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Ancient Monuments Laboratory
Report 52/95

A TECHNICAL EXAMINATION OF THE NON-GLASS BEADS FROM TWO ANGLO-SAXON CEMETERIES AT MUCKING, ESSEX

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Summary

557 Beads were examined for identification of material and technical information. Of these, 533 were Amber, 10 were jet or jet-like, 5 were rock crystal, 3 were smokey quartz, 2 were silver, 3 were faience and 1 was a pebble of cornelian. The information is presented as a written report and a computer disc on which are two databases, one for each cemetery, which describe the beads individually.

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A TECHNICAL EXAMINATION OF THE NON-GLASS BEADS FROM TWO ANGLO-SAXON CEMETERIES AT MUCKING, ESSEX.

M E Hutchinson, FGA, DGA

This report is a synthesis of the technical examination of the non-glass beads and quartz 'spindle-whorls' from the two cemeteries at Mucking, Essex (general grid ref TQ673803). These cemeteries, Cemetery I and Cemetery II (CI and CII) are Anglo-Saxon and date from the fifth to the early seventh century AD. For archaeological information on this material please see the catalogues prepared by S Hirst (Cemetery II) and D Clark (Cemetery I), (Hirst et al, forthcoming). Accompanying this report is a computer disc with two data-bases (one for each cemetery), describing the beads individually. Each bead was individually examined and measured and the results entered on the appropriate database. For more information on this, please see Appendix II which is a print-out of the README file on the disc.

Restrictions on time and access meant that the work was not done in a concentrated block, but intermittently over approximately three and a half years. There has, therefore, been time for views to change radically on the significance of features observed, but not enough time to recheck all 558 beads individually. For this reason, there will be occasional inconsistencies, especially in Cemetery II, which was examined first. Also, the original purpose of the work changed; what started as a request to assist the two researchers cataloguing the beads grew into something larger as the amount of potential information was realised. The main purposes of this report are to indicate information available and areas which need investigation; not to present the results of a finished piece of work.

The beads are discussed according to material; comments which are not differentiated can be taken to apply to the beads of that material from both cemeteries.

Cemetery I	Cemetery II
192 amber beads	341 amber beads
5 jet/shale beads	5 jet/shale beads
1 faience bead	2 faience beads
	5 rock crystal beads/spindle whorls
	3 smokey quartz beads
	2 silver beads
	1 cornelian bead
Total: 198 beads	Total: 359 beads

Number of non-glass beads from Cemeteries I and II: 557

Total number of beads from Cemeteries I and II: 2041

THE AMBER BEADS

Material

Of the 557 beads examined, 533 were amber, about 25% of the total number of beads. Their identification as amber is using the word in the broadest sense as a natural fossil resin. No attempt has been made to determine whether they are Baltic amber, or one of the native fossil resins described by Beck and Shennan (1991, 19-27), partly through lack of opportunity, but mainly because it was thought unlikely that the amber would be anything but Baltic.

The specific gravity (SG) of about half a dozen randomly selected beads and fragments was tested (see the databases for which), and most sank slowly in a liquid of approximately SG 1.13 (see the databases for which) indicating that their SG was higher. This is surprising, as the SG of amber is usually quoted as 1.08 (Anderson 1990, 333) or 1.08 ± 0.02 (Günther 1981, 59), and at slightly more than 1.13 the Mucking amber is denser than expected. However, a small flake from a large lump of identified Baltic amber from Richborough, a Roman site, has the same density and Larsson (1978, 9) gives a range of SG from 1.0 - 1.3. The refractive index (RI) for amber is usually given as 1.54 (Anderson 1990, 333) or ranging from 1.539-1.545 (Günther 1981, 59 and it was possible to polish one fragment (CII 690 3k 12) well enough to give a shadowy reading of about 1.545 on a gem refractometer. When exposed to long wave ultra violet light (LWUV), a slight greeny-mustard fluorescence was seen, most strongly on edges. This, however, is of little use as authorities disagree on the colour amber fluoresces, eg Günther and Webster mentioning a bluish white fluorescence under LWUV light (Günther 1981, 59; Webster 1975, 510) whereas Liddicoat (1989, 172) describes the fluorescence as yellowish under LWUV.

Colour

Initially, the beads were individually inspected for colour and degree of transparency by holding them in front of a standard light source, the method used for the glass beads. This showed colours ranging from bright orange-yellow to a dull crimson but it was soon realised that these colours were false and bore no relation to what the beads actually looked like in the hand. The beads from both cemeteries, with virtually no exceptions, are now a translucent to opaque orange (where new chips and fractures reveal unweathered surfaces), so recording colour was abandoned as meaningless. The different colours seen by transmitted light are probably related to the thickness of the bead and the amount of weathering which has occurred.

Surface

The beads were examined by low-powered microscope and the surface categorised as cracked, crazed, pimply, eroding, or lost, (see fig 1 and plates 1 and 2). As far as could be determined, these are progressive stages the surface passes though on its way from perfect to lost. The first stage of decay seems to be a network of fine straightish cracks on the surface. This network is then sub-divided by many more cracks with curved outlines; this stage is described as 'crazed'. 'Pimply' is the next stage, where the flat surface of the crazing becomes distinctly rounded and convex and may sub-divide further. These 'pimples' then fall off leaving curved cup-like depressions behind and this stage is described as 'eroding' or 'lost' depending on how far the process has gone. All five stages may be present on the same bead. On some beads the surface is being lost at the crazed stage, especially inside the holes and these effects are almost certainly due to shrinkage from the loss of volatile material. A puzzling feature of the surface is that it survives in much better condition on the high spots and areas of maximum wear. On the ends, and round the middle the beads are often only cracked superficially, while the remainder of the surface can be pimply or even lost (plate 2). Larsson (1978, 13) comments that amber jewellery which is worn frequently 'appears to be protected against this drying by its repeated contact with the human skin'. On some beads the top layer of amber has already disappeared and the next layer is now decaying, eg CII grave 615/3j bead 8. It was noted that whereas new fractures are bright and lustrous, older fractures are dull.

Shape

Most of the beads are now very irregular in shape and at first it was assumed that the beads had been fashioned to make best use of irregular and possibly expensive pieces of amber rough. However, it is possible that almost all the amber beads from Mucking originally conformed to one of three regular shapes; disc, globular or biconical. Many beads are regularly shaped for most of their surface: globular beads are often round in longitudinal section, ie parallel to the hole, but irregular at right angles to this and barrel beads frequently have at least one oblique end. Originally there were two fields in the databases called 'make' and 'cut'. 'Make' to describe how well made the beads were, and 'cut' to describe what had been done to shape them. When, towards the end of the allocated time it was realised that wear was a major,if not the most important shaping agent, 'cut' was renamed 'cut/wear' and 'make' was renamed 'aspect', as it was obviously impossible to make judgements as to workmanship. Unfortunately, there was no time to re-examine all the beads listed under 'cut/wear' as 'roughly shaped' to check whether the shaping was deliberate, or caused by wear. In all cases, the term 'abrasion' and 'abraded' are used neutrally and do not imply a manufacturing process.

Some of the effects of wear are obvious as when hole are worn egg or pear-shaped (plate 3), but others may escape notice.

