DEPARTMENT OF URBAN ARCHAEOLOGY MUSEUM OF LONDON
CHIEF URBAN ARCHAEOLOGIST: BRIAN HOBLEY

PROBLEMS AND POSSIBLE CONCLUSIONS RELATED TO THE HISTORY AND ARCHAEOLOGY OF THE THAMES IN THE LONDON REGION

G. H. WILLCOX

INTRODUCTION

In the first century A.D. the level of the Thames in the City was perhaps as much as 4 m. below its present high tidal level[1] and because the probable mean sea-level in the Thames estuary was below this level,[2] it is unlikely that the London Thames (to mean the Thames in the region of the City) was appreciably affected by tides. A continuous rise in sea-level since the Pleistocene period in relation to the land has radically altered the whole regime of the lower Thames. Thus settlement in the area has had to adapt to these changes and it is clear that the recent concern which has led to the raising of the embankments is a repetition of what went on in the past. However, an understanding of the history of the London Thames can only be based on fragmentary evidence, making it all too easy to make misleading statements based on assumptions and insubstantial data. This is partly due to the fact that the evidence comes from a wide variety of specialized disciplines and further, the multiple interacting factors acting on the river constitute a very complex and constantly varying system. It would, therefore, seem useful to outline these factors, followed by a discussion of the evidence and problems of interpretation.

PRINCIPLES AND PROBLEMS

There have been nine basic variable factors acting upon the Thames, causing it to undergo various changes. (1) Post-glacial eustatic rise in sea-level. During the last glaciation considerable amounts of water were locked in the form of ice sheets, causing a universal lowering of the sea-level. As the ice melted, the sea-level began to rise. This universal rise in sea-level began to peter out *c.* 4,000 years ago.[3] (2) Isostatic readjustment of the land is also connected with the last glaciation when huge amounts of ice in the north of Britain depressed the surface causing uplift in the south. Disappearance of the ice has thus resulted in a lowering of the land surface in southern Britain. (3) Tectonic movements associated with the London Basin syncline may have caused depression of the land surface. (4) Subsidence and compaction of deposits, no doubt, exerted a considerable influence.[4] Erosion, both, (5) down-cutting and (6) lateral movement of the river channel, combined with, (7) deposition, are ever present factors which affect, (8) changes in tidal regime, as do (9) flood prevention schemes, dredging and bridge building.[5] To this one must add the influences of changes in climate, inland ecology and drainage.

These factors are interacting and interdependent, producing a complex variable system acting upon and changing the volume, rate of flow, the meander system, depth and width, salinity, tidal regime, including position of the head and amplitude. The overwhelming influence on the river has been the relative rise in sea-level in relation to the land, resulting from subsidence and/or a universal rise in sea-level—this process appears greater in London than elsewhere in Southern Britain.[6]

To come to conclusions on these changes one needs accurately dated deposits related to O.D. (Ordnance Datum Newlyn), because the actual relationship between exposures is often lost and, further, their areal distribution is usually limited. Complications also arise because it is difficult to distinguish between material which is derived and that which represents the actual conditions of deposition.

Pre-Roman River

During the latter part of the Pleistocene the Thames underwent a number of changes resulting from large scale variation of sea-levels and climate. These changes are manifest in three main gravel terraces,[7] the Boyn Hill Terrace, the Taplow Terrace on which the City is partly sited and where it is capped by brickearth, and the Flood Plain Terrace, less than a metre above O.D. The latter is the most recent and extensive. It is represented, for example, by the gravels at Westminster and Southwark. A full understanding of these complex series of gravels is complicated by an apparent series of buried channels.[8] The low sea-level known to have existed at the end of the last glaciation must have led to deep erosion of the channel, but by the beginning of the Holocene, eustatic raising of the sea-level began to flood the Thames estuary from the east, causing deposition of silts, forming a wedge which becomes progressively thinner to the west, where only later deposits are present. This marine transgression is interrupted by three recessions indicated by peat layers,[9] the most recent at just below O.D., is the only one to stretch as far as the City. It is dated by a number of radiocarbon dates to the Iron Age and Roman periods and was seen in sections exposed at New Palace Yard, Westminster, Mark Brown's Wharf and Courage Breweries[10] (see Fig. 1), but should not be confused with highly organic deposits so commonly encountered on sites in the City, for the majority is of cultural origin. However, for the immediate pre-Roman period there

