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Lower and early Middle Palaeolithic of Southern Britain: the evidence from the River Test

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Abstract

Fluvial terrace sequences of Pleistocene rivers provide a chronological framework for examining broad patterns of change in the Palaeolithic record. Collections of artefacts recovered from individual terraces represent a time-averaged sample of the range of lithic technology discarded in a river valley over thousands of years. These can be compared and contrasted with other terraces to identify the timing of the appearance of key technological innovations and chronological variation in lithic technology. In Britain, the punctuated nature of human presence during the Pleistocene means that archaeological variation across a river terrace sequence is likely to relate in part to successive phases of occupation by human groups derived from populations in mainland Europe. This paper presents an analysis of the Lower and early Middle Palaeolithic record of the River Test, Hampshire, which was a tributary river of the former River Solent. The timing of the first appearance of handaxes and Levallois technology is established and chronological patterning in handaxe typology and technology is identified. The Test record is placed in its regional context and its implications for understanding the human occupation history of northwest Europe during the Middle Pleistocene is discussed.

Key words: Middle Pleistocene, Palaeolithic, Acheulean, Levallois, handaxes, Solent, River Test

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1. Introduction

In recent years, a major focus of research of the Middle Pleistocene human record of northwest Europe has been identifying the timing of human presence and its relationship to changing climate, environments and palaeogeography (e.g. White and Schreve 2000; Ashton and Lewis 2002; Parfitt et al. 2005, 2010; Roebroeks 2006; Ashton et al. 2011; Dennell et al. 2011; Antoine et al. 2015; Moncel et al. 2015; White et al. 2018). Alongside this has been continued interest in temporal patterning in the archaeological record, and whether spatially and temporally discrete variation in lithic technology can be attributed to cultural differences or ecological and/or behavioural situational circumstances (e.g. Moncel et al. 2015; White et al. 2018, 2019; Davis and Ashton 2019; Ravon 2019; Shipton and White 2020). Our understanding of these issues is gained from a record that provides a range of resolutions, from the brief moments in time that represent single events of past human behaviour, sites in primary context that represent human occupation of a specific place over a limited time period, to the time-averaged lithic assemblages found in secondary context in fluvial gravels, which may represent the aggregate of human technological behaviour in a river valley across tens of thousands of years.

Each of these three broad assemblage types have their strengths and weaknesses in terms of understanding human occupation history. All three provide evidence of human presence, which may be attributable to brackets of time often defined by correlation with reconstructions of past climatic variation, and can therefore be used to help map human presence and absence through time and space. Sites in primary context, especially those with refitting lithic assemblages, can provide fine-grained detail of human behaviour and, where environmental information is preserved, habitat. However, the problem of demonstrating contemporaneity and the influence of raw materials, site function and other situationally-determined factors have in the past hindered the recognition of chronological and cultural patterning, despite the fact that it has long been recognised that sites could be grouped on the basis of artefact morphology (e.g. Roe 1968a). This situation has now changed with improved chronological frameworks and dating methods. In Britain, chronological patterning has started to emerge from both the primary and secondary context records that cannot be fully explained by raw material, resharpening or site function (Shipton and White 2020). Instead, it has been suggested that it represents successive phases of colonisation by human groups bearing distinctive lithic technology (Wenban-Smith 2004; Bridgland and White 2014; White et al. 2018, 2019; Davis and Ashton 2019; Shipton and White 2020; Davis et al. 2021). In the case of the British Marine Isotope Stage (MIS) 11 record, where multiple sites can be correlated with a sufficiently high degree of resolution, it may be possible to begin to identify cultural groupings and their territories (Ashton et al. 2016; Davis and Ashton 2019; White et al. 2019; Ashton and Davis in press).

The many thousands of artefacts recovered from the sands and gravels of Pleistocene rivers provide a much coarser view of past human occupation. This material, which forms a significant part of the Lower Palaeolithic record, is largely in secondary context, derived and mixed. It is time-averaged, potentially representing human presence over thousands of years, and affected by a series of biases introduced by the unsystematic nature of recovery (Hosfield 1999). Consequently, this record is often dominated by handaxes, with other artefact categories underrepresented. The fact that it is divorced from its context of manufacture, use and discard has meant the secondary context record has sometimes been considered to be behaviourally uninformative (e.g. Wymer 1968). However, the characteristics of this record mean that it is well placed to support examination of patterns of change through time, albeit at a coarse scale of resolution and so long as its inherent biases can be mitigated (Gamble 1996; Wenban-Smith 2001).

A Pleistocene river terrace sequence provides a relative chronological framework, which becomes a more useful tool if it can be dated and correlated with the marine isotopic record (Bridgland et al. 2006). Artefacts within the sands and gravels that form a terrace are likely to include a sample of the full-range of lithic technology used and discarded within the river valley during the period of time over which that terrace formed (Wenban-Smith 2001). Variation related to factors such as site function, social setting, resharpening and skill should be represented within the sample from each terrace. By comparing terrace records, the first appearance of key technologies, broad patterns of change in the lithic record and the relative intensity of occupation can be examined (Wenban-Smith 2001; Ashton and Lewis 2002; Bridgland et al. 2006; Ashton and Hosfield 2010; Ashton et al. 2011). In Britain, where human presence is punctuated by long periods of absence during cold climatic stages, successive terrace records are likely to relate to successive phases of repeopling of the southern British landscape. While a terrace record may include material culture relating to multiple human groups that occupied the river valley during the same climatic cycle, a terrace sequence can still provide a framework of change against which primary context sites can be considered.

This paper examines the Lower and Middle Palaeolithic archaeology of the River Test (Hampshire, UK), which was a tributary of the River Solent during much of the Pleistocene. The archaeological record of the Solent river system is a relatively untapped source of information regarding the character of Lower Palaeolithic occupation of southern Britain. In terms of numbers of sites and artefacts, the Solent is one of three major concentrations of Lower Palaeolithic material in Britain (Wymer 1999), yet, unlike the Thames and East Anglia, the Solent is little more than a footnote in recent syntheses of the British Lower Palaeolithic (e.g. Pettitt and White 2012). This relates to difficulties in producing a robust chronology for the terraces of the region, problems correlating the terrace sequences of the region's various rivers and uncertainty over the precise context of much of the archaeological material (Wenban-Smith and Hosfield 2001; Ashton and Hosfield 2010). However, a number of recent studies have begun to overcome these issues (e.g. Hosfield 1999; Bates et al. 2004, 2007; Briant et al. 2006, 2009b, 2012; Westaway et al. 2006; Ashton and Hosfield 2010; Harding et al. 2012; Davis 2013, 2014; Hatch 2014; Davis et al. 2016; Egberts 2016; Hatch et al. 2017; Egberts et al. 2020), so that it is now possible to start to consider aspects of the region's archaeological record in the context of broader debates in Palaeolithic archaeology.

An analysis is presented of the large quantity of Palaeolithic material that has been recovered from the extensive spreads of fluvial gravels preserved in the Test Valley and its tributaries, most notably the River Itchen, and along the eastern side of Southampton Water (hereafter referred to collectively as the Test). Recent mapping and dating work on these deposits (Briant et al. 2012; Harding et al. 2012; Hatch et al. 2017) provide the chronological framework to assess how the archaeological record changed through time and allows questions to be addressed regarding the settlement history of southern Britain during the Middle Pleistocene.

2. The River Test

The River Test rises near Ashe in Hampshire and flows southwards to Southampton where it meets the River Itchen (Fig. 1). The lowest reaches of the Test were inundated in the early Holocene, probably by eustatic sea level rise (Hodson and West 1972), resulting in the formation of Southampton Water. However, prior to this, and prior to the breaching of the Purbeck-Wight monocline during the late Middle/Late Pleistocene (Preece et al. 1990; Velegrakis et al. 1999; Westaway et al. 2006), the Test was a left-bank tributary of the River Solent, which itself was a tributary of the Channel River system during low sea-level stands (Gibbard 1988; Lericolais et al. 2003; Gupta et al. 2007). Thus, during the early Palaeolithic, the Test was at times connected to other parts of Britain and northwest Europe via fluvial networks.

2.1. Geological framework

The upper reaches of the Test flow across Chalk bedrock and in this portion of the valley there is limited preservation of Pleistocene deposits. This changes near Dunbridge, where the transition to Palaeogene marine sands and clays marks a change in the river rejuvenation regime (Allen and Gibbard 1993; Hosfield 2001). Periodic lateral downcutting to new base levels has resulted in the preservation of large swathes of fluvial sands and gravels on both sides of the valley between Dunbridge and Southampton and on the eastern flank of Southampton Water. British Geological Survey (BGS) mapping of the deposits from Romsey to Portsmouth

(Sheets 315 and 316) recognises a sequence of 11 terrestrial terraces and three submerged terraces under Southampton Water, the lowest of which is infilled with Holocene deposits (Edwards and Freshney 1987). The BGS mapping of the deposits north of Romsey (Sheet 299) identifies fewer terraces and employs an independent numbering system (Booth 2002). Consequently, in some cases upstream and downstream correlates have different terrace numbers. This issue has been addressed in a number of recent studies of the Test's terrestrial terraces, which have employed different methods to provide a series of unified but competing mapping schemes for the Test terraces (Table 1).

Westaway et al. (2006) produced a revised mapping scheme based on a study of terrace surface heights cross-referenced with outcrop data from Edwards and Freshney (1987) and introduced a new nomenclature based on named stratotypes. This scheme was revised by Harding et al. (2012). A separate study of the Test terraces was undertaken as part of the Palaeolithic Archaeology of the Sussex/Hampshire Coastal Corridor project (PASHCC; Bates et al. 2004; Briant et al. 2012). The PASHCC scheme is based on correlation of gravel thicknesses provided by 96 BGS boreholes, 12 PASHCC project test pits and the Dunbridge test pits reported by Bridgland and Harding (1987). Most recently, Hatch (Hatch 2014; Hatch et al. 2017; Fig. 1b and Fig. 2) reassessed the Test terrace mapping employing the PASHCC gravel envelope method but drawing on a larger dataset. This comprised 280 BGS borehole records, 30 synthetic boreholes inferred from ground penetrating radar (GPR) survey of areas with poor borehole coverage and 41 other records drawn from published sections/logs. This increased dataset reduces the issue of intra-terrace variation in gravel thickness whilst also avoiding the pitfalls of correlating terrace fragments using surface heights alone (Briant et al. 2012), and it is the Hatch scheme that is employed in the current study.

Detailed comparisons between these three schemes are provided by Briant et al. (2012) and Hatch et al. (2017), with the main differences summarised in Table 1. They are largely in agreement regarding the terrace stratigraphy between Romsey and Southampton, with some minor differences in their mapping of the higher, more fragmentary deposits. There is more significant disagreement over the mapping of the gravels in the Warsash area and north of Romsey. The PASHCC scheme endorses the BGS mapping of the Warsash area gravels, with the lowest aggradation flanking Southampton Water assigned to Terrace 2, the main spread of gravel underlying Warsash assigned to Terrace 3 and the large gravel spread underlying Locks Heath to the north and east of Warsash assigned to Terrace 5, 6 and 8. The Westaway/Harding scheme differs only in the division of the gravel underlying Warsash into their Lower Warsash and Upper Warsash terraces (BGS Terraces 3 and 4). The Hatch scheme also recognises this division, based on the projection of 48 borehole/section logs onto a NE-SW profile (Hatch et al. 2017: Fig. 7). This shows four altitudinally-distinct aggradations, the highest assigned to the Mallard Moor terrace (BGS Terrace 5) with a bedrock-gravel contact at c. 26 m OD, then the Upper Warsash terrace at c. 18 m OD, the Lower Warsash terrace at c. 11m OD and the Hamble terrace (BGS Terrace 2) at c. 7m OD. This work also identified several areas south of Warsash where gravels previously mapped as Hamble terrace are in fact altitudinally more consistent with the Lower Warsash terrace. Further analysis of boreholes in the Locks Heath area indicated that the southern portion of the gravel spread previously assigned to the Nursling terrace (BGS Terrace 6) is more consistent with the Mallards Moor terrace, and also identified gravels consistent with the Bitterne terrace (BGS Terrace 7).

The PASHCC, Westaway/Harding and Hatch schemes differ significantly in their mapping of the terraces in the area of Dunbridge, largely due to different gradients being employed to project the terraces of BGS Sheet 315 northwards into BGS Sheet 299. Harding et al. and Hatch also have the benefit of additional data points from sections recorded during the watching brief at Kimbridge Farm Quarry (Harding et al. 2012). These support previous observations of the presence of two terraces at Dunbridge and Kimbridge, which Westaway/Harding and Hatch assign to the Mottisfont and Belbin terraces. In contrast, the PASHCC scheme does not recognise this division and, employing shallower long profile gradients, assign the whole Dunbridge/Kimbridge gravel spread to the Ganger Wood terrace (their Terrace 5), although Briant et al. (2012) acknowledge the difficulty of separating Terrace 4 and 5 of their scheme in this area. North of Dunbridge, the only data points are provided by test pits excavated by PASHCC at Mottisfont Field, Great Copse, Yewtree Cottage and Spearywell Wood (Bates et al. 2004; Briant et al. 2012). The fluvial sediments encountered are attributed by PASHCC to the Mallards Moor, Bitterne (their Terrace 7) and Midanbury (their Terrace 8) terraces, and the Belbin, Nursling, Bitterne and Midanbury terraces in the Hatch scheme. The additional terrace in this area in the Hatch scheme reflects the difference in the altitude of the gravels in Yewtree Cottage Test Pit 4 (c. 65 to 68 m OD) and at Spearywell Wood (c. 73 to 77 m OD), which PASHCC and Harding et al. assign to the same terrace (Midanbury terrace).

Given the differences outlined above, the use of one scheme over another has implications for understanding the archaeological record. The majority of the Test sites, however, are associated with gravels assigned to the same terrace in each of the schemes, particularly in the Romsey and Southampton areas (Table 1). In the Warsash area, most of the material is from gravel pits and coastal exposures associated with the Hamble and Lower Warsash terraces in all three schemes. Importantly, the detailed study of this area by Hatch et al. (2017) has fine-tuned the mapping of these terraces, with the result that a much larger portion of the Warsash Palaeolithic record can be assigned to specific terraces (Davis et al. 2016). The different interpretations of the gravels in the Dunbridge area have more significant implications. Under the Hatch and Westaway/Harding schemes, the large collection of Palaeolithic material from the Dunbridge Pit and the smaller assemblages from the old Kimbridge Pit and Kimbridge Farm Pit are assigned to the Belbin and Mottisfont terraces respectively. Under the PASHCC scheme, these sites are assigned to the higher and therefore older Mallards Moor terrace. Likewise, the three waste flakes and one handaxe recovered from the test pits at Great Copse (Bates et al. 2004) are assigned to the Nursling terrace under the Hatch mapping scheme and the older Bitterne terrace under the PASHCC scheme. The implications of the use of the Hatch scheme in the current study are revisited in section 5.1.

2.2. Chronological framework

The terrace sequence provides a relative chronological framework for examining the archaeological record. However, if the Test's record is to be drawn fully into broader debates, it is necessary to correlate its terraces with the marine isotope record. This has been a problem for the Test and the Solent sequence more broadly, largely due to the dearth of interglacial fossil-bearing sediments prohibiting the use of biostratigraphical methods to provide dating control. Instead, recent research has turned to optically-stimulated luminescence (OSL) to provide age estimates for the emplacement of fluvial sands (Table 2 and Fig. 3).

PASHCC report a series of OSL age estimates for sediments related to the Broadlands Farm, Hamble, Mallards Moor, Nursling and Bitterne terraces, with only those from the lowest two terraces deemed reliable (Bates et al.

2010; Briant et al. 2012). Replicate samples taken from the cliff exposure at Solent Breezes provide a coherent set of age estimates for the Hamble terrace, indicating emplacement during a colder phase of MIS 7 (Briant et al. 2012). This is likely to be MIS 7d, a period of significant cooling that that has been associated with terrace formation in other UK rivers such as the Severn-Avon (Bridgland et al. 2004) as well as in the Somme in France (Antoine et al. 2007, 2015). Bates et al. (2010) suggest the Hamble terrace can be correlated with a period of downcutting identified in the Sussex raised beach sequence and related to a low sea-level stand during MIS 7d.

Hatch et al. (2017) report an OSL age estimate of MIS 7/6 for the Hamble terrace and MIS 8/7 for the Lower Warsash terrace. The Hamble terrace estimate is in agreement within errors of all four PASHCC estimates. The Lower Warsash estimate also has a midpoint that falls within MIS 7 and overlaps within errors of all the Hamble terrace estimates. Given that this sample is from a demonstrably higher aggradation, it is suggested that the Lower Warsash terrace was formed during MIS 8, but the ages also suggest that the emplacement of the Hamble and Lower Warsash terraces occurred relatively closely in time. Again, parallels can be found in the other river valleys mentioned above, where two terraces span MIS 8/7.

