Interpreting Stratigraphy 5
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Edited by Liz Shepherd

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It is intended that the paper entitled Contemporary building collapse and deposition associated with substantial stone buildings in the Yorkshire Dales which was presented at the conference by Rob Janaway will be published in a future volume of proceedings.
Foreword

*a job of unearthing and piecing together
and sometimes a piece won’t fit
because it’s part of something else
and sometimes it is just a bit of old rubbish.*

Seeking ideas for this foreword, I rediscovered John Hegley’s poem ‘Digging for it’ from which the above lines seemed particularly apt. The extract sums up the process of archaeological enquiry and the frustrations of trying to find an interpretation that can be reconciled with all the evidence.

‘Interpreting Stratigraphy’ is a dynamic conference series, characterised by informal presentation and lively debate. By disseminating expertise and experience, it encourages the innovation, development and wider application of archaeological methods, both practical and analytical. The diversity of contributions reflects the increasing collaboration between stratigraphers and other specialists that an holistic approach to interpretation and publication demands.

The fifth conference, held at Norwich Castle Museum, was attended by over eighty people in spite of a rail strike. It covered three broad subjects: the study of redeposition and residuality, processes of building collapse and approaches to interpreting the remains of timber structures. A year on, I hope that the papers retain in published form their individual character and freshness as I have deliberately kept editing to a minimum. They appear in this volume in the order in which they were given.

*Liz Shepherd*

Acknowledgements

I would like to thank everyone who contributed to making the conference such an enjoyable event, particularly those who presented papers and the session chairs Tim Williams and Andrew Westman. Thanks also to the staff of the Norfolk Archaeological Unit and Norwich Castle Museum for their various contributions to organising the day. Piers Wallace has provided invaluable help with layout and cover design as well as advice on production. I am indebted to to Phil Emery for his detailed comments on the text. Many thanks to Jez Reeve and Brian Ayers for their comments, advice and encouragement. Finally, these proceedings could not have been published without the administrative and financial support of the Norfolk Archaeological Unit.
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Contexts, Their Contents and Residuality

Duncan H. Brown

Summary

Residual finds are those which occur in deposits later than the date of their origin and dispersal. Redeposited contexts are those which have been disturbed and laid down again subsequent to the date of their original deposition. Residual finds are often seen as an indicator of reposition. This raises one question of the validity of finds for such a purpose, and another regarding the problems of identifying redeposited contexts where no finds are present. In addressing this, the placement of an archaeological context within a stratigraphic sequence is examined. This is followed by a consideration of the types of finds which are useful in the construction and interpretation of a sequence. Case studies are presented before a conclusion is made.

Context

Crumney and Terry, in a significant contribution to the site chronology debate, classified contexts into two groups. Their Class I deposits are those in which all the finds are in their original positions while Class II contexts are those which contain residual material (Crumney and Terry 1979). Fifteen years on it is easy to see this as simplistic. Their discussion was grounded in Roman archaeology, where dates were, indeed often still are, attributed to artefacts with a degree of certainty that is rarely attempted by students of other periods. This paper is offered by a specialist in medieval pottery, a class of find which cannot always be dated to within 50 or 100 years. The problem of residuality, or reposition, may not therefore always be easily identified. This perspective has led to a consideration of the subject at a fundamental level.

In constructing a stratigraphic sequence for a site the following questions are likely to be asked of each context.

Question 1: What is a context later than? The answer to this question will initially be another layer and/or structure and can be answered without recourse to finds evidence. However, this question is also asked of contexts which have no physical relationship, for instance those which are horizontally discrete. Here, stratigraphy may lead the course of the enquiry, but information gleaned from finds analysis will inevitably be of some use.

Question 2: How much later is it? The composition of a deposit or the character of an interface may help to answer this question, but finds are regarded as significant in providing a chronological framework for a stratigraphic relationship.

Question 3: What is a context earlier than? This question will probably be answered by the same means as question one.

Question 4: How much earlier is it? Similarly, this question will be answered by the same means as question two.

Question 5: When was a context laid down? If questions one to four have been answered then a relative date, or date-range, signified by terminae post and ante quem, will result. An absolute date may be indicated by finds, or by scientific analysis of the deposit matrix. This will not necessarily answer question 6.

Question 6: How long did the process of deposition take? Sometimes this may also be answered from the results of questions one to four. In some cases however, this will not be possible, for instance where deposits have been truncated. Finds evidence may be of some use in identifying short or long periods of deposition.

Question 7: What happened to a context during or after the process of deposition? The results of questions one to six may solve this. However, it can be the most difficult question to answer, and the task of doing so may invoke the problem of reposition, for example where sealing layers have subsided into earlier features that are then re-cut. The structural evidence will certainly be significant here. Finds will provide a chronology for post-depositional events, and may also supply a cultural or environmental explanation for them.

If it is agreed that these are the problems which must be addressed before any deposit can be accurately placed within a stratigraphic sequence, and it is acknowledged that not all readers will accept this, then it may be possible to provide an alternative context.

Duncan H. Brown
Table 1: Distribution by sherd number of twenty cross-fitting vessels within medieval deposits at Southampton Castle (SOU123)

<table>
<thead>
<tr>
<th>Context no.</th>
<th>293</th>
<th>294</th>
<th>295</th>
<th>296</th>
<th>297</th>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>4</td>
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</tbody>
</table>

Table 2: Quantities of pottery for each period in the garderobe at Southampton Castle (SOU123)

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight (grammes)</th>
<th>Sherd no.</th>
<th>% weight</th>
<th>% sherd no.</th>
</tr>
</thead>
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<tr>
<td>Early Medieval</td>
<td>19,218</td>
<td>427</td>
<td>90</td>
<td>88</td>
</tr>
<tr>
<td>High Medieval</td>
<td>2,102</td>
<td>56</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Post-Medieval</td>
<td>44</td>
<td>1</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Totals</td>
<td>21,364</td>
<td>484</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
classification. Here, Class 1 contexts are those where all seven questions have been answered. These can be placed in sequence with relative ease. Class 2 contexts will be those for which none of the seven questions can be answered. These represent those ‘floating contexts’ that plague all but the most fortunate matrix-builders. It is not the purpose of this paper to pursue a context classification, however, and that must remain an aside. It may be claimed that finds have no part to play in the building of a stratigraphic sequence. This is, in theory, perhaps the best way to approach such an exercise. Indeed, most provisional phasing is carried out before the finds evidence is available. However, in practice finds will help to answer the seven questions set out above; and given that these need to be answered in order to ascribe each context its stratigraphic value; it is worth considering just what finds can and cannot offer.

Finds

Finds may be classified according to their value as chronological indicators.

Class 1: Dated finds include coins, inscribed artefacts and scientifically dated material such as dendrochronological or C-14 samples. Few of the dates given will relate to the date of deposition however.

Class 2: Chronologically diagnostic finds are those for which no absolute date can be ascertained, but which retain characteristics that suggest a date-range for the period of their creation. Certain types of artefacts, such as ceramic building material, clay pipes, pottery, glass and metalwork, are the most common and are thus regarded as the most reliable types of finds in this group. Of these, pottery is possibly the most common, and pottery specialists are usually the first people to be asked to give dates to archaeological deposits. Ecofacts are rarely identifiable as chronologically diagnostic, although the bones of certain animals, such as rabbits, will provide a broad terminus post quem.

Class 3: Chronologically non-diagnostic finds have no datable characteristics. This group includes most ecofacts and materials such as stone, daub and formless fragments of ceramic building material and metal.

Given that Class 2 artefacts are those which are most often used in the establishment of a site chronology it is worth looking more closely at the ways in which they themselves are dated. Typological elements such as manufacturing technique, shape and style, especially of decoration, are all deployed in the dating of artefacts. Most specialists will assign a date simply on the basis of an object’s appearance. Typologies are of course chronologically relative, for although they allow the development of a type to be traced through time, no actual dates can be assumed. All too often a typology is set alongside a stratigraphic sequence. Put basically, if Type A is found in an earlier deposit than Type B then the one can be shown to pre-date the other. Dates are introduced into this sequence when certain types are found in association with dated finds (Class 1 above), or in contexts of known date, such as buildings. In short, the dates given to certain types of finds have been attained by the same means as the dates given to archaeological contexts; by stratigraphy and comparison. Finds specialists have refined their knowledge of finds to the extent that stratigraphic confirmation of their dates is rarely required. That is why excavators ask specialists to provide dates more frequently than specialists request dates from excavators. This fact may conceal a complacent attitude towards finds dating, for it is truly not as reliable as we would like it to be. It is revealing to consider that, ultimately, contexts are dated by finds that are dated by contexts. Does this mean we are all mad? Well, it does emphasise the foolishness of relying exclusively on finds for dating evidence.

Most finds, certainly of Class 2 types, will be given a date range. Medieval pottery in Southampton, for example, is placed into one of three ceramic periods: early medieval, the 12th and 13th centuries; high medieval, the mid-13th to mid-14th centuries; late medieval, the mid-14th to 15th centuries. A few types, particularly some imported wares that are known from excavations elsewhere, can be dated more accurately. These may provide dates for those types which are associated with them, but their presence will not necessarily allow the closer dating of archaeological deposits. The presence of each pottery type in every context is quantified to allow statistical analysis of many aspects, including the chronological information. The technique of dating by seriation is also discussed in detail by Crummy and Terry (ibid). This analysis will provide both a date-range and a consensus date for a deposit. The latter is based upon the premise that the ceramic period which is best represented is most likely to indicate the date of deposition. This of course only works where significant quantities of pottery are present. Other aspects, such as sherd size and condition, will also affect the assignment of a date, but it is ultimately simply a process of interpretation. The case studies offered below will illustrate this further and also show that residual finds are present in most
Figure 1: Schematised matrix of the fills of a section of the castle ditch, Southampton (SOU124). Pottery-producing contexts are shown in bold type. The distribution of each cross-fitting vessel is denoted by letters a to h (eg vessel 'a' is present in contexts 525 and 531).
urban contexts. Furthermore, finds that are later than the date of deposition are also horribly common. This infuriating phenomenon undermines even further the efforts made at dating archaeological deposits, for it is not necessarily true that contexts can be dated by the latest finds they produce. This serves to emphasise the fragility of our most common dating techniques.

Redeposition

Having examined the basics of stratigraphy and finds dating, the identification of redeposited contexts may now be discussed. Once again, a hierarchy of context types may be suggested. This is related to the probability of identifying a context as redeposited.

**Class 1: Contexts containing dated finds** should in theory be the most easy to date.

**Class 2: Contexts containing chronologically diagnostic finds** can be given a date range or a consensus date.

**Class 3: Contexts containing only chronologically non-diagnostic finds** will be assigned a relative date from the stratigraphic evidence.

**Class 4: Contexts containing no finds** will also be dated on the basis of the stratigraphy.

Residual finds will be identified only in contexts of Classes 1 and 2. If residual finds are the main indicator of redeposition, then Class 1 and 2 contexts are those which will most frequently be shown to be redeposited. Class 3 contexts will have points of comparison with Classes 1 and 2, if the latter contain similar undatable finds (the question of whether or not this makes such finds chronologically diagnostic will be passed over here), but for these, and Class 4 contexts, structural and stratigraphic factors are the primary indicators of redeposition. How often therefore are contexts that have not produced datable finds identified as redeposited? Not often enough perhaps.

This suggests that contexts which cannot easily be ascribed dates are often not regarded as significant, yet they pose many structural and cultural problems that cannot be ignored. Here, then, is an argument for setting aside the finds evidence during the initial phasing of the stratigraphy. One further point arises. If deposits are identified as redeposited only if they contain certain types of finds, then an unknown proportion of redeposited contexts must go unrecognised. Is this important? If it is, then archaeologists need to refine methods of stratifying and dating contexts, because it is clear that the evidence provided by finds is inadequate, if only because they do not occur in every deposit. If it is not important, then perhaps there is no need to worry too much about the phenomenon of residuality and redeposition. After all, in urban assemblages especially, residual and intrusive finds are a fact of life, but they rarely distort the overall interpretation.

Case Studies

Table 1 shows the relationship between the fills of a closed feature, a garderobe at Southampton castle, and the pottery recovered therefrom. Fragments of each of twenty vessels were recovered from two or more of the five medieval fills. It has been argued that this series of cross-fits demonstrates that the in-filling of this feature took place as a single operation despite the fact that each layer is distinctly different (Brown 1986). Fragments of Vessel 11, for example, were found in four contexts, closely linking their deposition. It is probable that this material was derived from another source, perhaps an adjacent above-ground midden. Given that contexts 293 to 297 represent a single phase of deposition the answering of stratigraphic questions 1 to 7, as listed above, is straightforward. Furthermore, it should be possible to use the pottery to provide a date of deposition. Table 2 shows that almost all of it is early medieval, probably early 13th century. However, some later pieces are also present, and these may be dated to the mid-13th century at the earliest. A date c.1250 is the earliest option and this represents a consensus date based on the date-range indicated. This date and the date-range relate not only to the closing of the garderobe, but also to the accumulation of the material utilised in that operation. The fills of the garderobe should therefore be viewed as redeposited. However, the large sherd size and the unabraded condition of the pottery suggests that if an earlier deposit was used then it had not been standing for very long before being transferred to the garderobe. This chronology could hardly be described as refined, and the main use of the datable finds here is to suggest a timescale, if not a precise date, for the filling of the feature. This is also true of the second case study.

Figure 1 is a schematised matrix of the fills excavated within the castle ditch at Southampton. This shows how cross-fitting sherds from eight different pottery vessels are distributed throughout the sequence. It has been argued in this case that the ditch fills.

_Duncan H. Brown_ - 5
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<th>Context no.</th>
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<th>Late Medieval</th>
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<td>% Totals</td>
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Table 3: Quantities (by sherd number) of pottery from each period in the fills of a section of the castle ditch, Southampton (SOU124)

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight (grammes)</th>
<th>Sherd no.</th>
<th>% weight</th>
<th>% sherd no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Medieval</td>
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<td>2</td>
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<tr>
<td>High Medieval</td>
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<td>106</td>
<td>64</td>
<td>90</td>
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<td>Late Medieval</td>
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<td>1</td>
<td>4</td>
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<tr>
<td>Post-Medieval</td>
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<tr>
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</table>

Table 4: Quantities of pottery of each period from a burnt deposit excavated in Southampton (SOU124, Context 40)
accumulated over a period of time, during which the pottery was tumbled about and found its way into
different layers. Table 3 shows how pottery of the late
medieval periods is distributed among all but the fills
earlier than context 606. Sherds of cross-fit vessel H
are present in these fills and also those above,
including 526, where a post-medieval sherd was
recovered. This demonstrates the mixed quality of the
ditch-fills and suggests longevity for the period of
deposition (ibid.). Although stratigraphic questions 1
and 3, as listed above, can be answered, it is difficult
to address the other five. Many of these deposits may
be identified as redeposited within the confines of the
ditch itself and few of these contexts can be assigned
any accurate date.

The final example is a single deposit from a domestic
dwelling within the medieval town of Southampton.
Here, a burnt layer covered the site, sealing the walls
of a 13th-century house. The destruction of this
building may result from a French-instigated attack on
the town in 1338. The proportions of pottery of
different periods recovered from this deposit are
shown in Table 4. High medieval pottery is the best
represented and burnt pottery comprises 65% of the
high medieval material by sherd weight. This is likely
to be associated with the destruction event and can be
interpreted as being more or less in situ. Among the
unburnt material there is a negligible residual
presence. The remaining unburnt finds may be
presumed to post-date the deposition of the burnt
layer. Much of this is high medieval and possibly
represents the dumping of waste on the site in the
aftermath of destruction. Although the post-medieval
material comprises a significant proportion of the total
pottery weight, this is represented by just five sherds.
The higher breakage rate shown for the high medieval
pottery suggests that the layer had lain exposed for
some time after deposition. A consensus date for this
context might be in the post-medieval period, but an
actual date is provided by the presence of burnt pottery
that can be related to the creation of the destruction
deposit. The presence of post-medieval pottery, and
the relative sherd size difference between this and the
high medieval finds indicates the subsequent history of
this deposit and goes some way towards answering
stratigraphic question 7; what happened after the
deposit was first laid down?

