Part 2 – building materials

Stone – by David Bone

Methodology: In carrying out the determination, it has become apparent that the association with other building material can be crucial in determining the origin of some of the more poorly represented stones. In the Fishbourne area, flint is a common material (as it is throughout most of the south of England), frequently used in tracks or walls, and easily recognised. It is not collected from excavations unless it is mistaken for some other substance or artefact.

Unfortunately, the flint gravels of the West Sussex coastal plain also contain numerous "erratics" - stones that were transported by drifting ice during the glacial periods of the Pleistocene period. Cunliffe (1971) suggested the possibility of this material being imported as ship's ballast, but it is now recognised that erratics occur naturally in large numbers in the area, from boulders of several tonnes in weight down to small pebbles. The sources of the erratics are generally unknown, although some can be recognised as probably from south-west England, the Channel Islands or Brittany. Consequently, the occasional exotic pebbles may be of purely natural origin and nothing to do with imports of foreign material.

It is therefore recommended that the occurrence of flint pebbles in such contexts is recorded so that the stray find of more exotic material can be recognised as either having been specially selected or is just randomly mixed with flint rubble.

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The highest proportion of worked stones came from the large midden deposit in Area A (Phase AF). This is consistent with the idea that such worked stones represent occasional building debris discarded from time to time during refurbishments to the Palace.

Table 62 Worked Stones

Year	Small Find No	Context	Context Type	Stone Type	Comments
FBE 98	4470	558	midden in Area A - Phase AF	Marble or cut from block of massive crystalline calcite	Worked fragment
FBE 98	5662	585	midden in Area A - Phase AF	Marble or cut from block of massive crystalline calcite	Worked fragment
FBE 98	5664	585	midden in Area A - Phase AF	Marble or cut from block of massive crystalline calcite	Worked fragment
FBE 98	5818	585	midden in Area A - Phase AF	Chalk	Small worked block
FBE 98	5819	585	midden in Area A - Phase AF	Marble (white)	Worked fragment – slice

FBE 98	6298	598	lower level of midden in Area A	Purbeck 'marble' – limestone	With fossil *Viviparus cariniferus* (small *V.* gastropods). Worked fragment – slice
FBE 98	6377	598	lower level of midden in Area A	Marble (white)	Worked fragment
FBE 98	6809	598	lower level of midden in Area A	Marble (white breccia in pink matrix)	Worked fragment – slice
FBE 98	7041	598	lower level of midden in Area A	Mudstone	Grey, calcareous. Possibly worked, but could be natural
FBE 98	7057	598	lower level of midden in Area A	Marble (off-white breccia in grey matrix)	Worked fragment – slice

A large amount of stone was recovered from the midden in Area B (Phase BE).

Table 63 Stones from the midden in Area B

Year	Small Find No	Context	Context Type	Stone Type	Comments
FBE 99	12314	904	upper midden	Slate	Four pieces
FBE 99	12315	904	upper midden	Sandstone	Small fragment. Fine-grained, purple coloured sandstone
FBE 99	12316	904	upper midden	Sandstone	Dark-brown, well-cemented quartz sandstone, non-glauconitic, non-calcareous
FBE 99	10396	905	middle midden	Purbeck 'marble' - limestone	With fossil *Viviparus cariniferus* (small *V.* gastropods)
FBE 99	10514	905	middle midden	Tufa	
FBE 99	10955	905	middle midden	Calcite	2 pieces (small fragments) of crystal masses
FBE 99	11017	905	middle midden	Sandstone	Hard, brown, laminated sandstone, non-glauconitic, non-calcareous
FBE 99	11018	905	middle midden	Sandstone	Probably Upper Greensand 'malmstone', but weathered and stained brown
FBE 99	11019	905	middle midden	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11424	905	middle midden	Mixon limestone	Two pieces
FBE 99	12261	905	middle midden	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	12262	905	middle midden	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	12263	905	middle midden	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'

FBE 99	12317	905	middle midden	Sandstone, calcareous	Soft, pale non-glauconitic calcareous sandstone
FBE 99	12318	905	middle midden	Mixture	Five pieces, includes mortar and weathered Purbeck stone. All very small
FBE 99	12319	905	middle midden	Sandstone	Greyish-cream coloured, fine-grained
FBE 99	12320	905	middle midden	Mortar	
FBE 99	12321	905	middle midden	Chalk	Three pieces
FBE 99	12322	905	middle midden	Chalk	
FBE 99	12323	905	middle midden	Mixon limestone	
FBE 99	10643	906	line of smashed pottery-Phase BD	Sandstone, calcareous	Soft, pale non-glauconitic calcareous sandstone
FBE 99	11148	906	line of smashed pottery-Phase BD	Sandstone, glauconitic	Darker, glauconitic, non-calcareous, possibly Upper Greensand from Isle of Wight
FBE 99	12265	906	line of smashed pottery-Phase BD	Sandstone	Hard, brown, fine-grained, non-glauconitic, non-calcareous
FBE 99	12266	906	line of smashed pottery-Phase BD	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’. Four pieces
FBE 99	12267	906	line of smashed pottery-Phase BD	Sandstone	Hard, brown, fine-grained, non-glauconitic, non-calcareous
FBE 99	12330	906.2	line of smashed pottery-Phase BD	Sandstone, glauconitic	Non-calcareous, probably Upper Greensand, not ‘malmstone’
FBE 99	10354	907	lower midden	Tufa	
FBE 99	10738	907	lower midden	Sandstone, glauconitic	Darker, glauconitic, non-calcareous, possibly Upper Greensand from Isle of Wight
FBE 99	10741	907	lower midden	Chalk	
FBE 99	10744	907	lower midden	Limestone	Badly weathered, dense stone with possible fossil traces
FBE 99	10762	907	lower midden	Sandstone, glauconitic	Darker, glauconitic, non-calcareous, possibly Upper Greensand from Isle of Wight
FBE 99	10914	907	lower midden	Flint	Natural flint pebble
FBE 99	10972	907	lower midden	Mixon limestone	
FBE 99	12178	907	lower midden	Sandstone – Upper Greensand	Burnt. Typical of Sussex ‘malmstone’
FBE 99	12179	907	lower midden	Mixon limestone	
FBE 99	12268	907	lower midden	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’

FBE 99	12324	907	lower midden	Sandstone – Upper Greensand	Probably. Pale grey, calcareous and slightly glauconitic sandstone
FBE 99	12325	907	lower midden	Mixon limestone	
FBE 99	12326	907	lower midden	Chalk	
FBE 99	12327	907	lower midden	Sandstone, glauconitic	Darker, probably Upper Greensand
FBE 99	12328	907	lower midden	Purbeck 'marble' & Mixon limestone	Two pieces.
FBE 99	12329	907	lower midden	Indeterminate	Small pebble

Finally, an amount of stone was collected from the northern pit in Area B (Phase BF).

Table 64 Stones from the northern pit in Area B

Year	Small Find No	Context	Stone Type	Comments
FBE 99	10862	909	Tufa	
FBE 99	10868	909	Limestone	Pale cream limestone, possibly Isle of Wight (cf. Bembridge Limestone)
FBE 99	10871	909	Limestone	Pale cream limestone, possibly Isle of Wight (cf. Bembridge Limestone)
FBE 99	10872	909	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	10913	909	Purbeck 'marble' - limestone	Quarter-round moulding. With fossil *Viviparus cariniferus* (small *V.* gastropods)
FBE 99	10928	909	Mixon limestone	
FBE 99	10930	909	Sandstone, glauconitic	Darker, glauconitic, non-calcareous, possibly Upper Greensand from Isle of Wight
FBE 99	10973	909	Mixon limestone	
FBE 99	11409	909	Calcite	Crystal
FBE 99	12264	909	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'. Two pieces
FBE 99	10947	909.2	Mixon limestone	
FBE 99	10994	909.2	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11345	909.2	Chalk	Hard and dense, slightly gritty with comminuted shell debris
FBE 99	11084	909.3	Mixon limestone	Waterworn
FBE 99	11085	909.3	Sandstone	Coarse-grained, reminiscent of Hythe Formation (Lower Greensand)
FBE 99	11087	909.3	Sandstone, calcareous	Fine-grained

FBE 99	11105	909.3	Sandstone	Horsham stone or similar
FBE 99	11353	909.3	Sandstone – Upper Greensand	Fairly typical of Sussex ‘malmstone’, but very chalky
FBE 99	11840	909.3	Mixon limestone	
FBE 99	11842	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11843	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11845	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11847	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11848	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’, but darker
FBE 99	11849	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11850	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’, but very chalky
FBE 99	11851	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11852	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11853	909.3	Limestone	Possibly Bembridge limestone or similar from the Isle of Wight
FBE 99	12001	909.3	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11356	909.4	Tufa	
FBE 99	11381	909.4	Sandstone	Horsham Stone or similar
FBE 99	11382	909.4	Mixon limestone	
FBE 99	11383	909.4	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11510	909.6	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11512	909.6	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11514	909.6	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11535	909.6	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11536	909.6	Mixon limestone	
FBE 99	11537	909.6	Sandstone – Upper Greensand	Typical of Sussex ‘malmstone’
FBE 99	11538	909.6	Limestone	Possibly Bembridge limestone or similar from the Isle of Wight

FBE 99	11539	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11540	909.6	Sandstone, glauconitic	Coarse-grained, glauconitic, non-calcareous with red/yellow banded staining – possible Upper Greensand
FBE 99	11541	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11542	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11606	909.6	Sandstone – Upper Greensand	Fairly typical of Sussex 'malmstone', but very chalky
FBE 99	11630	909.6	Limestone	Waterworn. Possibly Bembridge limestone or similar from the Isle of Wight
FBE 99	11632	909.6	Limestone	Tuffaceous. Possibly Bembridge limestone or similar from the Isle of Wight
FBE 99	11633	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11673	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone', but slightly darker
FBE 99	11674	909.6	Limestone	Possibly Bembridge limestone or similar from the Isle of Wight
FBE 99	11676	909.6	Sandstone, glauconitic	Grey, slightly glauconitic, possibly an Isle of Wight Upper Greensand
FBE 99	11677	909.6	Sandstone, glauconitic	Dark grey, glauconitic, possibly an Isle of Wight Upper Greensand
FBE 99	11679	909.6	Chalk	Hard, probably high Upper Chalk. Could be local or French
FBE 99	11682	909.6	Tufa	
FBE 99	11683	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11684	909.6	Sandstone – Upper Greensand	Typical of Sussex 'malmstone'
FBE 99	11685	909.6	Purbeck 'marble' - limestone	16mm thick sawn block. With fossil *Viviparus cariniferus* (small *V*. gastropods)

Figures

Fig.169 Two worked stones 1-2

Brick and Tile – by Derek Turner

Method During the five-year excavation period a total of 7,710.059 kg of Roman brick and tile was retrieved and cleaned (Figs 170,171,173,174). From 1995 to 1997, unidentifiable fragments generally badly abraded, or tile less than 28mm thick without diagnostic features, were weighed, assessed for fabric, then listed as 'Unclassified' prior to reburial on the site. In 1998 and 1999 all bifacial material was retained; badly abraded material was weighed, listed as 'Discarded' then buried on the excavation site. During this period bifacial tiles less than 28mm thick were recorded by weight and fabric as 'Unclassified'. To avoid confusion all unclassified and discarded material has been excluded from the pie charts.

Tegulae

All fragments were examined; flange types, cut-outs (Fig.170), signatures and imprints were recorded.

Flanges have been categorised in accord with a type-series derived from finds in the Chichester area. Although 1997 produced the greater weight of *tegula* material, 1998 produced a slightly greater number of identifiable flanges. In all some 1509 flanged fragments were reviewed. Fragments where the flange had been completely removed or was present only as a stub have been listed as unclassified. The type B (or close variant) flange predominates in this area (77%).

Of 230 lower cut-outs, from the eaves end, only four were so fragmentary as to be unclassifiable; the commonest variant was the type G with 199 incidences (86.5%). The number of cut-outs show that we have a collection from at least 117 *tegulae*.

Table 65 Percentages of flanges and cut-outs of tegula

Flange			Cut-out		
Type	Number	%	Type	Number	%
A	63	4.175	A	12	5.217
B	1164	77.137	B	4	1.739
C	4	0.265	C	4	1.739
D	15	0.994	D	1	0.435
E	3	0.199	E	5	2.174
F	43	2.850	F	1	0.435
G	11	0.729	G	199	86.522
H	45	2.982	Unclas	4	1.739
J	56	3.711			
K	1	0.063		230	100
L	14	0.928			
M	5	0.331			
N	7	0.464			
O	-	-			
P	-	-			
Q	14	0.928			
R	11	0.729			
S	-	-			
Unclas	53	3.512			
	1509	100			

The thickness of the *tegula* body was recorded in 1999 together with the height of the flange measured from the base of the tile to the top of the flange. The 1998 tile was assessed last and in that count the width of the flange was also recorded – this, however, is not particularly useful as typically the *tegula* flange is markedly tapered from a lower value at the top (ridge) end to a greater value at the bottom (eaves) end. Where the length of the fragment was in the order of 100mm or more the degree of taper was noted - over a range of 30 records the lowest percentage taper was 1.5% (over a length of 200mm), the largest 6.7% (over a length of 90mm); a value of 2.4% was noted on a half *tegula* (420mm in length).

With a good range of values for thickness and flange height available a simple statistical review of the data recorded in Microsoft Excel is possible. In order to ensure that the computer's selection of data is consistent, a check was carried out by manually inputting acceptable values into a calculator; the results were in good accord. The results were as follows (all measurements in millimetres):

Table 66 Values for tegula thicknesses and flange heights

Thickness	1998	1999	1998/9	1999 (Area B only)
Median	24/25	25	25	
Mean	24.61	25.34	24.80	25.21
σn-1	4.10	5.08	4.38	4.89

σn	4.09	5.07	4.38	4.86
Flange height				
	1998	1999	1998/9	1999 (Area B only)
Median	52/53	52	52	
Mean	52.18	49.37	51.38	51.20
σn-1	6.52	9.72	7.49	8.52
σn	6.51	9.70	7.49	8.48
Width (1998 only)	Median 31	Mean 31.31	σn-1 6.162	σn 6.156

Clearly there is no significant statistical variation between the 1998 and 1999 excavations or between the contexts in Area B and the other contexts. This is not unexpected as there is no significant geographical and minimal temporal variation between the various contexts.