Age estimates for the Mottisfont gravel, which is the upstream correlate of the Lower Warsash terrace under the Harding et al. and Hatch schemes, are provided by Harding et al. (2012). Of 10 samples taken from two adjacent sections through the Mottisfont terrace sediments, 6 provided age estimates deemed to be reliable. These provided a wide range of results, some with large error margins, with midpoints falling in MIS 8, 9 and 10, and errors from MIS 9/7 to MIS 11/8. Three samples taken from the same sand unit at 15 cm intervals (1A, 1B and 1C) provide the widest spread of ages, with a weighted mean age of 277 ± 18 ka. This would suggest emplacement of the Mottisfont terrace during MIS 8. The weighted mean age of all six samples is 305 ± 25 ka, which equates to MIS 9/8. Only one sample (1C) overlaps with the age estimate for the Lower Warsash terrace. The spread of these results neither contradicts nor provides conclusive support for either of the terrace scheme interpretations of the Mottisfont gravels (Section 2.1).

There is no reliable independent dating of any of the terrace sediments above the Mottisfont/Lower Warsash terrace. It is widely agreed that terrace formation occurs in response to global changes in climate and land surface uplift, and that the main body of terrace gravels are deposited during periods of cold climate. In some river systems such as the Thames and the Somme where the terraces have been correlated through biostratigraphy, amino-stratigraphy, or geochronology to Marine Isotope Stages, most terrace aggradations are related to a glacial-interglacial cycle (Bridgland 1994, 2006; Antoine et al. 2017, 2019). If this model applies to the Test, then as many as eight major cold stages might be represented by the gravel aggradations above the Lower Warsash terrace.

An alternative approach to dating the Solent terrace sequences, using uplift modelling in conjunction with artefact typology, was employed by Westaway et al. (2006; Harding et al. 2012). For the Test, the first appearance of Levallois technology, which they argue is likely to have occurred around the MIS 9/8 transition, was used as a chronological tie-point to determine the uplift solution that provided terrace ages that were a best fit for the archaeological record (Table 2). The use of lithic typology as chronological tie-points has been criticised, not least the assumption of synchronous first appearance of new technologies in different river valleys across Britain (Ashton and Hosfield 2010). In order to use the Solent to test whether technological developments were indeed synchronous across different regions of Britain, independent dating of the terrace sediments is required.

In this paper, we use the terrace stratigraphy as a relative chronological framework for examining the archaeological record, with the OSL age estimates described above as chronological tie-points that enable us to begin to assess how the Test fluvial succession and related Palaeolithic assemblages correlate with the marine isotope record.

2.3. Palaeolithic archaeology

The Solent is one of the richest regions for Lower Palaeolithic archaeology in Britain and the Test provides a major component of this record. In excess of 4500 lithic artefacts have been recovered from more than 150 individual sites (Wessex Archaeology 1993). The majority of artefacts are handaxes. The Test's Middle Palaeolithic record is comparatively small, numbering no more than 50 diagnostic artefacts, including Levallois cores, flakes, and at least one *bout coupé* handaxe (Wessex Archaeology 1993; Davis 2013). The sites are primarily distributed between Dunbridge and Lee-on-Solent (Fig. 1B), with key sites or locales at Dunbridge (Dale 1912, 1918; White 1912; Bridgland and Harding 1987, 1993; Harding 1998; Hosfield and Chambers 2004; Harding et al. 2012) and Kimbridge (Dale 1912, 1918; White 1912; Harding et al. 2012), Romsey, including Belbin's Pit, Chiver's Gravel Pit, Luzborough Pits and Test Road Materials Pit (Roe 1981, 2001; Wessex Archaeology 1993; Bates et al. 2004), Ridge Gravel Pit (MacRae 1991), numerous findspots in and around Southampton (Evans 1872, 1897; Wessex Archaeology 1993; Wenban-Smith 2001), Warsash (Burkitt et al. 1939; Shackley 1974, 1978; Roe 2001; Davis et al. 2016; Hatch et al. 2017) and the foreshore beneath the cliffs that extend from Solent Breezes to Lee-on-Solent on the east side of Southampton Water (Evans 1872, 1897; Wessex Archaeology 1993).

The bias towards handaxes (Harding 1998) is likely a consequence of the main mode of recovery of the record, which was largely collected from gravel pits during the late 19th and early 20th centuries, although collecting activities continued at a few sites through the mid to late 20th Century (e.g. MacRae 1991). There are few reported artefacts that are well-contextualised. Most of these were recovered by coarse sieving of gravel contexts encountered in the PASHCC test pits (Bates et al. 2004). These consist of: one heavily rolled waste flake from horizontally-bedded gravels of the Belbin terrace at Whitenap Open Space, near Romsey; one waste flake from Belbin terrace gravels at Mottisfont Field; one rolled and one fresh waste flake from basal gravel of the Nursling terrace at Ridge Gravel Pit; three waste flakes and one very rolled sub-cordate handaxe from Nursling terrace gravels at Great Copse; and two possible waste flakes from Midanbury terrace gravels at Spearywell Wood. At Warsash, excavations by Shackley (1978) recovered a small lithic assemblage, including slightly and heavily rolled handaxes and one fresh Levallois core, from gravels interpreted as a preserved gravel bar towards the top of the Lower Warsash terrace sequence at Fleet End Pits.

There is less certainty over the precise context of the 198 artefacts recovered during the watching brief at Kimbridge Farm Quarry, which exploited gravels of both the Belbin and Mottisfont terraces (Harding et al. 2012). It was possible to reconstruct the locations of most of the artefacts and link them back to one terrace or the other. Most of the artefacts were associated with the Belbin terrace. These included 56 handaxes or handaxe roughouts, three unipolar cores with parallel removals from a flaking surface with a prepared platform and described as ‘proto-Levallois’, one fully developed Levallois core and one Levallois flake. Most of the artefacts are rolled and iron-stained but the Levallois core and flake are fresh with a light yellow staining over a white patina, which Harding et al. argue indicates their derivation from the upper part of the Belbin terrace sequence due to its similar colour. This mirrors earlier observations of the material from the old Dunbridge Pit, which suggest two groups of artefacts are present that are stratigraphically distinct (Dale 1912, 1918; Roe 1981). The largest group is rolled and stained, with a preponderance of pointed handaxes alongside ovates in similar condition (Hosfield and Chambers 2004), and thought to have been recovered from the basal gravels. A smaller group of fresher artefacts, often patinated white and including ‘classic’ pointed handaxes, some Levallois elements and a *bout coupé* (Roe 1981), are suggested to have originated in the upper gravels, which in places are bleached white (Dale 1912; Bridgland and Harding 1993). The small number of artefacts recovered during the watching brief at Kimbridge Farm Quarry that could be confidently assigned to the Mottisfont terrace gravels included a slightly rolled Levallois core and five handaxes (Harding et al. 2012).

The artefacts on which the current study is based can all be related to specific sites or findspots. In the case of recent quarries, where artefacts were typically recovered from reject heaps of gravel extracted after the site had been stripped of overburden, the artefacts must come from within terrace gravels or their surface. This applies to the material recovered from Ridge Gravel Pit and Test Road Materials Pit. At Ridge Gravel Pit, the main collector, John Keeping, drew a sketch section that shows a stratigraphic separation of two assemblages, with crude pointed handaxes in the middle part of the gravels and ovates in the upper gravels (Terry Hardaker pers. comm.). However, it is unclear how this interpretation of the stratigraphic context of the archaeology was reached.

At other sites, it is possible that some artefacts may be derived from sediments that overlie the fluvial gravels. At all of the sites there is also the likelihood that a portion of the archaeological material has been reworked from older fluvial sediments. In the absence of detailed contextual information, artefact condition can be used as an indication of the type of context from which it is derived. Artefacts that are rolled can be assumed to have been recovered from the fluvial sediments of the associated terrace. Heavily rolled material is likely to include artefacts reworked from higher terrace gravels (vertical reworking) and therefore are likely to either pre-date or be contemporary with terrace formation. Less rolled material is likely to include material reworked over shorter distances downstream (horizontal reworking) that are contemporary with terrace formation. Fresh material is more likely to include artefacts from overlying fine-grained sediments and therefore are likely to either be contemporary with or post-date terrace formation. Clearly such a broad brush approach does not eliminate mixing of material of different ages, but it does provide a means of assessing whether there are any broad patterns of typological or technological variation between artefacts with different taphonomic histories.

3. Materials and methods

The basic unit of analysis in this study is the terrace record. The starting point was the SRPP database (Wessex Archaeology 1993; Mepham 2009), which provides a site list, a typological breakdown of the assemblages and an indication of their geological context based on the BGS mapping current at the time of the study. The Southampton, Winchester and Hampshire Historic Environment Records (HER) were consulted and any sites not listed by the SRPP were added to the database. All available contextual information was consulted to check the locations of the sites. This included journal publications, historic mapping, collector notebooks and correspondence, and information written on the artefacts themselves. This refinement of the SRPP database is essential to ensure assemblages are assigned to the correct terrace (e.g. Davis 2014). The sites were then assigned to terraces by overlaying the updated site locations on current terrace mapping (Hatch et al. 2017) in ArcGIS. Any assemblages that could not be assigned to a specific terrace were excluded from the study. The terrace records could then be compared to identify any chronological patterning.

Given the biased nature of the record, lithic analysis is limited to the handaxes and Levallois artefacts. Samples were obtained by recording all relevant collections held at 11 museums and in four private collections (Table 3 and Table S1). It was not possible to track down a representative sample of the small Broadlands Farm or Ganger Wood/Mallards Moor terrace records. The other terrace records are well represented and form the basis of analysis (Tables 3 and 4).

Taphonomic attributes, including degree of rolling, edge damage, patination and staining, were recorded for all artefacts by macroscopic observation using a four-point scale (after Ashton 1998). Handaxes were recorded using a standard set of measurements and attributes. Handaxe type, tip shape and butt type were recorded following Wymer's (1968) scheme. Edge shape was recorded in plan and profile. Digital callipers were used to take a series of measurements for morphometric analysis following Roe's (1968a) method. Raw material and blank type were recorded, as were the presence or absence of tranchet flaking or other edge modification. Flake scars larger than 5mm were counted and a scar index was calculated by dividing total flake removals by length. Cortex retention was measured to the nearest 10%. Bifacial edge length was measured and recorded as a proportion of the total perimeter. The 49 handaxes from Ridge Gravel Pit in the Dowland collection were recorded by Phil Harding (pers. comm.). These records included handaxe type after Wymer (1968), raw material and blank type, maximum length, width and thickness measurements, condition and edge shape. Levallois cores were recorded following Scott (2010), with identification based on Boëda's (1995) volumetric definition of the Levallois method. Levallois flakes were identified and recorded following Scott (2010), based on the identification of characteristics indicative of their removal from the flaking surface of a Levallois core. Simple prepared (proto-Levallois) cores share some of the characteristics of Levallois cores, namely the hierarchical relationship between a striking platform surface and a flaking surface separated by a plane of intersection, where flakes have been removed by hard hammer percussion from the flaking surface and are broadly parallel to the plane of intersection (White and Ashton 2003). However, they generally lack the maintenance of distal and lateral convexities, and surface preparation is minimal. Although no simple prepared cores were identified in the Test collections recorded in this study, the definitions above apply to the simple prepared cores and Levallois cores and flakes from other British assemblages discussed in Section 5.

4. Results

The results of the contextual study are summarised in Table 4. A full catalogue of sites can be found in supplementary information (Table S2). The main differences between the results presented here and those of previous studies (e.g. Ashton and Hosfield 2010) are the exclusion of most of the material associated with the highest five terraces and a significant increase in the number of artefacts assigned to the Lower Warsash terrace. The latter reflects previous uncertainty over the provenance of much of the Warsash material, a significant portion of which can now be assigned to the Lower Warsash terrace (Davis et al. 2016). The SRPP lists a small number of artefacts from each of the highest five terraces, all of which bar three have been excluded here. The survivors are three handaxes from Town Pits, located on the northern edge of Southampton Common. The provenance of these can be determined from a letter from Mr. W. Read to John Evans that is conserved in the archives of the Ashmolean Museum, and which describes the recovery of handaxes from gravels between 55 and 58 m OD that are mapped as the Midanbury terrace (Davis 2015). The other higher terrace sites have been excluded because it has not been possible to determine their precise provenance and, in many cases, it has not been possible to track down the artefacts in question to assess whether their condition is indicative of their recovery from a fluvial gravel.

4.1. First appearance data

The earliest evidence for human presence in the Test valley is associated with the Midanbury terrace. PASHCC recovered two possible waste flakes from test pits at Spearywell Wood, to which can be added the three handaxes from Town Pits (Table 4). One of these is a sub-cordate handaxe that is rolled and stained (Fig. 4). Handaxes appear in significant numbers in the Nursling, Belbin, Mottisfont/Lower Warsash and Hamble terraces, with the Belbin terrace producing by far the largest record. The relatively small number of handaxes associated with the Broadlands Farm terrace is to be expected given its likely young age, however the low number from the Ganger Wood/Mallards Moor terrace is more surprising. Levallois technology first appears in the Belbin terrace assemblage and is most numerous in the Lower Warsash terrace record.

4.2. Handaxes

The handaxes are from sites in different parts of the river valley (Fig. 1b; Table 3). The Nursling terrace record consists of material from just two sites, Ridge Gravel Pit and Pauncefoot Hill gravel pit, which are situated 1.75 km apart on the same spread of Nursling gravels. The Belbin terrace handaxe record consists of material from 16 separate sites. These can be placed in to three groups based on location. The material from Dunbridge forms one group, Belbin's Pit, Chiver's Gravel Pit, Luzborough Gravel Pits and Test Road Materials Pit are all located near Romsey and form a second group, while the remaining 11 sites are all located in Southampton and form a third group. The Mottisfont/Lower Warsash terrace sample is formed of artefacts from 16 sites. These can be divided into four groups. The first consists of material from Kimbridge Pit and the small assemblage from Lone Barn Farm, the second is Colden Common in the Itchin Valley, the third consists of six sites in Southampton and the final group is formed of the material from Warsash. The Hamble terrace record sample is drawn from eight sites (Table 2). A single handaxe is from High Street, Southampton, otherwise all of the material is from sites on the eastern side of Southampton Water, from gravel pits south of Warsash and from the foreshore between Solent Breezes and Lee-on-Solent. The analysis below is based on the terrace records as a whole, but a summary of the characteristics of the handaxes in each of these groups is provided in the supplementary information (Tables S3-S7).

4.2.1. Handaxe condition

The vast majority of the handaxes from the Test are rolled, often iron-stained and have substantial edge damage (Fig. 5). This is consistent with their recovery from coarse terrace gravels and indicates a degree of fluvial reworking. The Nursling terrace record has a notably lower degree of rolling, which increases in each successively younger terrace. This is likely to reflect the influence of vertical reworking (Ashton and Hosfield 2010). This suggests that the proportion of a terrace record derived from older terrace deposits, and therefore the degree of mixing, increases with each successive terrace. Fresher material is more likely to represent human occupation contemporary with terrace formation. This may be the case for the majority of the Nursling terrace record. There are 105 (13.3%) handaxes from the Belbin terrace that are either fresh or slightly rolled, most notably from Dunbridge where 32 of the 65 fresher handaxes are also patinated (Table S5a). These are likely to be a sample of Dale's (1918) 'white' series. The fresher material from the Mottisfont/Lower Warsash terrace consists of just 42 (10.5%) handaxes, of which 31 are from Warsash (Table S6). The Hamble terrace handaxes show the highest degree of rolling, with more than 80% heavily rolled and just five (3.6%) handaxes that are either slightly rolled or fresh.

4.2.2. Handaxe typology and technology

The vast majority of the handaxes are made on flint and the remainder (1.6%) are made on chert (Table 5). The dominance of flint raw material is unsurprising given the flint-rich nature of the gravels and the presence of Chalk bedrock in the upper reaches of the Test. Clast lithological analysis of the Belbin and Mottisfont terrace gravels at Dunbridge shows that chert is extremely rare, with all non-flint lithologies accounting for just 0.16% of clasts (Harding et al. 2012). However, chert is more common in the River Solent terraces, accounting for between 1.6% and 3.2% of clasts (Allen and Gibbard 1993). It is possible that the chert handaxes represent some limited transport of raw materials and/or handaxes in to the Test from the main Solent valley, however there is no available data on the size of the chert clasts to be sure they are large enough for handaxe manufacture. The condition of remnant flint cortex indicates that both weathered river cobbles and fresher chalk nodules/cobbles were utilised. This is particularly clear for the Nursling terrace. For the lower terrace records, the high degree of rolling prevents a reliable assessment of the use of fresher flint as cortex condition may have been altered during fluvial transport.