These case studies illustrate the variety of
interpretations that can be placed on stratigraphic and
finds evidence, and also highlight some of their
shortcomings. Furthermore, it is hoped that the value
of finds has been shown to extend beyond the
provision of dates to allowing an insight into site
formation processes. Surely this technique is of greater
value in revealing and understanding redeposition.

Conclusion

The techniques of stratigraphic analysis and the dating
of finds have been set out here as a means of
examining attitudes to residuality and redeposition.
This may lead readers to consider in greater depth the
problem of identifying redeposition where there is
nothing but structural evidence.

As a pottery specialist it is dispiriting to be relied
upon by excavators to provide little more than
chronological information. Some finds cannot give
dates of sufficient accuracy, but they do offer a wealth
of cultural information (see Brown 1988). Animal
bone, chronologically non-diagnostic, is one of the
most common finds from excavations. Because of this
it has enormous value in interpreting the social and
structural dynamics of a site. Integrating this evidence
with that from other types of finds, whether
chronologically diagnostic or not, and with the
stratigraphic information, will reveal the true potential
of finds studies. Here is an opportunity to make a
political point about evaluations, small holes in the
ground, competitive tendering and the nurturing of
specialist expertise, but that is not the point. What it is
important to understand is that archaeological
interpretation must bring together every available
strand of evidence. The study of residuality and of
redeposition is no exception. This is a complex
phenomenon that cannot be unravelled simply by
looking for, or at, dates.

One final conclusion must be that redeposition is a
very difficult subject to write about. This has not
simply been an exercise in propounding internal
hierarchies. Hopefully, the approach of examining
techniques of stratigraphic and finds analysis has
clarified some of the principal issues and will form the
basis for further discussion. I can't help feeling,
however, that if any of this makes sense to you, then
yes, we probably are all mad.

Duncan H. Brown
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Approaches to Residuality in Urban Archaeology

Alan Vince

Residuality and Urban Archaeology

One of the main justifications for working on the finds (in the broadest sense of the term) from urban archaeological strata is the potential they seem to offer for providing close control on chronology and a low incidence of post-depositional transformations (Cowgill et al 1987, Crowfoot et al 1992, Egan & Pritchard 1991, Grew & de Neergaard 1988). Assemblages from some of the Thames waterfront excavations in the City of London could be dated within very close limits and were internally consistent with their depositional dates. For example, these sites showed that in the later 12th and 13th centuries the changeover from one dominant pottery source to another, long used to give a relative chronology to inland stratigraphy in the City, took place abruptly (Vince 1985). The smooth lentoid curves produced by analysing pottery from these inland sequences were clearly the result of blurring of the original pattern by a myriad of processes.

By 1991, when HBMC agreed to fund a major programme of post-exavcation analysis based on the results of c. 50 excavations which had taken place in Lincoln between 1972 and 1987, the seriousness of the effect of residuality on the conclusions reached by a whole range of specialists working on finds from urban excavations was recognised. The post-exavcation team at the City of Lincoln Archaeology Unit therefore was faced with a large problem. These 50 or so excavations offered the potential to study the archaeology of the entire city as a single site and to study some of the major themes in urban archaeology using a sizable body of data (Figs 1 & 2). These aims and objectives were listed in the Project Design submitted to HBMC and were designed to take advantage of the extensive geographical and chronological spread of the data at the expense of microstudies which could be carried out with better results through research excavation under more ideal circumstances at some later date.

The themes were:

**Theme One:** The extent of settlement in Lincoln and its suburbs through time and the development of major foci;

**Theme Two:** The study of spatial patterning within the town and its suburbs;

**Theme Three:** The examination of Lincoln's hinterland and its trading contacts and the way in which changes in their extent and shape are related to the fortunes of the town itself (Vince 1991).

How exactly these themes could be studied using the data at our disposal was considered on a case-by-case basis. For example, a different approach is required when dealing with coins, which are usually datable and found in small numbers, than that required when dealing with animal bones, which can only be dated by their stratigraphic context and occur in vast quantities. These approaches can be summarised under four headings.

Professional Judgement

Most archaeological finds researchers are used to making judgements about the coherence of the assemblages they are studying by comparing the site narrative or basic stratigraphic record with the character of the finds themselves. At Beverley, for example, the presence of vivianite on iron objects recovered from aerobic deposits was used as an indication that these finds were redeposited as a result of disturbance of waterlogged deposits which underlay these late layers (Armstrong et al 1991). Many Romano-British artefacts are clearly datable and therefore can be identified as residual when found in post-Roman strata. Our approach to a number of these classes of artefact was to supply our specialists with a database giving the period and deposition date of the context in which the finds were found. These specialists also received a site narrative and sketch plans showing the location of the major features mentioned in the text. This gave sufficient data for the specialist to be able to relate the finds to the stratigraphic data and then to utilise this evidence in his or her report. This approach did, however, stretch the patience of specialists who were dealing with finds from hundreds of different contexts and from each site. Whereas it is quite reasonable to expect someone to try to understand the stratigraphic context of, say, less than one hundred individual finds it is a quite different matter once this task is multiplied by a factor of ten.
### Figure 2: Lincoln Excavations 1972-87 - Size of Computer Data Files (KB) for Selected Data Types

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### Figure 1: Lincoln Excavations 1972-87 - Number of Computer Records for Selected Data Types

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Classification of Context Type

The approach which we adopted to the study of all finds from the Lincoln excavations was to make a basic archive record for every find, or group of finds. For pottery this basic record consisted of the number of sherds of each Common Name group (and, where clear, the form also) from each context. For animal bone the basic record was a fragment count. However, whereas the pottery basic record was sufficiently detailed to allow a considerable amount of subsequent analysis to take place the fragment count for animal bone was clearly insufficient. We could only tell our animal bone specialists how many fragments a particular deposit contained (and this itself might be enough reason to exclude the material from further analysis) but we could not say what condition these bones might be in (which itself might be an indication of a mixed or residual assemblage) nor the size of the fragments (which would, of course, have been meaningless without some indication of what species were present). Since to create a basic record of this level of detail was ruled out on grounds of value for money (much of the recorded data would have ended up being redundant) another approach was required.

As a means of retrieval for internal use, every context group identified in the database was given at least one interpretative keyword from a restricted word list - for example, 'pit', 'robber trench', 'gully' or 'makeup'). Kate Steane and I used these keywords to classify deposits into what we took to be an order of their likely usefulness for animal bone studies. Thus, an assemblage of animal bones from the fill of a robber trench might be expected on average to be more likely to contain residual, mixed material than an assemblage of animal bone of similar size from a rubbish pit. We tested our classification by looking at the overall ratio of animal bone fragments to pot sherds for different classes of deposit, taking as our hypothesis that rubbish deposits should correlate with the frequency of animal bone fragments. At this level of analysis our model appeared to work, but individual features might well have a fill of refuse even if they were also interpreted as a robber trench. As we were to note on site after site, it is actually impossible to predict that a particular deposit would contain refuse simply by looking at its stratigraphic interpretation. Land reclamation deposits are the most obvious example of this duality. One stratigrapher might interpret a deposit as a response to the problem of refuse disposal and code it as 'dump' whilst another might take the same evidence and code it as 'make-up'. Our problem, of course, was that in our original system we had not distinguished between the interpreted function of a deposit and the interpreted origin of the material which made up that deposit. Furthermore, to take this sort of analysis any further would have required more detail than was actually present in the site records.

In the end we combined the evidence of stratigraphic interpretation with data derived from analysing the basic pottery record. Several comments can be made based upon our initial attempts to use stratigraphic interpretation as a means of selection of animal bone for further study.

i) Classification using controlled word-lists is essential for the efficient assessment and analysis of large stratigraphic data sets and, since any urban excavation archive might one day be required to become part of a larger data set, this actually means that virtually every urban excavation archive must contain sufficient data to allow classification to take place.

ii) We must make a distinction at the post-excavation stage between the functional interpretations of a deposit (soil profile, make-up, rubbish pit fill, for example), the interpretations of the origin of the deposit (river silt, re-deposited sand, primary refuse, constructional debris and so on) and the identification of post-depositional transformations (erosion, soil formation, horticulture, root and animal disturbance).

iii) The relationship between a deposit's function and its content is complex and itself worthy of study. For example, at what point in a settlement's development does the disposal of rubbish lead to its being used as land-fill in preference to re-deposited natural deposits? Does the incidence of refuse, or the circumstances in which it was disposed of, correlate with intensity of occupation, or the practice of certain crafts and industries, or was it simply random choice?

Stratigraphic interpretation alone therefore is seen in Lincoln as being the first stage in a process of increasingly detailed study of a site sequence. The next stage usually involves the study of pottery.

Pottery Assemblages as a Guide to Residuality

Using the basic archive record of the pottery from the Lincoln excavations it is possible to undertake some quite sophisticated analysis, providing a clear and accurate model of the succession of pottery sources and forms is known. From the Anglo-Scandinavian period until the end of the medieval period the range of pottery forms in common use was
Figure 3: The diagram shows successive pottery from successive phase of the site. The black histograms show the date range of the entire collection and the graphs show the date range of the collection excluding Samian ware. (LUB = land use block. Horizontal scale is date in twenty year time brackets, vertical scale is frequency of pottery.)
limited and the most common pottery sources were sequential. It is therefore possible to say with some certainty whether two sherds found in the same assemblage could have been in contemporary use. If they could not have been used together then the assemblage is mixed, although at this stage in analysis it is not possible to say what the cause of this mixing might have been. Given data on the sequence of pottery types by Jane Young, Kate Steane and I were able to calculate the percentage of pottery sherds of particular periods within each assemblage and from this to divide the assemblages into three groups: those with heavily mixed assemblages which are presumed to have had a complex taphonomy; those with relatively coherent assemblages in which the majority of sherds might have been in contemporary use and, thirdly, groups which consist mainly of contemporary material but with some residual pottery. We then used the presence of contemporary assemblages of pottery, as defined above, to modify selection procedures for animal bone study based on stratigraphic interpretation (Fig.3).

For Roman pottery a different approach had to be adopted; many of the common pottery fabrics used in Roman Lincoln had a very long life and most seem to span a long period. Changes in pottery sources really do seem to have been slow and gradual so that identifying residual pottery really requires a study of pottery forms as well as fabrics and has to be based more on the relative frequency of pottery types within an assemblage. For the animal bone assessment Maggi Darling and Barbara Davies produced a division of the Roman pottery fabrics into four major periods: first century, late first to second century, late second to third century and late third to fourth century. However, this classification had to leave out a large part of each assemblage which consisted of sherds of fabrics which could only be broadly dated.

This study was quite adequate for the purposes of animal bone selection but left a high potential untapped. The solution to this problem was presented by Paul Tyers who wrote a computer programme which allowed the combined dating evidence from any assemblage consisting of items with an earliest and latest possible date to be portrayed as a graph (this routine, *plodate* is written in perl script and runs on our Unix server). Maggi Darling and Barbara Davies then took each fabric/form combination found in the Roman pottery of Lincoln and assigned an earliest and latest date to the type, based on a standard stratigraphic analysis of the pottery sequence. This lookup table was then used to transform the data set from any stratigraphic assemblage so that it could be compared to see exactly what differences there were between contemporary assemblages. The results were a revelation. They show that assemblages that contain almost the same range of pottery types and would have been given the same *terminus post quem* based on the presence/absence of pottery types could actually be distinguished and grouped in meaningful ways. For example, if the stratigrapher suggests that group X on an excavation was formed by the levelling and reworking of earlier stratigraphy this can be tested using *plodate* by superimposing the *plodate* graphs of the two sets of pottery. Similarly, the hypothesis that isolated deposits were derived from the same original refuse can be tested. This data can then be compared with the evidence derived from sherd links which may be able to confirm the relationship of the deposits. In this way, the way in which a site's stratigraphy was built up can be repeatedly modelled and tested.

**Site Formation Processes**

The importance of site taphonomy for the interpretation and study of finds became very clear at Lincoln once we began to study industrial and craft waste. Jane Cowgill has examined the stratigraphic position of several types of industrial waste, mostly from ferrous and non-ferrous metalworking, and has found that in many cases it is extremely likely that instead of an industry being practised over a long period of time, as had originally been thought, the waste came onto the site at a single stage in the site's history and was then incorporated into later deposits through the standard processes of pit-digging, building construction and terracing. This redirectional sequence can be established if a physical relationship can be demonstrated between the earlier and later deposits (if, for example, the earlier deposits were actually cut by later pits). Even so, without actual structural evidence for furnaces or smithing floors there is no obvious way of telling whether the original deposition indicates on-site metalworking or whether the waste was brought onto the site as hardcore but even this study shows that the analysis of even extremely well-stratified waste fragments could be extremely misleading unless the taphonomy of the waste has been studied.

*Alan Vince* - 13
Conclusion

Although I have emphasised the problems of dealing with residuality and the ways in which the Lincoln database could be upgraded this should not detract from the immense value of our database as a testing ground for models of site formation and approaches to the study of residuality. The entire database is 'live' and a copy will be lodged on a computer at Lincolnshire Archives, which is attached to Lincoln City and County Museum, the repository for the finds (and animal bone) archive. The data exist and are accessible, the finds (or records of them) exist and within 18 months three volumes of site reports will be in print, giving access to this vast archive to researchers unfamiliar with the sites. Given the scale of most urban excavations and the conditions under which they are now being carried out it may be that our best hope for understanding urban site formation comes from continued quarrying at this old source rather than the increasingly mythical 'future excavations' which form the subject of many a pious hope at the end of an inconclusive site report.

Acknowledgments

The Lincoln Post-Excavation team has included both staff of the City of Lincoln Archaeology Unit and external specialists. It would be difficult to acknowledge individually all those within this team (let alone those outside of it) who have contributed to our thinking or approaches to the study of residuality. Nevertheless, certain people's contributions stand out. They include: Jane Cowgill, Maggi Darling, Barbara Davies, Keith Dobney, Annie Milles, Kate Steane, Tim Williams and Jane Young. Last but not least, without Paul Tyers' software, plotdate (c), we would not have had the ability to analyse our pottery assemblages.

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'The greatest depository of archaeological material':
The Role of Pottery in Ploughzone Archaeology

Anna M. Slowikowski

Summary

Defining residuality and redeposition during the excavation of rural sites is a recurring problem. In this paper, the use of ceramic data in the interpretation of those processes will be considered. Of necessity this has resulted in a paper that raises more questions than it answers, although some suggestions will be made in an attempt to define more clearly the problems in current, accepted methodologies.

Urban & Rural Sites

There are major differences between site formation processes in the urban and rural domains which are not always acknowledged. These need to be considered before methodologies for dealing with them are discussed.

On urban sites excavators are confident that boundaries between stratigraphic units can be clearly identified, leading to an emphasis on the recording of vertical stratification, within which well-defined, "sealed" groups of artefacts can be isolated. The primary formation processes on urban sites are, in order of importance: deposition, for example the build up of refuse or the dumping of constructional make-up; truncation, for example terracing or levelling; and re-working, for example agricultural activity leading to the formation of dark earth deposits.

On rural sites a different order of processes pertains. A major factor is truncation, usually the result of modern or medieval agriculture, resulting in what might be termed the "classic" rural site which consists of isolated cut features and few or no horizontal layers. A second factor is re-working, which may be either contemporary with occupation (and continuous on multi-period sites) or which relates to post-depositional processes within the soil, either physical or chemical in nature. The final factor for consideration is deposition, which obviously does occur on rural sites, but which is often complicated by truncation and re-working.

It can therefore be said that urban deposits are characterised by deposition and build-up, while rural deposits are characterised by truncation and re-working.

In the recent past, the methodologies and techniques of urban excavation have dominated archaeological thinking. As a result, rural sites are, in many ways, being excavated as if they were poorly preserved urban sites, with no thought given to the different formation process at work and the resulting major biases in artefact patterning and distribution.

