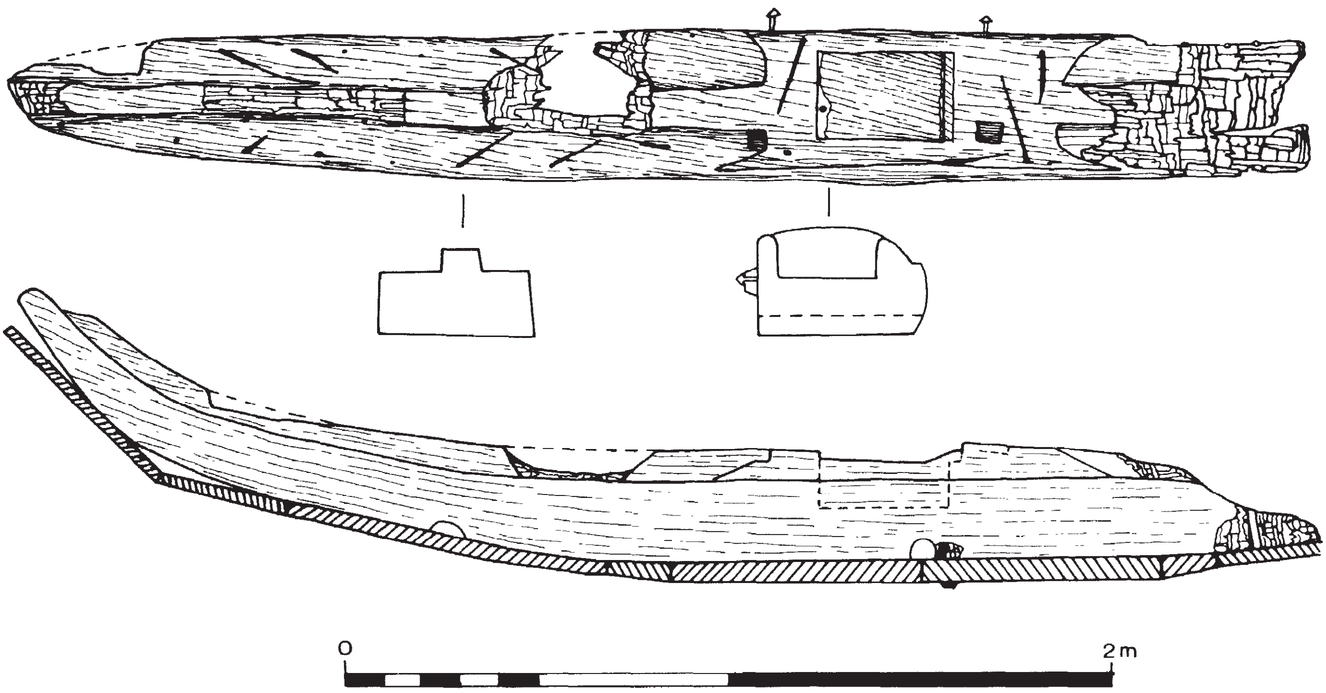

Figure 7.2 Mast-step frame of the Blackfriars ship. Note the nail headprojecting below the planking and not recessed as are nail heads in the Guernsey Ship (see Rule, this volume, fig 5.2). (Drawing: Museum of London).

Roman military sawmills also existed in Germany (Meiggs 1982, 186).

For the two central thick planks to be shaped they must have been laid on stocks with sufficient access below to allow them to be nailed to the floor timber frames. Floor timbers, excluding the two at the bow, after being shaped, had limber holes cut to enable bilge water to flow, and had vertical nail holes drilled, after which they were placed on the central planks (Fig 7.3(1)). These floor timbers were up to 0.457 m wide and 0.229 m thick in cross section, and were in pairs about 0.14 m apart, the space between the pairs being about 0.38 m.

Oak treenails, 0.019 m in diameter, were placed in the nail holes in the frames, and smaller holes were bored through them and through the bottom planking. Iron nails were then driven through the planks and frames from outboard and clenched by turning through 180° on top of the frames (Fig 7.4). These nails had shanks circular in section and 0.017 m in diameter, with points square in section. Their hollow cone-shaped heads contained a fibrous caulking material, not yet identified, whose purpose was presumably to stop seepage into the planking and frames.

The stem and stern posts were positioned at the ends of the two central planks and were fastened by nails to the undersides of floor timbers. The remainder of the bottom planks were nailed to the floor timbers and to the stem and stern posts (Fig 7.3(2)). Frames at the bow were then nailed into position over the stem post, and strakes were nailed to the angled ends of the floor timbers to form the first plank of each side (Fig 7.3(3)). Side frames were then fastened to these strakes, usually by two clenched nails, but as these were probably an insufficient support it is thought that temporary transverse timbers were probably fastened at a high level to make the side frames more stable while attaching the side planking (Fig 7.3(4)). The side frames, up to 0.241 m wide and 0.127 m thick in section, were spaced 0.19-0.406 m apart, and their lower ends were fastened to the first strake above the chine, between the ends of the floor timbers. The side planks, 0.05 m thick, were attached to the side frames by clenched nails, and similar nails fastened them into rabbets in the stem post. The ceiling planking was then fastened to the frames by only a few iron nails, as if the shipwright intended to make it easy to replace damaged planks from time to time.

Although this is the most likely sequence of building the ship, it must be remembered that in recent times, in some forms of shipbuilding with flush-laid planking, temporary wooden battens were nailed to adjacent strakes to hold them to each other before the strakes were nailed to the frames (Hasslof 1977, 74, fig 8.2). It is just possible that this 'shell' construction technique could have been used on the Blackfriars ship, for this would explain the small bungs which filled drilled holes in broken planks.

The final stages in building the ship are less clear, but it seems that they included constructing a deck, a hatchway over the hold, and accommodation for the crew probably in the stern. The mast was stepped, probably during a 'ceremony', for a votive coin of the Roman emperor Domitian was placed with its reverse uppermost in a recess in the mast-step before the mast was lowered into position. This enabled the reverse image of Fortuna, goddess of luck, to touch the foot of the mast.

When completed the Blackfriars ship was 12.8 m in length between the foot of the stem and stern posts, and probably 19 m long overall. Since its beam was

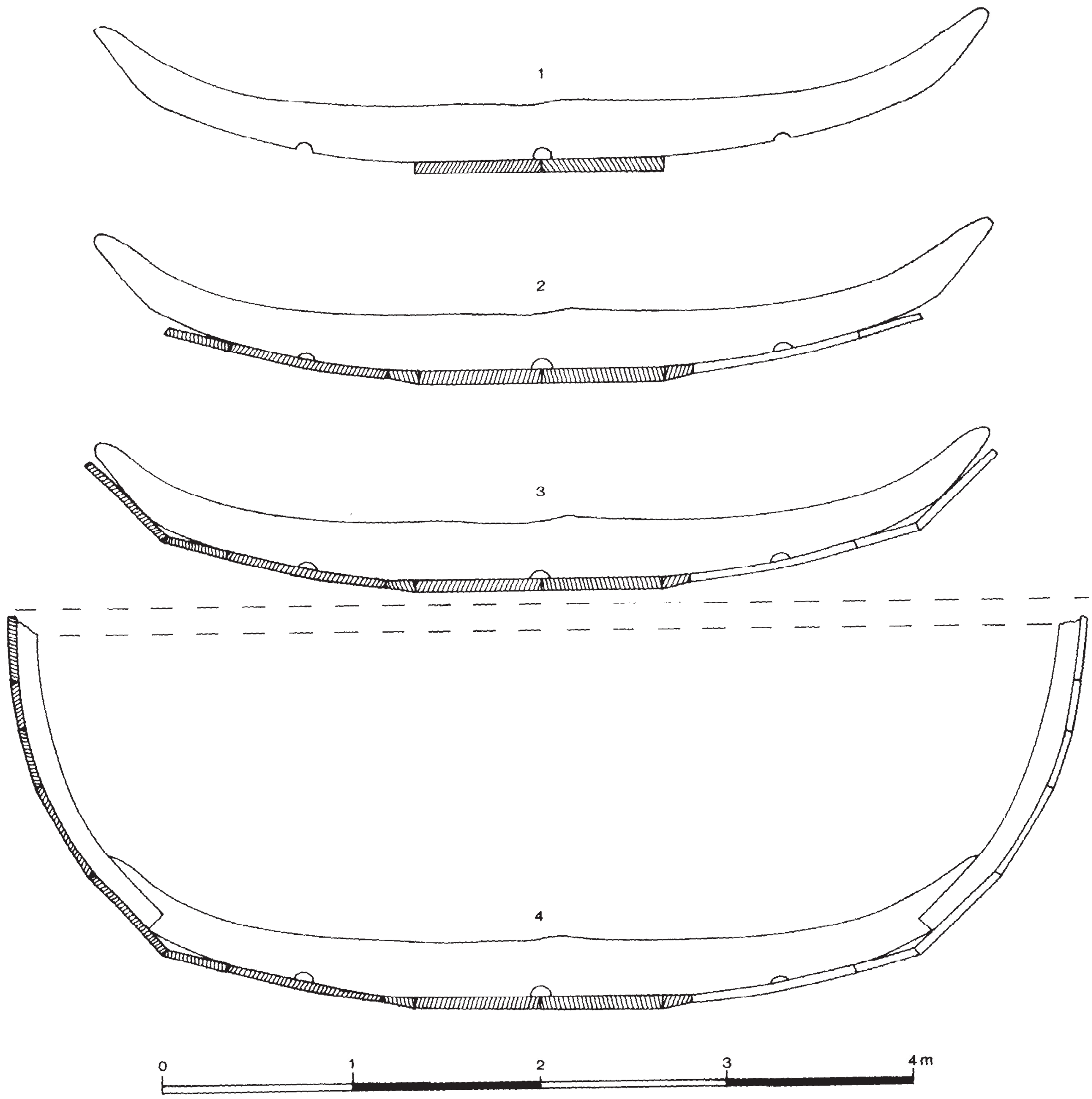

Figure 7.3 Conjectured stages in the construction of the Blackfriars ship. (Drawing: Museum of London).

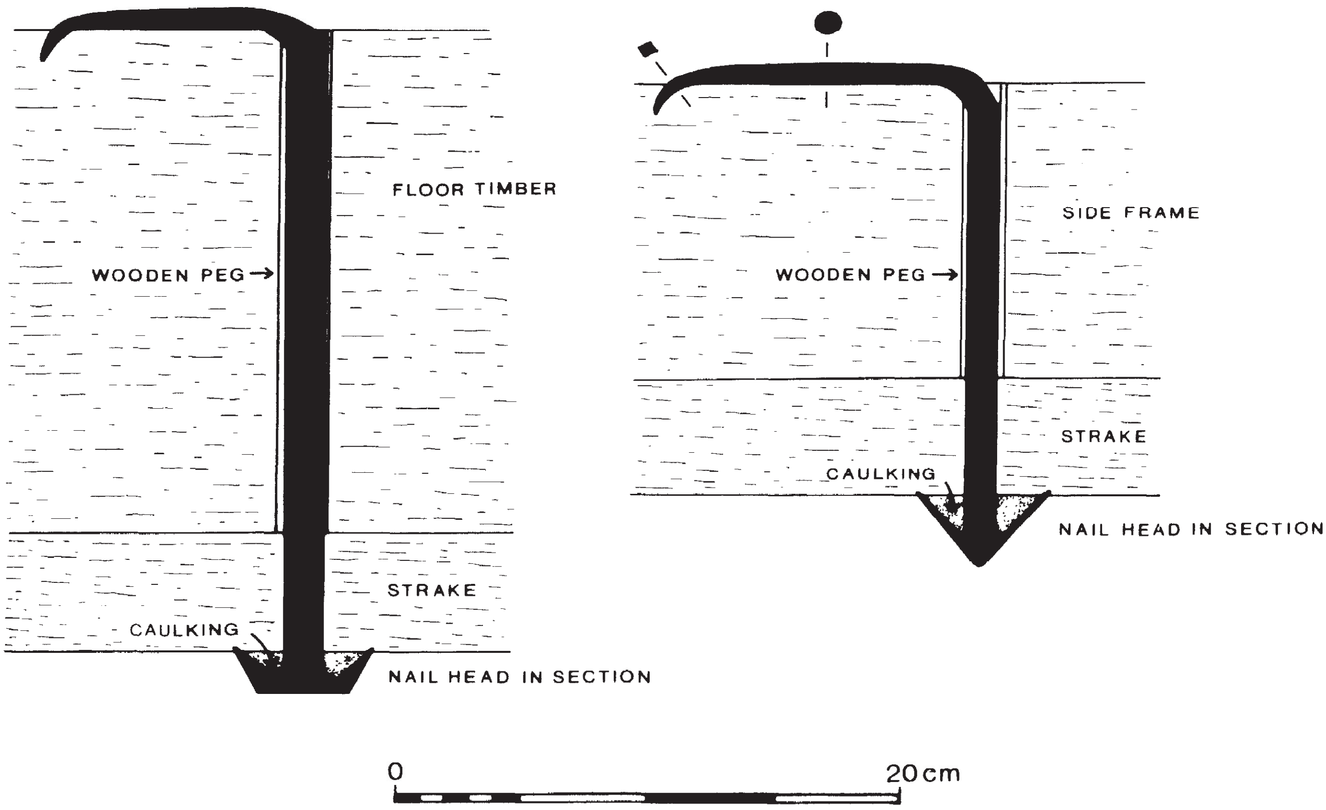

Figure 7.4 Section of nail fastenings (left) in floor timbers (ie, bottom frames) and (right) in side frames of the Blackfriars ship. (Drawing: Museum of London).

about 6.12 m, it had a length to breadth ratio of 3: 1. This contrasts with the similarly constructed Guernsey ship of the late 3rd century, whose hull is believed to have been c 23-25 m long and 5-6 m wide, a ratio of about 4:1 (Frere 1987, 359; see also Rule, this volume).

Suggested evidence from coins

As the Blackfriars ship was of a Celtic tradition of shipbuilding its ancestry presumably dates back long before the Roman invasions of northern Europe in the 1st centuries BC/AD. It might be thought, therefore, that the Blackfriars ship could have resembled the ship depicted on pre-Roman Belgic coins of Cunobelin (McGrail, this volume, Figs 4.11 and 4.12), found at Canterbury and Colchester. These had been minted in south-east England probably during the first quarter of the 1st century AD (Muckleroy et al 1978, 439-44; McGrail 1987, 234, 236).

The coins show the same side view of a ship with angled stem and stern posts, a quarter rudder on the starboard side, a projecting forefoot, and a mast with a yard from which a square sail was apparently to be hung. Muckleroy suggested that the vessel was similar to the Veneti ships described by Caesar, and thought that the forefoot was a projecting timber to assist in beaching. In support of this view he drew attention to the projecting keels and gunwales shown both in Scandinavian prehistoric rock carvings, and in the actual remains of the Hjortspring boat of the 4th century BC, found in Denmark (Åkerlund 1963, 133-5).

However, this interpretation is doubtful, for the citing of parallels from the quite different Scandinavian tradition as comparative evidence is somewhat stretching the interpretation of the archaeological data, particularly as the Scandinavian craft appear to be rowing boats, and the vessel on the coins was apparently a large sailing ship. Moreover, there are other important aspects that cast doubt on the view that the ship on the coins was Celtic, and instead suggest that it could be Roman. Firstly, the representation is unlike any of the Romano-Celtic ships discovered in central and north-western Europe, none of which have been found with a forefoot or with stem and stern posts rising at the angle depicted; secondly, the representations on Belgic coins tend to show Romanised rather than British features (Mack 1975, 70; Allen 1978, 69-71) and the ship shown could well have been a normal Roman merchant ship with a ram bow of the type that is commonly represented in Roman art (eg Meiggs 1960, pl xxiii, xxiv). The reverse of the ship coin, for example, shows a standing winged Victory holding a ring or wreath, and is clearly based upon a Roman prototype; and thirdly, Caesar considered the Belgae as separate from the Gauls, but he linked the ships he was describing only with the Gauls. In this context it is important to note that although he crossed to south-eastern Britain in the area being occupied by the Belgae, he did not mention their ships.

Since trade with the Roman world as early as the 1st century BC, is demonstrated by Roman objects on Iron Age sites in Britain (Peacock 1971), it seems likely that the depiction of a Roman ship on the coins could, like the figure of Victory, be a political boast by Cunobelin extolling the trade links with the Roman world across the Channel. Indeed, such trading links before the Roman invasion of AD 43 are highlighted by the discovery of a Classical lead anchor stock, probably of the late 2nd century BC, in the sea off the Lleyn peninsula, north Wales (Boon 1977, 10-30).

Whatever the truth behind the ship representation on the coins, therefore, it is clear from the discussion above that they should not be regarded as probable representations of Celtic ships trading around southern Britain, and therefore cannot be considered as a clue to the hull form of Blackfriars ship 1 (but see McGrail, this volume, for an opposing view).

Rig

The rig of the Blackfriars ship is suggested by the position of the mast-step which lay about one third of the length of the ship from the bow. Although several types of rig were used in Roman times (Casson 1973, 239-45; Ellmers 1978, 11) the most common type was the square sail. However, there are problems in using such a sail on a mast so far forward (McGrail 1987, 216-8) and it is just possible that the Blackfriars ship had a fore-and-aft sail such as a sprit. It is fortunate that much of the mast of the Bruges boat had survived for this perhaps provides a clue to the height of the mast in the Blackfriars ship (Marsden 1976, 40-1). The Bruges mast was at least 9.3 m high, and had a maximum diameter of 0.16 m. Since it is likely that there was a relationship between the beam of a vessel and the height of its mast, the conjectured beam of 4.7 m of the Bruges boat and the 6.12 m beam of the Blackfriars ship suggests that the mast in the latter might have been about 12.5 m high.

Steering

No trace of a steering mechanism had survived in the Blackfriars ship, but a large oak rudder found with the Bruges boat may be indicative of the type of steering used. The publication of 1903 (Marsden 1976, 26) shows that it was at least 4.1 m long, and its blade was 0.7 m wide. A tiller hole recorded in 1903, at a right angle to the blade indicates that this was either a quarter rudder or perhaps a steering oar with a transverse tiller. A slight narrowing of the shaft just above the blade suggests that it might have had a sleeve, perhaps of leather, by which it was fastened to the hull, or this could be where it was pivoted had it been a steering oar. The discovery of just one rudder may suggest that the Bruges boat did not have a pair of quarter rudders as used in Classical ships in the Mediterranean.

Crew's quarters

During the excavation of the forward half of the Blackfriars ship 1 a search was carried out for evidence of occupation by the crew, but none was found except for two conjoining sherds of the same coarse ware pot (Marsden 1967, fig 18, no 39). The after half of the ship was hardly excavated, and it is presumably there that the crew's quarters lay.

Use of the ship

There is clear evidence that the Blackfriars ship was a sea-going vessel, for the planks contained Teredo and Limnoria borings. A sample of planking had slight signs of attack by Limnoria, represented only by two or three characteristic holes amid the numerous Teredo channels. Since the position of the Teredo infestation in the ship is an important indicator of the draught of the vessel, the presence of borings in two side frames 1.22 m above the bottom of the vessel shows that the waterline lay above this level and that the ship was probably leaking.

The most obvious evidence for the use of the ship was its cargo of building stone that was presumably being transported from a depot close to the quarry, to Roman London. A pile of stone rubble, up to one metre thick, was situated aft of the mast-step: between the floor timbers where it had broken through the ceiling planks. Many of the lumps of stone were large, weighing between 27 and 31 kg (60-70 lbs) each. In view of this it is likely that the stones were lowered rather than dropped into the hold, for they were angular, and the oak ceiling planks were only 0.025 m thick.

Samples of the stone were found to be of ragstone, probably from the Hythe Beds of Kent, in south-east England. This Cretaceous blue-grey sandy limestone outcrops from the Sevenoaks area through Maidstone to Hythe and Folkestone. The fossils in one sample could not be matched exactly outside west Kent, and, as the River Medway is the only navigable river through the outcrop area, the neighbourhood of Maidstone, on its east bank, is a likely quarry source. Since ragstone was used extensively in Roman London it is probable that the stone on board the Blackfriars 1 wreck was cargo rather than just ballast.

The last voyage of the Blackfriars ship would appear to have been down the winding River Medway from the Maidstone area, past the Roman town of Rochester, and into the Thames estuary. As the voyage up the Thames was both against the prevailing wind and against the river current it is likely that the ship used flood tides to help it reach the city of London. It is significant that recent environmental analyses on the Roman waterfront at London have demonstrated that the river was tidal there at that time (Milne 1985,81-4).

A large unfinished millstone was found, lying convex side uppermost, on top of floor timbers in the bow. It was a 'blank' awaiting finishing for it had no hole in the centre, and no grooves to spread the grain evenly when used. As such it would seem most likely that it was collected near the place of manufacture, though this should be considered as by no means certain. Its location within the ship shows that it was not being used in the vessel, though its position forward of the mast-step suggests that it was intended that it should not be damaged by or mixed with the ragstone cargo. Also, as it was a single stone, it was unlikely to have been part of a larger consignment of millstones.

The stone is Millstone Grit, perhaps from the Pennine area of the Yorkshire region of north-east England or from the Namur region around the Meuse valley, Belgium. Even though the area in which Millstone Grit outcrops is known, it is not precisely clear where the stone was worked in Roman times. Its presence on board the Blackfriars vessel suggests an earlier voyage.

It seems unlikely that London was the planned destination of the millstone, for a recent study of Roman millstones and querns from that city (King 1987) shows that of the 32 examples found, excluding the millstone from the Blackfriars ship, only three (9.4%) were of Millstone Grit. The remaining 29 (90.6%) were of lava imported from the Continent, probably from the Rhine. In contrast, however, the millstones and querns found at the inland Roman city of Verulamium (St Albans), show that British products were apparently far more

Figure 7.5 Finds of ships of the main shipbuilding traditions, 4th century BC - 4th century AD (sources: Marsden forthcoming). (Drawing: Museum of London).

important there than at London. Of the 33 Roman querns and millstones found at Verulamium, 54% were from a variety of British quarries, of which 10 (30%) were of Millstone Grit and thought to be from Britain too. Although the number of identified and dated objects is small, the difference between St Albans and London is sufficiently striking to suggest that the Blackfriars millstone was not to be offloaded in London.

Where was the ship built?

At present there are two important clues to where the Blackfriars ship was built: firstly, the distribution of ships of that tradition and of neighbouring traditions in central and northern Europe; and secondly, the distribution of vessels with the constructional characteristics of the Blackfriars type. In due course dendrochronology may contribute further indications.

The sea-going ships of the Romano-Celtic tradition, from Blackfriars, Bruges and Guernsey, could have been built in many parts of northern Europe. However, the distribution of sites where river vessels of Romano-Celtic type have been found is a valuable indicator of the extent of the tradition overall, for they would have remained on the river system where they were built (Fig 7.6).

In north-eastern Europe and Scandinavia, roughly contemporary vessels have been found of the clinker shipbuilding tradition, in which each strake overlaps its neighbour and is riveted or pegged together. These are the boats from Nydam, in northern Germany (Åkerlund 1963), and from Halsenoy in southern Norway (Christensen 1972, 163); and, dating from the 4th century BC, there is a sewn clinker built boat from Hjortspring on the island of Als, Denmark (Christensen 1972, 162; Greenhill 1976, 178-82; Åkerlund 1963, 134-5). It was only after the end of the Roman period, in the early 5th century AD, that peoples from north Germany introduced this type of clinker shipbuilding tradition into southern Britain, as illustrated by the Sutton Hoo ship of the 7th century AD (Evans & Bruce-Mitford 1975).

In southern Europe, around the Mediterranean basin, all Roman ships found so far dating from the 1st-4th centuries AD were built with flush-laid planking using mortise and tenon joints to hold the planks together edge-to-edge (Casson 1973, 202-6). Examples of the Mediterranean tradition have also been found in northern Europe, particularly the County Hall ship, London (Marsden 1974), the Vechten boat, Netherlands (de Weerd 1988, 184-94), and part of a boat found at Zwammerdam, Netherlands (de Weerd 1988, 162-73). A curious hybrid structure found at Zwammerdam, however, was a steering oar of Rhenish type in the Romano-Celtic tradition which had been constructed with mortise and tenon joints as in the Mediterranean tradition (de Weerd 1988, 162-73).

The Romano-Celtic river craft are found in central and north-western Europe between the areas dominated by the Scandinavian and Mediterranean traditions, from the Rhine westwards, on both sides of the Channel (de Weerd 1988), on the Thames, in northern Belgium (de Boe 1978, 22-30) and, it seems, on the Somme (Traulle 1809). (For full references to boat finds, see McGrail 1981, 23; de Weerd 1988).

One of the most distinctive features of the sea-going Blackfriars ship type is the mast-step frame with its central socket and raised surround, and medial ridges along the upper face (Fig 7.3), which may have strengthened these frames. The discovery of yet another mast-step frame of this type in a river craft of the 4th century AD at Mainz (vessel no 9) shows that vessels with this distinctive feature were being built on the Rhine (Rupprecht 1983, 81; Crumlin-Pedersen 1985, 90, fig 13D), and suggests that the sea-going ships may have been built there.

The former presence of other ships of Blackfriars type in this northern region is also suggested by the discovery of their distinctive iron cone-headed nails. Two were found at the Roman fort site at Richborough, in eastern Kent (Cunliffe 1968, pl lvii, no 284); one in the 1st century AD legionary fort at Inchtuthil, Scotland (Healy 1978, pl 64b; Manning 1985, fig 86F, 290); and two in London (Guildhall Museum 1908, 55, no 139-40. Now catalogue no 1643).

A possible clue to where the Blackfriars ship was built are the hazel twigs used as caulking, for this material does not seem to occur generally as a caulking in Romano-Celtic vessels, although it was used in the New Guy's House boat, a river barge which must have been built beside the River Thames for it was not a sea-going type. It is possible, therefore, that the Blackfriars ship was recaulked at London, but built elsewhere. However, a recent study of the tree-rings of the ships timbers shows that the vessel had probably been built about the middle of the 2nd century AD and that, as the tree-ring pattern is similar to that of contemporary local timbers from the London area, it is possible that the ship was built in south-east England.

References

Åkerlund, H, 1963 *Nydamskeppen.*

Allen, D, 1978 *An introduction to Celtic coins.*

Arnold, B, 1978 Gallo-Roman boat finds in Switzerland, in du Plat Taylor, J, & Cleere, H, (eds), *Roman shipping and trade*, CBA Res Rep **24**, 31-35.

de Boe, G, 1978 Roman boats from a small river harbour at Pommeroeul, Belgium, in du Plat Taylor, J, & Cleere, H, (eds), *Roman shipping and trade*, CBA Res Rep **24**, 22-30.

Boon, G, 1971 A Greco-Roman anchor-stock from north Wales, *Antiq J* **57**, 10-30.

Caesar, J, *De Bello Gallico.*

Casson, L, 1973 *Ships and seamanship in the ancient world.*

Christensen, A, 1972 Scandinavian ships from earliest times to the Vikings, in Bass, (ed), *A history of seafaring*, 159-68.

Crumlin-Pedersen, O, 1965 Cog-Kogge-Kaag, *Snertryk af Handels — og Sofartsmuseets Arbog, 1965.*

——, 1985 Cargo ships of northern Europe AD 800-1300, in Herteig A, E, (ed), *Conference on waterfront archaeology in north European towns* **2**.

Cunliffe, B, (ed), 1968 *Fifth report on the excavations of the Roman fort at Richborough, Kent*, Soc Antiq London Res Rep **23**.

de Weerd, M, 1988 *Schepen voor Zwammerdam.*

Ellmers, D, 1978 Shipping on the Rhine during the Roman period: the pictorial evidence, in du Plat Taylor, J, & Cleere, H, (eds), *Roman shipping and trade*, CBA Res Rep **24**, 1-14.

Evans, A, & Bruce-Mitford, R, 1975 The ship, in Bruce-Mitford, R, *The Sutton Hoo ship-burial, Vol 1.*

Frere, S, 1987 Roman Britain in 1986, *Britannia* **18**, 302-59.

Greenhill, B, 1976 *Archaeology of the boat.*
Guildhall Museum, 1908 *Catalogue of the collection of London antiquities in the Guildhall Museum.*
Hasslof, O, 1977 Ethnography and living tradition, in McGrail, S, (ed), *Sources and techniques in boat archaeology*, Brit Archaeol Rep **S29**, 65-76.
Healy, J, 1978 *Mining and metallurgy in the Greek and Roman world.*
King, D, 1987 Petrology, dating and distribution of querns and millstones. The results of research in Bedfordshire, Buckinghamshire, Hertfordshire and Middlesex. *Bull Inst Archaeol* **23**, 65-127.
McGrail, S, 1981 *The ship: rafts, boats and ships.*
——, 1987 *Ancient boats of north-west Europe.*
Mack, R, 1975 *The coinage of ancient Britain.*
Marsden, P, 1965 A boat of the Roman period discovered on the site of New Guys House, Bermondsey, 1958, *Trans London Middlesex Archaeol Soc* **21**, 118-31.
——, 1967 *A Roman ship from Blackfriars, London.*
——, 1974 The County Hall ship, *Int J Naut Archaeol* **3**, 55-65.
——, 1976 A boat of the Roman period found at Bruges, Belgium, in 1899, and related types, *Int J Naut Archaeol* **5**, 23-55.
Meiggs, R, 1960 *Roman Ostia.*
——, 1982 *Trees and timber in the ancient Mediterranean world.*
Milne, G, 1985 *The port of Roman London.*
Muckleroy K, Haselgrove, C, Nash, D, 1978 A pre-Roman coin from Canterbury and the ship represented on it, *Proc Prehist Soc* **44**, 439-44.
Peacock, D P S, 1971 Roman amphorae in pre-Roman Britain, in Jessop, M, & Hill, D, (eds), *The Iron Age and its hill-forts*, 161-88.
Rupprecht, G, 1983 The importance of Mainz in the Roman days, in Herteig (ed), 1983, 79-82.
Traulle, M, 1809 *Lettre adressée à M Mongez ... par M Traulle, sur les débris d'un bateau détérre dans les levées de la Somme, près d'Abbeville*, (Paris), (see also *Archaeologica* **118**, 54).

8 Barges of the Zwammerdam type and their building procedures

M D de Weerd

The six boats from the Roman period at Zwammerdam (de Weerd 1978) have recently been published by the author as his thesis, defended at Amsterdam University (de Weerd 1988b). The conclusions are summarised in de Weerd (1989) which runs parallel to the thesis' Zusammenfassung.

After a petite histoire of the ship-archaeological excavations 1971-4, de Weerd (1988b) gives a full description of the three logboats (one extended); the steering oar displaying mortise and tenon technique; and one of the three big barges (no 2). Barges 4 and 6 — still being conserved with PEG 4000 — await a full description. The thesis also included a discussion of the 1893 Vechten boat, of which the old excavation plan was recently rediscovered in the archives.

Full evidence is given — and is open to criticism and further analysis — to conclude that:

A Barges of the Zwammerdam type (3x Zwammerdam; 2x Woerden; Kapel-Avezaath; Druten; Abbeville; 2x Pommeroeul; Cologne; Mainz; Bevaix; 2x Yverdon, see also Arnold 1989; and Avenches) are not rooted in a Celtic shipbuilding tradition. The flat-bottomed rivercraft with flush-laid planking show a shift in technology from that used in the North Adriatic coastal craft (Ljubljana; Comacchio; Cervia; Pomposa Borgo Caprile; and Nin). To stiffen the boat in the transverse direction, the edge-joining by sewing planks in sutiles naves of the North Adriatic was replaced, in the Zwammerdam boats, by bridging the full width of the flush-laid bottom planking with a system of floor timbers running from side to side. This procedure was made possible by the massive use of big iron nails (see also de Weerd 1988a). The characteristics of the type — 'celtic' to use Marsden's (1977) term — are not Celtic in terms of archaeological attributes. In the last 15 years a number of newly discovered boats have contributed much evidence; vessels of the Zwammerdam type — with L-shaped chines or transition strakes (Ellmers 1984: chine-girders) which cannot be seen as an evolutionary development from split logboats — intruded into the Northern Provinces along with the Romans in the 1st century AD (de Weerd 1987a; 1988b).

B The individual planks are sawn/scarfed at lengths in round numbers of Roman feet (pedes monetales). Full discussion of the Roman roots of the 'Zwammerdam type' (Marsden 1976) barges appears in de Weerd (1987a; 1988a; 1988b).

C An analysis has also been undertaken of drawings of all known Roman river barges (Blackfriars 1; Marsden 1976); of extended logboats of the Utrecht type (Utrecht 1 and 2, Antwerp and Velsen (medieval) and (Roman) finds from Zwammerdam and Woerden; Vlek (1987) and de Weerd (1987b and c)); and of a 14th century cog-like boat from Flevoland (Reiners 1980). This has revealed a variety of methods for the sequence used to place floor timbers in position but generally it seems to have been:

(a) two or three master floor timbers were placed on top of the bottom planking at the midship station and at bow and stern. Hulst (1985) has reconstructed this procedure in the building of cogs. Upon analysis these floor timbers were spaced (measuring from faces) at round numbers in Roman feet, eg ¼ or ½ an actus.

(b) The bottom planking was then fastened to the master floor timbers. In this way, the flush-laid bottom planking was held in position to 'behave' as a shell in which the other floor timbers were inserted in the remaining phases of the sequence.

(c) Further floor timbers were placed in position — halving the spaces between the earlier inserted floors — and fastened.

Schemes and types of schemes are discussed in de Weerd (1988b and 1989). Höckmann (1988) has concluded that the Zwammerdam type of floor spacing — in pedes monetales — can also be found in the plans of the two Nemi boats published by Ucelli (1950). This proves once again that the uses of standardised floor spacing in boats of widely varying types and period can be seen as a traditional building procedure, which represents ongoing traditions at the level of boatbuilding handicraft.

References

Extensive bibliographies are found in Höckmann (1988), Vlek (1987) and de Weerd (1988b).

Arnold, B, 1989 Architecture navale en Helvétie à l'époque romaine: les barques de Bevaix et d'Yverdon, *Helvetia Archaeologica* **20 (Nr 77)**, 2-28.

de Weerd, M D, 1978 Ships of the Roman period at Zwammerdam/Nigrum Pullem, Germania Inferior, in du Plat-Taylor, J, and Cleere, H, (eds), *Roman shipping and trade*, CBA Res Rep **24**, 15-21.

——, 1987a Maatvoering in pedes monetales em andere nieuwigheden bij de bouw van de z g Keltische rijnaken van Zwammerdam, in Reinders, H R, (ed), *Raakvlakken tussen scheepsarcheologie, maritieme geschiedenis en scheepsbouwkunde, Flevobericht* **280**, 15-23.

——, 1987b The medieval logboat Velsen, in Brandt, R W, Groenman van Waateringe, W, & van der Leeuw, S E, (eds), *Assendelver Polder papers* **1** (*Lingular* 10), 265-83.

——, 1987c Use of standard measures and reconstruction of the sequence of rib placings in plank boats and extended log-base boats: Zwammerdam elements in the Utrecht boat and the Waterstraat boat, in Vlek, 1987, 147-60.
——, 1988a A landlubber's view of shipbuilding procedure in the celtic barges of Zwammerdam, the Netherlands, in Filgueiras, O L, (ed), *Local boats*, Brit Archaeol Rep **S438**, 35-51.
——, 1988b *Schepen voor Zwammerdam. Bouwwijze van enkele vaartuigtypen in West- en Middeneuropa uit de Romeinse tijd en de Middeleeuwen in archeologisch perspectief*, thesis, Univ of Amsterdam, privately printed.
——, 1989 Sind keltische Schiffe römisch? *Jahrbuch Römisch-Germanisches Zentralmuseum Mainz* **34**, 1987.
Ellmers, D, 1984 Punt, barge or pram — is there one tradition or several?, in McGrail, S, (ed) *Aspects of maritime archaeology and ethnography*, 153-72.
Höckmann, O, 1988 Zwammerdam und Nemi: zur Bauplanung römischer Schiffe, *Archaologisches Korrespondenzblatt* **18**, 389-96.
Hulst, R A, 1985 *Kijk op koggen*, (Lelystad, Rijksdienst voor de Ijsselmeerpolders).
Marsden, P, 1976 A boat of the Roman period, found at Bruges, Belgium, in 1899, and related types, *Int J Naut Archaeol* 5, 23-55.
——, 1977 Celtic ships of Europe, in McGrail, S, (ed) *Sources and techniques in boat archaeology*, Brit Archaeol Rep **S29**, 281-8.
Reinders, H R, 1980 Het onderzoek van een schip op kavel N5, *Flevobericht* **166**, 6-15.
Ucelli, G, 1950 *Le Navi di Nemi* (2nd ed, reprint 1983).
Vlek, R, 1987 *The medieval Utrecht boat*, Brit Archaeol Rep **S382**.

9 The Romano-Celtic boats from Druten and Kapel-Avezaath

L Th Lehmann

Abstract

Knowledge of the Druten boat comes from a three-day rescue dig. She is dated to the 2nd century AD and originally may have had a trapezium-shaped bottom. It is also possible that a timber picked up among scattered remains was once a stem post. Her bottom was probably made of irregularly shaped slabs of wood, Quercus robur; oak common all over Europe. Her cargo had been of slate, probably brought from the Eiffel mountains in what is now Germany. Two pieces of Quercus petraea in a secondary position may indicate that she had been much further up the Rhine.

The Kapel-Avezaath boat had the 'punt' shape that is still very common, but with irregular bottom planks. It is possible that this planking may have been re-used from another boat. All wood was the ubiquitous oak. A few potsherds dated her c AD 200.

The Druten boat

In 1973 the alarm was raised by Mr van Dinteren that a conglomeration of wood, possibly an ancient ship, had been found in the sand of a building site near Druten (Fig 9.1) and an emergency excavation, directed by Mr R S Hulst, was begun by the Archaeological State Service, Amersfoort. A contractor had, by this time, already taken up and scattered about 11 m of it.

The remaining 16 m of wreck lay in a west northwest-east southeast direction (Fig 9.2). The north side showed a rounded, pre-moulded chine. In the places where it was best preserved it was c 0.80 m high. Towards the east a series of rusty spots in the sand just above the preserved wood suggested an upper strake nailed on, or a repair. At the west end the outside of the chine curved inward, the underside upward, while the hollow at the inside became shallower more abruptly, probably to become flush with the inside edge that lay against the bottom. The latter had a breadth of 2.80 m in the east, tapered to 1.70 m and was 60-80 mm thick. It could still be seen that the bottom planks had curved upwards together with the underside of the chine. There were 25 frames, each consisting of two floor timbers, each with an integral knee which functioned as a futtock. Counting from the west, each floor timber with an even number had its knee on the north side; some vestiges were left showing that at least some floor timbers with uneven numbers had their knees on the south side, as is logical. No trace was found of separate futtocks.

As to her shape, the sides tapered to the west with no sign of a curve in them. Centuries after the date of this wreck and at least until the end of the 17th century, there was a class of vessels on the Rhine, the bottom of which had the shape of a very long trapezium, with the

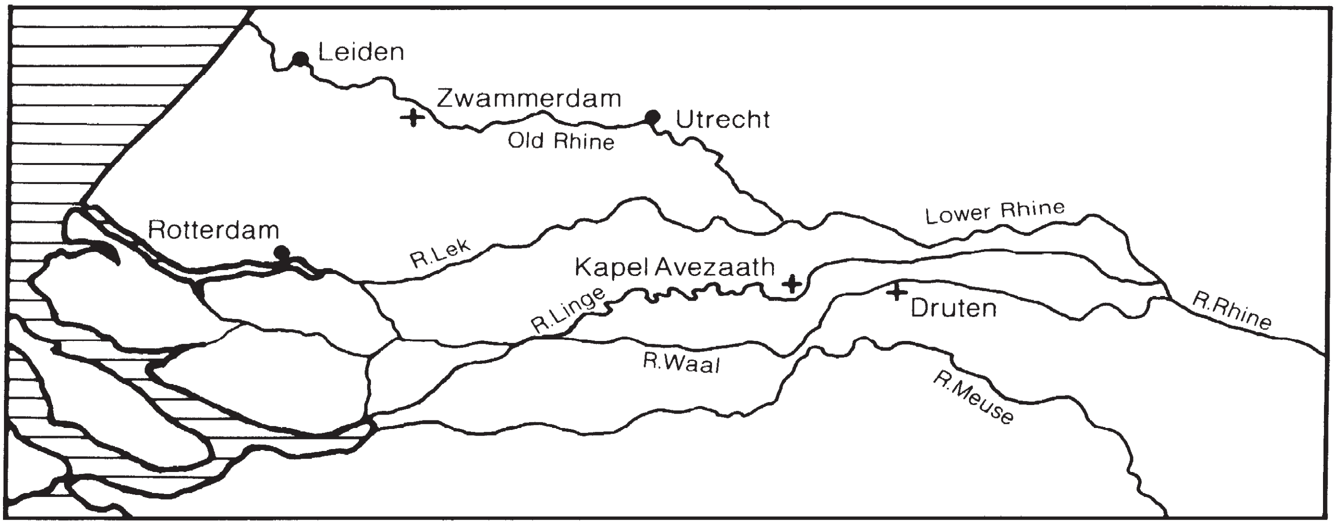

Figure 9.1 Map showing location of Druten and Kapel-Avezaath. (Map: Author).

Figure 9.2 View of Druten wreck from west-north-west. (Photo: R O B).

narrower parallel side forward; these were known as oberländers. There is no evidence however of a straight development from Roman times to oberländers. Prints showing the latter, and two small examples found near Krefeld in Germany (Ellmers 1976, 47) and near Meinerswijck in the Netherlands (Reinders et al 1983, 21-33), show them to be much higher than the Druten boat, with much steeper swimheads and considerable tumblehome. There is no evidence of the latter in antiquity, A trapezium shape for the Druten barge, with the bow to the west, is not unthinkable however, and to make her stern end in a simple transom is a solution taken not only from the small boat of Krefeld, but also from Zwammerdam boats 1 and 5 (de Weerd 1988, 55-68, 83-92).