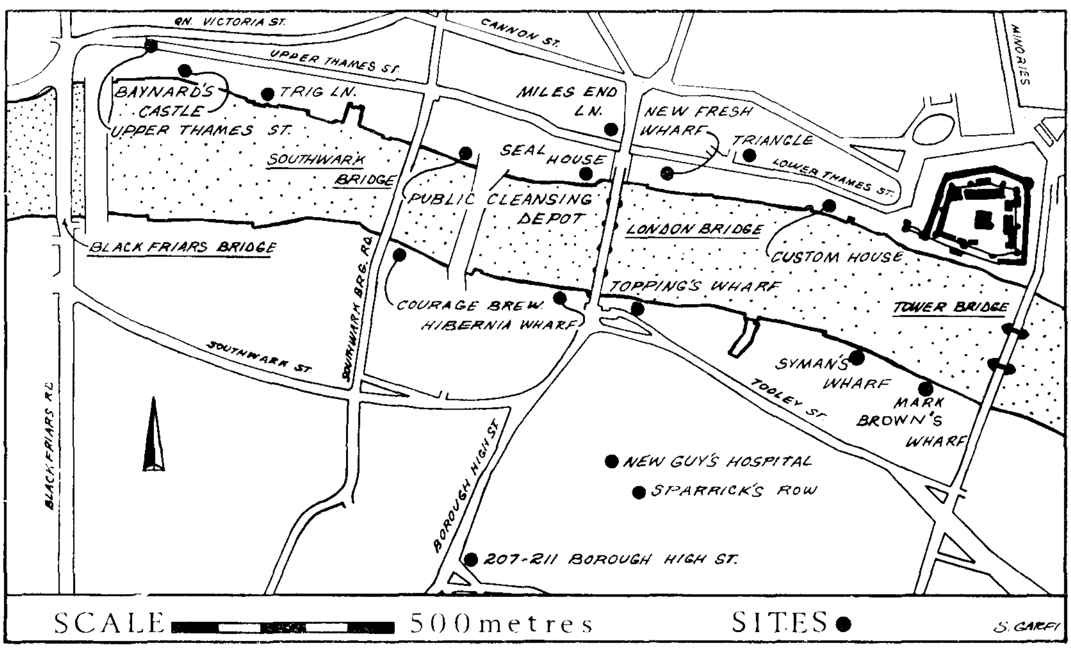

Fig. 1. The Thames in the London Region. Site location map

are virtually no suitable sites so far excavated which provide *in situ* indications of occupation at a suitable elevation along the Thames, possibly because of erosion or burial by more recent deposits. Numerous finds of Iron Age pottery from Brentford to Tilbury offer little in the way of concrete data.

Given the low sea-level, the London Thames must have looked very different from today. Woodley[11] suggests that if the Thames was tideless and a "free flowing river, disregarding dry weather of summer and only considering the average winter flow . . . , the channel would be 200 feet wide with an average depth of 4 feet". Reasonable estimates of the size of the hypothetical pre-Roman river are difficult to make. In the past, many authors have suggested that the river was wider in Roman times, but given the decreased volume of saline water and the decreased damming effect of a low sea-level, we can conclude that the channel was considerably smaller before it was flooded by the sea. The present river is *c.* 900 feet wide, with an average depth of 30 feet at high tide at London Bridge.

One can infer that between the end of the last glaciation and the Roman period, the Thames around London would have been a fairly fast running, tideless river, continually cutting into its banks and changing its course, forming sand and gravel banks. This is particularly evident at Southwark, where a complex series of sands and gravels underlie Iron Age material in some areas, while in other lower regions material is covered by the later silt and peat strata associated with the progressive flooding of the estuary from the east.