Holes

There are several curious features about the holes in the amber beads. One is the way that they are occasionally the strongest part of a fragile bead: the bead may be rapidly crumbling but the lining of the hole is still coherent and strong, with no sign of a consolidant having been used. Another feature is that cracks can sometimes be seen encircling the inside of the hole in the same way as drill marks and this can be very deceiving as they look like shadows in a groove. The most interesting feature about the holes, however, is the number and variety of tool or abrasive marks preserved in them and the evidence they offer as to how the holes were made, see plates 5a and 5b. Most of the holes were bored from both ends, and part profiles of the curved end of the instrument used can be seen in many holes where the holes from each end do not meet accurately in the centre. Occasionally the hole was bored completely from one end, probably by accident, with the result that the exit hole is ragged (plate 4), suggesting that hole-making was a quick process. Holes in beads are traditionally drilled from both ends to prevent chipping when breaking through the exit hole, despite the difficulty of accomplishing an accurate join in the middle.

The tool marks seen in the holes invariably go round the holes, not along the length, but it is impossible to tell whether the marks are circles or spirals without taking casts. Sometimes they take the form of gentle corrugations, sometimes they are sawtoothed as in CII 648/3r (12), or 'battlements' as in CII 785/1g (17), and sometimes almost triangular as in CI 785/1g (1). In one bead, bored from both ends, the 'sawteeth' are reversed in direction from each end.

Discussion

The uniformity of colour, though apparently common in excavated amber, is strange considering that fresh, untreated, Baltic amber exists in a variety of shades and opacities of white, yellow and orange (see Anderson 1990, plate 39 for a colour picture). It is possible, but extremely unlikely, that amber of only one colour was collected and that the colour has remained unchanged. Consider the history of the Mucking beads. After its formation, the amber was buried for about 35 million years until the early years of the Christian era. It was then recovered, fashioned, worn for about 100 years, buried in a grave for another 1500 years, recovered again by excavation and has now been left in the air for about 20 years. For some reason it has changed to an almost uniform orange. It is said in the jewellery trade that one should not repolish Victorian amber as it will be much paler beneath the surface, but this is only a surface darkening after about 100 years and the Mucking amber has probably been above ground for not more than 150 years altogether. The colour change may be due to oxidation, or possibly was caused by local burial conditions. Describing what happens to amber in showcases, Larsson comments that pieces of amber from the seventeenth century "Royal collection" 'which were formerly golden in colour now have a dull reddish-brown tint', (Larsson 1978, 12).

This report suggests that virtually all the amber beads, with the possible exception of some of the larger disc beads, were originally round in the plane at right angles to the hole. The databases show that many different shapes (illustrated in fig 2) are now present and that most beads are no longer circular in section. It is suggested that this is due to wear by abrasion: abrasion against clothes and against other beads, especially in the case of a double string. If the beads were prevented from revolving freely, eg by the weight of a great many glass beads on the ends of the necklace, then a flat wear facet would be formed on the side of the bead and once formed, it would tend to stop the bead rotating until the bead became so thin and light on that side that gravity would move the bead round when the necklace was temporarily supported. When the necklace hung free again, another wear facet would form. The hardness of amber is usually quoted as about 2 - 2½ on Mohs's scale, the same as fingernails, so its rate of wear can be readily appreciated.

One necklace, CI 283/3, is a double string, and the curious concave facets on these amber beads must have been made by mutual abrasion, caused by the beads on one string getting jammed between the beads on the neighbouring string (see fig 8). As the only non-amber bead on this necklace is a central faience melon bead, it is difficult to see how the beads on one string could have been kept sufficiently tight up against the second string to cause this amount of wear as virtually all strings stretch. Perhaps the beads were once part of a much longer necklace, with many glass beads at the ends adding the necessary weight.

Most of the round beads show marked abrasion round the holes at one, or both, ends. It is possible that this is deliberate to produce a flat area for stability while boring the hole, but some beads, including some disc/wedge beads, have a quite marked dishing at one or both ends which has a sharp edge, as though abraded by the next bead. On other beads, the facet on the end may be flat, curved, or oblique (fig 3). Frequently the edges of the hole on the abraded ends are very sharp, suggesting that continuous abrasion has removed any rounded edges caused by the string rubbing (plates 3 and 5b). A good example of worn ends is CI 116/1o 8, a barrel bead which has a dished facet on one end, and on the other a wear facet so oblique that the bead is verging on wedge-shape. For these reasons, it is possible that many beads described as 'barrel beads' may not have been barrel shape when made. On the other hand, if they were originally globular, one might expect their diameter to be greater than their length and this is not necessarily so. It may be noted that pearls on old necklaces of natural marine pearls become barrel shaped through wear.

With biconical amber beads the wear pattern is rather different. On first examination, it was assumed that where the edges of the holes had been chipped before burial, this occurred when the hole was drilled. This could easily have happened because amber is brittle, not sectile, but it was later realised, when more extreme examples from Cemetery I had been examined, that this was yet another example of wear. The supposed chips are notches which the string has worn in the top of the bead bordering the hole. If the beads are looked at carefully, a wear facet can be seen below the notch. On some beads, wear by the string has been so extensive that the notch is long enough to be called a slot (see fig 4). It is suggested that this is caused by the weight of other beads pushing down on the biconical beads and causing them to try and slide over each other because of their conical shape. This pushes the string to one side, and starts it wearing down the side of the bead as the next bead over-rides it. This may also be the reason why some biconical beads have no flat end at all, but taper to a point. These notches and slots must not be confused with post-excavation damage caused by threading the strings of labels down the holes; recent chips and breaks have a glassy surface, whereas pre-excavation ones have the same weathered surface as the rest of the bead.

The amber beads variously described as disc or disc/wedge usually show signs of abrasion, either deliberate or through wear, on their ends. This abrasion was originally described as 'grinding' and considered to constitute a rough form of shaping, hence 'roughly shaped' used in describing some disc/wedge beads in the CII database. It is not, however, consistent. Sometimes one end is at least partly flattened, as if to steady the bead for boring, and the hole is perpendicular to it (fig 5). On others, both ends are abraded flat, but the hole is not perpendicular to either but is parallel to the sides. One bead, CII 334/10w 5, has a hollow round each end of the hole which must surely have been caused by the neighbouring beads being rounded and abrading their profiles into it. Other beads, eg CI 99/4qiv 89, are virtually triangular prisms. These can be thought of as double wedges; that is, two wedges back to back, points outward with the hole in the centre (see fig 5 for an example). It is suggested that many, if not all, of the disc/wedge beads are really disc beads which have been abraded to wedges in the same way as the barrel beads mentioned above have been.

THE JET-LIKE BEADS

There are ten jet-like beads, five from each cemetery. Those from Cemetery I are all from grave 99, but those from Cemetery II are from two graves, one bead from 530 and four from 860. All the beads were analysed, (see the table, below). The beads are of interest as the two from Cemetery I are unfinished and the faceted beads from both cemeteries show excessive wear.

Material

The beads have been only been divided into the jet and the non-jet: no attempt has been made to identify identify the material further, although the analyses of CII 860/3t 36a and 36b suggest a substance like cannel coal. Various shales have been used in the past ranging from the fragile (when excavated) Kimmeridge shale used at Wroxeter to the strong virtually black shale used in the North of England. The analytical methods used were those developed by the AML Conservation section and S Watts (Bradford University) using energy-dispersive X-ray dispersion spectroscopy (ED-XRF) and relative transparency to X-rays.

Number	Material	Shape	Comment
CI 99/4ri 11	jet	annular*	low Fe, more X-ray transpt.
rii 49	not jet	faceted	high Fe, more X-ray opaque
riii 5	not jet	faceted	high Fe, more X-ray opaque
riv 83	jet	faceted	low Fe, more X-ray transpt.
rv 13	jet	faceted*	low Fe, more X-ray transpt.
CII 530/1	jet	disc	low Fe, more X-ray transpt.
860/3t 36a	not jet	annular	high Fe, lack of Zr, X-ray transpt., ?cannel coal
36b	not jet	annular	high Fe, lack of Zr, X-ray transpt., ?cannel coal
860/3u 36x	jet	faceted	v low Fe, more X-ray trans.
36y	jet	faceted	low Fe, more X-ray transpt.