For example, on many rural sites, it is still standard practice to machine strip topsoil to reveal "the archaeology", or rather that which is currently recognised as material of archaeological interest. This may be legitimate in the urban environment where valueless, modern overburden can be clearly identified. However, the processes of truncation and re-working on the rural site do not allow such easy decision-making. If most of the surviving, recoverable artefacts from a site have been re-worked into the topsoil, should that topsoil be ignored?

A typical rural finds assemblage might be regarded as poorly stratified and physically fragmented. In comparison with the sealed groups of an urban site, the majority of the material may indeed be either residual, or unstratified. But how is "unstratified" defined? Are the excavation and collection methodologies used on rural sites really exploiting the full potential of the assemblages and, therefore, of the sites themselves?

Ploughzone Pottery

At present, artefacts, particularly pottery, recovered piecemeal from the ploughsoil can only be used to supplement a regional type series or are only of intrinsic interest. The potential of this material for spatial analysis is lost.

Examples are known, however, where the systematic collection of artefacts from within the ploughsoil, preceding excavation, has shown the potential of this...
Figure 1: Quantities of different forms (by vessel) in the ploughsoil
material to add to the interpretation of a site. Hillam Burchard is a deserted medieval village near Aberford in West Yorkshire with upstanding earthworks, gradually being ploughed flat. In 1981 excavations were carried out in the area most at risk (West Yorkshire Archaeology Service unpubl.). Preliminary surface collection indicated that the ploughsoil was rich in artefacts and an attempt was therefore made to assess the value of these artefacts, and in particular the pottery.

The ploughsoil sealing the settlement remains was hand excavated, and all material collected and recorded on a 10m x 10m grid. Of the total assemblage, collected from both the ploughsoil and the features, 74% came from the ploughsoil. The work on the ceramics focused on the spatial distribution of pottery in the ploughsoil and the examination of crossjoins between features, and between features and ploughsoil (Slowikowski 1991, 216). Distributions of fabric types as chronological indicators are common, both in a fieldwalking context and from more detailed studies such as that at Maxey (Crowther 1983). The pottery from Hillam was examined not only by fabric type but also by form. The predominant forms were jars or cooking-pots, jugs and bowls. Unlike the jar and the jug, the ceramic bowl is not commonly found on every site, due to the prevalence of other, less durable, materials such as wood. At Hillam, however, there was a high percentage of this form. Of the total ploughsoil assemblage, 16% consisted of bowls, with jars making up 63% and jugs 21%. In grids with over 100 vessels, however, percentages of bowls are comparable to those of jugs (Fig.1).

The type of bowl found is distinctive, not only in its large size (up to 40cm diameter), but also in that it is uniformly straight-sided with occasional vertically applied thumbed strip decoration. This form of decoration also provided a firm grip when lifting such a heavy vessel. The presence of visible residues and external sooting, combined with their size and form, suggested that these bowls were used as dairying vessels (Moorhouse 1983, 48). The abnormally large number of these bowls and their distribution in the ploughsoil, concentrated at one end of a timber Structure 1, has led to this building being interpreted as a dairy, or at least the focus of some sort of dairying activity (Fig.2).

In addition to the spatial distribution of the pottery, an examination was undertaken of cross-context joins, an aspect of ceramic analysis that has often been cited but which is rarely routinely carried out (Brown 1985; Moorhouse 1986). Its value is clearly demonstrated at Hillam. From the date of the pottery, Structure 2 was dated to the 15th century. The same date was allocated to the pottery in a quarry, suggesting, at first glance, that the building was occupied while the quarry was being worked. However, cross-context joins were found between the pottery in the quarry and the building platform for Structure 2. The quarry must, therefore, have gone out of use and been filled in before Structure 2 was built. The lack of any stratigraphic relationship between the quarry and the structure meant that, without the cross-context pottery joins, the relationship between these two features would have remained undefined.

Pottery joins between features and ploughsoil can give an indication of how much movement there has been in the soil. The plough will bring material to the surface and cultivation will move it laterally across the surface. Clark and Schofield (1991, 93) have shown that displacement by agricultural activity is not as great as might be thought. At Hillam, cross-context joins between features and ploughsoil supported Clark and Schofield's view. The joins between pottery from features and that from the ploughsoil, as well as the overall distribution of pottery in the ploughsoil, did indicate re-working away from the original point of deposition, but to a degree far less than might have been expected. Nearly all the joins in the ploughsoil were found within the distance of one grid square.

At Maxey, Cambs., systematic collection of material from the surface and from the ploughsoil preceded excavation (Cogbill and Lane 1985). Only 2% of the material from the ploughsoil was represented by surface material and was subject to weathering. Even on this site which had been intensively ploughed since the Saxon period, most of the pottery from within the ploughsoil was unabraded. Despite a collection bias due to sherd size, hardness, fabric colour and glaze iridescence, it was still possible to define areas where shallow features had been ploughed out, areas of pastoral use and dispersed middens (Crowther 1983, 39).

Despite the lack of vertical stratigraphy and the "horizontal" nature of rural sites, the complex relationship between depositional and post-depositional processes means that they are not "simple". Residuality is as great, if not greater, than on urban sites, largely due to the process of re-working. Primary horizontal deposits are frequently "re-deposited" in secondary or even tertiary contexts and constant intercutting of pits and ditches, occurring in the same plane, releases earlier material into later environments.

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Figure 2: Distribution of bowls (■) in the ploughsoil at Hillam Burchard, West Yorkshire
The status and value of an assemblage have to be established by determining the level of residuality. Identification of residuality helps to prevent the expensive and fruitless analysis of material that is not as chronologically sensitive as ceramics. The class of feature will, to a certain extent, determine whether its contents are likely to be high in residual material. Ditches, storage pits, quarry pits etc will all have differing levels of primary and/or secondary deposits, depending on how long they had been left open or how often re-cut and cleaned out. In this way rough structural models can be used to predict the potential for residuality.

Pottery, because of its nature, stability and ubiquity, is perhaps more valuable in helping to sort out this problem of residuality. No other type of artefact, except perhaps coins, can play this role. Abrasion is the main attribute to consider. The level of abrasion should be recorded routinely, if only on a simple and perhaps subjective basis: low, medium or heavy abrasion.

An example where the recording of the level of abrasion was used is the East Anglian Kingdom Survey for pottery recovered from fieldwalking (Wade 1983). High abrasion was the result of past agricultural activity (manuring), while low abrasion and, presumably, size of sherd indicated a settlement recently disturbed by modern agricultural activity. In this way it was possible to distinguish between areas of settlement and areas of cultivation.

In addition to abrasion, what might be called the degree of brokenness of pottery must be considered. This is measured as the ratio of different measures of pottery quantification: sherds to either vessels or EVEs (estimated vessel equivalence, based on percentages of rim diameter), sherds to weight, or EVEs to weight. There are different views among ceramicists as to which are the best units of quantification; any one of these ratios, however, examined together with the level of abrasion, would give an indication of what and how much is residual in a feature. For example, twenty unabraded sherds representing a single vessel lend more weight to the date of a context and the other material within it, than twenty battered sherds each representing a different vessel. These methodologies can be applied equally well to unstratified as to stratified assemblages.

Conclusions

The methodologies used to examine rural sites must be different from those used on urban sites, due to the different formation processes. Thought must be given to the seemingly unstratified nature of ploughsoil material before it is wantonly machine away. Allied to this, there has to be an increased emphasis on spatial distribution and therefore the recording of artefacts in at least two dimensions, as on the sites described above, and, in certain circumstances in three dimensions, as is being done at West Heslerton by Dominic Powlesland. This is hardly ever done and even more rarely published, with the result that the true potential of what is machine away has not yet been recognised.

The Earth's surface has been, and will continue to be, the greatest depository of archaeological material. Modern ploughsoils distort old land surfaces but cannot destroy them utterly, and we ignore such a colossal data resource at our peril (Crowther 1983, 43).

Acknowledgements

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The Life and Death of a Post-hole

Peter J. Reynolds

Summary

The construction of the Pimperne Round House and subsequent dismantlement have already been reported (Harding, Blake & Reynolds 1993). This paper seeks to focus upon one specific aspect/discovery made during the dismantlement process which has considerable significance for future analysis of prehistoric round houses on two specific counts; first, the projected longevity of such a structure and, second, the nature of material finds from principal post-holes. For these latter, the probability that their deposition is coeval with the early phases of the occupation of the structure is far greater than their representing a post-depositional phase of the site.

Objectives

The original purpose for building a construct for the Pimperne House was to explore the three-dimensional nature of such a structure in terms of both the minimum resources necessary for the building itself and the minimum architectural engineering required for its construction. The single philosophy adopted was that the structure had to be driven by the archaeological data in that it was entirely site specific. No borrowing of other data from other sites was to be countenanced nor was ethnography to be used unless without it the building would fail (i.e. sine qua non). In no sense should the resultant structure be regarded as a reconstruction. It was, in fact, a three-dimensional projection of the data built at a one-to-one scale.

The secondary objective once the building was completed was to study it through time in order to assess degradation through natural causes, primarily the climate, and subsequent ease of repair and maintenance. Similarly, changes which might occur within the structure, especially with regard to the dirt floor, were to be isolated and measured. As with the primary objective, the collection of these learned experimental data was to be fed back into the archaeological record to enhance future excavation strategies and techniques.

The tertiary objective, initially unintended but forced upon the writer by local government bureaucracy which determined that a research zone of fifteen years standing had to be converted into a barbecue area pro bono publico, was to extract the maximum information possible from the careful dismantlement of the building.

Constructing the Pimperne House

In brief, the evidence for the Pimperne House was that of the classic double ring house (Guilbert 1981). It was chosen not least because the data was in a remarkably good state, the product of an excellent excavation technique and a first class archive (Harding, Blake & Reynolds). At the time of its building, it was the largest construct of a prehistoric round house ever to be undertaken (Reynolds 1979). Its overall diameter of 12.81 m (42 feet) with a free span of 9.76 m (32 feet) presented huge challenges not only in procuring the necessary timber (over two hundred trees were used) and cladding material (0.5 hectares of hazel coppice and 0.12 tonnes of thatching straw) but also in devising a method of roofing such a large span.

The primary objectives were achieved with remarkable insight being gained from the archaeological data themselves. In the event only one engineering requirement, that of the ring beam in the roof itself, had to be created under the rule of sine qua non. All the other "discoveries" could have been ultimately deduced logically but the act of building simply focussed upon precise detail. It proved possible, for example, to establish outer wall height and, therefore, apex height beyond all reasonable doubt. For these discoveries alone the construct was invaluable.

The pursuit of the secondary objective was necessarily more subjective in that wear and tear implied an actual living condition. Such a projection of modern human recreation of past living processes had been repeatedly denied by the writer (Reynolds 1994) as being unscientific if not impossible. Thus, focus was invariably upon degradation brought about by non-human agencies.

Thus after eight years the external porch posts virtually rotted away at the ground interface, a condition brought about by microbial activity in the infinitely variable humidity at this point. The
architectural effect, a drunken lean, underlined the essential difference between a simple unbraced square or rectangular structure where lateral forces are continuously at work and a round structure which is inherently stable. The porch is essentially an add-on rectangular building to the main mass of the round house. However, of more interest was the action of rotting. Each upright had sheared off leaving the stump, at this time largely unaffected, firmly lodged in its post-hole. The normal nature of these porch post-holes as recovered by the excavation is one of considerable disturbance. Certainly this was the case with the Pimperne excavation. The findings from the construct that the porch posts need replacing after a mere eight years offer a ready explanation for this specific disturbance simply because the stump had to be removed from its post-hole. Examination of the archaeological evidence even suggested the method of removal with a slot-like disturbance on the outer side of the post-hole, perhaps made by the use of a pointed lever. This method was, in fact, employed although this in itself is a kind of wish fulfilment. The second post-hole of the porch was approached in a different way initially, the objective being to extract the post-packing stones, flints which had been rammed into place, to allow removal of the post stump. In practice, this proved extremely difficult once the uppermost level of packing stones had been removed. It was virtually impossible to prise out any of the rammed flint below a level of 100 mm. The only way to remove the stump was by using a pointed metal bar as a lever. Even this had to have a raised fulcrum in order to break finally the suction exerted by the humidity of the post-pipe itself. The end result of all this activity was to have created virtually the same levels of disturbance in the post-hole as observed in the original archaeological data. The replacement of the original pair of posts by new ones being carefully placed in the post-pipes was relatively easy, although the fit was not as precise. This, therefore, required initially small slivers of flint to be slipped into place and thereafter the whole post packing to be rammed again. This process necessarily caused disruption of the original packing material creating a pronounced downward angle from post-hole edge to post. The finer material introduced as supplementary packing formed a disrupted secondary post-pipe. It was impossible to check this phenomenon against the original data since this level of observation, unless forewarned, is unlikely to be achieved. However, it is the essence of such an experimental structure not to criticise the data to hand but to focus attention upon the possibilities of recognising such data in future.

**Dismantling the Pimperne House**

The tertiary objective, imposed rather than sought as indicated above, was the analysis of the dismantlement of the construct in the autumn of 1990, fifteen years after its construction. Surface examination of the building showed it to be perfectly sound and functional. Even the replaced outer porch posts were in better condition after seven years than their predecessors had been. Examination of the rotting at the ground/interface argued for at least another five years of functional service before replacement. In consequence, one might suggest regular replacement of these particular posts would on average be at ten year intervals. The rest of the structure including the cladding, thatch and daub, were in relatively good condition and required only the annual two or three days of minor refurbishment and maintenance.

The process of dismantlement operated exactly in reverse to the construction - having rejected the attractive alternative of burning the structure. This particular fate awaited a smaller round house based upon the excavations at Moel Y Gaer in North Wales (Reynolds, forthcoming). The thatch was carefully stripped off from the roof allowing detailed examination of the ties and the underlying purlins. The thatch literally wears away from the outer surface of the roof from the action of wetting and drying and wind. A simple estimation argued the roof would have lasted for another ten years before another half-coat would have been needed. In other words, like any other straw thatched building, life expectancy is about fifteen years. All the ties were in good order despite being a natural fibre. Similarly all the purlins were strong having been seasoned in place. The lashings at the roof apex, although heavily sooted from the hearth immediately beneath, were as strong as the day they were put in place. In fact, all the major roof timbers were saved and ear-marked for re-use on the new site of the Ancient Farm.

The destruction of the outer wall, plastered as it was with daub inside and out giving an overall width in excess of 350 mm, required the use of a seven kilo lump hammer to break down. There can be no doubting the brittle and enduring strength of a wattle and daub wall. However, all the stakes which formed the uprights in the wall had rotted away below a depth of 100 mm from the old ground surface. Beneath this level a clear gully had been formed by the activities of rodents, mice, rats and voles, all of which had been observed during the life of the house so that the original firm ground between each stake had been totally disturbed.
A minor excavation showed that clearing this material revealed a neat gully punctuated by minor depressions where the original pointed stakes had been driven into place. In a real sense it appeared to be the so beloved 'classic' drip gully. In all the research devoted to round house constructs conducted by the writer over some twenty five years, the phenomenon of the drip gully has signalised failure to occur. The reverse, a humic lump, is the normal result being the product of a protected vegetative habitat. The only inferences one can make are that such a gully is deliberately manufactured under the roof eave to collect or control rain water; that such a gully is created by drip action only if the ground surface beneath the eave is completely denuded of vegetation or thirdly that the so-called drip gully is, in fact, the outer wall of the building. Of these possibilities only the first and third make any real sense, the second requiring such exceptional circumstances as to make it virtually impossible. However, such as drip gully has been observed by the writer around a construct of a prehistoric round house at the museum site of Cragganoven in Southern Ireland. The reason for its presence owed much, not to the soft Irish rain but to the fact that the whole site had been sprayed with chemicals to kill all the vegetation!

The most startling discovery of the whole dismantlement process and perhaps the most significant finding to emerge from the building of any round house construct, was reserved for the posts and post-holes of the inner ring. This element of the building is essentially that which holds it all together and sustains the vertical weight thrust of the roof. Once the building is completed the outer wall is virtually redundant as a structural element and can be completely replaced. Similarly, it is possible to replace individual or even pairs of uprights in the inner ring since the roof holds the building together during such relatively minor repairs. But for overall stability the inner ring of posts is quite crucial.