Other silts and sands in the immediate Southwark region have been found to cover Iron Age material between 0.5 m. and 1.3 m. O.D. at sites such as 106 Borough High Street and Toppings Wharf. In the light of other evidence these deposits would appear to have been laid down during exceptional floods when the river burst its banks. This would require the flood waters to raise the level of the Thames by at least 1.5 m. which, with a more restricted channel, is by no means unlikely.

Roman Period

Roman material has been found at approximately O.D. at Brentford,[12] Southwark,[13] Tilbury[14] and the North Kent Marshes,[15] which indicates that the river was below this level. Evidence from Roman waterfronts in the City (see Fig. 2) corroborates these data, showing the level of the Thames was 4–4.5 m. below the present Trinity High Water Mark, which agrees with estimates made by Akeroyd, as well as estimated average rates of subsidence and/or sea-level rise made by d'Olier for the last 9,000 years. However, changes in tidal regime suggested by Bowen[16] and Longfield's[17] data from comparison of levellings, demonstrate the difficulty of determining mean levels even with modern, relatively precise data.

Needless to say, one can make some suggestions, for example, since the land in London was higher in relation to the mean sea-level (the recently excavated waterfronts are over 4.0 m. below the present high tide level, though they may only represent subsidence of 3.0 m. if one takes into account changes in tidal regime) it would have been less affected by tides. Indeed, Akeroyd and Spurrel[18] suggest that the tidal head may have been as far east as Dagenham and Crossness. Analysis of organic remains from various localities indicate that fresh water conditions prevailed east of the City, though this does not preclude a tidal river. Information from the Thames Water Authority shows that today freshwater conditions can stretch as far as Woolwich after a rainy period, while after a dry period saline conditions may reach as far as Barnes. Since the channel may have been relatively deep due to erosion