* unfinished bead

Shape

As can be seen from the table, four of the beads are disc or annular in shape, and six are faceted. The faceted beads are all cut to the shape known as a 'cut-cornered cube' ie, a cube with the corners cut of leaving a six-sided shape with six diamond-shaped and eight triangular facets, see fig Y. Five of the faceted beads are very worn and the sixth is unfinished.

The two unfinished beads CI 99/4ri 11 and CI 99/4rv 13 are interesting in that they illustrate Anglo-Saxon technology. Bead 11 has been left at the roughed out stage with the surface covered with small flat facets, see fig 7. These show that it was shaped by rubbing it, one section at a time, on a flat abrasive surface which has left coarse lines on the flat 'facets'. Eventually it would have been finished and the marks left by the abrasive would have polished off to a smooth and regular surface. The unfinished faceted bead, CI 99/4rv 13 (fig 7), has had its diamond and triangular facets roughly abraded to shape and plate 6 shows a diamond facet still made up of several small facets, all at slightly different angles and all abraded in different directions. Work on it ceased at approximately the same stage of manufacture as CI 99/4ri 11. The other five faceted beads are all exceedingly worn and are now wedge-like: C1 99/riv 83 is now only half as long as it is wide (fig 6) and CII 860/3 36y is so worn that it is 7.0mm long on one side but only 4.3mm on the other. On the abraded surface the lustre is almost mirror-like.

It is surprising that it is two of the jet beads which show signs of breaking up; the surface of CII 860/3 36x is cracked into regular blocks and CII 530/1 is splitting in parallel planes. These are usually taken to be signs that the artefact is not made of jet (Davis 1993).

Holes

Three of the faceted beads from CI grave 99 and CII grave 530/1 have toolmarks surviving in the holes.

Discussion

The hardness of jet is variously stated as 3½ (Anderson 1990, 335) and 2½ - 4 (Günther 1981, 102-3) on Mohs's hardness scale, which is slightly harder than amber (see above). This makes it the more surprising that the faceted beads have been worn away to a far greater extent than the amber beads; wear has proceeded to such an extent that the facets are very indistinct and all edges except for the ends are rounded. The ends have sharp edges, see fig 6.

Beads cut to this shape and made of a jet-like material have been excavated at South Shields, a Roman site (Allason-Jones L and Miket R F, 1984, 304) and it is possible that the excessive wear of the Mucking beads is because they are Roman beads: three Roman faience beads were excavated at Mucking. These jet-like beads have certainly been worn for a long time; Victorian jet necklaces, which have been around for about 100 years show only small chips and slight rounding of facet edges as the result of wear.

It is possible that the unfinished beads represent a local attempt to make replacements, or it may be that the tradition of making annular and cut-cornered cube beads still continued. Note that the unfinished beads seem to be made of true jet.

THE QUARTZ BEADS

There are nine quartz beads, all from Cemetery II. Five rock-crystal, three smokey quartz and one natural pierced pebble of orange chalcedony. Apart from the pebble, these are considered together as the materials are the same but for a slight difference in colour, and, apart from the smaller faceted examples which are both rock crystal, the same shapes occur in both rock crystal and smokey quartz. Of the eight beads examined, four are biconical, two are faceted, and two are of the large faceted type often called spindle whorls.

Number	Material	Shape	Comment
CII 334/10z 3	smokey quartz	biconical	
125	rock crystal	biconical	
548/5	rock crystal	faceted (large)	'spindle whorl'
615/3k 10a	smokey quartz	biconical	
10b	smokey quartz	biconical	
649/7o 7	cornelian	natural	beach pebble
690/3k 11	rock crystal	faceted (small)	
12	rock crystal	faceted (small)	
843/6	smokey quartz	faceted (large)	'spindle whorl'

Shape

a, The biconical beads. These are from two graves, CII 334 and CII 615, but whereas the two from 334 have marked differences, the two from Grave 615 are very similar.

CII 334/10z 3 is very slightly smokey and was probably well polished originally, although parts of the surface are now abraded. Bead 125 from the same grave is colourless rock crystal and incomplete, about one third is missing. The broken surface gives a clear view of the longitudinal section of the hole. An interesting feature of this bead is its surface. Not only is it extremely worn, with the worn surface extending over the edge of the lustrous fracture indicating considerable use after being broken (plate 7b), but it has circular percussion marks like those seen on beach or wave-battered stones but on a smaller scale (plate 7a, compare plate 9b). The surface of this bead (125) also demonstrates that the shaping and polishing were carried out in small sections, for a series of facets can still be seen on the surface with the polishing lines changing direction at their edges.

The other two biconical beads from CII 615/3k, 10a and 10b are smokey quartz and so similar that they may have been made by the same person from the same piece of rough. They are the same size to within a millimetre and have similar holes. Both show slight colour zoning.

b, The small faceted beads. These are both from CII 690, (see table above). They are very similar to each other and almost the same size. Both are cut with four diamond-shaped facets and eight triangular ones and have many healed cracks and inclusions (bead 12 has two-phase (liquid and gas) inclusions). In bead 11 some of these diffract light into spectral colours which would have been extremely attractive when worn. The standard of workmanship is poor; the shape is irregular and the coarse polishing lines can be seen by the naked eye. Some facet edges and junctions are very abraded, but this is probably by wear rather than bad cutting and polishing. Both beads have small conchoidal chips round the edges of their holes. The chips themselves have a high lustre, but their margins are worn so they cannot be post excavation damage. The beads have a refractive index of c 1.54, the refractive index of crystalline quartz. One end of bead 12 is etched, probably by the liquids of putrefaction from the decaying body. It may seem extraordinary that these can etch silica, but the phenomenon has been seen on quartz beads from other burial sites, eg Wakerley, Northants.

c, The large faceted beads/spindle whorls. Two of the quartz beads are large faceted examples of the type often described as spindle whorls. One is colourless rock crystal, the other is smokey quartz (plate 9). Both are cut in the same style with twenty flat facets; ten trapezoid and ten triangular, plus the two ends (fig 9). They will be described separately.

CII 548/5, rock crystal. This appears to be regular in shape, but the top and bottom are not parallel and the facets are badly cut. Figure 9 shows that some of the triangular facets have four sides. This is bad workmanship. On the other hand, most of the facets are cut and polished flat, which is extremely difficult to achieve when polishing by hand as the facets tend to become convex. The hole is relatively large, c7mm across, and is very smooth but not polished. The main facet edges are abraded and one end is etched (see bead 12, above) probably by the liquids of putrefaction. The rock crystal is moderately included with feathers (healed cracks). It weighs approximately 22g.

CII 843/6. This is made of pale smokey quartz containing many healed cracks and two-phase inclusions and although cut to the same plan as CII 548/5, it is more squat in shape. That is, whereas 548/5 is reasonably symmetrical each side of a median plane perpendicular to the hole, 843/6 is much flatter on one side. This has resulted in one end being considerably larger than the other (see fig 9). (For the purposes of this description, the wider end will be called the base although it may not be so). The interior of the hole has been virtually polished. When the bead is suspended it hangs in one position only, and both the edge of the hole and the surrounding bevelled edge directly above the point of suspension are markedly less sharp: they are rounded and more glossy, more polished. All the facet edges are very worn, see plate 9, although those round the base are less so, and they show the same curved percussion marks as described on CII 334/10 z 125, above. The surface appears to be etched and this etching covers all the flat surfaces, including part of some very small conchoidal chips and the worn facet edges. Again, this is probably due to the processes of decay of the body. It weighs approximately 48g.