The boat depicted on the 1st century AD monument to Blussus (Ellmers 1978, fig 5) now in Mainz museum, looks somewhat like the prints of oberländers, but we do not know the ship it represented. Some mistrust is justified towards Roman ship representations. Sculptors were very much inclined to compress ships lengthwise and to make disproportionately large heads (as in Victorian caricatures) stick out of them. Examples of this abound on Trajan's Column.

A trapezium shape in plan is not the only possibility. Van Dinteren, inspecting the scattered wood of the eastern part of the Druten boat, found a piece looking very much like a solid stem post, about 1.75 m long, without rabbets. A ship with a stem post at the bow and an upcurving swimhead for a stern might seem fanciful, but a photograph (Neweklowsky 1952-68, II, fig 29) shows that similar barges plied the Danube until recently. These boats apparently did not exist before 1850 (J Sarrazin, pers comm), but there are other examples of ancient ideas surviving to surface again much later.

Over floor timbers 4 and 5, c 0.20 m north of the longitudinal axis of the bottom, a piece of wood was housed, with a square mortise in the middle. Floor timber 7 showed a ridge over its western edge, about 30 mm higher than the general height of the floor timbers (50-60 mm). In the northern half of this ridge two oblong mortises were cut. The ridge continued over the breadth of floor timber 7's northern end and on to timber 8, where it formed a 'step' under a knee grown to shape. Whether this arrangement was repeated on the southern side could not be observed due to the condition of the wood.

On top of, and parallel to, floor timber 14 lay a batten, crossed by some narrow planks that seemed to pass underneath it. They also looked as though they had been deliberately finished at their eastern ends, not broken off. Between timbers 8 and 14 some plank fragments of the same size were scattered.

Floor timbers 7 and 8 were partly covered by a fragment of a panel made of planks only 5 mm thick, sharpened down on one edge and up at the other, so that they overlapped and made a smooth surface. On top lay two transverse pieces, one of which was co-incidental, but the other was a batten connecting the planks. Underneath this fragment was an articulated iron hook, attached to floor timber 7.

The eccentric position of the block with mortise between timbers 4 and 5 suggests it formerly had a nearby partner (Fig 9.3). Stanchions for a deck in bow or stern might have ended near these mortises or at timber 7. It is possible that these mortises were formerly fastened to two bitts, between which a steering oar could be slung, as on the foredeck of the big oberländer in a print by Antonius Woensam (Reinders 1983, fig 35).

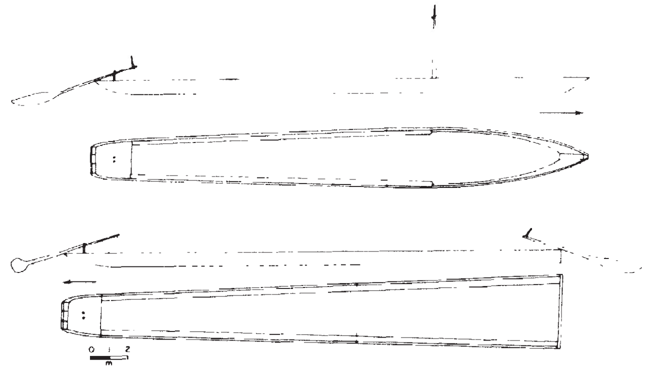

Figure 9.3 Hypothetical reconstruction of the Druten barge. (Drawing: Author).

This idea is especially attractive as, at the time and place of the Druten boat, steering oars could be expected forward as well as aft (cf Tacitus, Annales II, 6).

Now for the thin wood construction. At Pommeroeul in Hainault the remains of a cabin were found in Roman barge I. Situated aft, it was 2 m from the end of the swimhead and was 2.30 m long. It covered the whole breadth of the barge and was fixed by tenons in mortises cut in the covering board and in one frame. The walls were made of thin, overlapping oak planks.

At Druten there was no trace of a covering board and the swimhead was incomplete, the surviving curve suggest strongly that there was not much more than 2 m to the west of floor timber 7. From the centre of floor timber 7 to the centre of 14 is c 2.30 m. The little planks on top of timber 14 may have been the remains of limber planks, those to the west being kept in place by the ridge on timbers 7 and 8. Putting a connecting batten on top of the limber planks instead of underneath, between the floor timbers, is a good way of tripping up your crew, unless it marks the end of a working space and the beginning of a cargo space. Most disturbing is the hook, unless it was a means, admittedly unusual, to belay a rope, eg to keep the steering oar within reach. This may seem to cancel out the cabin, unless there was shelter over the steering oar, as on the 'Leonardic' ferry (one like it appears in a 'bird's eye view' by Leonardo da Vinci) on the River Adda at Imbersago near Milan. The presence of a cabin would point to the bow being east, and a further argument for the presence of a cabin is the fact that the Roman-age vessel from St Peter Port, Guernsey had the remains of a cabin connected to a floor timber by mortises (Rule, this volume).

It is clear that some of the possibilities suggested by the Druten wreck are mutually exclusive.

The dating material found in the ship at Druten consisted of a worn coin, two pieces of amphora and some samian and Castor ware. They all pointed to a period around AD 200 (Hulst & Lehmann 1974, 18-21).

The Kapel-Avezaath boat

An even more star-crossed emergency dig had been conducted five years earlier, in 1968, near Kapel-Avezaath (Louwe-Kooijmans 1968). It could only last two days and was much hampered by water (Fig 9.4). Little was left apart from a bottom 30.50 m long. The greatest breadth was found, chiefly by prodding, to be 3.20 m. Across this bottom lay the now familiar pairs of floor timbers; about 200 mm wide and 50 mm thick.

Figure 9.4 View of Kapel-Avezaath wreck under excavation. (Photo: R O B).

Their spacing was not quite regular but the average length of the bottom occupied by a frame plus the distance from the next frame, was 0.70 m. This should mean that there would have been 43 timbers in all, but photographs show only 31 and, alas, the draftsman was not able to go beyond timber 19. Before being driven off by water, he managed to draw a section of the wreck, at floor timber 8, from the west, which shows that there was a pre-moulded chine, rounded but much less than its Druten equivalent. Not a trace was left of knees. The 13th floor timber from the west (the barge was lying east-west) showed a ridge like the 7th timber at Druten, but had no mortises.

The onset of the chine could be followed at the western end for 3.50 m. Towards the west it came nearer to the longitudinal axis of the ship. So it probably had the familiar (certainly at Oxford) punt or 'aak' shape.

Some hardware was found on the barge. One piece, probably a sleeve around the handle of a bargepole or boathook, had a piece of pottery sticking to it of a kind that Professor Brunsting has dated to the 2nd century AD (Brunsting 1937, 155-6). Other sherds were found in the layers that had piled up over the ship. One of them was of 12th century date (Louwe-Kooijmans 1968, 6).

What was rescued from the fray was a radiocarbon date of AD 130 ± 30 (GrN-5382; Vogel & Waterbolk 1972, 100). In consequence of the rescue dig situation the diggers of Druten never saw what was left of the bottom without the frames. There was some puzzling over photographs trying to make sense of seams and/or cracks, but no satisfactory conclusion ensued. With hindsight we may say that the Druten barge may have had an irregular mosaic bottom (Lehmann 1987, 29). At Kapel-Avezaath there was no uncertainty; the bottom was composed of rather disorderly slabs of wood fitted together. The vast size of these slabs suggests that the oak forests had not been decimated by the scale on which Muri Gallici had been built, but something did suggest thrift. There were depressions in the bottom that might have fitted in the spaces between the frames, but frames were fastened halfway over them, suggesting that this might have been a bottom re-used from another boat.

The context of the boats

In Roman times the Rhine was the frontier of this part of the empire, but in the Roman conception it had more of the character of territorial waters. These large cargo ships must have played an important part in the logistics of the limes.

The middle east-west strip of the Netherlands is the Rhine delta, with the Meuse joining from the south. The northernmost arm of the Rhine, running past Leiden and discharging into the sea at Katwijk, was then the most important and carried the limes on its shore. The Zwammerdam boats were found, as it were, on the doorstep of a fortress (de Weerd 1988, 22-3).

The Druten boat was found in a silted-up meander of the Waal, which is the southernmost arm and was already perfectly respectable. Caesar knew it as the

Vacalus (Belli Gallici IV, 10) and Tacitus as the Vahalis (Annales II.6). Druten is the successor of a Roman settlement but there were other reasons to sail westward through the lowlands. In the south-west, where now is the northern half of the island of Walcheren and water, there was probably an estuary with a temple of the goddess Nehallennia on each bank. Remains of at least one were found at Domburg on the west coast of Walcheren and another one in the water north-east of Walcheren. Of the nature of the temples themselves, nothing is known, but many votive altars were retrieved, that had been erected by tradesmen who brought wares from the hinterland (ie, parts of the present Germany and France) to this place and had them shipped over to Britain (Louwe-Kooijmans 1971).

In the Druten boat there were traces of cargo; stones from the Ardennes or from the German mountains, but chiefly slate. This was, and is, mined in the Eiffel (Hulst & Lehmann 1974, 20). The wood of the boat was common oak (Quercus robur) that grows all over Europe but there were some accessories made of another oak (Q petraea Lieblein) which grows south from the Eiffel mountains (Hulst & Lehmann 1974, 18). So it is possible that she had been up as well as down the Rhine, but where she was built and had her home port we do not know.

Why the Kapel-Avezaath barge was deposited where it was found is not so self-evident in the light of modern maps. The site was a silted upstream channel in the lower course of the Linge, a small river that has its source a little west of the place where the Rhine splits up, and which ran westward between the two Rhine arms before joining the Waal. At one time it was shorter, the lower course being a loop of the Waal. In that state it was a stream on which one could expect long distance barges. In fact, Linge and Waal were only separated in AD 1304 by a man-made dam, well above Kapel-Avezaath (Henderikx 1986, 458, 462-3, 468, 512). Before dykes were thrown up everywhere the delta was a very unstable area, with streams madly meandering. Interfering with the landscape was begun at least by the Romans. Drusus, brother of the emperor Tiberius, campaigning intensively north and east of these parts, where he had his base, had a canal dug (Tacitus, Annales 11.8) or perhaps more than one (Suetonius V.I.2) and maybe a dyke built (Willems 1985, 52). The canal, under the names Fossa Drusiana and its translation (Drususgracht) especially haunted Dutch scholars. Much ink was spilt, many guesses made, but still nobody knows where it was. Gnaeus Domitius Corbulo went empire building north of the Rhine until the emperor Claudius blew the whistle on him, calling him back to the Rhine, thus consolidating the limes. Corbulo too had a canal dug somewhere (Tacitus, Annales XII.8).

A last question, that may never be answered: were these barges, and others (most of which were found in waters with access to the Rhine) Celtic or not? The late Victorians added the noun 'twilight' to the adjective Celtic, the combination historically and archaeologically makes sense. Mr de Weerd's paper on the measurements of these vessels suggests that they were, or had been, made part of a Roman system (de Weerd 1988, 210-79): but see the paper by Arnold in this volume for an opposing view.

References

Brunsting, H, 1937 *Het grafveld onder Hees bÿ Nÿmegen*.

Caesar, J, *Belli Gallici* Libri VII.

de Boe, G, & Hubert, F, 1978 Methode et resultats du sauvetage archeologique a Pommeroeul, *Archaeologica Belgica* **207**.

de Weerd, M D, 1988 *Schepen voor Zwammerdam*.

Ellmers, D, 1976 *Kogge, Kahn und Kunststoffboot*.

——, 1978 Shipping in the Rhine during the Roman period, in du Plat Taylor, J, and Cleere, H, (eds), *Roman shipping and trade*, CBA Res Rep **24**, 1-14.

Henderikx, P, 1986 The lower Delta of the Rhine and Maas, *Berichten van der Rijksdienst voor Oudheidkundig Bodemonderzoek* **36**, 447-599.

Hulst, R S, & Lehmann, L Th, 1974 The Roman barge of Druten, *Berichten van der Rijksdienst voor Oudheidkundig Bodemonderzoek* **24**, 7-24.

Lehmann, L Th, 1987 Constructieverschillen in Romeinse platbodems, *Flevobericht* **280**, 29-31.

Louwe-Kooijmans, L P, 1968 Een onderzoek en een opgraving, *Studium Generale* **14.11**, 6-7.

——, 1971 *Deae Nehallenniae*.

Neweklovsky, E, 1952-68 *Schiffahrt und Flösserei im Raume der oberen Donau*, 3 vols.

Reinders, H R, 1983 Drei Middeleeuwse Rivierschepen, *Flevobericht* **221**.

Suetonius Tranquillus, C, *Vitae XII imperatorum*.

Tacitus, P C, *Annales*.

Vogel, J C, & Waterbolk, H T, 1972 Groningen radiocarbon dates X, *Radiocarbon* **14**, 11.6-110.

Willems, W J H, 1985 *Romans and Batavians*.

10 Maritime traffic between the Rhine and Roman Britain: a preliminary note

Gustav Milne

Abstract

Merchandise from many parts of the Roman Empire reached the province of Britannia via a complex system of trans-shipment centres. At these ports, cargoes were transferred from river barge to sea-going ship at river estuaries, and then offloaded onto coastal or river craft at the British trans-shipment ports. It is suggested that the River Rhine was a principal artery in this network, and evidence for the location of some of the British ports which indirectly handled these Rhine cargoes is considered.

Since 1973, an extensive programme of rescue excavations on the Thames waterfront in London has produced a detailed picture of a Roman provincial harbour, with its quays, warehouses, bridge and boats (Milne 1985; Miller et al 1986). These investigations also produced evidence for the importation of material from many parts of the Roman Empire: pottery from Gaul, wine from the Mediterranean, fish sauce from Spain, marble from Italy, olive oil from north Africa. Such material has been interpreted as showing direct links with those provinces, producing an accompanying vision of the harbour in Londinium crowded with ships from many different countries. However, further study suggests that such direct long-distance maritime ventures were the exception and not the rule. Ships designed to sail in the tideless Mediterranean would not necessarily be suitable for the battle around the Atlantic coast of western Europe, the Channel and the North Sea. The winds, swells and tidal harbours of these northern seas demanded a different nautical technology.

That Londinium did receive much exotic material is not disputed: how that material arrived in Britannia is a more complex question, for it involved the setting up of a long chain of trans-shipment centres. At these centres, cargoes would be laboriously transferred from cart to river barge, or from river barge to sea-going vessel, the process involving much double or treble handling of loads. The vital supply network stretched over the whole Empire of necessity, and was used for military supplies and administrative communications as well as for commercial traffic. Strabo mentions four crossings commonly used in getting from the continent to Britannia, from the mouths of the Rivers Rhine, Seine, Loire and Garonne (Strabo IV, 5.2). For much of the Roman occupation of Britain, it is suggested, there may have been more traffic arriving in or being exported from the province utilising the arteries serving the Rhine garrison than the other rivers (du Plat Taylor & Cleere 1978).

Rome and its trans-shipment ports

Perhaps the best-known examples of Roman trans-shipment centres are those which directly served Rome itself. Before the great harbourworks were built at the mouth of the Tiber near Ostia in the mid 1st century, some merchantmen could be rowed upriver to Rome while other shallow-draft vessels were towed by teams of men trudging along a towpath (Casson 1965, 32). But the standard size of merchantmen was approximately 340 tons, and these large vessels had to anchor offshore in the open sea, and transfer their cargoes to shallow-draft lighters, probably known as lenunculi auxiliarii. Alternatively, they sailed to the well-protected harbour at Pozzuoli (Puteoli) where their cargoes could be loaded on coastal vessels small enough to negotiate the Tiber. Once the ambitious artificial harbour project was completed however, merchantmen could be berthed against the deep water quays in relative safety, and their cargoes could be manhandled into the neighbouring warehouses or on to special boats designed to be towed up the non-tidal Tiber to Rome. The complexities of the routes employed in sending exotic cargoes from Rome to Britain are recorded in Suetonius's description of the Claudian invasion of that province. He describes how the new Emperor himself was shipped from Ostia to Massilia, and was nearly wrecked. He was then marched overland through Gaul to Boulogne, from whence he was shipped to Britain, presumably to Richborough, without further mishap (Suetonius, The Twelve Ceasars; see Graves 1957).

Traffic from the Rhine to Britannia

A similar system of trans-shipment centres was in operation on the Roman Rhine. Archaeological excavations have shown that the contemporary Rhine barges were quite different from the vessels which worked the Tiber. Northern European vessels such as those recorded at Zwammerdam in the Netherlands (de Weerd 1978) were flat-bottomed barges up to 34 m long. Their structure is described by Arnold and by Lehmann in this volume. The mast on these barges was set towards the bows and may have been used to support a sail or for towing.

Barges of this and related types must have been among the most common working boats of northern Europe. However, their shallow draft and keel-less profile meant that they were not suitable for service on the North Sea. As a consequence, the produce they carried must have been transferred to or from round-

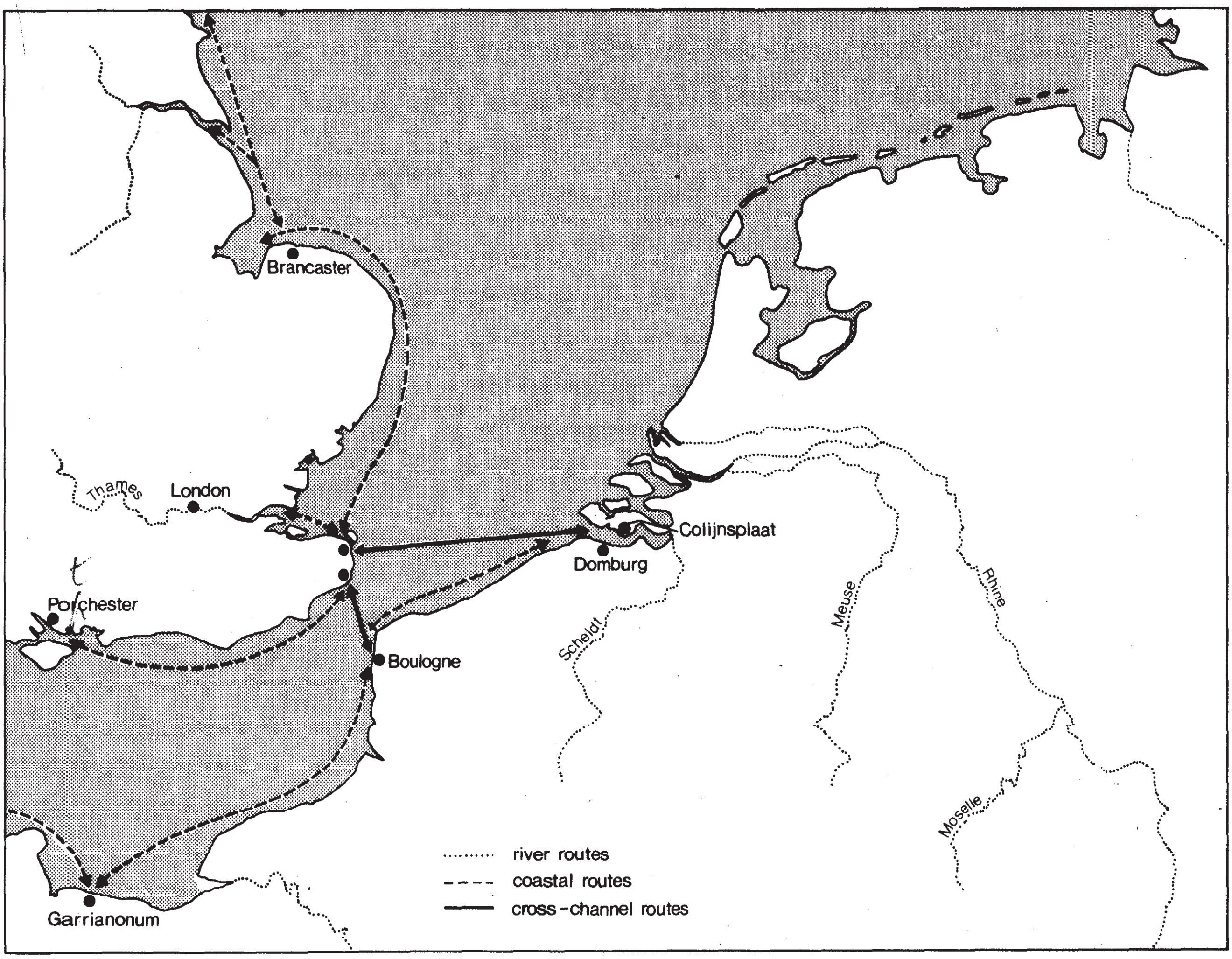

Figure 10.1 Maritime traffic between the Rhine and Roman Britain. (Map: Chrissie Milne).

hulled&sea-going ships in harbours situated on the coast. The two trans-shipment centres at Colijnsplaat and Domburg on the River Scheldt in the Netherlands (Fig 10.1) are of especial interest since they provide clear proof of contact with British traders (Hassall 1978). Both had shrines to the goddess Nehalennia, a 'guardian' goddess, to whom altars had been erected by merchants to commemorate safe sea crossings. Study of the dedications on these altars had shown that pottery and wine destined for Britain and salt, fish and possibly woollen cloths imported from there were handled at these ports, presumably being transferred between ship and river barge at this 'point.

There are also some incidental references to the practice of trans-shipping merchandise from sea-going vessels to Rhine barges in the documentary record. For example, Strabo (IV, 5.2) mentions that in the 1st century the principal port for sea crossings was not on the Rhine estuary itself, but further west at Boulogne. This suggests that there was a considerable traffic in river and coastal vessels discharging or taking on their cargoes at Boulogne at that period. In the mid 4th century, when Julian was appointed Caesar in charge of Britain, he began campaigning to reopen the crucial supply route along the Rhine. Commenting on this episode, Libanius records how corn had formerly been shipped over the sea from Britannia on the first stage of its journey, after which it was sent up the Rhine. When the Rhine waterway was closed by barbarian action, the few grain carriers that still plied the sea route continued to discharge their cargoes at coastal ports. However, the grain had then to be transported by waggon, a system considered to be far more expensive than the barges used previously (Libanius, Oration 18, 82-3).

Trans-shipment ports in Roman Britain

The location of the principal British ports which were part of the Roman supply network will now be considered. Regretably, few harbour sites have been excavated by archaeologists (Milne 1987), and so the form (or absence) of the facilities associated with the different types of river and coastal port are not clearly known. Each port requires its own study since the local topography, ancient river and sea levels, tidal effects, and rate of silting or erosion all need to be determined before a meaningful evaluation of the potential of the port can begin. Then a closely-dated sequence of development must be established, after which comparison with the neighbouring ports in the network can be made. There is also a need to examine more of the contemporary vessels themselves, since only four Roman period wrecks have been recorded in Britain in any detail, and three of those are from the Thames (Marsden 1981; and this volume).

Until this work is done, only superficial surveys can be attempted, to provide a useful starting point and indicate directions for future research. For example, in 1978 Cleere identified the general location of some 45 possible harbour sites based primarily on an assessment of the Roman road system and its associated coastal and riverside settlements (Cleere 1978). These sites were then subdivided into 'military' or 'civilian' harbours. However, it is now suggested that such a distinction may be neither valid nor valuable for our present purpose, After all, a harbour used to accommodate the troop transports and supply vessels plying to and from the Rhine would enjoy a location and range of facilities equally suitable for purely 'commercial' traffic.

In addition, there is little evidence to suggest that the Romans themselves drew such a clear distinction between military and civilian harbours when considering the bulk handling of cargoes. It is therefore argued that the harbours known to have been used by the Classis Britannica should be seen as the ones most likely to have sheltered the bulk cargo carriers serving the civilian market. The identification of the fort for the Classis Britannica at Dover, for example, marks that port out as a principal British trans-shipment centre in that period, and therefore worthy of military protection.

The suggestion that most harbours in Britannia could and were used to serve the needs of both military and civilian cargoes has several important implications. First and foremost, it renders their identification the more easy, since the more important ports will have been conspicuously fortified with masonry walls, at least during the later Roman period. For example, the so-called 'Saxon Shore forts' (Johnson 1977) could now be seen as the principal fortified ports of the Saxon Shore, rather than naval police stations.

A preliminary study of the development of these ports on the southern and eastern coasts suggests that Richborough, protected by the Isle of Thanet, was seen as the major trans-shipment centre in the 1st century, with Dover and London developing in the late 1st and early 2nd (Philp 1981; Milne 1985). By the late 3rd century, however, the London harbour was not being maintained, and the harbours at Domsburg and Colijnsplaat on the Scheldt were no longer used. At this period other British ports such as those at Dover, Richborough and Reculver were being refortified. That the Rhine axis seems to have seen less traffic in the late 3rd and 4th centuries is perhaps borne out by the development of Garrianonum on the French coast together with Portchester and Clausentum in Britain, marking a pronounced westwards shift of the main Roman cross-Channel supply lines.

To sum up, the Roman supply network comprised many trans-shipment centres spread out along long lines of communication, crossing land, rivers and seas. An attempt has been made to identify some of those centres used by the traffic from the Rhinelands to Britannia. Of the British ports, Richborough, Reculver and Dover were, at various times, the major ports of entry, seeing the trans-shipment of cargoes to and from a second string of ports, of which London was one of the more important centres from the late 1st-mid 3rd centuries.

This hierarchy of centres would have been marked by the differing types of vessels used on the various stages: river boats, coastal craft and sea-going ships. It therefore follows that for every one ship of c 500 tons there would have been at least 10-20 smaller vessels needed to move the same cargo on to the next port. Although some of the ships built in the Roman period were of a considerable size (Casson 1971, 171-2, 183-200), the wealth of the Roman world would have to be carried at some stage in its long journey by one of the armada of much humbler craft which comprised the bulk of the Roman merchant fleet, a conclusion supported by a recent study of literary, epigraphic and comparative material (Houston forthcoming). Although the vessel excavated at Blackfriars, London in 1962-3 had sunk while carrying a mundane cargo of ragstone from Kent (Marsden, this volume), there is every reason to suspect that, on previous journeys, it may have carried more exotic cargoes derived from the Mediterranean and beyond, brought to London via the Rhine through the series of trans-shipment centres which were such a feature of the laborious Roman supply network.

References

Casson, L, 1965 Harbour and river-boats of ancient Rome, *J Roman Stud* **55**, 31-9.

——, 1971 *Ships & seamanship in the ancient world.*

Cleere, H, 1978 Roman harbours in Britain south of Hadrian's Wall, in du Plat Taylor, & ——, (eds), 1978, 36-40.

de Weerd, M, 1978 Ships of the Roman period at Zwammerdam/Nigrum Pullum, Germania Inferior, in du Plat Taylor, J, & Cleere, H, (eds), 1978, 15-21.

du Plat Taylor, J, & Cleere, H, (eds), 1978 *Roman shipping and trade*, CBA Res Rep **24**.

Graves, R, (ed), 1957 *The Twelve Ceasars.*

Hassall, M, 1978 Britain & the Rhine provinces: epigraphic evidence for Roman trade, in du Plat Taylor, J, & Cleere, H, (eds), 1978, 41-8.

Houston, G W, forthcoming Ports in perspective: comparative materials on Roman merchant ships and ports, *Amer J Archaeol.*

Johnson, D E, (ed), 1977 *The Saxon Shore*, CBA Res Rep **18**.

Marsden, P, 1967 *A ship of the Roman period from Blackfriars, London.*

——, 1981 Early shipping and the waterfronts of London, in Milne, G, & Hobley, B, (eds), *Waterfront archaeology in Britain and northern Europe* CBA Res Rep **41**, 10-16.

Miller, L, Schofield, J, & Rhodes, M, 1986 *The Roman quay at St Magnus House, London*, London Middx Archaeol Soc Special pap **8**.

Milne, G, 1985 *The port of Roman London.*

——, 1987 Waterfront archaeology in British towns, in Schofield, J, & Leech, R, (eds), *Urban archaeology in Britain*, CBA Res Rep **61**, 192-200.

Philp, B, 1981 *The excavation of the Roman forts of the Classis Britannica at Dover 1970-77.*

Translations of classical authors are from:

Ireland, S, 1986 *Roman Britain: a sourcebook.*

11 On the use of the word 'Frisian' in the 6th-10th centuries written sources: some interpretations

Stéphane Lebecq

Abstract

As they appear in the 6th-10th centuries written sources, the name and adjective 'Frisian' raise a question among historians of the Dark Ages and early Middle Ages: were the so-called Frisian merchants, Frisian seamen, Frisian-shaped ships, Frisian Sea, Frisian clothes … really Frisian? If not, what were they? This paper examines written sources and other evidence from the 6th-10th centuries in an attempt to answer such questions.

Everyone remembers the famous dispute between Henri Pirenne and other scholars about the Pallia or Saga fresonica, the so-called Frisian cloths: according to the former they were Flemish; according to the latter they were English … I think that they were authentically Frisian (for further information about the question see Lebecq 1983a, 131-4). There was just as much controversy about other occurrences of the word 'Frisian' in written sources from the 6th-10th centuries.

When a diploma of Louis the Pious for the Bishop of Worms mentions in AD 829 the negotiatores artifices et Frisiones (Lebecq 1983b, 422), are these 'Frisians' Frisian, or are they a synonym for 'international traders'? When the author of the Anglo-Saxon Chronicle juxtaposes the word FRIESA with the name of three important personalities involved in a sea battle in 896 (Lebecq 1983b, 244-5), does it mean they were Frisian, or is not it a title referring to the steersmen of the English boats, as has been suggested by some scholars? And when, in the same year, the Chronicler refers to a new type of ship different from the Fresisc pattern, what does he mean? And finally, is the Frenessicum or Fresicum Sea of the Historia Brittonum (Lebecq 1983b, 239-40) a 'Frisian Sea'? If so, what does it mean? The Firth of Forth? The Irish Sea? Or the North Sea?

Frisian settlement

The first Frisian merchant who appears in a text is the Freso quidam who bought slaves on the London market in 679 (Bede IV 22; see Colgrave & Mynors 1969,404). For an Englishman such as Bede, he was a Frisian; for us too. But was he a Frisian from an ethnological or from a linguistic point of view? We must remember that, from the 5th-7th centuries, the Frisians knew an expansion that led them from their original land, located on the eastern shores of Lake Flevo or Almere (the Zuyderzee of Ijsselmeer) eastward to the mouth of the Weser and, sporadically, beyond; and westward to the great delta of the Rhine, the Meuse and the Scheldt (Fig 11.1). This included all the Zeeland Islands (Lebecq 1983a, 105-11; Halbertsma 1982). Probably the London Frisian mentioned by Bede was from the part of Great Frisia which Bede called Fresia citerior (Bede V 10; see Colgrave & Mynors 1969, 480). Here was located Domburg, or Walcheren, as the written sources call it (Lebecq 1983a, 142-4), an emporium for trade between the continent and south-east England from the end of the 6th century. Half of the 1600 so-called sceattas, minted between 670 and 750, recovered from Great Frisia, were discovered in the Walcheren/Domburg area alone. The Frisians only occupied the lower Rhineland and the Zeeland Islands from the 6th century onward. While no sign of settlement can be found in Walcheren between the end of the 2nd century and the 6th (certainly because of a great flood), such was not the case for the lower Rhine, where essentially Germanic populations, famous for their seamanship, can be found from the 3rd-6th centuries. A great part of these populations sailed away to Britain, others went by land to the inner part of Gaul. But there is no denying that some of them remained in the lower Rhine region, in touch with the great rivers and the sea.

Such was the case, in particular, for those small nations from the lower Rhine whose kings Theodoric the Great wrote to in 507 to conclude a treaty against the Franks of Clovis; the Herules, the Thuringians and the Varnes (Wood 1983,7). Most of them were branches of populations who had come from the Baltic and settled mostly in central Europe. For example, a branch of the Varnes, a great part of whom settled in the Carpathians 'extended as far as the Northern Ocean along the river Rhine' (Procopius VIII 20; see Dewing 1928,252), and when they were at war with the so-called Brittia (generally identified as Great Britain; see comments by Thompson 1980), 'they were encamped not far from the shore of the ocean and the mouths of the Rhine' (Procopius VIII 20; Dewing 1928,262). Procopius goes on to say that 'all the men [from Brittia, but also the Varnes] rowed with their own hands … They have no sail, and they always navigate by rowing alone' (Procopius VIII 20; Dewing 1928, 260). Most of these nations appear in 6th century sources dealing with their struggle with the Franks, who were beginning to expand along the North Sea shores (Wood 1983). But this eastward Frankish expansion was stopped by the westward Frisian conquest. When the period of great commercial development began, at the end of the 6th and beginning of the 7th centuries, the Frisians ruled the

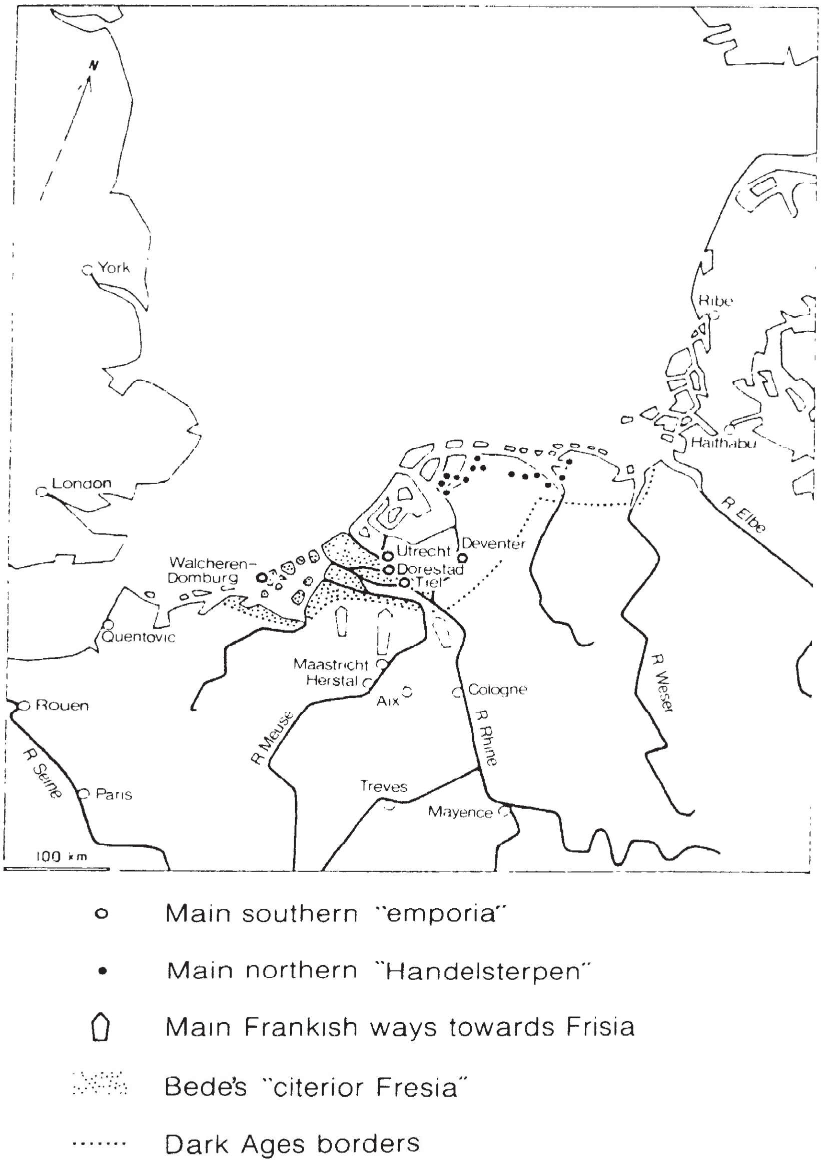

Figure 11.1 Great Frisia during the Dark Ages. (Map: Author).

great Delta, and also what was left of the smaller tribes, such as the Varnes.

In my opinion, there must also have been some Franks (more exactly some Chamaves, some Amsivarii, together with some Batavians) involved in this first commercial development. From the 3rd-5th centuries — until Sidonius Apollinaris — the Franks had been sailors and plunderers of some repute, both in the western seas and in the western shores (de Boone 1954; Wood 1983; Périn and Feffer 1987) but, later on, they were never mentioned as being sailors. What became of these Frankish sailors from the great Delta area, in the 6th/7th centuries — possibly they became Frisians?

Frisian merchants and seamen

In the beginning of their commercial development, the 'Frisian' merchants were probably mainly Frisian but they may also have been Franks, Varnes, Chauks, and so on. As the Varnes described by Procopius, until the end of the 7th century, they used only oars to propel their ships. Then, and mainly during the 8th century, they began to use sail (Lebecq 1983a, 177-81). At first, this was probably the case in the great Delta area, where the Celtic sail and rigging tradition may have survived (Ellmers 1969); and later in all the waters they navigated. Thanks to the use of this sailing rig, Frisian trade reached its climax at the end of the 8th and turn of the 9th century.

What had become of the Frisians by this time? They had lost their independence and they had fallen under the domination of the Franks (Lebecq 1978; 1983a, 111-17; Blok 1979; Halbertsma 1982). Then the Frankish elite, mainly the Austrasians and the family of the Pippinids, encouraged their sea trade with the obvious purpose of drawing and economic and fiscal

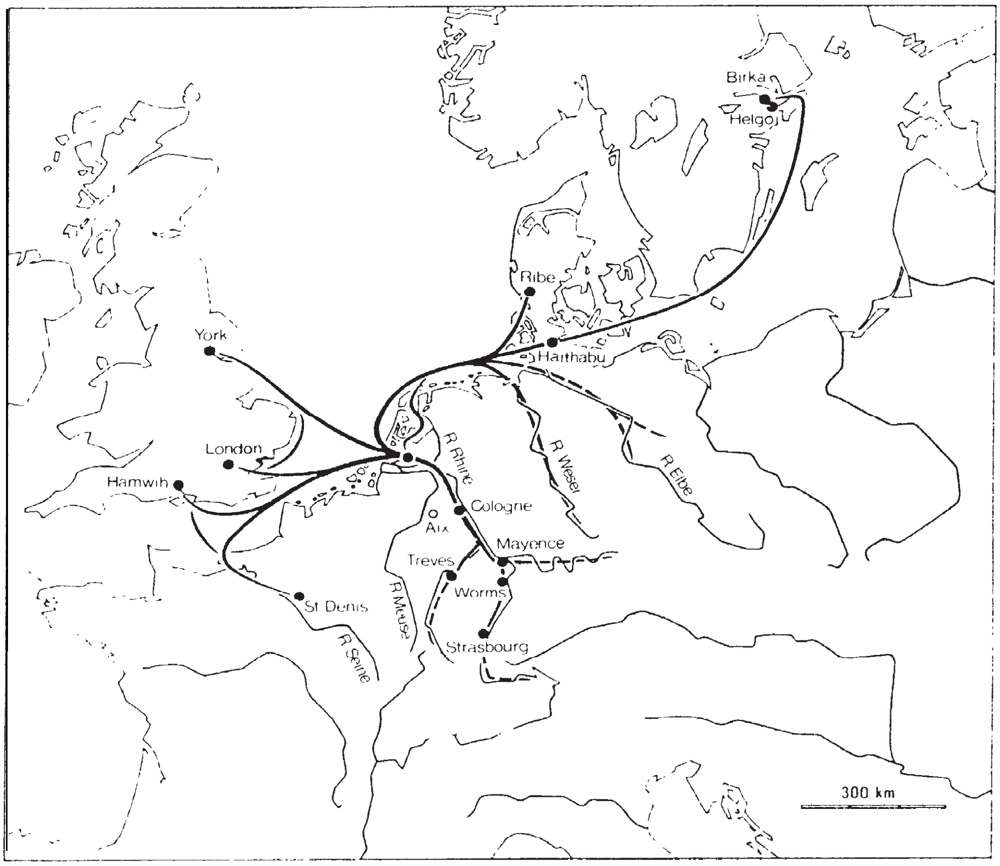

Figure 11.2 Frisian trade routes during the 7th-9th centuries. (Map: Author).

advantage out of it. Thus the Frisian trade became a Frankish/Frisian trade (Jankuhn 1953; Lebecq 1986).

In its heyday this Frankish/Frisian trade revolved mainly around the Frankish/Frisian port of Dorestad (Fig 11.2). The first development of this harbour began during the time of Frisian independence, and it is c 675 — that is to say before the Frankish conquest — that the famous wooden harbour complex excavated by Van Es and Verwers began to be built (Dorestad 1978; Van Es & Verwers 1980). The harbour's heyday, however, coincides with the Frankish domination around the year 800, when the most important mint of the Carolingian Empire (second only to the one of the Imperial Palace) was operating in Dorestad (Volckers 1965; Morrison & Grunthal 1957,90-1; Lebecq 1983a, 60-6). In Dorestad also was the main customs office of the Empire, where a decima toll was payable on every cargo (see Louis the Pious' Praeceptum negotiatorum dated 828, in Lebecq 1983b, 436-7); and many texts show the movement in and out of the harbour of ships, goods and men (see Vita Bonifatii, Alcuin's Letters, Vita Anskarii in Lebecq 1983b). It is interesting to note that, whilst undoubtedly many merchants of Dorestad were Frisians, who had come from the northern terpen area (they continued to sail to Scandinavia from Dorestad, just as they had done in the past from their terpen and their Handelsterpen), the only Dorestad merchant whose name is known, thanks to a poem written by Alcuin in 780, was called Hrodberct, which is an authentically Frankish name (Lebecq 1983b, 21).