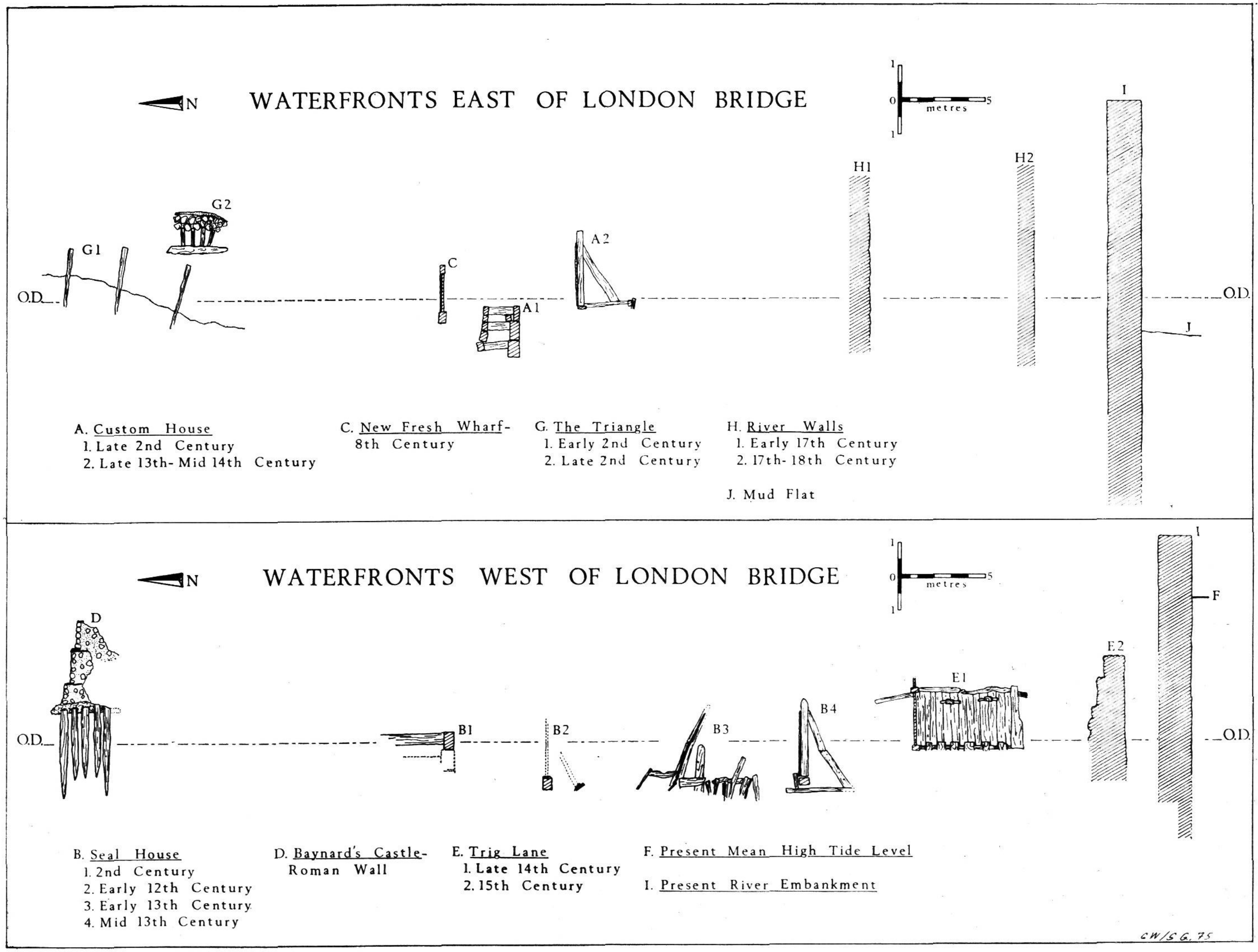

Fig. 2. The Thames in the London Region. Sections showing ancient waterfronts as revealed by archaeology in relation to ordnance datum, mean high tide and the modern embankment. The structures have been **artificially aligned on a north-south axis**