Cornelian

CII 649/7o 7 is a flat egg-shaped bead with a hole through the narrower end. In the hand it appears black, but by transmitted light it is orange and has been identified be ED-XRF as quartz and optically as cornelian, an orange variety of chalcedony. The hole appears to be natural. This bead also has rounded percussion marks on its surface and these are probably the results of wave or beach-battering; the bead was very likely found on a beach (plates 9a, 9b).

Holes

In every case the holes were bored from both ends. This is the traditional method to prevent chipping as the drill breaks through the other side. Both the biconical beads from CII 615/3k, 10a and 10b, have shallow grooved toolmarks and a marked ridge in the holes. Bead 10a has what looks like a false start to the hole at one end. In CII 334/10z 3, profiles of the tool ends can be seen halfway down the hole at the ridge.

CII 334/10z 125 appears to have been bored by tools of two, if not three, different diameters (plate 7b). There is a wide section each end, with a narrower section in the middle. A possible explanation for this is that the hole was bored with an abrasive supported by something like a soft metal rod, and the wider holes at the end was made as reservoirs to hold a supply of fine abrasive slurry, but they may not be large enough to be usable in this way.

From the point of view of the wearer this type of hole is undesirable as it means more sharp edges to rub through the string. Quartz is hardness 7 on Mohs's scale, considerably harder than amber or jet, so quartz beads will abrade the string, rather than be abraded by it as are amber and jet-like materials. This is especially so when the two ends of the hole do not meet properly, leaving a ridge in the middle. Modern quartz beads made in India are drilled from both ends and the accuracy with which the holes meet is important in judging quality (Possehl 1981). If a ridge is formed in the hole of a hard stone bed by the two holes not meeting exactly, it will rapidly abrade the string, even plastic covered steel wire ('Tigertail'), unless the bead is immobilised on the string in some way.

The holes in the large faceted beads are far better made, with no ridges in the centre. The hole in CII 548/5 is relatively large, c7mm across, and is very smooth but not polished. It seems to have been bored from one end except for the last 1.5 - 2mm, and under low magnification fine lines can be seen running round the inside at one end. Each end of the hole has the edge bevelled off but this bevel does not appear to have been cut or polished by rotary motion. On one end there are lines going straight across the depression, at the other they go to the centre.

There are very fine striations round the interior of the hole of CII 843/6 and it has been virtually polished. There is a slight flare at each end of the hole and each end of the hole is bevelled, the base more so than the top.

Discussion

The semi-circular percussion marks seen on the surface of CII 334/10z 125 and CII 843/6 are hard to understand. These marks have been seen on Sarmatian chalcedony beads (Hutchinson 1992) and on modern cornelian beads, including some purchased in India. They are very similar to the circular percussion marks commonly found on marine beach pebbles and in the case of CII 649/7o 7 they are one of the reasons for considering it to be a beach pebble. Although the Anglo-Saxons may have used pieces of clear quartz found on the beach which could have been wave or beach-battered, this is not the case with modern beads, and investigation has not so far revealed the source of these percussion marks, which are most probably caused by either the shaping or polishing processes. The Anglo-Saxon beads may have been pounded into shape, but this would not apply to the modern ones.

Although the modern beads were almost certainly polished in tumblers, and it is frequently said in the trade that stone beads were tumbled-polished in bags in stream beds in the past, it is difficult to imagine how either method could produce enough force to reproduce the high-energy conditions of waves hitting a shoreline.

The purpose of the large faceted spindle whorls/beads is unclear and different people may have put them to different uses. If they were used as spindle whorls, as is frequently suggested, the spindle could not have been just friction tight in the hole if the spindle was used for spinning wool 'in the grease' ie, unwashed, (which is usual). Lanolin is an efficient lubricant and the whorl would tend both to spin loosely round the spindle when the latter was twisted, instead of acting as a flywheel and also to keep sliding off unless the spindle was expanded or otherwise modified beneath the whorl. If, however, these objects were used to spin flax, when water is used, the water would probably tend to make a wooden spindle swell, fill the hole more tightly and therefore fit better, as well as preventing the whorl from sliding off. On the other hand it can be argued that these points apply to all spindle whorls, so there must have been a method of keeping whorls firmly fixed to the stem of the spindle.

Evidence to suggest that one at least of these large quartz 'whorls' was worn as a bead comes from CII 843/6, where the edge of the hole is rubbed above the position of rest when suspended. It is also possible that the bevelling or 'countersinking' of the ends of the holes may be to prevent wear on the string rather than remove chipping which occurred when the holes were bored.

The recurrence of the figure five in the construction of these beads is striking, especially as five has a long history as a number of mystic significance. According to Meaney (1981, 79) they have been found elsewhere with six or eight sides, although the octagonal one she illustrates looks to be cut on a different plan. It is also interesting to compare the arrangement of the facets on these quartz putative whorls with the decoration of the glass spindle whorls from Mucking. CII 351/5, CII 924/5f and CII 842/3, although it is less clear on the latter, all have a five-pointed, petal-like pattern on their curved tops very like the arrangement of the facets on the quartz examples. Fossil echinoids (sea-urchins), which are clearly divided into five, have also been found in Saxon graves (Meaney 1981, 117, 119).

THE FAIENCE BEADS

There are three of these beads, one from Cemetery I and two from Cemetery II. All three look like Roman melon beads (see fig 8 for one of them) which were often made of faience.

THE SILVER BEADS

These two objects from CII 843 may not be beads. They are basically two tubes made from soldered silver strip with applied 'D' section decorated ends. Firstly the thin strip was overlapped before being soldered, and the join was burnished. Bands of gold were then applied as decorative 'stripes' round the tubes and the decorated ends were soldered on. It is noted that these objects were found with eleven beads and one of the large faceted rock crystal beads described above, at the waist of the skeleton.

CONCLUSION

The most striking feature of these beads is the amount of wear the amber and jet-like beads exhibit, especially those from Cemetery I. Some of the beads have lost nearly half their original bulk, eg the jet-like beads CI 99 1 and CII 860/3u 36y and this raises questions as to how and why it happened.

If wear is taken as the product of time multiplied by abrasive force, it would be interesting to know which is the more important with regard to these beads. In some cases, where there was a great weight of glass beads on both sides of central amber beads, then wear may have been relatively fast, but in the case of CI 283 there were no glass beads on the necklace, yet the amber beads have clearly been jammed against the beads on the other half of the double string. Possibly the beads of CI 283 were once the central portion of a much longer necklace with many glass beads on it, which was broken up and redistributed. In the only case where it was tried, the abraded surfaces and the holes of two adjacent disc/wedge beads fitted together perfectly on one side only, which, if it is permissible to draw any conclusions from a single attempt, suggests that beads were not just strung together for burial, but had been next to each other for a long time. This is particularly true if the disc/wedge beads were originally disc shaped with more-or-less parallel ends. Necklaces apparently exist where disc/wedge beads fan out to accommodate the curve of the string when worn and it seems to be assumed that this is deliberate (Meaney 1981, 73-4). With some at least of the Mucking disc/wedge beads the hole is perpendicular to only one end, suggesting wear on the other end rather than deliberate shaping.

There is much information still to be gained from the amber beads and an attempt should be made to stop them decaying. Already the surface as excavated has eroded from many of them, and they are literally breaking into pieces. Attaching labels by threading them through the holes may well damage surviving tool marks, as well as chip the bead.