There are some similarities but also some differences between the mean size and shape of the handaxes and the proportions of different handaxe types in the terraces records (Table 6). The mean size of the handaxes is fairly consistent, although the Belbin terrace handaxes are slightly smaller on average than the other three terraces. There is little variation in the elongation ratio and they also display a similar mean refinement ratio, suggesting the intensity of thinning was broadly consistent across the four terraces. The Hamble terrace handaxes are slightly more refined on average, while the Nursling terrace shows greater variation than the other terraces. The other two shape ratios show greater differentiation between the terraces, with the Belbin and Mottisfont/Lower Warsash terrace handaxes having on average wider and thicker butts relative to their tips. This difference is reflected in the typological data, which show ovates to dominate the Nursling and Hamble terraces, whereas pointed handaxes are more common in the Belbin and Mottisfont/Lower Warsash terraces. The Nursling terrace has the lowest degree of typological diversity. Ficrons, twisted ovates and flat-butted cordates first appear in the Belbin terrace. One of the two flat-butted cordates is the classic *bout coupé* from Dunbridge, which is in fresh condition and patinated. Ficrons and twisted ovates also occur in low numbers in the Mottisfont/Lower Warsash and Hamble terraces. Cleavers occur in low numbers in all four terraces.

Handaxes are predominantly made on flint cobbles or nodules across all four terraces, with the use of large flakes as blanks a persistent but minor part of handaxe technology (Table 7). The majority of the handaxes have rounded tips, although this may in part reflect the effect of fluvial reworking damaging and rounding more finely worked tips. Handaxes with straight, cleaver-like tips occur in similar numbers across the four terraces. In the Nursling terrace, these are often produced by the removal of a tranchet flake from the tip (Fig. 6). Tranchet-sharpened tips are much more common in the Nursling terrace, present on almost 25% of the handaxes. This is specifically a feature of the Ridge Gravel Pit material and is completely absent from the Pauncefoot Hill assemblage (Table S3). Tranchet flaking is a minor component of the other three terraces. Mean cortex retention, cortex retention on the butt, cutting edge length and scar index are broadly similar between the terraces. This suggests that reduction intensity does not vary greatly. However, the differences that do exist also reflect the typological composition of the records, with the two ovate-dominated records displaying greater reduction intensity than those with more pointed handaxes, reflecting the greater working and thinning of the butt of ovates. This is particularly the case for the Hamble terrace record.

The fresher artefacts from the Nursling, Belbin and Mottisfont/Lower Warsash terraces that can be compared to the rolled handaxes from the same terrace to examine the effect of reworking (Tables 8 and 9). In each case, the fresher group is characterised by a dominant handaxe form (> 50% for Wymer type and >60% for Roe metric type). In the Nursling terrace, the fresher material is dominated by ovate handaxes with frequent tranchet-sharpened tips, whereas the rolled group has fewer ovates and a greater proportion of crude, pointed and sub-cordate handaxes. The rolled handaxe group is also less refined than all the other Test handaxe groups as shown by its relatively high mean ratio of maximum thickness to maximum width, where a high ratio reflects low refinement (Table 8). This is largely due to the characteristics of the crude and pointed handaxes (Fig. 7), which are less refined in the Nursling terrace than the same types in the other terraces (Fig. 8).

The fresher material from the Belbin terrace (Fig. 9) is dominated by elongated pointed handaxes, often with relatively thick butts that have only been partially worked. These appear in all three areas, occurring in significant numbers at Dunbridge, Romsey and Southampton (Table S5). Pointed handaxes are also the most common type among the rolled material but crude, sub-cordate and ovate handaxes are also well represented. There is some geographical variation, however, with the rolled material from Romsey dominated by pointed handaxes, whereas it is more mixed at Dunbridge and Southampton (Table S5). All but one of the twisted ovates occur in the rolled material and the other rarer handaxe types appear in both the rolled and fresher groups.

The fresher group from the Mottisfont/Lower Warsash terrace is dominated by large, well-made pointed handaxes, including one large ficron and two pointed forms made on flakes and shaped by flaking to the dorsal surface only (Fig. 10). The use of flake blanks is most common in this group, resulting in a group of plano-convex handaxes that has been highlighted previously as a typological feature of the Warsash assemblage (Burkitt et al. 1939; Davis et al. 2016; Roe 1981, 2001). The rolled material is much more mixed with crude, pointed, sub-cordate and ovate handaxes all well represented. Cleavers are more common among the rolled material and ficrons and twisted ovates are also present.

4.3. Levallois technology

The Levallois artefacts are typically much fresher and more frequently patinated than the handaxes from the same sites (Fig. 5). They are all made on flint and there are similarities in technology across the terraces (Fig. 11).

The Belbin terrace is the highest Test terrace to be associated with Levallois artefacts (Table 4). Seven have been recorded for this study, six from the Romsey sites and one from Hill Lane, Southampton (Table 3). Five are only slightly rolled, of which four are patinated, one is moderately rolled and patinated and one, from Belbin's Pit, is very rolled and stained. All of the Romsey examples have facetted striking platforms and scar patterns consistent with centripetal flaking surface preparation and recurrent unipolar exploitation. The Hill Lane example is similar except it has a plain striking platform.

Of the 22 Levallois artefacts from the Mottisfont/Lower Warsash terrace recorded for this study, 21 are from Warsash and have been described previously (Davis et al. 2016). They consist of 17 flakes and 4 cores. The majority are fresh and have a creamy white patina but 2 cores are more rolled, one moderately, the other heavily with iron staining. The cores and the majority of the flakes indicate centripetal flaking surface preparation, lineal removals and facetted striking platforms, however a few of the flakes indicate unipolar and bipolar flaking surface preparation. Added to these is one rolled and stained Levallois flake from Colden Common. It has a facetted striking platform and a dorsal scar pattern indicating centripetal flaking surface preparation.

Two probable Middle Palaeolithic artefacts associated with the Hamble terrace were recorded for this study. One is a discoidal core from the foreshore at Brownwich Farm. It is fresh and patinated. The second is a large Levallois flake from the foreshore at Lee-on-Solent. It is patinated with some rolling to the scar ridges and edge damage. It has a faceted striking platform and a dorsal scar pattern indicative of centripetal flaking surface preparation.

4.4. Interpretation

In the absence of detailed contextual and stratigraphic information, the condition of the artefacts is key to interpreting the Test record. The presence of artefacts in both fresh and rolled condition indicates a degree of mixing of material derived over shorter and longer distances. The fresher material from each site is likely to represent relatively local human occupation contemporary with the formation of that terrace, with the potential addition of younger material subsequently discarded on the terrace surface and becoming incorporated into the deposit or collected from the surface. The rolled material is likely to be a mixed collection of artefacts derived from further upstream and reworked from older terrace deposits. The increase in rolling through time from the Nursling terrace to the Hamble terrace (Fig. 5) suggests that material reworked from higher terraces makes a significant contribution to the rolled handaxe groups. The fact that the fresher groups are consistently dominated by a particular handaxe form while the rolled groups are not, suggests that handaxe manufacture contemporary with each terrace is characterised by the production of a single modal form. This is particularly clear for the Belbin terrace, where the fresher handaxes from Dunbridge, Romsey and Southampton are all dominated by pointed forms, indicating a homogeneity of handaxe form throughout the river valley. The potential for spatial variation cannot be assessed for the Nursling and Mottisfont/Lower Warsash terraces due to their more geographically restricted samples of fresher handaxes. However, the presence of a modal handaxe form in the fresher material from each of these terraces is consistent with the British record more broadly (Roe 1968a;

Wenban-Smith 2004; Bridgland and White 2014, 2015; White et al. 2018; Shipton and White 2020; Davis et al. 2021).

The analysis above provides evidence of chronological variation in human occupation and technology within the relative chronological framework of the terrace sequence (Table 4 and Table 10). The evidence for the age of the assemblages is discussed in Section 5.1, with suggested MIS attributions provided in Table 10 and in parentheses below. Handaxes first appear in the Midanbury terrace (≥MIS 16) before appearing in significant numbers in the Nursling terrace (≥MIS 13). Most of these are likely to be contemporary with terrace formation and are dominated by ovates. The rolled material has a greater number of crude and pointed handaxes. This partly mirrors the differences between the Ridge Gravel Pit and Pauncefoot Hill assemblages (Table S3), which may indicate a degree of contemporary downstream reworking, although some reworking from older terrace deposits cannot be discounted. The fresher material from the Belbin (MIS 9) and Mottisfont/Lower Warsash (MIS 8) terraces is dominated by pointed handaxes. Handaxe diversity increases in the Belbin terrace and Levallois also appears for the first time, becoming more common in the Mottisfont/Lower Warsash terrace. The majority of the Levallois artefacts are fresh and patinated but a small number from both terraces are in a condition consistent with deposition within a fluvial environment. This suggests Levallois first appears in the Test Valley during the formation of the Belbin terrace (Westaway et al. 2006; Harding et al. 2012). The fresher material may also be contemporary with terrace formation, however it is also possible that these artefacts were discarded on the terrace surfaces and represent later occupation (Davis et al. 2016). At Dunbridge (Belbin terrace), the fresher and often patinated material includes pointed handaxes, Levallois cores and flakes, and a classic *bout coupé*. Given that the latter is likely to date to MIS 3 (White and Jacobi 2002), this indicates that the fresher assemblage includes artefacts that were discarded on the terrace surface at a much later date.

Further research is required to understand the extent to which the terrace records are representative of the density of artefacts occurring in each terrace (e.g. Ashton and Lewis 2002; Ashton and Hosfield 2010; Ashton et al. 2011). Clearly the preservation of terrace deposits determines the potential for artefact recovery, but the location of those deposits in relation to modern aggregate extraction and urban development is also a key factor by providing exposures for artefact collection to take place (Hosfield 1999). In the case of the Hamble terrace, the coastal erosion along the eastern side of Southampton Water has created an extensive and long-lasting exposure that is likely to have resulted in it being overrepresented in the Test archaeological record. Likewise, the fact that the Broadlands Farm, Mottisfont/Lower Warsash and Belbin/Upper Warsash terraces underlie Southampton, and the Hamble and Mottisfont/Lower Warsash terraces underlie Warsash, has provided ample opportunities for material to have been recovered from these terraces. In contrast, the absence of the higher terraces from these areas is likely to have reduced the number of opportunities for artefact recovery. This may explain the paucity of archaeological material from the Ganger Wood/Mallards Moor terrace, but also serves to highlight the potential richness of the Nursling terrace.

5. Discussion

5.1. Context, terrace stratigraphy and chronology

The Test record provides a coarse view of technological change over the long period of time represented by the relative chronological framework of its fluvial terraces. It, and the Solent more widely, has the potential to offer a different regional perspective on early human occupation of Britain to the other major concentrations of Palaeolithic sites in the Thames Valley and East Anglia. There are three problems that have prevented it from fully doing so: a lack of contextual information for much of the record; uncertainty over correlation of fluvial deposits both within and between the river valleys of the Solent system; and the absence of a robust chronology for the formation of the fluvial terraces. While there has been much work over the past two decades to address this (e.g. Hosfield 1999; Wenban-Smith and Hosfield 2001; Bates et al. 2004; Briant et al. 2006, 2009b, 2012; Westaway et al. 2006; Ashton and Hosfield 2010; Harding et al. 2012; Davis 2013, 2014; Hatch 2014; Davis et al. 2016; Egberts 2016; Hatch et al. 2017; Egberts et al. 2020), to lesser or greater extents these problems remain. However, this synthesis uses the latest geological studies with a more robust framework and provides the most extensive study to date of the artefacts and the contexts from which they derive.

New fieldwork, either through research projects or developer-funded watching briefs and excavations, will be essential for recovering new information that can help to further contextualise the historical collections. The limited information from the PASHCC test pits (Bates et al. 2004), the Kimbridge Farm Quarry watching brief (Harding et al. 2012) and the small excavation at Warsash by Shackley (1978) provides some details that support the interpretation of the Test record presented above. In all of these cases, flakes were the most common artefact type recovered, confirming that the historical collections are biased towards handaxes. Together, they provide evidence of artefacts occurring within the Lower Warsash, Belbin and Nursling terrace deposits, and possibly the Midanbury terrace too if the two flakes from Spearywell Wood are artefactual and not geofactual. They also provide evidence of the mixing of artefacts in contrasting conditions in the fluvial deposits of the Mottisfont/Lower Warsash, Belbin and Nursling terraces. At Fleet End Pits, Warsash, a small lithic assemblage excavated from a concentration of large cobbles towards the top of the Lower Warsash fluvial sequence included one very fresh Levallois core, two pointed and one ovate handaxe with slight abrasion, and two handaxes that were heavily abraded (Shackley 1978). The assemblage from Kimbridge Farm Quarry also provides evidence of the contrasting condition of handaxes and Levallois artefacts. The Levallois cores associated with the Belbin terrace are described as being fresh and therefore it cannot be ruled out that they are derived from the surface of the fluvial deposits and may post-date terrace formation. The Levallois core associated with the Mottisfont terrace is slightly abraded and is therefore likely to derive from the fluvial deposits and may be broadly contemporary with the Levallois core recovered from the Lower Warsash gravels at Fleet End Pits.

With regards to the historical collections, while it is possible that additional collector notes, letters or catalogues may turn up in museum archives (e.g. Davis 2014), in the main the level of contextual detail associated with these artefacts is unlikely to be improved. The SRPP (Wessex Archaeology 1993) and TERPS (The English Rivers Palaeolithic Survey; Wessex Archaeology 1996) are indispensable resources for studying the fluvial archive of southern Britain but they must be engaged with critically to ensure sites and assemblages are assigned to the correct sediment body. The condition of artefacts is also important for disentangling mixed secondary context assemblages, particularly where stratigraphic information is absent. The condition of an artefact relates directly to the post-depositional processes that it has been subjected to, and while it may not be possible to reconstruct those processes precisely, and while artefacts can arrive at the same final condition via a different combination of processes, variation in condition between artefacts can at least be taken to indicate the presence of different taphonomic histories. For the Test and the Solent more broadly, as well as the secondary context records from river valleys in other parts of Britain, the degree of rolling and the degree of patination have been important attributes for interpreting mixed assemblages. For example, three technologically distinct components of the Lower Palaeolithic record of the Bytham River in central East Anglia can also be separated on the basis of degree of rolling and degree of patination, as well as the presence or absence of frost-cracking. This hasbeen interpreted as the mixing of assemblages reworked from different sedimentary contexts of varying character and age (Davis et al. 2021). Support for this interpretation comes from High Lodge, where two of the assemblage types – intensively retouched scrapers and ovate handaxes – are found in stratigraphic order in primary context, whilst the third assemblage type – crude hard-hammer handaxes – are absent. Similarly, the contrasting condition of handaxes and Levallois artefacts in historical collections from sites on the Lynch Hill terrace of the Middle Thames, where the former are typically rolled and iron-stained and the latter fresher and patinated, has been interpreted as reflecting the different stratigraphic position, and therefore age, of the two technologies (White et al. 2006). As described in Section 4.4 above, a similar situation is found in the Test, where the majority of the Levallois artefacts are fresher and more patinated than the handaxes from the same sites.

The uncertainty regarding terrace mapping in the Test is mirrored elsewhere in the Solent, with multiple competing mapping schemes for most of the river valleys, and there is no consensus on a Solent-wide regional stratigraphic framework. As outlined above (Section 2.1), there is general agreement regarding the terrace stratigraphy between Romsey and Southampton, but different interpretations of the fluvial deposits around Warsash and Dunbridge. Hatch’s (2014; Hatch et al. 2017) detailed study of the Warsash area produced additional data points that enabled the local terrace mapping to be fine-tuned. This is important archaeologically because it showed that all of the gravel pits reported by Burkitt et al. (1939) exploited Lower Warsash terrace gravels (Davis et al. 2016).

The differences in the mapping of the Dunbridge terraces is due to the use of different gradients for long profile projection. The main implication of this for our understanding of the archaeology is the position of the Dunbridge gravels in the terrace stratigraphy. Had the analysis presented above been based on the PASHCC mapping of the Dunbridge area, the large Dunbridge assemblage would be assigned to the Ganger Wood terrace. The exclusion of Dunbridge from the Belbin terrace record would not have a significant impact on its main characteristics (Table 10), as these are common to Dunbridge and the Romsey and Southampton sites (Table S4 and S5). However, it would provide evidence of human occupation during the time represented by the Ganger Wood/Mallards Moor terrace, adding an additional pointed handaxe-dominated record in between the ovate-dominated record of the Nursling terrace and the point-dominated record of the Belbin terrace. It would also shift the earliest appearance of Levallois up one terrace.