Thus, when the inner ring was finally taken down, the state of the butts of the posts caused a major revelation. During the life of the structure superficial examinations of the posts immediately below the ground surface had been made regularly by the simple expedient of probing with a strong knife. Some deterioration had occurred but was considered to be relatively minor. The argument was that all the inner ring posts were protected by the roof and were, therefore, dry and would not rot. Quite the reverse proved to be the case. All the upright posts had been severely affected by rotting. In all cases the pith wood had rotted away completely leaving only a butt of heart wood. All these butts were rotted at least 100 mm from their bases. In five cases the butt had rotted away completely leaving the post above ground seemingly suspended in mid-air. This was not, in fact, true since the visible and unrotted post was still held in place by the upper stones of the post-hole packing forming a supporting lip. Thus each post-hole was to a greater or lesser degree empty or void. Once all the uprights had been removed each post-hole was completely examined. The following description synthesises the findings for a typical post-hole.

The post-pipe was perfectly preserved with the original bark still surviving in good condition and tight against the flint packing material. The base of the post-hole had begun to 'silt' up with a combination of soil particles and rotting wood fragments. The silting showed a gradual accretion of layers in the form of an inverted cone. The uppermost stones in the packing around the post had variously shifted forming a slight overhang or lip irregularly around the circumference of the post-hole itself. Some artefacts were recovered from the post-holes. These included two aluminium beer cans, one marble, one plastic toy soldier (an American G.I.), one ladies hair grip and several sherds of local (ie experimentally fired on the Ancient Farm) pottery. Notwithstanding the voids in the post-holes, the framework of the house had remained stable primarily because of the lipping of the uppermost packing stones in each post-hole. It is important to reflect that all the weight of the structure, the roof and the posts themselves comprising at least 40 tonnes, is vertical. Given the aerodynamic shape of a cone surmounting a cylinder, it is difficult to conceive of a natural force, excepting an earthquake, capable of exerting sufficient lateral thrust to cause a movement significant enough to disturb such a weight and hence the stability of the building. In fact, during the winter of 1989-90 several severe gusts and gales were experienced with no effect upon the structure at all. Similarly, the house had withstood the famous gale of 1987 with virtually no damage.

The significance of these findings, however, is not inconsiderable. If it is assumed that the deterioration of the post-holes experienced in this construct is the normal process, then, given that the traditions of round house building span some two millennia of prehistory, this process would have been recognised as an inevitable state gradually reached over a period of, say, two decades. Thus instead of the shock experienced by the experimenter on finding voids, the house occupier could well have taken simple steps to counteract the problem. By regular assessment probing and careful filling of the voids created by the
rotting timber, the spaces would have been filled sequentially producing distinct layering in the fill, an activity which could well include inadvertent addition of artefactual material. Ultimately, as in the five cases recorded in the construct where the buits had entirely disappeared, the whole post-pipe is filled with the final layer comprising larger stones not unlike the ordinary packing stones. Each post itself remains entirely supported until finally it is sitting on the surface of its original post-hole. Throughout, stability is completely unthreatened.

This scenario is remarkably similar to the archaeological reality of recognising post-holes by the concentration of stones across their surface, removal of which reveals a post-pipe surrounded by packing material, the pipe itself in section revealing layering in inverted conical form with occasional intrusive artefacts!

The implication of these findings, if the foregoing argument based as it is upon real data is accepted, is that a structure like a round house has a potential life span far in excess of its foundation post-holes. Similarly anything found within the context of a post-hole cannot necessarily be regarded as a deposit after the destruction and removal of the building, but is much more likely to date to the first twenty years of its life.

Conclusions

In conclusion it is as well to remember the principles of a wood framed building like the tithe barns, where the base of the cruck sits upon a dry-built stone pier. It is quite impossible to build in this way but once the roof is finished and holding each frame in position, it is quite simple to cut off each individual post one at a time and build rot-proof supporting piers. The round house as evidenced in the archaeological data recovered from Pimperne Down and projected on a three-dimensional construct proved to be unexpectedly powerful. Whatever arguments or debates may be raised concerning detailed joinery, whether simple or sophisticated, the critical elements remain the same. A 3 m length of oak 300 mm in diameter, weighs in excess of 150 kilos and is virtually impossible to crush in its length. A round house comprises a cone set upon a cylinder and the cylinder itself is massively overbuilt. The sheer investment of labour and material in constructing such a building argues that its life span should certainly exceed one generation of c. 25 years. However, the findings above indicate that within that time period the post butts will have rotted and that probable action will have been taken to infill the resultant cavities - including, one suspects, the product of floor sweepings, being positively used as opposed to the negative of 'beneath the carpet' of later periods. The inference from this experiment is absolutely clear. The material evidence recovered from the excavation of a post-hole which forms an element of the inner ring of a double ring house cannot be used to date the terminal state of the house, rather it must indicate the early occupation phase.

By this same argument, the round house structure as a whole can long outlive its foundation post-holes which have their primary use only during the building phase itself. It would be perfectly provable in structural engineering terms to build such a house and when complete deliberately cut off each post at ground level and insert a stone support pad. This clearly is not evidenced in the archaeology but evidence of the alternative process described above is regularly found.

As a post script the Celtic story of Bricrius' Feast from the Book of the Dun Cow recorded by the chief scribe Mael Muire in the 12th century (c. 1106) describes how Cuchulain lifted the wall of Bricrius' house to allow his wife Emma and her fifty women attendants to win a race with dramatic results - the house almost collapsed. It is attractive to think that the posts forming the inner ring were displaced from the vertical causing the house to lean at an alarming angle. Ultimately, after the usual heroic reverses, Cuchulain raises the lopsided house into an upright position - i.e. he sets the inner ring posts back into the vertical.

Glossary

Cruck: either of a pair of inclined timbers, usually curved, in timber-framing
Purlin: a horizontal beam that provides intermediate support for the common rafters of a roof construction
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Processes of Collapse in Romano-British Buildings:
A Review of the Evidence

Graham D. Keevill

Summary

Roman archaeology has always involved a strong element of buildings study. In many areas of the Empire this has included investigation of substantially intact structures. In the western Empire, however, archaeologists have of necessity kept their eyes closer to the ground. This has led to a great deal of research into building plans, but superstructural evidence has largely been neglected. This paper will be in two parts. The first will review the evidence for building superstructures in the form of collapsed walls. These have been excavated in Italy, Germany, Britain, and elsewhere. The second part will discuss the means by which structures collapse, and the ways this can be studied in the archaeological record.

Introduction

Buildings are multi-dimensional entities in space and time. They can be extended, divided, reduced and destroyed. They may be available for study as standing structures, but they also occur commonly on excavations where they may have been subjected to a wide range of "post-depositional" processes such as truncation, robbing or animal disturbance (especially, but not exclusively, in the case of timber buildings).

An intermediate stage often occurs between the life of a building in use and its entry into the world of 'buried' archaeology; indeed a ruinous building such as an abbey can occupy both the standing and buried worlds at the same time. When a building is abandoned it will begin to decay and the products of this process may find their way into the archaeological record as a distinctive deposit. The precise nature of this deposit will be determined to a large degree by the parent material of the structure concerned, i.e. what it was made of. The deposit may be subject to post-depositional processes like any other archaeological entity, but this need not affect its value in the interpretation both of its parent structure, and of site formation processes. This paper seeks to demonstrate that detailed analysis of these deposits can elucidate the different processes of decay, collapse and demolition. The discussion will largely be confined to masonry structures (in a broad sense) of the Roman period.

The Nature of the Evidence and Limitations of the Study

A number of recent projects have provided the opportunity to study excavated Roman buildings in three spatial dimensions - plan and elevation - because substantial areas of collapsed masonry were recognised. Some of these discoveries have been truly spectacular, but if others have been more mundane they have often been just as useful for interpretative purposes. The projects have been widely distributed geographically, both within England and Wales (Fig. 1) and in Europe, and a brief review of evidence from earlier excavations has shown that a surprisingly large number of collapsed structures were already known before the recent spate of discoveries.

My interest in collapsed buildings began in 1990 during the excavation of a small Roman villa in Northamptonshire (Keevill 1990). Several areas of collapsed masonry were found, including a virtually intact gable end wall. Informal contacts and research in the coming months began to show the quantity of collapsed structures already known about or being discovered and also demonstrated the quality and research value of the data. The sheer quantity of data (or certain elements of it), allied to the frustration of not being able to undertake detailed analysis of my own villa excavation, has limited the amount of research I have been able to undertake in subsequent years.

It is therefore impossible to present more than a general overview of this extensive subject here. I have been able to make extensive (but by no means exhaustive) searches for collapsed Romano-British buildings (although no attempt has yet been made to examine sites between the Hadrianic and Antonine frontiers), and a map of the Roman sites mentioned in this paper is presented in Figure 1. Research into parallels in continental Europe and beyond has been on an ad hoc basis and has relied especially heavily on information from excavators and others. I am
Figure 1: Map of English and Welsh sites mentioned in the text (Oxford Archaeological Unit)
therefore happy to acknowledge my debt to the many colleagues who have brought examples to my attention, although space precludes a complete listing.

The study area has been restricted to Roman buildings for convenience, although Saxon (Keevill and Chambers 1991, 102) and medieval examples are also known (Klein and Roe 1987, 59; Sherlock and Woods 1988, 47-53). Roof structures are only dealt with in a very summary manner because so many collapsed roofs have been excavated; they deserve a major study in their own right, but there is not enough space here to deal with anything other than the largest examples, all of which are from military or municipal Thermae. Most of the buildings cited below had masonry superstructures in various materials, although timberwork was often an integral element of framing.

Excavated Evidence for Collapsed Roman Buildings

i) Redlands Farm, Northamptonshire (Keevill 1990, 1992, forthcoming): The Redlands Farm villa was discovered by the Oxford Archaeological Unit in 1990 during an excavation in advance of gravel extraction on land in the floodplain of the River Nene. The villa lay at the centre of a small farmstead comprising rectangular barns, later replaced by roundhouses, enclosed by a perimeter wall and associated with field systems (Figs.2a & b). The villa began its life in the 2nd century as a mill, powered by leats draining subsidiary channels of the River Nene. In the early 3rd century the mill was converted to domestic use by the addition of a rear corridor on the north side of the mill, with wings on the east and west sides projecting beyond the south façade. The 3rd and 4th centuries saw various developments, including the addition of a verandah to the front façade and successive divisions of the wings into two rooms each. The central suite of rooms (ie within the old mill building) included a hypocaust and tessellated pavements. Construction was in limestone throughout the life of the building, with tufa also present. Roofs were tiled.

The villa went into steady decline from the late 4th century onwards. Most rooms in the building were covered with stone rubble characteristic of the gradual decay of masonry over a long period of time, while the rear corridor contained a mass of broken tile which probably represents a fallen roof; there is evidence to suggest that this room was maintained when others were abandoned (see below). In the hypocausted room, the rubble filled most of the cellar and had destroyed most of the pilae. A few fragments of masonry were still bonded together, including part of a wall flue, while numerous lumps of wall plaster were also present. One substantial area of masonry facing at the south-east corner of the room had collapsed inwards with its painted wall plaster still in situ. Small areas of collapsed masonry were found in other rooms as well.

The most impressive evidence came from the rear of the two wings. The west wing was the only part of the villa to suffer later stone robbing, but even so four intact courses of collapsed masonry survived lying 1.2 m north of the gable wall. The east wing, however, was largely undisturbed. The northern gable wall (ie at the rear of the villa, Fig.3) had collapsed outwards, and survived virtually intact where it had fallen. The roof may have been removed prior to collapse, as intact imbreces had been stacked in the rear corridor, although several of them had been smashed during the later dereliction of the surviving masonry (including the collapsed roof noted above).

Twenty nine courses of masonry were present in the collapsed gable, in addition to the three standing courses of the rear wall. A course of tegulae and imbreces towards the top of the wall apparently protected an offset in the masonry. The collapsed fragment was 6.4 m long, but had clearly expanded and twisted slightly as it fell; detailed recording showed that its actual height would have been c. 5.7 m to the roof ridge, or 6.5 m including the standing masonry. The roof appears to have had a pitch of only 22.5°. Quoins were used, but were absent in all of the seven lowest courses of collapsed masonry. The west side of the wall also had quoins in the eight surviving courses below the roof eaves. Below this the wall would have continued across the rear corridor. The latter evidently survived in use, as the lower courses of the east wing collapse stop at a point corresponding with the end wall of the corridor.

ii) Meonstoke, Hampshire (King and Potter 1990): Work began on the site of a presumed villa at Meonstoke in 1986 and a 3rd- to 4th-century aisled building was found, measuring 15 m wide and at least 30 m long. The flint and chalk block masonry showed evidence of several constructional phases, the most important of which involved a 2.6 m extension of the building and the associated construction of a new façade with a central door 2.85 m wide.

The most significant discovery was made in front of the south-east façade, where an extensive area of collapsed masonry was revealed (Fig.4). This is undoubtedly the most impressive excavated example so far from Roman Britain, containing as it does both windows and a blind arcade above them, along with
Figure 2a: Phase plan of the Redland's Farm excavations (Oxford Archaeological Unit)

Figure 2b: Phase plan of the Redland's Farm Roman Villa (Oxford Archaeological Unit)
Figure 3: Plan of the collapsed east wing gable at Redland's Farm (Oxford Archaeological Unit)
evidence for a highly decorated overall design scheme. This involved the use of coursed flint, tile and mortar to create an extraordinary striped and chequered effect. The windows and blind arcade used tile pilasters incorporating projecting and moulded tiles and greenstone bases and capitals, springing into semi-circular arches. The façade also incorporated a projecting hood between the windows and the blind arcade. The hood was angled downwards and consisted of two tile courses, the lower one in stone and the upper comprising tegulae and imbreces.

The collapsed masonry derived from the 'nave' of the building and the lower part of the façade, including the aisles, was not present. The upper portion therefore represents a clerestory, and the lower walls probably remained standing. Evidence from the collapsed masonry shows that the roof pitch was 47.5° over the clerestory, an angle made possible by the use of stone tiles (presumably pegged). King and Potter (1990, 197) suggest that the aisle roofs were tiled, with a much lower pitch of c. 30°.

iii) Lebach, Saarland, Germany (Miron 1990): Perhaps the most spectacular example of collapsed masonry in Europe comes from a 1989 excavation in the Saarland, Germany, where an agricultural building measuring some 23 m x 12 m was found within a villa estate. Opposed 2.5 m-wide central doorways were found in the long walls of the building, but otherwise the architectural detail of the groundplan is unremarkable. However, all four walls had collapsed in the mid-4th century (Fig. 5), allowing for an extraordinarily detailed reconstruction of the superstructure. The walls were 10 m or more high, and the regular stone courses of the facing were extremely well preserved in places. The arches of both central doors can be seen in the collapsed long walls, with possible evidence for subsidence of the original superstructure in the form of displaced voussoirs in the southern arch. The evidence suggests that the doors were about 6 m high. The south wall also preserves one round-headed window, while a further three can be seen in the north wall. All of the windows occur in the east half of the building, but unfortunately insufficient detail survived in the west half to determine whether matching windows were present there. It is clear, though, that the heads of the windows were level with the crown of the door arches, producing lights high up within the masonry.

iv) Pianabella, Ostia, Italy (Coccia and Paroli 1990): Excavations took place at the funerary basilica at Pianabella in the 1970s and again in 1988-89. The basilica, which was built c. AD 400, is simple in plan, with a narthex, nave and atrium; it remained essentially unchanged until about AD 1000. The 1988-89 excavations revealed a substantial part of the collapsed south wall. This survived to roof height, while five windows and a section of narthex arcade were also preserved within the masonry. Once again this provided the excavators with the kind of architectural and superstructural detail which could only have been guessed at from the groundplan.

v) Other examples: At Batten Hanger, near Chichester in Sussex, the virtually intact collapsed gable of an ailed building was excavated in 1990. The wall was built of coursed flint, with the necessary string courses in greensand. At least one string of tegulae and imbreces was included, possibly again to protect an offset. The wall had evidently been faced in plaster externally (information from John Magilton). Collapsed flint walls have also been excavated at Feltwell, Norfolk (Gurney 1986, 8 and 45-6), Sparsholt, Hampshire (information from David Johnston), Dicket Mead, Welwyn, Hertfordshire (Rook 1983-6, 91 and Fig.13), Littlecote, Wiltshire (information from Bryn Walters) and Dewlish, Dorset; the latter incorporated a semi-circular brick arch from the verandah (Putnam and Rainey 1975, 54).