At that time (around 800) the Frisians mentioned in the texts (ie, the Frankish/Frisian traders from Frisia and the mouths of the Rhine, mainly from Dorestad) were the most famous merchants, not only in the Frankish Empire, but in the whole western world. They became so notorious that their name could give rise to a genuine semantic extrapolation. This seems to be the case in the diploma by which, in 829, Louis the Pious confirmed the concession to the Bishop of Worms of the rights to all the tolls levied in his city on the negotiatores, artifices [craftsmen] et Frisiones (Lebecq 1983b, 422), as if the Frisians — clearly distinguished from the negotiatores (certainly the local merchants) — were the only foreign traders who had business in this great Rhenish wine-market. In fact, this term was certainly being used as a synonym for 'international traders'. Their fame died hard. In a West-Saxon poem in the Book of Exeter (compiled at the end of the 10th century; but maybe the poem itself was older), the Frisian sailor became the literary archetype of the long-distance seaman (Whitbread 1946; Lebecq 1983b, 37-9).

However, I do not believe one can derive from legitimate scepticism an argument against historical importance of the Frisians' role in stimulating maritime exchanges during the Dark and early Middle Ages. On the contrary, if their name had become a synonym for a long-distance merchant and sailor both in Anglo-Saxon poetry and in a Rhenish diplomatic formula, the Frisians must have justified this identification by their activities. In my opinion, two testimonies confirm this Frisian

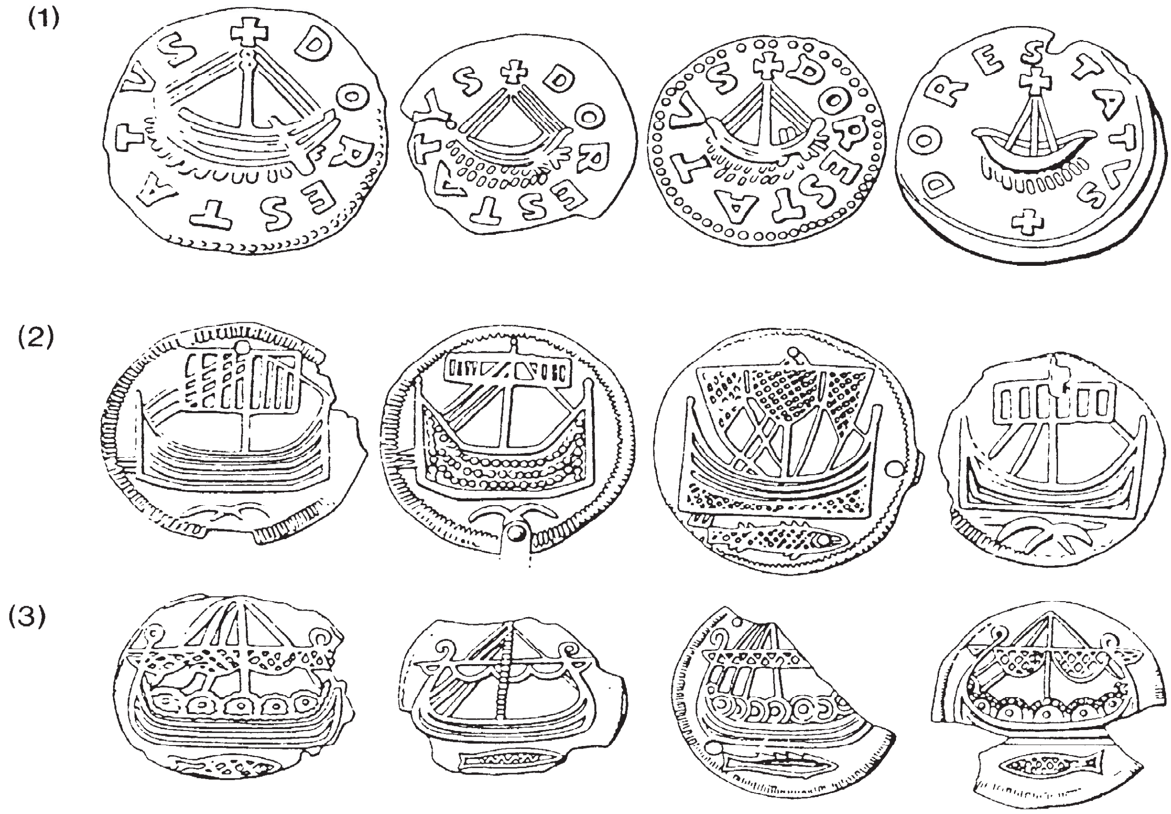

Figure 11.3 1. Dorestad coins of Charlemagne and Louis the Pious with a proto-hulc; 2. Haithubu bracteater with a proto-cog; 3. Haithabu bracteates with a Scandinavian ship type. The 'Danish pattern boat' is undoubtedly (3). Was the 'Frisian pattern ship' (1) or (2)? (After Ellmers 1972, 56).

nautical superiority: the use of the word 'Frisian' applied to the North Sea, and to one of the most common types of ships in the waters of northern Europe. I shall more particularly dwell on these last points, which are highly controversial.

The Frisian Sea

A Mare Frenessicum or Fresicum is mentioned in chapter 38 of the Historia Brittonum, ascribed to the so-called Nennius, and partly inspired by an old Kentish Chronicle (Lot 1934; Morris 1980; Lebecq 1983b, 239-40; Dumville 1985). We have two families of manuscripts. The first, the more ancient of which is the Harleian (early 9th century), relates the movements of Saxon ships up to the Orkneys, and the Saxon occupation of regiones plurimas mare Frenessicum. The other family of manuscripts — particularly the Vatican one — does not mention the mare Frenessicum, but the mare Fresicum. Fresicum is very explicit, but what does Frenessicum mean? In his translation, John Morris writes the 'Frenessican sea'; this is an overcritical interpretation, which has no meaning. I think that Frenessicum is a mistake — inverting two consonants produces Fresenicum mare, which sounds like the Pallia Fresonica. If it really is the Sea of the Frisians, it cannot mean the Irish Sea — as Poelman thought (1908, 49); nor the Firth of Forth — as Ferdinand Lot (1934, 177,222) or John Morris (1977, 61) believed. It can only be the North Sea, because there were neither important Frisian sailing, nor significant Saxon settlement on the shores of the Irish Sea or of the Firth of Forth. Indeed, in the 11th century, Adam of Bremen refers to the North Sea as the oceanum Fresonicum (in the Gesta Hammaburgensis Ecclesiae Pontificum IV 1; Lebecq 1983b, 195); and in the 12th century Nicolas of Liege calls it the mare Fresonum (in the Vita Landiberti V; Lebecq 1983b, 55). So the identification of the North Sea as the Sea of the Frisians died hard — at least until the period when the Frisians were no longer dominant in the North Sea.

Frisian ships

In a well-known text (Lebecq 1983b, 244-5) the Anglo-Saxon chronicler writes that ships were built on Fresisc, that is, in the Frisian fashion. In 896 King Alfred wanted to build a new type of vessel in order to fight the Viking ships. The new boats would be tu swa lange tha othru (1.3) — 'twice as long as the others' — but which others? Then they would be swiftran, unwealtran and hierran (ran is a comparative form in the plural); this means 'swifter', 'steadier' and — more interesting for my purpose — 'higher' in the water. Higher than which kind of ships? The rest of the text says that 'they should not be built according to the Danish pattern, nor the Frisian pattern' (Appendix I). It means that, for the English shipbuilders, only two patterns of big ships (the beginning of the text mentions langskipu) existed in the south-western waters of the North Sea at the end of the 9th century. It is not necessary to describe the well-known pattern of the Danish long-ship and, thanks to Ole Crumlin-Pedersen (1965) and Detlev Ellmers

(1985), we know the Frisian origin of the flat-bottomed cog, the main type of ship which sailed between the Rhine Delta and Scandinavia, particularly in the sandy waters of the Wadden Sea. But the main kind of ship used in the south-western waters of the North Sea was not the cog but a round-bottomed ship — in fact a kind of extended, or heightened logboat — generally considered as the hulc or, rather, the proto-hulc, after Detlev Ellmer's suggestion that the word derived from the old German verb hohlen or hölken, meaning 'to dig' or 'to hollow out' (Ellmers 1972, 60-1).

We can see this kind of boat on the coins of Quentovic and Dorestad struck in the beginning of the 9th century (Fig 11.3), and later on the fonts of Winchester Cathedral and the Flemish church of Zedelgem near Bruges, certainly carved in the Tournal area in the 12th century. Later still they appear on some seals of ports in south-east England, in particular on the seal of New Shoreham, which carries the word hulc to define the ship. The 'Frisian pattern ship' of the Chronicle cannot be a cog because the cog was not a major type of ship in 9th century Britain, it is more likely the extended logboat (the proto-hulc) which was very common in these waters. Is not the first occurrence of the word hulcus in the London toll-list of King Aethelred in the beginning of the 11th century (Lebecq 1983b, 443)?

The best proof is that the new ships built by King Alfred's builders must be 'higher above the water than the others'. Now the freeboard of the cog was already very great, whilst the freeboard of the hulc was very low, just like that of the Viking ships. As Crumlin-Pedersen (1972, 186) wrote about the wreck of Utrecht 1, the proto-hulc was a 'banana-shaped' boat. Of course, it has often been noted that the hulc-type coinage was first minted in Quentovic (close by Montreuil-sur-Mer) and only later in Dorestad. But all ancient hulc-wrecks were discovered in the lower Rhine area, even though Robert Vlek thinks that they were not exactly hulks (Vlek 1987, 143-5); these are the two Utrecht wrecks, which date to the 11th/12th centuries, particularly the famous boat found in 1930, which was long considered as dating to the end of the 8th (Vlek 1987,67). There is also the ship which was excavated at Velsen (near Ijmuiden), which is an extended and heightened logboat from the 10th/11th centuries (de Weerd 1987).

Conclusion

A certain kind of vessel — probably the round-shaped one generally considered to be a hulc — was called a 'Frisian pattern ship' by the Chronicler — which proves that the Frisians were, if not their creators, at least their main users. Similarly the 'Frisian' merchant was not necessarily a Frisian, but surely an international trader; as was also the case of the 'Frisian' steersman was not necessarily a Frisian. This is another proof, and not the least, of the importance of Frisian seamanship in the Dark and early Middle Ages — the importance surely, the monopoly maybe. (But see Ellmers, this volume).

References

Blok, D P, 1979 *De Franken in Nederland*, (3rd ed).

Clograve, B, & Mynors, R A B, 1969 *Bede's Ecclesiastical history of the English people*, Oxford Med texts.

Crumlin-Pedersen, O, 1965 Cog-kogge-kaag, *Handels og Søfartsmuseet på Kronborg Årbog*, 81-144.

——, 1972 The Vikings and the Hanseatic merchants, in Bass, G, (ed), *A history of seafaring based on underwater archaeology*, 181-204.

de Boone, W J, 1954 *De Franken van hun eerste optreden tot de doot van Childerik*.

de Weerd, M D, 1987 Velsen: the medieval logboat, in Brandt, Groenman- van Wateringe, W, & van der Leeuw, S, (eds), *Assendelver Polder Pap* **1**, 265-83.

Dewing, H P, 1928 *Procopius, with an English translation*, vol 5.

Dorestad, 1978 *Spiegel Historiael* special no **13.4**

Dumville, D, 1985 *The Historia Brittonum. The Vatican recension*.

Ellmers, D, 1969 Keltischer Schiffbau, *Jahrbuch des Römisch-Germanischen Zentralmuseum* **16**, 73-122.

——, 1972 *Frühmittelalterliche Handelsschiffahrt in Mittel- und Nordeuropa*.

——, 1985 Frisian and Hanseatic merchants sailed the cog, in Bang-Anderson, Greenhill, & Grude, (eds), *The North Sea. A highway of economic and cultural exchange. Character, history*.

Halbertsma, H, 1982, *Friesland Oudheid*, dissertation, Groningen.

Jankuhn, H, 1953 Der Fränkisch-friesische Handel zur Ostsee im frühen Mittelalter, *Vierteljahrschrift für Sozial- und Wertschaftsgeschichte* **40**, 193-243.

Lebecq, S, 1978 Francs contre Frisons (VIè/VIIIè siècles), *La guerre et la paix au Moyen Age. Actes du CIe Congrès national des Sociétés savantes, Paris 1978*, 53-71.

——, 1983a *Marchands et navigateurs frisons du haut Moyen Age*, vol 1, *Essai*.

——, 1983b *Marchands et navigateurs frisons du haut Moyen Age*, vol 2, *Corpus des sources écrites*.

——, 1986 Dans l'Europe du Nord des VIIè/IXè siècles: commerce frison ou commerce franco-frison?, *Annales. Economies. Sociétés. Civilisations* **41**, 361-77.

Lot, F, 1934 *Nennius et l'Historia Brittonum*.

Morris, J, 1977 *The age of Arthur. A history of the British Isles from 350 to 650*, 2nd ed, (3 vols).

——, 1980 *Nennius: British history and the Welsh Annals*.

Morrison, K F, & Grunthal, H, 1967 *Carolingian coinage*.

Périn, P, & Feffer, L Ch, 1987 *Les Francs*, vol 1, *A la conquête de la Gaule*.

Poelman, H A, 1908 *Geschiedenis van den handel van Noord-Nederland gedurende het merovingische en karolingische tijdperk*.

Thompson, E A, 1980 Procopius on Brittia and Britannia, *Class Quart* **30**, 498-507.

Van Es, W A, & Verwers, W J H, 1980 *Excavations at Dorestad 1. The harbour Hoogstraat 1*, (2 vols).

Vlek, R, 1987 *Medieval Utrecht boat*, Brit Archaeol Rep **S382**.

Völckers, H H, 1965 *Karolingische Munzfunde der Frühzeit (751/800)*.

Whitbread, L, 1946 The Frisian Sailor passage in the old English gnomic verses, *Rev English Stud* **22**, 215-9.

Wood, I, 1983 *The Merovingian North Sea*.

Appendix I: Anglo-Saxon Chronicle a° 896

References: Thorpe 1861; Whitelock 1961.

Then King Alfred had 'long ships' built to oppose the Danish warships. They were almost twice as long as the others. Some had 60 oars, some more. They were both swifter and steadier and also higher than the others. They were built neither on the Frisian nor the Danish pattern, but as it seemed to himself that they could be most useful.
Then on a certain occasion of the same year, six ships came to the Isle of Wight and did great harm there, both in Devon and everywhere along the coast. Then the king ordered [a force] to go thither with nine of the new ships, and they blocked the estuary from the seaward end. Then the Danes went out against them with three ships, and three were on dry land farther up the estuary; the men from them had gone up on land. Then the English captured two of those three ships at the entrance to the estuary, and killed the men, and the one ship escaped. On it also the men were killed except five. These got away because the ships of their opponents ran aground. Moreover, they had run aground very awkwardly: three were aground on that side of the channel on which the Danish ships were aground, and all [the others] on the other side, so that none of them could get to the others. But when the water had ebbed many furlongs from the ship the Danes from the remaining three ships went to the other three ships which were stranded on their side, and they then fought there. And there were killed the king's reeve Lucuman, Wulfheard the Frisian, Aebba the Frisian, Aethelhere the Frisian, Aethelfrith the king's geneat, and in all 62 Frisians and English and 120 of the Danes. Then, however, the tide reached the Danish ships before the Christians could launch theirs, and therefore they rowed away out ...

Appendix II: Historia Brittonum, c38

References: Lot 1934; Morris 1980; Dumville 1985)

Hengist said to Vortigern 'I am your father, and will be your adviser. Never ignore my advice, and you will never fear conquest by any man or any people, for my people are strong. I will invite my son and his cousin to fight against the Irish, for they are fine warriors. Give them lands in the north about the Wall that is called Guaul'. So he told him to invite them, and he invited Octha and Ebissa, with forty keels. They sailed round the Picts and wasted the Orkney Islands, and came and occupied many districts beyond the Frenessican Sea, as far as the borders of the Picts. So Hengist gradually brought more and more keels, until they left the islands whence they became uninhabited; and as his people grew in strength and numbers, they came to the aforesaid city of the Kentishmen. (Translation: Morris 1980, 29).

12 The Frisian monopoly of coastal transport in the 6th-8th centuries AD

Detlev Ellmers

Abstract

On their way west the Slavonic tribes at *c* AD 560 interrupted the transcontinental trading routes which led from Byzantium via the eastern parts of middle Europe to Scandinavia. From that time on the only trade connection between Scandinavia and the Mediterranean was maintained by the Frisians who, in their coastal vessels, sailed cargo from England as well as from the Merovingian empire along their shores to Scandinavia, and *vice versa.* This paper deals with this monopoly situation of Frisian trade.

Maritime Frisians

The strongest impulse to the coastal seafaring of the Frisians was given by an event far outside Frisia (Ellmers 1985a; 1985c). In the middle of the 6th century Avaric and Slavonic tribes invaded large parts of eastern Europe and interrupted the trade connections from Byzantium to Scandinavia. At this time nobody was able to cross the North Sea directly from the British Isles to Scandinavia and the latter depended for its whole supply of goods from western, central and southern Europe completely on Frisian coastal trade. In all Scandinavia for 200 years or more before the Viking Age, there is not one single find of foreign origin that came there without Frisian intermediate trade (Bakka 1971).

At the beginning of this phase of Frisian monopoly in trade they had no towns which could serve as trading centres. Frisian traders were peasants, skippers and merchants in one person and lived throughout their country in small farms erected on top of artificial hills (terpen) near tidal creeks and streams. In a 7th century layer in one of these, excavated at Hessen in the town of Wilhelmshaven, there was found a slipway on which flat bottomed boats could be built (Ellmers 1972). Another important find was a side rudder of the firrer type which, today, is still in use on the traditional sailing boats of Steinhuder Meer, a lake north of Hannover. This type of rudder was specific to smaller vessels within the shipbuilding tradition of the cog. In the late 12th century, Hanseatic cogs replaced the firrer by a stern rudder (Ellmers 1985b, 15ff).

The firrer of Hessen tells us that the farmer-merchant there intended to build boats of the cog type on his slipway. A flat bottom was essential on Frisian craft which were designed for the special conditions encountered when sailing the shoals of the Wattenmeer along the Frisian shores.

The economic base of the farm at Hessen was sheep of two different breeds with different types of wool. From this raw material cloth of very high quality was woven in many different varieties. Provided with this excellent home-made commodity our farmer-merchant sailed to the beach markets along the Frisian borders to meet neighbouring merchants or customers. One of these rural beach markets has been excavated on the Jutish (Jutland) west coast near Dankirke, south of Ribe (Thorvildsen & Bendixen 1972). Located near the farm of a rich customer, this market place lay close to the shore where flat bottomed boats could beach and dry out at low tide and where merchandise could be sold to visitors to the market. The presence of Frisian merchants is confirmed by stray finds of not less than 13 coins which, among other small objects, had been lost during the process of buying and selling.

Frisian landing places

From c AD 650 Frisian merchants started to settle at these beach markets along their borders and thus founded the first trading centres with permanent settlement east of the former Roman empire, on the shores of the North Sea. Dorestad on the Rhine, south of Utrecht, near the border with the Franks, is the best known example (van Es & Verwers 1980). Around AD 625 there was nothing but an official manor house and some fortification, under the protection of which a beach market was organised and coins were struck for use there. Some 50 years later abundant finds indicate the first permanent settlement.

Southern goods were brought by riverboats along the River Rhine to Dorestad and transferred to coastal vessels bound for England, on the one hand, and for the eastern parts of Frisia and Scandinavia on the other (see Lebecq, this volume). Due to this key position Dorestad, in a short time, became the most flourishing of the Frisian trading ports. The houses of the merchants were built in a long row along the riverbank so that ships of the merchants and of their customers could beach in front of the appropriate house. For this pattern, the German historian Walter Vogel created the, not very suitable, term Einstrassenanlage. All trading towns of the early Middle Ages are laid out after this pattern — as a long row of houses along the waterfront.

At Dorestad, in the course of time, the River Rhine shifted away from this row of houses, leaving a considerable area of open beach between houses and riverbank, where ships landed by beaching. The gap was bridged by carefully made causeways, which led from every merchant's house to the ships' landing places, thus demonstrating that a lot of the trade was carried out directly from ship to house and vice versa. In addition to the trade within the houses there was a second significant area of trade and other activities at the landing places. The ever growing distance between houses and ships made it possible for archaeologists to distinguish between the finds from both areas and to prove money exchange near the ships, from stray finds of coins, weights and balances. Not less than six suspension lugs for cauldrons and one cauldron handle bear witness to the cooking of hot meals for the ships' crews who, after weeks of sailing in cold and rainy weather, wanted to have their first warm meal at the landing place. Of course, the sailors had to repair their ships at these landing places, as the recovery of many lost tools indicates. Stones, which had been used as sinkers for nets or fish traps, provide evidence for fishing.

To sum up, even in those Frisian ports with permanent settlements, especially of merchants in a row of houses along the waterfront, the old beach market with all its activities along the ships' landing places played a continuing role.

Frisian ships

In the late 8th century Charlemagne struck coins at Dorestad depicting a sailing vessel of banana shape side view (see Lebecq, this volume, Fig 11.3). This type of ship is an early version of the hulc in which the Frisians sailed to England and English merchants sailed to Frisia. At Utrecht an 18 m long hull of this type has been excavated and dated to the 8th century. And as the word hulc means something being hollowed out, the hulc of Utrecht was constructed on top of a huge logboat (Ellmers 1972, 59ff, but see Vlek 1987 for an opposing view). After the prototype of the Dorestad coin, another coin was struck in the early 9th century by illiterates at Hedeby (near Schleswig on the shore of the Baltic) where Frisian merchants settled in large numbers to organise the transit trade from the North Sea to the Baltic. The ship on this coin differs very much from the hulc of the Dorestad coin. Instead of the round side view of the hulc, she has an angular one, with flat bottom, long and straight stem and stern posts, a side rudder of firrer type and side planking in clinker technique (the heads of the clinker nails are to be seen on some issues). All these features are typical of early cogs. Some of the coins even show the broken line of the flat bottom with both ends being bent upwards some degrees. Ships of this construction are designed for sailing the Wattenmeer in between the dunes and the shore. At low water the cog would take the ground; as the tide rose the water could get underneath the bent-up ends of the bottom to make the ship float again. Without these bent-up ends the flat bottomed ship would stick to the ground. The Wattenfahrt is the reason why the Frisians used two different types of ship for their trade; the hulc for trade with England, and the cog for trade to the east, that is, to the Continental Saxons and, especially, to Scandinavia (Ellmers 1972, 63ff). Though the first evidence for Frisian contact with the Slavonians is not earlier than the late 8th century, we cannot completely exclude earlier Frisian trade even to them.

Frisians in the Viking Age

For Scandinavia this cog-route, especially in the 7th and 8th centuries AD, was the only trade connection to western, middle and southern Europe. We can hardly imagine what a relief it was to the Scandinavians when, towards the end of the 8th century, for the first time, they discovered an alternative sailing route from Norway via the Shetlands to the British Isles. In the early 9th century they opened a third trade connection from Sweden along the Russian rivers to Byzantium and to the Islamic world. Thus the Scandinavians ended the Frisian monopoly and initiated a new chapter in the history of shipping: the age of the Vikings.

In spite of the loss of the monopoly and in spite of all the Viking raids in Frisia, the archaeological sources available do not give the slightest hint at a decline of Frisian trade. Only Dorestad, in the course of the 9th century, lost its predominance, but Tiel inherited its English trade and Utrecht its trade to the east. Other Frisian ports began to flourish even in Viking times. There is some very interesting evidence for Frisian presence in one of the centres of the Viking world. As we know, the clinker seams of cogs and related boats were not fastened by iron rivets like Viking ships but by 'J'-shaped iron nails, which are much smaller than those of Celtic ships (see, for example, Marsden, this volume). By these small nails we are able to identify the shipbuilding tradition of cogs even when all timber has rotted away.

At Birka, near Stockholm, the nails of a 10th century cog have been excavated. We learn from them that Frisian merchants at that time sailed to Birka in their own ships. And when, in 1159, the Hanseatic league was founded at Lubeck, Frisian merchants became members of the league and provided the merchants from Westfalia with the necessary ships for their trade with Gotland. Thus the Frisian cog became a Hanseatic one: but that is a new chapter in maritime history (Ellmers 1985b; 1985c).

References

Bakka, E, 1971 Scandinavian trade relations with the continent and the British Isles in pre-Viking times, *Antikvariskt Arkiv* **40**, 37-51.

Ellmers, D, 1972 *Frühmittelalterliche Handelsschiffahrt in Mittel- und Nordeuropa*.

——, 1985a Die Bedeutung der Friesen für die Handelsverbindungen des Ostseeraumes bis zur Wikingerzeit, in *Society and trade in the Baltic during the Viking Age, Acta Visbyensia* **7**, 7-54.

——, 1985b Die Entstehung der Hanse, *Hansische Geschichtsblatter* **103**, 3-40.

——, 1985c Frisians and Hanseatic merchants sailed the cog, in Bang-Andersen, A, (eds), *The North Sea. A highway of economic and cultural exchange*, 79-96.

Thorvildsen, E, & Bendixen, K, 1972 Dankirke, *Frå Nationalmuseets Arbejdsmark*, 47-66

van Es, W A, & Verwers, W, 1980 *Excavations at Dorestad* vol 1 *The harbour Hoogstraat*, *Nederlandse Oudheden* **9**.

Vlek, R, 1987 *The Mediaeval Utrecht boat*, Brit Archaeol Rep **S382**.

13 The Channel from the 4th to the 7th centuries AD

Ian Wood

Abstract

The history of the Channel in the late and post-Roman periods is usually seen in terms of Saxon raids and, ultimately, of the Saxon settlement of England. Close attention to the texts suggests a rather different picture. In the late 3rd and early 4th centuries it was the Franks who were regarded as the chief threat to the Channel, and this threat was largely thought to affect the German and Gallic coasts, and not the coast of Britain. It was only towards the end of the 4th century that raids on the north side of the Channel were clearly recorded, with the Saxons as the raiders. Although it is not clear from the literary sources that there was a firm distinction between the Franks and Saxons at this time, the evidence does, therefore, imply that the Saxon Shore was only so named around the year 400, and it also provides a context out of which later Frankish interest in England could emerge.

Communication and piracy

The history of the Channel in the Roman and post-Roman world is dominated by two issues. The first concerns peaceful communication between Britain and the Continent. This can be explored through the evidence for the imperial administration of Britain, through the history of the classis Britannica, and in the few indications of civilian seafaring that survive, including references to the early career of Carausius as a paid navigator (Aurelius Victor, XXXIX, 20), and his recruitment of Gallic mercatores as troops (Pan Lat, IV, 12). Evidence for official contacts between Rome and Britain trickles on through Constantius's accounts of the visits of Germanus to Britain (Vita Germani, III, 12-18; V, 25-7) to the appeal to Aetius in c 446, recorded by Gildas (DEB, 20, 1). In the 6th century the nearest equivalent to this is to be found in the interest shown by the Merovingians in the kingdoms of south-east England; the same material also includes references to a traffic in dead souls, which may be a garbled account of trade between Francia and Kent (Wood 1983, 12-13; 1984, 24).

The second issue concerns the role of the Channel as a route for piracy and invasion, from free Germany and the Rhine mouth, directed both against Britain and against the shores of Gaul and even as far as Spain (Pan Lat, X, 17, 1). Such activity was clearly endemic in the late Roman period, but probably reached a peak in the 5th century, possibly tailing off thereafter, although the slave trade ensured that piracy did not die out completely (Pelteret 1981). Looked at in this context the Saxons might be said to provide a constant factor in the history of the Channel, at least in modern historiography, which has tended to move from consideration of the Litus Saxonicum to the Adventus Saxonum, and finally to the creation of the Saxon kingdoms of England.

Saxons and the Litus Saxonicum

In these considerations there are, inevitably, uncertainties, not least the question as to whether the Litus Saxonicum was the shore defended or the shore attacked by the Saxons, and although the weight of opinion seems to have settled on the latter interpretation, the matter is by no means resolved (Johnson 1976, 7-10; Bartholemew 1984, 185). Certainly there were plenty of Germanic troops in Britain during the 3rd and 4th centuries, as can be seen in the 297 panegyric on Constantius Chlorus (Pan Lat, IV, 17, 1-2) and in the narrative histories of Ammianus Marcellinus (XX, 1, 1; 3; 4, 2), although it has to be admitted that none of the barbarian units recorded there is said to be Saxon.

It is, however, possible that the question of the nature of Saxon involvement in the Litus Saxonicum is one that is badly posed, and that, as currently interpreted, it depends too much on the knowledge that by 700 southern England was largely Saxon. In short, the emphasis on Saxon involvement in the Channel may be one created by hindsight, and not by a proper evaluation of the sources in their own context. Before offering an interpretation of the history of the Channel in this period, it is as well to reconsider precisely what our sources have to say.

The Frankish threat

The accounts of the rebellion of Carausius in the contemporary panegyrics dealing with Maximian and Constantius Chlorus, and in the narratives of Aurelius Victor, writing in the 360s, his contemporary Eutropius, writing in 370 (Aurelius Victor, xvi), and Orosius writing shortly after 417, provide a convenient starting point. These last three texts, which are closely related, are best taken first, since the panegyrics, by their very nature, are allusive works, which are often ambiguous.

According to Aurelius Victor, Carausius was appointed to drive away the Germans who were infesting the seas (XXXIX, 20: propulsandis Germanis maria infestantibus). Eutropius is more specific, in defining both the area infested, the tractus Belgicae et Armorici — essentially the coastline from the Rhine to the Loire on the south side of the Channel — and the Germans involved, the Franks and Saxons (Eutropius, IX, 21). Orosius's account is derived from this (Orosius, VII, 25, 3).

The panegyrics are less clear, not least because they are concerned to give no credit to Carausius for clearing up the seas. Indeed he is himself transmogrified rhetorically into a pirate (Pan Lat, II, 12, 1; IV, 12), just as Maximus would later be transmogrified after his usurpation in Britain (Pan Lat, XII, 26,4). The label in the former case, however, is particularly confusing, since it allows the panegyrists to equate Carausius with the threat he had been sent to tame. Hence it is not altogether clear whether Maximian's defeat of the piratical Franks mentioned by Mamertinus involved Carausius's supporters or the raiders against whom he had originally been sent (Pan Lat, III, 7,2); it may even be that the latter had turned into the former (Pan Lat, IV, 17). The important point, however, is that in speeches delivered in the 280s and 290s the chief maritime threat to the Empire was perceived as being Frankish, not even as Frankish and Saxon, as claimed later by Aurelius Victor and Eutropius. Further, this perception is backed up by the statement of the panegyrist Nazarius, speaking in 321, that the Franks had ravaged the Ocean coast as far as Spain (Pan Lat, X, 17, 1).

Franks and Saxons

This picture of Frankish piracy is both extended and modified by the historian Ammianus Marcellinus, writing in the 380s or 390s. Here for the first time there are raids on the coast of Gaul associated exclusively with the Saxons, dating to the year 370 (XXVIII, 5, 1; XXX, 7, 8); there may even be a reference to a Saxon raid on Britain, although this is questionable (Ammianus Marcellinus, XXVI, 4, 5; Bartholemew 1984, 173-5). Nevertheless, in the introductory comments to his account of Theodosius the Elder in Britain, Ammianus refers generally to the raids of the Franks and the Saxons on the Gallicanos tractus (XXVII, 8, 5). Moreover, Ammianus's exact contemporary, Ambrose, bishop of Milan, also talks of the Franks and Saxons as being active in this period, since he alludes to defeats suffered by Magnus Maximus at the hands of both of them (Ambrose, ep LXIIII, 23).

In other words, late 4th century writers looking back on the period of Carausius's rebellion saw the Franks as acting in collaboration with the Saxons, whereas the late 3rd and early 4th century panegyrists mention only Franks. Such collaboration, however, is recorded for the 360s and later, and it may be that Aurelius Victor and Eutropius were putting their own perceptions on earlier events. The relative increase in Saxon piracy, and consequent diminution of the role of the Franks, might be associated with the punitive campaigns directed against the latter by Julian, during the reign of Constantius II (Ammianus Marcellinus, XVII, 2, 1-4; 8, 3; XX, 10, 2). Nevertheless, even in the late 4th century there is a tendency not just to group the Franks and Saxons together, but also to place the Franks first in any reference to their joint activity. The natural conclusion of this is that up until the last decade of the 4th century the Franks were regarded as the major threat to the coast of Gaul, and the coast of Britain is scarcely mentioned (Bartholemew 1984, 175-7).

The Saxon Shore

In the 390s the picture changes. There may already be a hint of this in Pacatus's panegyric of 389, since he refers to a naval victory achieved by Theodosius the Elder against the Saxons (Pan Lat, XII, 5,2). Presumably he has in mind an event during the Frankish and Saxon raids mentioned by Ammianus. The clearest indication of change, however, comes with the poet Claudian, for whom it is the Saxons who are the seaborne menace (carm XVII, 392; XXII, 255). In a notable passage he contrasts Britain harassed by Saxons with Gaul ravaged by the Franks (carm XXII, 241-55); both provinces, he claims, have been rescued by Stilicho; the Rhine is now peaceful and there is no need to keep a coastal watch on the Saxons. Henceforth, according to the sources, it is this last tribe which both dominated the Channel and threatened Britain (Constantius, Vita Germani, III, 17-18; Chronicle of 452, OL CCXC III, OL CCCVI XVIIII; Chronicle of 511, Theodosius and Valentinian III, XVI; Gildas, DEB, XXIII, 1; Bede, Hist Ecc, I, 20). In the case of Sidonius Apollinaris, commenting in 456 on events of previous years, the activities of Franks and Saxons are once again contrasted, as in Claudian; the latter people are seen as ploughing the British seas and threatening the Aremoricus tractus, while the former ravage Germania Prima and Belgica Secunda (carm VII, 369-72).

If, as appears to be the case, our sources only identify the Saxons as being the most notable raiders in the Channel zone in the last decade or so of the 4th century, and if the Litus Saxonicum is named after the people who threatened the coasts of Britain and Gaul, this ought to have some implication for dating the name assigned to the coastal region, since it is hardly likely that such a command would be named after the lesser of two menaces (Johnson 1976, 10).

That the designation Litus Saxonicum could be as late as the 390s is further indicated by the fact that the phrase is used for the first and only time in the Notitia Dignitatum, which, although it may depend on earlier sources, is in its present form a 5th century document and may date from the reign of the usurper Joannes, 423-5 (Mann 1976, 8; Salway 1981, 336, 476, n 2). Previous references to the Channel area and its commands never use the expression.

Thus Carausius is said by Eutropius, writing in 370, to have been given the task of pacifying the tractum Belgicae et Armorici (IX, 21), which Orosius transformed into the less specific phrase Oceani litora (VII, 25, 3). Ammianus Marcellinus, writing shortly after Eutropius, records the death of Nectaridus, comes maritimi tractus, apparently in Britain, during the problems of 367 (XXVII, 8, 1). He also talks of the Franks and Saxons plundering the GAllicanos vero tractus during the same period (XXVII, 8, 5), and he refers to Theodosius travelling to the Bononiae litus in order to embark for Britain (XXVII, 8, 6). It is extraordinary that no 4th century author should use the phrase Litus Saxonicum in an account of events which took place either in the 280s or 360s, unless, of course, the name was not in use by then.

Nevertheless, since the Notitia not only refers to the office of comes litoris Saxonici per Britannium (Johnson 1976, 64-5), but also lists additional Saxon shore forts under the command of the duces of the Tractus Armoricani et Nervicani and of Belgica Secunda (Johnson 1976, 73), it is possible that there had once been a command which straddled both coasts of the Channel. The account in the Notitia, however, does not describe such a unitary command, and it is, therefore, likely that the Litus Saxonum was in existence some while before the compilation of the text as we now have it, and, indeed, that it had ceased to exist by that time. In any case, an officially-recognised command extending across the Channel is almost certain to antedate the rebellion of Constantine III in 406, which provides the real terminus post quem non for its institution. Thus, since Ammianus Marcellinus seems not to have thought of the office as being in existence, at least under its present title, in 367, and since by that date the Saxons had scarcely emerged as meriting special attention in the appellation of a frontier zone, it seems likely that the command was renamed, if not created, either in the last years of the 4th century or the first years of the 5th.

Further, Claudian may provide evidence for imperial concern about the coastal defence of Britain in precisely this period, since in his Epithalamium for Palladius and Celerina he refers to the bride's father as having been responsible for the number of cohorts placed on the Ocean (carm XXV, 90-1). Moreover, he comes quite close to the language of the Notitia when he refers to watches which had been kept against the Saxons on the shore of Britain (carm XXII, 254-5). Granted the absence of any reference to the Litus Saxonicum in earlier prose writers, and the need to date the command earlier than 406, these poetical references may provide a clue to the establishment of the office of the comes Litoris Saxonici, which might conceivably have been the work of Stilicho (Salway 1981, 424).

The forts of the Saxon Shore

Although this command may have been a creation of the last years of the 4th or first years of the 5th century, it is possible that the office of comes maritimi tractus mentioned by Ammianus Marcellinus was essentially the same post (XXVII, 8, 1). This is not, however, an inevitable conclusion. There is no indisputable evidence that the maritime raids of the Franks and the Saxons in the period before that covered by Claudian actually reached Britain (Bartholemew 1984, 175-7). It might be assumed that the British Saxon Shore forts prove conclusively that there is here a lacuna in the written sources. Nevertheless it is possible to see the prime function of these forts as being concerned not so much with defence as with the embarkation and disembarkation of troops, and perhaps more significantly with the transfer of British corn to the Rhine army (Ammianus Marcellinus, XVIII, 2, 3). Thus the forts could have been first and foremost military depots, an interpretation which would be perfectly in keeping with the extremely patchy archaeological evidence from their interiors (Cunliffe 1977, 5). Nor would such an interpretation be incompatible with the use of the forts as defensive centres in time of crisis, although it may be doubted whether they were particularly well-placed to deal with piracy.

It is possible, therefore, that the British Saxon Shore forts only became part of a major defensive system at the time of the creation of the office of comes Litoris Saxonici under Theodosius or Honorius. At the same time, recognition by the Romans that the Saxons constituted the major maritime threat to the coasts of Britain and Gaul, and the subsequent naming of a command after the threat in the late 4th or early 5th century, might be thought to indicate a significant growth of Saxon power in this period. Certainly there was a shift in perception and nomenclature which requires examination.

Saxons and Franks

This shift in perception might be no more than the result of a growing awareness on the part of the Romans that the people who threatened the Channel coasts were not Frankish but Saxon (Bartholomew 1984, 184). That there was some confusion even in official circles is perhaps indicated by the apparent contradiction between Pacatus's reference to Theodosius the Elder defeating the Saxons (Pan Lat, XII, 5, 4), and the 369 inscription on the Ponte S Bartolomeo, crediting the Emperor with a victory over the Franks (Bartholomew 1984, 184). Nevertheless it may be that this confusion is illusory, and that there is a wider context to be considered which explains the imprecise use of ethnic terms employed by the Romans. Indeed, it may be that the comments of the Romans can only be understood in the light of their assumptions about contemporary Germanic tribes.

Here the comment of the emperor Julian, that the Franks and the Saxons were related, provides a useful indication of the Roman understanding of the barbarians (Or I, 51), not least because Julian himself had campaigned in the Rhineland, and had certainly come into direct contact with Frankish peoples in that area. Indeed, according to Zosimus, he had defeated a group of Saxons, called the Kouadoi, who were harassing the Salian Franks (III, 6, 1). If Julian thought that there was a relationship between Franks and Saxons, it was, therefore, not because they always collaborated. Nor was this the only time that they were in conflict; Jerome records a defeat of the Saxons in regione Francorum for the year 373, and he is followed in this by Orosius and Cassiodorus (Jerome, Chron OL CCLXXXVIII, VIII; Orosius, VII, 32, 10; Cassiodorus, Chron 1118).

The assertion that certain Germanic tribes were related needs to be seen in the context of then current knowledge that these tribes were made up of various subgroups. Thus, for Zosimus, the Kouadoi were Saxons (III, 6, 1), Ammianus included Salians and Atthuarii within the Franks (XVII, 8, 3; XX, 10, 2). Sulpicius Alexander, fragments of whose histories are preserved by the 5th century writer Gregory of Tours, seems to add to these Bricteri, Chamavi, Ampsivarii and Catthi (Lib Hist, II, 9), and the Peutinger table seems to support the identification of Chamavi as Franks (James 1988, 35; but see Wenskus 1961, 519). Most of these peoples are known from 3rd and 4th century sources, but are rarely mentioned thereafter, although the name Sigamber survives as a synonym for Francus well into the early medieval period (Gregory of Tours, Lib Hist, II, 31). Thus, after the 5th century, there is a growing emphasis in the literary sources on large tribal confederations, rather than on their component parts.

Granted this awareness of the diversity of the Frankish peoples, it is perhaps not surprising that kinship between them and the Saxons should be assumed. After all, they were to be found in the same geographical area, and they were known to have collaborated in raiding the Channel coast. There is, however, a further piece of information. Bede records the dispersal of a tribe called the Boructuarii at the hands of the Old Saxons towards the end of the 7th century (Bede, Hist Ecc, V, 11). He also lists them among a group of peoples from whom the Angle and Saxon invaders of Britain had been drawn. The others were the Fresones, Rugini, Danai, Hunni and the Old Saxons themselves (Bede, Hist Ecc, V, 9). The Boructuarii, however, are likely to be the same people as the Frankish Bricteri of Gregory of Tours (Lib Hist, II, 9). In which case there was an overlap within the perceptions of early medieval writers between the Franks and one of the tribes that was thought to have been involved in the Germanic settlement of Britain.