One way in which these mapping uncertainties could be overcome is correlation of fluvial deposits by age estimates through the wider application of chronometric dating techniques (Briant et al. 2012). At present there are not enough age estimates to build a robust stratigraphic framework, but they do provide some chronological tie-points for the archaeological sequence. The extensive exposure of the Hamble terrace between Solent Breezes and Brownwich Lane has provided the ideal field conditions for sampling for OSL dating, producing a coherent set of age estimates that suggest terrace formation during MIS 7 (Briant et al. 2012; Hatch et al. 2017). This is likely to be related to the significant cooling and low sea level stand during MIS 7d (Bates et al. 2010).

Almost all of the archaeological material associated with this terrace is heavily rolled and it is likely that it is derived from older terrace deposits. The next terrace up in the sequence is likely to have formed during the preceding cold phase of MIS 8. This is supported by an age estimate of MIS 8/7 for the Lower Warsash terrace (Hatch et al. 2017). The fresher material from Warsash is therefore likely to date to MIS 8 or early MIS 7. This assemblage includes large pointed handaxes and Levallois cores and flakes. The handaxes and Levallois can be separated out on the basis of surface condition, with more than 80% of the Levallois artefacts having a creamy white patina compared to just 17% of the handaxes, which are more typically iron-stained (Table S7). This suggests that the two artefact types have different taphonomic histories and therefore may relate to two different phases of occupation. This interpretation is supported by Shackley's (1978) study of the small lithic assemblage from the Lower Warsash terrace at Fleet End Pits.

Attempts to date some of the higher terraces have been less successful, probably due to the unsuitable characteristics of the sand units encountered in test pits (Briant et al. 2012). If the terraces above the Mottisfont/Lower Warsash terrace formed at a rate of one per glacial/interglacial cycle, as suggested by previous work on other fluvial sequences (Bridgland 1994, 2006; Antoine et al. 2007, 2015), then the Belbin, Nursling and Midanbury terraces would equate to MIS 10/9, MIS 14/13 and MIS 18/17 respectively. If correct, the Town Pits handaxes would date to at least MIS 17, while the fresher artefact groups from the Belbin and Nursling terraces would represent human occupation during MIS 9 and MIS 13 respectively. However, if any of these terraces relate to sub-stage climatic fluctuations (Bridgland 1996), as suggested for the Hamble terrace, then they may be younger than suggested above.

5.2. The River Test and its regional context

Correlating the Test sequence with other parts of the Solent river system is fraught with difficulties. The most straight forward correlations can be made with the gravels on the western side of Southampton Water. In particular, the Hamble and Mottisfont/Lower Warsash terraces are at similar altitudes to the Stanswood Bay and Tom's Down gravels respectively (Ashton and Hosfield 2010). These correlations are supported by OSL age estimates for the lower terraces at the eastern end of the Western Solent sequence (Briant et al. 2006). Towards the western end of the Western Solent, OSL age estimates have also been provided for the Old Milton Gravel exposed in the cliff at Barton-on-Sea, indicating deposition between MIS 11-9 (Briant et al. 2009c). The only significant Palaeolithic assemblage from the Western Solent has been recovered from the foreshore beneath these cliffs, however there is some uncertainty over its provenance as the cliff exposures in this area consist of sediments from multiple terraces (*ibid.*). The handaxes show a high degree of rolling and a mix of forms including twisted ovates, which account for approximately 5% of the handaxes (Roe 1968a; Briant et al. 2019b). Westaway et al. (2006) used the presence of twisted ovates at Barton-on-Sea to suggest an MIS 11 age for the Old Milton Gravel.

At present, there is much disagreement over the mapping of the Western Solent terraces (Allen and Gibbard 1993; Briant et al. 2006; Westaway et al. 2006; Hatch 2014). Consequently, it remains unclear how the archaeological material from Barton cliff and elsewhere in the Western Solent relates to the Test record. The Western Solent also provides the critical stratigraphic link between the Test and the artefact-rich Solent and Stour gravels in the Bournemouth area, so the uncertainty in the Western Solent area prevents correlation between these two significant archaeological records (Hatch 2014). Westaway et al. (2006; Table 11) provide age estimates for the Bournemouth sequence but at present there is no independent dating to corroborate their model.

Archaeologically, the Bournemouth sequence is remarkably similar to the Test (Davis 2013; Table 11). There are four handaxes associated with the highest two terraces, indicating a relatively early appearance of handaxe technology. Handaxes first appear in significant numbers in the Setley Plain terrace, most notably at Corfe Mullen. This assemblage is thought to be pre-Anglian (Roe 2001; Westaway et al. 2006) and it is dominated by ovate handaxes, often with a tranchet-sharpened tip, alongside thick, unrefined pointed and crude hard-hammer struck handaxes (Calkin and Green 1949; Roe 2001; McNabb et al. 2012; Davis 2013). The Setley Plain terrace record is generally fresher than the material from the lower terraces, which gets progressively more rolled, presumably indicating the increasing effect of reworking on the terrace records (Ashton and Hosfield 2010). There are relatively few artefacts associated with the Old Milton terrace, although this may be due to limited exposures during key periods of artefact collection (Davis 2013). This material is dominated by pointed handaxes. The most prolific terrace is the Taddiford Farm/Ensbury Park terrace, which has also produced the largest Levallois assemblage, including some that are rolled (Davis et al. 2016). Pointed handaxes are the most common form in the Taddiford Farm/Ensbury Park and the Stanswood Bay/West Southbourne terraces, although both include significant numbers of other handaxe types. The Milford-on-Sea terrace record is characterised by a very high degree of abrasion and it is likely that most if not all of these have been reworked from older terrace deposits. In the absence of dating evidence, the similarities between the Bournemouth and Test records provide an indication of potential correlations between the areas' terrace sequences based on the assumption that key developments in lithic technology were synchronous across the Solent region. However, this assumption requires testing through further dating programmes in both areas and by resolving the terrace mapping uncertainties in the Western Solent.

A significant number of handaxes have also been recovered from the gravels of the River Avon, particularly from Wood Green (Bridgland and Harding 1987; Hosfield 2001), Bemerton and Milford Hill (Harding and Bridgland 1998). Recent work by Egberts et al. (2020) indicates that the gravels at Bemerton are the oldest (pre-MIS 10), followed by Wood Green (MIS 10/9). The Wood Green and Bemerton assemblages include approximately 400 and 80 handaxes respectively (Wessex Archaeology 1993). Both assemblages are described by Roe (1981) as being mixed but with ovate handaxes occurring most frequently. The gravels at Milford Hill, which are approximately 4 km east of Bemerton and 5 m lower, have produced at least 379 handaxes (Wessex Archaeology 1993), characterised by frequent pointed handaxes including ficrons (Roe 1981; Harding and Bridgland 1998). The primary context site at Harnham is located a few kilometres south of Milford Hill and associated with terrace gravels of similar height (Bates et al. 2014). Occupation at the site has been dated to late MIS 8 on the basis of OSL, amino acid racemisation (AAR) and biostratigraphy, providing rare evidence of human occupation during a period of relatively cool climate. The lithic assemblage is almost entirely related to the manufacture of handaxes, which are predominantly pointed and include ficrons.

An assemblage of more than 300 handaxes has been recovered from Priory Bay, located on the eastern coast of the Isle of Wight. The assemblage is dominated by ovate handaxes and includes both fresh and rolled material. These are likely to have eroded from a sequence of Pleistocene sediments that occur between approximately 29 m and 34 m OD at the top of the cliff (Poulton 1909; Roe 1968b; Loader 2001; Wenban-Smith et al. 2009). This was confirmed during recent fieldwork, which recovered eight handaxes including one twisted ovate (Wenban-Smith et al. 2009). However, there is some debate over whether the sands and gravels at the base of the sequence are fluvial or associated with a raised beach. If the latter, then the sequence is likely to be younger than the MIS 13 high sea-level stand represented by the 40 m raised beach at Bembridge and Boxgrove (Wenban-Smith et al. 2009). If the Priory Bay sediments are fluvial, then correlation with the raised beach sequence is much more difficult due to their likely deposition during periods of low sea level (Bates 2001; Westaway et al. 2006). Wenban-Smith et al. (2009) report a series of OSL age estimates that indicate deposition of the basal sands and gravels sometime during MIS 11-9.

Finally, there are two primary context sites east of the River Solent that add further detail to the region's Palaeolithic record. Red Barns is located on the southern side of Portsdown Hill, near Portsmouth, overlooking the former Solent estuarine floodplain. The archaeology is associated with a solifluction deposit, which contained large frost-fractured flint nodules that were used to manufacture handaxes (Wenban-Smith et al. 2000). The number of complete or finished handaxes is relatively small and include a number of distinctive plano-convex sub-cordate forms. The site's chronology is poorly constrained, dated to between MIS 11 and MIS 7, with an MIS 9 age suggested by the uplift modelling of Westaway et al. (2006). Human occupation at Boxgrove has been dated to late MIS 13 and is associated with intertidal silts deposited on the edge of a semi-enclosed marine embayment located approximately 20 km east of the estuary of the River Solent (Roberts and Parfitt 1999; Bates et al. 2010; Roberts and Pope 2018; Pope et al. 2020). Lithic technology was focused on the production of refined ovate handaxes, frequently with tranchet-sharpened tips, which sometimes produced straight, cleaver-like tips (Roberts and Parfitt 1999; Garcia-Medrano et al. 2019).

5.3. The Lower and early Middle Palaeolithic of northwest Europe: the view from the Solent

The discussion above clearly highlights the work still required to produce a robust regional stratigraphic and chronological framework for the Solent river system in order for its Palaeolithic record to be fully integrated with evidence from elsewhere. However, there are a number of aspects of the Solent record as it stands that have implications for our understanding of the Lower and early Middle Palaeolithic of northwest Europe.

5.3.1. Early human occupation of northwest Europe and the emergence of the Acheulean

The discoveries at Happisburgh Site 3, dated to late in either MIS 25 or MIS 21 (Parfitt et al. 2010; Ashton et al. 2014), and Pakefield, dated to late MIS 19 or MIS 17 (Parfitt et al. 2005), have raised important questions concerning the development of adaptations and strategies required by humans to colonise northwest Europe (Ashton and Lewis 2012; Cohen et al. 2012; Hosfield 2016, 2020). Both are coastal sites with small lithic assemblages consisting of cores, flakes and simple flake tools. In order to begin to contextualise these two sites, it is of utmost importance to examine sediments of similar ages in other parts of Britain to test for presence/absence of humans in different environmental settings and, if possible, to expand our understanding of the technology of these pioneer populations. Fluvial terraces provide an ideal opportunity to test presence/absence of humans in different river valleys through large scale sieving programmes. The long terrace sequences in the Solent are likely to span this critical time period, making them an obvious target for such work.

The higher terraces have been affected far less by quarrying and urban development than the lower terraces and consequently little to nothing is known of their archaeological content.

With regards to the record as it stands, the occurrence of handaxes in the Midanbury terrace in the Test and the Sway terrace in Bournemouth suggest an early appearance of handaxe technology in the Solent region. The earliest evidence for bifacial technology in Europe is currently found in the Iberian peninsula, at La Boella in northeast Spain and dated to 1-0.9 Ma (Vallverdú et al., 2014), and Cueva Negra del Estrecho del Río Quípar in southeast Spain, dated to the late Early Pleistocene (Walker et al., 2020). Whether the few bifacial tools from these sites represent one-off innovations or a more sustained establishment of this technology is not clear. Better evidence for the establishment of handaxe technology comes during MIS 16, from la Noira in central France (Moncel et al. 2013), Moulin Quignon at Abbeville, northern France (Antoine et al. 2019), and Notarchirico in southern Italy (Moncel et al. 2019). There is now good evidence from Britain for the introduction of handaxes from MIS 15 in the Bytham River system (Davis et al. 2021). Together, these sites suggest an expansion of groups with handaxes into northwest Europe between early MIS 16 and MIS 15. However, the possibility of an earlier appearance of handaxes in northwest Europe has recently been mooted by Bynoe et al. (2021), based on the discovery of fresh condition handaxes on the surface of modern beach sands directly overlying Happisburgh Site 3. The early appearance of handaxes in the Solent record may also challenge the established view of the emergence of Acheulean technology in northwest Europe. Establishing the age of the Midanbury and Sway terraces is a priority for future research in the region.

5.3.2. Chronological patterning in handaxe assemblages

The analysis presented above has identified chronological patterning in handaxe form in the Test terrace records (Tables 6-10). This variation occurs in a relatively stable landscape with a single, enduring raw material package. It occurs despite the secondary context of the record, which is likely to sample a range of functional and behavioural settings, and therefore represent the full spectrum of variation introduced by the range of factors that influenced the form of individual artefacts (e.g. Machin 2009). The most likely explanation for this variation is that it represents the different technological traditions of human populations occupying the Test Valley at different times during the Lower Palaeolithic. It is a product of the discontinuity of the British record, where long periods of abandonment during glacial stages separated phases of occupation of southern Britain by groups derived from different continental European populations, with their own technological traditions that was manifested in distinctive material culture. That chronological patterning in handaxe form can be identified from the mixed, time-averaged record of a fluvial archive suggests that at least some of the variation in lithic technology from primary context sites is due to cultural factors.

The patterning in the Test, also discernible elsewhere in the Solent region, mirrors some of the chronological variation in handaxe morphology identified in other parts of Britain (Wenban-Smith 2004; Bridgland and White 2014; White et al. 2018; Davis et al. 2021). Assemblages dated to MIS 13 are typically dominated by refined ovate handaxes. This is represented in the Solent region at Boxgrove. The ovate-dominated assemblages from Corfe Mullen and Ridge Gravel Pit may also date to MIS 13, as has been suggested previously (Roe 2001; Westaway et al. 2006), and therefore may provide a broader regional context to the occupation at Boxgrove, indicating a preference for the manufacture of ovate handaxes regardless of whether occupation was at the foot of a chalk cliff or in a river valley. This would be consistent with recent analysis of the Boxgrove handaxes (Garcia-Medrano et al. 2019), which demonstrated the imposition of an ovate planform irrespective of blank form and knapping accidents. The British MIS 11 record is more complex, in part due to the better resolution of the record enabling a greater number of phases of occupation to be identified (Davis and Ashton 2019; White et al. 2019), and possibly also reflecting demographic and palaeogeographic factors (Ashton and Lewis 2002; Ashton et al. 2011). It is unclear which Solent assemblages are likely to date to MIS 11, with Priory Bay and the handaxes from the Old Milton gravel perhaps the most likely. The handaxe record for MIS 9 is remarkably consistent, with most assemblages across Britain dominated by pointed handaxes. These are often accompanied by ficrons and cleavers, which seem to be particularly prevalent at sites associated with the Thames-Medway system. Despite the uncertainty of the dating, it is clear that the Solent conforms to this pattern, with pointed handaxes dominating the potential MIS 9 terraces in the Test, Avon and Stour/Solent.

Comparisons of variation in handaxe morphology to neighbouring parts of mainland Europe are more problematic, in part due to the different systems of analysis in those areas, where there has been more emphasis on the *chaine operatoire* method (Boeda 1995; Lamotte and Tuffreau 2016), rather than the traditional Bordean approach (Bordes 1961). In addition, the context of many of the historic collections of handaxes from river systems such as the Somme is less certain than for example the Thames, due to the considerably thicker sequences of loess that overlie the fluvial gravels. Despite these problems, progress has been made in recent years that enables comparisons to be made (Moncel et al. 2015; Voinchet et al. 2015; Antoine et al. 2015, 2019).

The Somme is one of the best dated river systems in Europe and has a wealth of archaeological material either within or overlying the terraces. As noted above, Moulin Quignon in Abbeville has been dated to early MIS 16, being towards the base of the Renancourt Formation (VII; Antoine et al. 2019). The handaxes tend to be manufactured by hard-hammer, and thick in form. Comparisons could be drawn to the earliest British sites, such as Brandon Fields and Maidscross Hill, which are likely to date to MIS 15 (Davis et al. 2021), and possibly to the more rolled handaxes from Corfe Mullen and Ridge Gravel Pit in the Solent and the Black Park terrace of the Middle Thames. Within 500 m of Moulin Quignon, recent fieldwork at Carrière Carpentier recovered three finely-made ovate handaxes in fresh condition from slope sediments above the fluvial deposits of the Renancourt Formation (Antoine et al. 2016). Importantly, they are from above the ‘marne blanche’, which is attributed to MIS 15, indicating an MIS 15 or post-MIS 15 age. They have similarities to the ovate handaxes of MIS 13 age from High Lodge and Boxgrove (Ashton et al. 1992; Roberts and Parfitt 1999), but without clearer dating of the slope deposits at Carrière Carpentier, it would be premature to make this connection. Unfortunately, they can currently only be given a post-MIS 16 attribution. The Fréville Formation (VI) forms the gravels of the next lowest terrace, and is attributed to MIS 14 (Antoine et al. 2015). Recent rescue fieldwork at Rue du Manège established the presence of cores and flakes within the fluvial sediments, but no handaxes were recovered within the small assemblage. The sites at Cagny-la-Garenne in Amiens lie at the base of the Garenne Formation (V) and have been dated to MIS 12. The handaxes tend to be part-finished and crude in form, which may reflect the interpretation of the locations as manufacturing sites, but finished ovate forms have also been noted (Moncel et al. 2015; Lamotte and Tuffreau 2016). Direct comparisons to Britain cannot be made, due to the lack of MIS 12 primary context sites in the UK. Finally, Rue de Cagny at St Acheul has been attributed to MIS 11-10. Notably, the historic collection includes twisted ovate handaxes with obvious comparisons to the British MIS 11 sites with these forms (Moncel et al. 2015; Lamotte and Tuffreau 2016; White et al. 2019).