Limestone was used at the Roman villa at Piddington, Northamptonshire (Friendship-Taylor and Friendship-Taylor 1989). Here the inner face of a wall, perhaps 5.5 m high in its original state, had slumped into a cellar. The remainder then fell over this and partly covered an adjoining room to the north (information from Roy Friendship-Taylor). Other stone examples such as the upper part of a gable from Carsington, Derbyshire (Ling and Courtney 1981, Ling 1992) and parts of three walls from one villa room at Medbourne/Drayton, Leicestershire (information from Richard Pollard) are of interest not only structurally but also because they were not immediately recognised as collapsed walls; one wonders how many such structures lie hidden in published references to "rubble/stone spreads". Collapsed stone walls have also been found at a roadside settlement at Baines Farm, Catterick (information from Peter Wilson), and on a villa site at Toversham, Cambridgeshire (Freer 1989, 296). Three examples were found at Cold Knap, South Glamorgan, Wales, comprising two walls of one room and a terrace wall (Evans 1985, 64, 68). Another Welsh example comes from the civil settlement at Caerleon, where part of a wattle and daub building collapsed due to fire damage (information from Edith Evans).
Not all collapsed walls occur on rural sites. Examples have been found at Canterbury (information from Maggy Taylor), suburban Leicester (Mellor and Lucas 1978-9), London (Perring and Roskams 1991, 77-84), Cirencester (McWhirr 1978, Plate XXXVIll), Lincoln (information from Alan Vince), Colliton Park in Dorchester (Dorset; Drew and Collingwood-Selby, 1937) and Caister-on-Sea (Darling 1993). The latter included timber partitions as well as roof structures, while the Cirencester example comprised stone infill to a timber frame. The London and Leicester examples are of mud-brick.

Sections of collapsed fort wall have been found at Dover (Philp 1984) and Pevensey (Peers 1985), while fallen masonry from a barrack block was found in the fortress at Caerleon (information from Edith Evans). A further example of a collapsed fort wall comes from the Valkenburg at the mouth of the Rhine west of Leiden (information from Dr L P Louwe Kooijmans). Other continental collapsed walls are known at Winkel, Switzerland, and the Villa di Patti, Sicily (information from Peter Johnson and Bryn Walters). A notable example from another continental villa is the fallen wall at Newel, north of Trier in Germany, where the height of the masonry suggests the existence of an upper storey (Wightman 1970). Further afield one must note the *exedra* of the Severan Nymphaeum at Lepcis Magna (Bianchi-Bardinelli et al 1966, Fig. 149).

Roofs only form an incidental part of this paper, but three examples from *Thermae* deserve mention. At Bath, substantial elements of the stone vaulting were found when rubble was cleared from the main bath (Cunliffe 1969; see especially Figs XX and XXI); the masonry included several articulated vault ribs, some of which are still on display at the site. At Canterbury, voussoir tiles in *opus signinum* were found, representing part of the collapsed vault of the laconicum (Blockley et al forthcoming). At Chester, a similar tiled vault was found in the legionary baths. The roof structure comprised hollow tile voussoirs forming an internal skin with a thick layer of *opus signinum* poured over it; this was then protected by a standard pitched roof of tegulae and imbrices. An unusual facet of the construction was the use of hollow, interconnected ceramic tubes in the formation of vault ribs (Mason 1990).

### Processes of Collapse and their Archaeological Representation

There are several processes which may lead to the collapse of a building, and these need not be restricted to the period following abandonment. Neither is it inevitable that one process will occur in isolation. Partial collapse caused by structural instability or weather damage, for instance, may be followed by deliberate and systematic demolition. Sometimes interpretation of fallen walls is reasonably straightforward, as in the case of the wattle and daub building at Caerleon noted above where the collapse had clearly been caused by fire. It is also possible in some instances to speculate on genuine catastrophe as the cause of collapse. The basilica at Pianabella is one such case (Coccia and Paroli 1990) where an earthquake may have been responsible, although even here the completeness of the masonry suggests that a degree of deliberate action was involved in the fall. It is less easy to accept earthquakes as a cause in England, although this is not absolutely impossible and has been put forward in at least one case (Philp 1984).

The vast majority of collapses, however, are likely to have occurred through three principal processes: structural failure, demolition, and dilapidation. The first and last of these could be closely linked in that gradual decay might cause severe structural problems, and it may not be easy to disentangle them in the archaeological record. This will tend to be accentuated where bonding materials are either absent or of poor quality. Drystone field walls, for example, tend to fall apart because of water and/or frost penetration, sometimes exacerbated by an unusual process: the regular use of defined `runs` by animals such as foxes and badgers tends to cause serious erosion of masonry.

Collapse through decay - ruination - tends to be easily recognisable even in mortared walls. At Redlands Farm, for instance, it was clear that walls in the central suite of rooms had fallen apart gradually after abandonment. This led to the accumulation of apparently random rubble spread over the rooms, although occasional `articulated` fragments of masonry were present including one substantial panel in the hypocaust. Similarly the collapse of the rear corridor roof appears to have happened piecemeal, and the tile debris was intermixed with stone rubble rather than appearing as an obvious roof structure (cf Mason 1990).

A spectacular example of collapse through gradual decay occurred very recently in the medieval curtain...
Figure 5: Plan of the agricultural building at Lebocha, showing collapse of all four walls (courtesy of Dr. A. Miron).
wall of Ludlow Castle. A part of the wall face near the south-east angle fell away after wet weather early in 1990, and an attempt was made to scaffold the relatively small area straight away. Before this could be completed, a 15 m length of the whole 1.8 m thick elevation collapsed; fortunately no-one was injured. The most significant aspect of the incident for this paper, however, was the extent to which the masonry literally fell apart. Articulated fragments of masonry were rare and generally small, and architectural features such as loops simply disappeared. Most of the wall was reduced to rubble, although face stones could at least be separated from core material by their weathered surfaces. Most of the masonry comprised random rubble skins on an earth and stone core, and had not been repointed for many years. This seems to have contributed to the massive water penetration which is believed to have caused the collapse (Morriss and Shoesmith 1990; I am grateful to Ron Shoesmith for drawing this case to my attention).

This picture of collapse into jumbled chaos contrasts sharply with the most spectacular Roman examples noted above (eg Redlands Farm, Meonstoke, Lebach, Batten Hanger, and others). It seems clear that a quite different process was at work in these cases, and the completeness of the masonry surely argues for a deliberate cause: demolition. This is certainly my interpretation of the gables at Redlands Farm, where there is both direct and indirect supporting evidence. The indirect evidence comes from the contrast between the intact east wing gable and the mostly random rubble elsewhere (the west gable had suffered robbing and so interpretation is more problematic).

The direct evidence derives from the east gable itself. Firstly, the lowest seven quoins were absent from the external corner of the collapsed wall. This is interpreted as a deliberate action: removal of cornerstone stones will inevitably lead to complete destabilisation, as these are the critical elements which lock the structure together. Secondly, the fallen portion stopped on the line of the division wall between the east wing and the rear corridor: evidently an effort had been made to retain the latter. Finally, a distinct ‘fault line’ could be seen in the masonry where the regular courses had distorted during collapse. This line occurred at the point where the wing was built over a leat feeding water into the original mill building. Insufficient account appears to have been taken of this feature in building the wing, causing instability in the masonry. A substantial buttress was added to the east face of the rear gable corner, but this seems to have been unsuccessful and the wing had to be demolished. The roof was probably removed in advance and imbreces were found stacked in the rear corridor. The north end of the west wing was also built over a leat. Thus at least two quite distinct processes were at work in the same building - dereliction and demolition.

The Meonstoke façade exhibits similar evidence of deliberate action. In this case it is clear that only the ‘nave’ clerestory is represented in the collapse, and this lay only just in front of the foundations for the extended facade. These were very substantial, and it seems plausible that the upper masonry was deliberately brought down while the lower masonry was equally deliberately left standing. When one turns to Lebach, by contrast, all four walls were brought down, including architectural features. It is scarcely conceivable that the masonry could survive intact during accidental collapse. Catastrophe must remain as a possibility, but even here one would expect a much greater degree of disintegration (witness recent disasters such as the Kobe earthquake, where many masonry buildings suffered severe damage and walls did not survive intact). One of the door arches and perhaps two windows at Lebach showed signs of structural stress in the form of displaced voussoirs; this could have been caused by the collapse, but it is at least possible that such stress led to a decision to demolish. Dr Miron, the excavator, also believes that the building was demolished.

Conclusion

One could go on, but space is restricted. There are a number of cases which do not wholly fall into the categories of random rubble (dilapidation) or intactness (demolition). These include examples such as the wall panels from London, Cirencester and Cold Knap. They could conceivably represent decay processes; this certainly seems to be so at Piddington, where one face of a wall slid into a cellar and the other then fell across it. In the end interpretation of such cases will be a matter of personal opinion, but I hope I have shown that there can be less doubt about the mechanisms involved at the ends of the spectrum of collapsed Roman buildings.
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Some Observations on the Old Age, Dereliction and Ruination of Classical Buildings and Structures

Tim Strickland

Introduction and Background

My interest in this subject goes back a number of years and was first stimulated by my archaeological work in Jordan where a number of ancient classical buildings survive as impressive ruins to this day - a circumstance which taught me early on in my professional career to look for archaeological evidence sideways and upwards in addition to downwards! Incidentally, from a slightly earlier experience I remember too the discovery that a number of British Army barrack-blocks were uncannily similar to their Roman counterparts which later I spent many years in Chester attempting to elucidate. In Chester also came the growing awareness of the fact that a number of Roman legionary buildings had survived to an impressive extent for centuries after the end of Rome (Strickland 1994 (a)). Looking back on it I think, too, that my archaeological work at Winchester and Wroxeter had also fostered my interest in what becomes of buildings in their old age and ruination. This was particularly the case at Wroxeter (Barker 1973) where, of course, the growing awareness of the late Roman and Dark Age fate of the public buildings of that Roman city has added significantly to the range of experience on which I base a number of the thoughts presented below.

That said, I doubt very much whether many of my thoughts will be altogether new; and indeed some readers may even question the relevance of some of the parallels I draw. I present this contribution therefore as a supplement to Graham Keevill's interesting and stimulating paper, in the hope that some of the images I present will help to stimulate your visual imaginations - an absolutely essential ingredient in the interpretation of the archaeological evidence relating to the fate of ancient buildings.

We must remember also that we are caught up, rightly or wrongly (whether we like it or not) in the "heritage industry" and I believe it is becoming increasingly important to society that we play our full part in the assessment, analysis and elucidation of the original appearance of ancient buildings, some of which will be restored or replicated. I call to mind, for instance, the astonishing Austrian achievement in the accurate and detailed reconstruction of the 2nd century library of Celsus at Ephesus where an imposing three-storey edifice has been rebuilt from tumbled, earthquake-shattered, fragments of stone (Erdemgil 1986). Do we not have a public duty to explain and resurrect the past in terms which the layperson will understand?

The Importance of the Visual Image in Understanding Archaeological Evidence

It is clearly of the greatest importance to those of us who are increasingly involved in interpreting and presenting the past to the general public that we try to build up a picture of what it is we are attempting to describe from fragmentary evidence. An awareness of the original appearance of buildings and working practices at different times in history is essential. Thus, for example, it is salutary to be reminded of the fact that in antiquity buildings which were constructed out of beautifully dressed and squared blocks of stone were frequently stuccoed - and sometimes the stucco was even designed to reproduce what was actually hidden by it in the first place! Some examples of this custom which come to mind are the "Qasr el Bint" temple at Petra (Browning 1977), the gate and window arch-stones of the Roman fort at South Shields (Bidwell and Speak 1994) and parts of the Saarlburg fort on the limes frontier in Germany. Incidentally, we should remember that decaying stucco can also produce considerable deposits alongside wall-footings and that it can sometimes be reduced to its constituent materials by weathering.

Where examining the evidence for ruination of buildings on sites which consist almost entirely of stone it is my experience that there are always considerable quantities of stone rubble lying adjacent to the footings of walls, except in those places which have experienced intensive occupation over a period of subsequent centuries (for example, Kennedy and Riley 1990). It must, of course, be said at this point that decent squared blocks of stone tend to get reused many times over and will thus frequently be missing altogether from the vicinity of the structures from which they originally came. In this context I have noticed that stone from flights of steps is often the first
to be robbed for reuse - it is most easily removed. Prior to the systematic robbing of such stone which is frequently a feature of the late Saxon revival of urban communities in Britain (Thacker 1987) one suspects that the rubble-strewn building sites to be seen in various parts of the Mediterranean world to this day convey to us a probably reasonably accurate picture of what it must have been like in Britain adjacent to the ruins of the Roman period in the ninth and tenth centuries - to which must be added the nettles, docks and brambles of course! Whilst on this last subject has anyone done any work on the palaeoenvironmental evidence for the weed-cover of ruins in this country?

I suspect that property boundaries also have an impact on survival. The straight stretch of Roman road which abruptly comes to an end on a hairpin bend where it is crossed by the site of an early medieval boundary is something we must all have experienced (Chevalier 1976). The varied degrees of survival of two adjacent legionary barrack buildings off Princess Street in Chester, one substantially intact and the other completely robbed out, was probably also the result of an intervening early medieval property division (Ward 1994 (a)).

**Ultimate Uses**

Here I am referring to what I call the "second hand carpet salesman" concept. This is something which happens to many of our larger buildings however varied in importance their original functions, and we should not blind ourselves to the fact that this must have happened in antiquity as well. Certainly there are large numbers of redundant churches which have been converted to fundamentally different uses. I think of one church which I pass on my way to work which has been converted to an electrical salesroom. I think, too, of the public library in Chester, whose grand imposing entrance is dominated by an inscription which states proudly to all the world that it is "Lofty’s Coachworks". The basilica in the Constantian imperial palace at Trier has survived to this day as a church (Wightman 1985). Indeed, the great 3rd century Porta Nigra in the same city became a medieval Bishops’ Palace (Wheeler 1969 (c)). These are lessons which we must constantly bear in mind when we examine the remains of substantial buildings from antiquity and puzzle over the relevance of the finds evidence and how, all too frequently, this may have no bearing on our assumptions about the original functions of the building concerned. There are so many modern examples of this phenomenon that I hesitate to mention any more. However, you will understand my drift if I say that an uncritical assessment of the archaeological evidence currently being generated by the armies of India and Pakistan would prove conclusively that the British Indian Army was still in residence nearly fifty years after it had actually departed.

**Dereliction**

Nowadays, we are well aware of the processes of structural collapse and stone-robbing but, given the effects of our climate and what can happen during the long-term abandonment of substantial buildings, we
should perhaps be more conscious of the processes of
dereliction and decay and the evidence for them.
Inevitably, the dereliction process is bound to be
influenced by a number of factors, not least the quality
and nature of the original structure concerned. To
illustrate this point, I take an extreme example:
namely, the ancient frontier fortress-town of Umm-el-
Jimal in northern Jordan which was constructed
totally of stone - all forms of timber being totally
absent. Thus, even the doors and roof-beams are
made of stone (DeVries, Undated).

In suffering as they have done from weather erosion
and increasingly nowadays from atmospheric
pollution, it is frequently possible to identify deposits of
dissolved stone adjacent to the footings of major
structures. The Taj Mahal at Agra is a case in point.
I also recall such an example adjacent to the foot of the
City Wall at Chester (Strickland 1983).