Quartz is a hard stone yet most of the beads show considerable wear, either round the edges of the facets, or on the surface in the case of the biconical examples. All the faceted beads have some worn facet edges yet quartz is as hard, if not harder, than most steels. Two faceted rock crystal necklaces about 65 years old were examined and in the hand appeared completely unabraded. Inspected at a magnification of x 10, the only sign of wear was an occasional chip where three facets met at the widest part of the bead. These were almost certainly caused by a blow, or by being dropped, rather than by abrasion, so the reason why the quartz beads are so abraded remains a mystery.

As can be seen from this report, there are a number of questions which still need answering. These are listed below.

1. Manufacturing processes and tools.
We do not know how these beads were made, but traces of the shaping processes remain on the quartz and jet-like beads and evidence of the means used to bore the holes is still present as toolmarks. There are also the percussion marks on the surface of the quartz beads. Close examination together with experimentation might provide the answer.

2. The aging of amber.
It would be valuable to know what controls the aging process of amber and why the specific gravity of excavated amber is higher than one would expect. Also, whether the SG increases with the age of the object, or with the time it has been exposed to the air. The answers to these questions have implications regarding the correct storage of amber.

3. Rates of wear and wear patterns.
It would be instructive to know how long it takes beads of amber, quartz and jet-like materials to exhibit the degree of wear shown by the beads from this site. Detailed examination of end surfaces might show whether wedge beads really exist as an original form, or whether they are always products of wear.

4. Sources of raw materials.
Jet-like materials. Recent work by the Fossil Fuels and Environmental Geochemistry Institute and the Museum of Antiquities, both of the University of Newcastle upon Tyne, has shown that, given the resources, these materials can be both identified and closely provenanced. For example, jet from Whitby can be distinguished from jet from Robin Hood's Bay. (Allason-Jones and Jones, 1994).

Amber. It is assumed that all the amber is Baltic in type if not in provenance and this is probably correct. There is no difference between amber picked up on the east coast of Britain and that coming from North Germany, Poland or Scandinavia. Amber, however, also comes from the Mediterranean area and there are other fossil resins found in this country and elsewhere which could have been used (Beck and Shennan, 1991).

Quartz. It is probably useless trying to provenance the quartz as it is so common, but the writer is collecting Old World examples of decorative quartzes in case a method is evolved.

ACKNOWLEDGEMENTS

I wish to acknowledge help and advice from Sue Hirst and Dido Clark of the Mucking Project, Bob Bailey and other Museum Assistants of the British Museum (Dept of M & LA) and Glynis Edwards and other members of the Ancient Monuments Laboratory. Some of the drawings used are by Kate Morton, the others are by unidentified DAMHB and English Heritage illustrators. Studio photographs were taken by the English Heritage Photographic Unit and the photomicrographs by the author.

REFERENCES AND BIBLIOGRAPHY

Allason-Jones, L, and Jones, D M, 1994, Jet and other material in Roman artefact studies, Archaeologia Aeliana, 5th series, XXII.

Allason-Jones, L, and Miket, R F, 1984, Catalogue of Small Finds from South Shields Roman Fort, Society of Antiquaries of Newcastle upon Tyne Monograph 2, Section 7.

Anderson, B W, 1990, Gem testing, 10 edn revised E A Jobbins, London.

Beck, Curt, and Shennan, Stephen, 1991, Amber in Prehistoric Britain, Oxbow Monograph 8, Oxford.

Davis, Mary, 1993 The identification of various jet and jet-like materials used in the Early Bronze Age in Scotland, The Conservator, 17, 11-18, London.

Günther, Birgit, 1981 Tables of gemstone identification, Kirschweiler, Germany.

Hirst, S, Clark, D, and Jones WT, forthcoming, Excavations at Mucking vol 3: the Anglo-Saxon Cemeteries, English Heritage with British Museum Press.

Hodges, Henry, 1964, Artifacts, London.

Hutchinson, ME, 1992 The Examination and Identification of 29 beads from Ardleigh, Essex. AML Site No. 880. Ancient Monuments Laboratory Report 84/92.

Larsson, Sven Gisle, 1978 Baltic Amber - a Palaeobiological Study, Entomonograph vol 1, Scandinavian Science Press, Klampenborg.

Liddicoat Jr, Richard T, 1989 Handbook of Gem Identification, 12 edn revised, Santa Monica.

Meaney, Audrey L, 1981 Anglo-Saxon Amulets and Curing Stones, BAR British Series 96, Oxford.

Possehl, Gregory L, 1981 Cambay Beadmaking. An Ancient craft in Modern India, Expedition, 23(4), 39-47, Philadelphia.

Webster, R, 1975, Gems, their Sources, Descriptions and Identification, 3 edn, London.

APPENDIX I

PHOTOGRAPHS

Bead	Picture No.
CI 99/4qx 18	F940146
CII 334/10y 49	F940146
CII 334/10z 125	F940144
" " " "	F940145
CII 648/3q 39	F940143
CII 649/7o 7	F940147
CII 843/6	F940142

PHOTOMICROGRAPHS Wild film 69, (35mm transparencies)

CI 99/4qx 18
CI 99/4rv 13
CI 256 col 3 (45)
CI 256 col 6 (109)
CI 256 col 5 (98)

CII 334/10y 49
CII 334/10z 125
CII 615/3j 8
CII 648/3r 77
CII 649/7o 7
CII 785/1f (7)
CII 785/1g (1)
CII 843/6

ANALYSES

CI 99/4ri 11
rii 49
riii 5
riv 83
rv 13

CII 530/1
649/7o
860/3s 36iii
860/37 36a and 36b
860/3u 36x and 36y

APPENDIX II

PLEASE READ THIS DOCUMENT BEFORE LOOKING AT THE DATABASES

These databases describe the non-glass beads from Cemeteries I and II at Mucking, Essex, AML Site No. 239. The cemeteries are Anglo-Saxon and date from the fifth to the early seventh century AD.

Structure

There are two separate databases; MUCKING1 dealing with the non-glass beads from Cemetery I and MUCKING2 for those from Cemetery II. They were compiled using the database facility of LotusWorks and use the same file structure as ALPHA/three, ALPHA/four and dBASE III Plus. Users of these can work directly with these databases.

What the Databases are

Both the databases are purely technical descriptions of the non-glass beads and beadlike objects. There are 198 records in MUCKING1 and 360 in MUCKING2 and each record has 16 fields:-

Grave Number	Shape
Group Number	Aspect
Bead Number	Cut/wear
BM Registration Number	Section
Material	How the hole was bored
Condition	Drill marks
Maximum length in mm	Surface
Maximum diameter in mm	Comments

Needless to say, opinions were changed and ideas developed as more beads were examined and for this reason it should be remembered that Cemetery II was examined before Cemetery I. For example, the field named 'Aspect' was originally called 'Make' and was intended to indicate how well a bead had been made. This was changed to 'Aspect', when it was realised from examining the beads from Cemetery I that many of the amber beads were so worn that their original shape could often not be determined, let alone the standard of craftsmanship. It seems possible that both barrel and wedge shaped beads are mainly products of wear. Unfortunately, time did not permit a re-examination of all the beads from Cemetery II.

The Fields

GRAVE NUMBER AND GROUP NUMBER. These are taken from the catalogues compiled for the Excavation Report by Dido Clark (Cemetery I) and Sue Hirst (Cemetery II).

BEAD NUMBER. Where the bead had no discoverable number, or many were in the same bag, each bead was allocated an MEH number for identification. These numbers are written on the bags in a circle, with the initials MEH. For Cemetery II and most of Cemetery II they were written in pencil. In the databases these MEH numbers are followed by a round bracket thus).