Although there is still much work to be undertaken to understand better the comparisons between the river systems of southern Britain and northwest France, there do appear to be some underlying patterns in handaxe form that deserve further investigation. Comparison with other river systems in western Europe also merits attention, and future work to refine dating and encourage the use of comparable systems of handaxe analysis holds great promise for understanding cultural developments and shifts in Acheulean population during the Middle Pleistocene (e.g. Garcia-Medrano 2020).

5.3.3. Transition to the Early Middle Palaeolithic

An important component of the Solent record is the evidence for occupation during MIS 8, which is the key period for understanding the Lower to Middle Palaeolithic transition in northwest Europe (Hérisson and Soriano 2020). An intriguing question in Britain regarding the transition is the nature of the relationship between sites that contain handaxes with no evidence of Levallois technology and those that, by contrast, have abundant evidence of Levallois technology and no handaxe manufacture.

For the Solent, the handaxe assemblage from Harnham is argued to date to late MIS 8 (Bates et al. 2014), and it is likely that the fresher handaxes from Warsash also relate to occupation at this time. Elsewhere in Britain, the handaxe assemblage from Cuxton has also been suggested to date to MIS 8 (Wenban-Smith 2004; Wenban-Smith et al. 2007). These assemblages are remarkably similar to many of the MIS 9 assemblages, being dominated by pointed handaxes with ficrons and, in the case of Cuxton, cleavers. Three potential explanations can be suggested: the assemblages assigned to MIS 8 are in fact derived from MIS 9 sediments (White et al. 2018); one or more of the handaxe assemblages date to MIS 8 and represent persistence of human occupation of southern Britain from MIS 9 through to late MIS 8 (Bates et al. 2014); or one or more of the handaxe assemblages date to MIS 8 and represent the dispersal of humans into Britain from continental Europe during MIS 8 (Ashton and Hosfield 2010; Ashton et al. 2011; Scott and Ashton 2011). If the latter, then the continuity in handaxe typology from MIS 9 to MIS 8 could suggest the maintenance of a handaxe tradition south of Britain during the initial part of MIS 8, as has been suggested for the reappearance of twisted ovates in the British record at the end of MIS 11 (White et al. 2019).

The apparent persistence of handaxe technology into MIS 8, and the paucity of early Middle Palaeolithic artefacts in the form of Levallois cores and flakes in the Solent compared to the Thames, has been interpreted as evidence of an east-west divide in the character of early Middle Palaeolithic occupation of Britain (Ashton and Hosfield 2010; Ashton et al. 2011). However, when early collecting behaviour is taken into account, the disparity in the number of Levallois artefacts between the Solent and the Thames seems to be a product of the intensity and quality of collecting, and in particular a greater bias towards the recovery of handaxes in some areas (Ashton et al. 2018). Rather than reflecting an east-west divide, the distribution of Levallois artefacts is concentrated in the lower reaches of major rivers in southern and eastern Britain (*ibid.*). Further, the timing of the occurrence of Levallois technology seems to be broadly synchronous between the Solent and the Thames (Davis et al. 2016).

In the Thames, prepared core technology occurs in a non-handaxe assemblage from the Botany Gravel at the top of the Purfleet sequence, dated to late MIS 9 or early MIS 8 (Bridgland et al. 2013; Schreve et al. 2002). Many of these are simple prepared cores (White and Ashton 2003) but a small number adhere to all six of Boëda's (1995) criteria for the identification of Levallois technology (White and Ashton 2003; Bridgland et al. 2013). These predate the main phase of early Middle Palaeolithic occupation of the Thames Valley, which is argued to date to late MIS 8 or early MIS 7. This main phase is represented by several large Levallois assemblages that occur on the surface of the Lynch Hill terrace in the Middle Thames (e.g. Yiewsley and Creffield Road) or in deposits associated with the Mucking terrace of the Lower Thames (e.g. Baker's Hole; Scott 2010; Ashton et al. 2011, 2018; Scott et al. 2011).

The small number of rolled Levallois cores and flakes and simple prepared cores from the Belbin and Mottisfont/Lower Warsash terrace in the Test, and the three rolled Levallois cores from the Ensbury Park terrace in Bournemouth, point to an early appearance of this technology in the Solent region, potentially during MIS 9 or early MIS 8. However, the majority of the Solent Levallois material is found in fresh condition, with the largest assemblage associated with the Lower Warsash terrace at Warsash. As has been discussed above, this material is likely to date to late MIS 8 or early MIS 7, predating the formation of the Hamble terrace during MIS 7d. Crucially, this material can be separated from the handaxes from the same sites on the basis of condition. So rather than representing a phase of occupation associated with the persistence of handaxe technology, the Levallois assemblage from Warsash is more likely part of a broader pattern of Neanderthal occupation of southern Britain during late MIS 8/early MIS 7 (Ashton et al. 2018), associated with the widespread adoption of classic Levallois flaking at many sites in northwest Europe at this time (Hérisson et al. 2016).

However, the relationship between handaxe and Levallois technology is also complex in northwest Europe. At Mesvin IV in Belgium, attributed to early MIS 8, the assemblage has a mix of handaxes and simple prepared cores, although differences in condition suggests that they are not directly associated (Cahen and Michel 1986; Ryssaert 2006). Also in Belgium, Kesselt-Op de Schans has been attributed to late MIS 9, or early MIS 8 and contains early Levallois material, but no handaxes (van Baelen 2007, 2008). But at several sites in northwest France handaxe technology persists into late MIS 7, such as the upper levels at Gentelles (Tuffreau et al. 2008) and Oisieres à Bapaume (Tuffreau 1976; Koelher 2008), with the latter associated with Levallois technology. Both technologies are also present in level 5 at La Cotte de St Brelade on Jersey (Callow and Cornford 1986). Other sites attributed to MIS 7 contain only Levallois, such as Maastricht-Belvedere in the Netherlands (Roebroeks et al., 1992; De Loecker, 2006), and the northern French sites of Pucheuil (A/C; Delagnes and Ropars 1996), Biache-Saint-Vaast (Boeda 1986) and Therdonne (Herisson 2007).

As with southern Britain, the complex variation in the early Middle Palaeolithic assemblages in northwest Europe may reflect discontinuities in occupation during cooler climates with repopulation events bringing in a variety of material cultures. The relationship to sites in southern Europe, where there appears to be semi-continuous occupation is not clear, but at sites such as Orgnac in southern France or Gran Dolina in northern Spain there is evidence for the more gradual development of prepared core technologies as handaxe production played a lesser role (Moncel et al. 2011; Lombera-Hermida et al. 2020).

6. Conclusion

Despite much recent work, the Solent remains a difficult record to interpret, primarily due to the lack of a robust chronology but also because of uncertainties over the mapping and correlation of terraces in its various river valleys. However, given its rich lithic assemblages and long terrace sequence, it also remains an important archive with the potential to test understanding of the early Palaeolithic occupation of northwest Europe and to provide a southern perspective on the chronological and regional patterning in the British record emerging from the Thames and East Anglia. At present, the evidence that can be extracted from the Solent suggests it largely mirrors the developments in the Thames and East Anglia, particularly in terms of chronological variation in handaxe typology and the timing of the occurrence of Levallois technology. But it also hints at some differences, most notably the potential for an earlier first appearance of handaxe technology, potentially during MIS 17, and the persistence of the same technology into MIS 8.

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Conflicts of interest – On behalf of all authors, the corresponding author states that there is no conflict of interest.

Availability of data and material – The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request

Electronic Supplementary Material

Electronic Supplementary Material 1 Supplementary tables: 1) museum collections used for this study; 2) site catalogue; 3) summary data for Nursling terrace sites; 4 and 5) summary data for the Belbin terrace sites; 6) summary data for the Mottisfont/Lower Warsash terrace sites; 7) summary data for the Hamble terrace sites

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Figure and table captions

Fig. 1 The River Test and its regional context. A) The wider Solent region with key sites mentioned in the text. B) Mapping of the terrace stratigraphy of the River Test and River Itchen after Hatch et al. (2017) with study site locations. 1. Belbin's Pit, 2. Brownwich Beach, 3. Chilling Church Pit, 4. Chilling-Hook Gravel Pit, 5. Chiver's Gravel Pit, 6. Colden Common, 7. Coxford, 8. Dunbridge, 9. Dyke's Pit, 10. Emsworth Road, 11. Fleet End Pit, 12. Harris Pit, 13. High Street, 14. Highfield, 15. Hill Head, 16. Hill Lane, 17. Hook, 18. Kimbridge Pits, 19. Lee-on-Solent, 20. Lone Barn Farm, 21. Luzborough Gravel Pits, 22. Mousehole Pit, 23. New Pit, 24. Newbury's Pit, 25. Ogle Road, 26. Old Shirley, 27. Park's Pit, 28. Pauncefoot Hill, 29. Portswood Pits, 30. Ridge Gravel Pit, 31. Rockstone Place, 32. Shirley Avenue, 33. Shirley Road, 34. Shirley Warren, 35. Southampton Cemetery, 36. Spa Road, 37. St James's Church Pit, Shirley, 38. Test Road Materials Pit, 39. Warsash (Lower Warsash terrace), 40. Warsash (Hamble terrace), 41. Warsash Church Pit, 42. Withedswood Gravel Pit

Fig. 2 The terrace stratigraphy of the River Test as mapped by Hatch et al. (2017). Profile projected along N135ºE with distance measured from zero at SU 31595 29000

Fig. 3 Summary of OSL age estimates from the Test terraces in relation to Marine Isotope Stages (after Lisiecki and Raymo 2005). Age estimates from [1]Briant et al. (2012), [2]Harding et al. (2012) and [3]Hatch et al. (2017). Only age estimates deemed reliable by these authors are depicted. Harding et al. report a weighted mean average of 305 ± 25 ka for the Mottisfont terrace samples

Fig. 4 One of the handaxes found by Mr W. Read in 1869 at Town Pits at the northwest corner of Southampton Common. These gravels are assigned to the Midanbury Terrace (Photo R.D.; reproduced courtesy of the Ashmolean Museum, Oxford)

Fig. 5 Comparison of artefact condition between the Test terrace records. A) degree of abrasion of handaxes; B) handaxe surface condition; C) degree of abrasion of Levallois artefacts; D) Levallois surface condition

Fig. 6 Examples of ovate handaxes from Ridge Gravel Pit. A and C: slightly rolled ovate with straight cleaver-like tip; B and E: moderately rolled ovate handaxe with tranchet-sharpened tip; D: rolled cordate/ovate handaxe; F: moderately rolled ovate handaxe (Photos R.D.)

Fig. 7 Examples of crude and pointed handaxes from Ridge Gravel Pit. A: moderately rolled crude pointed handaxe; B: moderately rolled small pointed handaxe; C and E: very rolled thick asymmetrical pointed handaxe; D: slightly rolled crude pointed handaxe (Photos R.D.)

Fig. 8 Comparison of refinement (max. width/max. thickness) of crude, pointed, sub-cordate and ovate handaxes between Test terrace records

Fig. 9 Examples of fresher handaxes from the Belbin terrace. A and C: slightly rolled pointed handaxe from Dunbridge; B: fresh *bout coupé* from Dunbridge; D: slightly rolled pointed handaxe from Luzborough Gravel Pits; E and F: slightly rolled pointed handaxe from Test Road Materials Pit; G: slightly rolled pointed handaxe with straight cleaver-like tip from Test Road Materials Pit; H: slightly rolled sub-cordate handaxe from Test Road Materials Pit (Photos R.D.; A-D reproduced courtesy of the British Museum)

Fig. 10 Examples of fresher handaxes from the Mottisfont/Lower Warsash terrace. A: slightly rolled ficron from Dyke's Pit, Warsash; B: fresh pointed handaxe from Warsash; C: slightly rolled pointed handaxe made on a flake from Warsash; D and E: slightly rolled pointed handaxe from Warsash (Photos R.D.; reproduced courtesy of the British Museum)

Fig. 11 Examples of Levallois artefacts from the Test terraces. A: very rolled Levallois flake from Belbin's Pit; B: slightly rolled Levallois flake from Chiver's Pit; C: slightly rolled Levallois flake from Belbin's Pit; D: moderately rolled Levallois flake from Test Road Materials Pit; E: very rolled Levallois flake from Colden Common; F: fresh Levallois core from Fleet End Pits, Warsash; G: fresh Levallois core from Warsash; H and J: fresh Levallois flake from Warsash; I: slightly rolled Levallois flake from Warsash; K: moderately rolled Levallois flake from Lee-on-Solent (Photos R.D.; A-C and E-K reproduced courtesy of the British Museum)

Table 1 Comparison of the Hatch et al. (2017) terrace mapping at Dunbridge, Romsey, Southampton and Warsash with the terrace mapping of Harding et al. (2012), PASHCC (Bates et al., 2004; Briant et al., 2012) and the BGS. Italics indicate significant differences between Hatch et al. and other schemes. [a] BGS stratigraphy of

Booth (2002) for Sheet 299 and Edwards and Freshney (1987) for Sheet 315. [b] See Figure 1 caption for key to numbered study sites. Additional sites mentioned in the text are named

Table 2 Summary of age estimates for the Test terraces. OSL age estimates in brackets are deemed unreliable by Briant et al. (2012). OSL age estimates from [a] Briant et al. (2012), [b] Harding et al. (2012) and [c] Hatch et al. (2017)

Table 3 Summary of the archaeological sample examined for this study

Table 4 The number of handaxes and Levallois artefacts that can be assigned to each Test terrace. See Table S2 in supplementary information for a complete site catalogue for the Test

Table 5 Summary of the raw material characteristics of the Test terrace handaxe records

Table 6 Summary of metric (mean and standard deviation) and typological data for the Test terrace handaxe records. Elongation = Breadth/Length; Refinement = Thickness/Breadth; Edge Shape = Tip Width/Butt Width; Profile shape = Tip Thickness/Butt Thickness (after Roe, 1968a)

Table 7 Summary of selected attributes of the Test terrace handaxe records. Scar index = number of scars > 5mm/length (mm)

Table 8 Comparison of metric (mean and standard deviation) and typological data between fresher and rolled handaxes from the Nursling, Belbin and Mottisfont/Lower Warsash terrace records. Elongation = Breadth/Length; Refinement = Thickness/Breadth; Edge Shape = Tip Width/Butt Width; Profile shape = Tip Thickness/Butt Thickness (after Roe, 1968a)

Table 9 Comparison of selected attributes between fresher and rolled handaxes from the Nursling, Belbin and Mottisfont/Lower Warsash terrace records. Scar index = number of scars > 5mm/length (mm)

Table 10 Summary of the key characteristics of the Test terrace handaxe records. Age interpretation based on terrace stratigraphy, OSL age estimates for the Hamble and Mottisfont/Lower Warsash terraces, and an assumed one terrace per glacial/interglacial cycle for the higher terraces (see text for discussion)

Table 11 Number of handaxe and Levallois artefacts assigned to the Solent and Stour terraces in the Bournemouth area (after Davis, 2013) and suggested terrace ages