I discovered by accident that Roman tegulae and
imbrices may be fairly resistant to frost so long as they
are maintained at an angle on a roof structure; but
once they fall to the ground the effects of frost action
on them are very rapid and considerable. Such tiles
can be reduced to the smallest of fragments in a very
short space of time. Whilst on the subject of roofing,
observation of what can happen today on derelict
buildings will demonstrate that roof-dereliction and
collapse can, on the other hand, be an extremely long-
term affair. Thus, it is my experience that as a
general rule roofing tiles or slates will fall piecemeal
long before the actual wooden roof structure comes
down. Furthermore, roof tiles/slates do not come to
the ground on a single occasion in this process and we
should therefore look for the evidence of them spread
vertically through the archaeological stratigraphy.
This may well be the reason why, in urban
archaeology, we so rarely find the extensive traces of
collapsed roofing in a single deposit or sequence of
deposits. Incidentally, is this why we so often assume
mistakenly that the roofing tiles have been robbed?
Should anyone doubt the effect of frost-action on a
substantial structure, go to Castell Dinas Brân in North
Wales on a fine winter’s day and listen to the process
of freeze-and-thaw tearing the castle apart.

The Robbing and Re-use of Building Materials

Once again, a familiar and much discussed subject.
However, remember that any assumptions that we
might make about the robbing of now-missing
structures must be determined by an understanding of
what the complete structures concerned had originally
consisted of. Thus for example the stubs of the stone
wall-sills of formerly half-timbered buildings might
well tend not to be covered or associated with
quantities of adjacent stone rubble. Indeed, where
wall-stubs survive, the very clearness of the adjacent
parts of the site might suggest the former existence
of half-timbering - or pisé - rather than robbed out stone
walls. After all, by its very nature the partial robbing
of masonry structures is often a haphazard and untidy
process and can even on some occasions be
responsible for pulling parts of a building down -
especially if the robbing has been highly selective and
restricted to the better quality more reusable elements
of a structure. That said, we must also be wise to the
fact that some forms of substantial structure
-especially, for instance, brickwork and ashlar
masonry - can be totally removed for reuse elsewhere.
One can think of so many modern examples of this
that the concept of such total removal requires no
further elaboration. The important point here is that,
by and large, total robbing implies that the robbed
structure was worth robbing totally and that it could be
robbed without leaving substantial remains behind.
This in itself will say something for the nature of the
original structure and its structural condition at the
time of robbing.

Abandonment of Roads and Bridges

Anyone who has studied Ivan Margary’s famous pilot-
study of Roman roads in the Weald will be familiar
with his remarkable discovery of some sections of
perfectly preserved Roman road which must not only
have been completely abandoned but, as a consequence
of this abandonment, have left no hint of their
existence in the present-day surface landscape
(Margary 1948). As with property-boundaries, local
changes in political geography must of course have
contributed to the break-up of some Roman road
systems. Politics can sometimes play a major part in
the fate of buildings. A modern example is the Berlin
Wall which, of course, has been totally demolished
relatively suddenly on the collapse of the Soviet
empire.

Modern experience again also demonstrates that it is
sometimes easier to construct new structures on new
sites rather than on the sites of existing ones. This
also applies to roads. Roads themselves are not
especially the subject of this paper but they serve to
remind us of what must have happened with the
gradual dereliction of the Roman bridge across the
River Dee at Chester. Here, research has
demonstrated that the Roman bridge, which incidently
appears to have survived into the Middle Ages, was some ten metres downstream of its medieval counterpart. The very choice of a new line for the replacement structure caused diversions in the roads leading to the bridge from each side and these diversions are clear in the modern-day urban landscape (Strickland 1994 (b)). One should not forget either that it is sometimes necessary to keep an existing, though decayed, structure in use while its replacement is being constructed. That said, in the case of the Roman bridge at Chester contemporary documentary evidence suggests that it had fallen down in a flood. It is not only easier but cheaper of course to build on a new clean site than to have to contend with, and clear away, the rubble of an imposing structure first.

Defensive Walls

From observation and archaeological work adjacent to the stone defences of Roman forts in Jordan I have always been able to bring to bear on my analysis of the walls of Chester a clear picture of what can happen in the ruination of such structures. A few examples should suffice here. First, it is very clear that defensive walls, albeit simple in their function, can have surprisingly long and complex histories. This is particularly well illustrated in the case of the city walls of Chester where recent dissection of two stretches of wall has demonstrated the presence of a 1st century turf-revetted rampart, a 2nd and 3rd century stone revetment, a medieval structure, an 18th century wall and a 19th century interior face, all within one superficially simple length of wall (Strickland, forthcoming).

I have also observed that with features like defensive walls what appears to be the structural history of one section in dereliction and decay need have no relevance whatsoever for a stretch a short distance away (Strickland 1994 (c)). It is also clear that even when completely in ruin the tumbled masonry from formerly substantial defensive walls can be a very significant obstacle in its own right and thus can render a site still effectively defensible against less organised opposition (Strickland 1994 (d)). Add to this the English bramble and nettle and an attack can be rendered extremely difficult. Whilst on the subject of defensive walls it may be of interest to the reader that I have observed a number of sites that, during the dereliction-process, the corners of towers seem to survive far longer than the stretches of walling in between them and, furthermore, that the outward-facing wall of a tower tends to collapse before any of its other three sides or the adjacent stretches of curtain-walling. Could this be the explanation of some of the curious anomalies in the facing masonry of parts of the northern City Wall at Chester where post-medieval repair coincides with the sites of several Roman towers?

Superficial Abandonment

Referring to the winter of 893/4 the Anglo-Saxon Chronicle refers to Chester as an empty fortress (Thacker 1987); but is this an accurate description? The largely neglected ruins of ancient settlements and towns can frequently appear to the superficial glance to be completely unoccupied but, on closer inspection, it becomes clear that occupation in some form or another continues. As an example of this phenomenon I call to mind again the Nabataean and Roman town of Umm-el-Jimal in northern Jordan where a general view convincingly indicates abandonment. A walk down the remains of any street, however, will demonstrate that some ancient houses are still in use.

Whilst on this subject, it is worth noting that the walls of formerly major buildings can make superb animal pens! Thus for example the white camels of the local sheikh at Umm-al-Jimal are kept within the shell of the so-called praetorium. Surely such activity must provide part of the explanation of the deposit we describe as "dark earth" which, so often, lies within or adjacent to the walls of ancient buildings in this country (Ward 1994 (b)).

Summary and Conclusions

There are five points with which I should like to sum up:

1. In trying to understand what has happened to a robbed-out structure it is obviously important to make a careful assessment of what are likely to have been the original building-materials used.

2. Be aware of the fact that it is possible to apply many of the processes we see around us today to our analysis of incomplete archaeological evidence of the distant past.

3. It is important to form a clear picture of what a site under analysis might have looked like in its contemporary setting. Again, plentiful modern parallels exist.
4. Remember that dereliction, because it is a long-term process, can leave archaeological evidence spread piecemeal through a vertical stratigraphy. Do not make the mistake of assuming the results of roof-collapse in the dereliction scenario will be found in a single stratigraphical horizon.

5. When considering the fate of large buildings and structures always remember that events in one part may have no relevance to events in another.

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Beyond the Post-hole: Notes on Stratigraphy and Timber Buildings from a London Perspective

Damian Goodburn

Summary

This paper presents some new information on the nature of timber buildings in English towns during the periods c. AD50-300 and c. AD890-1250. The principal source for the generalisations presented below are recent excavations in waterlogged areas of the City of London and Southwark carried out by the Museum of London (since 1992 the Museum of London Archaeology Service or MoLAS). During these excavations much new evidence of the techniques of construction of early timber and timber-and-earth buildings were recorded in detail. Substantial work remains to be done on the post-excavation analysis of the records of these structures but a number of key facts are already apparent which are replicated in evidence from more than one site. A guiding assumption of this writer is that post-hole plans are plans of post-holes, not "buildings" as they seem to be thought of by some archaeologists. Therefore much of this summary of new information concerns the nature of buildings in three dimensions, that is, their above ground characteristics, beyond the post-hole. It is hoped that the paper may be of use to those interpreting the stratigraphy of "dry" sites as well as those dealing with "wet" site excavation.

Background

London's historic core areas contain many waterlogged zones both along the natural watercourses, in land-fill areas and sometimes even in relatively elevated positions (Ayre et al forthcoming, Hill and Woodger forthcoming, Bateman 1994). Much has been published on the excavation of timber waterfront structures such as river walls or "revetments", river stairs, jetties and related structures (Milne and Milne 1982, Milne 1985 and Milne et al 1992). Summary publications have also appeared on the excavation of timber wells and similar structures (Wilmott 1991). It gradually became apparent to workers during the 1980s that these structures could tell us a great deal about structural woodworking techniques of the periods concerned. This pool of well-recorded, closely dated data was drawn upon to produce a hypothetical developmental scheme for early and later medieval timber building techniques as a whole (Milne et al, 1992, 131-137). By 1990 systematic work had also been carried out on the recording and interpretation of some groups of reused building timbers of Roman and Saxo-Norman date (Goodburn 1991, Brigham 1992). Following closely on the heels of this work excavation of timber, and timber-and-earth buildings, partially preserved in situ, took place on a number of London sites (Fig. 1). Important groups of reused timbers were also found, recorded in detail, and analysed (Goodburn 1993, Goodburn Museum of London unpublished Ancient Woodwork archive and assessment reports since 1988). Currently the results of some earlier excavations have been subjected to detailed re-analysis yielding substantial new information (Brigham and Goodburn et al forthcoming). All the preceding types of work have been drawn upon for this brief summary paper.

Space and time will not allow detailed descriptions of many of the groups of building timbers or the buildings in situ, but readers can obtain more information from the publications cited above and by written request from MoLAS. Some of what is discussed below also has to be seen as work in progress likely to be revised as research continues and particularly as more comparable material is published in detail.

The Roman Revolution in Structural Woodworking

First, it is essential to stress that the Romans introduced a range of new approaches to structural woodworking that revolutionized the built environment, even at the urban vernacular level. By the AD 50's in the new town of Londinium, the new concepts of timber frame building, the dead straight line, all square and level were introduced (Goodburn CID90 unpublished Ancient Woodwork report). The radically new technologies of sawing along and across the grain appeared and an organised timber trade was established (Goodburn VAL88, VRY89, CO88, and GYE92 sites, Museum of London unpublished Ancient Woodwork archive and assessment reports).
Figure 1: Map of central London showing the line of the medieval City wall and recent sites with preserved building timbers, with sites codes appended and symbols to indicate which yielded Roman (+) and or Saxo-Norman building woodwork (-), in situ and which produced reused building timbers ('). Including: VAL88, CID90, BUC87, CO88, UPT90, VRY89, TEX88, GYE92, FW84, PWB88, LYD88, BUF90 and COV87.
It is important here to attempt a definition of the term "timber-framing"; timber-framing is a broad approach to structural woodwork which involves the prefabrication of solid, articulated, closely jointed and regularly planned two-dimensional frames which are then reassembled on site to form the main three-dimensional structure of a timber construction, building, bridge, jetty or whatever. Most forms of framing will stand independently of the site they occupy unlike the much more ancient forms of "earth-fast" buildings in which many of the building's key elements are set in the ground upon which it is built. It would appear that little prefabrication is carried out in earth-fast systems of building.

From recent excavations in London it is clear that earth-fast approaches to building continued, to some extent alongside the new-style, modular, Roman framed buildings (Goodburn CID90 site Museum of London unpublished Ancient Woodwork archive report). It is well known that in small rural settlements pre-Roman traditions of earth-fast round house construction continued.

A variety of approaches to timber-framing are documented in detail from recent London excavations and a reconstruction of one common system is shown in Figure 2 (see Goodburn 1991 for detailed discussion). Surprisingly, in many cases the baseplates of these timber-framed buildings were laid directly on the ground as at the COV87 site (Lees 1989 Museum of London unpublished archive report) or in some cases even just below it. Thus, the lower timbers of the walls were still exposed to the rot-inducing damp soil. Clearly these structures were not intended to last indefinitely. It is important to note here that we have often found clusters of short, cleft oak, piles under the baseplates of Roman timber and earth buildings in London. On dry sites these groups of pile holes on an interrupted linear axis are all that may remain to indicate the presence of such a timber-framed wall (Fig.3a). In other cases where piles were not used and a planked floor employed, as in the Courage Brewery building (Dillon 1989) little evidence of the ancient presence of a building might be found at all. However, it might be the case that some discontinuities in stratigraphy and finds distributions around the edges of the building and perhaps a few baseplate levelling chocks or stones could survive.

Along with timber-framing the Romans introduced the tightly cut mortise and tenon joint (where the tenon has a carefully cut shoulder), lap dovetails, complex scarf joints and the wide spread use of iron nails as building fastenings (Goodburn 1991). Whilst these joints were similar in very broad terms to those used in high medieval carpentry there are important differences. For example, Roman joints used in Britannia were only very occasionally locked with pegs in the manner of high medieval carpentry. From the excavated evidence so far published from later prehistoric sites in Britain it is clear that a rather different range of joints were used (eg. Coles and Orme 1982, Pryor 1992). The terms "mortise" and or "tenon" are often loosely used to describe prehistoric and pre-Norman Conquest joints, but they were of a very different form to those used later. Generally a whole tapered timber was passed through another by way of an axe cut hole rather than a neat mortise.

Those engaged in attempts to reconstruct ancient timber structures from dry site evidence such as post-holes, floors and beam slots would do well to examine the published data on structural woodwork. It is also important that those working in this field acquaint themselves with relevant studies of vernacular architecture and standing building research. Otherwise the often derogatory descriptions used by students of surviving architecture to characterise such archaeological reconstructions as "whimsical" will continue to be rightly applied. For example, one of the most important lessons of wet site excavations in Britain since the early 1970s is that the practice of lashing together of structural woodwork on land was not practised at any early period from which we have substantial remains in Britain. However, it is well known in some other forms of specialised woodwork such as prehistoric boatbuilding or ethnographically from Africa and the Americas. I would be very interested to hear from anyone with well documented material evidence to the contrary. This is not a trivial concern as currently the public is usually presented with a rather debased view of the woodworking abilities of our ancestors in most graphic, model or full-sized archaeological reconstructions of early buildings where the structures are held up by anachronistic joints and miles of twine!

Important Advantages and Wider Implications of the New Timber Framing Technology

One great advantage of the use of framing techniques is that framed buildings can be given greatly increased stability, enabling them to be supported above ground on pad stones, dwarf walls, or even masonry lower storeys. Given a sound roof and lack of fires such buildings, protected from timber-destroying damp soil, can survive for hundreds of years. A number of standing timber-framed buildings are known from
Figure 2: A hypothetical reconstruction of a common system of Roman timber framing used in London and other parts of the NW. provinces, redrawn from Goodburn 1991.

Figure 3: Diagram shows; a) a common type of Roman timber-framed wall with a baseplate set on clusters of irregular piles, b) the base plate arrangement used in the timber framed, plank clad building from the CO88 site. Not to scale.
Figure 4: Hypothetical reconstruction drawing showing how the 10th century arcade post assembly from the VRY89 site may have looked in use. The articulated timbers found are stippled. Redrawn from Goodburn 1993.
England to have survived substantially intact for over 600 years. It is also important, when interpreting the function and meaning of a Roman timber building, to consider the issue of storeys. One and a half, two, two and a half or even more storeys would have been possible for all but the very slightest of framed structures. This has important consequences for reconstructing populations of settlements and the functions of buildings on the basis of the ground floor archaeological evidence.

Summary of New Evidence from London for the Nature of Late Anglo-Saxon and Norman Timber-and-Earth Buildings

Currently there is a gap in the systematically documented wet site evidence from London from the middle of the Roman period until the very end of the 9th century. It has been clear for many years that Anglo-Saxon and Anglo-Scandinavian approaches to structural woodwork were quite distinct from those of the urbanised parts of Roman Britain. Indeed, recent work in London and elsewhere has shown that in many ways the work of Anglo-Saxon structural woodworkers was rather more like that of prehistoric woodworkers than their Romano-British forebears. The Roman technology of sawing, timber-framing, tight mortise and tenon joints and the preparing of neatly squared timber was abandoned. The essentially prehistoric techniques of controlled cleaving, working roundwood, and cutting a variety of lap and tongue and groove joints with axes held sway (Milne et al. 1992). The vast majority of buildings were also built earth-fast once more. However, some new technological tendencies are clear. For example, the use of face pegs or treenails was much more widespread than it was in prehistory, or Roman times.