BM (BRITISH MUSEUM) REGISTRATION NUMBER. Cemetery I, Graves 90, 99, and 102 have British Museum registration numbers and these have been included. As more beads are eventually numbered these can be added if wished.

MATERIAL. What the bead is made of. Jet/shale indicates that the bead looks like jet. A more positive identification may be in 'Comments', also, check to see if the bead is on the list of analyses at the end of the written report.

CONDITION. This says whether the bead is complete, almost complete, incomplete, or fragmented, usually as compared with its state when excavated, unless 'Comments' has other information. Very few, if any, of the amber beads are complete if compared with what they were when new. 'Almost complete' indicates that there is slight damage or loss, but not enough to affect the shape or size of the bead.

LENGTH. The maximum present length of the bead in millimetres. Many of the amber and jet/shale beads were probably longer when new.

DIAMETER. The maximum present diameter of the bead in millimetres. Many of the amber and jet/shale beads were probably wider when new.

SHAPE. The present shape of the bead unless the original shape can be determined.

ASPECT. Whether the bead looks regular or irregular. See remarks on this field, page 1, above. This information will be omitted in future as it is meaningless.

CUT/WEAR. This field was originally named 'Cut' and indicated shaping processes, eg faceted, ends ground flat. It was renamed when it became clear that abrasion through wear had played a major part in forming the present shape of the beads.

SECTION. The present shape of the bead in a roughly median section perpendicular to the hole. The shapes given are the nearest to which the section approximates, eg, 'square' can have rounded corners, but the four sides are roughly equal and the included angles approximately 90° . In view of the amount of wear, it is doubtful whether this field has any real value for amber beads except to indicate the amount of lateral wear. Please see the drawings of idealised sections, fig 2, in the written report.

HOW HOLE BORED. Whether the hole was bored from one end or both. Beads where the hole is not formed as the bead is made are usually bored from both ends.

DRILL MARKS. Whether there is any evidence in the hole as to the sort of drill or abrasive used.

SURFACE. What the most important aspect of the surface is out of: rough, cracked, crazed, pimply, eroding, lost. With the exception of 'rough', these are listed in ascending order of decay. Please refer to the report for sketches (fig 1) and photographs of these surfaces

COMMENTS. Two lines of descriptive text.

M E Hutchinson FGA DGA, Dip Con (London), Cert Geol Sc (London)

30th July 1995.

Fig 1 THE AMBER BEADS, SURFACES × 12·5

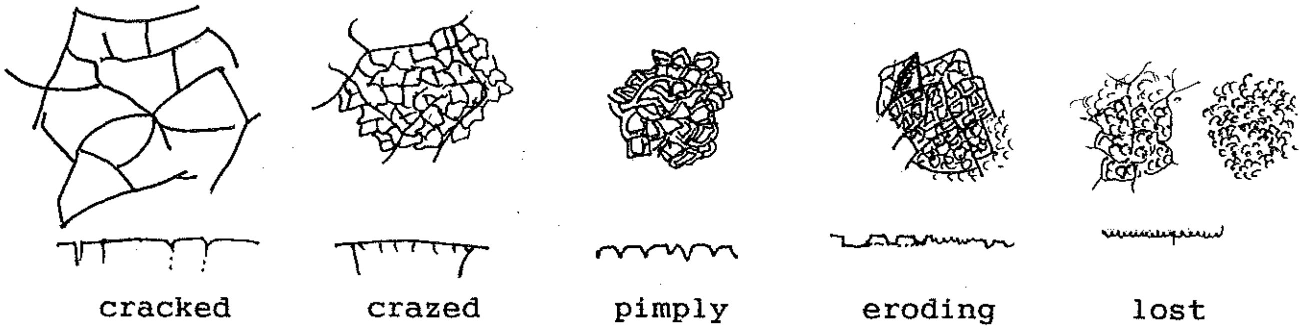
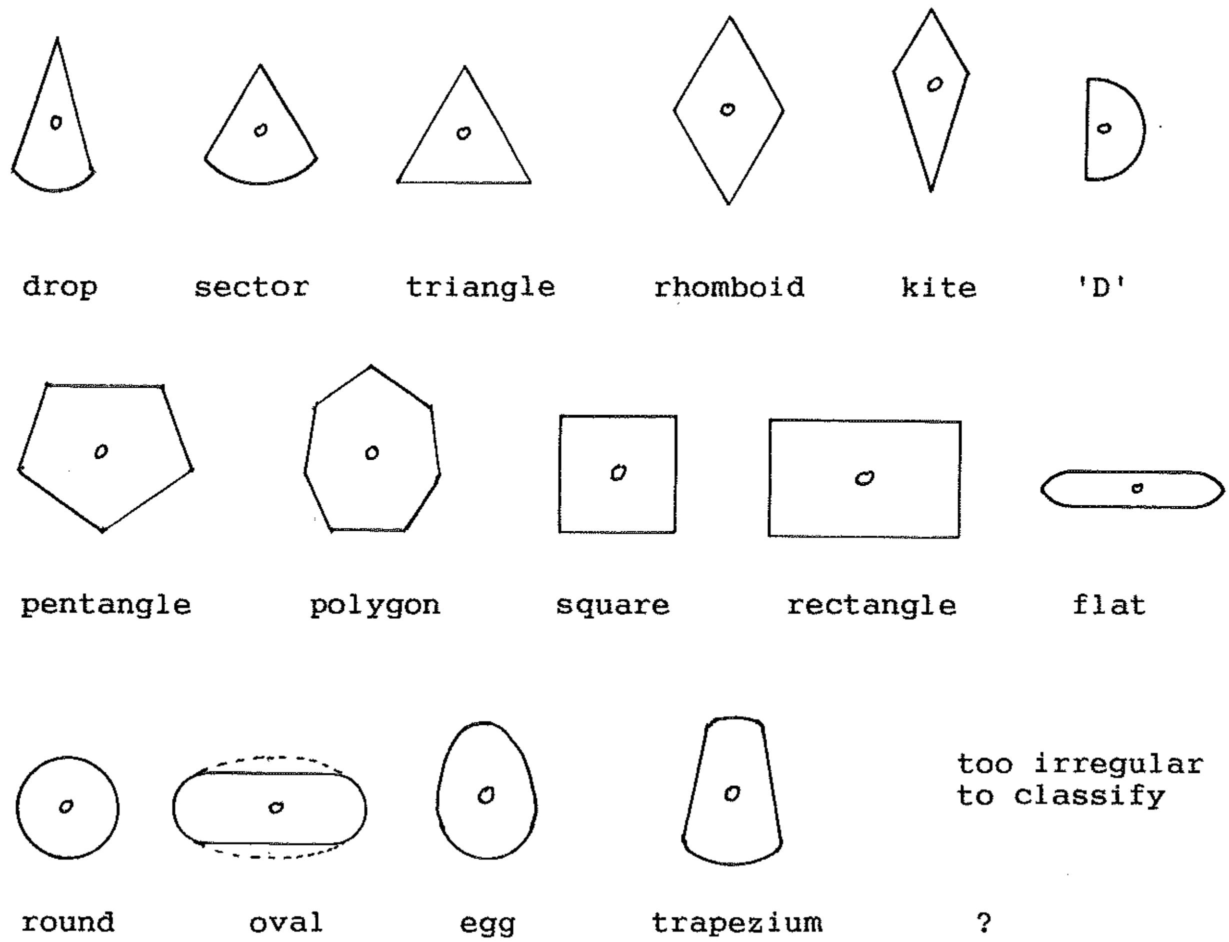
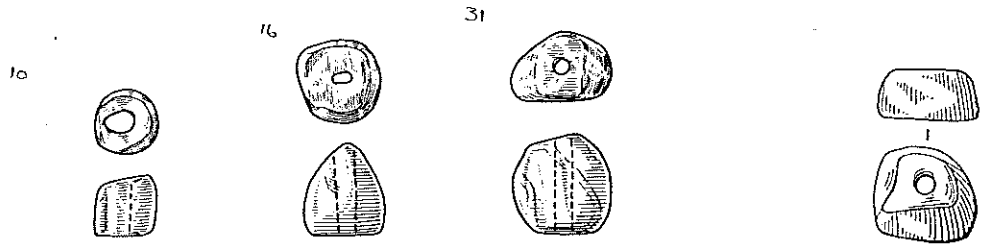


Fig 2 THE AMBER BEADS, CROSS-SECTIONS



NB These sections are schematic and not to scale. The description of the cross-section in the databases refers to the diagram the bead most nearly resembles in cross-section, perpendicular to the hole.