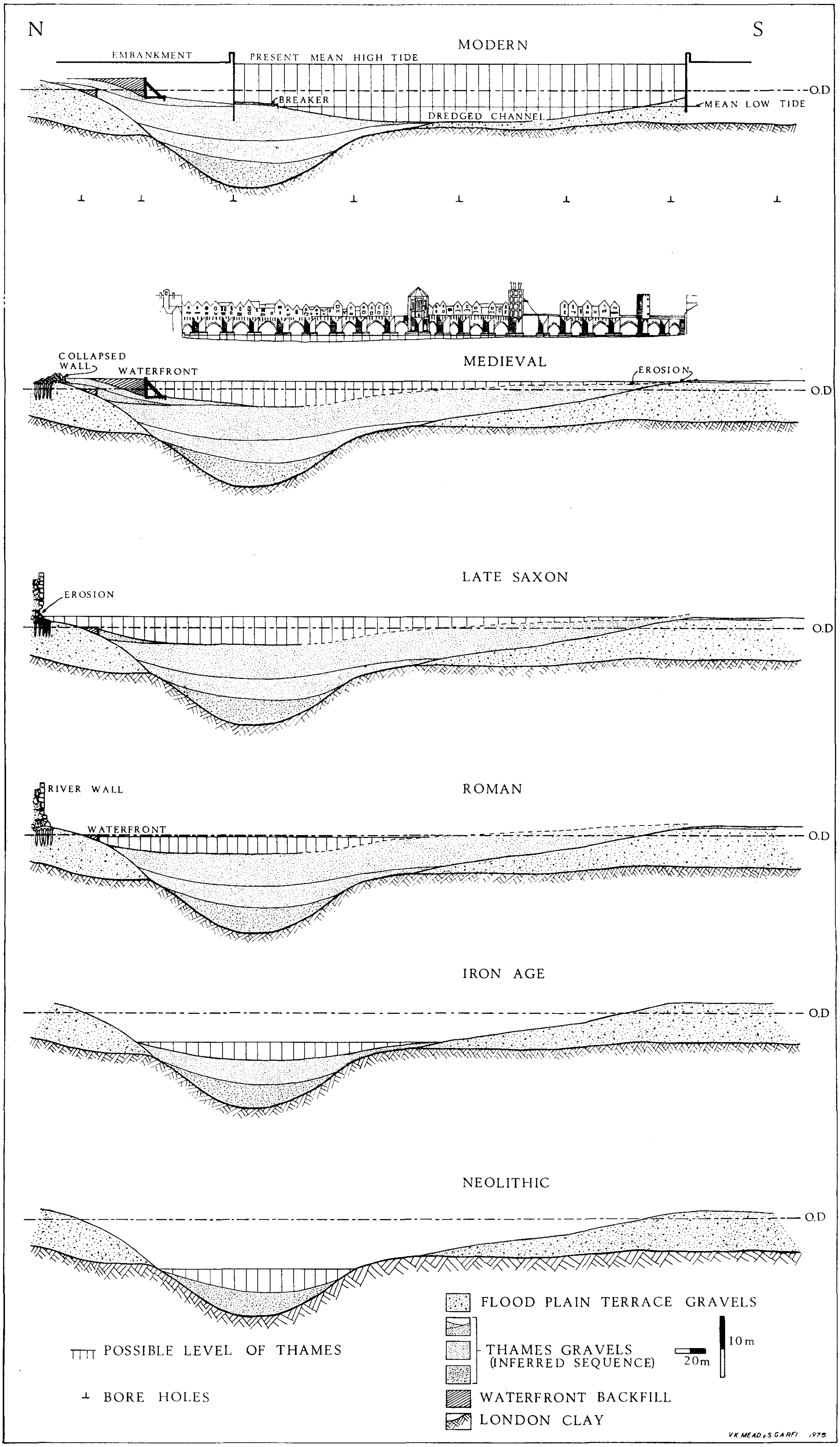

Fig. 3. The Thames in the London Region. The tentative reconstruction of sections across the Thames at London Bridge, based on data from boreholes, archaeology and past sea-levels. The sections of river gravels and the base of the channels are hypothetical (medieval bridge not to scale)

during the low sea-level, it is plausible that the London Thames was marginally affected by tides, but obviously the position of the tidal head is extremely variable depending on factors mentioned in the first section and, added to these, one can include the effects of spring tides and meteorological conditions. At present our data is too insubstantial to state the position of the tidal head even within broad limits.

Roman waterfronts at Custom House, New Fresh Wharf and Seal House (see Figs. 1 and 2) suggest that the north bank of the channel lay in a more northerly position, implying that the south bank (assuming a narrower channel) would have been well out into the present river and may have subsequently been eroded away. Further evidence from recent boreholes beneath London Bridge[19] shows a greater thickness of deposits towards the north bank, implying that the channel has migrated in a southerly direction at this point (see Fig. 3). Further downstream at Custom House the earlier Roman waterfront was set further back than the later one. At the former there is some evidence of erosion and it is likely that the river was susceptible to flooding by storm waters (which is not the case today) and this possibly explains the revetments found at Miles Lane,[20] the Walbrook[21] and those recently discovered at Triangle (see Fig. 1) which were constructed on the unstable banks to prevent erosion. We do not know the exact width of the river in Roman times, but since the channel must have been only marginally affected by the sea, the volume of water in the channel must have been considerably less than at present. Though the river appears to have been much smaller, it was ample for navigation by large Roman craft which have been found at several sites.[22]