As there is a small collection of tile from the Dell Quay tilery (Rudling 1987), some 3km south of the Fishbourne excavation site, a similar review was carried out on the 13 undoubted roof tiles. One flange was too damaged to be assessable but the other 12 were of type B; there were 11 cut-outs - all were type E. The statistical results in millimetres were:

Table 67 Tegula thicknesses, flange heights and widths from Dell Quay tilery

	Thickness	Flange Height	Flange Width
Median21	48	32	
Mean	21.46	48.00	32.7
σn-1	3.99	3.34	3.83
σn	3.84	3.21	3.63

In 1982/3 a Romano-British site, 400 metres south-west of Fishbourne Roman Palace, was excavated (Rudkin 1986). A large masonry aisled building replaced an earlier timber structure in the mid-2nd Century AD. There is an unusually low proportion by weight and number of *tegula* fragments in the store compared to *imbrex*. The few *tegula* fragments were reviewed but no meaningful variation was identified.

Rook (McWhirr 1979, 295 - 301) has postulated that *tegulae* could have been produced using a fairly sophisticated wooden mould and wire cutting; such a technique would produce standard and rectilinearly finished tiles. The evidence from the reviewed Fishbourne tile, however, confirms Adam's (1994) comment that *tegulae* do not appear to have been produced in standard sizes. In addition, the Fishbourne sample indicates that the majority of the flanges were finished by hand-stroke rather than tool-finished, and in a number of cases the eaves end cut out retained the evidence of knife cutting after the tile had been shaped.

The evidence indicates that in Fishbourne area *tegulae* were not produced to a standard size, were formed in a very simple mould (or between two battens), the flanges were only exceptionally 'tool'-smoothed and knives were used to fashion the cut outs.

Any discussion suggesting that there was a recognisable Fishbourne *tegula* 'type' must be treated with some caution. However, it seems clear that the 'norm' was for the tile to be in the

order of 25mm thick with a type-B flange and a type-G cut-out; the 'typical' flange height (measured from the base of the tile) is 52mm. The results were consistent within the excavated area, but a review of the Dell Quay material retrieved from the kiln site (Rudling 1987) suggests that the product of that tilery was in the order of 21mm thick with an average flange height of 48mm. Due to taper, flange width would only be of limited use if consistently measured at a known point such as either identified *tegula* end.

Significantly all 11 of the Dell Quay cut-outs were of type-E, compared with only 5 out of 230 on the excavated Fishbourne site. The Dell Quay flanges were all type-B, or close variant, and probably not tool-finished. This certainly would support the hypothesis of at least two tilers operating in the area and the difference in fabrics indicates at least two tileries. It would be a little too optimistic to attempt to adduce a suggested number of individual tilers from the number of observed cut-out types in our sample.

Distribution charts of tile thickness and flange height are appended. Although such charts could be used as a characteristic template, they would only be valid for comparison purposes where the output could be tied to one particular tiler. In this case there are a number of tilers/tileries involved over a non-discrete period. Individual signatures and other marks were recorded as small finds.

Imbrex

Over the five-year excavation period a total of 451.615 kg of confirmed imbrex material was recovered; of this some 76.9% was found in 1997, when it represented 10.26% of the total ceramic building material retrieved.

Only one fragment from the excavation was seen to have any diagnostic feature - finger marks on SF 1886 from context 433.3. In contrast, in the very small number of imbrex fragments deposited from the Dell Quay tilery there are two examples of pierced imbrex - one with a rectangular cut-out and the other circular in form.

The large amount of ceramic building material retrieved in 1997 came from the area adjacent to the stream and possibly represents a palace modification or demolition phase; the high proportion of imbrex compared to amounts in other years may reflect the fact that the imbrices are relatively fragile and were probably mortared into place (from the evidence of the 1982/3 excavation) resulting in greater damage/wastage during the dismantling of a roof.

Brick

Bricks were initially categorised by thickness in an attempt to identify the overall sizes of bricks represented in the sample. By 1997 the lower end ranges were defined as less than 28mm, 28 - 32mm, 33-37mm and 38-40mm with further groupings greater than 40mm. In 1998 and 1999 the above groupings were used, but all tile/brick fragments thicker than 40mm, or having specific diagnostic features, were individually listed. The recorded thickness range is from 14 to 82mm.

Some of the thinner tile fragments will be unrecognised *opus spicatum*, *tegula, imbrex*, string course and wall-bonding fragments. In the range *c*. 30-48mm the lower end may represent *bessales* or *lydia* (hypocaust pilae tiles and wall-bonding bricks respectively), the mid range may be *pedales* (pila capping tiles) and the upper range *sesquipedales* and *bipedales* (the extra large

tiles used to bridge hypocaust pilae). In practice a firm ascription can only be based on bi-facial tile/brick with three finished edges.

All fragments of *tegula mammata* have been individually reported. Where possible the mamma has been typed as one of five local categories (A1 - 3, B1, B2) and positions recorded either as one of eight layouts (A - H) or as a distance from an edge or corner. In practice a precise layout can only be determined if a substantial (ideally three-edged) fragment is recovered. There were several incidences of a *mamma* being placed on a combed surface; this has been noted on other sites in the Fishbourne area.

Numbers of mainly domestic animal prints and finger prints were noted - the former were treated as small finds. The more common animal imprints were dog paw prints.

Flue tile

Approximately 40% of the flue tile was recovered in 1997 and the bulk of the remainder in 1998/9. This is most of the patterned, 'keyed' tile from the site. Several categorisation schemes have already been suggested and these have been combined into one experimental system (Appendix A).

A number of groove/space variations can be identified. In particular SF790 from context 212 has an identifiable pattern on Dell Quay fabric; this comb appears to have been used on SF1876 from context 443.3, which is also Dell Quay fabric. Other identified pairings (context/small find number) for this comb include 512/5198 and 590/6427, 905/10339 and 556/5977, 502/3728 and 511/4055, 577/4698 and 562/4130, 202/791 and 443/1527.

A broken comb with a missing tine, giving a pattern of 2 tines - gap - 3 tines, was seen on a half box-tile SF 6427 (context 590) and also on another fragment of flue tile - SF 5198 (context 512). Both fragments were made of sandy fabric (local 1F). Black (in Betts *et al* 1994) has already characterised Chichester area relief pattern flue tile as being 'sandy'. In order to minimise shrinkage and reduce the danger of thermal shock it would certainly have been desirable to temper flue tile; sand is a readily available and cheap filler.

These instances confirm a wide spread of destruction material, including Palace material and possibly a degree of mixing in the post-Palatial period.

Several forms of scoring were noted; the narrowest scores were probably made by a sharp metal implement such as a knife, but the broader grooves could have been produced by any casually picked up nail, twig, scrap wood or bone fragment.

Water pipe

No ceramic water pipe was found *in situ*. By weight 70% of the pipe fragments were found in 1998. SF 12385 found in context 718.2 may be a fragment of small bore ceramic water pipe; a second fragment (SF 8054 in context 507) may also be small bore water pipe. These latter finds could be associated with, for example, a fountain in the garden. Cunliffe (1971, 44) firmly dates the water pipe to the Flavian period. The freshwater pipeline to the east of the Palace (Kenny 1992, 34) may have been laid to bring water to the early-2nd century bath house at the east end of the Palace North Wing. However, this aqueduct has been dated to the mid-1st century AD

(Phase AC) by the current excavations. It does not appear to have contained a ceramic pipe, at least in the sections excavated.

The water pipes appear in primary structures in the late 1st /early 2nd centuries but could have been re-used at any subsequent period.

Other

The 'Other' category contains a number of items which were of interest including *opus spicatum* and *tesserae. Opus spicatum* floor tiles are associated, as primary structures, with first period levels (following the chronological divisions in Cunliffe, 1971, 44).

Fabric

Since 1995 fabrics have been assessed using a local numbering system. The basis of the system was partly subjective and more recent experience suggests that information may be lost because research workers have varying interpretations. A suggested more objective categorisation framework is shown in Appendix B and material has been collected as the basis for a small reference collection.

There are three main sources of raw material in the Chichester area: London Clay, Reading Beds clay and alluvial brickearth. Of these the commonest in the immediate Fishbourne area is Reading Beds clay. Excavations in Fishbourne Glebe uncovered a Reading Beds deposit with very obvious cut marks where the clay had been mined (pers. comm. D. Turner) and of course the lane running east and north of the site is called Clay Lane.

There is no reason to suppose that fuel supplies were any more difficult to procure in the Fishbourne area than, say, Dell Quay, and beach sand for tile-making could be lightered up the harbour on any convenient tide to any site between East Head and Fishbourne. There is no logical reason why the bulk of the tile required for the construction of the Palace could not have been made and fired on site with considerable savings on transport. As recently as Georgian times brick for new houses in Chichester was fired on site.

Although in relatively small quantities, the very distinctive Dell Quay fabric has been found in the debris. Mention has already been made of the tilery known to have existed at Copperas Point near Dell Quay and there is some evidence from surface finds that a second may have existed nearer to Dell Quay itself.

In 1995 it was noted that the locally classified types-2 and -5 are possibly only further variants of local type-1 which means that in that year 99.82% of the tile identified was type-1. This assessment is largely substantiated in subsequent years. It seems clear from the overall results that 'tempering' is common in flue tile variants with sand being the commonest inclusion - a conclusion which agrees with Black's (in Betts *et al* 1994) assessment of Chichester relief pattern flue tile being 'sandy'.

Tempering is less noticeable in tile not likely to be exposed to considerable temperature fluctuation - *tegulae* for example. Even so, it was found in the 1998-9 sample that some 17.51% of the unclassified material and 18.01% of identified *tegulae* material contained sand. In the same period only 5.97% of *imbrex* was noted as sandy.

Discussion

Several intact *tegulae* were laid as a form of channel/levelling course in Area B (context 906); other than that the ceramic building material was found in very fragmentary - and sometimes very abraded - state. The presence of one undoubted waster SF8099 in context 589 (part of the road surface contemporary with Building 3 – Phase AB), a probable waste mammate brick in context 646 (causeway – Phase AE) and a very over-fired and distorted *tegula* fragment from Context 18 (the fill of the linear slot – Phase AD) indicate the possibility that some of the detritus represents breakage/wastage during constructional phases, but in the main the spread of material seems likely to represent the scattering of broken or dropped salvaged material from the demolition of Building 3, from Palace rebuilding phases and the final demolition of the Palace.

During the construction phase of a masonry building the detritus will include substantial quantities of greensand chippings and some flint. Although chalk blocks might be used in construction, any chippings arising are likely to have been burnt for slaked lime. Tile fragments are likely to be relatively few, arising from breakage and wasters.

During the destruction phase of a masonry structure the casualty rate in roof material - especially the more fragile and mortared imbrices - is likely to be high with most of the greensand blocks being retrieved for reuse.

Given the high water table of the period and our first-hand knowledge of how rapidly the surface becomes churned by foot and wheeled traffic, it is probable that material deposited on destruction level surfaces could be trodden or sink into lower layers, 'contaminating' earlier features. Unless deliberately dug in, destruction rubbish should not normally be found, for example, below the earliest masonry or metalled road surfaces.

Several examples of tile-packed post-holes were found in Fishbourne Glebe (Kenny 1995, 15); these were carefully packed with substantial fragments of tile. Some 116 post-holes were found in the 1995-9 excavation, but relatively few (10.34%) had quantities of 1000g or more of tile in the fill:

Table 68 Tiles from post-holes in FBE 95-99

229/211	packed with greensand and 1135g tile (one piece)
466/462	1100g tile - single tile on edge plus greensand and flint
524/543	2050g tile - believed to have fallen in when post removed
568/567	3095g tile - flint and greensand in fill, imbrex on 'surface'
576/575	1095g tile - in upper fill; no evidence of 'packing'
583/582	1085g tile - four sharp-edged fragments
635/630	4180g tile (three pieces) - possibly packing
652/651	2895g tile - described as packed with greensand and red clay
649/648	1000g tile - tile on edge plus greensand and flint
793/741	1590g tile (large fragments) - not assessed as packed
792/742	2925g tile - not assessed as packed
807/752	3331g tile - tile and flint packing

Of the remaining 'fills':

10.34% contained only small quantities of tile (500 to 999g)
18.97% contained less (50 to 499g)
7.76% contained less than 50g

50.83% contained no tile at all.

Thirteen of the post-holes had already been excavated by A. Down (Cunliffe, Down & Rudkin 1996, 17), assessed as packed with clay, stone and gravel and assigned to Cunliffe's period 1a.

These were:

C1/22	524	
C6	526	Gravel-packed
C9	522	
C14	531	
C15	533	Gravel-packed
C16	532	
C17	523	
C18	534	Gravel-packed
C19	529	Gravel-packed
C20	528	
C21	526	Gravel-packed
C23	530	
C24	525	

The three post-holes around the central pit (226, 229 and 246 – Phase AH) are all best described as rubble filled using greensand fragments and flint. The 1135g of tile in 229 was a single piece.

None of the post-holes contained the weight of tile that would realistically be required for effective packing. Given the effectiveness of large tile fragments as packing pieces, it would be surprising if they would not have been used had they been available. It seems probable that most, if not all, the post-holes were dug prior to any large-scale destruction or re-modelling of Building 3 but probably after the construction of the masonry building.

The incidence of tile-free post-holes was plotted on the site diagram. The most northerly line (row 5) of post-holes contained only two (plus one presumed) totally tile-free out of eighteen. In the more southerly row 4 most of the tile contaminated post-holes were associated with the greensand road. The most southerly rows (rows 1 and 2) contained the greater number of tile-free post-holes.

Significantly, post-hole 793 contained a fragment of half-box-tile while post-holes 568, 869 and 803 contained combed flue tile - all are in the northern two rows. This presence suggests material from the Palace site and is in a sensible proportion relative to the total ceramic building material found in the post-holes. Lattice-scored flue tile was found in the courtyard pit (282 – Phase AH), combed flue tile in a beam slot (718 – Phase AD) and thin-walled flue tile in a drain (39 – Phase AH). No flue tile was found in the post-holes 229, 226 and 246 surrounding floor 284 which contained both flue tile and *opus spicatum*.

From the evidence of the tile alone it seems possible that the rows of post-holes may have been removed at different times; that the southern posts were extracted, and levelled, first and the most northerly line later. Dating by tile presence alone - even roller-impressed - is likely to be unsatiSFactory; given the likelihood of trample contamination during demolition.

Slot 718 contained 40.471kg of brick and tile including flue tile and pipe fragments. The fill of 896 (water-pipe trench – Phase AE) contained only 90g of unclassified/brick material. Collars

for a wooden water pipe were found *in situ* in the pipe trench; the pipe probably rotted away and the small amount of ceramic building material may be contamination from above. The slot, however, appears from the tile evidence to have been robbed out and the building material deposited after a Palace destruction/re-modelling phase.