Table 1

Area	Hatch et al. (2017)	Harding et al. (2012)	PASHCC	BGS[a]	Sites[b]
<u>Sheet 299 - Dunbridge</u>					
	Broadlands Farm	Broadlands Farm	Terrace 1	Terrace 1	
	Mottisfont	Mottisfont	*Terrace 5*	*Terrace 2/3*	18
	Belbin	Belbin	*Terrace 5*	*Terrace 2/3*	8
	Nursling	*Unspecified*	*Terrace 7*	*Terrace 4*	Great Copse
	Bitterne	*Midanbury*	*Terrace 8*	*Terrace 5/6*	
	Midanbury	Midanbury	Terrace 8	*Terrace 5/6*	Spearywell Wood
<u>Sheet 315 – Romsey</u>					
	Broadlands Farm	Broadlands Farm	Terrace 1	Terrace 1	
	Mottisfont	Mottisfont	Terrace 3	Terrace 3	20
	Belbin	Belbin	Terrace 4	Terrace 4	1, 5, 21, 38
	Ganger Wood	Ganger Wood	Terrace 5	Terrace 5	
	Nursling	Nursling	Terrace 6	Terrace 6	28, 30
	Bitterne	Bitterne	Terrace 7	Terrace 7	
	Midanbury	*Castle Hill*	Terrace 8	Terrace 8	
<u>Sheet 315 - Southampton</u>					
	Broadlands Farm	Broadlands Farm	Terrace 1	Terrace 1	
	Hamble	Hamble	Terrace 2	Terrace 2	13
	Mottisfont	Mottisfont	Terrace 3	Terrace 3	10, 22, 25, 26, 33, 36
	Belbin	Belbin	Terrace 4	Terrace 4	7, 12, 14, 16, 29, 31, 32, 34, 35, 37
	Ganger Wood	Ganger Wood	Terrace 5	Terrace 5	
	Nursling	Nursling	Terrace 6	Terrace 6	
	Bitterne	Bitterne	Terrace 7	Terrace 7	
	Rownhams Farm	Rownhams Farm	Terrace 8	Terrace 8	Town Pits
	Castle Hill	Castle Hill	Terrace 9	Terrace 9	
	Toot Hill	Toot Hill	Terrace 10	Terrace 10	
	Lordswood Lane	Lordswood Lane	*Terrace 10*	Terrace 11	
	Lordswood Lane	*Chilworth*	*Terrace 10*	Terrace 11	
<u>Sheet 315 – Warsash</u>					
	Hamble	Hamble & Lower Warsash	*Terrace 2 & Terrace 3*	*Terrace 2 & Terrace 3*	2, 3, 4, 15, 17, 19, 40
	Lower Warsash	Lower Warsash	Terrace 3	Terrace 3	9, 11, 23, 27, 39, 41
	Upper Warsash	Upper Warsash	*Terrace 3*	*Terrace 3*	
	Mallards Moor	*Mallards Moor & Nursling*	*Terrace 5 & Terrace 6*	*Terrace 5 & Terrace 6*	
	Nursling	Nursling	Terrace 6	Terrace 6	
	Bitterne	*Nursling*	*Terrace 6*	*Terrace 6*	
	Rownhams Farm	Rownhams Farm	Terrace 8	Terrace 8	

Table 1 Comparison of the Hatch et al. (2017) terrace mapping at Dunbridge, Romsey, Southampton and Warsash with the terrace mapping of Harding et al. (2012), PASHCC (Bates et al., 2004; Briant et al., 2012) and the BGS. Italics indicate significant differences between Hatch et al. and other schemes. [a] BGS stratigraphy of Booth (2002) for Sheet 299 and Edwards and Freshney (1987) for Sheet 315. [b] See Figure 1 caption for key to numbered study sites. Additional sites mentioned in the text are named

Table 2

	OSL age estimates	OSL MIS attribution	Westaway et al. (2006) age estimate
Lordswood Lane/West End	-	-	MIS 26
Toot Hill/Netley Hill	-	-	MIS 22
Castle Hill	-	-	MIS 18
Midanbury/Rownham's Farm	-	-	MIS 16/15b
Bitterne	(>200[a])	(pre-MIS 7)	MIS 14
Nursling	(413 ± 26[a])	(MIS 12/11)	MIS 13b
	(280 ± 19[a])	(MIS 8)	
Ganger Wood/Mallards Moor	(292 ± 20[a])	(MIS 9/8)	MIS 12
	(233 ± 37[a])	(MIS 8/7)	
Belbin/Upper Warsash	-	-	MIS 10
Mottisfont/Lower Warsash	305 ± 25[b]	MIS 9/8	MIS 8
	229 ± 24[c]	MIS 8/7	
Hamble	231 ± 24[a]	MIS 8/7	MIS 6
	221 ± 20[a]	MIS 7	
	212 ± 25[a]	MIS 7/6	
	204 ± 17[a]	MIS 7/6	
	200 ± 23[c]	MIS 7/6	
Broadlands Farm	69 ± 5[a]	MIS 4	MIS 2

Table 2 Summary of age estimates for the Test terraces. OSL age estimates in brackets are deemed unreliable by Briant et al. (2012). OSL age estimates from [a] Briant et al. (2012), [b] Harding et al. (2012) and [c] Hatch et al. (2017)

Table 3

Nursling terrace		Belbin terrace		Mottisfont/Lower Warsash terrace		Hamble terrace	
Site	Handaxes/ Levallois	Site	Handaxes/ Levallois	Site	Handaxes/ Levallois	Site	Handaxes/ Levallois
Pauncefoot Hill	26	Belbin's Pit	112/3	Colden Common	58/1	Brownwich Beach	1/1
Ridge	131	Chiver's Gravel Pit	12/1	Dyke's Pit	2	Chilling Church Pit	8
		Coxford	17	Emsworth Road	1	Chilling-Hook Gravel Pit	4
		Dunbridge	386	Fleet End Pit	14/2	High Street	1
		Harris Pit	4	Kimbridge Pits	30	Hill Head	70
		Highfield	69	Mousehole Pit	22	Hook	4
		Hill Lane	11/1	New Pit	15/5	Lee-on-Solent	0/1
		Luzborough Gravel Pits	51	Newbury's Pit	5	Warsash	51
		Portswood Pits	2	Ogle Road	2		
		Rockstone Place	1	Old Shirley	16		
		St James's Church Pit, Shirley	25	Park's Pit	10		
		Shirley Avenue	1	Shirley Road	18		
		Shirley Warren	18	Spa Road	1		
		Southampton Cemetery	20	Lone Barn Farm	5		
		Test Road Materials Pit	43/2	Warsash	200/14		
		Withedswood Gravel Pit	18	Warsash Church Pit	1		
Total	157	Total	790/7	Total	400/22	Total	139/2

Table 3 Summary of the archaeological sample examined for this study

Table 4

Terrace	No. of sites	Handaxes	Levallois	Key sites (% of terrace total)
Lordswood Lane/West End	-	-	-	
Toot Hill/Netley Hill	-	-	-	
Castle Hill	-	-	-	
Midanbury/Rownham's Farm	1	3	-	Town Pit (100%)
Bitterne	-	-	-	
Nursling	3	170	-	Ridge Gravel Pit (79%); Pauncefoot Hill (19%)
Ganger Wood/Mallards Moor	3	13	-	Old Netley Gravel Pit (56%)
Belbin/Upper Warsash	29	1595	12	Dunbridge (66%); Belbin's Pit (11%)
Mottisfont/Lower Warsash	26	467	31	Warsash (54%); Kimbridge (17%); Colden Common (14%)
Hamble	12	432	3	Hill Head (52%); Warsash (16%); Lee-on-Solent (15%)
Broadlands Farm	10	39	-	Redbridge (48%)

Table 4 The number of handaxes and Levallois artefacts that can be assigned to each Test terrace. See Table S2 in supplementary information for a complete site catalogue for the Test

Table 5

	Nursling terrace		Belbin terrace		Mottisfont/Lower Warsash terrace		Hamble terrace	
	Fresher	Rolled	Fresher	Rolled	Fresher	Rolled	Fresher	Rolled
Raw material								
Flint	100.0%	99.0%	99.0%	99.1%	92.7%	97.2%	100.0%	98.5%
Chert	-	1.0%	1.0%	0.9%	7.3%	2.8%	-	1.5%
n	54	103	105	685	42	358	5	134
Cortex condition								
Fresh	47.5%	42.0%	14.6%	1.9%	29.4%	3.6%	20.0%	7.6%
Worn	52.5%	58.0%	85.4%	98.1%	70.6%	96.4%	80.0%	92.4%
n	40	69	89	519	17	195	5	92

Table 5 Summary of the raw material characteristics of the Test terrace handaxe records

Table 6

	Nursling terrace	Belbin terrace	Mottisfont/Lower Warsash terrace	Hamble terrace
Length (mm)	128.6 ± 35.9	121.5 ± 34.0	129.6 ± 35.0	132.8 ± 31.5
Breadth (mm)	75.0 ± 15.35	73.7 ± 15.6	78.2 ± 16.1	82.7 ± 14.1
Thickness (mm)	37.48 ± 11.7	36.2 ± 9.5	37.8 ± 9.1	37.8 ± 9.1
Elongation	0.60 ± 0.11	0.62 ± 0.12	0.61 ± 0.10	0.63 ± 0.10
Refinement	0.50 ± 0.15	0.50 ± 0.11	0.49 ± 0.10	0.46 ± 0.09
Edge Shape	0.75 ± 0.15	0.69 ± 0.20	0.68 ± 0.22	0.75 ± 0.21
Profile Shape	0.69 ± 0.19	0.61 ± 0.21	0.59 ± 0.19	0.68 ± 0.20
Wymer (1968) type				
Crude (D & E)	9.2%	15.3%	14.5%	8.2%
Pointed (F)	21.6%	41.2%	37.1%	32.8%
Sub-cordate (G)	12.4%	17.8%	17.3%	13.4%
Cleaver (H)	1.3%	1.2%	5.1%	3.0%
Ovate (J & K)	54.9%	20.7%	21.6%	37.3%
Twisted ovate (Kf)	-	1.8%	1.3%	2.2%
Ficron (M)	-	1.3%	2.3%	2.2%
Flat-butted cordate (N)	-	0.3%	-	0.7%
Uniface	0.7%	0.5%	1.0%	-
n	153	765	394	134
Roe (1968a) metric type				
Pointed	33.7%	52.6%	51.6%	33.7%
Ovate	64.2%	43.7%	44.5%	63.3%
Cleaver	2.1%	3.6%	3.9%	31.0%
n	95	631	335	98

Table 6 Summary of metric (mean and standard deviation) and typological data for the Test terrace handaxe records. Elongation = Breadth/Length; Refinement = Thickness/Breadth; Edge Shape = Tip Width/Butt Width; Profile shape = Tip Thickness/Butt Thickness (after Roe, 1968a)

Table 7

	Nursling terrace	Belbin terrace	Mottisfont/Lower Warsash terrace	Hamble terrace
Blank type				
Cobble/nodule	87.9%	87.5%	85.0%	91.4%
Flake	12.1%	12.5%	15.0%	8.6%
n	99	416	232	58
Tip shape				
Rounded	89.2%	90.2%	87.4%	91.3%
Pointed	-	0.1%	0.3%	-
Square	10.8%	9.7%	12.3%	8.7%
Tranchet sharpened tip				
Yes	24.2%	8.9%	10.4%	9.6%
No	75.8%	91.1%	89.6%	90.4%
n	149	696	358	115
Total cortex (%)	11.1 ± 13.7	11.9 ± 12.3	11.2 ± 13.5	8.1 ± 9.6
Butt cortex (%)	18.2 ± 23.6	20.7 ± 23.9	21.1 ± 25.6	16.0 ± 20.4
Total edge (%)	87 ± 16	82 ± 17	82 ± 17	86 ± 15
Scar index	0.36 ± 0.13	0.34 ± 0.11	0.35 ± 0.11	0.36 ± 0.11

Table 7 Summary of selected attributes of the Test terrace handaxe records. Scar index = number of scars > 5mm/length (mm)

Table 8

	Nursling terrace		Belbin terrace		Mottisfont/Lower Warsash terrace	
	Fresher	Rolled	Fresher	Rolled	Fresher	Rolled
Length	128.2 ± 37.9	130.4 ± 25.8	129.9 ± 35.7	120.3 ± 33.6	143.6 ± 40.4	127.9 ± 34.0
Breadth	75.2 ± 15.9	74.1 ± 12.8	72.5 ± 18.1	73.8 ± 15.2	79.5 ± 15.1	78.0 ± 16.2
Thickness	36.7 ± 11.7	40.7 ± 11.2	38.2 ± 9.7	35.8 ± 9.4	38.9 ± 8.7	37.7 ± 9.1
Elongation	0.61 ± 0.12	0.57 ± 0.07	0.56 ± 0.10	0.63 ± 0.12	0.57 ± 0.10	0.618 ± 0.1
Refinement	0.49 ± 0.14	0.56 ± 0.16	0.54 ± 0.13	0.49 ± 0.11	0.50 ± 0.10	0.49 ± 0.10
Edge Shape	0.76 ± 0.15	0.72 ± 0.15	0.65 ± 0.17	0.69 ± 0.20	0.63 ± 0.25	0.69 ± 0.21
Profile Shape	0.70 ± 0.19	0.66 ± 0.17	0.48 ± 0.19	0.62 ± 0.21	0.47 ± 0.15	0.60 ± 0.19
Wymer (1968) type						
Crude (D & E)	8.1%	13.8%	7.9%	16.4%	4.9%	15.6%
Pointed (F)	20.2%	27.6%	57.4%	38.7%	58.5%	34.6%
Sub-cordate (G)	11.3%	17.2%	17.8%	17.8%	14.6%	17.6%
Cleaver (H)	-	6.9%	0.9%	1.2%	2.4%	5.4%
Ovate (J & K)	59.7%	34.5%	9.9%	22.3%	12.2%	22.7%
Twisted ovate (Kf)	-	-	1.0%	2.0%	-	1.4%
Ficron (M)	-	-	3.0%	1.1%	2.4%	2.3%
Flat-butted cordate (N)	-	-	1.0%	0.2%	-	-
Uniface	0.8%	-	1.0%	0.5%	4.9%	0.6%
n	124	29	101	664	41	353
Roe (1968a) metric type						
Pointed	32.0%	40.0%	60.8%	51.4%	70.3%	49.3%
Ovate	68.0%	50.0%	34.2%	45.1%	24.3%	47.0%
Cleaver	-	10.0%	5.1%	3.4%	5.4%	3.7%
n	75	20	79	552	36	298

Table 8 Comparison of metric (mean and standard deviation) and typological data between fresher and rolled handaxes from the Nursling, Belbin and Mottisfont/Lower Warsash terrace records. Elongation = Breadth/Length; Refinement = Thickness/Breadth; Edge Shape = Tip Width/Butt Width; Profile shape = Tip Thickness/Butt Thickness (after Roe, 1968a)

Table 9

	Nursling terrace		Belbin terrace		Mottisfont/Lower Warsash terrace	
	Fresher	Rolled	Fresher	Rolled	Fresher	Rolled
Blank type						
Cobble/nodule	86.8%	91.3%	85.9%	87.8%	72.4	86.7%
Flake	13.2%	8.7%	14.1%	12.2%	27.6%	13.3%
n	76	23	64	352	29	204
Tip shape						
Rounded	90.9%	81.5%	90.4%	90.2%	91.9%	86.9%
Pointed	-	-	-	0.2%	2.7%	-
Square	9.1%	18.5%	9.6%	9.6%	5.4%	13.1%
Tranchet sharpened tip						
Yes	26.2%	14.8%	9.6%	8.8%	13.5%	10.0%
No	73.8%	85.2%	90.4%	91.2%	86.5%	90.0%
n	122	27	94	602	37	320
Total cortex	11.2 ± 14.5	10.4 ± 10.0	14.2 ± 14.1	11.5 ± 12.0	12.1 ± 14.9	11.1 ± 13.4
Butt cortex	18.2 ± 24.4	18.1 ± 21.0	25.5 ± 25.6	20.0 ± 23.6	24.1 ± 27.9	20.7 ± 25.3
Total edge	87 ± 16	87 ± 14	78 ± 17	82 ± 17	81 ± 17	82 ± 17
Scar index	0.36 ± 0.14	0.34 ± 0.10	0.35 ± 0.12	0.34 ± 0.10	0.37 ± 0.12	0.34 ± 0.11

Table 9 Comparison of selected attributes between fresher and rolled handaxes from the Nursling, Belbin and Mottisfont/Lower Warsash terrace records. Scar index = number of scars > 5mm/length (mm)

Table 10

Assemblage	Key features	Age interpretation
Nursling terrace rolled	Thick crude and pointed handaxes	≥ MIS 13
	Ovate handaxes	
	Few flake blanks	
Nursling terrace fresher	Ovate handaxes	MIS 13
	Tranchet-sharpened tips	
Belbin terrace rolled	Mixed assemblage	≥ MIS 9
	Twisted ovates (n = 13)	
Belbin terrace fresher	Pointed handaxes	MIS 9
	Less intensive working to handaxe butts	
Mottisfont/Lower Warsash terrace rolled	Mixed assemblage	≥ MIS 8
Mottisfont/Lower Warsash terrace fresher	Large pointed handaxes	MIS 8
	Less intensive working to handaxe butts	
	Frequent flake blanks	
Hamble terrace assemblage	Mixed assemblage	> MIS 7d
	Ovate handaxes	
	Few flake blanks	
	Low cortex retention	