Post-Roman Period

Between the fourth and eleventh centuries A.D. there is a dearth of archaeological evidence related to the Thames. Material of this period is almost entirely absent at Custom House. At the recently excavated site near Billingsgate (New Fresh Wharf, report forthcoming, see Fig. 1), a waterfront of stone and timber, dated to the eighth century, was found above a Roman quay which was at O.D. It is clear from evidence at New Fresh Wharf and later medieval sites that subsidence and/or an increase in the mean sea-level brought about a rise in the level of the river causing it to become increasingly affected by tides, so increasing its volume and width to such an extent that the Roman waterfronts went out of use (see Fig. 3). Thus the Saxon waterfronts, where they exist, may be located above and further to the north of those of Roman date.[23] It seems plausible that as the level of the river rose it reached a maximum width at the beginning of the medieval period causing the erosion noted at Custom House,[24] Toppings Wharf,[25] Hibernia Wharf,[26] Upper Thames Street[27] and at the Public Cleansing Depot[28], and following this period it became artificially constricted by the construction of quays, wharves and embankments. During the twelfth century documentary evidence[29] from Fitz Stephen's *Descriptio Londoniae* tells us that, "On the South, London was once walled and towered . . . but the Thames that mighty river teaming with fish . . . has in the course of time washed away those bulwarks, undermined and cast them down". This reference corroborates our earlier hypothesis and is further substantiated by archaeological excavation beneath Upper Thames Street where Millett and Hill[30] both found the eroded wall, the base of which was between 1.1 m. and 1.4 m. O.D., implying that the mean high tide was at least at that height when the erosion occurred.

Insufficient evidence precludes any interpretation of the nature of the tides for the medieval period, though we know that by the eleventh century navigation on the London Thames was affected by tides,[31] and at about this time too according to Evans[32] the first innings were constructed on the north Kent marshes when land at a similar elevation became subject to flooding. Construction of innings, river walls and embankments during the medieval period may have increased the tidal amplitude by reducing the volume to be filled by the incoming tide,[33] so necessitating further heightening of embankments.

By plotting the maximum height of all the known waterfronts against time of construction, a positive, continuous rise in the level of the Thames is indicated (see Fig. 4). However, these data should not be taken as an accurate measurement, for one cannot rule out factors such as differential subsidence, or that the highest point (which could be missing) represents the mean high tide level. Looked at in broad terms it does give us parameters in relation to O.D. to tie in with other areas where waterfronts are absent. At a number of sites deposition of silts provides evidence. For example, in Southwark, east of London Bridge, unconsolidated silts overlie a peat layer at Mark Brown's Wharf up to a height of *c.* 2.5 m. O.D. which in turn lies beneath late and post-medieval archaeological deposits.[34] Similar silts were noted at building sites at Symons Wharf, Courage Breweries, Sparricks Row,[35] and Guy's House.[36]