Courtyard pit 30/282 (Phase AH) contained 50.35kg of brick and tile, including flue tile and water pipe. Most of this material was found in the north-east corner of the feature. The associated drain 41 (Phase AH) contained 6.55kg brick and tile, including flue tile and water pipe. The fills of the courtyard pit and the drain indicate deposition of Palace destruction/re-modelling phase material; in the case of the pit the concentration of tile suggests intentional dumping rather than a scatter over a surface.

The extensive 2nd century Cunliffe Period 3 work on the east end of the North Wing of the Palace, less than 100 metres from the excavation site, is a point from which damaged flue material is likely to have appeared in fair quantity.

Figures

Relief-Patterned tiles – by Ernest Black

The **contexts** which produced the tile fragments can be grouped as follows:

a) 2nd-3rd century (pre - A.D.270): **237.1** die 21; **443** die 13 (two), ? die 22, ? die 40; **452** die 21; **511** die 13; **512** die 48; **513** die 55; **514** die 48; **557** die 13 (two), ?die 48; **558** die 13; **577** die 48; **639** die 13; **710** die 13; **719** die 48; **904** die 13, die 48, die 55 (two); **905** die 4, die 48. Total: 24 fragments.
b) Later 3rd – 4th century: **443.2** ?die 55; **445** die 13; **467** uncertain die; **489** die 13; **579** die 13 (five), die 48; **580** die 13 (two), die 24 (two); **590** die 13; **621** die 37; **907** die 13 (two); **909.6** die 81. Total 19 fragments.
c) Post - Roman: **24** ?die 20; **234** die 22; **240** ?die 21; **408** Die 13 (two and one uncertain), ?die 55, uncertain die; **417** ?die 60; **419** die 4; **422** die 13; **430** die 55; **431** die 48; **432** die 22; **437.1** die 21; **501**die 13; **503** die 13; **505** die 48; **507** die 48 (three); **508** die 4; **701** die 21, die 22; **901.2** die 48; **902** die 48; **903** ?die 48. Total: 27 fragments.

Dies 21, 22, 24, 37 and 81 (and the uncertainly identified dies 20, 40 and 60), along with die 19 from the earlier excavations, belong to the London - Sussex group of dies. Two fragments (from contexts **234** and **237.1**) were examined by Dr. Ian Betts who assigns them to Museum of London Archaeological Service (MOLAS) tile fabric number 3054, one of the two fabrics that

are usual for tiles keyed with London - Sussex dies. (For a description of the fabric see Betts *et al.* 1997).

The earliest context (**237.1**) was the Late Antonine - Severan fill of the stone - flagged sunken feature (Phase AH) in the eastern range of Building 3. Professor Cunliffe did not establish where tiles of the London - Sussex group found in his excavations had been used. Black (1985, 372 - 73) conjectured that it was in a refurbishment of the period 1C baths and its incorporation into the period 2 palace. If this was the case it is possible that the occurrence of the fragments in the 1995 - 1999 excavations indicates that these baths had been modified or partly dismantled by the Late Antonine - Severan period.

The small number of fragments from a large number of different dies suggests that the bulk of the tiles keyed with London - Sussex dies were removed from the site for reuse elsewhere. The only other site in Sussex with such a wide range of dies is the bath-building at Wiggonholt where dies 20, 21, 22, 23, 37, 83, ?86, 111 and an uncertain Group 5 (Diamond and Lattice) die are known. At both Fishbourne and Wiggonholt die 37 was used to key distinctive curved bricks of uncertain use (SF8103 from context 621; sump – Phase AC; Fig. 174.1), a nearly complete example of which is known from Trinity Square, London (Betts *et al.* 1994).

The specimen of die 81 from context **909.6** (the northern pit in Area B – phase BF;) has one corner of the tile with part of one keyed face and of one unkeyed side (SF11607; Fig 174.2). A cutaway is present in the side with an arched top / base *c.*98 mm from the end of the tile. The complete shape of the cutaway is uncertain. Particles of crushed tile (>8mm) are visible embedded in the surfaces. At the original corner and at the exterior junction of the two surviving surfaces are traces of grey staining, possibly burning. The face is abraded and the size of the impression seems to be *c.*10 - 20% smaller than other examples keyed with die 81. The keying was done when the roller had become considerably worn and splintered. The maximum surviving dimensions of the face of the tile are *c.*137 x 182 mm and the maximum surviving depth is *c.*90 mm. There is no trace of the triangular cutaway that is present in a double width box-flue tile of the kind used as a *bipedalis* at the Eastbourne villa (Betts *et al.* 1997, 8 and 10, fig.4) and it seems likely that the tile from context **909.6** was a standard box-tile. The measurements of such tiles from the Batten Hanger villa were *c.*480 x 180 - 85 x 140 mm.

It is clear from Professor Cunliffe's excavations that dies 4, 13, 48 and 55 were used in the Period 3 east wing baths, constructed *c.*130 - 160 (Cunliffe 1971, 175 & 179). The earliest specimen appears to be a fragment of die 13 from context **639** which represents the upper level of a causeway across the stream (Phase AE). This is dated to the first half of the 2nd century. But overlying context **590** represents a dump of demolition of 3rd and 4th century date and David Rudkin (pers. comm.) suggests that it would not have been unreasonable for this piece of tile to have been trodden into the surface of the causeway between its construction in the late 1st century and the later dumping. A second fragment of die 13 came from context **590** itself. Even so, there are several contexts with tile fragments keyed with this group of dies which are dated to the early 3rd century or earlier (contexts **511**, **513**, **514**, **558**, **577**, **905**, **710**, **719**). It is possible that these, and presumably the fragments from later contexts, came from tiles broken when the east wing baths were constructed. It is equally possible that they derive from a subsequent phase of alteration that took place in the late 2nd or early 3rd century. Professor Cunliffe had good evidence for dating the abandonment of the baths and the robbing of tiles from it to the last decade of the 3rd century (Cunliffe 1971, 189 & 220).

Figures

Tile Fragments within the foundations of Building 3 (B3) – by Ernest Black

A fragment of tegula (SF1562) was found within wall 411, and five joining fragments (SF1566) of a 'thin-walled box-tile' were found within wall 414 (Fig. 174.3).

Discussion: The presence of the thin-walled box-tile from the wall construction of the courtyard masonry Building 3 should mean that this is no earlier than Cunliffe's Period 1C, when such tiles were used in the proto-palace baths (Building M2). However, pottery and stratigraphic dating has suggested a possible construction date for Building 3 in Period 1B. The problem may be resolved in two possible ways.

1. An unlocated bath-building may have existed in Period 1A or 1B and the box-tile fragments from context 414 in Building 3 came from this. The difficulty is the existence of a bath-building in Period 1C where such tiles were used. It seems more reasonable to assign the tiles to this building, especially in view of the infrequency with which baths were totally replaced rather than simply altered or extended. The survival of the Period 1C baths incorporated into the Period 2 palace at Fishbourne is a case in point.
2. If the tile fragments from context 414 came from the proto-palace can this be re-dated to Period 1A or 1B to fit the dating assigned to Building 3? Professor Cunliffe's dating of M2 relied on its stratigraphical relationship to other buildings and features. A masons' working-yard, associated with the construction of M2 involved the diversion of the stream further east with the infilled former stream-bed underlying the eastern side of M2. This was therefore assigned to Period 1C. However, this sequence and dating cannot strictly be applied to the whole of the proto-palace. It is only an assumption that M2 had a single phase of construction. The northern courtyard and porticoes and the east range abutting these and extending south beyond the baths must indeed belong to Period 1C as Professor Cunliffe deduced, but the southern baths need not have been contemporary. Rooms 10-15 could have functioned as a free-standing bath-block alongside the original stream. If so, a date in Period 1A or 1B is quite possible for this and fits the occurrence of the thin-walled box-tile fragments from context 414 in Building 3.

Figures

174. Three relief-patterned tiles

The Tesserae – by Derek Turner

The first obvious point is that the *tesserae* vary considerably in size. The occasional near perfect cube is probably sheer happenstance. After a floor is laid the surface is ground smooth removing variable but significant amounts of material from the upper surface of each *tessera*. In theory the ideal would be a small, square-section elongated cuboid, the *tesserae* being pushed longwise,

closely set, into the mortar to give maximum mutual support and adhesion. Examination of *in situ* mosaics and excavated fragments of floor indicate that this did not happen in practice.

In order to assess average sizes the three recorded *tessera* dimensions were multiplied together to arrive at a size in cubic millimetres; the cube root of this figure provides a good average side dimension. In a 10% sample cube sizes varied from 5400mm^3 to 632mm^3 - ie 17.5mm to 8.5mm side length, the overall average being 11.25mm.

Using a value of 15% for grouting, this derived length gives good concordance with *in situ* mosaics at the palace where on mosaic floors of average quality there are in the order of 11 *tesserae* to 150mm of floor using less than regularly sized *tesserae* and noticeable grouting. In a sample of high-quality flooring however, the *tesserae* were small, square-sectioned and fitted so closely together that the interstices appeared as little more than hairline cracks.

In the three contexts examined first it was noted that the colour distribution was predominantly white (in the order of 75%) so this aspect was examined by context with the following percentage results listed in order of sample size:

Table 69 Tessera colours from key contexts

Context	**White**	**Grey**	**Red**	**Green**	**Yellow**	**Unassessed**
All	57.84	29.75	11.17	0.07	0.69	0.49
598	78.72	17.02	3.95	0.0	0.03	0.0
558	80.10	18.88	1.02	0.0	0.0	0.0
585	72.73	23.03	3.64	0.0	0.0	0.0
559	76.58	18.02	5.41	0.0	0.0	0.0
507	41.67	44.79	13.54	0.0	0.0	0.0
535	72.88	23.73	1.69	0.0	1.69	0.0

The colours were graded only as white, grey/dark, clearly red, green and yellow. Listed with grey are all very dark hues varying from blackish to very dark brown. The percentage of yellow in C535 represents one *tessera*. A green *tessera* was recorded in C613. Material used included chalk, shale, greensand, tile and flint.

A block of four moderately large chalk *tesserae* was found in the backfill material re-excavated from context 403, and a mortared pair of smaller units was found in both context 585 and context 598. These apart, all *tesserae* were found as single units, some abraded, some with mortar adhering and others very sharp and clean.

Several square-section ‘rods’ of both white and red material were found - one red rod in each of contexts 424 and 417, two in 402; white rods were found in contexts 598, 585, 710 and 510. A number of clean red tile cubes of a size appropriate to the edging round a floor, were also noted.

A number of rather long *tesserae* are probably the 'stub ends' of rods. A fragment of yellow sandstone 25 x 25 x 8mm was found which may be a 'blank' from which two or three small yellow *tesserae* could be cut. A number of larger flat flints, found in the ditch of Area B, appear to have been cut possibly for use as *opus sectile.*

Figures

176. Bar Chart illustrating principal contexts containing tesserae

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Blue Frit – by Susan Clegg and Julia Freeman

Introduction: The aim of this report is to present results following the analysis of blue pellets recently recovered from Fishbourne Roman Palace. These pellets have been examined under a Stereomicroscope; they were also examined by X-ray Fluorescence Spectroscopy in order to determine their chemical composition.

The word pigment (Latin *pigmentum*) means a coloured substance, usually in the form of a dry powder which, when mixed with a vehicle, constitutes a 'paint'. Pigments, whether crystalline or amorphous, were ground into uniform particles and, as they have no adhesive qualities, required a binding material or medium to hold them in place (Mora, *et al*., 1984).

Pigments may be divided into different categories such as mineral or organic and natural or artificial, depending on their origin. Natural pigments are found in the earth in the form of carbonates, sulphates, sulphides and oxides. After extraction the mineral was left to dry naturally in the sun. It was then roughly ground and sieved to remove any impurities, re-ground to a fine powder, cleaned and dried. Artificial mineral pigments are the product of a well-defined chemical process. They are obtained by sublimation or by a wet method through precipitation of chemical solutions (Mora, *et al., 1984.*).

It was during the third millennium BC that Egyptian artisans, being '*… masters* [in] *the art of fire* …' began to develop the first synthetic pigment known as '*blue frit'* (Delamare & Guineau, 1999, p.22 2:2). Large samples of blue pigment were found in flat-bottomed containers dating from the mid to late 14th century BC by Sir Flinders Petrie at a 'factory' site in the ancient metropolis of Tel el Amarna in Middle Egypt in the late 1890s. These samples, which were examined by Spurrell (1895), consisted of a crystalline compound resulting from the fusion of silica, copper ore and an alkali. Their colours varied from a pale to a dark blue.

The manufacture of *blue frit* was codified by Vestorius at the Campanian city of Puteoli in the 1st century BC (Ling, 1992). The procedure involved the mixing of finely ground silica, copper filings and flowers of soda into a water-based paste which was then rolled into small pellets. The pellets were allowed to dry naturally then placed in earthenware pots and

finally placed in an oven and, according to Vitruvius '… *As soon as the copper and sand grow hot and unite under the intensity of the fire, they mutually receive each other's sweat, relinquishing their particular qualities, and having lost their properties through the intensity of the fire, they are reduced to a blue colour'* (Book VII, 219:1). The resulting blue crystalline compound was coarsely ground before use. Blue pigmented pellets have been found on different Romano-British sites and were examined, using X-ray diffraction analysis, by the late Leo Biek in the early 1980s (Davey & Ling, 1982).

Materials and Methods: Twenty-six finds of blue pellets were obtained from the 1995 – 1999 excavations at Fishbourne Roman Palace, near Chichester in West Sussex. The specimens varied in size, shape, texture and colour.

X-ray Fluorescence Spectroscopy (XRF) was performed on all the samples. This non-destructive analytical technique is used to identify and determine the concentration of elements present in solid, powered and liquid samples. The technique is relatively sensitive and is capable of detecting elements above sodium (Na) in the Periodic Table and is particularly useful for detecting heavy metal pollutants such as lead (Pb). XRF is widely used in archaeological research because of its ability to carry out accurate analyses at high speed with the results being available within minutes. For this study it was used semi-quantitatively to assess the main elements present and their approximate proportions. No standardizations were carried out. The machine used for this report was Cambridge Instruments AN10000 X-Ray Spectrometer with a Philips PV9500 detector and X-ray tube.