None of this proves that ethnically there was a connection between the Franks and the Saxons, It does, nevertheless, indicate that it was possible for a tribe to be categorised both as Frankish and as belonging to the first English settlers. Moreover, since the fluidity of warbands east of the Rhine meant that tribal formation was not a matter of blood, the creation of nations in that region was as much a matter of perception and categorisation as of biology. Nor did this process of categorisation come to an end with Gregory of Tours; it was still unfinished in Bede's day, hence the apparent contradiction between his list of the peoples making up the Angles and Saxons who settled England, included in Book V of the Historia Ecclesiastica, and his more famous comment on the coming of the Angles, Saxons and Jutes (Hist Ecc, I, 15). Further, the shift of nomenclature from Gewissae to West Saxons attested by Bede (Hist Ecc, III, 7) provides another illustration of the evolution of tribal categorisation in his lifetime. More extended was the emergence of a preference for calling the Germanic tribes of Britain English rather than Saxon, which may perhaps be traced to a pun attributed to Gregory the Great (Wormald 1983,123-4). Such identifications are not statements of fact, but of perception.

South of the Channel

With this in mind it is possible to return to Claudian's description of Britain harassed by Saxons, and Gaul by Franks (carm XXII, 241-55). It cannot be inferred from this that there had been a change in the composition of groups attacking Gaul and Britain. All that can be said is that the former were usually labelled as Franks and the latter as Saxons. This observation has its significance for an understanding of the Saxon raids of the 5th and 6th centuries; the fact that our sources chose to call the barbarians who invaded Britain in that period Saxons is in no way incompatible with the archaeological identification of some of those Saxons as Franks (Evison 1965). Nevertheless we should not forget that the Saxons continued to be active south of the Channel, where they had once been thought of as fellow travellers with the Franks. Sidonius Apollinaris, for instance, refers to them ravaging Saintes (ep VIII, 6, 13), and Gregory of Tours records their presence in the Bessin (Lib Hist, V, 26; X, 9), where they can be detected archaeologically, as indeed they can on the Garonne (Arnold 1980, 101, 105).

At the same time the Franks continued to be thought of as a people associated with water; in Claudian and Sidonius they are mentioned in connection with the river systems of Germany, above all the Elbe (Claudian, carm XXI, 227, see also VIII, 452; Sidonius Apollinaris, carm VII, 236, 325, 390; XXIII, 244-7), that is with lands far to the east of the territories to which they are usually assigned, but not so far from those traditionally associated with the Saxons. Granted this emphasis on the waterways of northern Europe, the Frankish attack on Germania Prima and Belgica Secunda in 454-5 could have been as much a maritime raid as an invasion by land (Sidonius Apollinaris, carm VII, 372). Equally, the legend told in the 7th century of the origin of their royal family, the Merovingians, descended from a princess who went bathing with a sea-monster, only makes sense in the context of a nation proud of its maritime heritage (Fredegar, III, 9).

The Merovingians and England

All this provides a background to the relations between the Franks and the Saxons in the 5th and 7th centuries. It is hardly surprising that the Merovingians should have kept an eye on the descendants of peoples who had been thought of as related to the Franks, with whom they had plundered the coasts of Gaul, apparently as junior partners, in the 4th century. Moreover, Merovingian concerns were not merely antiquarian; in all probability the Saxons were plundering the coasts of Frankish Gaul, just as they had plundered the Roman Empire. Certainly the Merovingians legislated over the matter of slaves taken overseas, who were to be retrieved after registration of claims in both Frankish and foreign law-courts (Wood 1983, 12-3; 1986, 21-2), a point which may be relevant to the development of such early medieval centres as London. They also settled Saxons on Frankish territory, and tried to use this settlement as a means of claiming lordship over parts of England, even going so far as to include a group of Angles in an embassy to Constantinople to substantiate their claim (Procopius, Wars, VIII, 20, 8-10). How far they succeeded is open to question, but Venantius Fortunatus repeated claims of this sort in his verse panegyrics, and certainly there was considerable Frankish influence in Aethelberht's Kent (Wood 1983, 15-6). A similar case can also be made for East Anglia under Sigberct, who had been in exile in Francia, and who relied on a Frankish missionary, Felix, to support him in the Christianisation of his kingdom on his return (Wood forthcoming). Further, the role of the Frankish bishops Agilbert and Leutherius in the ecclesiastical history of Wessex also suggests considerable Frankish involvement (Campbell 1986, 55). The contribution of the Merovingian church to the Christianisation of England in the 7th century may suggest that Dagobert I realised that his predecessors had missed an opportunity in leaving the conversion of Kent to the Italian Augustin;, rather than taking the task into their own hands.

Conclusion

In Merovingian eyes, it seems, southern England in the 6th century was subject to a Frankish hegemony, and Dagobert, the greatest of the 7th century kings, had no desire to see a decline in the authority he had inherited. In the 3rd century, however, the Romans had looked upon the Franks as being the chief threat to the Channel coast, and they continued to be so regarded until the last years of the 4th. From the viewpoint of contemporaries, therefore, the history of the Channel from the 3rd to the 7th centuries was not a Saxon history. The Saxon Shore was apparently only so named for a very brief period of time, and the Adventus Saxonum, whatever it was, is scarcely noticed by 5th and 6th century writers; it is only Bede, interpreting Gildas, who transforms the 'Coming of the Saxons' into a major event in the emergence of England. More obviously the Late Antique and sub-Roman period saw a development in the Channel from Frankish piracy to Frankish hegemony. Such a view is, of course, partial, but it does have the advantage of dealing with the evidence in its correct chronological setting, without the benefit of hindsight.

References

Ambrose Zelzer, M, (ed), 1982, *Sancti Ambrosi Opera* X (iii), *Corpus Scriptorum Ecclesiasticorum Latinorum* **LXXXII**.

Ammianus Marcellinus Rolfe, J C, (ed), 1935-9, Ammianus Marcellinus, *Rerum Gestarum Libri qui supersunt*, (3 vols).

Arnold, C, 1980 Wealth and social structure: a matter of life and death, in Rahtz, P, Dickinson, T, & Watts, L, (eds), *Anglo-Saxon cemeteries 1979*, Brit Archaeol Rep **82**, 81-142.
Aurelius Victor Dufraigne, P, (ed), 1975 Aurelius Victor, *Livre des Cesars*.
Bartholemew, P, 1984 Fourth-century Saxons, *Britannia* **15**, 169-85.
Bede, *Hist Eccl* Plummer, C, (ed), 1896, Bede, *Historia Ecclesiastica*.
Campbell, J, 1986 The first century of Christianity in England, in Essays, in *Anglo-Saxon History*, 49-67.
Cassiodorus, *Chron* Mommsen, T, (ed), 1894, *Chronica Minora II, Monumenta Germaniae Historica, Auctores Antiquissimi* **XI**, 109-61.
Chronicle of 452 Mommsen, T, (ed), 1892, *Chronica Minora I, Monumenta Germaniae Historica, Auctores Antiquissimi* **IX**, 615-66.
Chronicle of 511 Mommsen, T, (ed), 1892, *Chronica Minora I, Monumenta Germaniae Historica, Auctores Antiquissimi* **IX**, 615-66.
Claudian Platnauer, M, (ed), 1922, *Claudii Claudiani Carmina*, (2 vols).
Constantius, *Vita Germani* Borius, R, (ed), 1965, Constance de Lyon, *Vie de Saint Germain d'Auxerre*.
Cunliffe, B, 1977 The Saxon Shore — some problems and misconceptions, in Johnston, D E, (ed), *The Saxon Shore*, CBA Res Rep **18**, 1-6.
Eutropius Ruhl, F, (ed), 1901, *Eutropi Breviarium ab urbe condita*.
Evison, V I, 1965 *The fifth-century invasions south of the Thames*.
Fredegar Krusch, B, (ed), 1888, *Chronicarum quae dicuntur Fredegarii Scholastici Libri IV cum continuationibus, Monumenta Germaniae Historica, Scriptores Rerum Merovingicarum* **II**, 1-193.
Gildas, *DEB* Winterbottom, M, (ed), 1978, Gildas, *The Ruin of Britain and other documents*.
Gregory of Tours, *Lib Hist* Krusch, B, & Levison, W, (eds), 1951, Gregory of Tours, *Libri Historiarum Decem, Monumenta Germaniae Historica, Scriptores Rerum Merovingicarum* **I**, 1.
James, E, 1988 *The Franks*.
Jerome, *Chron* Helm, R, (ed), 1956, *Eusebius Werke, 7 Band, Chronik des Hieronymus*.
Johnson, S, 1976 *The Roman forts of the Saxon Shore*.
Julian Bidez, J, (ed), 1913, L'Empereur Julien, *Oeuvres Complètes I, Discours*.
Mann, J C, 1976 What was the Notitia Dignitatum for?, in Goodburn, R, & Bartholemew, P, (eds), *Aspects of the Notitia Dignitatum*, Brit Archaeol Rep **S15**, 1-9.
Orosius Zangemeister, C, (ed), 1882, *Pauli Orosii Historiarum adversum paganos Libri VII, Corpus Scriptorum Ecclesiaticorum Latinorum* **V**.
Pan Lat Galletier, E, (ed), 1949-55, *Panégyriques Latins*, (3 vols) (*NB* I have followed the chronological numbering of the panegyrics used by Galletier, rather than that of the manuscripts followed by R A B Mynors in his edition of 1964, where II = X, III = XI, IV = VIII, X = IV, XII = II. Nixon, C E V, 1987, *Pacatus, Panegyric to the Emperor Theodosius* is a translation of XII, with a useful commentary).
Pelteret, D, 1981 Slave raiding and slave trading in Early England, *Anglo-Saxon England* **9**, 99-114.
Procopius, *Wars* Dewing, H B, (ed), 1914-28, Procopius, *The Wars*, (5 vols).
Salway, P, 1981 *Roman Britain*.
Sidonius Apollinaris Loyen, A, (ed), 1960-70, Sidoine Apollinaire, *Poèmes, Lettres*, (3 vols).
Wenskus, R, 1961 *Stammesbildung und Verfassung*.
Wood, I N, 1983 *The Merovingian North Sea*.
——, 1984 The end of Roman Britain: continental evidence and parallels, in Lapidge, M, & Dumville, D, (eds), *Gildas: new approaches*, 1-25.
——, 1986 Disputes in late fifth- and sixth-century Gaul, some problems, in Davies, W, & Fouracre, P, (eds), *The settlement of disputes in early medieval Europe*, 7-22.
——, forthcoming The Franks and Sutton Hoo, in ——, & Lund, N (eds), *People and places in northern Europe 500-1600: essays presented to Peter Sawyer to celebrate his sixtieth birthday*.
Wormald, P, 1983 Bede, the *Bretwaldas* and the origins of the *Gens Anglorum*, in Wormald, P, (ed), *Ideal and reality in Frankish and Anglo-Saxon Society*, 99-129.
Zosimus Paschoud, F, (ed), 1971-86, Zosime, *Histoire Nouvelle*, (3 vols).

14 The boats and ships of the Angles and Jutes

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Abstract

Pre-Viking boatbuilding traditions are now being studied in Denmark on the basis of new finds as well as re-assessment of earlier finds such as the Hjortspring boat, and new studies of the Nydam boat find are underway. The 2nd-3rd century grave boats from Slusegård provide important evidence for the use of the expansion technique for logboats, also attested in other finds, as well as of early boat graves. Such graves are also found on the Jutland peninsula, the homelands of the Angles and Jutes. Newly found fragments of ships of the 7th century as well as an incised early sailing ship are described and discussed in relation to the traces of Anglo-Saxon ships known from England.

Maritime archaeology ought to play a major role in the study of contacts across the North Sea, as sea-going vessels evidently must have been a key factor in any passage to Britain. However, there are unfortunately very few finds of boats and ships dated before AD 800, and hardly anything is left of the boats of the Saxons, Frisians and Franks.

When we consider the few boat finds known to us, we must remember that boats are mobile; they may be found far away from their home port or place of construction. This point is basic to all boat studies. It is an obvious one for sea-going vessels, but is also applicable to small boats carried on larger ships either as ships' boats or as trade goods.

Foreign ships may not only be found wrecked along the coast, they may even have been left and silted up in rivers far inland. Thus the Vikings used the rivers of England and France as their access to the interiors of these countries, and the Anglo-Saxons and any other visiting or conquering group before them may have done the same. Therefore, when dealing with any boat find it is of fundamental importance to analyse and discuss the provenance of the vessel. Materials and constructional features as well as the environmental evidence, the nature of the site and other boat finds in the region all offer us evidence for this analysis. It is only after such studies that a boat or ship find can be properly characterised as local or foreign.

The evidence from Scandinavian ship archaeological sites of the pre-Viking and the Viking age indicates that different find contexts tend to produce different types of ships and boats. Thus the boats from the Hjortspring and Nydam bog offerings of war booty are evidently long troop transporters, whereas the burial mounds of Gokstad and Oseberg contained broad ships of an exquisite standard fit for a king or a high priest. However, the plank boats used for fishing, general transport and trade are found neither in the bog offerings nor in the graves. These plank boats must be sought along the coastline, where they appear either as wrecks along the open coast, in silted up harbours, or as building elements in navigational obstacles and waterfront structures.

We must, therefore, hope that future excavations of harbour sites along the southern coast of the North Sea and the Channel between the rivers Elbe and Seine, such as Quentovic, will provide us with proper finds of boats and ships from these regions to be drawn into the discussion. Even the south-eastern coast of England presents several sites of interest as potential Dark Age harbour sites, which await excavations that might provide evidence of ships that once used these ports. The recent rich finds from the harbours of Mainz on the Rhine and Hedeby/Haithabu on the Schlei are good examples here.

The Slusegård boats and similar finds

The earliest important finds from Scandinavia of Roman Iron Age date are several expanded logboats discovered in more than 40 graves at Slusegård on the island of Bornholm in the Baltic (Fig 14.1), as well as in individual finds scattered over the Jutland peninsula. They represent boats of three different sizes: The short tubby 3 m boat, the slender 5 m boat, and the longboat over 10 m in length. They are made of carefully hollowed-out oak logs. These have elegantly shaped ends and thin smooth sides, meant to be expanded over an open fire and fitted with frames to maintain the correct boat shape (Rieck & Crumlin-Pedersen 1988, 79-89).

The Slusegård boats were buried with adults of both sexes as an element of one of several grave customs practised at this cemetery (Fig 14.2). A total of c 1400 graves of the first four centuries AD has been excavated here, one third being inhumation graves and two thirds cremations. Conditions for recording the graves were remarkably good, because they were cut into a light sandy soil and covered by drift sand. Complete excavation of the cemetery was therefore possible. Such delicate features as the outlines of the boats at various levels could be traced, even if all wood had rotted away, and no iron rivets were used in the boats (Klindt-Jensen 1978).

This site is the earliest cemetery including boat graves yet recorded in Scandinavia. At the same time, it is one of the largest known, with about 45 graves containing boats or parts of boats. The fact that there are so many boat graves here and that they can be compared with other kinds of contemporary graves in the same cemetery provides evidence for a re-evaluation of some current ideas about the boat grave custom (Crumlin-Pedersen, in press). This custom has previously been discussed primarily in the light of the large Viking Age

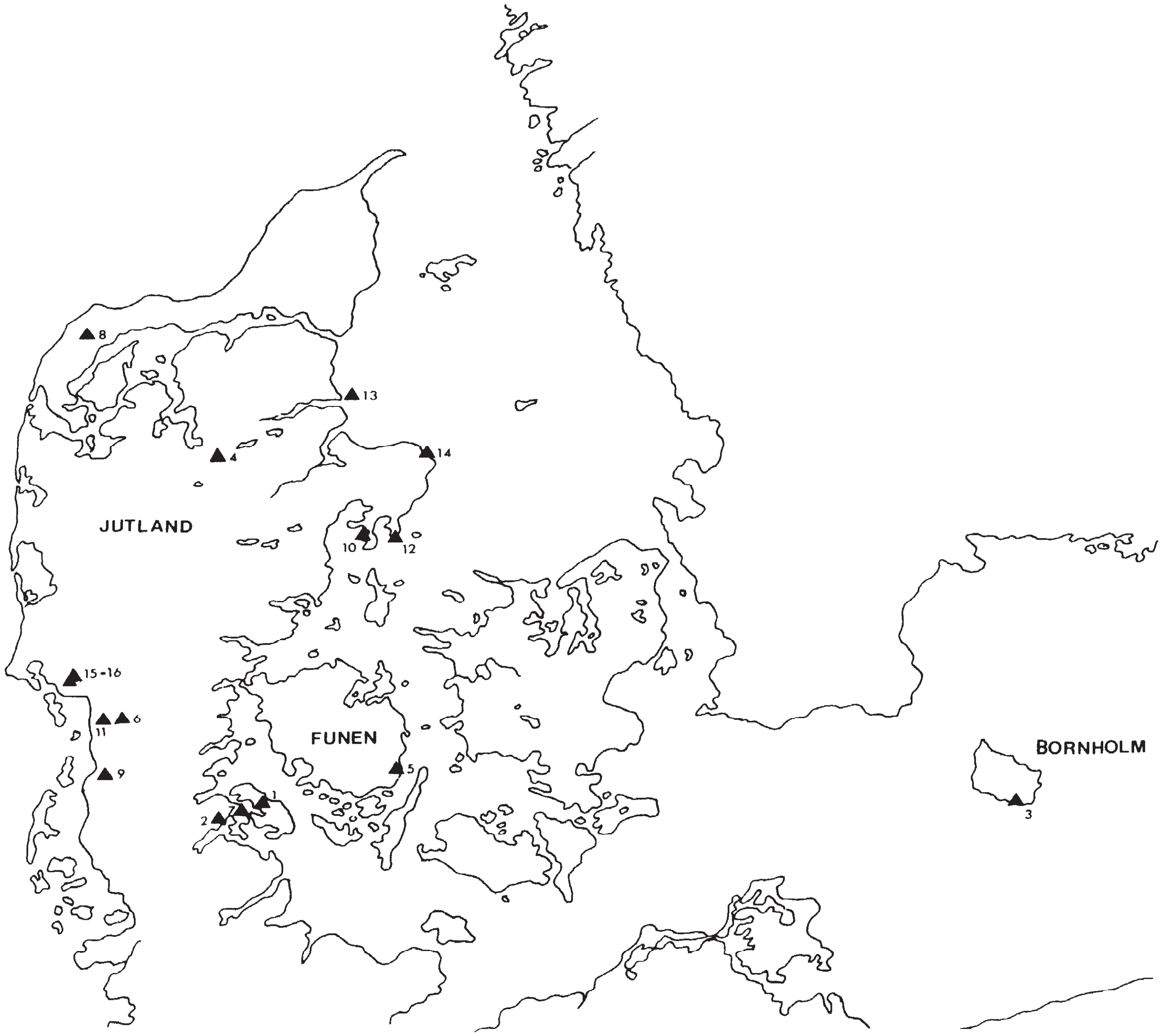

Figure 14.1 Map of Denmark showing sites where pre-Viking ships and boats and representations of ships mentioned in text were found. (Map: Danish National Museum). For key see Table 14.1, p103.

ship burials. However, these represent the last phase of a long development, for which the Slusegård boat graves provide important evidence from an early stage in the 2nd and 3rd centuries (Table 14.1). The Slusegård boat graves provide early parallels to some of the East Anglian boat graves, such as the logboat grave at Snape excavated 1987-8 by William Filmer-Sankey (this volume). However, this paper will concentrate on the maritime aspects of the Slusegård boats.

None of these boats had preserved the original shape in the grave, as the ribs had been removed to provide space for the body. In several cases, the boats had been chopped in half or split to pieces, before being placed above or below the body. There is, therefore, only circumstantial evidence of the original shape and layout of frames. However, the shape of the basic boat-element and its most likely expanded form can be determined for the 3 m and 5 m boats (Figs 14.3, 14.4).

Thin strips of resin were found in many of the grave boats. These had covered knot-holes and cracks. The imprints left here show that at least some of the boats were made of oak. In some cases the resin had been used to affix wooden patches that were sewn on to the interior of the boat. However, there was not a single indication that any of these boats had washstrakes fitted along the sides, or that they had built-up stem and stern ends

The shape and general character of the 5 m boats from Slusegård is strikingly reflected in a series of about 100 small boat models, each of which is made of gold foil

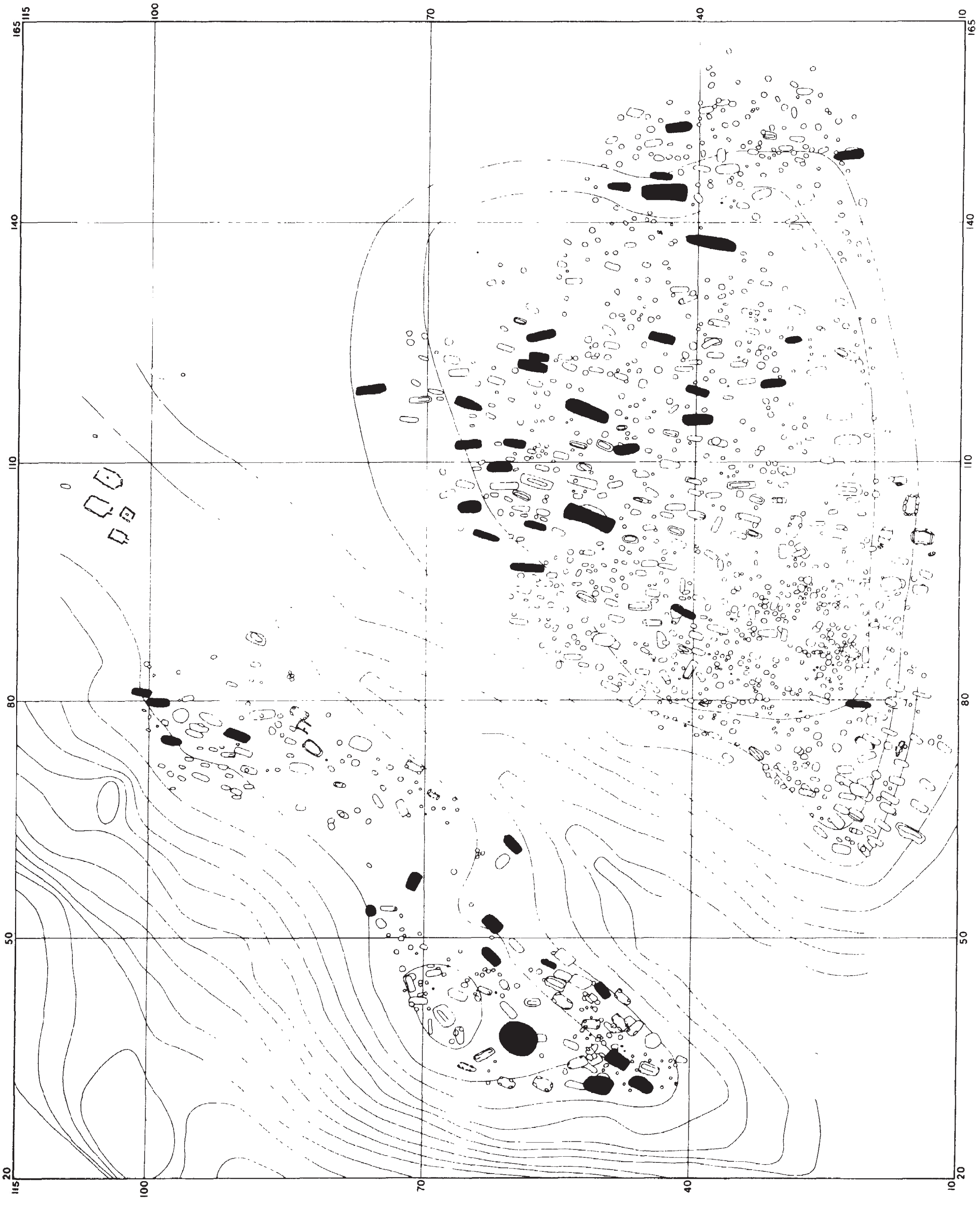

Figure 14.2 Plan of Slusegård cemetery with boat graves shown in black (Drawing: Danish National (Museum).

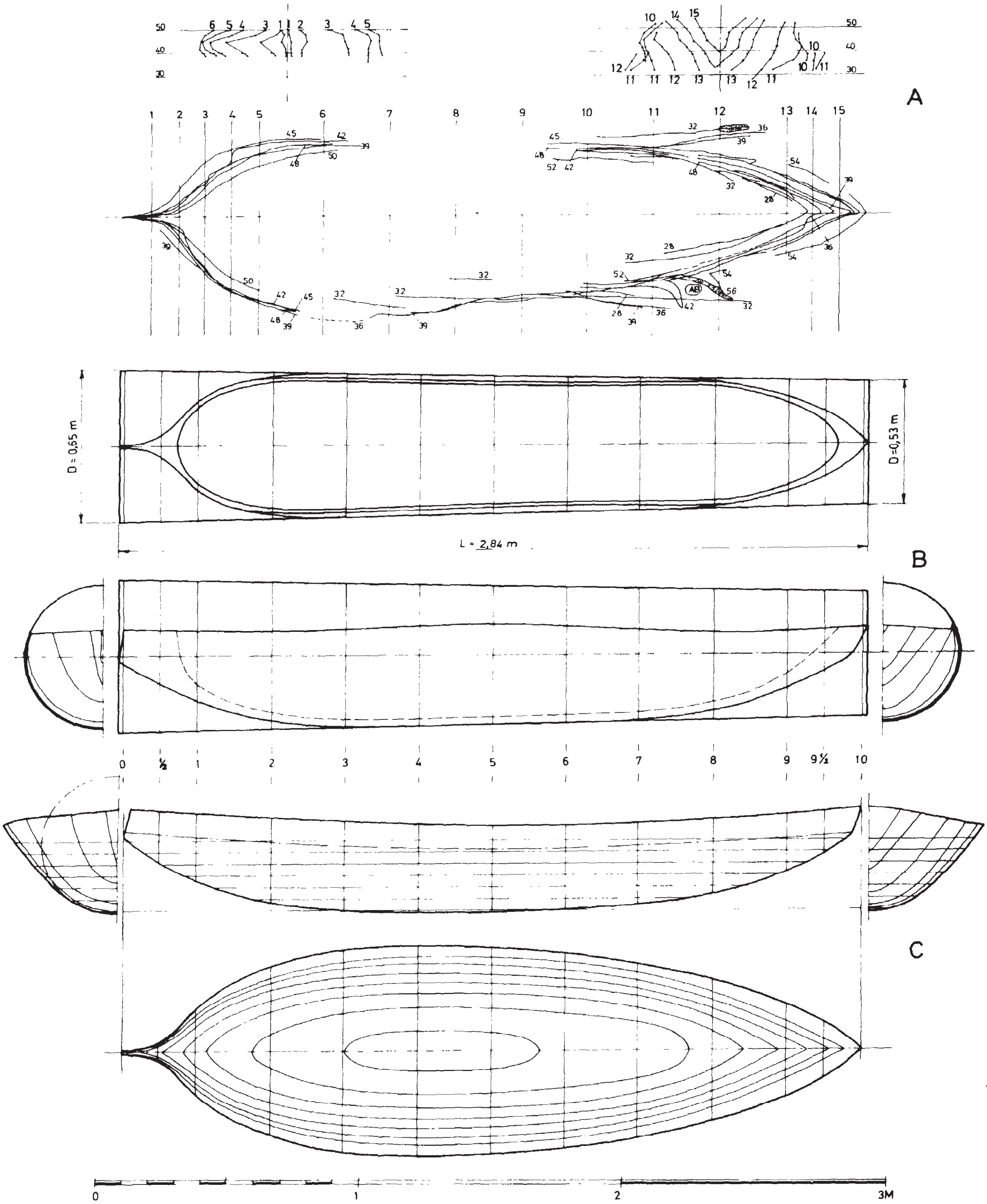

Figure 14.3 Slusegård grave boat no 1131, a 3 m boat, as recorded in the ground (top); reconstructed as boat element before expansion (middle); and as expanded boat (bottom). (Drawing: Danish National Museum).

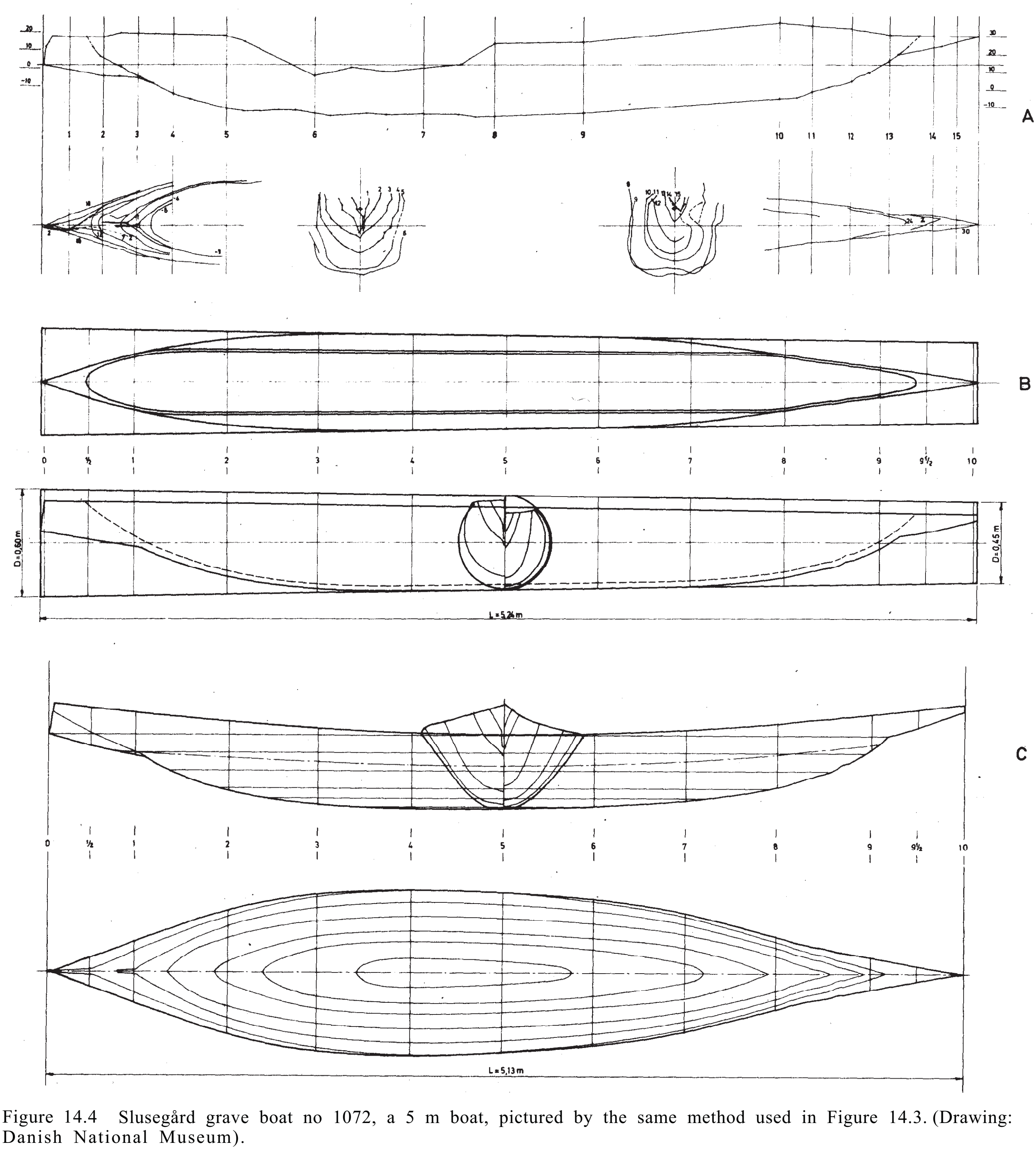

Figure 14.4 Slusegård grave boat no 1072, a 5 m boat, pictured by the same method used in Figure 14.3. (Drawing: Danish National Museum).

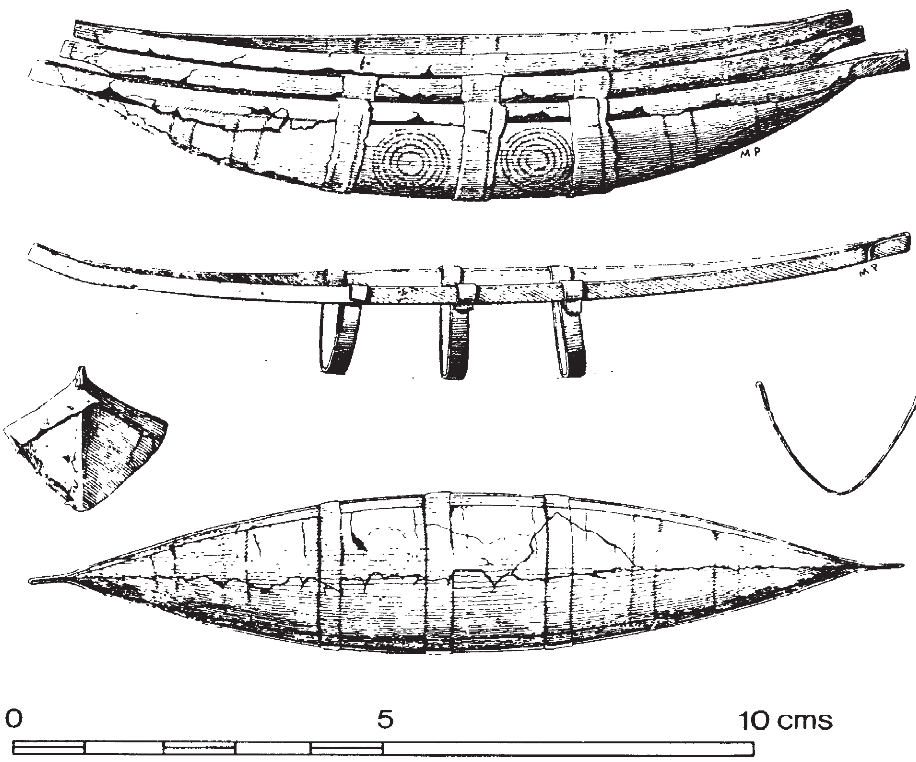

Figure 14.5 Gold boats from Nors, found in 1885, now in the National Museum, Copenhagen. (Drawing: Magnus Petersen).

Table 14.1 Dates of Danish boat finds mentioned in the text

Site	Find	Dating by archaeological context	Radiocarbon dates: uncalibrated BP	calibrated	Lab identity
1 Hjortspring	boat, c 19 m long	pre-Roman Iron Age	2240 ± 50	370 BC	K-5015
2 Egernsund	expanded logboat		1940/1900 ± 75	AD 70/90	K-2512/13
3 Slusegård	graves with c 45 boats	c AD 80-250			
4 Foulum	grave with half boat	4th century AD			
5 Lundeborg	iron rivets	4th century AD			
6 Brokær	grave with 12 m boat	undated			
7 Nydam	3 boats	AD 350-400			
8 Nors	c 100 boat models	5th-6th century AD			
9 Hjemsted	keel fragment	7th century AD			
10 Kongsgårde	rib fragments		1570 ± 55	AD 450*	K-4838
11 Gredstedbro	ship fragments		1450 ± 100	AD 610	K-1094
12 Hasnæs	boat fragments		1360 ± 100	AD 660	K-1096
13 Alsodde	steering oar		1315 ± 110	AD 675	Ua-1062
14 Karlby	ship engraving	undated			
15 Tømmerby	grave with half boat	undated			
16 Gammelby	grave with half boat	9th century AD			

* Sample taken from wood formed minimum of 150 years before felling.
Site numbers refer to the sites marked on Figure 14.1

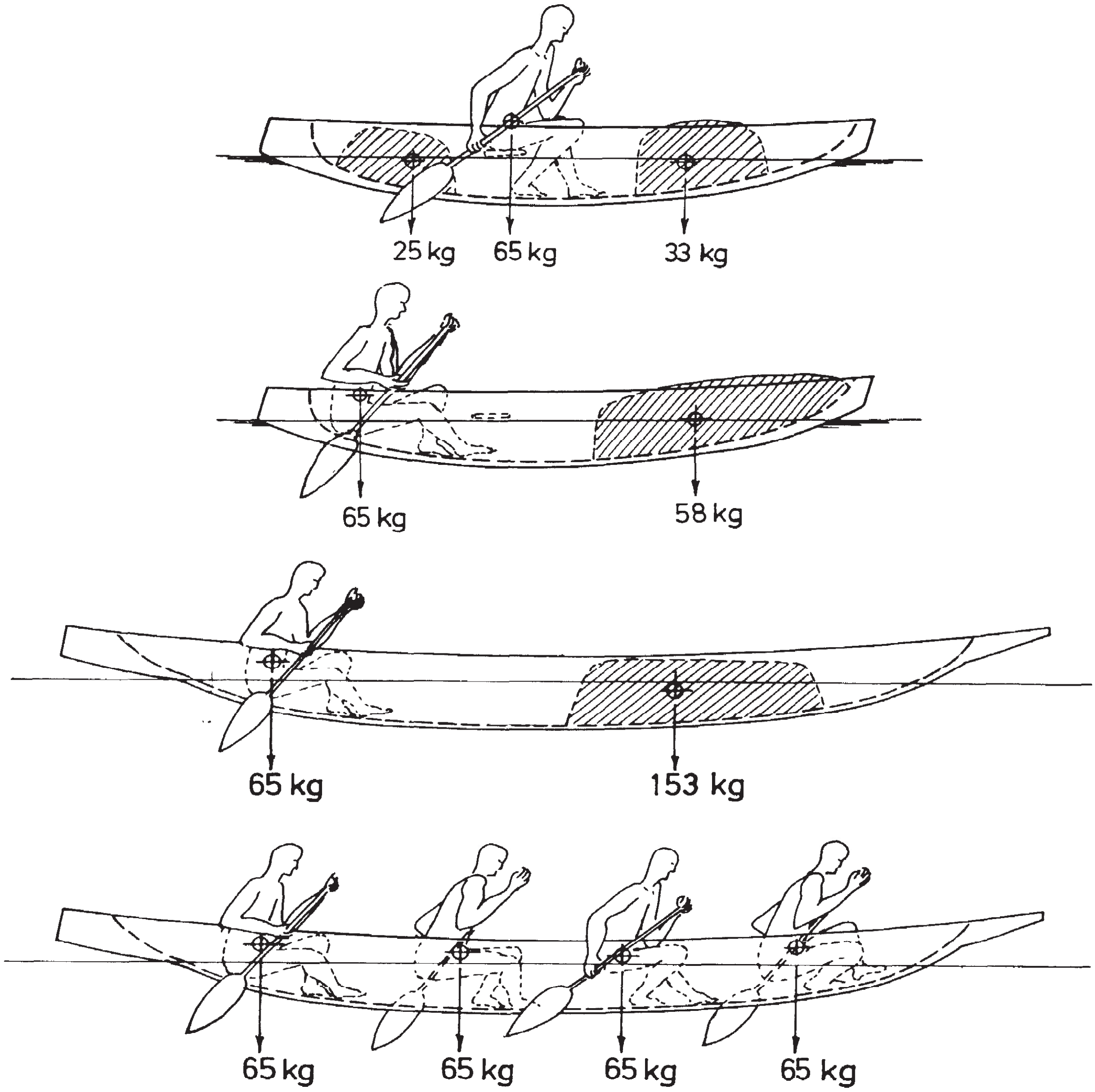

Figure 14.6 3 m and 5 m boats from Slusegård in various load conditions at a freeboard of 130-150 mm. (Drawing: Danish National Museum).

spanned over a framework of brass bands (Fig 14.5). These gold boats were found in 1885 at Nors in the northern part of Jutland. They probably date to the 5th or 6th century AD, judging from a (now lost) Norwegian find, where such boats were discovered together with gold foil figures (guldgubber) of that date (Rieck & Crumlin-Pedersen 1988, 158-9; Capelle 1988).

The Slusegård logboats cannot, of course, be used to prove there were no plank boats in use in Scandinavia in the Early Roman Iron Age. However, the large number of Slusegård boats clearly represents a local tradition of building small and medium sized boats as expanded logboats (Fig 14.6). The expansion technique had probably already been used to shape the bottom plank of the Hjortspring boat; however, this was made of lime wood in contrast to the oak used in the Slusegård boats (Rosenberg 1937; Rieck & Crumlin-Pedersen 1988).

Three expanded logboats have been found in a more or less complete state of preservation at Vaale, Leck, and Egernsund at the base of the Jutland peninsula (Rieck & Crumlin-Pedersen 1988,88-9). They are of the same type as the largest of the boats traced at Slusegård, although they were only present in the graves as sections. The Vaale boat, found in 1878, is preserved and exhibited in the Nydamhalle in Schleswig as a 12 m long oak boat fitted with 11 frames (Åkerlund 1963, 118-21; Ellmers 1972,300). The Leek boat was found in 1953 and recorded, but unfortunately not conserved (Ellmers 1972, 297). It was 11.8 m long with 11 of the original 12 frames preserved in situ (Fig 14.7), with a paddle wedged under one of them.

Figure 14.7 The 11.8 m long expanded logboat found in 1953 at Leck, just south of the Danish-German border. (Photo: Archaeologisches Landesmuseum, Schleswig).

The Egernsund boat was dredged up in fragments along with parts of a medieval barge in 1966. The Vaale and Leek boats have been radiocarbon dated and found to be contemporaneous with the Slusegård boats, from the 2nd and 3rd centuries AD. The Egernsund boat has a calibrated date in the 1st or 2nd century. Two of these boats were found at the marshy west coast, while the third was found in a fjord on the east coast. This distribution is a good indication that the boats represent a local rather than a foreign building tradition. The fact that the Vaale boat was found at its moorings further supports this classification.

There is thus very solid evidence now of the use of the expansion technique in the homeland of the Angles shortly before a considerable emigration started from this region to Britain. It is thus not unlikely that the same boatbuilding technique was practised in the new homeland. In fact, at least three logboats found within the central Anglo-Saxon settlement area of England seem to have been made by boatbuilders familiar with the expansion technique, even if only one of these had ribs preserved in the boat at the time of its recovery; this is the boat from Stanley Ferry in Yorkshire, radiocarbon dated to ad 990 ± 70 (HAR-2835). This boat was recently restored in the Yorkshire Museum, although its shape does not seem to do full justice to the original hull form (McGrail 1978, 275-6; 1981, 160-4).