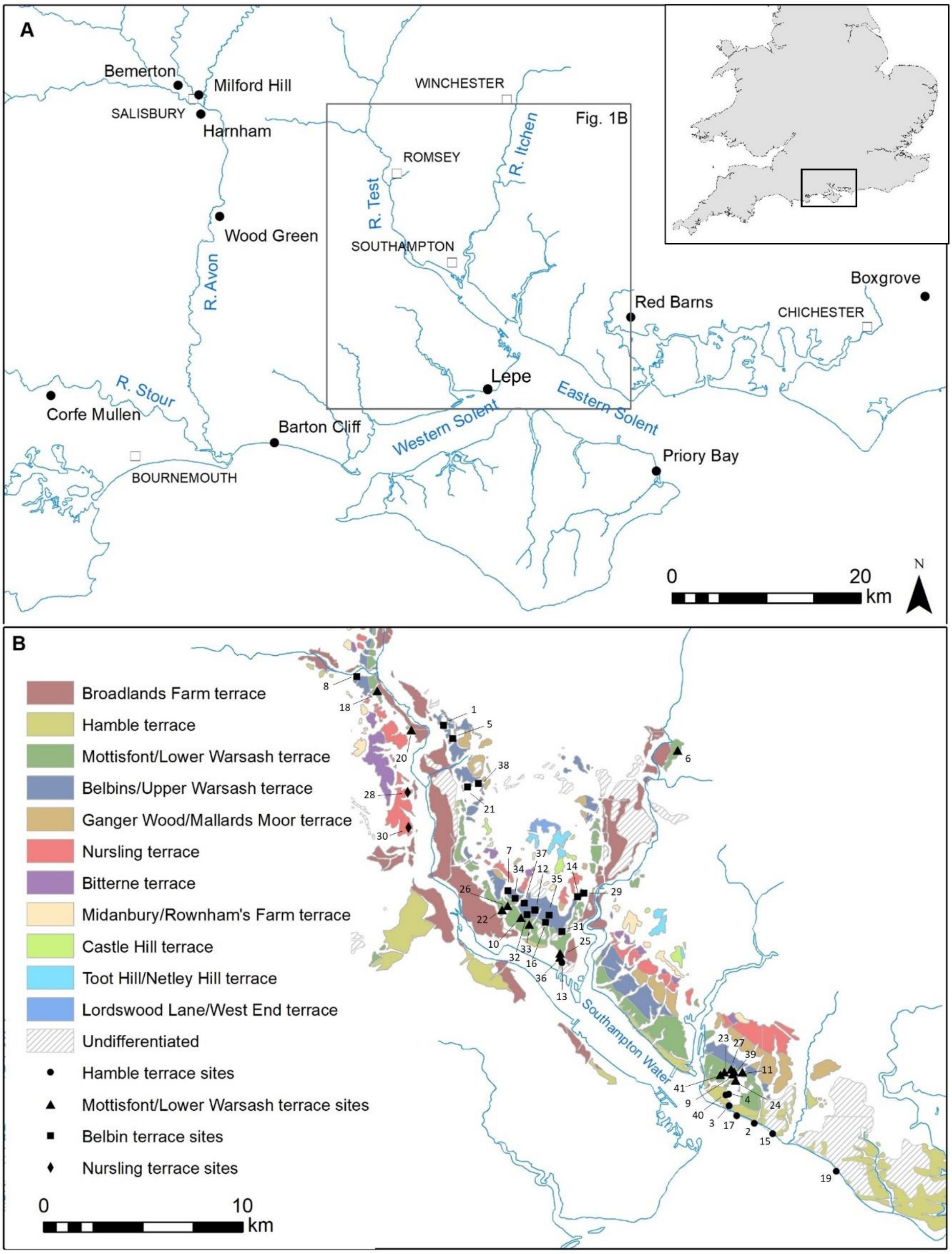
Table 10 Summary of the key characteristics of the Test terrace handaxe records. Age interpretation based on terrace stratigraphy, OSL age estimates for the Hamble and Mottisfont/Lower Warsash terraces, and an assumed one terrace per glacial/interglacial cycle for the higher terraces (see text for discussion)

Table 11

	Handaxes	Levallois	Westaway et al. (2006) age estimate
Sway Gravel	3	-	MIS 16
Tiptoe Gravel	1	-	MIS 14
Setley Plain Gravel	392	2	MIS 12
Old Milton Gravel	77	1	MIS 10
Taddiford Farm/Ensbury Park Gravel	835	19	MIS 9
Stanswood Bay/West Southbourne Gravel	80	3	MIS 8
Milford-on-Sea Gravel	83	7	MIS 6
Pennington Gravel	290	1	MIS 4-2

Table 11 Number of handaxe and Levallois artefacts assigned to the Solent and Stour terraces in the Bournemouth area (after Davis, 2013) and suggested terrace ages

Figure 1



A
Bemerton
Milford Hill
SALISBURY
Harnham
WINCHESTER
Fig. 1B
ROMSEY
R. Itchen
R. Test
Wood Green
R. Avon
SOUTHAMPTON
Boxgrove
Red Barns
CHICHESTER
Lepe
R. Stour
Corfe Mullen
Barton Cliff
Western Solent
Eastern Solent
Priory Bay
BOURNEMOUTH
0
20
km
N
B
Broadlands Farm terrace
Hamble terrace
Mottisfont/Lower Warsash terrace
Belbins/Upper Warsash terrace
Ganger Wood/Mallards Moor terrace
Nursling terrace
Bitterne terrace
Midanbury/Rownham's Farm terrace
Castle Hill terrace
Toot Hill/Netley Hill terrace
Lordswood Lane/West End terrace
Undifferentiated
Hamble terrace sites
Mottisfont/Lower Warsash terrace sites
Belbin terrace sites
Nursling terrace sites
Southampton Water
0
10
km

Figure 2

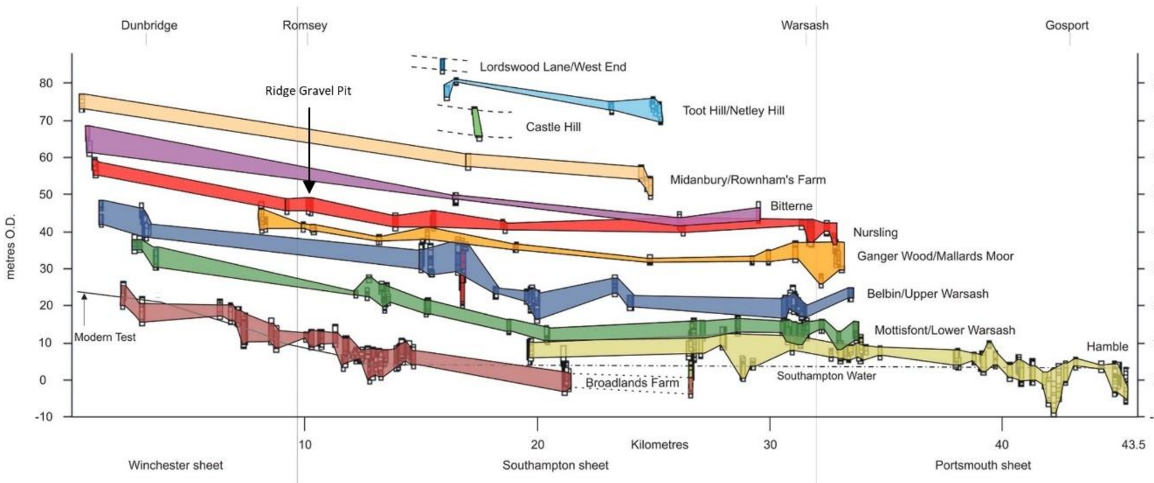


Figure 3

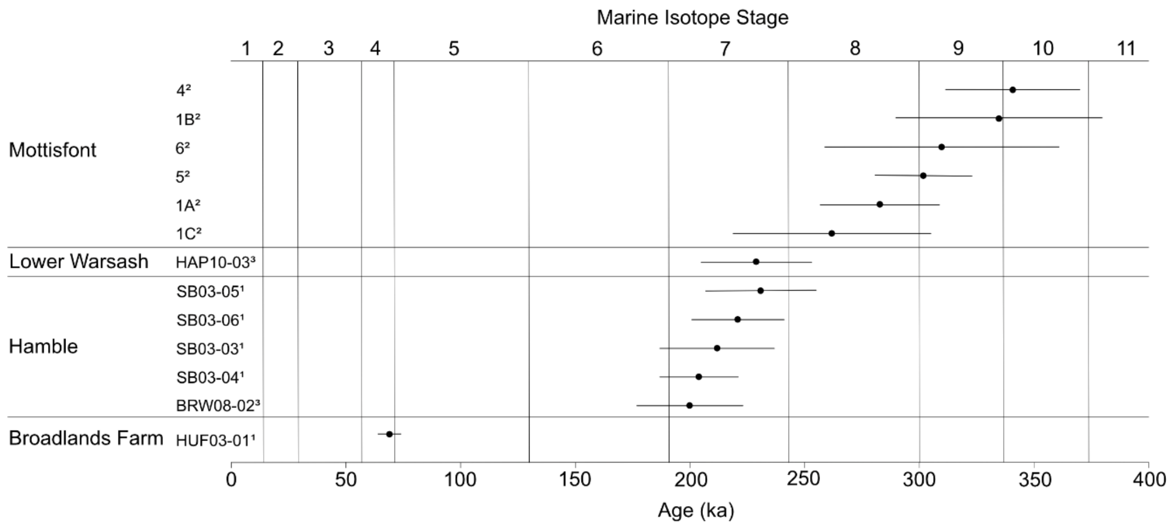


Figure 4

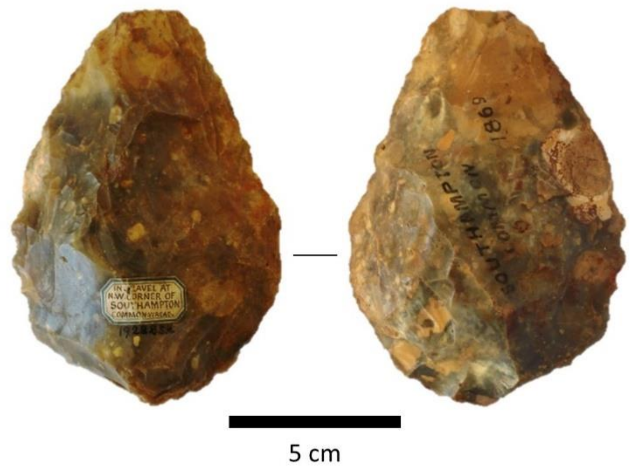


Figure 5

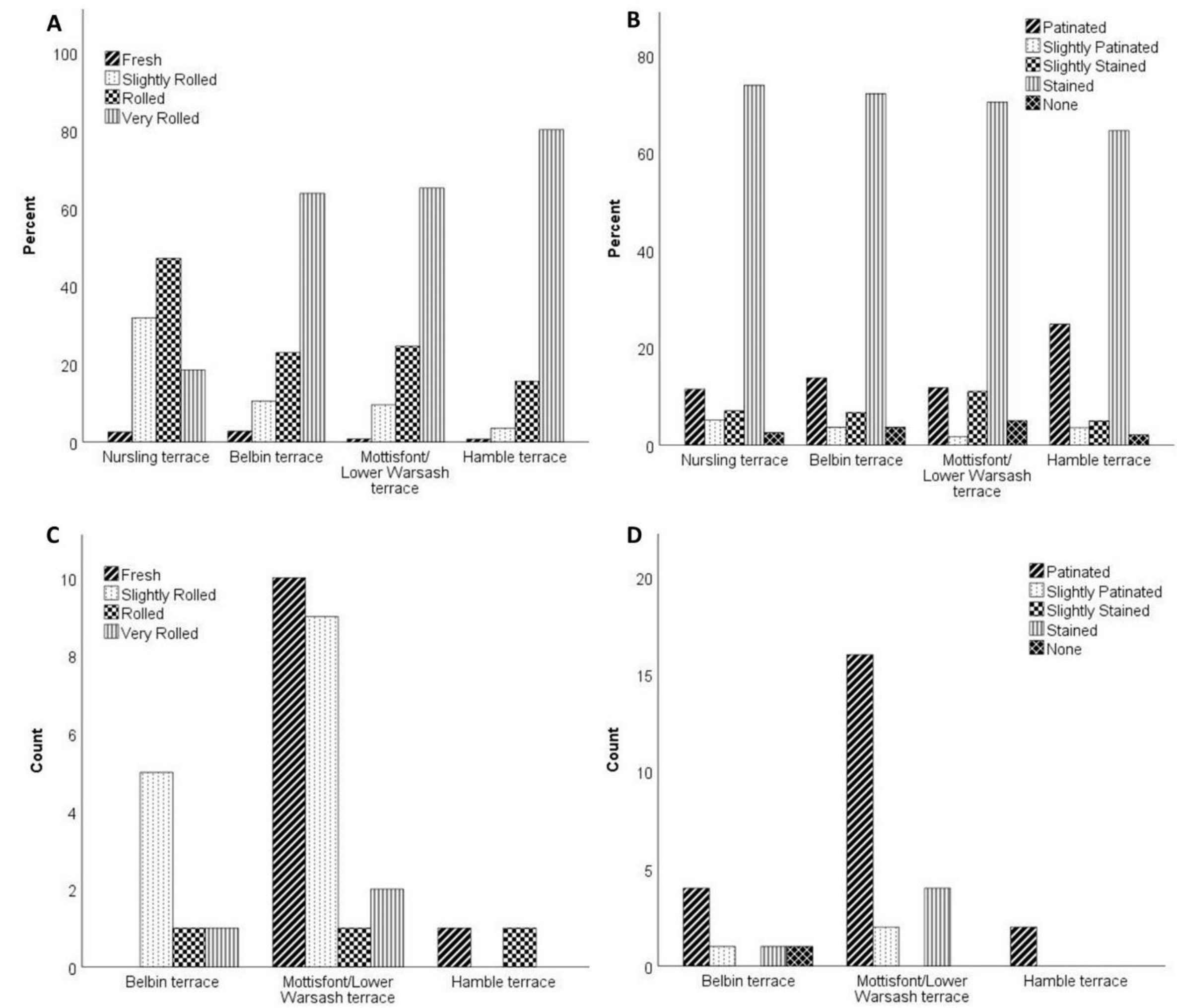

A
Percent
Fresh
Slightly Rolled
Rolled
Very Rolled
Nursling terrace
Belbin terrace
Mottisfont/ Lower Warsash terrace
Hamble terrace
B
Percent
Patinated
Slightly Patinated
Slightly Stained
Stained
None
C
Count
D