The samples were also examined under a MEIJI Techno RZ zoom Stereomicroscope with a fibre-optic light source to study the fine detail. All pellets made available for the study were photographed and photomicrographs were subsequently taken at magnifications between x 20 and x 60 using a Nikon Coolpix 950 digital camera. Because the pellets are never homogeneous, the colours were identified using the *Munsell Book of Color (Matte Finish Collection) 1973* and should be considered as a guide only.

Results: Below are photographs, together with a magnified view, of the pellets found in various contexts at the Fishbourne Roman Palace during the excavation seasons of 1997, 1998 and 1999. Beneath each photograph is a printout of the XRF results obtained for each of the pellets (Fig. 177 – photographs; Fig.178 – XRF printouts). Note that each pellet has an ID Number usually comprised of context/small finds number.

Pellet ID Number: 437.4/1999 (fill of robber-trench; internal wall, north side of Building 3)

Weight: 1.17 g Magnification: x 30
Dimensions: 13 x 11 x 9 mm
Munsell No: 10 B 6/6

Fig. 177.1a

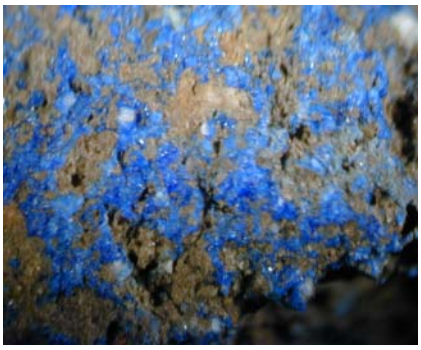

Fig. 177.1b

XRF:

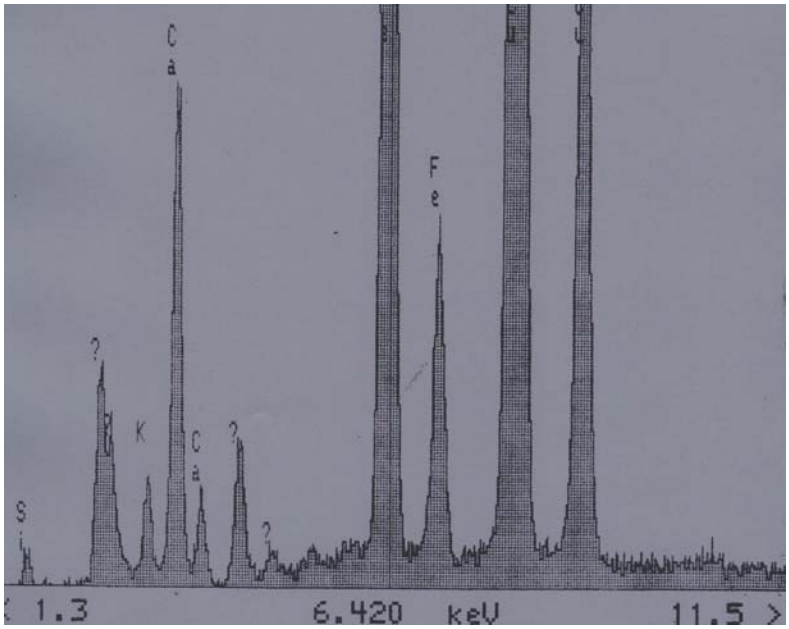

Fig. 178.1

Pellet ID Number: 501/2140 (Topsoil)

Weight: 0.09 g
Dimensions: 4 x 5 x 7mm
Munsell No: 10 B 6/6

Magnification: x 25

Fig. 177.2a

Fig. 177.2b

XRF:

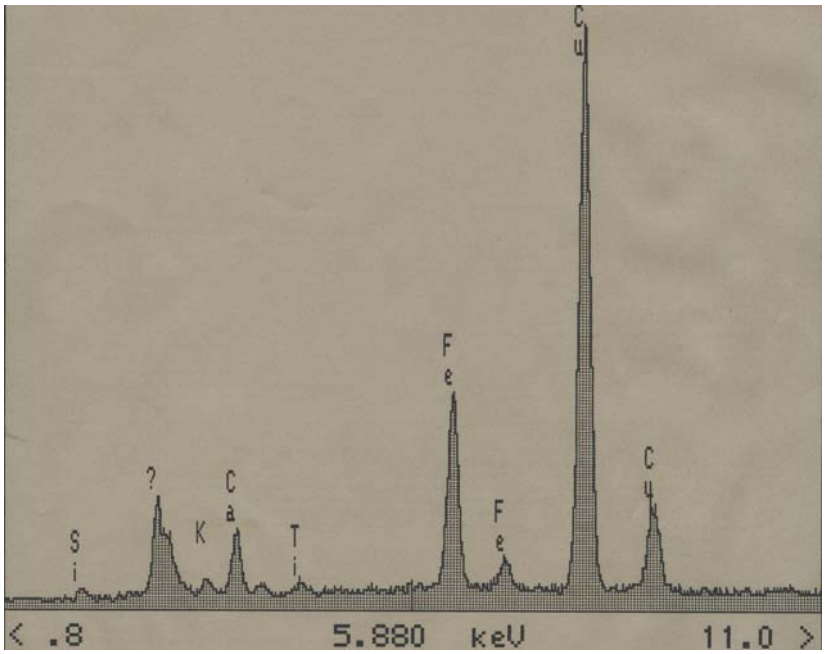

Fig. 178.2

Pellet ID Number: 501/2150 (Topsoil)

Weight: 0.44 g
Dimensions: 6 x 8 x 11 mm
Munsell No: 10 B 7/4

Magnification: x 20

Fig. 177.3a

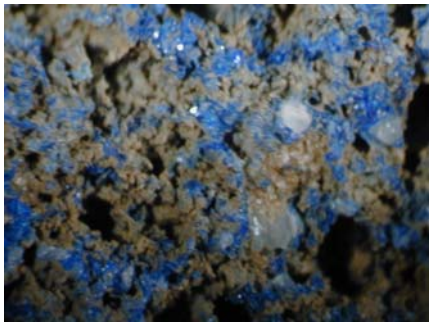

Fig. 177.3b

XRF:

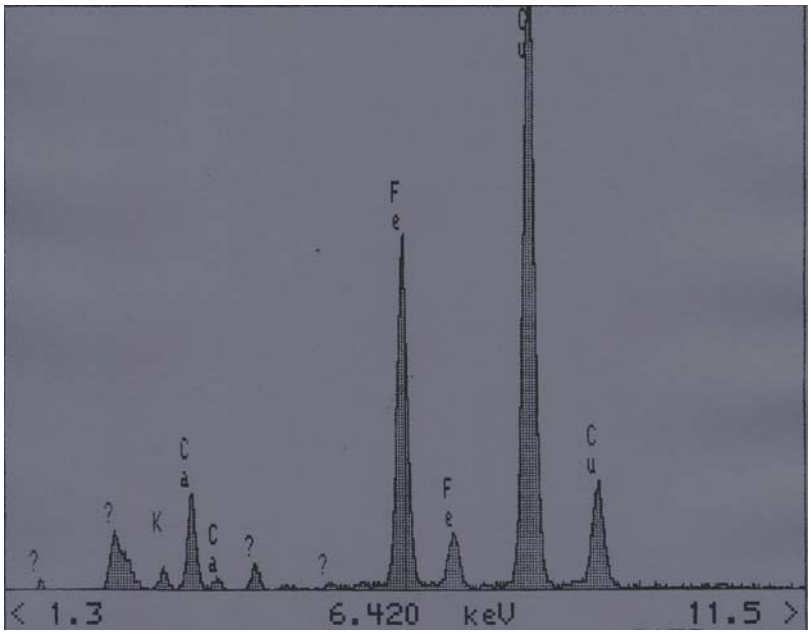

Fig. 178.3

Pellet ID Number: 505/2083 (Backfill from Alec Down trench)

Weight: 0.55 g Magnification: x 25
Dimensions: 7 x 9 x 10 mm
Munsell No: 10 B 6/8

Fig. 177.4a

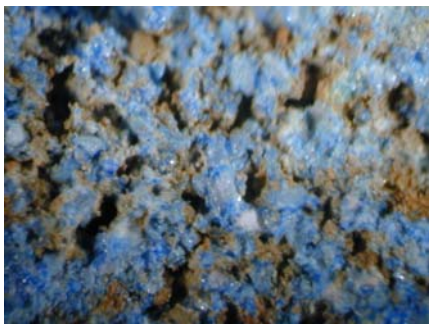

Fig. 177.4b

XRF:

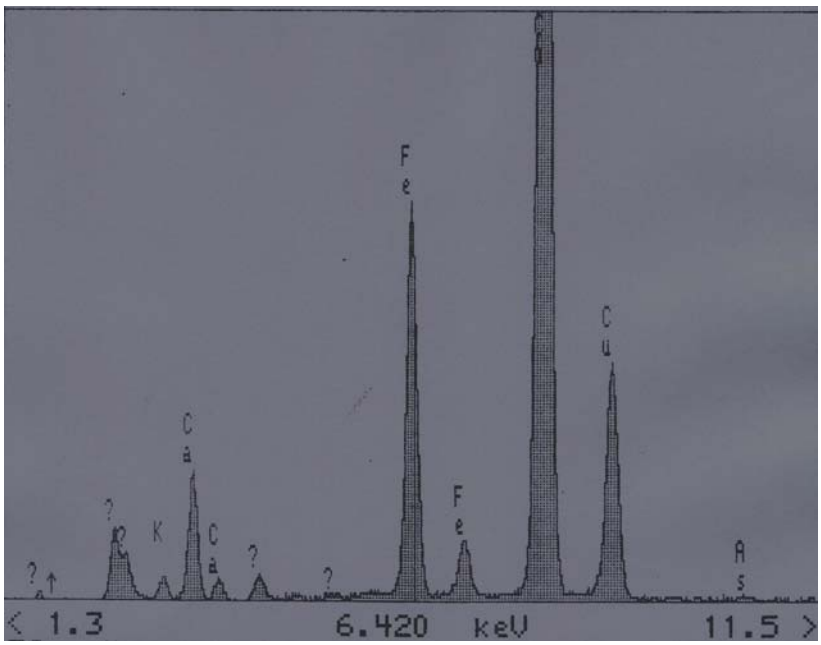

Fig. 178.4

Pellet ID Number: 507/2299 (General upper layer)

Weight: 0.32 g
Dimensions: 6 x 8 x 9 mm
Munsell No: 5 PB 5/10

Magnification: x 20

Fig. 177.5a

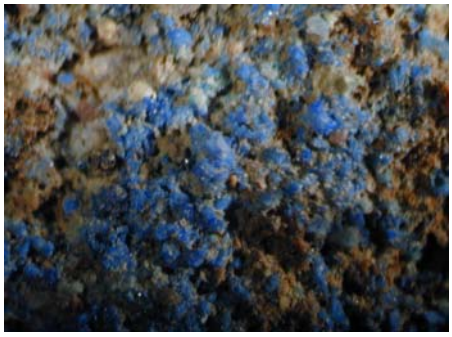

Fig. 177.5b

XRF:

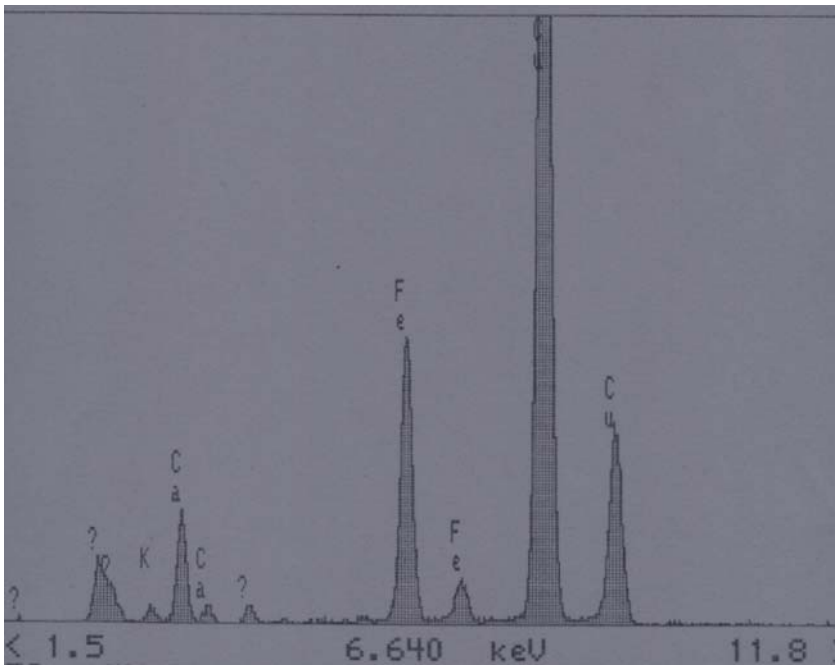

Fig. 178.5

Pellet ID Number: 507/2569 (General upper layer)

Weight: 2.66 g Magnification: x 20
Dimensions: 13 x 14 x 18 mm
Munsell No: 5 PB 5/10

Fig. 177.6a

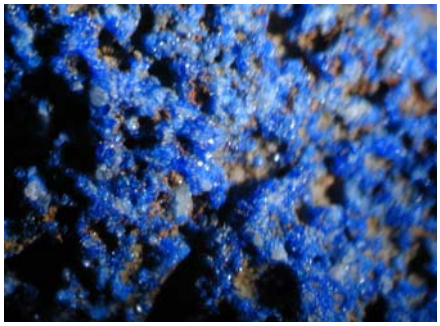

Fig. 177.6b

XRF:

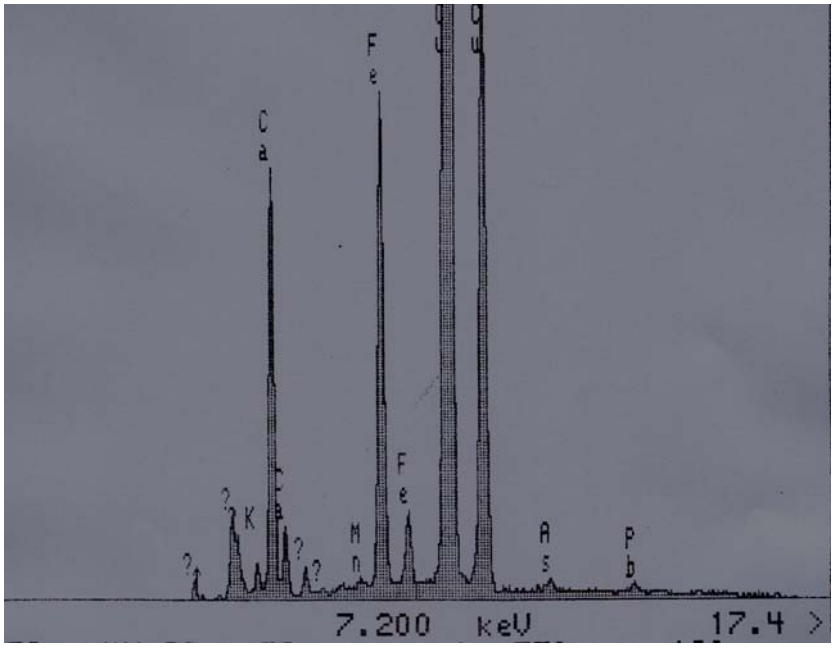

Fig. 178.6

Pellet ID Number: 507/2817 (General upper layer)