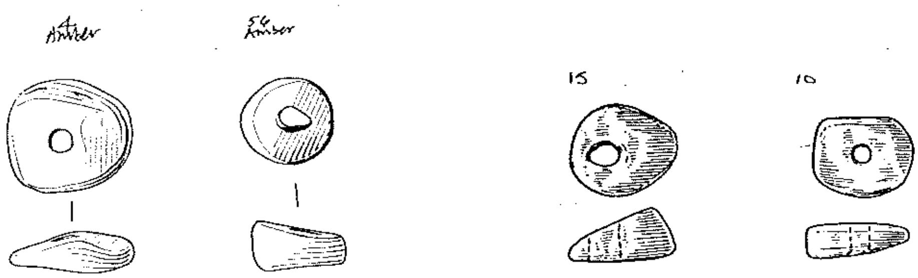


CI grave 116 CI grave 125

<u>Fig 3</u>. Wear facets on amber beads. Scale approximately 1:1.

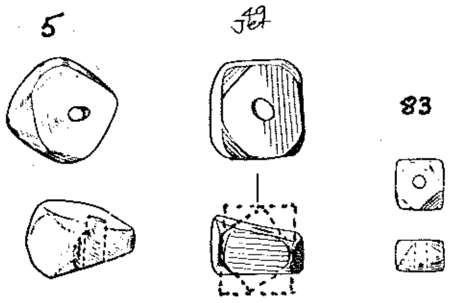
CI grave 99 CI grave 123a

<u>Fig 4</u>. Amber beads with slots worn down the side by the string. Scale approximately 1:1.

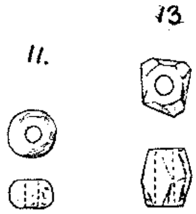


CI grave 99. CI grave 123a

<u>Fig 5</u>. Amber disc beads, now wedge shaped. Scale approx. 1:1.



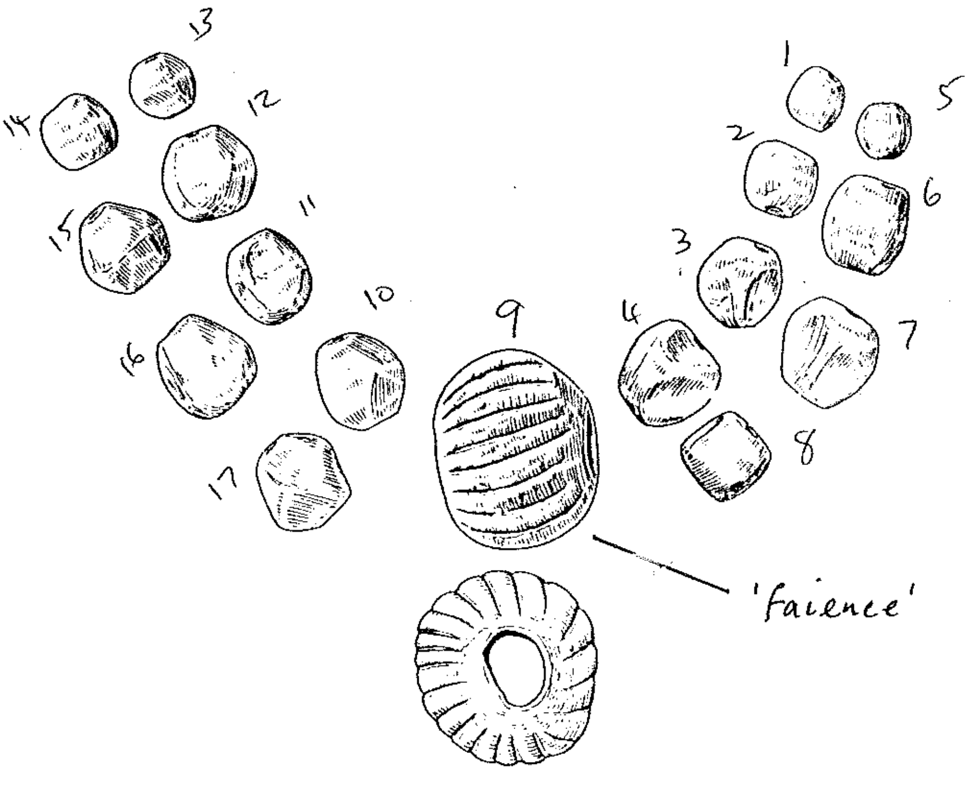
CI grave 99



CI grave 99

Fig 6. Very worn jet-like beads. Scale approx. 1:1.

Fig 7. Unfinished jet-like beads. Scale approx 1:1



CI grave 283

Fig 8. Double string of amber beads showing concave wear facets where beads have been trapped and abraded by those on the other string. Scale approximately 1:1.

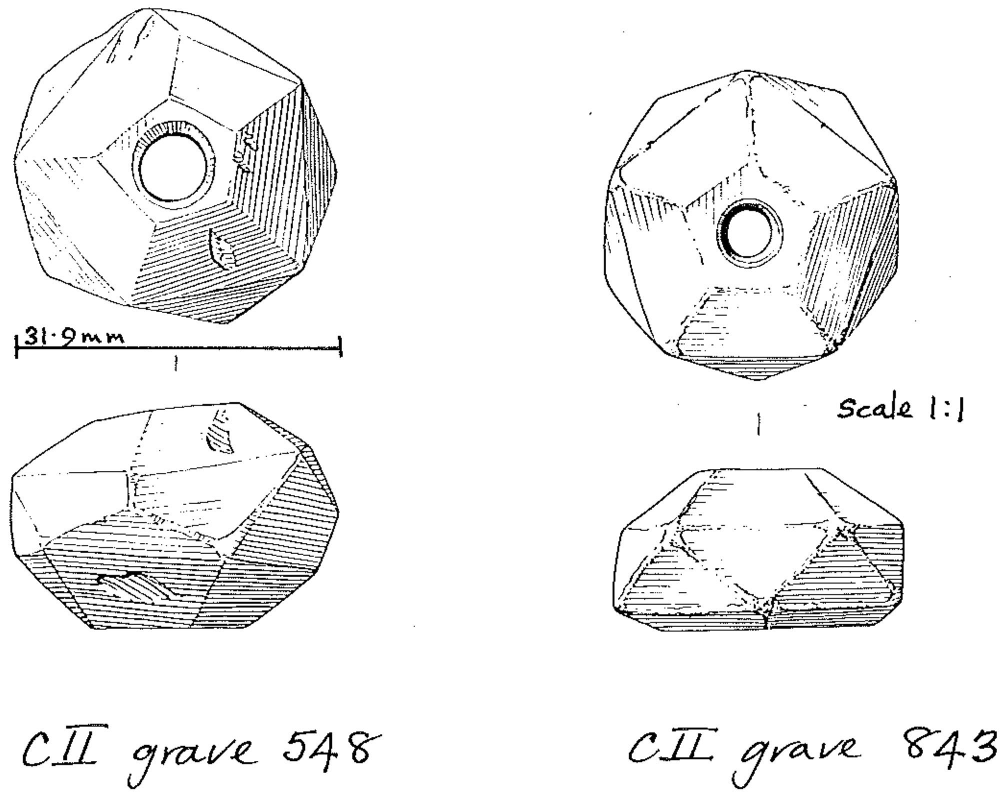


Fig 9. The large quartz beads, often thought to be spindle whorls, showing the bevelling or 'countersinking' round the holes and the wear on facet edges and junctions on the outer edges.