Figure 6

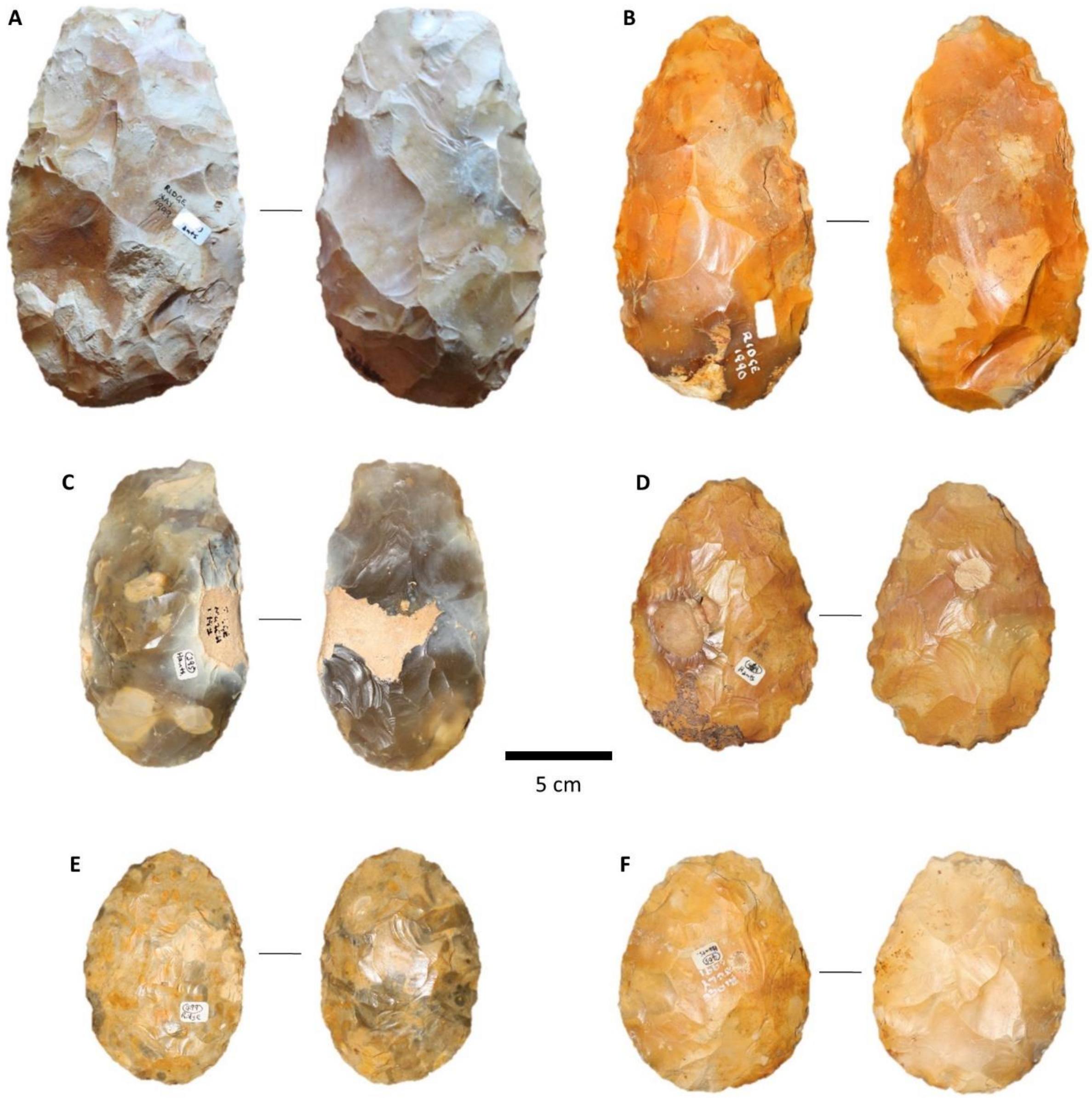


Figure 7

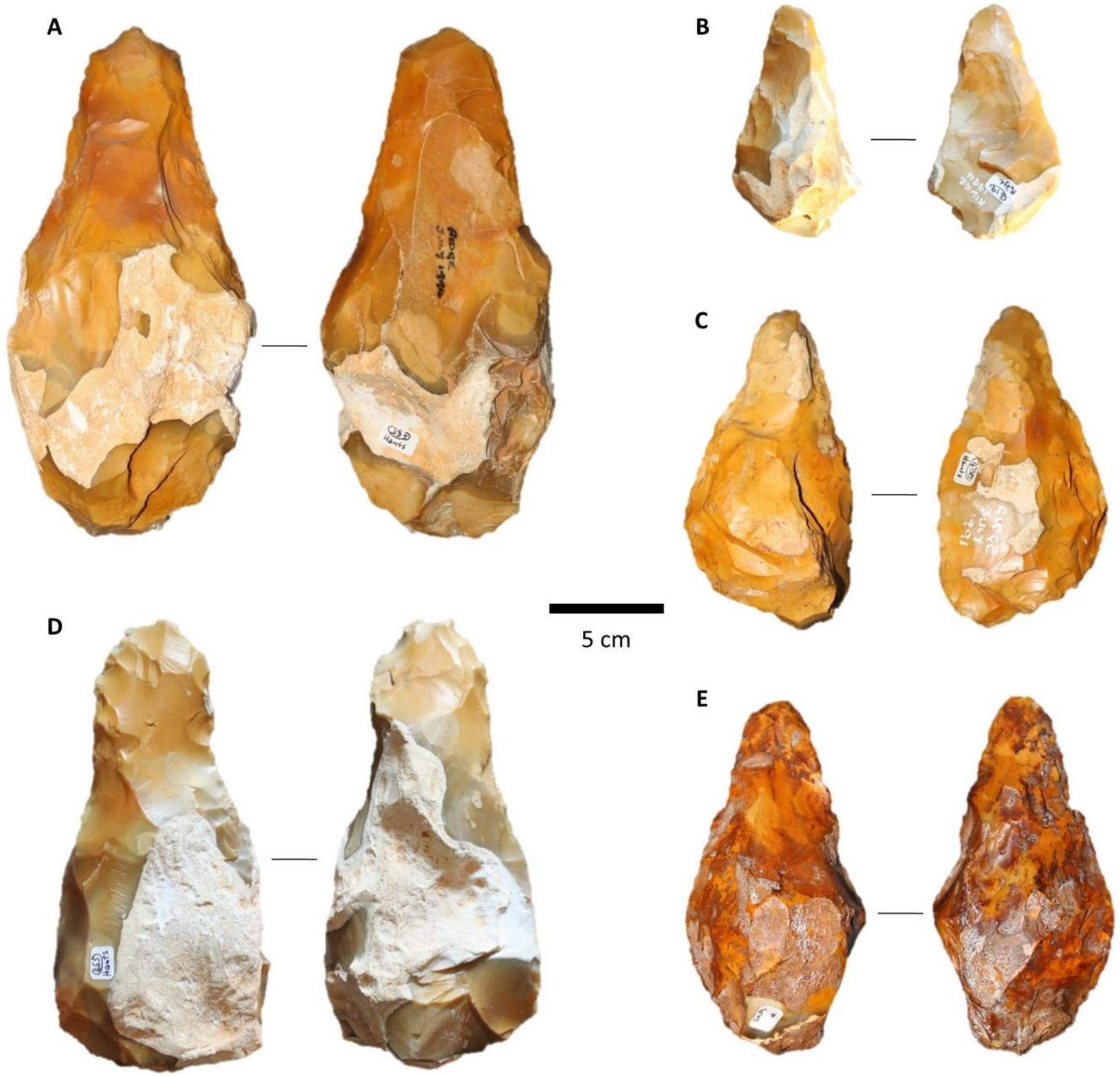


Figure 8

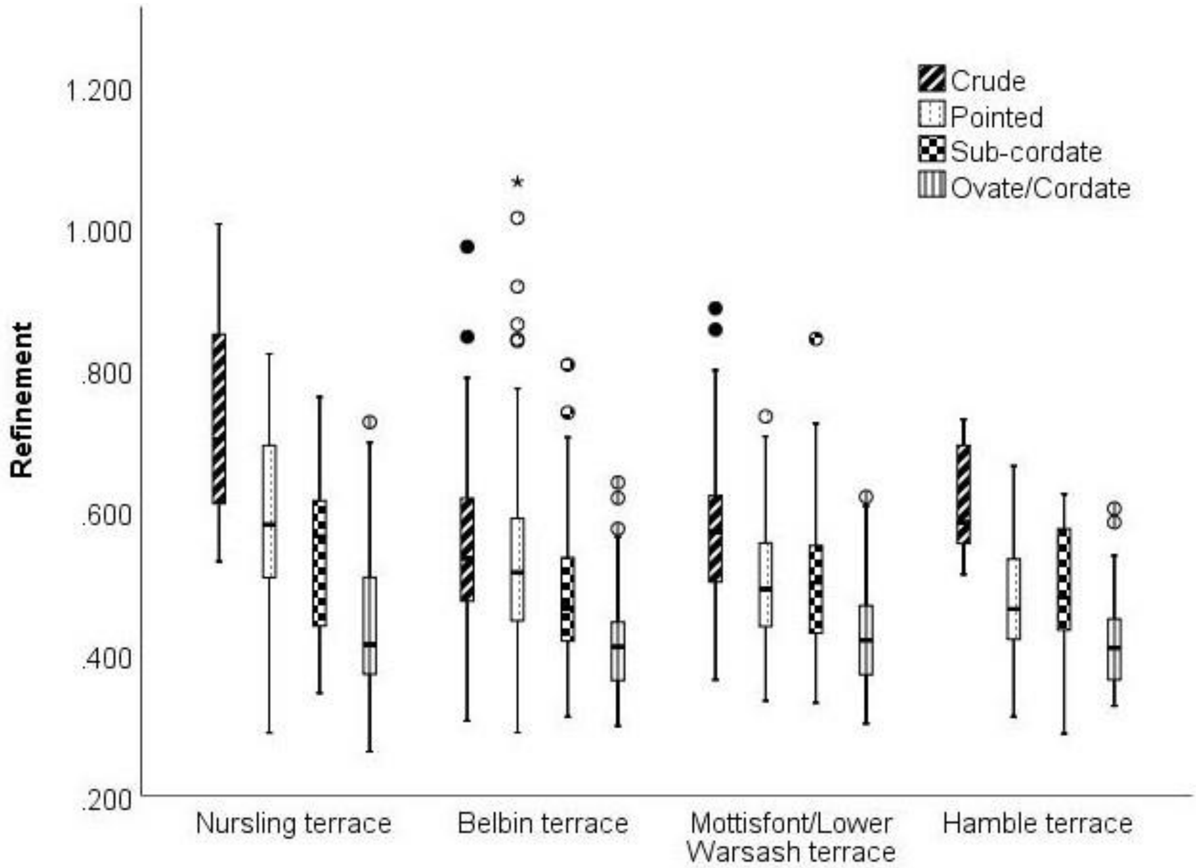

Crude
Pointed
Sub-cordate
Ovate/Cordate
Refinement
1.200
1.000
.800
.600
.400
.200
Nursling terrace
Belbin terrace
Mottisfont/Lower Warsash terrace
Hamble terrace

Figure 9

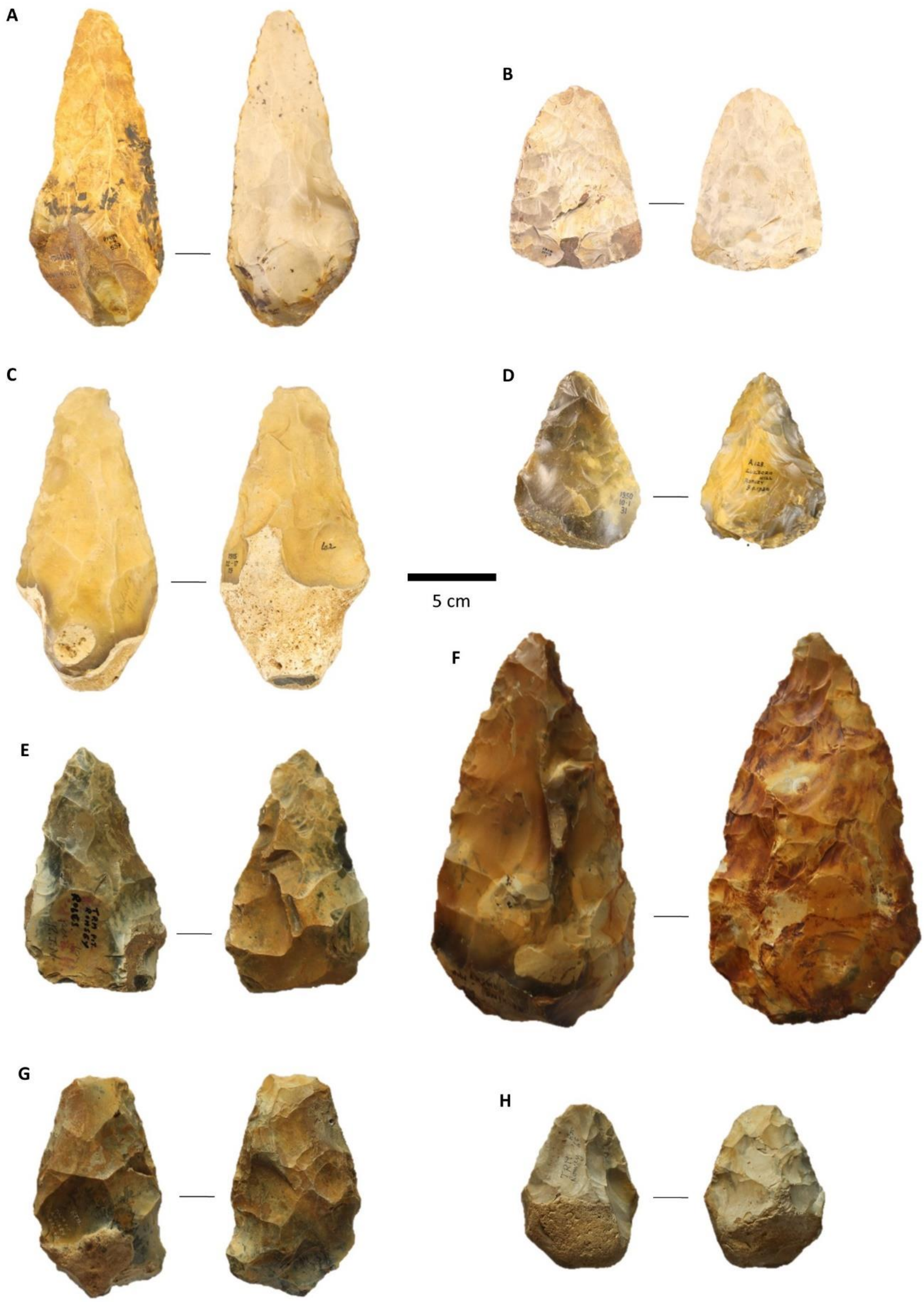


Figure 10

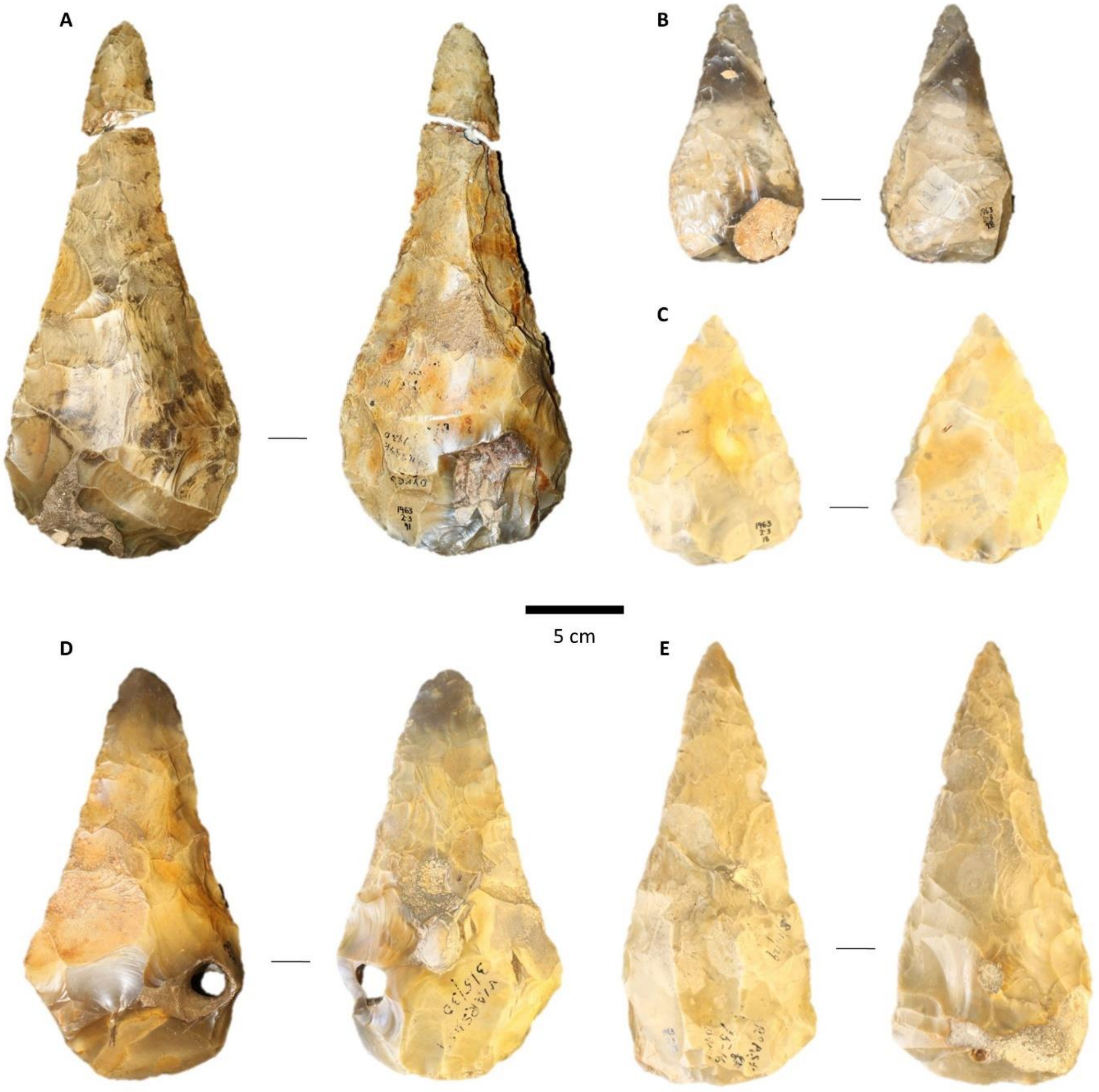


Figure 11