The expansion technique for building small, light boats remained in use in Denmark for centuries, right to the end of the Viking Age. This is demonstrated by fragments of a 7th century rowing boat found at Hasnæs (Fig 14.8) and an 11th century boat from Fannerup, both cut to be expanded and found on the east coast of the Jutland peninsula. The date of the Stanley Ferry boat is such that we cannot decide whether it represent a late example of an old Anglian practice or a Viking practice introduced later into this region. However, this question may be settled if the other potentially expanded logboats from Walton in Surrey and Smallburgh in Norfolk are also dated.

As far as larger boats go, we have to assume that the sewing techniques known from the Danish Hjortspring and the Norwegian Halsnoy finds were used for fastenings between the individual planks. We have evidence of this technique in the repair patches of the Slusegård boats, but no Danish examples of sewn plank boats from the centuries after the Hjortspring boat have yet been recorded.

The Nydam find provides clear evidence of late 4th century plank-built ships fastened with iron rivets. Recent excavations at Lundeborg (Thomsen 1987, 28-31), near the rich cult centre Gudme on Funen, have produced a large number of rivets spread in layers over the site. These include ready-made roves for shipbuilding and repair (Fig 14.9). This indicates that iron fastenings were in general use in the 4th century in Denmark and that they may have been introduced in the 3rd century or earlier.

A 12 m long and 2.5 m wide boat grave including rows of iron rivets was found in 1877 at Brokær, north of Ribe on the south-west coast of Jutland (Thorvildsen 1957, 102-4). No datable objects were found with the boat, but it lay surrounded by Roman Iron Age cremation graves, including some very rich graves from the 2nd and 3rd centuries. This boat grave is generally seen as a Viking Age element in the Roman Iron Age cemetery. This may be the case. However, after the excavation of the Slusegård graves, there is no immediate need to suggest that this single grave should be dated differently from the remaining graves of the cemetery; it may well be contemporaneous with them.

Further north along the same coast at Tommerby, near Esbjerg, another undated grave including boats' rivets was excavated in 1916 (Nielsen 1984, 44-66). This grave had been disturbed, but it seems to have held only half a boat, as did a Viking age boat grave excavated at Gammelby, in Esbjerg (Vorting 1970). These boats serve as a testimony of the use of boat graves in this area of south-west Jutland, even if all three may be of Viking date. However, there is also a well-dated early boat grave from Jutland; a 4th century boat grave was excavated at Foulum, near Viborg (Høy 1980). This boat grave lies in the centre of the Jutish homeland.

The Nydam boats and similar finds

Yet we must turn to the old Nydam find to get into close range of the details of the shipbuilding technique among the North Germanic tribes in the Late Roman Period.

The Nydam find from Sundeved, north of the present Danish/German border, is one of the major north European boat finds of pre-Viking date. It was

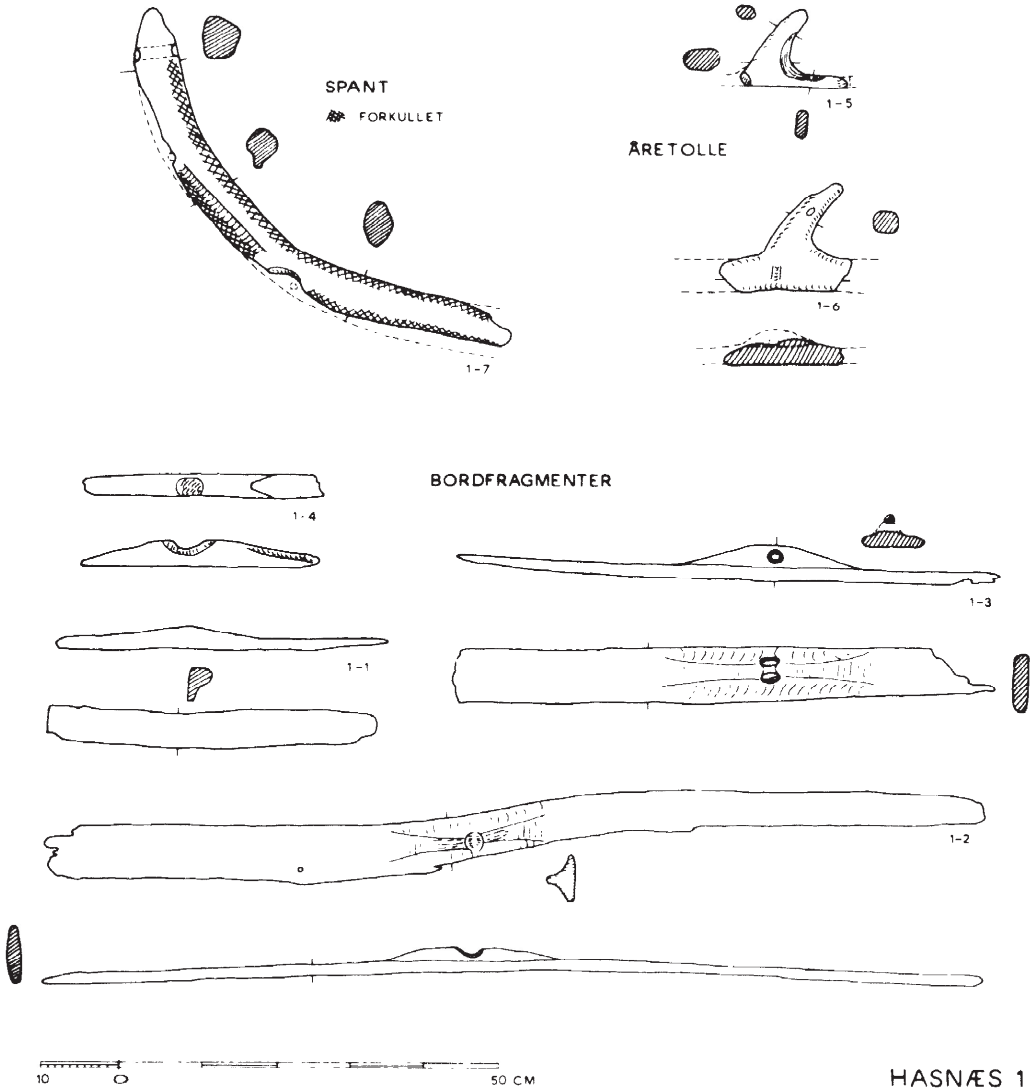

Figure 14.8 Fragments of small 7th century boat, probably an expanded logboat, found at Hasnæs, 1961. (Drawing: Danish National Museum).

excavated and reported by the Danish Archaeologist C Engelhardt, soon after his fieldwork had been brought to an all too sudden end by the outbreak of the Danish-Prussian war around Christmas 1863 (Engelhardt 1865). A complete English version of the publication was printed in 1866, as part of the book Denmark in the Early Iron Age (Engelhardt 1866). One hundred years after the excavation, the Swedish ship archaeologist H Åkerlund published his extensive analysis of this boat find (Åkerlund 1963). Nevertheless there is a widespread uncertainty as to what was actually found at Nydam, even among ship archaeologists.

In fact, Engelhardt reported on three vessels he found in 1863, as well as a large number of weapons. On August 7th, he found parts of an oak vessel (Nydam 1) that had been deliberately chopped up. He found a fragment of a plank along with two cleats for the frame, as well as part of a gunwale plank with a loose oar thole stringer fitted on top. These pieces do not seem to have survived the turbulent events of 19th and 20th century wars. Yet the detailed drawings by Magnus Petersen make it possible to establish some features of this ship, such as the arrangement of the tholes and the decoration of the cleats (Fig 14.10).

This fact is important because the details differ from those of the well-known oak boat (Nydam 2) found 11 days later. This second ship was found largely intact, and Engelhardt had the timbers pulled out of the bog and reassembled in Flensborg, by then a Danish town, where he had been appointed director of the local museum (Fig 14.11). The ship was later moved to Kiel and is now exhibited in the Archaeologisches Landesmuseum in Schleswig.

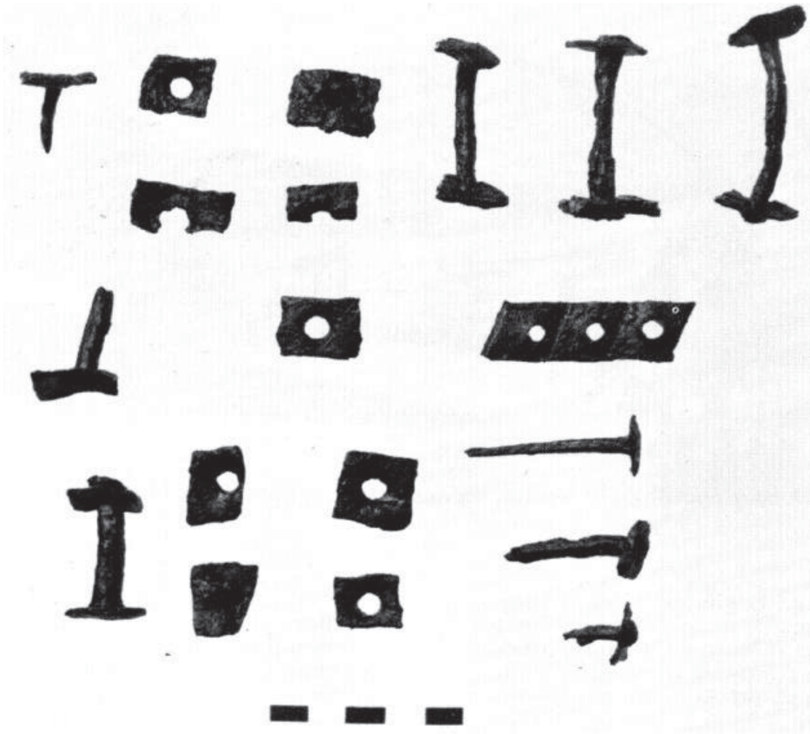

Figure 14.9 4th century iron nails and clench roves found at Lundeborg beach market site in 1986. (After Thomsen 1987).

The exhibited ship has been heavily affected by the fact that the oak timbers have been freely allowed to shrink over the years. Åkerlund was the first to draw attention to this fact, and his correction for a shrinkage of 13-14% has later been confirmed by measurements of the deformation of holes in the gunwale plank. Åkerlund presented a reconstruction of this Nydam oak boat which drastically changed not only the cross-section but the overall shape and orientation of the ends. He also built a hypothetical longitudinal 'stretching arrangement' into the ship. This was meant to provide longitudinal strength, as well as to find a use for some strange timbers found in the bog (Fig 14.12).

Current work on a new re-assessment of this ship based on Åkerlund's cross-sections shows us that the ship must have had a longitudinal shape slightly different from the one he arrived at. Our guideline in this respect is the fact that the planks of the ship (except for the gunwale planks) are made of one continuous length from stem to stern — up to 21 m in one length! Oak trees this large are probably not available anywhere today, and even in the Iron Age they must have been very hard to find. Our basic assumption in constructing a new model for the Museum in Schleswig was that these large trees would have produced straight logs, and that each plank should thus have no more edge curvature

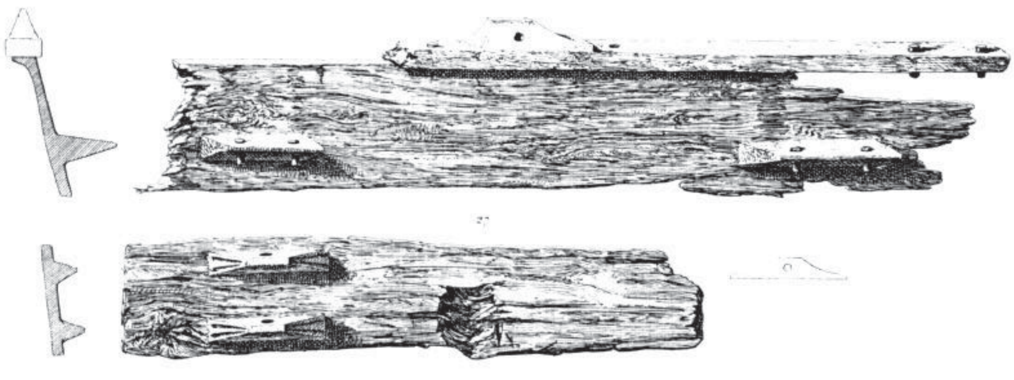

Figure 14.10 First parts of a boat (no 1) found in the Nydam bog in 1863. The parts of planking and gunwale with oar tholes are from a vessel deliberately broken up. (After Engelhardt 1865).

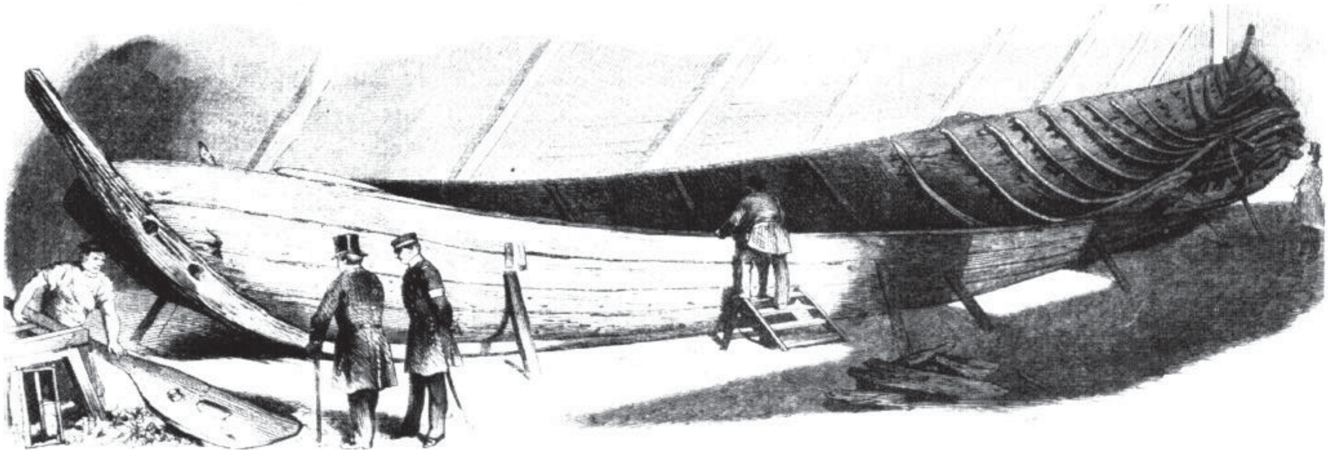

Figure 14.11 Large oak boat (no 2) from Nydam bog, exhibited in Flensburg. (After Leipziger Illustrierte Zeitung 1865).

than allowed for within a straight log. It turned out to be possible to find a reasonable longitudinal keel-curve to meet these requirements. We can thus display a model of this impressively large troop transporter (total length 23-24 m, and manning about 30 oars), which is firmly based on this evidence.

Engelhardt's work at Nydam did not stop with the find of the oak ships and the many objects discovered within these. He excavated yet another boat (Nydam 3) at the end of October of the same year (1863). This one was built of pine. It was pulled out of the bog piece by piece, to be placed on the ground covered with turf. Engelhardt planned to deal with it as soon as his urgent work on boat 2 would allow, but the war broke out less than two months later and prevented him from ever seeing the boat again. It probably ended up as firewood after foreign troops invaded the area, even digging in the bog to see if there were any valuables to find there.

Under these circumstances, it is remarkable that Engelhardt was nevertheless able to publish a series of precise drawings of various parts of boat 3. These include details of cleats and planking, tholes and bailers, and even a sketch of the complete keel (Fig 14.13). On the basis of these Åkerlund has a hypothetical reconstruction of this vessel as an 18.8 m long, 3 m wide boat with 22 oars — also in this case fitted with a longitudinal device for strengthening (Åkerlund 1963, 92-101).

These are the three boats on which Engelhardt reported in his publication. All three were excavated before he was forced to flee to Copenhagen. What he did not report was the fact that he had located what seemed to be a fourth ship in the bog. This was kept a secret between Engelhardt and his foreman, so that they could return to finish their work once the Prussian troops had withdrawn from the area. That withdrawal took 56 years, and in the course of that time both men died. However, before his death, the foreman revealed the secret of the ship and its position in the bog to a local patriot and politician H P Hanssen. Hanssen then had the relevant section of the bog secretly sold to a stand-in for the Danish National Museum (Hanssen 1925; Rieck & Crumlin-Pedersen 1988, 110-13). Thus, we may still be able to excavate a fourth Nydam boat and perhaps compensate for some of the heavy losses to this unique bog find during the war of 1864.

There are good reasons for renewed excavations of Nydam, started by the National Museum in 1989. Various small scale investigations since Engelhardt's have shown that the bog was used for offerings not only in the later part of the 4th century when the oak ship, now in Schleswig, was deposited, but also in the 5th century (Petersen 1988). It is not at all clear whether the boats represent a single deposition or whether they were deposited on various occasions in the course of the 3rd and 4th centuries. The three boats of which we have some knowledge are all constructed to the same general concept of clinker boatbuilding. Yet they display considerable differences in detail and choice of materials, which suggests that they were not built in the same region. It should also be remembered that finds of boats in war offerings are more likely to be foreign than local.

Rowing boats of the Nydam type are well known from the early phase of the engraved stones from Gotland (Fig 14.14). Lindquist dates these to the 5th-6th centuries (Lindquist 1941; 1942). In addition to the rowers, men are shown steering the ship at both bow and stern. Steering paddles found at both ends of the Hjortspring boat tends to support this feature. However, it was not until 1988 that a possible steering oar for the bow was found completely preserved at Alsodde on the east coast of Jutland. The oar is 4.3 m long. It is radiocarbon dated to the 7th century (Fig 14.15). The combination of the long narrow shape, the tiller-hole near the upper end, and the absence of a hole for hanging, strongly suggest that this is an example of a steering oar held vertically by a standing person.

Attempts to locate possible remains of the 7th century Gredstedbro ship (Fig 14.16) in situ on the banks of the Kongeå river have not yet been successful, even if the dredger reportedly did not bring up all parts of this ship in 1945 (Crumlin-Pedersen 1968). However, we have not given up the search. In fact, we see this site as a potential port for maritime connections between southern Jutland and the southern and western shores of the North Sea. It may even have links that go back to the Roman Iron Age, as the neighbouring Brokær cemetery and its boat grave, mentioned earlier, indicate.

At Hjemsted, on the same marshy west coast of Jutland, a short length of a ship's keel has recently been found re-used in a 7th century well (Rieck & Crumlin-

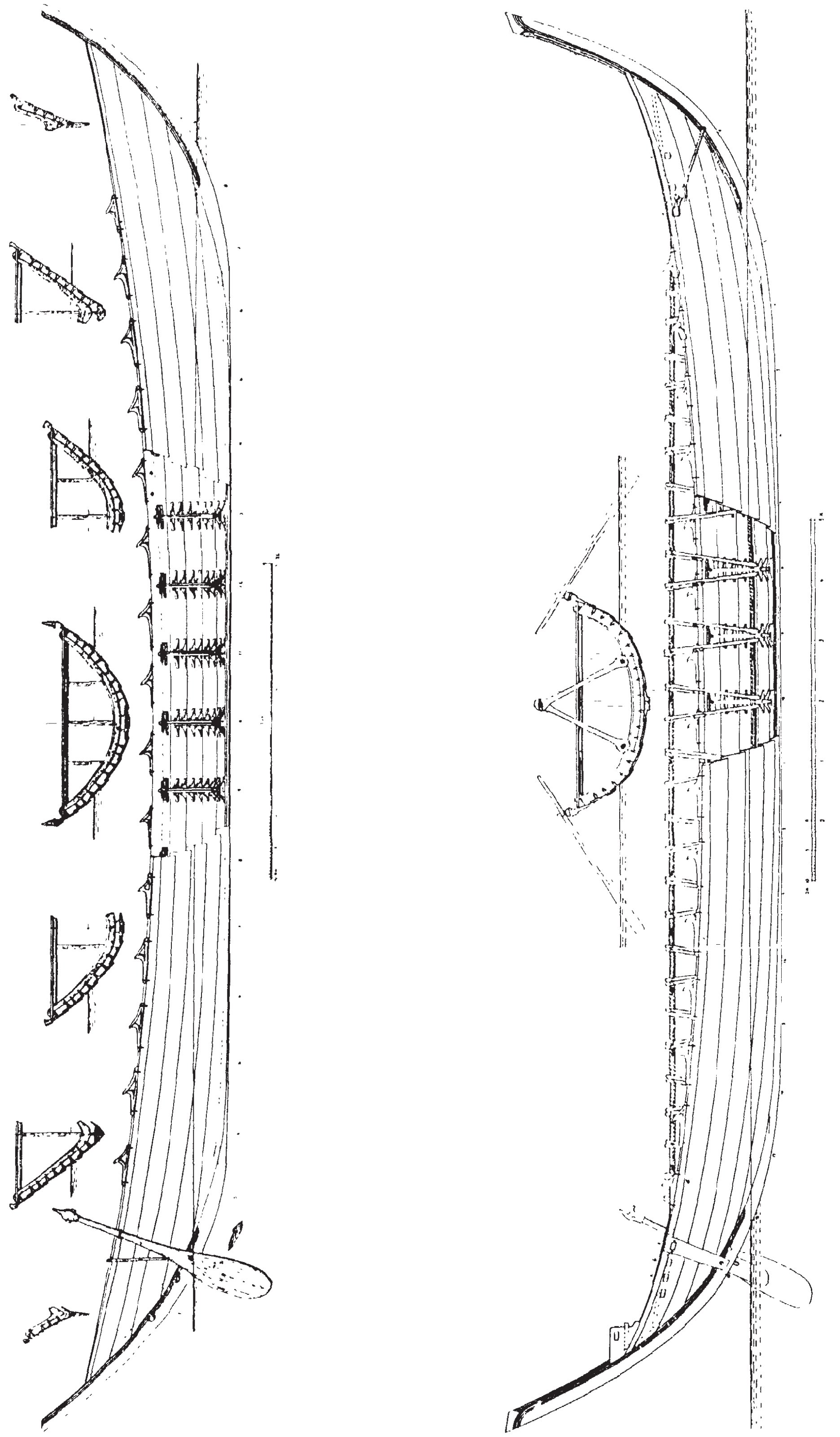

Figure 14.12 Reconstruction drawings of Nydam boat 2 by Johannessen (top) and Åkerlund (bottom). (After Shetelig 1930 and Åkerlund 1963).

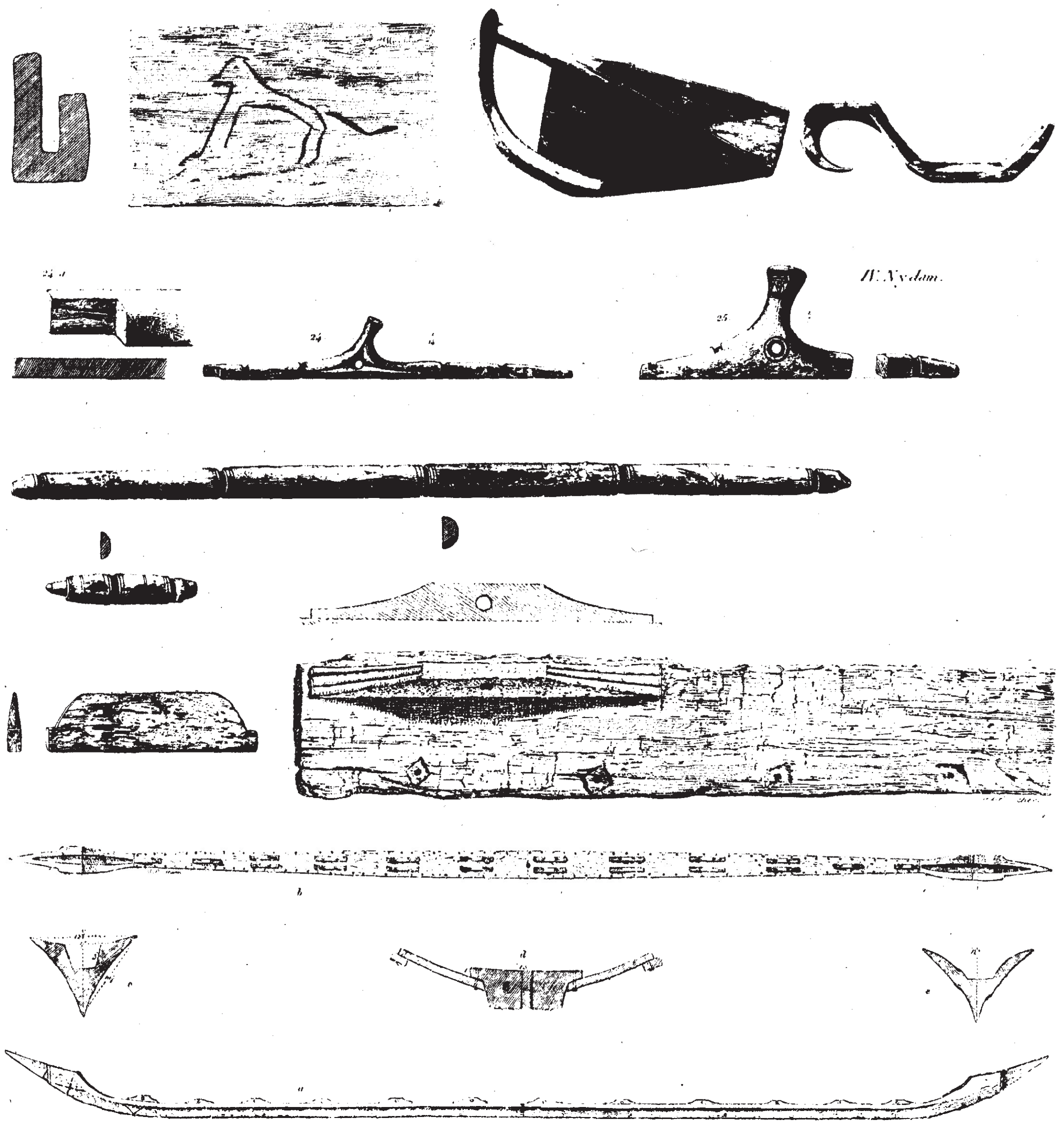

Figure 14.13 Only a few parts of Nydam boat 3 were recorded before the vessel was lost. Details of these however, differ markedly from those of the two oak boats. (After Engelhardt 1865).

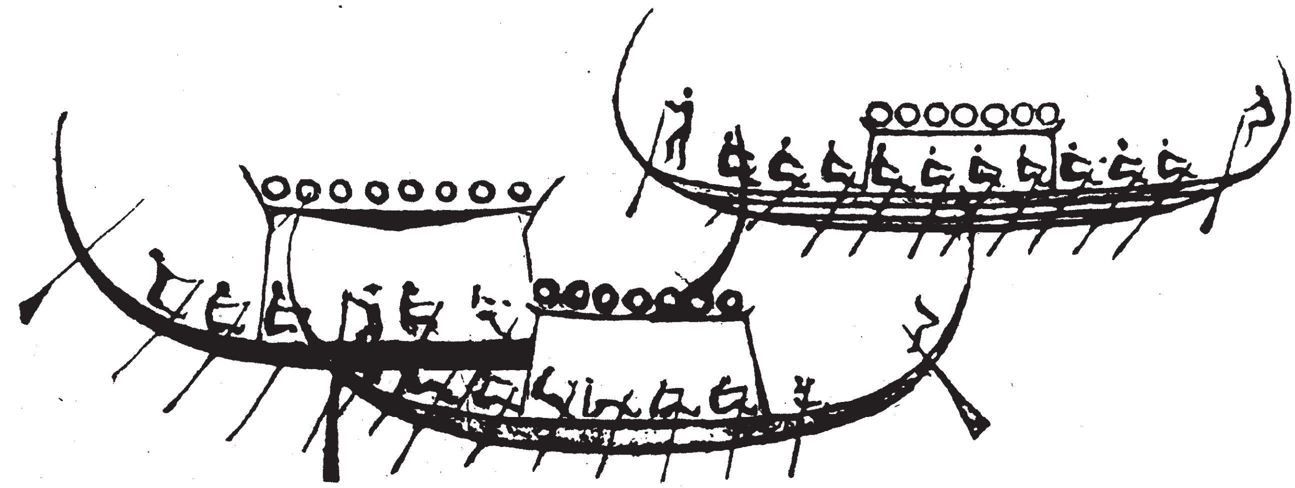

Figure 14.14 Oared boats of 5th-6th centuries ornamented Gotland stonesfrom Bro, Sanda and Stenkyrka. (After Nylén 1978).

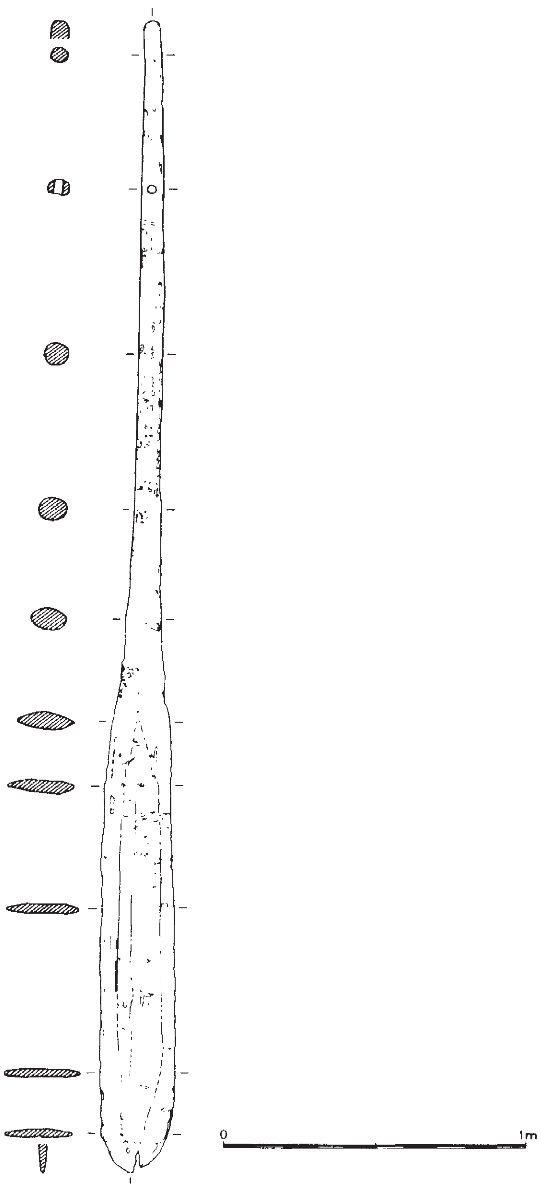

Figure 14.15 Steering oar of oak, 4.3 m long, found 1988 at Alsodde, East Jutlund. Dated to the 7th century and probably for use in the bow (cf Fig 14.14). (Drawing: W Karrasch).

Pedersen 1988, 133-4). This was only recognisable as part of a ship because it had two cleats for lashed frames, and its main point of interest is the fact that it was made of pine. There is no evidence to show whether a part of a local or a foreign ship was re-used here.

The most recent site in Denmark where ship parts of the 7th century have been recovered is Kongsgårde on the east coast of Jutland (Rieck & Crumlin-Pedersen 1988, 133-4). Parts of two frames of a large vessel with lashed frames were found in 1985 embedded in an old beach wall. The best preserved frame indicated that the original width of the ship was 3.9 m at a position near one of the ends (Fig 14.17). Such heavy frames and a maximum width of well over 4 m must have made this boat considerably larger than Nydam 2. In fact, it corresponds closely in size and shape to the ship in mound 1 at Sutton Hoo. However, the frames in the Sutton Hoo ship were treenailed as they were in the Gredstedbro ship, and not lashed to the planks.

It is hard to imagine such large ships as the Sutton Hoo ship and Kongsgårde propelled by oars only. On the other hand, the hull shape shows no signs of adaptation to the requirements of a sailing ship hull such as a deep or long keel or sharp ends to prevent a strong leeway.

The first sailing ships depicted on the ornamented stones at Gotland (Fig 14.18), probably in the 6th and 7th centuries, show hulls of a strange shape. They have long keels and an angular transition at both ends — very different from the crescent-shaped rowing vessels of the previous period. These angular stems also appear on some of the Hedeby coins of about AD 800 whereas other ships depicted on these coins have the hull shape known from the Oseberg ship, with its long, almost straight keel and steeply curved stem posts. Yet until recently, we had no illustrations of early sailing ships with the curved hull of the rowing ships.

However, in 1987, a small stone with an engraved ship of this type was found on the east coast of Jutland at Karlby as a stray find (Rieck & Crumlin-Pedersen 1988, 129-33). The diameter of the stone is only 22 mm and the ship is just 12 mm in length. The other side of the stone is engraved with an elk, only 6 mm in length but clearly distinguishable (Fig 14.19). There is no doubt that the stone was engraved by a competent craftsman.

Judging from the raking stem and stern posts of the ship and its sloping side rudder, the hull seems to be pre-Viking, possibly 7th century (Fig 14.20). The most remarkable feature of this engraving is that it combines a Sutton Hoo-like hull with a mast and sail. There are a number of other interesting features to be observed on this ship, such as the bent-down ends of the stem and stern posts, possibly reflecting figureheads such as those known from the River Scheldt in Belgium (Fig 14.21). The horizontal and vertical lines on the hull, the diagonal ones on the sail, and the weathervane at the top of the mast are also notable.

Anglo-Saxon seafaring

This presentation of old and newer ship finds from the Jutish and Anglian homelands has been little more than a gazetteer of sites that have produced bits and pieces of evidence relating to our theme. Only the fact that all other parts of the North Sea coastal regions are even worse off in regards to actual finds of ships or pictures of ships can serve as an excuse for an attempt to relate the Anglo-Saxon invasion of Britain and the development of the North Sea traffic to these few finds.

Our starting point should clearly not be the invasions of the 5th century. We should go back to at least the 3rd century, when Germanic soldiers played an important role — either within the Roman forces in Britain or on the Continent, or as so-called 'Saxon pirates'. Many of the soldiers had the opportunity to become acquainted with Roman naval tactics and ship construction, which was practised along the Danube, the Rhine and the British coast, partly in response to seaborne attacks by the 'pirates'. Some of these pirates and soldiers either went home or were sent to places

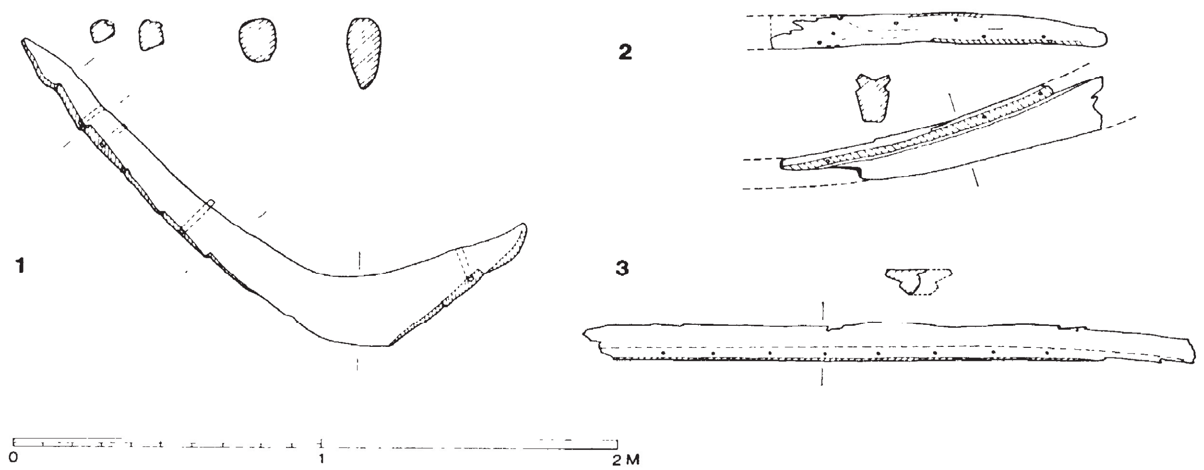

Figure 14.16 Parts of the 7th century Gredstedbro ship recovered in 1945. 1. frame; 2. lower part of stem or stern; 3. part of keel. Scale 1:25. (After Crumlin-Pedersen 1968).

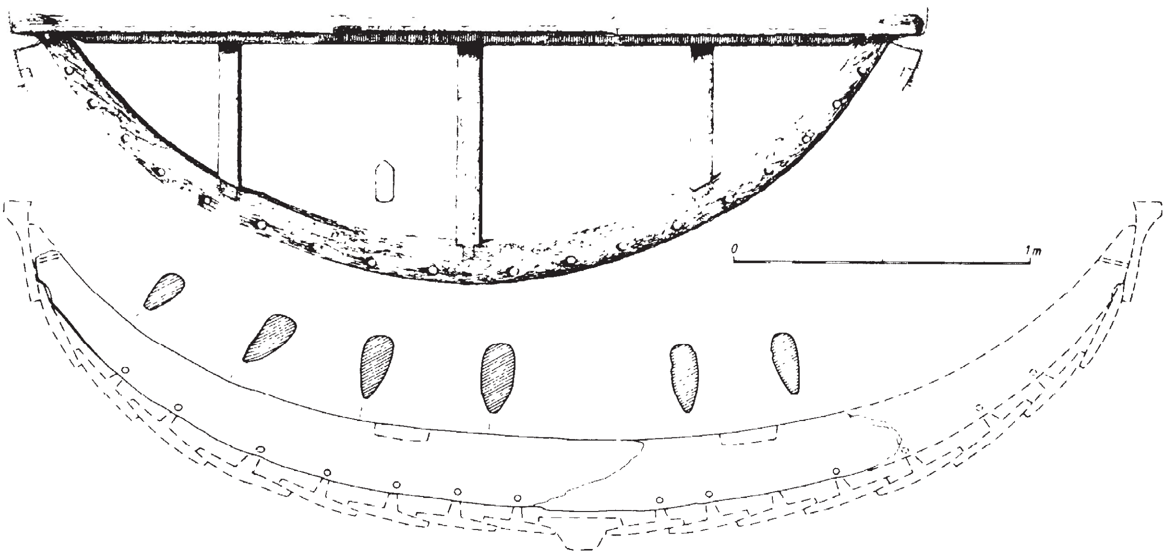

Figure 14.17 The considerable size of the Kongsgårde boat of the 7th century is evident when the best preserved frame from this boat (bottom) is compared to scale with a midship frame from Nydam boat 2 (top). (After Rieck & Crumlin-Pedersen 1988).

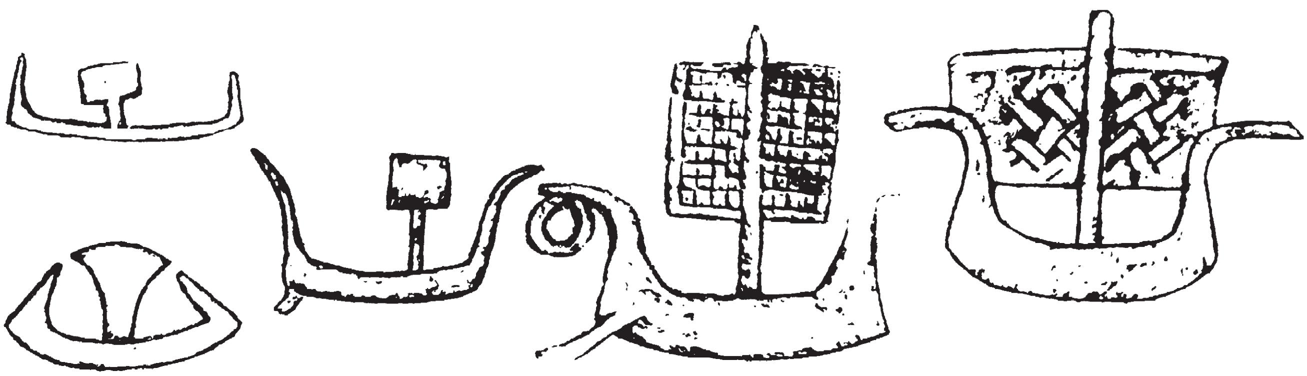

Figure 14.18 Sailing ships pictured on Gotland stones of the 6th and 7th centuries. (After Nylén 1978).

Figure 14.19 Photo of 22 mm broad stone with a ship engraving on one side and an elk on the other, found in 1987 at Karlby, Jutland. (After Rieck & Crumlin-Pedersen 1988).

where they were in a position to influence development in local shipbuilding.

It was probably in the 2nd or 3rd century AD that the construction of plank-built boats in Jutland adopted iron fastenings to replace the old sewn fastenings, and possibly at the same time that rowing replaced the old paddling technique as the means of propulsion. The Jutes and Angles could then build stronger boats of oak (and possibly pine on the west coast), and the width and freeboard of the ships could be increased to create true sea-going ships like the Nydam boats. However, rowing techniques did not change the fact that navigation was still based on landing or mooring offshore every night, except for the crossing of straits. Thus, all movements from Jutland to Britain were bound to be along the coastal regions of Lower Saxony and the Netherlands.

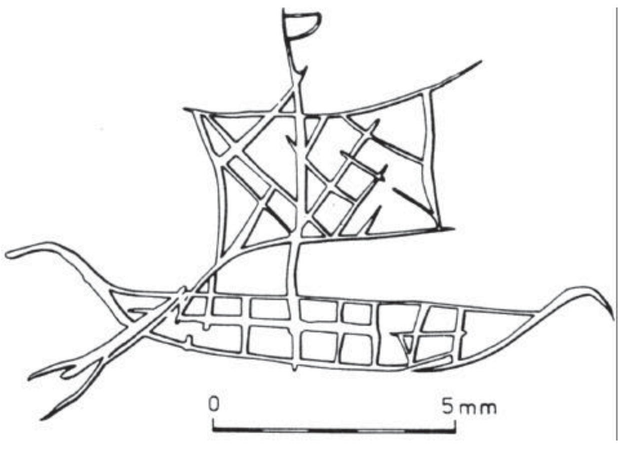

Figure 14.20 The Karlby ship. (Drawing: W Karrasch).