Importantly, it is clear that in the period c.890-1180 there was far less technological distance between land structural woodwork and that of boatbuilding and shipwrightry than there was in later medieval times. This is indicated by such features as the use of distinctive boat fastenings in buildings (Goodburn 1993, see below and Fig.4). Thus the use of the Old English term "treewright" meaning woodworker is more appropriate than the later medieval, more specialised term "carpenter".

It is also becoming clear that the timber and earth buildings in London were built in a great variety of ways (Fig.5). There appears to have been far more variety in wall construction and roof support methods than have been found in Dublin or York for example. Small and large surface laid buildings are known, some with ailed structures, in others the walls were the load bearing features. Slightly and deeply sunken buildings are also known (Horsman, Milne and Milne 1985). There is also some tentative evidence for the use of a form of "laft" or blockwork construction involving the use of thick cleft oak planks. This form of construction and stave building using baseplates (Brigham 1992) may have been reserved for more costly structures, because of the prodigious amounts of timber used. Both systems share with timber-framing the ability to be supported above ground level, and may therefore leave comparatively little trace. Lines of cross-wise baseplate levelling chocks of timber or stone rubble are sometimes all that remains in situ on the demolition of such a building. Some buildings were also given raised timber floors, set on "D" section beams laid on the ground, in this case evidence of external walls and internal supporting timbers may survive without "floors" or hearths (Goodburn 1993, and Figs.4 & 5).

In some ways earth-fast systems of construction can be more flexible than timber-framing systems in that it is comparatively easy for different walls of the same structure to be built or re-built rather differently. Combinations of post and wattle, stave, and/or "bulwark" (see below) walling have been found in the same building, functioning with the same clearly demarcated brick-earth floors.

As for the Roman period we are able to deal with vestigial evidence from dry sites, the in situ survival of features such as lower walls, buttresses, internal post bases and timber post pads on wet sites, and a large number of reused timbers. Figure 5 attempts a provisional, graphic summary of the types of wall construction in timber, roundwood and earth buildings c.890-1200 for which we have evidence from London excavations since 1988. The presentation of the phased and dated building plan evidence from all of the recently excavated sites is either still underway or stalled by a lack of funding. It is hoped that the information will be published in detail in due course. The dating of sequences is being carried out with the help of systematic tree-ring dating and woodwork recording (see Watson and Tyers this volume).

A key problem in understanding early medieval town buildings in London is the apparently commonplace phenomenon of long-lived property boundaries. Larger deeper later medieval foundations along early property boundaries very often completely destroy the external walls of the early medieval buildings leaving the partition walls, floor and occupation deposits only.
Figure 5: Diagrammatic glossary of wall and roof support systems known from in situ or reused building timbers excavated since 1988 in London: a) earth-fast stave, b) stave in grooved baseplate, c) earth-fast stave and muntin, d) mock stave and muntin, e) ailed round post with stave external wall, f) ailed with wattle lined turf external walls, g) plank on edge baseplate for wattle walls, h) earth-fast post and clapboard, i) sunken; post and plank revetted, j) bulwark wall construction, k) post and wattle walls, often buttressed, l) "laftwork" or blockhouse. Note that many of the above wall forms may be supplemented by earth and or turf external walls, and none are "timber-framed".
Figure 6: a) 10th century building clapboard of radially cleft oak found reused on the UPT90 site, with the remains of willow or poplar treenails used to fasten it to wall posts. The triangular axe cut opening is a small peep-hole window. b) A new hypothetical reconstruction sketch to show how the board may have originally been used, in the gable end of a building.

Figure 7: A late-Saxon, radially cleft, axe cut roof shingle of oak from the UPT90 site. It was clearly fastened with a wooden peg or treenail rather than an iron nail, and was heavily charred on its external exposed surface, implying an origin in a building destroyed by fire spreading from a neighbouring property.
Some Fragments of the Built Environment of London c.890-1200

What can be presented very briefly here are just a few concrete examples of timber elements from the upper works of buildings of the period. That is, from the three-dimensional space actually built and lived in by early medieval townsfolk, well above the normal focus of archaeological attention - post-hole level. One important group of reused building timbers has been published in detail elsewhere but is so useful for illustrating the unexpected nature of the work of London treewrights that it is touched upon here (Goodburn 1993). Figure 4 shows the articulated timbers of what appears to be some form of arcade post assembly from a substantial aisled building of late 10th century date. The post was sculpted from the three-dimensional shape of an oak and had non-structural planking fastened to it with distinctive Anglo-Saxon style boat nails. The form of the arch employed between the arcade posts was quite unexpected and may have been inspired by contact with the Islamic world.

Of about the same period we have evidence of the earliest vernacular English window in a building clapboard, probably from a gable end, reused in a revetment (Fig.6). The triangular form of the small peephole window is easily cut with an axe through such a board and is known in staves from Hedehy (Elsner Undated), and in stone Anglo-Saxon churches. The quantity of clapboard found on some sites suggests that it may have been a common form of wall (and perhaps roof) covering for buildings with earth fast posts. However, radially cleat oak shingles are also known (Fig.7). The rather oval shape being a function of being cross-cut with axes rather than saws such as are used in recent shingling.

Finally, evidence of what must have once been a relatively common form of timber wall construction has now been documented from a number of different types of in situ structure. The system of construction relies on the slotting of cleft boards, set on edge, into grooves in earth-fast posts to form the building wall (Fig.5j) The system has been documented in early medieval contexts elsewhere in N. Europe particularly in Denmark where it is sometimes known as "bulvaerck" (or "bulhus") and has survived in a modified form until relatively recent times (Jorgensen et al 1986, Benzon 1984, and Elsner Undated). So far the London bulwerk structures span the mid 11th to late 12th centuries. Unfortunately space does not allow the presentation of woodwork from post and wattle, stave or raftwork structures.

The Re-adoption of Roman Technology

As an end note it must be recorded that the earliest well dated post-Roman evidence we have of the use of timber-framing proper is in the 1180s. Within not much more than a generation modified forms of the old Roman technology, such as sawing, mortise and tenon joints and timber-framing were in wide spread use (Milne et al 1992:131-137).

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Aspects of Norwegian Waterfront Archaeology:  
The Case Study of Trondheim  
Gerry Martin

Summary

This paper attempts to deal with some of the stratigraphic problems that have been encountered on a large-scale archaeological investigation into a medieval waterfront in Trondheim, Norway. This excavation began in May 1993 and finished during October 1994. The area under examination consisted of a transect 350 m in length and 3 m wide running parallel to and to the west of the River Nid, where the medieval town was settled (Fig.1) The paper centres on recognising the excavated archaeological elements, assessing their influence on the physical townscape and detailing some of the problems in formulating relative and chronological phases.

Norwegian Archaeological Practice

Norwegian urban archaeological practice is based upon the understanding of the order of stratigraphic elements which creates the stratigraphic sequence. This event archaeology has been executed by using single or multi-context planning systems and recording those observed elements on context sheets. The sequence is then constructed in the form of a Harris Matrix and from that phases and finally periods are abstracted. Essentially, this is the standard practice exercised in Britain. Definition of these elements and understanding their physical influence on later archaeological phases has questioned the absolute efficiency of this line of enquiry, leading to the application of a less rigid recording format.

Problems with Excavating Waterfront Material

Typically, waterfront deposits are characterised by cycles of deposition and erosion, the effect of which often makes it difficult to define the context fully in plan with any security, especially where spatially cross-referencing across terrain. In order to avoid loss of data or erroneous recording, the preference has been to use multi-context plans initially, and then proceed to a single context planning system as definition of contexts becomes clearer. Even defining contexts within this mode of operation has been difficult to achieve, as a result of three main factors.

Firstly, where timber structures consisting of floor boards over joists occur, voids in the floor space are filled by later deposits which are stratigraphically difficult to detect and appear to be therefore earlier than the construction of the timber sills and floorboards. Secondly, later overburden compresses down fragile timber layers into earlier deposits, so that a timber surface can be below the sill beams upon which it originally rested. This compression can be up to 0.30 m (Long 1976, 198). Moreover, when these surfaces are pushed downwards, they often meet earlier immovable objects such as upright posts and can appear to be cut by these posts (Fig.2). The true relationship is only seen later as the archaeological sequence is revealed by excavation. This creates recording problems at the point of excavation, as to the true stratigraphic relationships of these elements and often necessitates major revision when excavation of the deposit has been completed. The effect is that the archaeologically observed terrain has been dramatically modified by natural transforms within the soil after deposition, which thereby, does not physically reflect its original condition or appearance. It is therefore, not a true physical representation of the deposit in the past.

Thirdly, aerobic and morphological conditions of the deposits have changed since deposition. In Trondheim, the land rise has been calculated as being c.3.97 mm per year, or c.4.00 m over a millennia (Christopherson, Cramer and Jones 1989, 7-37). Timbers which in the medieval period may have been waterlogged and standing in water have subsequently become dry deposits and prone to deterioration. Where the timbers have rotted, the space created has been replaced by later fills or surrounding stratigraphy has collapsed into the void. This has created a terminological problem in deciding what these ghosted fills or impressions should be described as. Strictly speaking, these are not fills or cuts, but vertical layers because there is no real cut and therefore there can be no fill. However, these elements have been treated in the conventional sense as fills and cuts as they do correspond to events within the detected archaeological sequence.
Defining the Start of the Archaeological Sequence

The final major definition problem has been recognising what constitutes natural ground. The River Nid was a slow, shallow, mature river characteristically depositing fine, grey silts and orange sands. However, it is subject to seasonal hiatuses due to meltwater and consequent erosion of material upstream which can lead to variable levels of deposition downstream. Organic material such as wood can therefore be sealed within natural river silts. The provenance of such materials remains uncertain. To the excavator this can appear to be primary deposition and interpreted as active use, but in reality there are very strong possibilities that this deposition is residual.

Moreover, the hydrological processes within the river can disperse material. In particular, crushed mussel shell appears to have accumulated as beds beside the river bank but it is probable that this action is the result of natural drift within the river, rather than human action. Geological expertise has become essential in determining what is natural and what is anthropogenic activity. The river was shallower in antiquity and a series of eyots or islands lay within it. Adaptation of the river appears to have included retrieving land by infilling between these small bars. The material used was coarse grain sand with angular pieces of rock. To all intents this looks like naturally lain material. Actually, this is artificially imported moraine material derived from a source 20 km away which could not be transported by natural agencies.

The repercussions are twofold. Firstly, it suggests a sophisticated and systematic programme of infilling and that to execute this programme there must have been pre-existing organisation. This would suggest that rather than nascent economic activity, trade and commerce were already firmly established and that this capital investment in order to reclaim further land was to bolster and maximise this advantage. Secondly, to understand how past peoples adapted and utilised their environment one must have firm evidence of those topographic conditions. This is vital if one is assessing the impact of cause and effect. By losing deposits at the origin of the cultural sequence through lack of archaeological recovery, it is extremely difficult to assess the importance of later elements and to interpret whether these reflect fundamental change or dislocation to the urban environment or merely ongoing adaptations within an inexorable process.

Inter-active Phases

Despite attempting to be as objective as possible, defining contexts and their sequence has been a more subjective exercise than was desirable. However, perhaps this is not as crucial as we normally assume. We may have become over-reliant on the origins of deposits and have paid less respect to how these deposits have influenced and been utilised in later urban landscapes.

The example of timber waterfronts illustrates this well. The Trondheim medieval waterfront recently excavated, had a short life as a quay being replaced by further encroachments into the river within fifty or a hundred years, but the timbers which formed its construction remained in situ. These timbers imposed themselves on the later townscape for up to four hundred years (robbing of the timbers is suggested by 17th century material in the post-pipes) and remained as free-standing structures.

Although primary function for these timbers may have ceased, an important alternative function emerges. An example of this is where ropes have been attached to upright posts in later phases (Fig. 3). Stratigraphically, these ropes lie above silts butting these timber posts, but probably more useful for determining the function and adaptation of the deposits is the fact that the ropes were tied to the posts. This physical relationship tells us that the posts are in active use during a later phase. Using the purely stratigraphic sequence, this important data is not readily available.

Moreover, the physical relationship is a constant reminder that this earlier timber post phase was “inter-active” in later phases and was a vital component in the functions undertaken in those phases. Although, the origin of the timber post phase in the Trondheim example was in the 13th century, perhaps of greater interest was its longevity and influence on the foreshore. This can be ascertained by dating the butting deposits surrounding the posts which have acknowledged physical links, e.g. via the tied ropes. The post phase can then be considered both a 13th century phase due to its origins deduced from the stratigraphic sequence, to in our case at least a 15th century phase, as evidenced by continued function derived from physical relationships.

This has partly been reconciled by employing land-use diagrams apportioning usage over multiple phases and applied to waterfronts (Westman, unpublished). Although a useful tool for over-viewing function within the site chronology, it remains an abstract
Figure 2: Schematic section showing possible stratigraphic anomalies. 1) Later material beneath earlier surface. 2) Squeezed deposit appearing to be cut by earlier post. 3) Choked filling in post-pipe caused by robbing or changes in groundwater conditions.
representation of land use and subsequent
development, perhaps being a little too deterministic
and allowing less scope for multi-functional
interpretations.

Dating Phases

The dates of Norwegian waterfront deposits are
normally derived from pottery dating, typologies of
other cultural material, known historical horizons,
dendrochronology and radio-carbon dating. All these
techniques have been employed on the Trondheim
waterfront in order to provide as wide and independent
range of spot dates. These techniques perhaps need a
little elaboration in relation to the characteristics of the
waterfront. The most accessible dating technique is
spot-dating from pottery. The Trondheim waterfront
deposits have unearthed numerically significant rather
than large assemblages. This is slightly surprising as it
is common for waterfront deposits to provide quite
high quantities of discarded ceramic material.
However, it must be remembered that Norway was an
ceramic region until the 17th century when local
wares begin production. Pottery which occurs in the
earlier archaeological record is all imported and was
therefore probably a prestigious product of some
rarity, although this cannot be assumed without
question.

The likely age of this material at deposition, combined
with a low sample, may suggest an earlier date for
contexts and thereby phases than is the actual case.
Moreover, because much of the waterfront deposit was
dumped material, there exists a strong possibility that
some if not all of the pottery within the assemblages is
residual. It remains uncertain whether this dumped
material was rubbish created within individual
properties fronting onto the waterfront or waste
emanating from elsewhere in the town and perhaps
assisting deliberate acts of encroachment (Reed 1990,
22-25). If the material had accrued within individual
properties fronting onto the river, then this would be
highly suggestive of a date for occupation of these
properties, possibly their status and the use or
adaptation of the waterfront. If it came from elsewhere
in the town, it still could be contemporary to the
waterfront but its dating security is less certain because
it may reflect the systematic removal and then
dumping in one act of rubbish accumulated over many
years (Reed 1990, 27).

Looking at other cultural material may answer this
paradox and place the pottery within a broader
contextual framework. The waterfront deposits
provided a very large quantity of leather shoes and to a
lesser degree bone combs and bone wasters. The
leather artefacts being organic material would certainly
survive poorly in aerobic conditions that one would
associate if these deposits had originally accrued on
higher ground elsewhere in the town.

The leather shoes displayed fine preservation and it
appears highly likely that they did not emanate from
elsewhere in the town. As the pottery was found in
association with the leather shoes it would seem
probable that the pottery was almost contemporary to
the waterfront. Typologies of leather shoes and bone
combs are being developed in Norway but this
research is hampered by a lack of material data to
cross-reference, difficulties in establishing security of
context, an interest in the intrinsic rather than the
holistic, lack of access to work undertaken elsewhere
and the format of project funding and research.

At present, there exists too much latitude in these
typologies to provide accurate spot-dating for contexts.
Also, there are difficulties in assessing the significance
of subtle stylistic changes and judging whether these
are wholesale or gradual developments (Larsen 1992,
11-15). However, because we have excavated the
complete archaeological record over a wide area of the
waterfront, the data exists for future research within a
relative site specific chronology. This line of enquiry
will hopefully produce encouraging results and the
typologies required.