Weight: 1.65 g Magnification: x 20
Dimensions: 11 x 12 x 19 mm
Munsell No: 10 B 7/4

Fig. 177.7a

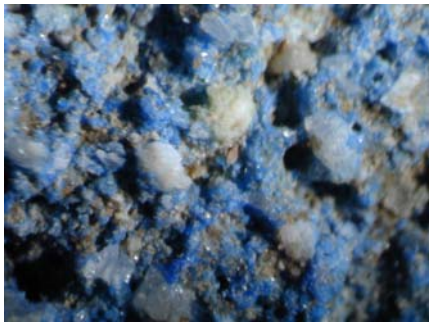

Fig. 177.7b

XRF:

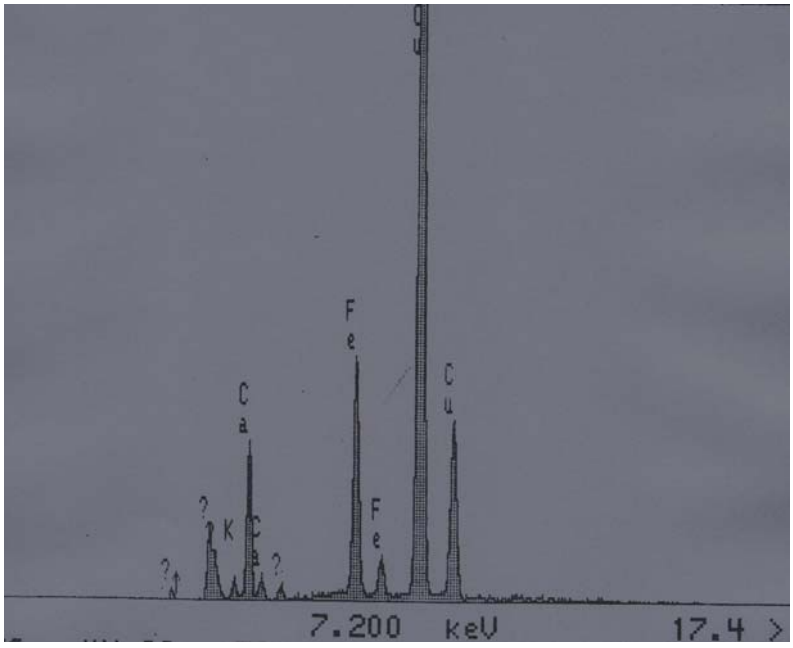

Fig. 178.7

Pellet ID Number: 507/3125 (General upper layer)

Weight: 1.5 g Magnification: x 20
Dimensions: 12 x 13 x 17 mm
Munsell No: 5 PB 5/8

Fig. 177.8a

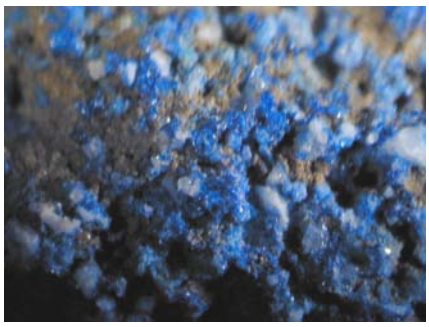

Fig. 177.8b

XRF:

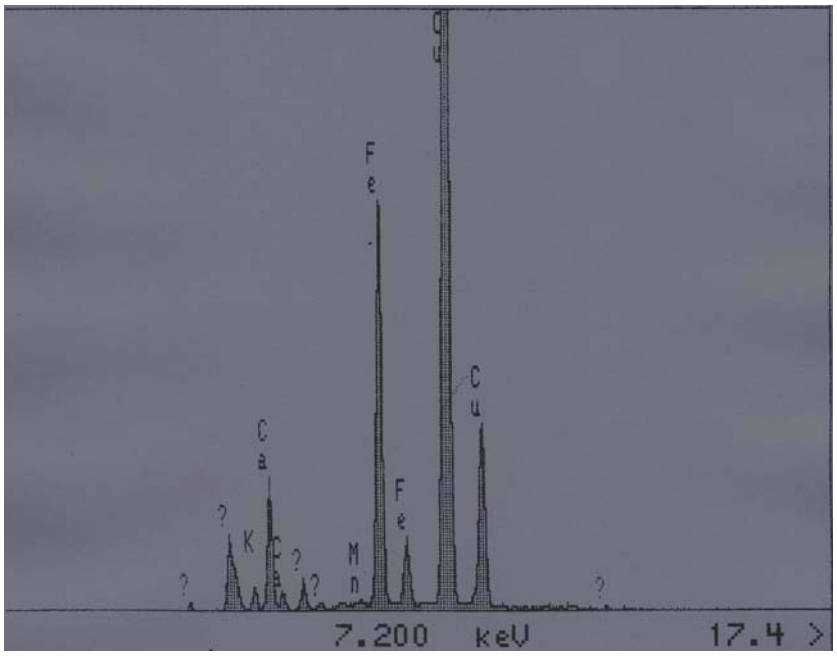

Fig. 178.8

Pellet ID Number: 510/2478 (Above greensand road)

Weight: 0.46 g
Dimensions: 6 x 8 x 10 mm
Munsell No: 10 B 7/6

Magnification: x 30

Fig. 177.9a

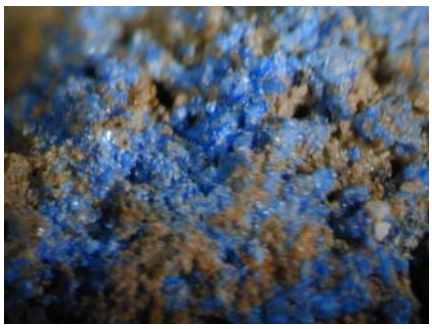

Fig. 177.9b

XRF:

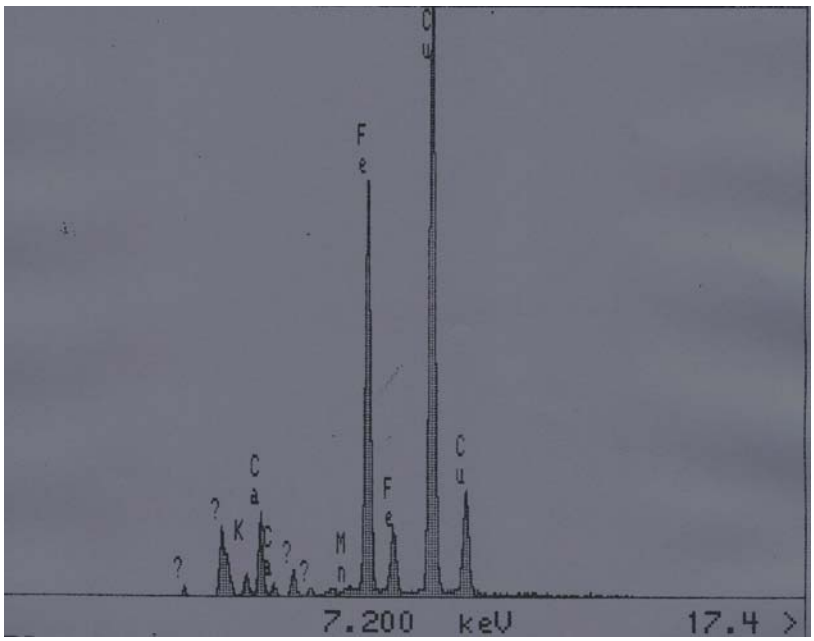

Fig. 178.9

Pellet ID Number: 512/2548 (Above greensand road)

Weight: 0.36 g Magnification: x 30
Dimensions: 5 x 7 x 9 mm
Munsell No: 10 B 6/6

Fig. 177.10a

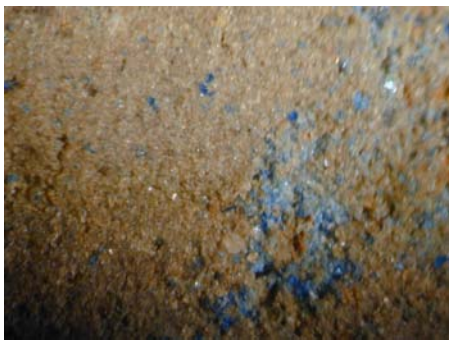

Fig. 177.10b

XRF:

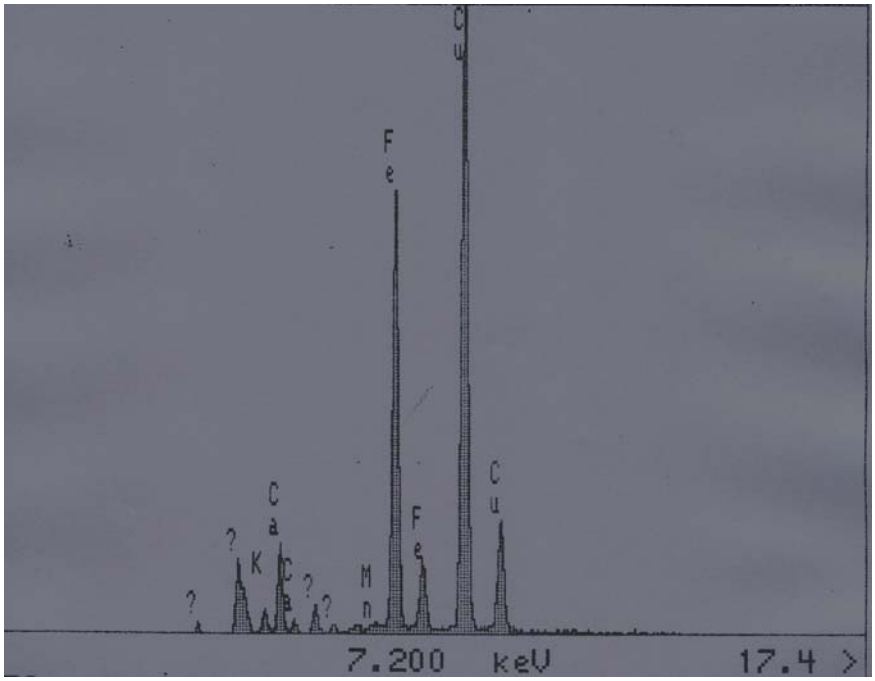

Fig. 178.10

Pellet ID Number: 513/2634 (South of greensand road)

Weight: 0.49 g
Dimensions: 7x 9 x 10 mm
Munsell No: 10 B 6/6

Magnification: x 30

Fig. 177.11a

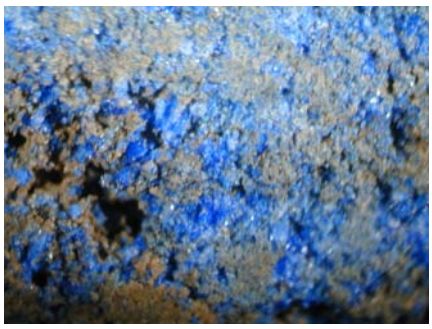

Fig. 177.11b

XRF:

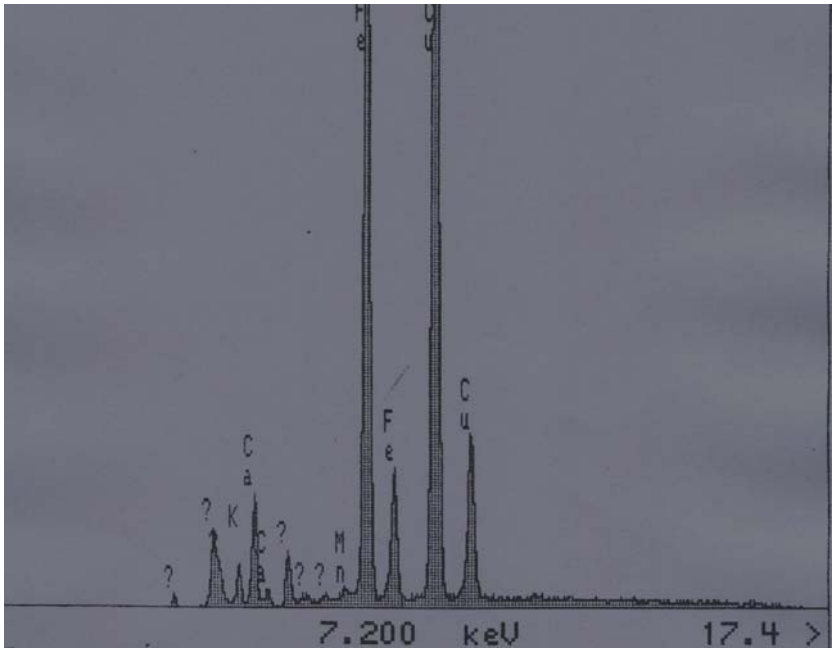

Fig. 178.11

Pellet ID Number: 513/2714 (South of greensand road)

Weight: 1.27 g Magnification: x 20
Dimensions: 8 x 10 x 17 mm
Munsell No: 10 B 7/4

Fig. 177.12a

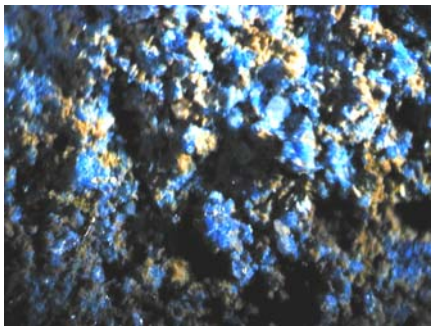

Fig. 177.12b

XRF:

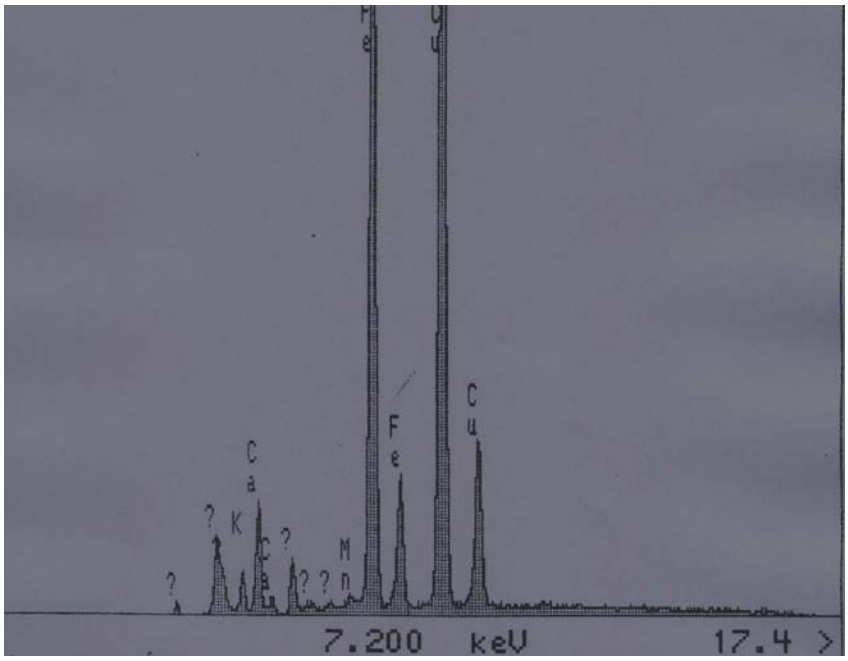

Fig. 178.12

Pellet ID Number: 513/2965 (South of greensand road)

Weight: 0.3 g Magnification: x 25
Dimensions: 5 x 7 x 8 mm
Munsell No: 5 PB 6/8

Fig. 177.13a

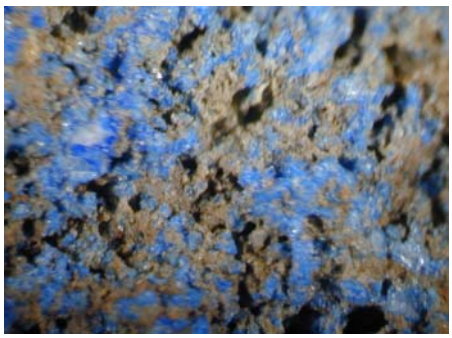

Fig. 177.13b

XRF:

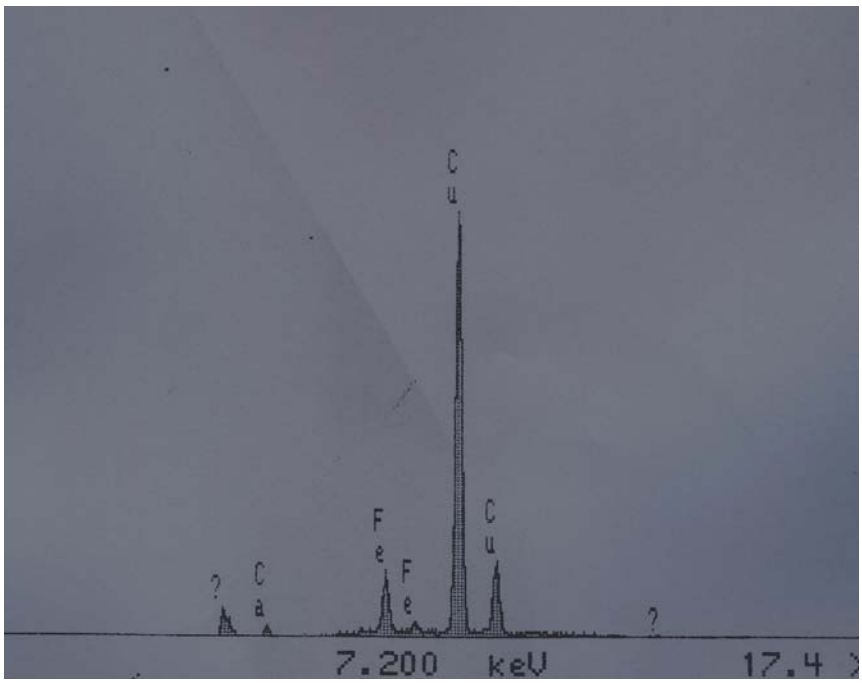

Fig. 178.13

Pellet ID Number 578/5627 (Palace Demolition)

(a) Upper Pellet:
Weight: 0.03 g Magnification: x 25
Dimensions: 2 x 3 x 3 mm
Munsell No: 5PB 6/6

(b) Lower pellet:
Weight: 0.07 g Magnification: x 25
Dimensions: 4 x 4 x 6 mm
Munsell No: 5 PB 6/6

Fig. 177.14a

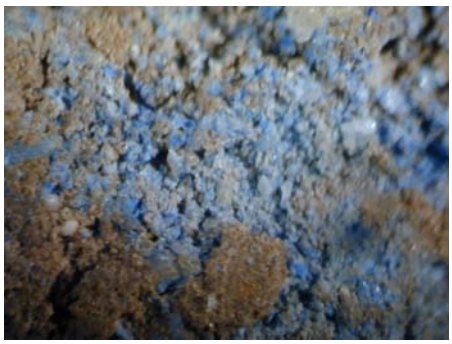

Fig. 177.14b

XRF:

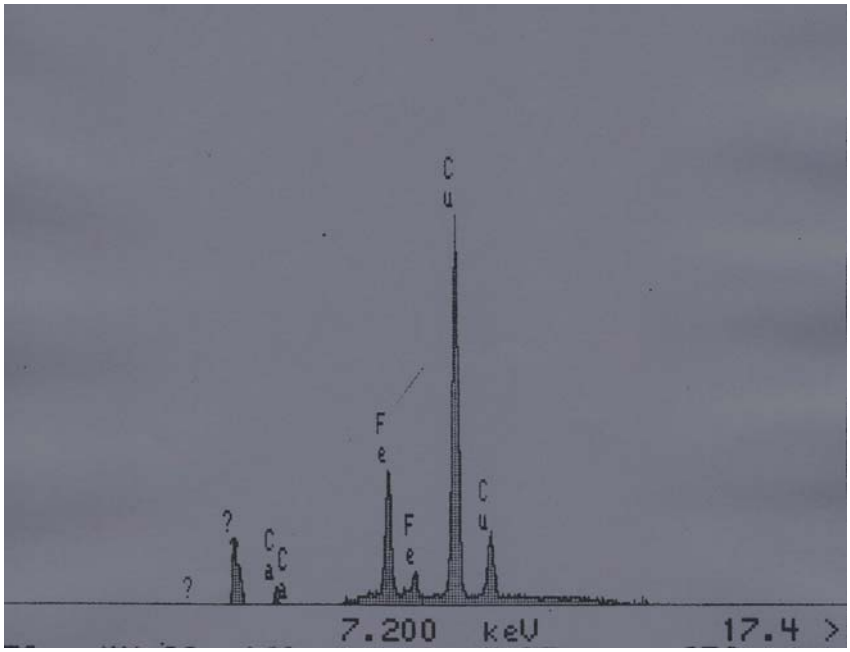

Fig. 178.14

Pellet ID Number: 578/5825 (Palace Demolition)

Weight: 0.58 g Magnification: x 25
Dimensions: 7 x 10 x 11 mm
Munsell No: 10 B 7/4

Fig. 177.15a

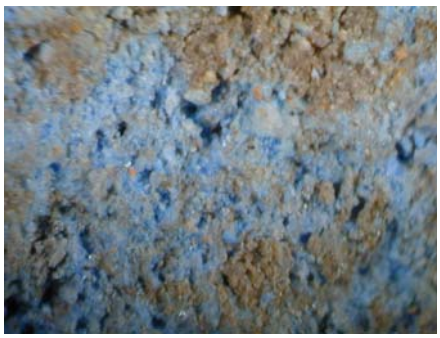

Fig. 177.15b

XRF:

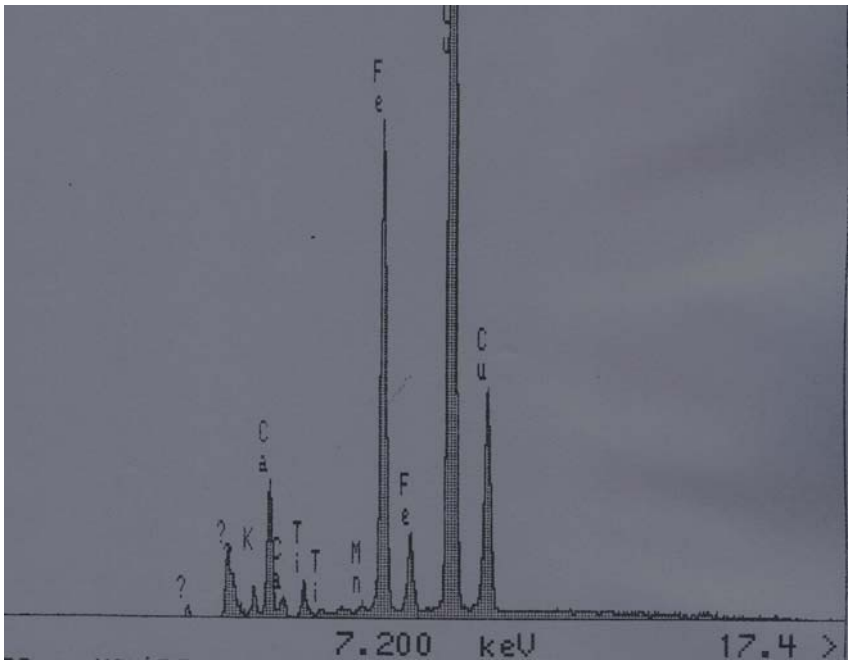

Fig. 178.15

Pellet ID Number: 579/5597 (Demolition over aqueduct)

Weight: 1.18g Magnification: x 20
Dimensions: 10 x 11 x 13 mm
Munsell No: 10 B 7/4

Fig. 177.16a

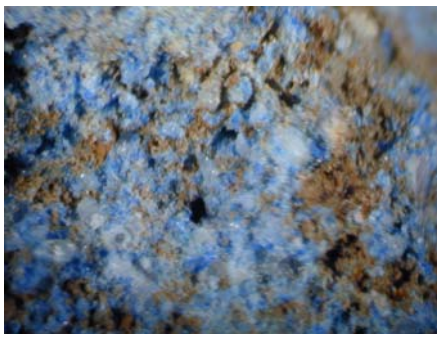

Fig. 177.16b

XRF:

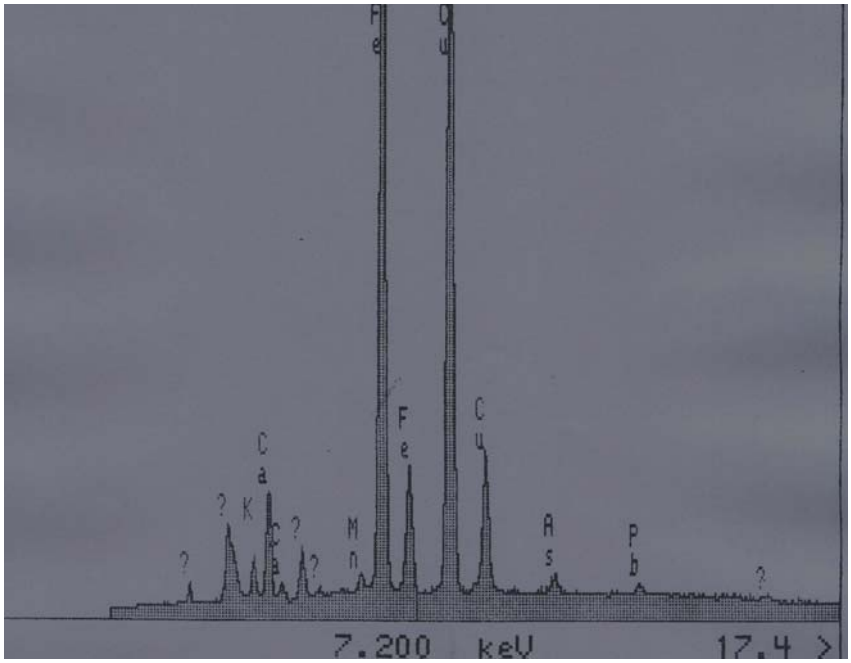

Fig. 178.16

Pellet ID Number: 588/7817 (N-S road surface of Phase AB)

Total Weight: 0.45 g Magnification: x 20

(a) Dimensions of largest part:: 3 x 6 x 7 mm

(b) Dimensions of second largest part: 3 x 5 x 5 mm

(c) Remainder in pieces:

Munsell No: 10 B 5/8

Fig. 177.17a

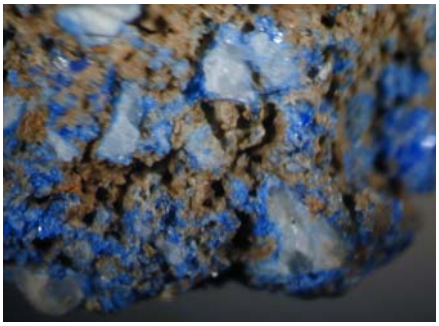

Fig. 177.17b

XRF:

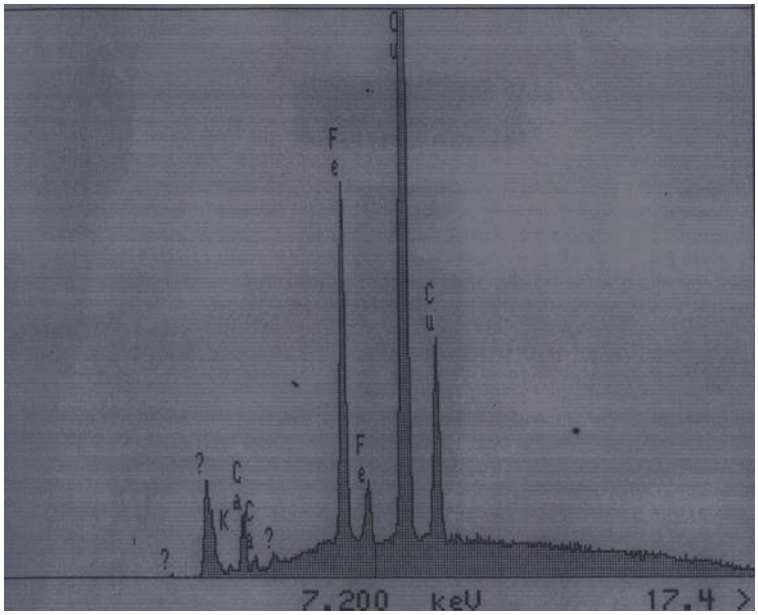

Fig. 178.17

Pellet ID Number: 604/6462 (Upper fill of aqueduct)