Thus it is no wonder that some of these migrating groups remained for a number of years in parts of the Netherlands where they could make a living, before continuing to Britain. It is also understandable that others chose an inland route along the main rivers of the Continent. At that time the configuration of the Netherlands coast was very different from what it is today. It was probably possible to row in sheltered waters almost all the way from the west coast of Jutland at Esbjerg to the entrance of the Channel, east of Calais.

A few Migration Period ships have been found near this route by dredging in the River Scheldt. Unfortunately only the figureheads of these have been preserved, even if it is known that other parts of them were also found (Bruce-Mitford 1968; Vierck 1970). These finds indicate that the great rivers of the Continent and Britain may still offer considerable potentials for ship archaeologists.

More finds are certainly needed before we can see what happened to the Anglian and Jutish boatbuilding traditions as they went westward. The boatbuilders may well have been inspired by the ships of Saxons, Frisians and Franks, as well as by late Roman and British ships when they reached that crossroad country of shipbuilding traditions to which the Angles gave their name.

This traffic increased in the 5th and 6th centuries. We do not know if the technique of sailing, known for centuries in the West, was adopted at this time by the Jutes and Angles for transport or cargo ships. However, they still relied on oars for their troop transporters, according to Sidonius, who wrote in the 5th century (Green 1963, 49).

Traffic along the North Sea coast was certainly not only in a westerly direction, and included more than Anglian, Saxon, and Jutish ships. The fact that the Gredstedbro ship from the west coast of Jutland has treenailed frames as does Sutton Hoo 1, whereas the Kongsgårde ship of similar date, but from the east coast, has frames lashed to cleats, might indicate that the west

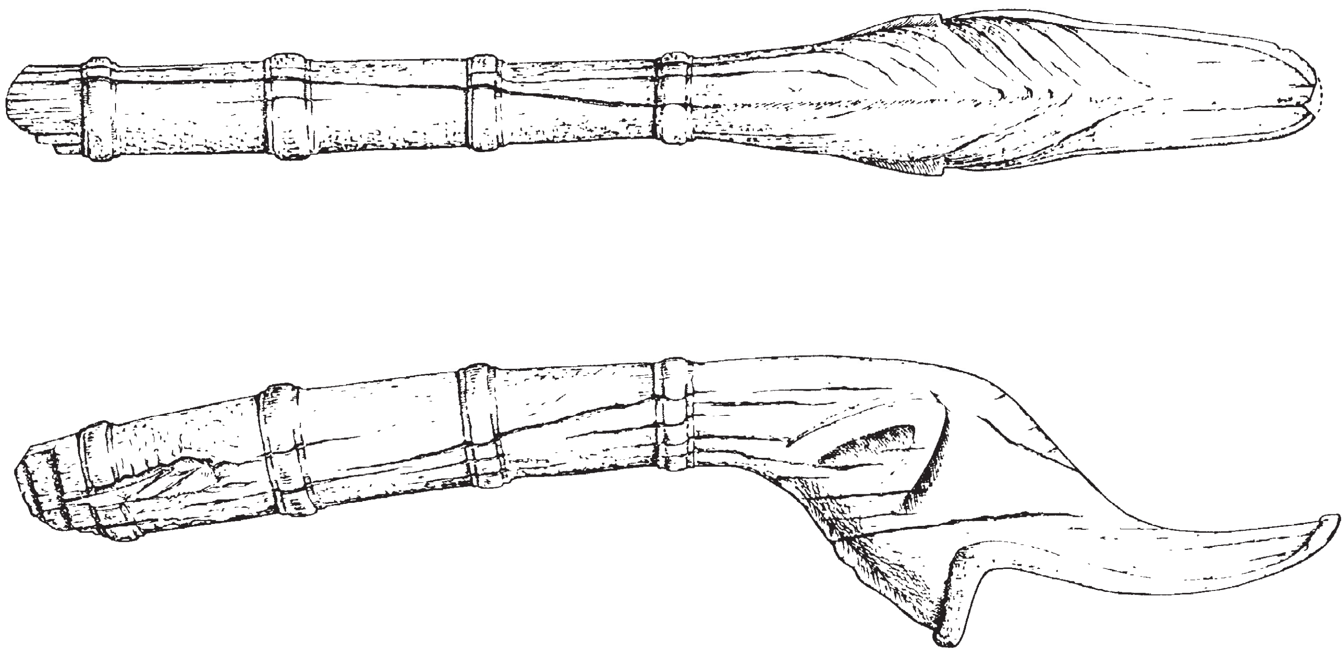

Figure 14.21 Figurehead from Moerzeke-Mariekerke, Belgium, dated to the 5th century. It was dredged up from the Scheldt River with several pieces of hull planks from a ship. (After Bruce-Mitford 1967).

coast ports led developments in pre-Viking Scandinavian shipbuilding — even if we cannot prove this on the basis of the scanty evidence available to us today.

But perhaps Baltic and North Sea shipbuilding traditions did not follow the same lines? It is at least interesting to note that if we include a wider range of finds, we discover a certain pattern in the distribution of the two different stem types known from the pre-Viking and Viking ship finds. One of these is the stem with a continuous rabbet, as in the Gredstedbro, Sutton Hoo, and Gokstad ships, which seem to have a primarily westerly distribution. This can be contrasted with the stepped stem, of which early examples are found around the coasts of the Baltic (Fig 14.22).

Once again, however, we must not forget the fact that ships and shipbuilders are mobile. Therefore, we must undertake detailed studies of both new and old finds before we try to draw far-reaching conclusions about Dark Age seafaring and migration along North Sea coasts on the basis of ship archaeology alone.

References

Åkerlund, H, 1963 *Nydamskeppen. En studie i tidig skandinavisk skeppsbygnadskonst.*

Bruce-Mitford, R, 1968 A new wooden ship's figure head found in the Scheldt, at Moerzeke-Mariekerke, *Acta Archaeologica* **38**, 199-209.

Capelle, T, 1988 Eine Auswanderungsflotte der Völkerungswanderungszeit, *Deutsches Schiffahrtsarchiv* **11**, 15-19.

Crumlin-Pedersen, O, 1968 The Gredstedbro Ship, *Acta Archaeologica* **39**, 262-7.

——, in press Bådgrave og gravbåde pa Slusegård, (English summary: Boat-graves and grave-boats at Slusegård, *Slusegårdgravpladsen III.*

Ellmers, D, & Schnall, U, 1986 Einbaum, *Reallexikon der Germanischen Altertumskunde* **Bd 6**, 601-13.

Engelhardt, C, 1865 *Nydam Mosefund 1859-1863.*

——, 1866 *Denmark in the Early Iron Age.*

Green, C, 1963 *Sutton Hoo.*

Hanssen, H P, 1925 Oldsagsfundene i Nydam Mose, *Hejmdal 1925*, 110-12.

Høy, G, 1981 Foulum-folkets sidste hvilested, *MIV* **11**, 48-51.

Klindt-Jensen, O, 1978 Slusegårdgravpladsen I-II, *Jysk Arkæologisk Selskabs skrifter* **XIV**, 1 and 2.

Lindquist, S, 1941 Fartygsbilder från Gotlands forntid, *Fören. Sveriges Sjøfartsmuseum i Stockholm, Årsbok*, 9-24.

——, 1942 *Gotlands Bildsteine I-II.*

McGrail, S, 1978 *Logboats of England and Wales with comparative material from Europe and other countries*, Brit Archaeol Rep **51**.

——, 1981 A medieval logboat from the River Calder at Stanley Ferry, Wakefield, Yorkshire, *Med Archaeol* **25**, 160-4.

Nielsen, L C, 1984 Nogle grave fra yngre germansk jernalder og vikingetid i Sydvestjylland, *Mark og Montre 1984*, 38-48.

Nylen, E, 1978 *Bildstenar.*

Petersen, P V, 1988 Nydam III - Et våbenoffer fra ældre germansk jernalder, *Årbøger fra Nordisk Oldkyndighed og Historie 1987*, 105-37.

Rieck, F, & Crumlin-Pedersen, O, 1988 *Både fra Danmarks Oldtid.*

Rosenberg, G, 1937 *Hjortspringfundet*, Nordiske Fortidsminder **III, 1**.

Shetelig, H, 1930 Das Nydamschiff, *Acta Archaeologica* **1**, 1-30.

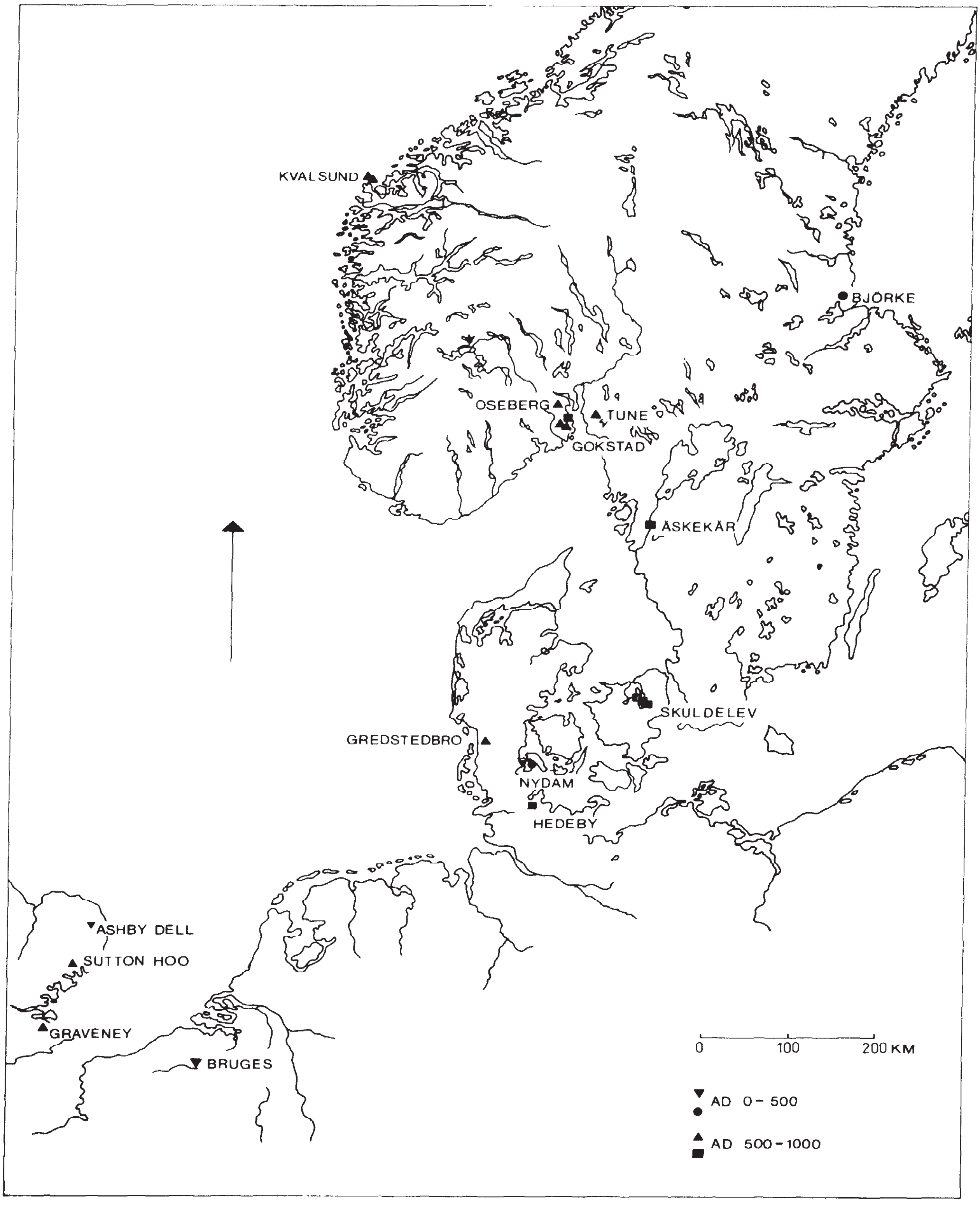

Figure 14.22 Map of finds from the 1st millennium AD with indication of different kinds of stem and stern posts: ▲ and ▼ for continuous rabbet for planking; ● and ■ for stepped stem posts. (Map: Danish National Museum).

Thomsen, P O, 1987 Lundeborg I. Havn og handelsplads fra 3. og 4. århundrede efter Kr, *Årbog for Svendborg & Omegns Museum 1987*, 12-52.

Thorvildsen, K, 1957 *Ladby-skibet*, Nordiske Fortidsminder **VI,1**.

Vierck, H E F, 1970 The origin and date of the ship's figure head from Moerzeke-Mariekerke, Antwerp, *Helinium* **10.2**, 139-49.

Vorting, H C, 1970 Flere grubehuse og andet nyt fra vikingetiden i Esbjerg, *Mark og Montre 1970*, 21-7.

15 Pre-Viking traffic in the North Sea

M O H Carver

Abstract

Sutton Hoo is a barrow cemetery on the south-east coast of Suffolk, where a rich ship burial of the 7th century AD was excavated in 1939 (Bruce-Mitford 1975; 1978; 1983) and another burial ship retrospectively implied from work carried out in 1938, 1985 and 1988 (Bulletin 1988). The Sutton Hoo Research Project has as its objective not merely the discovery of more early medieval ships to add to the meagre corpus, or the establishment of a context for ship burial, but the examination of the process of early medieval state formation, using the Kingdom of East Anglia as an archaeologically visible example (Carver 1986; 1989). In the course of this research it has become clear that the origins of the early English Kingdoms cannot be explained simply by looking at the archaeology of the island of Britain. Neither is it sufficient to consider political influence from the other side of the Channel. The archaeological signals suggest that the most crucial zone of interaction was the North Sea. However it is far from certain how such a maritime zone functioned. Whether the sea was crossed, if so how, and what that signified for the peoples at its edge, are some of the questions addressed here.

The East Anglian kingdom and its contacts

The settlement of eastern England from the 5th century by immigrants from north Germany and Denmark is well documented. Bohme has recently refined Bede's account by proposing that East Anglia rather than Kent was the first territory to achieve any kind of Germanic autonomy, which it did as early as the 5th century (Böhme 1986). This does not of itself imply any particular Anglo-Saxon crossing routine; coastal itineraries and direct routes from central Denmark, proposed and compared by Green (1988), can both be accepted and in any case, the earliest immigrants may well have arrived in Roman ships using Roman sea-lanes (Binns 1980, 5).

A second major wave of immigration, apparently unnoticed by Bede, has recently been proposed by John Hines (1984), just as valid archaeologically as the first, but involving settlers moving from south-west Norway to East Anglia and Humberside in the 6th century. Among the most suggestive objects are wrist-clasps, found in graves in both places and thought to denote immigration rather than trade, since they are quite useless unless attached to clothes. The clothes, worn for burial, are generally seen as tracht, specially designed to signal ethnic identity and thus not suitable for trade or exchange. A different interpretation can legitimately be suggested for glass of Anglo-Saxon provenance found in Scandinavia; here the impersonality of the material culture can allow more easily the mobility due to mercantile influence (Näsman 1984).

By the 7th century, Sutton Hoo itself provides at least two indications of influence from overseas — the exotic objects and the rite of ship burial. Over half the objects found in the ship burial had an overseas provenance, and included silver ware from Constantinople, a yellow cloak from Syria, a 'coptic' bowl, coins from Merovingian France, and a helmet and a shield, from, or closely connected with, the Swedish Uppland (Bruce-Mitford 1986; Carver 1986). All these objects, even those from Scandinavia, may have been obtained at an intermediate entrepôt — such as the St Denis fair represents for a later period (Levison 1943). They may also have been gifts, denoting political events; but even so some contact, if only the contact of awareness, is implied. After the conversion to Christianity, during the 7th and 8th centuries, when there is no reason to suppose that Scandinavia was dormant, the Scandinavian elements seem to fade from the admittedly meagre English repertoire, and the axis of contact shifts to the Rhineland and Francia (Näsman 1984).

The most powerful signal of contact is provided by the rite of ship burial itself, where the distribution argues in favour of a Scandinavian cultural nucleus before, during and after the 7th century (Müller-Wille 1974). Is this distribution ideological, ethnic or traditional, supposing these motivations can be distinguished? If ideological how and why does this cult of ship burial spread? ethnic, must we suppose continuous immigration into East Anglia from Norway or Sweden after the 6th century? If traditional, whose tradition is it? We might follow Crumlin-Pedersen in seeing in the new Snape logboat and its similarity to nautical sand-stains at Slusegård on Bornholm, the first glimmer of an Anglian tradition of boat burial, hitherto invisible because it did not use rivets (Crumlin-Pedersen, pers comm).

Alternatively, it is also possible (when exploring silence) to look still further back to a Bronze Age tradition of boat-like coffins, as found at Loose Howe in Yorkshire, but also found in East Anglia, as at Bowthorpe in Norfolk (Lawson 1986, 46). It is clearly difficult to construct a large hypothesis from a ghostly navy of hitherto unnoticed sandy stains, although the incentive to find them is greatly increased.

Considering for the moment the rivets only, and looking at a map of examples from graves, it can be seen that burial in boats in England is not very common, nor

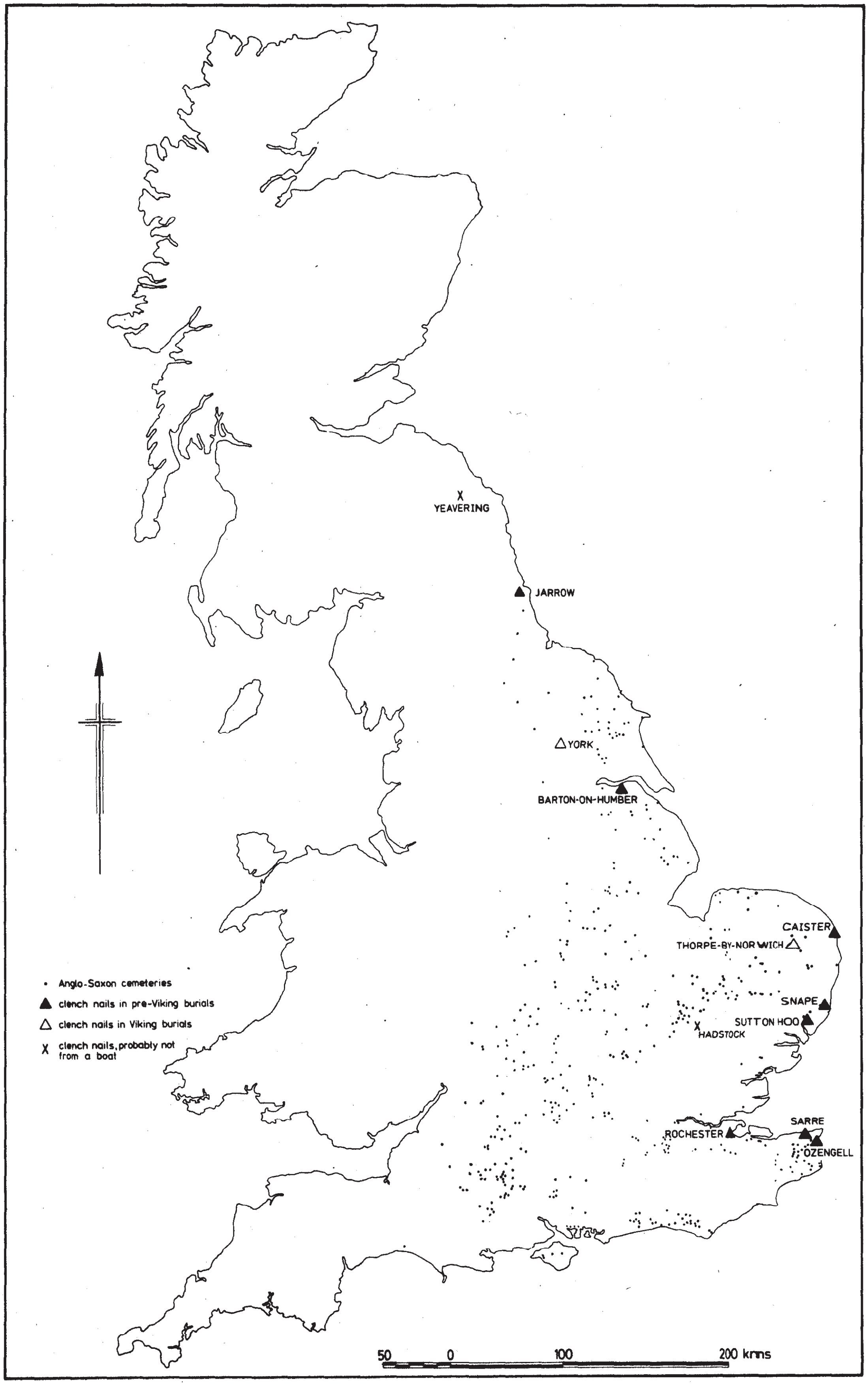

Figure 15.1 Distribution of iron rivets, probably derived from boats, and Anglo-Saxon cemeteries. (Map: Author).

does it occur at all times and all places (Fig 15.1). Even supposing a narrow window between the use of iron rivets in burial ships (let us say 6th century) and the dominance of Christianity (say 8th century), the distribution is not concentrated, but confined to the East Coast. This says more than that boats are used near the sea. It seems reasonable to suggest, firstly that boat burial is a signal of ideology rather than immigration (too casual) or tradition (insufficient evidence) or expedience (absent from The Channel); and secondly that the ideology is coming from, or shared with, contemporary peoples to the north-east across the North Sea.

Building a picture of an emergent state in East Anglia therefore does not allow us to ignore Scandinavia, and it is perhaps no accident that the most evocative parallel model is that constructed by Bjorn Myhre for south-west Norway (Myhre 1987). Using the evidence he has collected for changes in the number and type of hillforts, settlements, cemeteries and ship-shelters, he has been able to draw a map of the incipient Norwegian chiefdoms and their central places. The Norwegian social nucleation seems to have happened about 100 years earlier than that in East Anglia; in other words, for what it is worth, about the time of John Hines' proposed migration.

The material used for discerning state formation in East Anglia is much thinner, but more or less consistent (Carver 1989). The evidence of cemeteries suggests that early Anglo-Saxon communities were already stratified, for example at Spong Hill where the first barrow-burial and chamber-grave accompanies a set of early 5th century cremations (Böhme 1986). But by the end of 6th century, as many archaeologists have reported, there is a sudden acceleration in ranking; richer grave-goods clustered in fewer graves perhaps reflecting some alteration to the social structure. It would seem that a new aristocracy has managed to float off from the economic system, the new elite eventually producing settlements like North Elmham and Wicken Bonhunt and cemeteries like Sutton Hoo.

At the same time, so called emporia like Ipswich are formed, a town long under the archaeological microscope, and shown in the summer 1988 to have had a pre-Christian high status cemetery, immediately outside the primary settlement nucleus. There are now better reasons for thinking that Ipswich existed and perhaps functioned as a port at the time the Sutton Hoo ship was buried.

So, for a variety of reasons (some given here), it might be considered that the Kingdom of East Anglia was an innovation of the late 6th century, created by peer-group competition between financially independent and proto-feudal land-lords. The Kingdom was formed within an ideology which was not yet Christian, but pagan with strong Scandinavian affinities.

The study of maritime space

Are these affinities fortuitous, or symptomatic of the processes involved — or do they imply actual contact and direct influence? Since the principal arguments used by the opponents of Scandinavian influence are that Scandinavia was far away and the sea was dangerous, we shall have to confront these questions in three parts. Could there have been direct maritime traffic between East Anglia, Norway, Sweden and Denmark in the 5th-7th centuries? And if there could, was there? And if there wasn't, why not?

It is worth noting that we are trying to explain something rather more complex than the discovery of separated but similar finds. We are dealing rather with a number of linkages of different kinds, what might be termed a persistent valency across the North Sea. The model sketched above has included at least four kinds of link: exchange, immigration, political emulation and ideological alliance. Taken together they seem to imply quite a lot of different sorts of people getting into boats between the 5th-7th centuries, and some of the maritime traffic should, prima facie, have been directly between Scandinavia and England, without the mediation of Frisia or Merovingian France (cf Wood 1983; Lebecq 1983 and this volume).

This is not to say that neither Frisia nor France had any influence on England's east coast sea-lanes north of the Thames — only that there may have been a third source of traffic, the Nordic. The scale of such journeys would clearly depend on their purpose, but could still be seen as either subject to political control or attempting to achieve it, rather than simply adventurous or speculative. Political control in the 7th century was not as crude (or as effective) as a modern maritime exclusion zone. It is therefore possible to accept Nordic immigration and diplomatic activity in 6th century East Anglia, and a 'Merovingian' or Frisian North Sea at the same time; this can be done either by supposing that travellers kept to different parts of the sea (the 'Nordic north route' option) or that they belonged to different parts of the social spectrum, and thus were politically unprovocative, or that they tolerated each other's moves in the power game for their own reasons.

Less acceptable, for the reasons already given, is that Angles, Frisians, Franks and Scandinavians were simply unaware of each other's existence. Ian Wood's case for a Merovingian North Sea (referring rather to the southern North Sea and the Channel), can be modified by looking back to Levison who asserted that the territory of north-west Germany and the Netherlands lay outside the 6th century Merovingian Empire 'even if they sometimes recognised in theory the overlordship of its Frankish Kings' (Wood 1983; Levison 1943, 45). And Levison also saw a limit to more peaceful synnergy, thanks to ideological inhibition. 'The Franks and Saxons clung to the gods and rituals of their ancestors no less than to political independence. Frankish domination and the Christian religion were to them inseparable notions' (Levison 1943, 48). Feelings of a similar kind in East Anglia before its conversion may well have inspired both extravagant mortuary behaviour and travel between pagan peoples that was, naturally enough, undocumented.

Shipping seasons

If the North Sea is to be a thoroughfare rather than an obstacle to creep around, then to some extent it will have to be treated like a piece of land—or a piece of 'maritime space' to use Westerdahl's term (pers comm). To examine the potential use of this space, it is necessary to examine the 'topography' of the sea, its resources, hazards, currents, tides and winds, and then match these to the ship technology we know from archaeology (see McGrail 1987; Bruce-Mitford & Evans 1975). That done, the map of contacts and nearest neighbours can be drawn. Although the present author lacks the expertise and ocean lore to carry out this analysis properly, it will be seen that even a superficial exercise turns the conventional map of Anglo-Saxon England inside out.

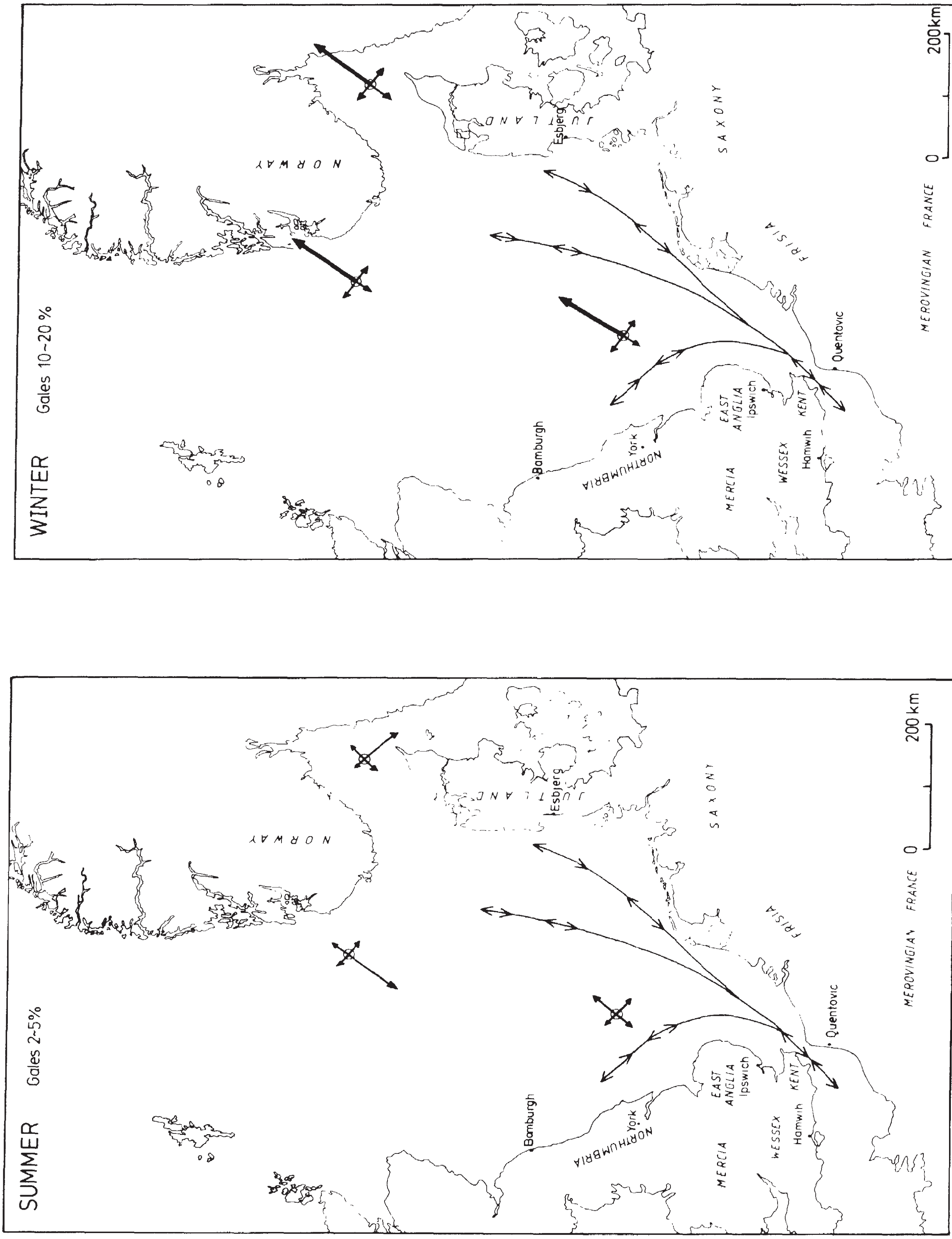

Figure 15.2 Tidal streams and dominant winds in the North Sea, winter and summer. Based on Admiralty Pilots 1979/82, 1973, 1983. Admiralty map of the North Sea (International Chart Series, Taunton 1979). (Drawing: Author).

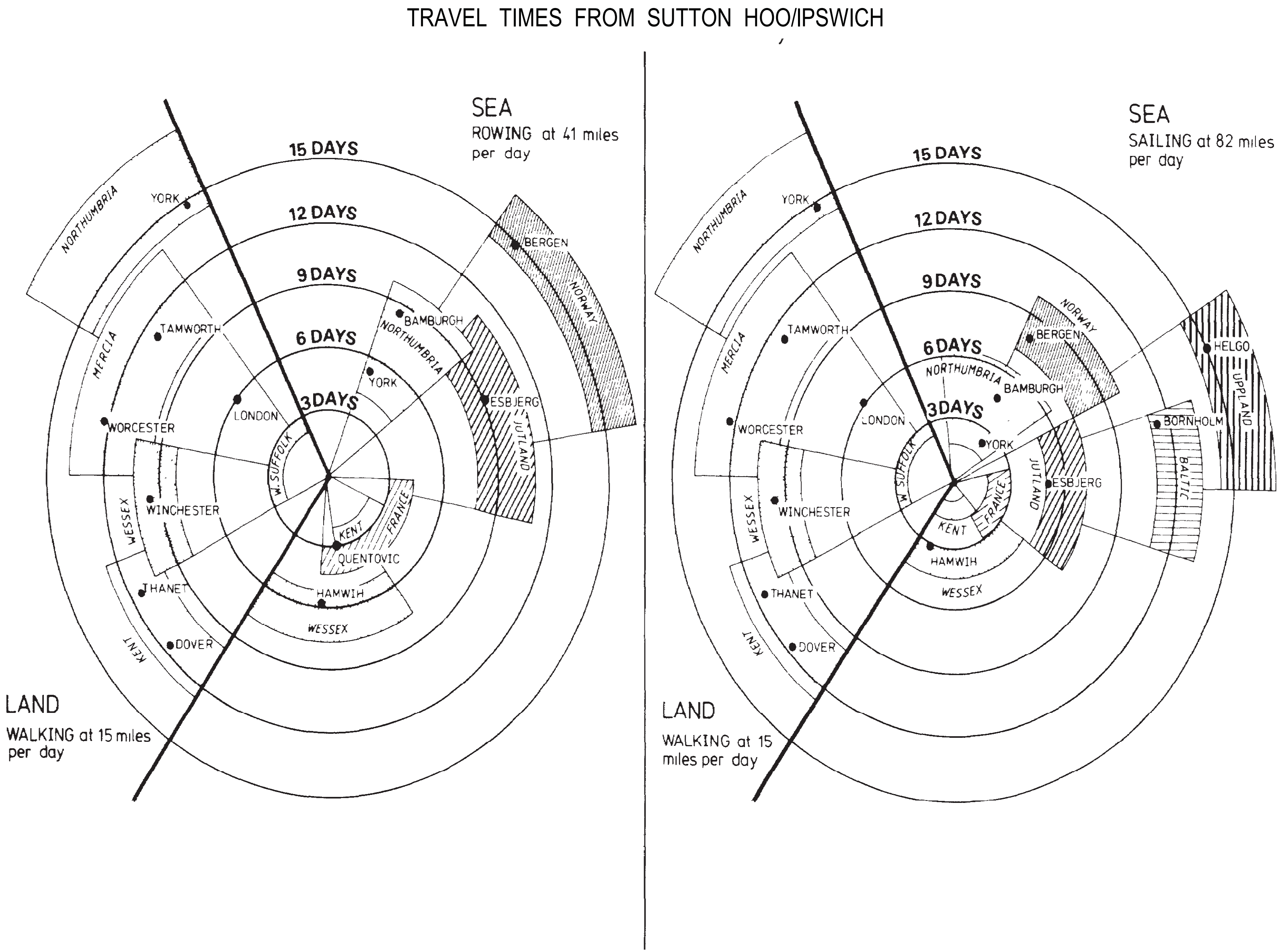

Figure 15.3 Accessibility to neighbours from Ipswich by sea (oar and sail) and land. Distances taken from Admiralty Map and rates of travel from Morken (1968) and Goodchild & Forbes (1957). (Drawing: Author).

Anglo-Saxon poets and the Admiralty Pilot (1983) agree on two things: first that the North Sea, while not particularly hazardous, is more hazardous in sight of land, and still more hazardous in winter. Figure 15.2 shows the tidal streams and three wind-roses (Dogger, Fisher and South Utsire) giving the average direction and strength of the wind in winter and summer (derived from Admiralty Pilot (1983) and Navin 1987). There are ten times as many gales in winter and south-westerly winds dominate. Thus when Alcuin (who elsewhere rhapsodises about the sea as a 'voluptuous delight') says of the sack of Lindisfarne in 793 'nor did anyone imagine such a voyage can be made' he might have meant to add 'in winter' (in other words the date of 8th January in the chronicle may not have been the scribal error sometimes supposed for 8 June; cf Binns 1980). The composite chart also implies that the North Sea weather discriminated between travellers from east and west. While travel in the North Sea is not particularly inhibited in any direction in summer, for seasonal Norwegian travellers it almost offers a system of those 'home-blowing winds', described by Taylor as so influential for overseas political and economic enterprise (1956, 18).

Propulsion

The effect of winds and tides would obviously be significant whether the method of propulsion is to be oar or sail. But it is fair to say that the balance of modern opinion is against open water crossings in rowing boats, although it is not easy to be sure this objection has a rational basis. English scholars, particularly, seem to find the prospect unthinkable, and conjure up a vision of an overcrowded Nydam-type skiff, the crew exhausted, the skipper lost, the passengers freezing, the sheep bleating, the children wailing and the rest of an extended kinship group fighting over the last sandwich (cf Welch 1987; Green 1988, chapter 8).

Some Scandinavian scholars have no such apprehensions. Arne-Emil Christensen (pers comm) for example, cites crossings made by rowing boat from Norway to the Scottish Islands in living memory, that is, during the Second World War. And many marine archaeologists have demonstrated that the boats and navigation skills available to prehistoric man were quite adequate for open sea crossings from at least the Bronze Age (eg Taylor 1956; Binns 1980). Some object to an analogy between refugee flight and regular traffic, claiming that only force majeure would oblige such crossings, which can hardly be taken as typical. Not until sail was in regular use, it is argued, would direct crossing of the North Sea be anything but precarious, carrying persistent risks of loss through the physical exhaustion of rowers — such as is recorded in recent Shetland (Osler 1983).

This seems to take a rather benign view of a past social milieu. There is no reason to doubt early medieval people had slaves and to have slaves pull oars is hardly an innovation of these centuries. A boat such as Sutton Hoo 1 was certainly broad enough to carry a relief crew. The master-servant relationship was implicit between the rowed and the rowers, and in this respect complete reliance on sail marks a revolution in the sociology of travel. It may be that the increasing prohibition against slave-trading, particularly with pagans (Levison 1943, 10) in the 8th century had a direct connection with the rise of sail.

A recent experiment with the Edda, a magnificent replica of the 9th century Oseberg ship, demonstrated that the skill of ancient sailing techniques, although by no means as easy to reproduce, is as important as the technology of rigging (Carver forthcoming). Indeed going on the evidence of Gotland picture stones, there already were sails in the Baltic in the 6th and 7th centuries (Rieck & Crumlin-Pedersen 1988, 127). Rather than assume that there was a definitive change in propulsion from 'only oars' to 'solely sail', it might be more appropriate to propose a gradual change in the way a sail was rigged and used. The 'Viking revolution' could then be seen as a revolution of skill, allowing small crews to travel and manoeuvre independently. This would be a social as well as a technical liberation.

Nearest neighbours

Figure 15.3 is an attempt to model the maritime world of south-east Suffolk in the 7th century. Rates of travel by oars and sail of 36 and 72 nautical miles per day have been taken from Morken (1968) and are contrasted with 15 miles a day for walking and carts recorded in the later middle ages (Goodchild & Forbes 1957, 527). These figures are of course average, approximate and notional; put with less spurious precision, the proposal is simply that sailing is twice as quick as rowing which is twice as quick as walking. If this may be accepted, the result is a dramatic remapping of the cultural zone to which East Anglia really belongs.

The diagrams suggest a new list of the nearest neighbours for Ipswich. Even under oars only, Quentovic is as accessible as Bury St Edmunds and Jutland is 'nearer' than Tamworth. East Anglia is surrounded, if that is the right word, by Kent, Northumbria and Frankia, rather than Mercia which, although physically next to it on land, has no comparable access. This 'real geography' seems compatible with the history and archaeology we have so far seen. With the adoption of sail, the map is skewed still more, since of course the land-locked communities stay where they are.

Further work

This preliminary analysis is only one among many that needs doing more thoroughly, alongside more experimental work on the water, to bring the maritime Saxons to life. A Sutton Hoo replica should most certainly be built, as should small clinker-built boats and logboats after models derived from Caister-on-Sea (Rodwell forthcoming) Snape and Bornholm. But in these experiments, the trials may prove more informative than the manufacture. Are logboats sea-going or intended for river and estuary use? Are blue-water crossings feasible under oars, and what are the ergonomics of such voyages over 5-10 days?

Much more work is also needed in the 'maritime space' which Anglo-Saxons enjoyed, and there could scarcely be a more propitious time to explore the ancient coastline soon to be submerged beyond reach (Devoy; Tooley, this volume). Such exploration will require terrestrial and maritime archaeologists working together and in close collaboration with local scholars such as George Arnott, who has used maps and place names to reconstruct the early coast-line of south-east Suffolk. Figure 15.4 is a tribute to his work and not necessarily an improvement, a strictly provisional attempt to resurrect the buried geography available to 7th century Anglo-Saxons in Suffolk through the simple device of notionally raising the water table. As with the analysis (above) of contacts across the sea, this smaller scale model greatly alters our perception of which places were really neighbours.