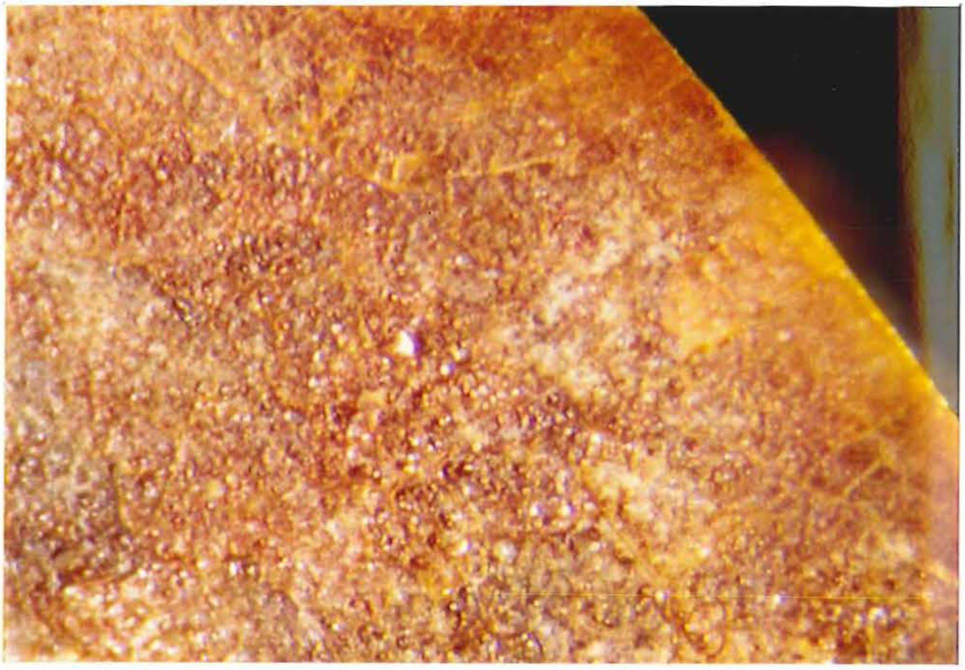


PLATE I. Eroded surface of an amber bead, CI 256/2 col 5 98. Field of view: c 4.1 x 2.8mm. Wild film 69, 18.

PLATE 2. Biconical amber bead, showing the superior preservation of the surface on raised areas. Note the cracked and pimply surface elsewhere. CI 99qx 18. Field of view: c 8.3 x 6.6mm. Wild film 69, 24.

PLATE 3. Side view of an amber disc bead, now wedge shaped. Note the worn, elongated ends of the hole, the sharp edges of both the ends of the hole and the sloping ends of the bead.
CII 648/3q 39; bead is 16.00 x 21.7mm.
Picture No. F940143

PLATE 4. End of an amber disc bead showing the ragged edge to the hole where the drill broke through, slightly slightly by wear. CII 785/1f 7.
Field of view: 4.1 x 2.8mm. Wild film 69, 14.

PLATE 5a. Tool marks in the hole of an amber barrel bead. Note the sharp edge to both the hole and the side of the bead. CII 785/1g 1.
Field of view: 8.3 x 5.6mm. Wild film 69, 15.

PLATE 5b. View of the other end of the hole shown in Plate 5a, at higher magnification. The toolmarks in the hole are different. Note the sharp edge to the hole. CII 785/1g. Field of view: 4.1 x 2.8mm. Wild film 69, 13.

PLATE 6. View of an unfinished jet bead showing the large diamond facet at the roughed-out stage. Note the differing directions of the lines of abrasion, (the line down the centre is a natural flaw). Compare this with Fig 7 (right) which is a drawing of the same bead. CI 99/4rv 13, AML 35. Field of view: 8.3 x 5.6mm. Wild film 69, 30.

PLATE 7a. Biconical rock crystal bead showing the worn surface and the circular percussion marks. CII 334/10z 125; bead is 14.9 x 19.3mm. Picture No. F940145.

PLATE 7b. The same bead as above, but looking through the fractured surface. Note the worn edges of the break and the wider ends of the hole. Picture No. F940144

PLATE 8. The smokey quartz 'spindle whorl', showing the bevel cut round the edge of the hole and the battered facet edges. (The dark areas may be due to the use of a polarizing filter by the photographer). CII 843/6; diameter: 40.9mm. Picture No. F940142.

PLATE 9a. The cornelian pebble, showing the hole and the beach-battered surface. (The orange colour is seen only by transmitted light). CII 649/7o 7: bead is 18.00 x 15.7mm. Picture No. F940147.

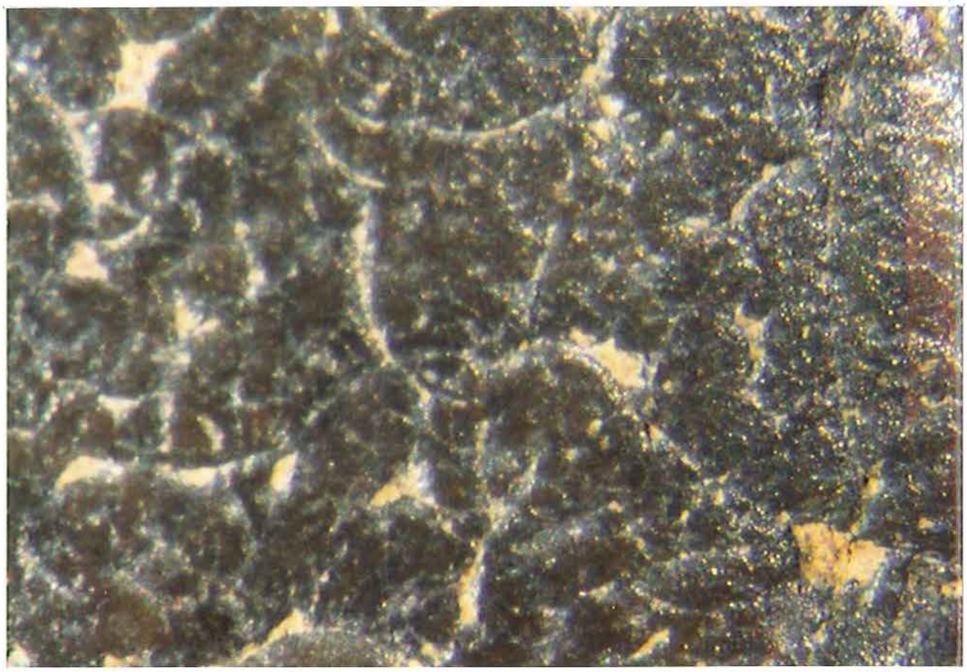


PLATE 9b. A close-up of the surface of the pebble pictured above, showing the circular percussion marks caused by beach or wave-battering. Field of view: 4.1 x 2.8mm.