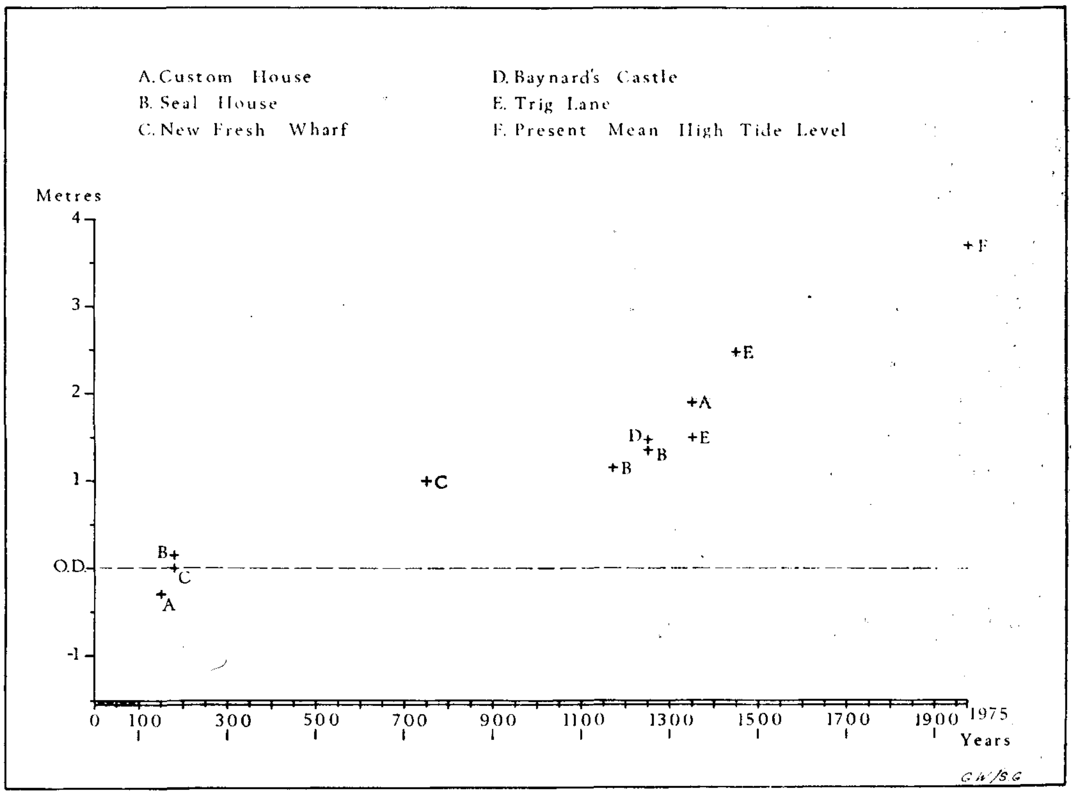

Fig. 4. The Thames in the London Region. Graph showing relationship between maximum known height of the waterfronts on the north bank of the Thames in the City against time of construction. (Since going to press Mr. John Schofield informs me that the eighth century level from New Fresh Wharf is inaccurate and should be disregarded.)

On the north bank river silts were found with Pingsdorf ware of the twelfth century overlaying gravels with Roman material at the site of the Public Cleansing Depot. These post-Roman silts were, no doubt, laid down at high tide level in the same manner as deposition occurs in saltings today and are associated with the continued progressive flooding of the estuary. Seen in relation to Fig. 4 they are corroborative of a positive continuous rise in sea-level. The distribution of silts in Southwark indicates that the pattern of embankment in the area was not as it is now. Indeed, there would appear to have been an area to the east and possibly the west which was flooded at high tide. The Roman boat found at Guy's House[37] suggests that this area was navigable prior to the deposition of the bulk of the silts and even as late as the eleventh century, there is historical documentation of Cnut cutting a channel and dragging his ships around the south of Southwark.[38] Possibly a pre-existing but partially silted channel was utilized. An absence of silts in the immediate bridgehead area suggests that some form of embankment must have been present unless differential subsidence has occurred, so that it might be possible to predict where the embankment lay by plotting the distribution of silts. The silts themselves are much finer than those laid down during the Roman period so one can conclude that the river was slower moving. If areas were still not embanked as it would appear, then the force of the tides would be less than at present. In summary, during the medieval period the London River was wider, shallower, with less of a tidal amplitude than it has today.

The construction of the medieval London Bridge in the twelfth century had a considerable effect on the tidal regime. According to Home[39] the starlings and later waterworks constricted the width of flow to one sixth, thus creating a weir which at low tide caused the water downstream to be three to five feet lower than that upstream of the bridge. It is not surprising, therefore, that there are numerous reports of repairs being carried out on the starlings and in some cases even the arches collapsing. The force of water was a hazard to navigation. When the bridge was demolished in 1832 erosion was so severe that it seriously threatened the foundations of Mylne's neighbouring bridge at blackfriars and of Old Westminster Bridge.[40]

Since the medieval period artificial structures increasingly affected the London Thames. It progressively became more restricted by the gradual encroachment by wharves, buildings and embankments, which arrested its natural evolution. The encroachment of embankments can be seen on an accurate 1″:100′ plan from London Bridge to Cuckold's Point drawn by Greenvil Collins in 1684 which is now in the Guildhall Library.

The most dominant change in the river since the medieval period has been not in plan but in depth of the channel (see Fig. 3) and tidal regime—hence the numerous records of floods right up to the present time. This would appear to result from (a) continued subsidence of the land and (b) an increased tidal amplitude resulting from encroachments which reduce the volume, and more recently the effects of dredging. Heightening of the embankments has continued right up to the present day, and the risk of serious flooding is as much a danger today as it was in the past.

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NOTES

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