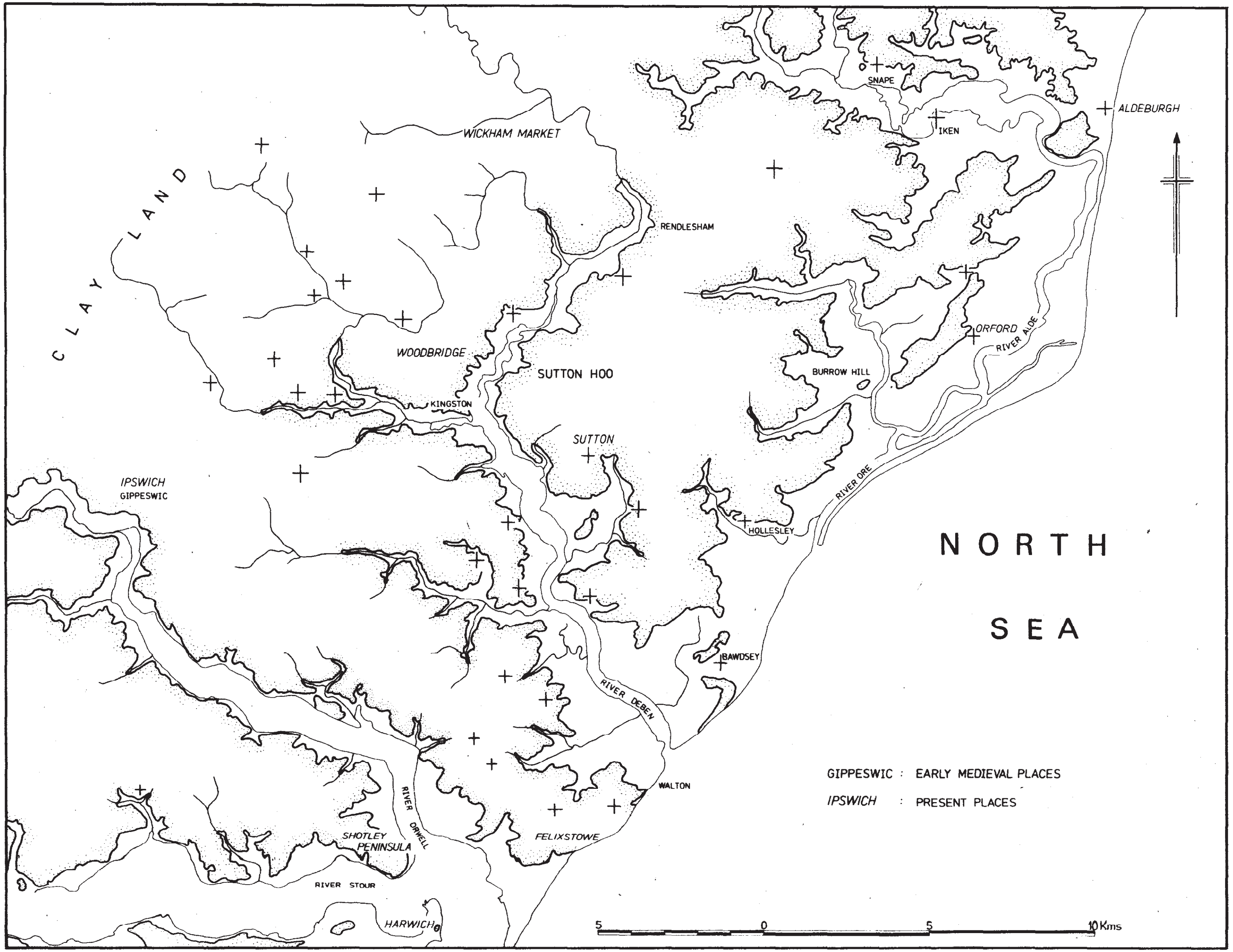

Figure 15.4 Coastline in the area of Sutton Hoo. Modern coastline in feint; bold line follows current 10 ft contour. Crosses show sites of medieval churches. Based on an idea by George Arnott. (Drawing: Author).

Conclusion

However the problem that this paper set out to solve has not yet been solved. Did Angeln, East Anglia, south-west Norway, and the Swedish Uppland develop independently from each other, or did they, all through the 5th-7th centuries, use the North Sea to keep alive that 'persistent valency' and provide each other with economic, political and ideological nourishment?

Since 'blue-water crossings' are proposed for the Bronze Age and the Iron Age in British waters, crossings which involve extended periods out of sight of land (McGrail 1983), and since the technology for such crossings, whether by sail or oar, existed by the 6th century AD in the North Sea and Baltic, one might think it incumbent on the 'coastal crawlers' rather than the 'ocean voyagers' to prove their case. However there seems to be little doubt that the ocean-voyagers are in a minority. Maritime commentators in general have convinced themselves that blue-water crossing of the North Sea between the 5-9th centuries is improbable, and even at the end of this period the favoured route is along the lines of latitude to the Northern Islands rather than via the direct diagonal.

Is this simply a prejudice, insidiously suggested by the imbalance of documentation? It may be, but for a number of reasons this imbalance cannot be decisively confronted at present by archaeology. Virtually all archaeological arguments for maritime contact derive from 'trails' of similar objects, monuments or behaviour, 'trails' which are, unsurprisingly, only discovered on land. They can therefore be used to argue direct or coastal movement, ad libidum. Archaeological theory does not seem to be sufficiently developed to deal with these 'trails', or the valency they imply. Generalised descriptions such as trade, exchange, immigration, emulation or diplomacy are inadequate; they do not account for the discontinuities in the 'trails' or the evanescence of material culture along them.

Archaeological survival aside, the reasons for the uneveness in the signalling of Anglo-Saxon or Viking contact must have to do with the use to which material culture is put at a particular conjuncture. If Norwegian migrants did move along the eastern coastlines of the North Sea (rather than crossing it) but left no material traces until they arrived in Norfolk or Humberside, this must be a symptom of their political relations with the peoples who occupied or claimed to control the space through which they passed. Discontinuity in the trail, the 'vanishing footprints' problem, is clearly a common problem for the migration period. The migrants carry the seeds of their culture wherever they go, but do not necessarily sow them. There comes a moment in the relations between indigenous population, immigrant population and the land, when one cultural portfolio or another must be opened and promoted. Archaeology reports on these moments, rather than the mapping of migration as such.

Modern writers would be wrong to dismiss direct pre-Viking crossing of the North Sea as impossible. But neither can we say that it certainly did happen. More interesting is to investigate the reasons for the preferential and discriminatory use of maritime space, whenever it is suspected. If the greater part of the pre-7th century traffic in the North Sea was directed along the coastal sea-lanes of eastern England, Frisia and Jutland, what kept it there was not terror of the open sea, or inadequate technology, but politics, allegiance and ideology. After the conversion to Christianity and the formation of the East Anglian Kingdom, allegiance and ideology changed, and so did the maritime traffic. Ports of trade such as Ipswich show the organising hand of royal control which canalised traffic for tax purposes, and turned away from the Scandinavian affiliation towards the Merovingian Empire. So, in the immediate pre-Viking centuries (7th-8th) the maritime traffic is largely redirected from the North Sea to the Channel and at the same time, perhaps reduced rather than increased in intensity.

References

Admiralty/Hydrographer to the Navy, 1973 *Pilot North Sea (West)*.

——, 1979/1982 *Pilot Norway Vols I-III*.

——, 1983 *Pilot North Sea (East)*.

Binns, A, 1980 *Viking Voyagers*.

Böhme, H W, 1986 Das ende der RömerHerrschaft in Britannien and die angelsachsische Besiedlung Englands in 5 Jahrhundert, *Jahrbuch des Romanisch-Germanischen Zentral Museum* **33**, 466-574.

Bruce-Mitford, R L S, 1975 *The Sutton Hoo ship burial Vol I*

——, 1978 *The Sutton Hoo ship burial Vol II*.

——, 1983 *The Sutton Hoo Ship Burial Vol III*.

——, 1986 The Sutton Hoo ship burial: some foreign connections, *Settimane di Studio del centro Italiano di Studio sull' alto medioevo* **32**, 143-218.

——, & Evans, A C, 1975 The ship in ——, 1975.

Bulletin Bulletin of the Sutton Hoo Research Committee, **1** (1983); **2** (1984); **3** (1985); **4** (1986); **5** (1987); **6** (1989).

Carver, M O H, 1986 Sutton Hoo in context, *Settimane di Studio dell centro Italiano di Studio sull' alto medioevo* **32**, 77-123.

——, 1989 Kingship and material culture in early Anglo-Saxon East Anglia, in Bassett, S, (ed), *The origins of the Anglo-Saxon Kingdoms*, 141-58.

——, forthcoming *On and off the Edda*.

Goodchild, R G, & Forbes, R J, 1957 Roads and land travel, in Singer, C, Holmyard, E J, Hall, A R, & Williams, T I, (eds), *A history of technology* **II**.

Green, C, 1988 *Sutton Hoo. The excavation of a royal ship burial*, (2nd ed).

Hines, J, 1984 *The Scandinavian character of Anglian England in the pre-Viking period*, Brit Archaeol Rep **124**.

Lawson, A J, (ed), 1986 *Barrow excavations in Norfolk 1950-82*, E Anglian Archaeol **29**.

Levison, W F, 1943 *England and the Continent in the 8th century*.

Lebecq, S, 1983 *Marchands et Navigateurs Frisons du Haut Moyen Age*, 2 vols.

McGrail, S, 1983 Cross-channel seamanship and navigation in the late first millennium BC, *Oxford J Archaeol* **2**, 299-335.

——, 1987 *Ancient boats in north-west Europe*.

Morken, R, 1968 Norse nautical units and distance measurements, *Mar Mirror* **54**, 393-401.

Müller-Wille, M, 1974 Boat-graves in northern Europe', *Int J Naut Archaeol* **3**, 187-204.

Myhre, B, 1987 Chieftains' graves and chieftain territories in south Norway in the Migration Period, *Studien zur Sachsenforschung* **6**, 169-88.

Näsman, V, 1984 Vendel period glass from Eketorp II, Öland, Sweden: on glass and trade from the late 6th to the late 8th century AD, *Acta Archaeologica* **55**, 55-116.

Navin, B, 1987 *North Sea passage pilot*.
Osler, A G, 1983 *Open boats of Shetland: South Mainland and Fair Isle*.
Rieck, F & Crumlin-Pedersen, O, 1988 *Både fra Danmarks Oldtid*.
Rodwell, K, forthcoming *Excavations at Caistor on Sea by Charles Green*, E Anglian Archaeol.
Taylor, E G R, 1956 *The haven-finding art*.
Welch, M G, 1987 Reflections on the archaeological connections between Scandinavia and eastern England in the Migration Period, *Studien zur Sachsen-forschung* **4**, 251-9.
Wood, I, 1983 *The Merovingian North Sea*, Occas Pap Med Topics **1**.

16 A new boat burial from the Snape Anglo-Saxon cemetery, Suffolk

William Filmer-Sankey

Abstract

The second boat grave to be excavated in the Snape Anglo-Saxon cemetery, Suffolk, contained the soil-stain of a 3 m logboat. This paper describes the methods used to excavate and record the stain, the details of the boat's construction, and the body and grave-goods contained within the boat. It ends with a consideration of the significance of the find for the understanding of the origins of the rite of boat burial in England.

Background

The Snape Anglo-Saxon cemetery lies at grid reference TM 4059, in the north-east corner of the modern parish of Snape in Suffolk, 7 km inland from the North Sea at Aldeburgh and 2.5 km north of the present course of the River Alde. The site has long been known to students of both maritime and Anglo-Saxon archaeology for the excavation in 1862 of a mound containing a ship burial (Bruce-Mitford 1974, 114-40). The grave had probably been robbed, but enough remained and, equally important, was recorded by the excavators, to show that the ship was c 14 m in length and 3 m in beam, of clinker-built and riveted construction and that it had eight strakes a side. The finds from within the ship indicated that it had contained a male burial of high status, dating in all probability to the second half of the 6th century and thus predating the mound 1 ship burial at Sutton Hoo (Werner 1971, 197-8).

While digging the ship and other mounds in the same area, the 1862 excavators also found a number of cremation burials, which made it clear that the ship burial was part of a much larger pagan Anglo-Saxon cemetery. However, despite other later finds, such questions as the precise character, the state of preservation and the size of this cemetery remained unanswered, while agricultural activity and the subsequent enclosure of part of the area in a garden meant that, by 1951, even the location of the 1862 ship burial was no longer certain (Bruce-Mitford 1974, 115). For these reasons, it was decided in 1985 that further excavation was needed, if only to assess the suitability of the site for preservation.

For the past four years, therefore, there have been annual seasons of excavation on the site, organised by the Snape Historical Trust and the Suffolk County Archaeological Unit and directed by the author. These have concentrated on the total excavation of an area of 17 x 20 m, lying immediately adjacent to the presumed site of the ship burial, as deduced from the accounts of the 1862 excavation (Bruce-Mitford 1974, 121). This area has been found to contain 21 inhumation and 17 cremation burials of the second half of the 6th and early 7th centuries AD (Filmer-Sankey 1987). The subsoil is sandy, with few stones and a high acid content. This means that human bone only survives in close proximity to metal, although the position of the skeleton can usually be deduced from a 'sand silhouette' of the body. On the other hand, organic preservation is unusually good, with such features as coffins being traceable from a high level within the grave.

During the September 1987 excavation season, one grave (excavation number 0328) was seen to be unusually long and narrow (3.70 x 0.80 m). After c 0.20 m of the fill had been removed, a V-shaped stain of a dark brown colour and an organic texture normally associated on the site with the decayed wood of coffins, appeared at the eastern end (Fig 16.1, + 71). It was only after a further 0.08 m of grave fill had been removed and the stain, now extended, was planned again (Fig 16.1, + 63), that it was realised that this was best interpreted as one end of a small boat.

If this were indeed a small boat grave, it would be the fourth pagan Anglo-Saxon boat burial to be found in England, and thus a find of considerable significance. Since the stain had appeared at a level well below that of potential plough damage, it was decided that further excavation of the grave should be postponed until advice and finance had been sought, in order to ensure excavation to the highest possible standard. The grave was accordingly covered with a plastic sheet and was backfilled, along with the rest of the site, until September 1988, when excavation recommenced.

The method of excavation and recording of grave 0328

At this stage it was not certain that the stain was indeed that of a boat. Nor was there any way of knowing whether, even if a boat, the stain would be sufficiently well-preserved to be understood. Accordingly, it was thought best to adopt a flexible approach to the excavation of the grave. It was decided to begin by excavating it (like all other graves on the site) in plan, removing everything including the stain. This would minimise the danger both of fabricating a non-existent boat and of missing important features.

The grave was therefore lowered in 10 mm horizontal spits. The surface was planned (at 1:10) and photographed at a maximum of every 50 mm, or more frequently if necessary. This method of excavation called for very precise excavation and recording, but it did allow the gradual development and extension of the stain to be accurately followed (Fig 16.1). At the eastern end, where it had first showed, the stain was up to 20 mm

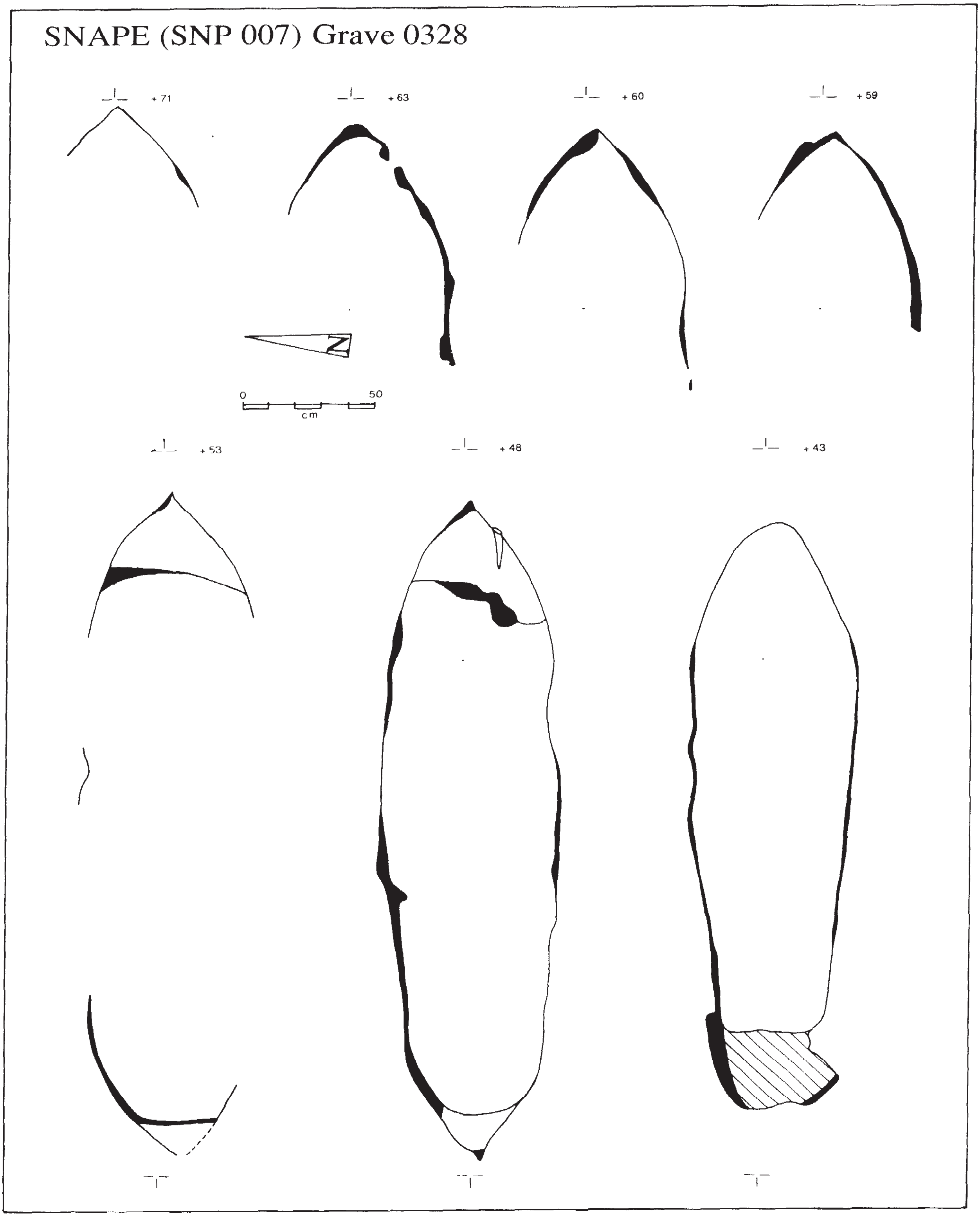

Figure 16.1 The Snape boat: plans of developing stain. Figures refer to height in centimetres above 15 m contour line. (Drawing: Author).

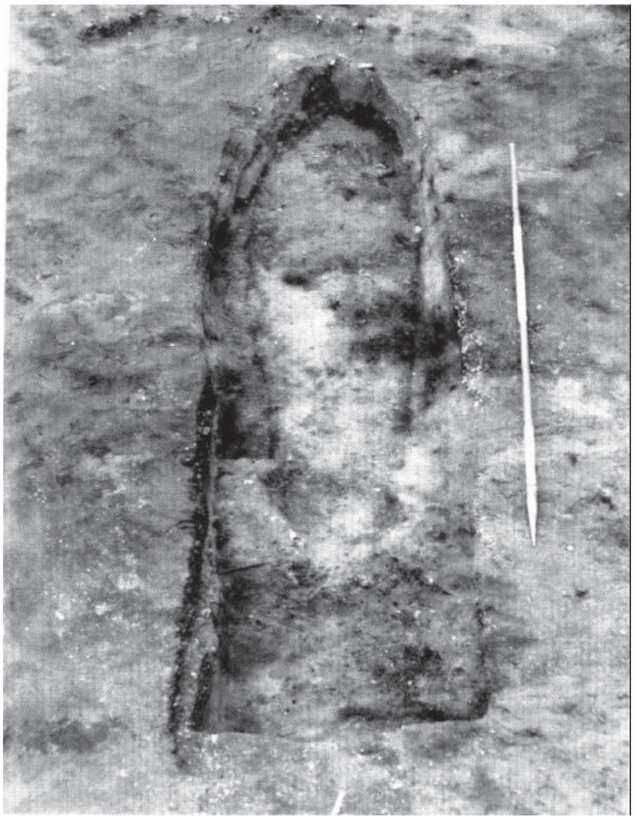

Figure 16.2 Stain at level +43, with north to the left. Side stains show particularly clearly, as does the difference between the length of the boat and of the grave at the west end (nearest the camera). (Photo: Author).

thick and was considered to be sufficiently strong and well-preserved to allow it to remain upstanding, while only the fill from inside it was removed. In all other areas the stain was either too thin or else did not exist at all and excavation in plan was rigorously adhered to. In many areas it was found that, even where there was no actual stain, the edge was visible as a contrast between the more orange fill outside, and the grey-brown fill inside, the area of the stain.

At a depth of c 0.50 m, the stain began to narrow and turn in to a flat bottom (Fig 16.1, + 43; Fig 16.2) and it became clear that excavation in plan was no longer suitable to pick up the details of the base. The stain in most areas remained extremely thin so that even 10 mm spits would risk losing important information. Accordingly, excavation in plan was abandoned and an alternative method adopted. The remaining fill, together with the traces of the body and the grave-goods, which lay in the bottom of the boat were therefore recorded and removed (see below), so that the base of the stain was fully revealed. Once this had been done, the upstanding area at the eastern end was excavated, also in 10 mm horizontal spits, but with plans at 25 mm. intervals, in order to capture the changing outline of this, the best preserved area of the stain (Fig 16.3). Finally, vertical sections at 50 mm intervals were cut along the entire length of the stain, until it had been totally excavated.

At the end of this process (which took one excavator and one recorder 21 days) we were left with seven main plans of the upper levels of the stain, eight detailed plans of the eastern end, and 54 sections across the base (Fig 16.4). Recording by photogrammetry had been impossible, on account of the method of excavation. However, by combining the plans and sections, it has been possible to produce a similar effect which enables the reconstruction of a complete section of any part of the stain.

Figure 16.5 shows a long section and a representative selection of cross-sections, together with a composite plan of the highest surviving levels of the stain. It is this information which must be used to interpret the precise form and function of the wooden object which left this suggestively-shaped stain in the sand of Snape.

The interpretation of the stain

In interpreting this stain, it is necessary to distinguish between the form of the stain, as it survived and was excavated, and the form of the original wooden object. For it is clear from the cross-sections that the pressure of the earth on the decaying wood has in some places distorted (and even destroyed) the lines of the object and this makes the task of reconstructing the original shape difficult. Thus the stain survived to a length of 3 m but the object would probably have been a little longer, since it is likely that the line of the top would originally have continued at full height, rather than following the line of the surviving stain, which drops to a height of only c 0.05 m near the western end. Its maximum surviving width was 0.70 m and this probably represents roughly its original width, since the actual grave cut is only 0.10 m wider. Its maximum surviving depth was some 0.40 m. It is also clear that the cross-sections have suffered from the weight of earth from above. This would have had the effect of flattening the base, thus tending to give a more squared profile than was originally the case (Bruce-Mitford 1975, 347). The fact that this object contained no metal fittings at all, combined with its narrow width in relation to its length (length:breadth ratio 4.3:1) and an apparent tendency to taper towards the west end, indicates that it was of dug-out construction, made from a single hollowed-out log.

Although the stain as it survived and was recorded is indisputably boat-shaped, the nature of its survival, as a dark brown sandy line, means that it cannot be proved that it was a boat, rather than, say, a boat-shaped coffin or even a trough. Nevertheless, all the indications are that it was an actual logboat. McGrail, in his work on logboats in England and Wales, dealt with the problems of distinguishing a logboat from among the various other uses to which a hollowed-out log may be put and he put forward six conditions, with the suggestion that at least two should be satisfied before a logboat is claimed (McGrail 1978, 19). In the case of the Snape stain, three of those conditions (i: that it is found in or near a (former) watercourse; ii: that it is associated with other nautical artefacts; and vi: bark and sapwood have been removed) cannot be applied because of the nature of the survival and of the secondary use as a coffin. The remaining three conditions are, however, all met. Thus (v) it is greater than 3 m in length, (iii) it does have at least one end shaped in one of the well-documented logboat shapes and (iv) it does have fittings which are normally associated with logboats. Even by itself, this would indicate that it was indeed a boat, rather than a trough or purpose built coffin. When taken together

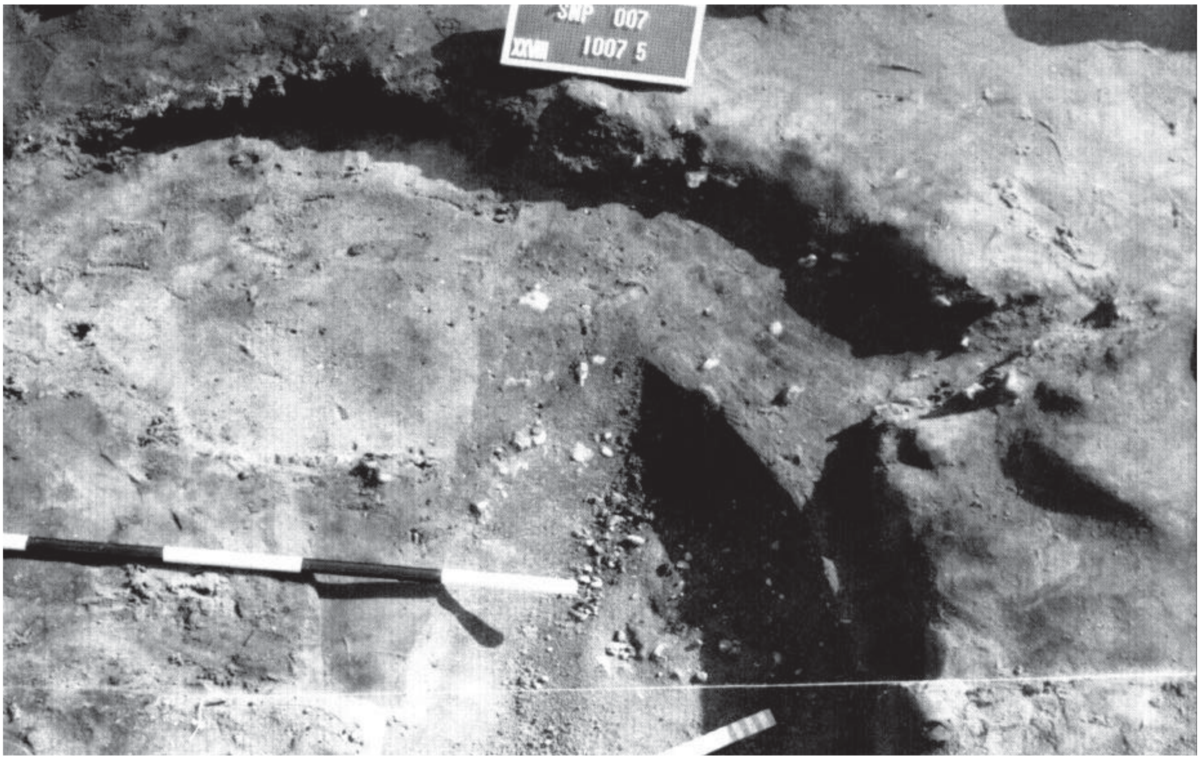

Figure 16.3 Vertical view of east end of the stain at level +43. The protruding 'fin shows as a dark triangle. (Photo: Author).

with the fact that it comes from an area, indeed a site, where boat burial is known to have occurred at this period, its identification as a boat seems wholly justified.

The bow and stern seem to have been similarly formed, with, appearing towards the waterline, a distinctive 'fin' (Fig 16.1, + 53; + 48; Fig 16.3). The evidence as to which end was which is contradictory and may indicate that the boat could be used in either direction. Thus the slight tapering of the log indicates that the western, narrower end was the bow (McGrail 1978, 86). On the other hand, if the grave fits the pattern from Sutton Hoo and Valsgärde, where the head of the corpse always faces the stern, then the bow is the eastern end (see below). This end, which showed from the very start, was far better preserved than the west end, which only became visible 0.10 m from the base and was, even then, obscured by iron-pan. The reason for this differential survival may be that the east end, pushed much more to the head of the grave and apparently supported by a turf, was more protected from the pressures of the earth.

No traces of any internal fittings were noted in the main body of the boat, but, at either end, a curved stain was clearly visible inside the line of the end. This was

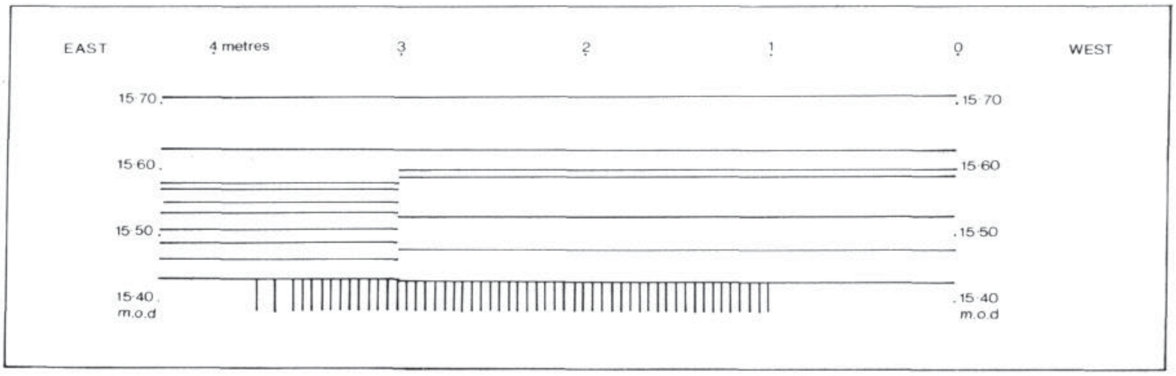

Figure 16.4 Diagram to show locations of plans (—) and sections (I) used in reconstruction of the stain (Fig 16.5). Vertical scale 1:10, horizontal scale 1:40. (Diagram: Author).

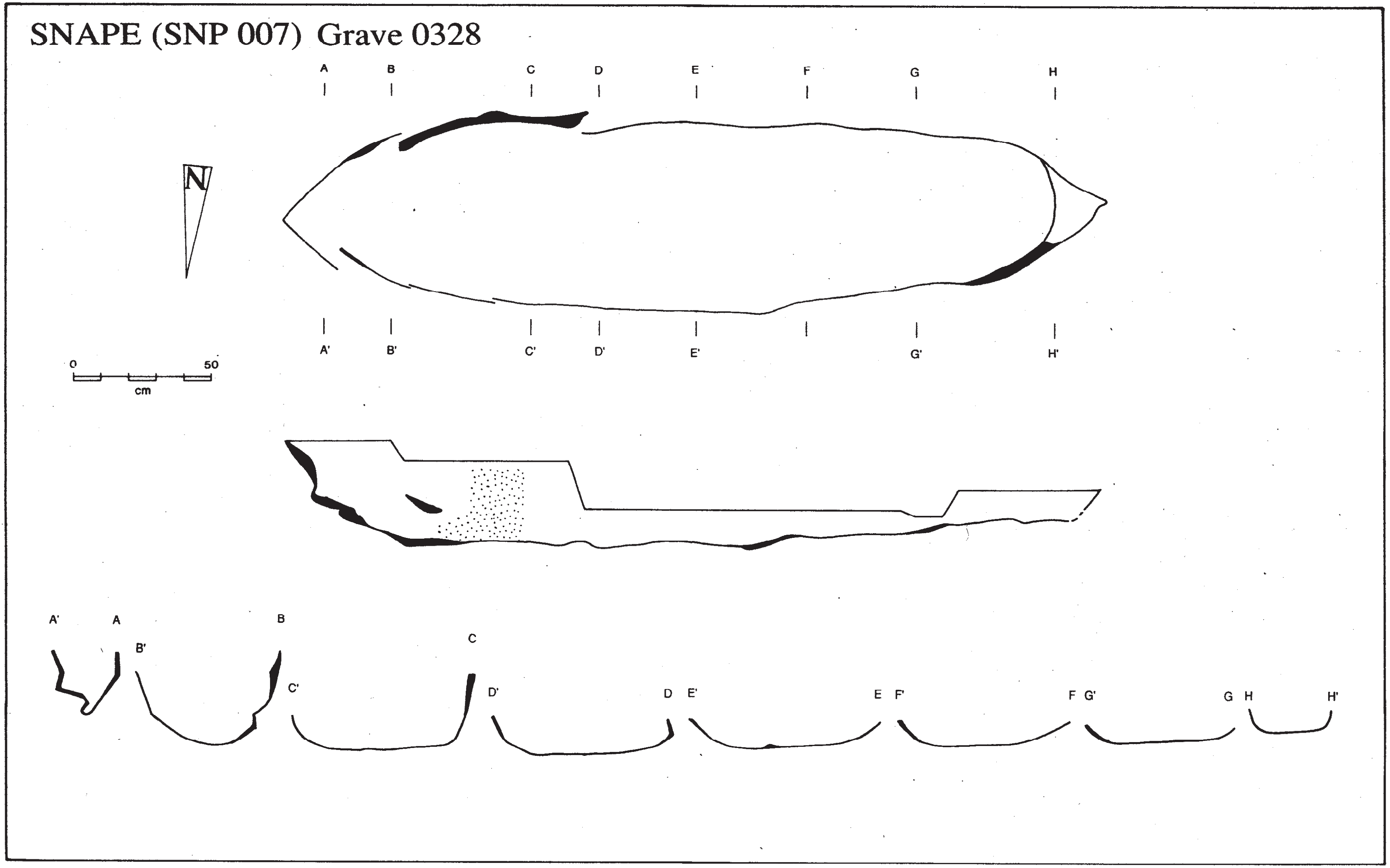

Figure 16.5 Plan of highest surviving level, long section and a selection of cross-sections of the surviving stain. Stippled area denotes possible hole in the hull. (Drawing: Author).

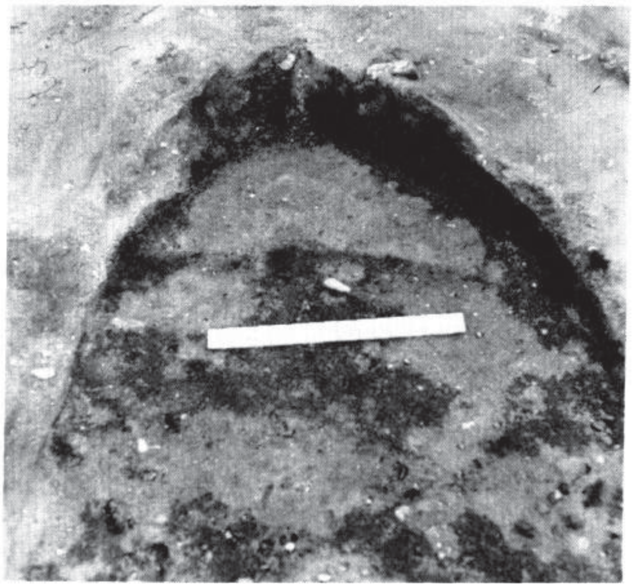

Figure 16.6 Detail of east end of stain at level + 53, showing internal curved stain (scale in cm). (Photo: Author).

most clearly defined at the east end (Fig 16.1, + 53; +48; Fig 16.6). The interpretation of these stains is difficult. It is possible that the represent only the outer surfaces of completely solid ends, such as are found, for example, on the Giggleswick Tarn boat (McGrail 1978, 190-5, fig 15). Two facts argue against such an interpretation. Firstly, the inner stain, although very well defined, was visible neither at the top nor at the base of the boat (Fig 16.1, +71 to + 59; +43; Fig 16.5). Secondly, the mouths of the pair of drinking horns (see below) were found directly beneath the lowest level of the inner stain. This suggests that these stains are most likely to represent separate thwarts or bulkheads to hold the sides apart.

A further feature of note was a 190 mm strip of greasy, grey organic material (as yet unanalysed) which was found clearly pressed into the hull from the outside at the eastern end (Fig 16.1, + 48). At the moment, this seems best interpreted as some form of caulking, used to fill a crack in the log, in the same way that resin was used in several of the Slusegård logboats (Rieck & Crumlin-Pedersen 1988, 81-2). In addition to this, there were indications that there was a substantial hole on the starboard side, just where the side began to curve in (Fig 16.5). This might have been caused during the post-depositional decay of the boat, but, since the stain around the area was particularly strong, an already existing hole seems more likely. Both the possible caulking and this hole tend to support the interpretation of this as a working boat that had outgrown its nautical use.

Although much detail about the form of the boat can be extracted from the stain, a number of uncertainties remain and, at this stage, make any attempt at more detailed reconstruction impossible. Thus the type of wood used is unknown, as is the extent to which the original shape has been distorted during the process of decay. It is therefore not possible to say whether the boat has been 'expanded', in the way that Crumlin-Pedersen has suggested for the very similar logboats from Slusegård (this volume, and see below).

The body and the grave-goods

The final function of the boat, as already indicated, was as a coffin (Fig 16.7). It had been placed in a grave that was rather too long, though none too wide for it. There was no trace of any covering or lid placed over the boat but, equally, there was no trace of any robbing. This was an intact grave.

The body within the boat was very poorly preserved. As is usual on the site, the bone had completely dissolved but in this case the 'sand silhouette' which normally replaces the skeleton was, in most places, no more than a smear and very hard to distinguish from the base of the boat. Phosphate samples were taken, but have not yet been analysed. In the meantime, the meagre surviving stain seems best interpreted as a flexed burial, with the head to the west and, if this is correct, an approximate height of 1.40 m. It seems possible, therefore, that it is not the body of a fully grown adult. One could point to the fact that the boat is considerably longer than the body it coffins as yet a further indication that this is a boat, not a boat-shaped coffin.

The grave-goods accompanying the body can unfortunately give us no clue as to the sex of the person buried. An iron knife of unusual form was found at the west end and an iron buckle and stud (both from the same belt?) lay at 'waist' level. Of greater interest were two horns, which had been placed symmetrically one on top of the other, at the feet of the dead person. At the tips and where they were pressed together, the horn was unusually well preserved, despite a complete absence of metal fittings (Fig 16.8). Elsewhere, a dark stain enabled the precise reconstruction of their original size (diameter of rim: 75 mm; distance between extreme points: 280 mm).

Although they had no metal rim bindings or terminals, it seems best to see them as a pair of drinking horns and their presence may thus give a clue as to the status of the person buried. Pairs of drinking horns are exceptionally unusual finds in Anglo-Saxon archaeology, occurring only in such clearly rich graves as Sutton Hoo mound 1 and Taplow (East in Bruce-Mitford 1983, 385-95). Their lucky survival at Snape thus contradicts the impression of 'low' status given by the small number and humble materials of the other grave-goods.

Just as the grave-goods give us no clue as to the sex of the person buried, so too they give no clues as to the date of the burial (and thereby a terminus ad quem for the construction of the boat). We must rely, therefore, on the dates from the surrounding area of the excavation. As already noted, virtually all the graves date to the second half of the 6th century, though two (both surrounded by ring ditches) are probably early 7th century. By implication, therefore, this grave should also date from c 550 — the early 7th century, roughly the same time span as is allotted to the 1862 ship burial.

A preliminary assessment of the significance of the grave

The importance of this grave can be seen on two levels: as providing fresh evidence firstly about the boats of the Anglo-Saxon period and secondly about the rite of boar burial, and it is intriguing that the evidence in both areas

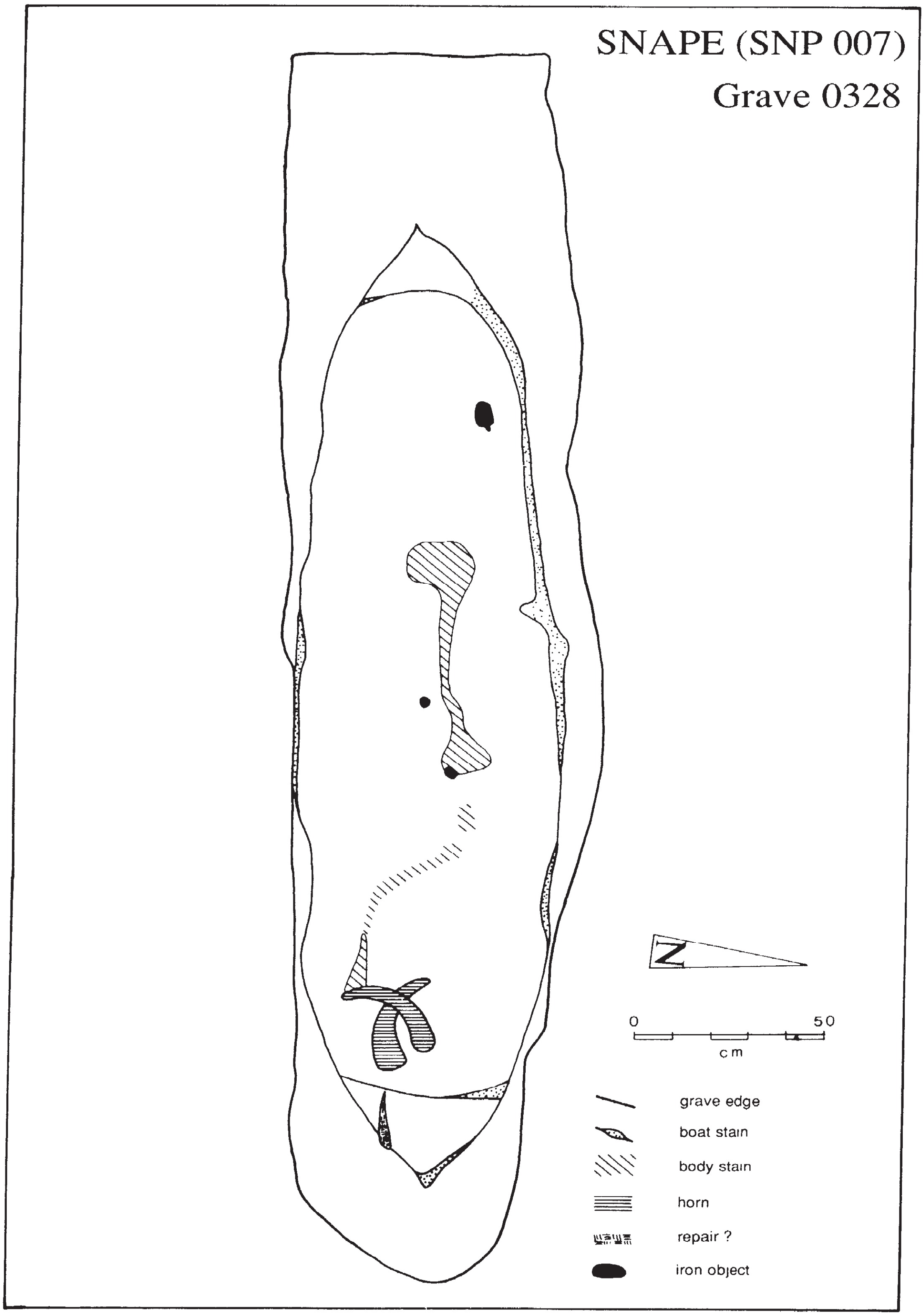

Figure 16.7 Plan of grave. (Drawing: Author).