Trondheim, being a town constructed almost entirely
from wood, has during its history been subject to
many conflagrations. These fires were particularly
serious in 1328, 1344, 1481, 1531, 1598, 1651, 1681
and 1708 (Long 1976, 184-185). In places, burnt
timbers and scorched material have been found along
the waterfront but only the 1681 historical horizon has
been isolated with any certainty. The poor definition
of these horizons is due to clearance of burnt debris and
salvage of timbers shortly after these fires, the
confines of the areas excavated and the uncertainty
within historical documents as to the extent of these
fires within the town. Only the 1681 Fire can provide a
terminus post quem for the underlying deposits along
the waterfront.

Dendrochronology has been widely employed in
Norwegian archaeology to determine phases. Along
the waterfront, the anaerobic conditions have
preserved the sapwood of the timbers making possible
multiple interpretations of these timbers. Although no
results have been received yet, it should be possible to
identify whether the timbers are all of one phase or
Figure 3: A post represented in 'inter-active' phases. 1) The post as a revetment. 2) A mooring post. 3) Consolidation of the post. 4) A mooring post. 5) A mooring post. 6) A platform or building.
multiple phases, identify replacement timbers within a main grouping, determine the season of felling and possibly even estimate the provenance of the timbers (Eckstein 1984, 25-26). This information may enable the production of a close range of dates for the timbers which, in association with the pottery evidence, can assist in the compilation of tighter chronologies for other cultural material. However, dendrochronological techniques may have limited applications with the Trondheim waterfront because coniferous trees such as fir or pine are not as sensitive to seasonal climatic changes as hard or deciduous woods (Long 1976, 198).

Finally, a limited amount of Radiocarbon samples have been taken from the waterfront. This analysis has been undertaken to assess the organic conditions of this area prior to the introduction of formal waterfronts (Mook and Waterbolk 1985, 44-45).

The formal waterfronts appear to reflect changes in technology and shipping practices which required deeper draughts for vessels (Jondell 1985, 127). However, strong indications exist that a maritime function was served in this vicinity prior to the establishment of these waterfronts (Christopherson 1991, 164-165). The evidence consists of occasional timbers from undatable contexts and layers of crushed shell. Preliminary Radiocarbon results do suggest a continuity of function typified by landing harder rather than formal timber waterfront constructions. This relative chronology suggests that this function was practised at least two centuries before the introduction of a formal waterfront. An absolute chronology based on comparative stratigraphy cannot easily provide this important information as to the origins of the waterfront.

Conclusions

This paper has attempted to highlight some of the problems encountered in excavating waterfront deposits. Some of these difficulties are typical of this form of archaeology anywhere, whilst some are unique to the natural processes and environment found in Norway. The key areas that I have attempted to raise are:

1. Definition of contexts, whether contextual "event" archaeology is the most satisfactory method in determining long-term deposition.

2. Recording problems with partially standing structures and respecting deposits.

3. How these structures effect the later urban landscape and impose themselves, despite loss of primary function.

4. Difficulties in dating these phases, calibrating material and producing absolute chronologies.

Resolution of these problems is not readily at hand, especially if we take a rigid view of what constitutes an event in the past be it a context, the date of an artefact or a known historical horizon. However, we are bound by this chronological structure if we are to understand relative changes and therein those dynamics which affected past societies. The lesson learnt from the excavation of Trondheim's waterfront thus far, appears to be that a flexible and open-minded approach to understanding the formation of waterfront deposits will reap the greatest reward.

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Wood and Water or Rebuilding Medieval London Bridge

Bruce Watson and Ian Tyers

Summary

During the redevelopment of Fenning's and Topping's wharves on the southern approach to modern London Bridge in 1984, a series of area excavations supplemented by salvage recording and watching brief observations were carried by the members of the Department of Greater London Archaeology of the Museum of London (now the Museum of London Archaeology Service or MoLAS). This work revealed the southern abutment of the 12th-century stone-built London Bridge (Fig.1), plus fragments of earlier timber bridges, the associated waterfronts and the buildings of the medieval and post-medieval bridgehead, truncation horizons and fluvial deposits, as well as a Bronze Age ring ditch. A comprehensive timber sampling policy resulted in the collection of a large number of dendrochronological samples.

The aim of this paper is to discuss the post-extraction methodology devised to produce a site-wide sequence from some 15 areas (covering some 2,020 sq m) which were examined in a random order before or during ground works. Until very recently dendrochronology has only been used archaeologically to provide dates from oak timbers. On this project, for the first time, dendrochronology was used as part of an integrated approach to help determine and then refine the site sequence, by using attributes such as "same-tree" links.

Cartographic research has enabled us to reconstruct the entire plan of the medieval bridge - as it appeared in 1799 - using a computer aided design package (AutoCAD). This data is being used with the 1820's soundings to reconstruct a profile of the river bed and determine the influence of the bridge on the estuarine hydrology.

Recovery of Data and Timber Samples

Archaeological work within the former Fenning's warehouse basement was a standard open area excavation (Fig.1). This area was extended several times to uncover more of selected features. In particular four narrow trenches were opened up along the northern side of the basement to examine the sloping foreshore. Work on Topping's Wharf consisted of a series of watching brief observations made during ground reduction, most of this area having been excavated in 1970-72 (Sheldon, 1974). Archaeological work on the area adjoining the foreshore was undertaken in a series of five to seven metre square close-wall shored boxes or "bays". To prevent the collapse of the river wall only alternate "bays" were dug out initially. In between each "clearance" or reduction in ground level of several metres, one or two days were available for recording structures and deposits. Thus it was possible to detect and record all major structures, but not in the detail that controlled excavation would have provided.

Problems in recording the archaeology were compounded by its very nature - a complex foreshore sequence with a combination of the normal vertical build-up of deposits, the lateral development (due to reclamation) and the truncation horizons caused by flooding, plus the daily problems of the incoming high tide flooding the areas of excavation. Large timbers were planned in situ, labelled, then lifted out by machine for further study and sampling. For the first time on a London waterfront site an extensive timber sampling policy was carried out of all species, not just the oak timbers. A total of 786 timber samples were recovered from Fenning's and a further four samples from Topping's Wharf, compared with only 94 oak samples recovered from the waterfront excavations at Trig Lane (Milne and Milne, 1982). In the Trig Lane publication it was noted by the dendrochronologist that - with hindsight, many more of the 450 timbers revealed at this extensive site should have been sampled in order to provide the necessary replication of the smaller timbers and to gain most information from them ... (Brett, 1982: 75).

All observations were located to the contractor's site grid, the precise position of every timber and section being plotted by theodolite survey. Without this crucial work, everything would have been in vain as it would not have been possible to put together composite plans or see details such as how the timber bridge structures were built one upon another.

During the reduction of each "bay" a stratigraphic sequence was assembled for all structures and deposits. However, as alternate "bays" were dug out, all the early portions of site sequence were too far apart for any correlation to be made until all the intervening areas had been examined. This method of working was rather like being given most of the pieces
Figure 1: Plan of the site at Fenning's and Topping's Wharf and Medieval London Bridge. The plan of the bridge is taken from the 1799 survey, notice the gap where one of the central starlings was removed in 1759. During the late 18th century all the buildings were removed from the bridge and the roadway widened.
of several large jig-saws, but in a random order, so trying to determine the importance of each piece, or even the exact number and subject of the various jig-saws was impossible until we had all the pieces at the end of the site.

Post-excavation: Pre-assessment

In 1993 Fenning’s Wharf became one of the English Heritage funded Greater London post-excavation and publication projects. All work on the project has been structured according to the framework laid down in MAP2 (Andrews, 1991) and the unpublished MoLAS MAP2 working party report. This management framework results in the work being organized into a series of linked stages (Fig.2).

At the pre-assessment stage of the project, a context index was compiled (including all samples). Originally all the contexts were classified into basic descriptive fields such as FILM, LAYER or TIMBER etc. But this proved to be very unsatisfactory for the timbers, as it provided no detail, so, with the help of MoLAS’ ancient timber specialist (Damian Goodburn), a detailed classification of all timbers was produced. From the stratigraphic records, checked matrices were produced for all the separate areas. At the same time all the dendrochronological samples were examined to determine their species and suitability for further work (samples with more than 50 rings) and the noting of characteristics such as the presence of bark edge or heart/sap-wood boundary. This data was added to the context index.

Post-excavation: Assessment

The aim of the site archive work at assessment level was to produce a grouped, site-wide sequence. This was done by combining the individual stratigraphic matrices for the numerous areas of investigation, into three sequences; one for the foreshore, a second for the landward part of the site and a third for Topping’s Wharf. Besides stratigraphic position, a number of criteria for linking deposits were used to construct the sequence. These were: similarity in colour, soil texture and frequency of inclusions. Due to the slope of the foreshore, OD levels were only of limited use for stratigraphic correlation. The criteria for linking masonry or timber structures were mainly spatial, but descriptions of stone and mortar types, dimensions and OD levels were also important. The site wide sequence was presented in two “interpretative group summaries”, one for Fenning’s Wharf and the other for Topping’s Wharf. These summaries consisted of lists of contexts, brief descriptions and interpretative comments for every group and sub-group. With these two documents and the 1:100 plans produced to illustrate key features, it was possible for the first time to have some real understanding of the site sequence and to start spotting the errors in earlier interpretations. Most important was the realization that we were dealing not only with the late 12th century stone bridge, but that there were fragments of a number of earlier timber bridge abutments and caissons below the 12th century stone abutment. Also it became apparent that the stone abutment had undergone several additions.

At this stage of the project dating evidence was provided by spot-dating of all pottery and a few dendrochronological dates. It should be explained that limited work had been done on the dendrochronological samples earlier before the present project began. Sufficient information was therefore available to assign broad dates to most but not all groups.

In 1984 some key oak timbers from Fenning’s Wharf - mostly abutment sill beams - were dated by Ian Tyers. In 1990, as part of an English Heritage funded London dendrochronological project, Ian dated the beech timbers from the 12th-century abutment by cross-referencing them to dated oak timbers from the same structure. A random sub-sample of the elm timbers was also examined but not dated. From 1988-92 a number of boat timbers from the site were dated by Ian as part of the Ancient Boats project (Marsden, 1994).

The interpretative group summaries (including all available dating evidence) and revised context indices (with group and sub-group data added) were produced for distribution to all the specialists before they produced their assessment reports. It was therefore possible for the specialists to view their material not simply on a context level but to compile or compare assemblages, using the sub-group or group structure, which is a great help when considering the potential of material for analysis. This decision was intended to facilitate integration of very diverse data, which it did to a degree. However, as all the specialists were producing reports independently at about the same time there was little opportunity to cross-reference the work. This work will have to be done at the analysis stage of the project, using the individual reports and the revised group summaries (to be produced at the start of the analysis).

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Stage 5: Publication

Tasks - preparation of graphics and editing of publication text

(Report to English Heritage)

Stage 4: Analysis

Tasks - get C14 dates on prehistoric material. Analysis of dendrochronological results. List of research aims to form agenda for discussion by contributors/specialists, who will prepare reports for publication, while the principal authors will be preparing the main publication text and an integrated synthesis.

(Report to English Heritage)

Stage 3B: Assessment

Tasks - Production of specialist reports on flints, pottery (spot dates), coins, environmental samples, dendrochronology (timbers dated), documentary research, etc. Cross-site correlation of matrices to facilitate production of group and sub-group sequences, incorporating spot dates and dendrochronology, etc. From this data an interpretative group summary is produced. Using this summary, all the specialists can relate their material to the site sequence and correlate their work with the other contributors. This data forms the basis of an assessment report and updated project design, which includes an interim site synthesis.

(Report to English Heritage)

Stage 3A: Structuring the site archive or pre-assessment

Tasks - Processing and cataloguing of finds, dendrochronological and environmental samples, etc. Compiling context index, checking site records, producing site location and area of excavation plans. Producing a checked stratigraphic matrix for each trench/area.

Stage 2: Excavation/fieldwork

Stage 1: Project planning/evaluation

Figure 2: The structure of the London Bridge Project post-excavation programme
The Results of the Dendrochronological Assessment

The largest and most important specialist report was on the dendrochronological samples (Tyers, 1993). This vast database is important for a number of reasons. Firstly, it has provided a chronology for the development of the waterfronts around the bridgehead - vital in view of their piecemeal archaeological investigation (described earlier). This has resulted in the identification of a fragment of the late Anglo-Saxon bridge abutment dating from c. 987-1032, which is the earliest remains of a medieval bridge found on site. Dendrochronology has now dated a series of Saxo-Norman landward abutments and box caissons all pre-dating the Norman stone bridge. The construction of the stone bridge by Peter of Colechurch is dated to c.1176-1209 by documentary evidence and the construction of the southern abutment is now dated to 1187-88 by dendrochronology.

Secondly, the boat timbers from the site had already been dated for part of another project (discussed earlier). But no work had been done on their associated timbers to determine their structural context (reused in revetments) and the date of their reuse, which would provide some idea of their use-life. For instance, a series of clinker boat planks dated to after 1081, were found reused as staves in a baseplate revetment with a date range of 1093-1145, suggesting that the boat may only have been in use for 10 to 20 years before it was broken up and reused.

Thirdly, the dendrochronological dates and same tree links have been used to test the identification of a number of structures assembled from the site records. For instance, same tree links demonstrated that certain timbers interpreted as reused material, serving as foundations for the mid 12th-century bridge caisson, were not only reused but probably came from the same structure and in some cases the same-tree links suggest which structure they were derived from. Interestingly some same-tree links show that a number of planks used as the caisson foundations were not reused. This type of information has prompted some important revisions to the group sequence. Also the dendrochronological dates and same-tree links between a number of timbers have been used to identify timbers from the same structure, which were found in secondary contexts due to reuse or flood damage.

Lastly, this was the first London site on which beech and elm timbers were sampled. The beech timbers have already proved datable (discussed earlier). It is hoped that by linking the elm timbers with oak and beech material, it may be possible to date them. This has not proved possible yet, because the elm is all “fast grown” - few samples have more than 50 rings and the growth pattern does not appear to be very consistent. However, it is worth remembering that in Scandinavia pine and spruce samples are now datable, so in time it may be possible to date English elm.

Thus the dendrochronology has been used as a dynamic part of the site assessment, to help revise and refine both the group and the dating structure. It has not simply been used as another dating technique, which has been its traditional archaeological role during the last 30 years.

Cartographic Research: Rebuilding London Bridge

Thinking about how the excavated portion of the 12th century stone bridge relates to the rest of the structure is obviously vital when considering issues like methods of construction, design, road links and comparison with other bridges. However, the rest of the medieval bridge was demolished in 1826-32, except for fragments of the northern-most piers, which were rediscovered and destroyed during the development in 1921 and 1937 (Pearson, 1922: 400).

Instead of using contemporary survey data, we have used large scale maps and surveys of the bridge produced shortly before its demolition to reconstruct its entire plan on CAD and the extent of the various properties on the southern "bridge-foot" and relate this data to the excavated structures on Fenning’s Wharf. Incidentally, this work has proved that the position of the medieval bridge shown on the Ordnance Survey maps is incorrect. Using detailed surveys of individual buildings on the bridge, like the chapel, it should be possible to produce a CAD plan of most if not all - the pre-18th century buildings on the bridge.

It is also proposed to use the 1820’s soundings data taken before the demolition of the old bridge to reconstruct a three dimensional profile of the riverbed. This profile will be constructed using the latest CAD technology (it is now possible to transfer incomplete 3D grids via “Surfer” to AutoCAD and produce surface profiles compatible with AutoCAD map tiles and models). The aim of this work is to show the influence of the piers and starlings on the tidal regime. It appears that the bridge was acting as a partial dam.
Acknowledgments

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The post-excavation has been project managed by Dick Malt and the following MoLAS staff have contributed to the project: Josephine Brown (CAD graphics), Naomi Crowley (ceramic building material and geology) Anne Davis (soil samples), Damian Goodburn (timbers), Jo Groves (Roman pot), Jackie Pearce (medieval and post-medieval pot), Alan Pipe (animal bones), Colin Taylor (documentary research) and Angela Wardle (accessioned finds).

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