Weight: 3.43 g
Dimensions: 15 x 18 x 20 mm
Munsell No: 10 B 7/6

Magnification: x 20

Fig. 177.18a

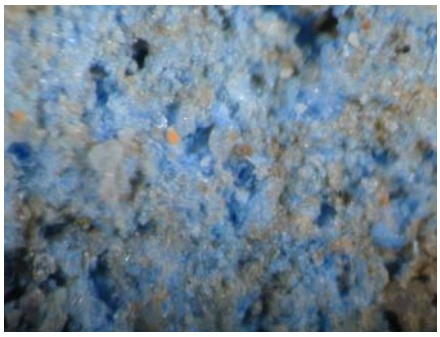

Fig. 177.18b

XRF:

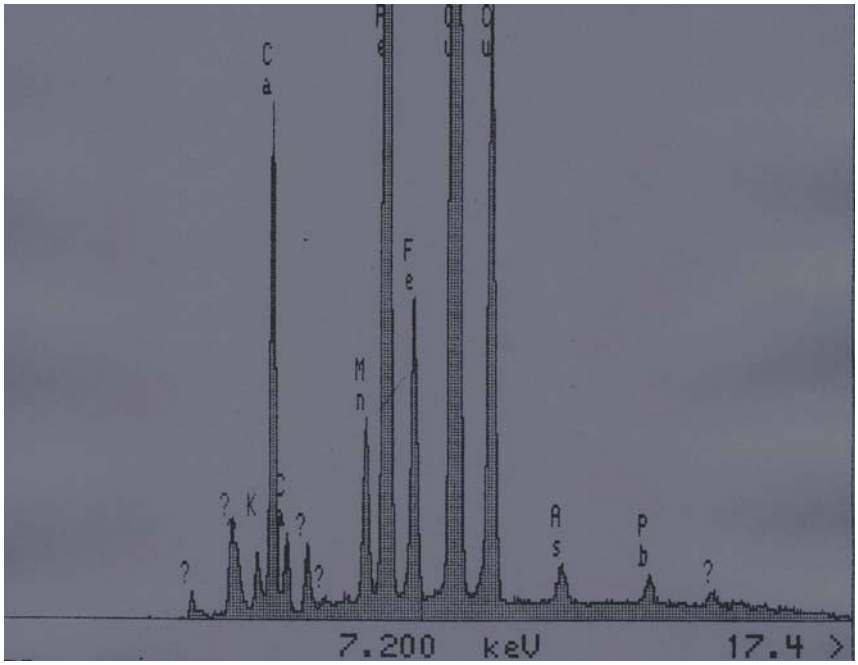

Fig. 178.18

Pellet ID Number: 711/9156 (Upper layer just below topsoil)

Weight: 0.59 g
Dimensions: 8 x 9 x 11 mm
Munsell No: 5 PB 5/6

Magnification: x 40

Fig. 177.19a

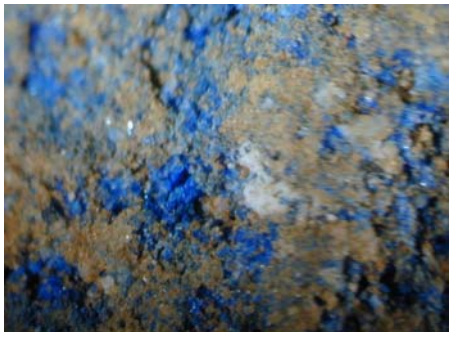

Fig. 177.19b

XRF:

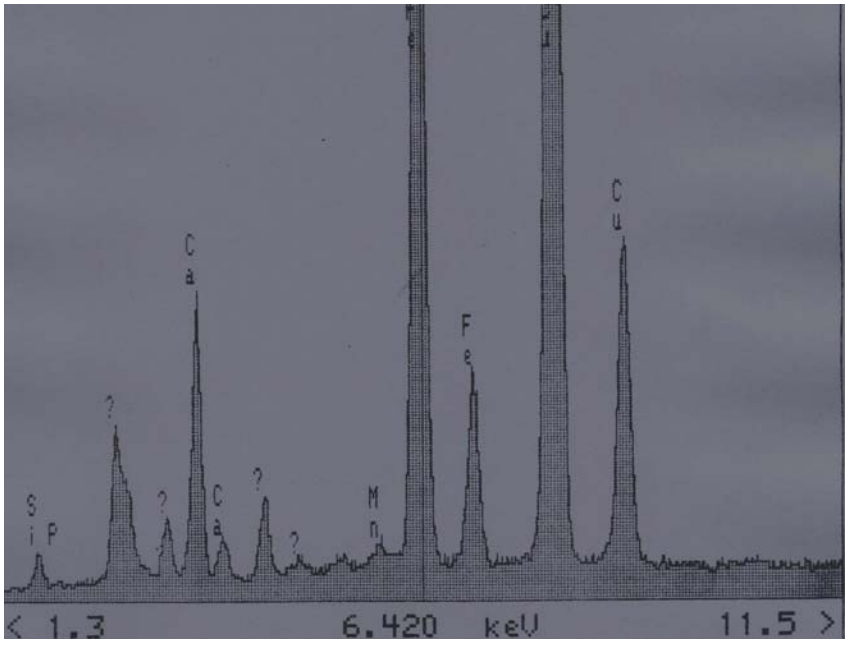

Fig. 178.19

Pellet ID Number: 711/9171(Upper layer just below topsoil)

Weight: 0.60 g Magnification: x 25
Dimensions: 7 x 9 x 10 mm
Munsell No: 5 PB 5/10

Fig. 177.20a

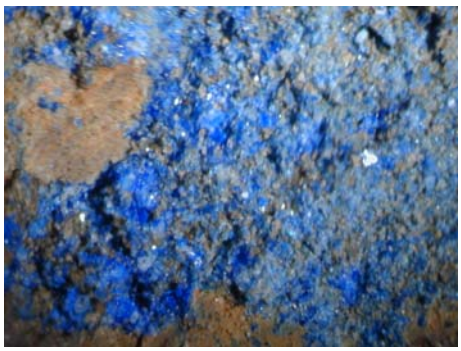

Fig. 177.20b

XRF:

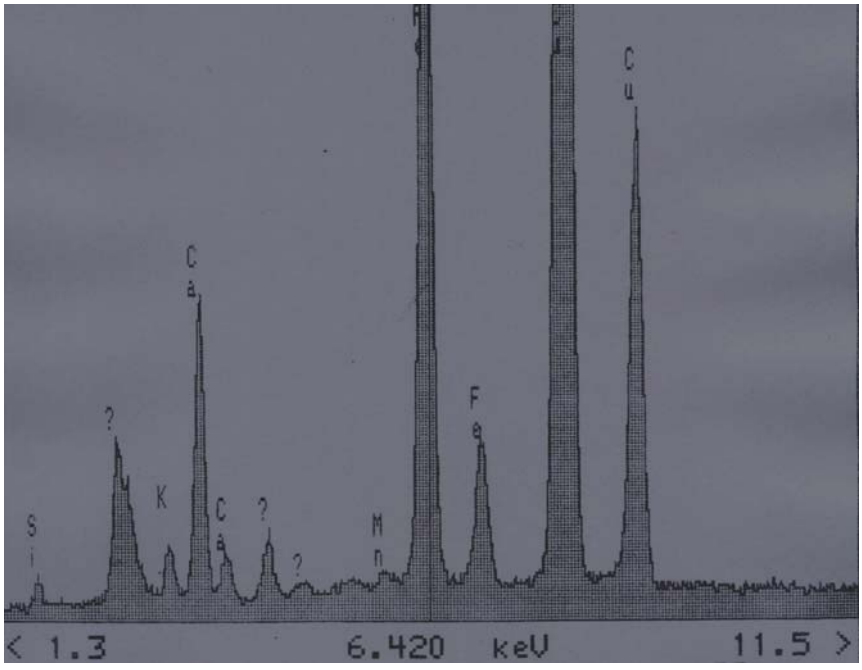

Fig. 178.20

Pellet ID Number: 711/9221(Upper layer just below topsoil)

Weight: 0.46 g
Dimensions: 7 x 8 x 8 mm
Munsell No: 5 PB 5/6

Magnification: x 20

Fig. 177.21a

Fig. 177.21b

XRF:

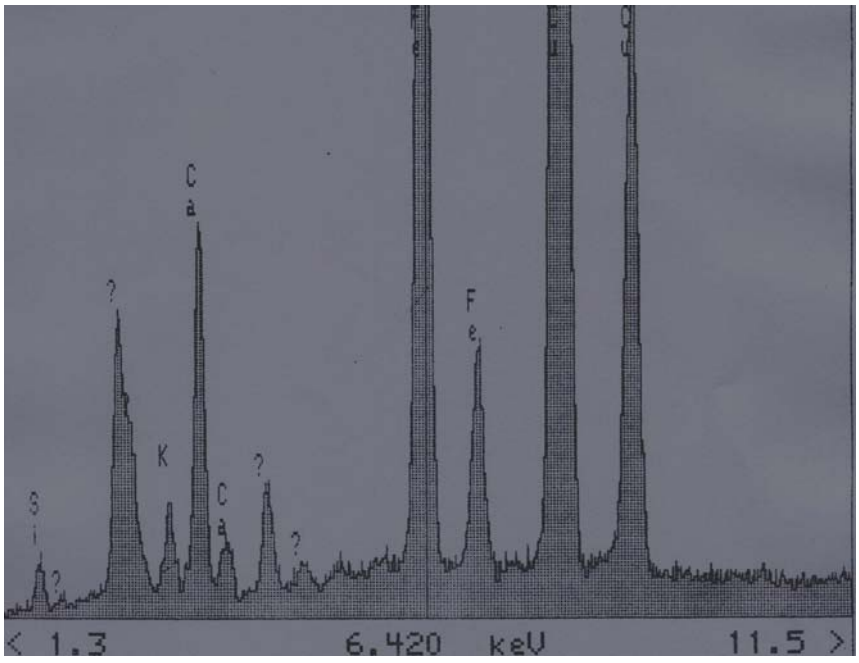

Fig. 178.21

Pellet ID Number: 726/9949 (Palace demolition deposit)

Weight: 0.12 g
Dimensions: 4 x 5 x 6 mm
Munsell No: 5 PB 5/8

Magnification: x 20

Fig. 177.22a

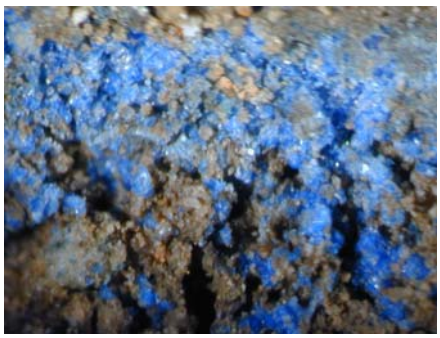

Fig. 177.22b

XRF:

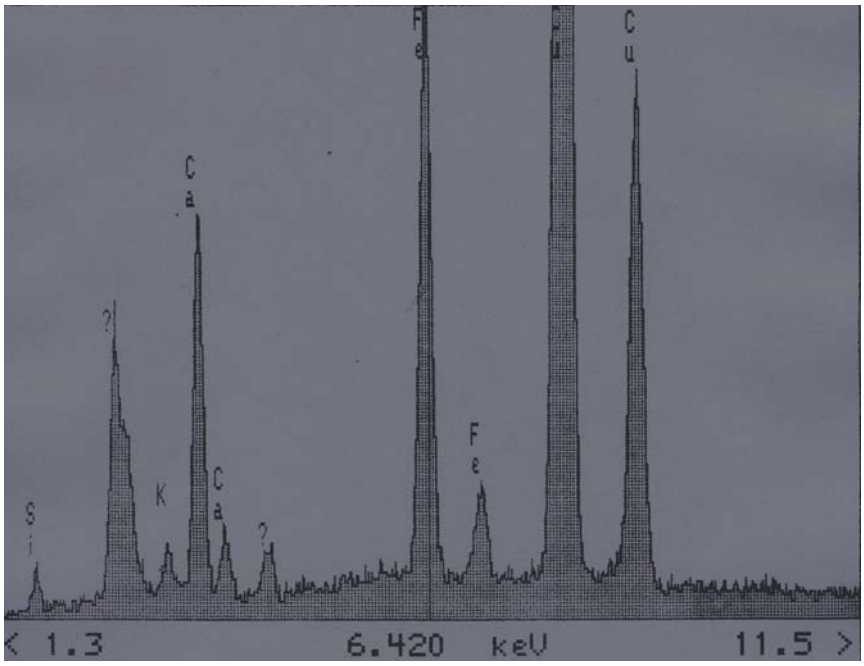

Fig. 178.22

Pellet ID Number: 742/10591 (Row 5 post-hole)

Weight: 1.38 g Magnification: x 20
Dimensions: 11 x 14 x 17 mm
Munsell No: 10B 6/6

Fig. 177.23a

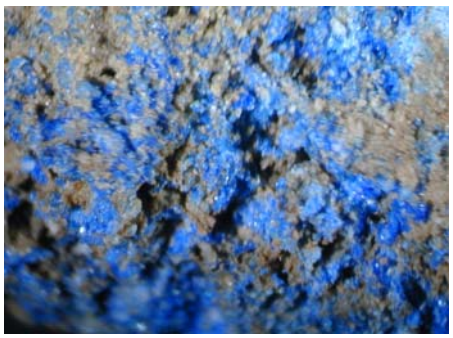

Fig. 177.23b

XRF:

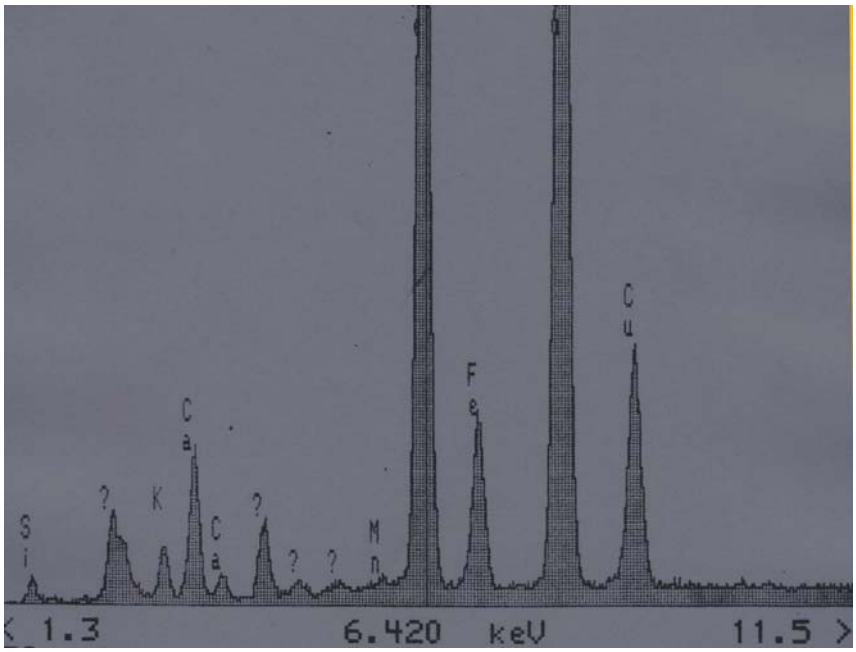

Fig. 178.23

Pellet ID Number: 818/10941 (Row 5 post-hole)

Weight: 0.39 g
Dimensions: 7 x 8 x 10 mm
Munsell No: 10B 6/6

Magnification: x 20

Fig. 177.24a

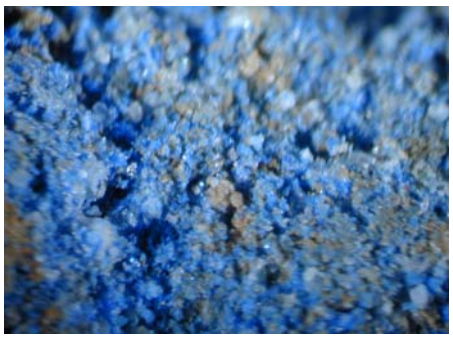

Fig. 177.24b

XRF:

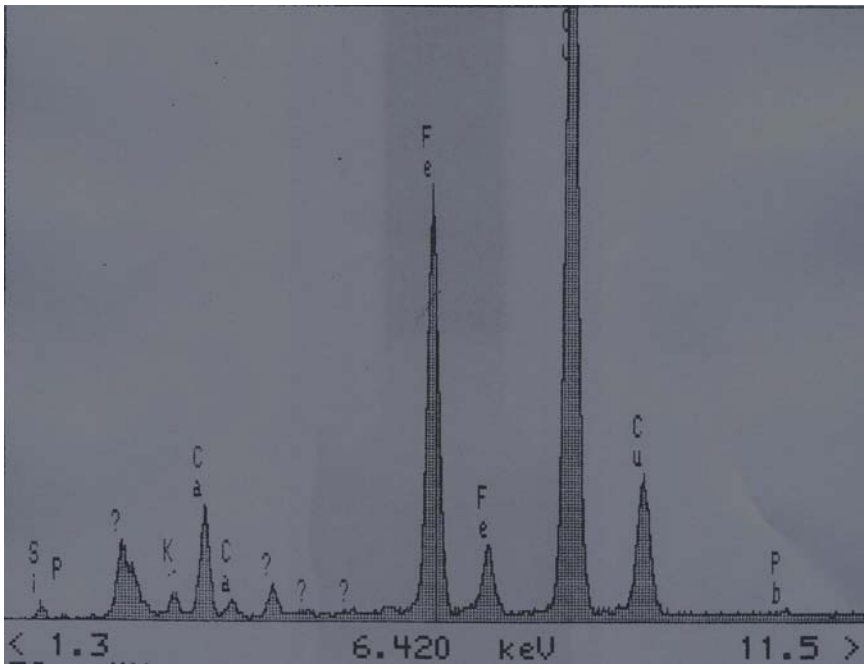

Fig. 178.24

Pellet ID Number: 904/10208 (Upper layer in Area B above Roman midden)

Weight: 0.8 g Magnification: x 30
Dimensions: 8 x 10 x 12 mm
Munsell No: 10 B 7/4

Fig. 177.25a

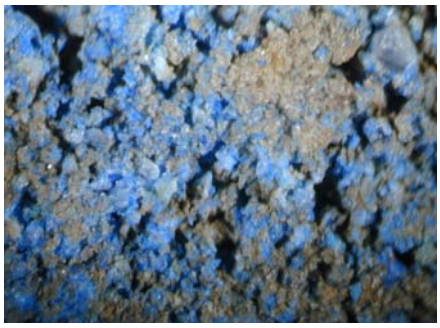

Fig. 177.25b

XRF:

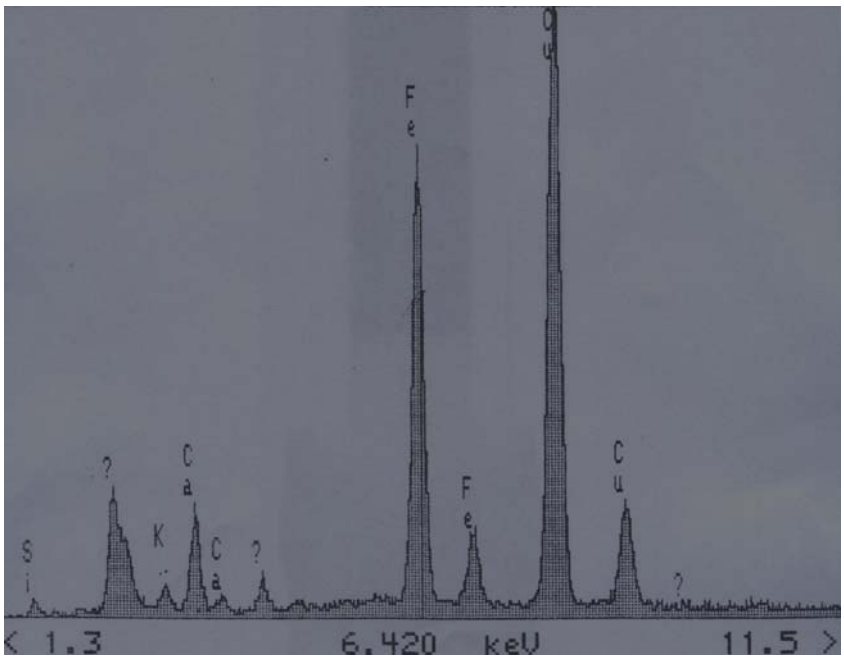

Fig. 178.25

Pellet ID Number: 907/11028 (Roman midden in Area B)

(a) Weight: 1.99 g Magnification: x 20
Dimensions: 10 x 16 x 18 mm
Munsell No: 5 PB 5/8

Fig. 177.26(a)a

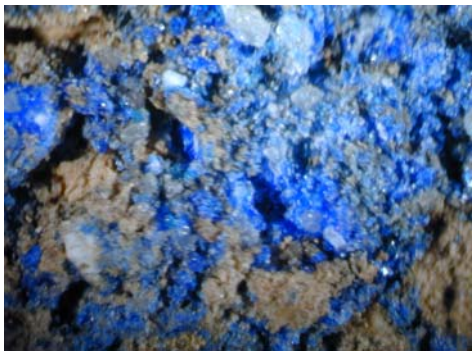

Fig. 177.26(a)b

XRF:

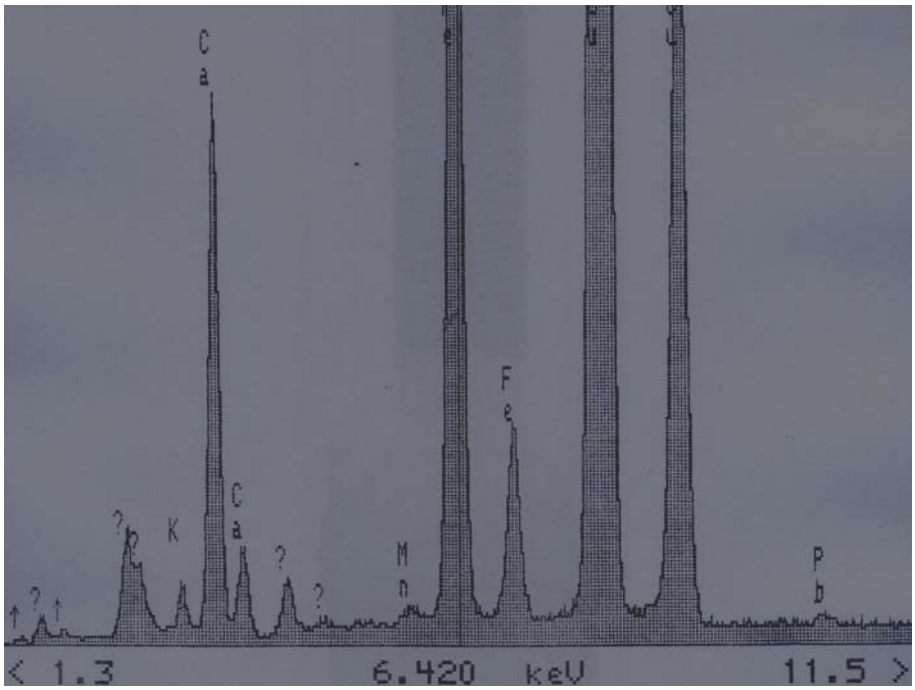

Fig. 178.26(a)

(b) Weight: 0.88 g Magnification: x 20
Dimensions: 9 x 13 x 15 mm
Munsell No: 5 PB 5/8

Fig. 177.26(b)a

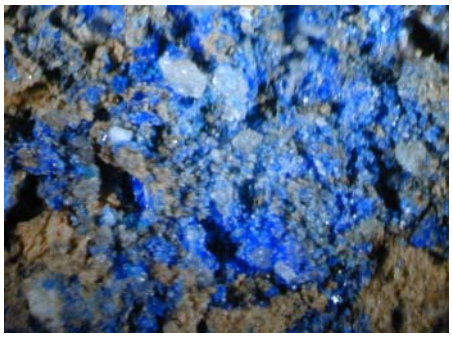

Fig. 177.26(b)b

XRF: As (a)

(c) Weight: 0.41 g Magnification: x 20
Dimensions: 5 x 9 x 11 mm
Munsell No: 5PB 5/8

Fig. 177.26(c)a

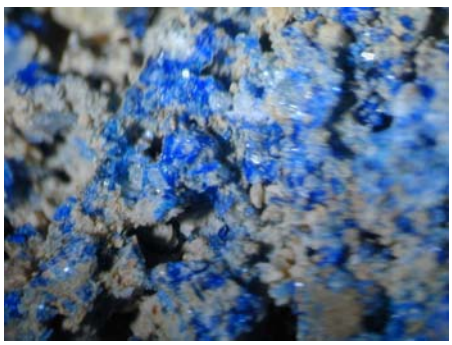

Fig. 177.26(c)b

XRF: As (a)

(d) Weight: 0.24 g
Dimensions: 5 x 7 x 12 mm
Munsell No: 5PB 5/8

Fig. 177.26(d)a

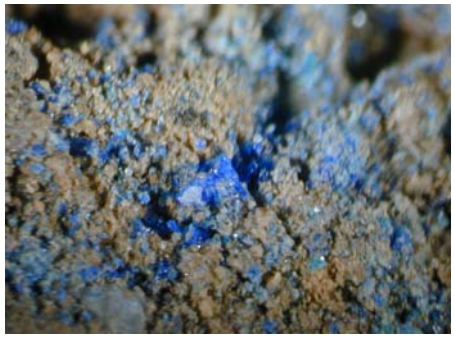

Fig. 177.26(d)b

XRF: As (a)

The **texture** and **detailed structure** of all the pellets were closely examined by the naked eye and also microscopically. As a result of this examination they were divided into four types, conveniently labelled as Fishbourne Roman Palace (FRP) Types I, II, III and IV.

The structure of FRP Type I shows that the ingredients of the pellets had been roughly ground. The quartz grains are large and there are a few inclusions. The composition of FRP Type II pellets is totally different: the ingredients of these pellets have been finely ground and there are some small inclusions. The quartz grains are also smaller in size. FRP Type III pellets varied slightly from those of Types I and II. Although the ingredients of these pellets have been finely ground there are a few large grains of quartz but very few inclusions. The ingredients of FRP Type IV pellets have been finely ground and there are no inclusions.

Chemical analysis of the pellets by XRF shows variations in the amount of copper (Cu), iron (Fe) and calcium (Ca) used in their manufacture. Lead (Pb) and arsenic (As) are also occasionally found. Using the XRF results (as printed above) the pellets were categorized by chemical composition into four groups:

Group 1

The secondary fluorescence peaks of copper and iron were similar in height whilst the calcium peak remains low. This implies similar proportions of copper and iron but low amounts of calcium.

Group 2

The secondary fluorescence iron peak is higher than the secondary copper peak whilst the secondary calcium peak is similar to that of Group 1. There is more iron contamination in these.

Group 3

The secondary fluorescence copper peak is higher than in Group 1. These pellets contain more copper than those in the other groups

Group 4

In this group the secondary fluorescence copper and calcium peaks are high whilst the secondary iron peak remains low; the proportions of copper and calcium are high, but the amount of iron is low compared with that found in the other groups. There are smaller peaks denoting the presence of lead and arsenic.

Table 70 below shows how the fabric and structure types relate to the chemical composition groups for each pellet found at Fishbourne Roman Palace during the excavations of 1995 to 1999.

Table 70 Blue frit from various contexts

Chemical Composition			**Texture**	
	FRP I	**FRP II**	**FRP III**	**FRP IV**
Group 1	FBE 99 742/10591	FBE 98 513/2714	FBE 99 904/10208	FBE 98 12/2548 FBE 98 513/296
Group 2	FBE 98 507/2299 FBE 98 507/2817 FBE 98 507/3125 FBE 98 578/5627 FBE 98 588/7817 FBE 99 726/9949	FBE 98 501/2150 FBE 98 513/2634 FBE 99 711/9171	FBE 98 501/2140 FBE 98 510/2478 FBE 98 578/5825	FBE 98 505/2083
Group 3		FBE 99 711/9156 FBE 99 711/9221	FBE 97 437.4/1999	
Group 4	FBE 98 507/2569 FBE 98 604/646 FBE 99 818/10941		FBE 98 597/5597 FBE 99 907/11028	

Figures

Fig.177 All Blue Frit photographs
Fig.178 All Blue Frit XRF print-outs