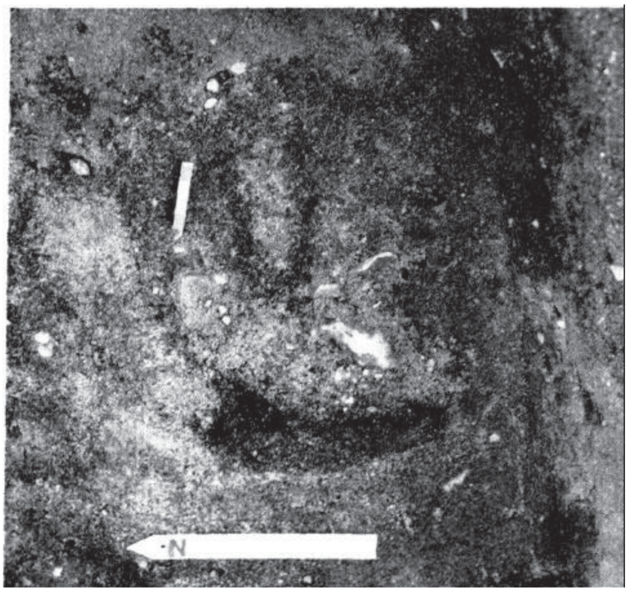

Figure 16.8 Uppermost horn in situ. Dark area in lower centre is preserved horn tip. Oval dark line at top centre is part of lower horn (scale in cm). (Photo: Author).

leads towards the same source, the cemetery of Slusegård, on the Baltic island of Bornholm, where a cemetery of some 1400 graves was found to contain 43 logboat graves, dating from c AD 100-250 (Klindt-Jensen 1978).

To take first the purely maritime evidence provided by the boat itself, it is an unusually well-dated logboat from an area which has hitherto produced few finds (McGrail 1978, fig 207). It thus broadens our view of the range of water-transport in use on the east coast at a period for which so much of the evidence derives from much larger (and arguably atypical) vessels such as the Sutton Hoo ship.

The details of the form and size of the boat, as far as they can be reconstructed, can be paralleled among the English and Welsh logboats. None of these parallels, however, are especially close. Most of the logboats are considerably longer, while the protruding 'fins' at each end of the Snape boat cannot be exactly matched. Infinitely more convincing are the parallels to be drawn with the Slusegård logboats. Had it been found in that cemetery, the Snape boat would have fitted perfectly into the category of boats of c 3 m (± l0%) which have protruding fins at either end. It is particularly similar to the boat from grave 1131 which measured 2.80 x 0.70 m (Rieck & Crumlin-Pedersen 1988, 79-86). Other features noted at Snape can be matched in other Slusegård graves. The curved line just inside each end, for example, appears on the surviving end of the boat in grave 1224 (Klindt-Jensen 1978, fig 144).

Turning to the rite of boat burial, it is equally clear that the grave is more at home among the Slusegård finds than it is in its local context. The three previous boat burials from the pagan Anglo-Saxon period (Sutton Hoo mounds 1 and 2; Snape), though they all come from within a radius of 8 km, could not be less like the new Snape boat. They all make use of large, clinker-built and riveted vessels, and, even when robbed (as was the 1862 boat at Snape and mound 2 at Sutton Hoo), they still contained unequivocal evidence of very high status. On these grounds, they have always been compared with the high-status boat graves of Vendel and Valsgarde. The new Snape find shares none of these characteristics, but nor do the Slusegård boat graves. There, all of the boats were logboats and, although the average status of the boat graves was certainly higher than normal, there were other 'normal' graves of equal or greater wealth.

That, despite the substantial time gap between Snape and Slusegård, there should be such close links between not only the actual boats but also the method of their burial is remarkable. It must mean, at the very least, that the suggested Vendel Swedish origin of the East Anglian rite of boat burial should be called into doubt. At the same time, it would surely be a mistake to substitute Bornholm for Uppland. It may be that the most important factor linking Snape and Slusegård is the sandy, stone-free soil of both sites, which preserves the stains of boats built without metal fittings in a way that most soils do not (Müller-Wille 1968/9, 25). It could be, therefore, that similar boat graves existed in other coastal cemeteries in both England and Scandinavia, but have left nothing (except perhaps an unusually long grave) by which they may be recognised. The discoveries of boat graves, bits of boats and boat-shaped coffins of a later date at York (Kjølbye-Biddle forthcoming), Caister on Sea (Green 1963, 57) and Butley (Fenwick 1984, 37) certainly hint at a fairly widespread rite.

It would follow from this that the adoption of the rite of boat burial is not so much a sign of a specific link between south-east Suffolk and Vendel Sweden, but a far more general indication of the influence of Scandinavian settlers on the character of Anglo-Saxon England. Nevertheless, it is likely to remain the case that boat burial is not a common rite, if the 28:1 normal:boat grave ratio at Slusegård is typical. The new Snape boat, with its curious selection of grave-goods, contradicts the impression that this rarity is due simply to its use as an extravagant status symbol and thus requires a new explanation as to why only certain people in an area where we must assume that a substantial proportion of the total population owned a boat ended up buried in one.

This explanation may well be that the boat symbolised something very specific in pagan Anglo-Saxon religious belief, and thus was thought appropriate for only certain burials. Whether it symbolised adherence to a specific family of Germanic gods (Rieck & Crumlin-Pedersen 1988, 151-2), or the need to make a journey by water to the next world (Werner 1988), cannot be answered by the Snape boat alone. Its particular significance lies in the unusual preservation which enabled its recognition and in the unexpected new angle that it has provided on the appearance of the rite of boat burial in pagan Anglo-Saxon England.

Acknowledgements

The boat grave was excavated by Shirley Carnegie, without whose skill much of the information contained in the grave would have been lost. Both she and I should like to thank Dr Stanley West and Dr Ole Crumlin-Pedersen for their advice on the best method of excavation and on the interpretation of the find. In addition, I am eternally indebted to Mrs Vernon-Wentworth, the owner of the site and to Mrs Harrison and the other Trustees of the Snape Historical Trust for their support. Finally, my thanks go to Professor Sean McGrail for asking me to write this paper and for commenting on its contents.

References

Bruce-Mitford, R, 1973 *Aspects of Anglo-Saxon Archaeology.*

——, 1975 *The Sutton Hoo ship-burial Vol 1.*

——, 1983 *The Sutton Hoo ship-burial Vol 3.*

Fenwick, V, 1984 Insula de Burgh: Excavations at Burrow Hill, Butley, Suffolk, 1978-1981, *Anglo-Saxon Stud in Archaeol Hist* **3**, 35-54.

Filmer-Sankey, W, 1987 *The Snape Anglo-Saxon cemetery: a first interim report on the 1987 excavation*, unpublished.

Green, C, 1963 *Sutton Hoo: the excavation of a royal ship burial.*

Kjølbe-Biddle, B, forthcoming in Philips, D, *Excavations at York Minster.*

Klindt-Jensen, O, 1978 *Slusegårdgravpladsen*, 2 vols.

McGrail, S, 1978 *Logboats of England and Wales with comparative material from Europe and other countries*, Brit Archaeol Rep **51**.

Müller-Wille, M, 1968/9 Bestatung im Boot. Studien zu einer nord-europäischer Grabsitte, *Offa* **25/26**.

Rieck, F, & Crumlin-Pedersen, O, 1988 *Både fra Danmarks Oldtid.*

Werner, J, 1971 Zur Zeitstellung des Bootgrabes von Snape, *Actes du VII Congrès International des Sciences Prehistoriques et Protohistoriques, Prague 1966* **2**.

——, 1988 *Adelsgräber von Niederstotzingen bei Ulm und von Bokchondong in Sudkorea: Jenseitsvorstellungen vor Rezeption von Christentum und Buddhismus im Lichte vergleichender Archäologie.*

Index

by Barbara Hird

Note: italicised page references denote Figures; there may also be textural references on these pages

'aak' shape 80
Abbeville, France; boat 75
Adam of Bremen 88
Adomonnan; Vita St Columbae 36
Adour, River, France 57, 62
Adriatic Sea 41, 75
adzes 53, 57-8, 66
Aethelbert, King of Kent 96
Aethelred, King of England 89
Aetius 93
Africa, north 55, 82
Agilbert (Frankish bishop) 96
Åkerlund, H 106, 107, 108, 109
Alcuin 87, 122
Alderney, Channel Islands 38, 55
Alet, France 41, 47, 55
Alfred, King of Wessex 88, 89, 90
Almere, Netherlands 85
Alsodde, Denmark 99, 103, 108, 111
Althiburus, Tunisia 41, 42, 43, 44, 45
Ambrose of Milan 94
Ammianus Marcellinus 93, 94, 95
amphorae 27, 41, 55
Ampsivarii 86, 95
anchors 41, 46, 71, 82
Angles 96, 98-116, 117
Anglo-Saxons: cemeteries 118, 119; christianisation 117; emporia 119; logboats 131, 133; migration to Britain 93, 96, 117; and Scandinavia 91, 92, 119, 120-1, 122, 124, 133; seafaring 111, 113-14; see also Angles; Saxons; Snape; Sutton Hoo
Anglo-Saxon Chronicle 85, 90
antler fragments, Husum 36
Antwerp, Belgium 75
Arabia 32, 92
Armorica 27, 38, 41, 47, 55, 83, 84; see also Veneti
Arnott, George 122, 123
Arthur, Loch, Kircudbright 32, 40
Ashby Dell, Norfolk 115
Äskekär boat 115
atmosphere 17, 20, 21-4
Atrebates, coins of 42, 43, 44, 45
Atthuarii 95
auger, spoon-bit 58
Aurelius Victor 93, 94
Australia 24
Avars 91
Avenches, Switzerland 75
Avienus; Ora Maritima 36
axes 53, 66

Bad Kreuznach, Germany; mosaic 45
buidara (Siberian hide boat) 39
bailers 108, 110
Baltic 85, 92, 114, 115
barges 11, 44, 45, 66, 73, 79, 82; see also: Druten; Kapel Avezaath; Zwammerdam
bark boats 32, 34
Barton-on-Humber, Humberside 118
basket boats 34
Batavians 86
beach markets 91, 92, 107
beaching 43, 44, 45, 46, 53, 91
Bede 85, 86, 94, 95, 96, 117
Belerion (Land's End) 38, 46
Belgae 41, 70
Belgium 32, 73, 114
Bessin, France 96
Bevaix, Switzerland 57-61, 62, 75; construction 57-8, 59, 61, 63, 64, 66; preservation 57, 58
Bicker Haven, Lincs 5, 8, 11
Birka, Sweden 87, 92
Björke, Sweden 115
Blackfriars, London, boat 1 viii, 66-74; cargo 67, 71, 73, 84; caulking 68, 70, 73; ceiling 66, 67; construction sequence 66, 68, 69, 70, 75; crew accommodation 68, 71; distribution of type 72, 73; floor timbers 45, 66, 68; mast-step 45, 66, 67, 68, 71, 73; nails 53, 68, 70, 73; rigging 45, 71; and Romano-Celtic tradition 45, 72, 73; stem and stern posts 67, 68; typology 45, 61, 66
Blessey, France; bronze ship model 42
Blockstevenboot 57, 62
Blussus' gravestone, Mainz 79
boat-building viii, 91; see also: construction sequence; expansion; Romano-Celtic tradition; tools
boat burials: Denmark 98-105; direction of burial 129; distribution 117, 118, 119; East Anglia 99, 133; half boats 99, 103, 105; rich 126, 133; rite 117, 119, 131, 133; see also: Brokær; Dalgety; Oseberg; rivets; sandy soils; Slusegård; Snape; Sutton Hoo
Bodenschalenboot, Rostock 57, 61
bog offerings 98, 108
Bornholm, Denmark 99; see also Slusegård
Boructuarii 95
Boston Haven, Lincolnshires 5, 8
Boulogne, France 82, 83
bowls; 'coptic' 117; shale 36
bows; logboat 33, 34, 129; rams 43, 70
Bowthorpe, Norfolk 117
braces 44
Brancaster, Norfolk 83
Brendan 39
Bricteri 95
Brigg, Lincolnshire 34, 39, 40
Britain: coastline x, 1, 5, 6-13, 14, 17, 22, 24; and Franks 93-4, 96, 117; trade, (exports) 27, 36, 46, 83, 95, (imports) 46, 82, 83, (trans-shipment) 83, 84; see also individual places, Anglo-Saxons, and under: Rhine; Scandinavia
Bro, Gotland, Denmark 110
Broighter, Derry 36, 37, 46
Brokær, Denmark 99, 103, 105, 108
Bronze Age 27, 39-40, 46, 117, 122
Broomhill, Kent 10, 12, 13, 14
Bruges, Belgium 66, 71, 72, 73, 115
Bulbury, Dorset; anchor and chain 41
bundle vessels 32, 34
Butley, Suffolk 133
Byzantium 91, 92, 96, 117

cabins 50, 68, 71, 79
Caergwrle, Wales; shale bowl 36
Caister-on-Sea, Norfolk 118, 122, 133
Callington, Cornwall 47
Canada 22, 24
Carausius 93-4
cargo capacities 34, 35, 40, 71
Carolingian empire 87, 88, 92
Carthage 36, 42
Cassiodorus 95
Catthi 95
cattle; cross-Channel trade 27, 46
cauldron lugs and handles 92
caulking 40, 45, 49, 58, 73; resin 99, 131; see also: moss: nails
ceiling 66, 67
Celebes 42
Celtic tradition see Romano-Celtic
cemeteries 118, 119; see also boat burials
centreline, marking of 52, 53, 54
Cervia, Italy 75
chains, iron anchor 41
chaland monoxyle assemblé 57, 62
Chamavi[es] 86, 95
Channel viii, 43; Frankish influence 93-7, 119; piracy 93, 95; routes across 27, 38, 41, 43, 46, 82; Saxon threat 93-7
Chauks 86

Chichester, Sussex 11, 18
chine girder see strakes (bilge)
chines, pre-moulded 77, 80
Christchurch Harbour, Dorset 18, 27, 28, 19
christianisation 96, 117, 119, 124
Classis Britannica 84, 93
Claudian 94, 95, 96
Claudius, Emperor 81, 82
Clausentum 84
cleats 40, 106, 107, 108, 110, 111, 113-14
climate 17, 18, 19, 20, 21, 22, 23
clinker construction viii, 40, 73, 92
coastline, changes in viii-ix, x, 1-16; human activity and 11, 17, 18-19, 81; see also: Romney Marsh; sea-level; and under: Fenlands; Netherlands; Suffolk
coffins, boat-shaped 40, 117, 128-9
cogs viii, 46, 75, 88, 89, 92
coins 43; of Allectus 42; Antoniniani 55; Atrebatic 42, 43, 44, 45; Belgic 70; bracteates 88; Celtic and Roman themes on 43, 70; of Charlemagne 88, 92; of Cunobelin 43, 44, 45, 66, 70-1; of Domitian 67, 68; of Dorestad 88, 89; of Hedeby 88, 111; of Louis the Pious 88; and mast-stepping 67; Merovingian 117; of Quentovic 89; Veneti gold 41; of Verica 43
Colijnsplaat, Netherlands 81, 83, 84
Cologne, Germany 75, 86, 87
Comacchio, Italy 75
comes maritimi tractus 94, 95
Constantius Chlorus 93, 94
construction sequence see: shell; skeleton; and under individual boats
cooking equipment 50
copper 27, 47
Corbulo, Gnaeus Domitius 81
Coriosolites 38, 41
corn 27, 46, 83, 95
County Hall, London 73
crustal heat flow 22
crustal movement 5, 11, 17, 19, 21, 22
crew accommodation 50, 68, 71, 79, 122
Cunobelin, coins of 43, 44, 45, 66, 70-1
cup, maple wood 55
curaghs 36, 39
customs tolls 46, 87, 89

Dagobert I, King of Franks 96
Dalgety, Fife; boat grave 36
Danai 95
Dankirke, Jutland 91
Danube, River 79, 111
Dartmoor; metals 47
decima (Carolingian toll) 87
dendrochronology 57, 58, 66
Denmark 32, 98-116, 117; map 99; sailing introduced 111; ship pattern 88, 90; see also: Hjortspring; Nydam; Slusegård; Viking
Deventer, Netherlands 86
Dio Cassius 39
Diodorus 46
dogs, hunting 27, 46
Domburg, Netherlands 81, 83, 84, 85, 86
Dorestad, Netherlands 86, 87, 88, 89, 91, 92
Dover, Kent 84
drainage works and coastline change 11
Drusus, Nero Claudius 81
Druten, Netherlands 77; boat 62, 75, 77, 78-9, 80, 81
Dürrnberg, Germany 40

East Anglia, Kingdom of 117-25; boat burials 99, 133; christianisation 96, 124; contacts 117, 118, 119; and Franks 96, 124; and Scandinavia 117, 119, 120-1, 122, 124, 133; state formation 119; see also: Ipswlch; Sutton Hoo
Edda (replica of Oseberg ship) 122
Egernsund, Denmark 99, 103, 104-5
Eiffel mountains 77, 81
Einstrassenanlage 91-2
El Niño current 24
Elbe, Franks on 96
emporia 85, 86, 119
Engelhardt, C 106, 108, 110
engineering works 11, 17, 18-19, 81, 87; see also: harbours; hards
'English' 96
entrepôts 46, 117
environmentalism viii-ix, 5
erosion, coastal 19, 28, 83
Essex 5, 18, 43
Eutropius 93, 94
Exeter, Book of 87
expansion techniques 32, 104, 105, 106, 131
eyes, boat's 40

Fannerup, Denmark 105
fastenings 40; see also caulking; cleats; nails; rivets; sewing
Felix (Frankish missionary) 96
Fenlands x, 1, 5, 7, 8-9, 11, 14, 18, 24
Ferriby, Humberside 34, 36, 39, 40
figs 27, 46
figureheads 111, 113, 114
Finland 32, 57
firrer side rudders 91, 92
fish, trade in 82, 83
Fishbourne, Sussex 55
flat-bottomed craft 40, 45, 75, 77, 79; see also: barges; cogs; floats; rafts
Flevoland medieval boat 75
floats 32, 34
flooding 18, 23, 85
floor timbers 41, 45, 77, 98, 111, 113; spacing 52, 73, 75, 79; see also under Blackfriars; St Peter Port
fonts 89
forefoot 42, 43, 44, 70
Fossa Drusiana 81
Foulum, Denmark 99, 103, 105
frames: side 53; see also floor timbers
France 22, 32, 117; see also: Armorica; Franks; and individual places
Franks 93-7; and christianisation 119; coins 88, 92, 117; and Germanic tribes 85, 96, 113, (Frisians) 85-6, 86-7; trade 86, 87, 119; see also Merovingians
Fredegar 96
Frisians 85-90; cogs 89, 92; and Danes 90, 92; emporia 86, 91, 119; and England 90, 119; and Franks 85-6, 86-7; as 'international traders' 87-8, 89; and Jutes and Angles 113; landing places 91-2; permanent settlements 91-2; routes 87; and Saxons 92; Scandinavian trade 90, 91, 92; ships viii, 85, 88, 89, 90, 92; terpen 87, 91; territory 85, 86; trade monopoly 85, 88, 89, 91-2, 119; in Viking age 90, 92; wool production 91
Frome, River, Dorset 34, 38
Funen, Denmark 99, 105
futtocks 53, 77

Gallo-Roman boats see Neuchâtel, Lake
Gallo-Roman tradition see Romano-Celtic
Gammelby, Denmark 99, 103
Garonne, River, France 41, 82, 96
Garrianonum, Brittany 83, 84
Gaul: Belgic 43, 70; Frankish threat 93, 94; pottery 55, 82; Saxon raids 94, 96
geoid shape 17, 22-3
geomorphology 31
Germanus 93
Germany: flooding 18; and Franks 85, 93, 96, 119; Frisians in 85; logboats 32; Roman army 68, 93, 111, 113
Gewissae (West Saxons) 96
Giggleswick Tarn, Yorks 131
Gildas 93, 94, 96
Gironde, River, France 47
glaciation 17, 21, 22, 23
glass 27, 46, 117
Gokstad, Norway 98, 114, 115
gold 27, 46; guldgrubber figures 104; small boat models 36, 99, 103, 104
Gotland, Sweden 108, 110, 111, 112, 122
Grågås (Icelandic law code) 34
grande galupe 62
Gratz on the Oder, Germany 57, 62
grave-goods 131, 133
Graveney, Kent 115
graves, boat see boat burials
gravestones 45, 66, 79

Gredstedbro, Denmark 99, 103, 108, 111, 112, 113, 114, 115
greenhouse effect 17, 23
Gregory of Tours 95, 96
Gregory the Great, Pope 96
gribble (Limnoria sp) 53, 71
Guernsey 38, 45, 51, 55; see also St Peter Port
guldgubber 104

Hadstock, Essex 118
Haithabu see Hedeby
Halsnøy, Norway 73, 105
'Handelsterpen' 86
Hanseatic league 91, 92
Hanssen, H P 108
harbour works 44, 46-7, 82, 84, 87
hards 29, 30-1, 46
Hasholme, N. Humberside 5, 32, 33, 35, 34, 36, 40
Hasnæs, Denmark 99, 103, 105, 106
hazel twigs as caulking 73
hearth, ship-board 50
heat treatment; to bend timbers 57, 64; see also expansion
Hedeby (Haithabu), Germany 86, 87, 88, 92, 98, 111, 115
Helgö, Sweden 87
Hengist 90
Hengistbury Head, Dorset 5, 27-31
Herm, Channel Islands 51, 55
Herules 85
Hessen, Wilhelmshaven, Germany 91
hide boats 34, 36, 37, 39, 40
hide floats 34
hides, trade in 46
Himilco of Carthage 36
Historia Brittonum 85, 88, 90
Hjemsted, Denmark 99, 103, 108, 111
Hjortspring, Denmark 39-40, 42, 70, 98, 99, 103, 104, 108; sewing 40, 73, 105
Holme Pierrepont, Norts 1, 32, 40
Honorius, Emperor 95
hooks 62, 79
horneblende-quartz-diorite 55
horns, drinking 131, 132, 133
Hrodberet (C8th merchant) 87
Huda's Fleet, Kent 12, 14
hulcs viii, 44, 88, 89, 92
Hulst, R S 77
Humber, River 34, 36, 40, 117; see also: Brigg; Ferriby; Hasholme
Hunni 95
Husum, Germany; antler fragments 36
Hythe, Kent 10, 11-12, 71

ice ages 17, 22; see also glaciation
Iceland; Law Code (Grågås) 34
Ictis 46
Inchtuthil, Scotland 73
Indian Ocean 42
inland waterways 32, 34, 36, 40, 45, 73
Inuit umiac (hide boat) 39
Ipswich, Suffolk 119, 121, 122, 123, 124
Ireland 23, 32, 90; land uplift 17, 19, 22; routes to 36, 41, 46; see also Broighter
iron 27, 46; knife, Snape 131
Italy 27, 42, 75, 82; see also Rome

Jarrow, Co Durham 118
Jerome 95
joints: butt 49; draw-tongue viii; mortise and tenon 73, 75, 79; stem to keel 43
Julian, Emperor 83, 94, 95
Julius Caesar 32, 36, 70, 80-1; on planked boats 41, 44, 45, 46, 66
Junkerath, Germany 45
Jutes and Jutland 96, 99, 108, 111, 113; boat graves 98, 105; seafaring 111, 113-14; settlers in Britain 117; see also: Dankirke; Gredstedbro; Kongsgårde; Ribe

Kapel Avezaath, Netherlands 75, 77, 79, 80, 81
Karlby, Denmark 99, 103, 111, 113
keels 40, 45-6, 108, 110, 111; hide boats 36; late IA planked ships 42, 43, 44, 70; tripartite plank 49, 52, 53, 54
Keen, Richard 49, 45
Kent 18, 71; Kingdom of 88, 96, 117; see also Romney Marshes
Kentish Chronicle 88
keys 33, 34, 40
Kimmeridge shale armlets 27
knees 43, 77, 79
Kongsgårde, Denmark 99, 103, 111, 112, 113
Kouadoi 95
Krefeld, Germany 62, 79
Kvalsund, Norway 115

land-level, changes in 5, 6-13, 14
landfall 46, 47
landing places 31, 39, 46-7, 91-2, 107; see also: beaching; harbour; hards
lanvéoc 41
lead 27, 36
Leck, Germany 104, 105
lenunculi auxiliarii (lighters) 82
Leonardo da Vinci 79
Leutherius (Frankish bishop) 96
Libanius 83
lighters 82
lime wood 104
limes 80, 81
Limnoria sp (gribble) 53, 71
Lincolnshire 11; see also Fenlands
Lindisfarne, Northumbria 122
Linge, R, Netherlands 77, 81
Lissus, Illyria 41
Lizard Point, Cornwall 38, 46
Ljubljana, Yugoslavia 75
Lleyn peninsula, Wales 71
Løddekøppinge, Sweden 42
logboats 32, 33-5, 36; Anglo-Saxon 131, 133; cargo capacity 34, 35; construction techniques 34, 36, 40, 61; distinguishing features 128-9; expanded 32, 36, 98-105, 131; extended 32, 34, 75; frames 98; Neolithic development 34; and planked boats 36, 57, 61, 64; sea-going 32, 34; steering 36; see also: Hasholme; Poole; Snape; Zwammerdam
Loire, River, France 38, 41, 82
London 66, 83, 84, 87, 89, 96; Roman 71, 73, 82; sea-level 18, 23; see also: Blackfriars; County Hall; New Guy's House
longshore drift 10, 11, 12, 28
Loose Howe, North Yorks 40, 117
Louis the Pious, King of Franks 85, 87, 88
Lucan 36
Lundeborg, Denmark 99, 103, 105, 107
Lympne, Kent 10, 11, 12

Madrague de Giens, France 42
Magdala, Germany 42
Mainz, Germany 79, 86, 87, 98; boats 61, 73, 75
Mamertinus 94
Manapii 41
maple wood cup 55
marble 82
Mark Antony 41
Marsala, Sicily 42
Massalia, France 46, 82; Periplus 36, 46
mast-step: Blackfriars 1 45, 66, 67, 68, 71, 73; Bruges 66, 71; ceremony 68; late IA planked ships 43, 44; Rhine 73, 82; St Peter Port 45, 54; Zwammerdam 82
Maximian, Emperor 93, 94
Maximus, Magnus, Emperor 94
measurements, standard 62, 63, 64, 75, 81; floor timber spacing 52, 73, 75, 79
Mediterranean: ship design 41, 42, 44, 45, 66, 72, 73, 82; trade 27, 46, 47, 82
Meinerswijck, Netherlands 62, 79
Merovingians 93, 96, 117, 119
Mesolithic era 34, 36
metals, trade in 27, 46, 47
Meuse, River, lower 77

Mictis 46
middle ages: coastline changes 8, 31; Frisians 85-90; see also: cogs; hulcs; Merovingians; Utrecht; Velsen
Midley eyot, Kent 11, 14
millstones 67, 71, 73
Minoan civilisation 42
models, ancient 40, 42; see also: Broighter; Dürrnberg; Nors; Roos Carr
Moerzeke-Mariekerke, Belgium 113, 114
mosaics 42, 45; see also Althiburus
moss caulking 40, 41, 49, 50, 53
Mount Batten, Cornwall 38, 46-7

nails 41, 45, 75, 107; caulking 50, 53, 70; clinker 92; cone-headed 50, 66, 68, 70, 73; countersunk 50, 53; Frisian 92; J-shaped 45, 49, 51, 53, 66, 68, 70, 92, 118; see also treenails
navigation 46, 91, 92, 111, 113, 122
Nazarius (panegyrist) 94
Nectaridus (comes maritimi tractus) 94
Nehalennia, temples of 81, 83
Nemi, Lake, Italy 75
Nene, River, Lincs. 5, 8
Nennius 88
Neolithic age 32, 34, 46
Netherlands 32, 81, 85, 113, 119; coastline change viii, 1, 2-3, 9, 18, 81, 85, 113; see also individual places
Neuchâtel, Lake, Switzerland 57-65
New Guy's House, London 66, 73
New Shoreham, Sussex 89
Nicolas of Liege 88
Nin, Yugoslavia 75
Nors, Denmark 36, 99, 103, 104
North Elmham, Norfolk 119
North Sea: English-Scandinavian contacts 91, 92, 119, 120-1, 122, 124; trade viii, 32, 43, 88, 92, 119
Norway 73, 105, 117, 119; see also Gokstad
Notitia Dignitatum 94
Nydam, Germany 73, 93, 99, 103, 105-6, 107-10, 112

oak 49, 68, 77, 81; exceptional length 106-7, 108; thrifty use of 80
oars: propulsion 36, 37, 39, 40, 85, 86, 111, 113, 121, 122; steering 36, 39, 40, 73, 75, 79, 99, 103, 108, 111
oberländer 77, 79
ocean atmosphere interaction 17, 20, 21-4
Oceania 42
oculi (boat's eyes) 40
Oestrymnin (headland) 36
olive oil 82
Orkney Islands 88, 90
Orosius 93, 95
Oseberg, Denmark 98, 111, 115, 122
Osismii 38, 41
Ostla, Italy 42, 82
Ouse, River, Lincolnshire 5, 7, 8
Ozengell, Kent 118

Pacatus 94, 95
paddles 40, 113
Pakistan 36
palaeo-geographic maps viii, 1, 2-3
Palaeolithic era 34
Pallia fresonica 85
panegyrics, Latin 93, 94
peat, lowland x, 1, 2-3, 29
pedes monetales 62, 64, 75
PEG 4000 75
pegs, wooden 58, 63, 66, 68
Periploi 36
Peutinger table 95
Pevensey, Sussex 11
Philips, Captain 36, 39
Piddle, River, Dorset 34, 38
pine wood 108, 111, 113
piracy 55, 93, 94, 95, 111, 113
Pirenne, Henri 85
planked boats viii, 32, 34, 40-6; Bronze Age 39-40; Iron Age 40-6; keels 40, 54; and logboats 36, 57; sewn 34; see also clinker
planking: flush-laid viii, 41, 49, 66, 73, 75; keel 49, 52, 53, 54; logboats, extended 32, 34, 75; nailed viii, 45, 49; overlapping viii, 40, (see also clinker); sewn 34, 73
Pliny 36, 39, 46
Pommeroeul, Belgium viii, 67, 75, 79
Pomposa Borgo Caprile, Italy 75
ponto 41, 42, 33, 44, 45
Poole, Dorset 38, 47; logboat 32, 34, 35, 40
Popham's Eau, Lincolnshire 7, 8
Portchester, Hampshire 55, 83, 84
Portus Lemanis, Kent 10, 11-12, 14
pottery 27, 46, 55, 82, 83
Pozzuoli (Puteoli), Italy 82
preservation techniques 57, 75
Procopius 85, 86, 96
punt shape 44, 77, 80
Puteoli (Pozzuoli), Italy 82
Pytheas 46

Quentovic, France 86, 89, 98, 122
querns 55, 71

rabbet, continuous 114, 115
rafts 32, 34, 40
rams 43, 70
Rance, River, France 38, 41
rebates 50, 53
Reculver, Kent 11, 84
Redcliff, Avon 47
Regni 43
repairs 33, 34, 105
resin caulking 99, 131
re-use of materials 58, 77, 80, 108, 111
Rhee Wall, Kent 11, 13
Rhine, Riser 1, 77; craft 32, 45, 73, 82, 86; engineering works 81; Frisians 85; and limes 77, 80-1; pirates 93; Romano-Celtic tradition 45, 86, trade viii, (Britain) 43, 81, 82-4, 91, 117 (Guernsey) 55, (Scandinavia) 89
Ribe, Denmark 86, 87
Richborough, Kent 11, 73, 82, 84
rigging 43, 44, 71, 122
rivers viii-ix, 21; craft 32, 40, 45, 73
rivets, Iron 98, 105, 117, 118, 119
road system, Roman in Britain 84
Rochester, Kent IIX
rock carvings 36, 42, 70
roddons 5
Roman empire: administrative communications 82, 93, army 68, 84, 93, 95, 111, 113; supplies 77, 80-1, 82, 95; perceptions of Franks and Saxons 95-6; ships 41, 111, 113
Roman-British Transgression 18
Roman-Celtic tradition viii, 44-6; Frisians and 86; Rhine delta 75, 81, 86; river craft 72; typology 61, 62, 64, 66; see also: construction sequence; nails, and under individual vessels
Rome 79, 82, 95; see also Roman empire
Romney Marsh 1, 5, 10-13, 14, 18
Roos Carr, North Humberside 32, 40
Restock, Germany 57, 61
Rother, River, Kent 11, 12, 13, 14, 20
round-hulled boats 40-6, 49-56, 66; see also: keels; sea-going vessels
roves 107
rudders 42, 43, 44, 71, 91, 92, 111, 113
Rugini 95
Russia 36, 39, 42, 92
Rye, Sussex 10, 14, 18, 20

Sage fresonica 85
sails: artemon 42, 44; barges 45, 71, 82; hide boats 36, 39; IA planked boats 41, 43, 44, 45, 46; lugsails 45; Rhine delta 85, 86; Scandinavia, pre-Viking 111, 113, 121, 122; spritsails 71
St Denis, France 87, 117
St Michael's Mount, Cornwall 38, 46, 47

St Peter Port, Guernsey viii, 45, 49-56; cabin 79; construction 49, 50-2, 53, 54, 55; context 55; excavation methods 49; finds 55; keel plank 52, 53, 54; La Plaiderie 55; mast step 45, 54; and Roman-Celtic tradition 45; sea-going 72, 73; size 70; stern post 52, 53, 54; strakes 54; unexcavated site (C1st/2nd) 55
Saintes, France 96
Salians 95
salt 5, 11, 27, 83
sand deposits, coastal x, 1, 2-3
sand silhouettes 126, 131, 132
Sanda, Gotland, Denmark 110
sandy soils 98, 126, 127-30, 131, 132, 133
Sarre, Kent 118
saws 53, 57, 58, 60, 66, 68
Saxon Shore 84, 93, 94-5, 96
Saxons 93-7, and Frisians 92; raids on Gaul 94, 96; and Jutes and Angles 113; Old 95; in Orkneys 88, 90; pirates 111, 113; settlers in Britain 93, 96, 117; West 96
Scandinavia 117-25; and Britain 91, 92, 117, 119, 120-1, 122, 124, 133; Byzantine trade 91, 92; coastline change 17, 22, 24; difference from Romano-Celtic tradition 66; Frisian trade 91, 92; rock carvings 36, 42, 70; shipbuilding types 72, 88; see also individual countries and places and Viking
Scheldt, River, Netherlands 81, 83, 111, 113, 114; see also: Colijnsplaat; Domburg
Scilly Islands 38, 46
Scotland 36, 73
sea-going vessels 32, 34, 36, 40-6, 82-4, 119, 122; logboats 32-3, 34; merchant ships 66; see also: hulcs; Peter Port; Sutton Hoo; troop transporters
sea level, changes in viii-ix, 1-16; and coastal position 17, 18-20; Fenland 5, 7, 8-9, 11; Hengistbury Head 28, 31; index points 1, 4, 5, 6, 7; ocean-atmosphere system and 20, 21-4; and ports in Roman Britain 83; relative 17, 18, Romano-British Transgression 18; Romney Marsh 5, 10-13, 14
sea-surface behaviour 22
sea temperature 32
seals, medieval 89
seasons, shipping 119, 120, 122
sedimentation x, 9, 10, 11, 17, 19, 83; and havens 1, 20, 83; Netherlands 2-3; Romney Marshes 12, 13, 14, 20
Seine, River, France 55, 82
Severin, T. 39
sewing 34, 40, 73, 75, 105, 113
Shapwick, Somerset 32
Sheepen, Essex 43, 44
sheerline 42, 43, 44
shell construction viii, 40, 68, 75
Shennan, I 5, 7, 9, 11
Sidonius Apollinaris 94, 96, 113
Sigamber ('Frank') 95
Sigberct, King of East Anglia 96
signal station, Alderney 55
silver 27, 117
sinagot 41
skeleton construction viii, 40, 45
Skertchly, S B J 1, 7, 9, 11
Skuldeley, Denmark 115
slate 77, 81
slaves 46, 93, 96, 122
Slavonic tribes 91, 92
Slusegård, Denmark 98-9, 100-2, 103, 104; no 1072, 5m boat 98, 99, 102, 104, no 1131, 3m boat 98, 101, 133; no 1224 133; 10m boat 98; dating 103; resin caulking 131; expansion techniques 98, 103, 104, 131; location 99; oak 99, 104; sewn repairs 105; Snape compared 117, 133
Smallburgh, Norfolk 105
Snape, Suffolk: 1862 boat 126, 133
1987 boat (grave 0328) 99, 118, 126-34;
body 131, 132; caulking 131; date 131; grave-goods 131, 132, 133; internal curved stain 129, 131, 133; interpretation of stain 128-9, 131; method of excavation 126, 127-30; Slusegård compared 117, 133
Solinus 36
Somerset Levels 1
Somme, River 55, 73
Spain 55, 82, 93
speed of- vessels 43, 44
Spong Hill, Norfolk 119
stains see sandy soil
Stanley Ferry, Yorkshire 105
state formation, medieval 117-25
steering: bow and stern 79, 108, 110; paddles 40; stem projections and 43; see also: oars; rudders
Steinhuder Meer, Germany 91
stems 40; Blackfriars 1 67, 68; Bronze Age 40; Druten 77, 79; Frisian 92; hide boats 36, 39; joint with keel 43; Karlby 111, 113; late Iron Age planked ships 42, 43, 44; logboats 40; pre-Viking and Viking 114, 115; projections 42, 43, 44, 45; St Peter Port 53; stepped 114, 115
Stenkyrka, Gotland, Denmark 110
sterns 79, 111, 113, 129; posts 52, 53, 54, 67, 68, 92
Stilicho 94, 95
stocks 68
stone trade 46, 67, 71, 77, 81, 84
stones, engraved 42; see also: Gotland; Karlby
storms 11, 17, 18, 20, 21, 23, 24; surges 11, 20, 23
Strabo 27, 41, 46. 82, 83
strakes 49, 54; bilge 57, 61, 62, 64; rubbing 42; transition 75; wash- 33, 34
Strasbourg, France 32, 87
strengthening, longitudinal 108
Suetonius 81, 82
Suffolk 122, 123; see also individual places
Sulpicius Alexander 95
surf boats 39
sutiles naves 75
Sutton Hoo, Suffolk 117-25; aristocracy 119; coastline near 123; direction of burial 129; mound 1 ship 73, 111, 113, 114, 115, 122, 131, 133; mound 2 ship 133; trade 117; travel times from 121, 122
Sweden 42, 117; see also individual places
Switzerland 57-65, 75
Syrian textiles 117

Tacitus 79, 81
Taplow, Bucks 131
Tartessus, Spain 36
technological development 17, 40
Teredo borings 71
terpen 87, 91; Handelsterpen 86
textiles 83, 91, 117
Thames, River 18, 43, 45, 47, 71, 82; see also London
Theodoric the Great 85
Theodosius the Elder 95, 94
tholes 106, 107, 108, 110
Thorpe-by-Norwich, Norfolk 118
Thuringians 85
Tiber, River, Italy 82
tides; use for river navigation 71
Tiel, Netherlands 86, 92
Timaeus 36, 46
times, travel 121, 122
tin trade 27, 36, 46, 47
tolls 46, 87, 89
tombstones 45, 66, 79
Tømmerby, Denmark 99, 103, 105
tools 53, 57-8, 66
trade see individual areas and commodities and transshipment
Trajan's Column, Rome 79
transoms 33, 79
trans-shipment 11, 41, 46, 47, 82-3, 91
transtra (thwartships timbers) 41
treenails 33, 34, 53, 63; frames 111, 113-14; with iron nails 68, 70; locked 40
Trier, Germany 87
troop transporters 106-7, 108, 113
tugs, oared 44
Tune, Norway 115
Tunisia 41, 42

umiac (Inuit hide boat) 39
Unelli 38, 41
unloading of ships 46, 47, 82
Ushant, France 36, 38, 41, 46
Utrecht, Netherlands 61, 75, 77, 86, 89, 92

Vaale, Germany 104, 105
Valsgärde, Denmark 129, 133
Varnes 85, 86
Vechten, Netherlands 73, 75
Vectis (Isle of Wight) 46
Velsen, Netherlands 61, 75, 89
Venantius Fortunatus 96
Vendel 133
Venelli 38, 41
Veneti viii, 38, 41, 44, 45, 46, 66, 70
Verulamium 71, 73
Victoria, Lake, Africa 42
Viking age viii, 88, 92, 105
Vilaine, River, France 38, 41
Vita Anskwii 87
Vita Bonifatii 87
Vortigern 90

Waal, River, Netherlands 77, 80-1
Wainway Channel, Kent 10, 12, 13, 14
Walcheren, Netherlands 81, 83, 85; see also: Colijnsplaat; Domburg
wales 42, 43, 44
Walton, Surrey 105
Watten Sea 89, 91, 92
Weald, Sussex 11
weather patterns 24
wedges 33
Welland-Glen estuary, Lincolnshire 5, 8
Wessex 96
Weymouth Bay, Dorset 47
Wicken Bonhunt, Essex 119
wickerwork hulls 36, 39
Wight, Isle of 38, 46, 90
Wilhelmshaven, Germany 91
willow shavings as caulking 49
Winchester, Hampshire 89
winds 19, 21
windward performance 43
wine 46, 82, 83
Woensam, Antonius 79
Woerden, Netherlands 62, 75
wool 83, 91
Worms, Germany 85, 87
Wrangle Haven, Lincolnshire 5, 8
wrist-clasps, Scandinavian 117

Yeavering, Northumbria 118
York 87, 118, 133
Yverdon, Switzerland 57, 62, 64, 75

Zedelgem, Belgium 89
Zeeland Islands, Netherlands 85
Zosimus 95
Zwammerdam, Netherlands 77, 80; boats viii, 61, 63, 73, 75-6, 79, 81, 82