# A GROUP OF EARLY ROMAN QUERNSTONES FROM NUMBER 1 POULTRY, LONDON, EC4

Site code: ONE94

**Undated**

Author: D F Williams and D P S Peacock

**Museum of London Archaeology**

Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED
tel 0207 410 2200 fax 0207 410 2201 email mola@mola.org.uk

**A GROUP OF EARLY ROMAN QUERNSTONES FROM NUMBER 1 POULTRY, LONDON, EC4**

D.F. Williams* and D.P.S. Peacock**

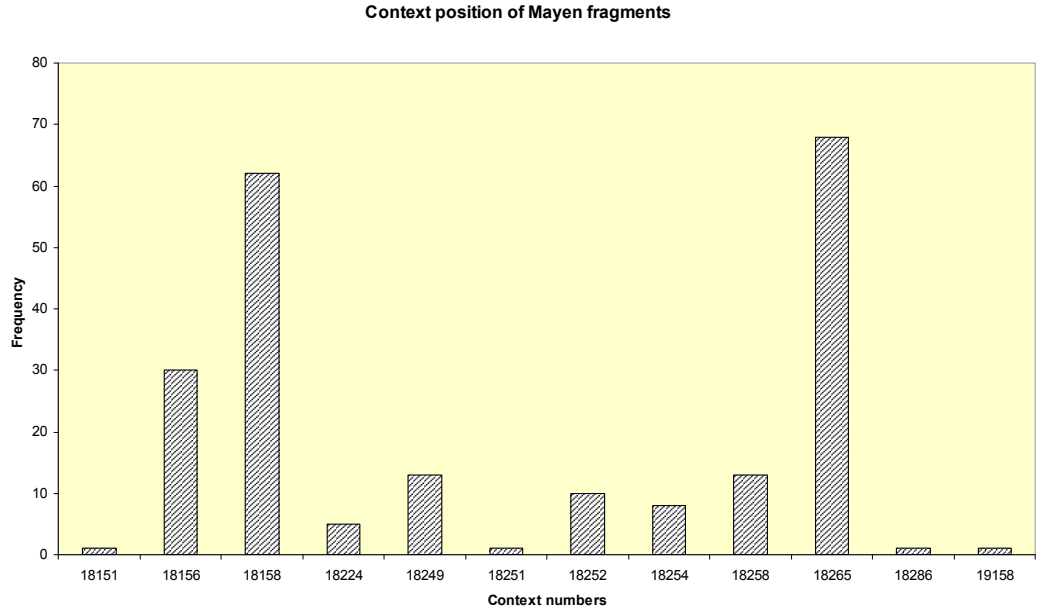
*English Heritage Ceramic & Lithic Petrology Project,
Department of Archaeology, University of Southampton.
**Department of Archaeology, University of Southampton.

with contributions by Jez Taylor, MoLAS, and a report on the mechanical behaviour of vesicular lava samples taken from the quern fragments by K.L. Watson, Department of Civil Engineering, University of Portsmouth.

## INTRODUCTION

An estimated total of 1,000 broken and discarded fragments (Fig 1) from rotary quernstones were recovered from a small number of closely related individual contexts within Area 12 of the excavation sequence at Poultry, located near the west bank of the Walbrook stream. These quern fragments, of variable size, had been used as an external cobbled surface and were adjacent to and thought to be contemporary with, a large timber-lined water reservoir dated by dendrochronology to c. A.D. 70-90.

*Fig 1 Context position of Mayen fragments*




The Poultry rotary querns are a truly remarkable assemblage without parallel in Britain, or indeed western Europe, with many of them occurring as large segments of upper or lower stones (Fig 2; Fig 3). This find is of particular significance because: (a) of its size, (b) the vast majority are made from lava, and (c) it seems to be a closely dated assemblage. There is also the question as to what this large group actually represents. They could, for example, be waste material collected from a nearby

importers yard or perhaps from a nearby mill or bakery or even ship's ballast, arriving in London after use elsewhere. The fragments of quern all show wear patterns, with some appearing very worn, indicating that they had been used before dumping. The great advantage of the lava querns is that the sharp edged vesicles on the grinding surfaces of both upper and lower stone would "shear" or cut the ears of corn, whereas sandstones, for example, would use a rolling, crushing action. The "shearing" action should produce a finer grade of flour than the "crushing" method.

*Fig 2 Quern stone type (all fabrics)*

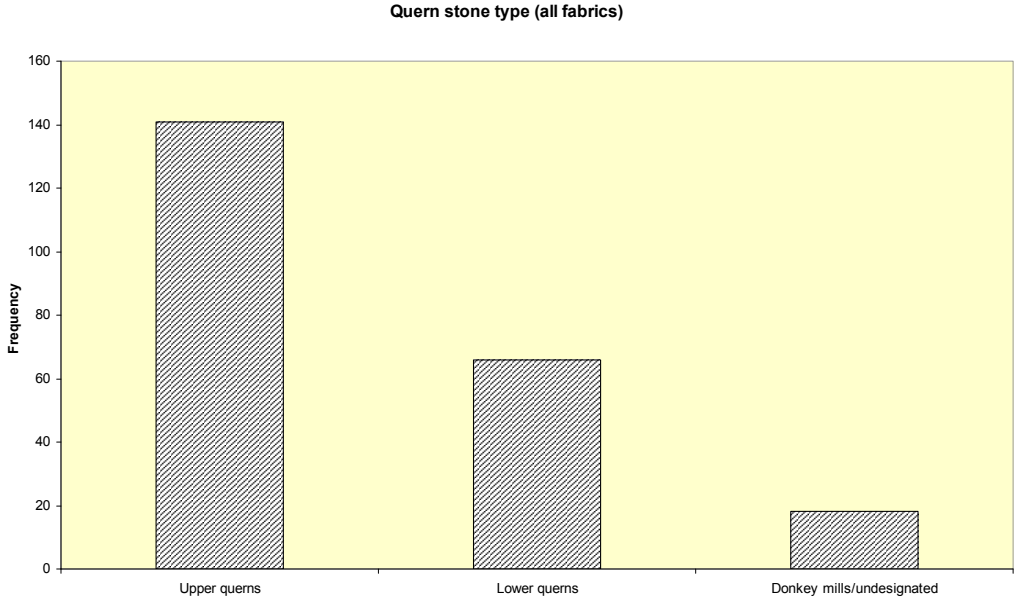
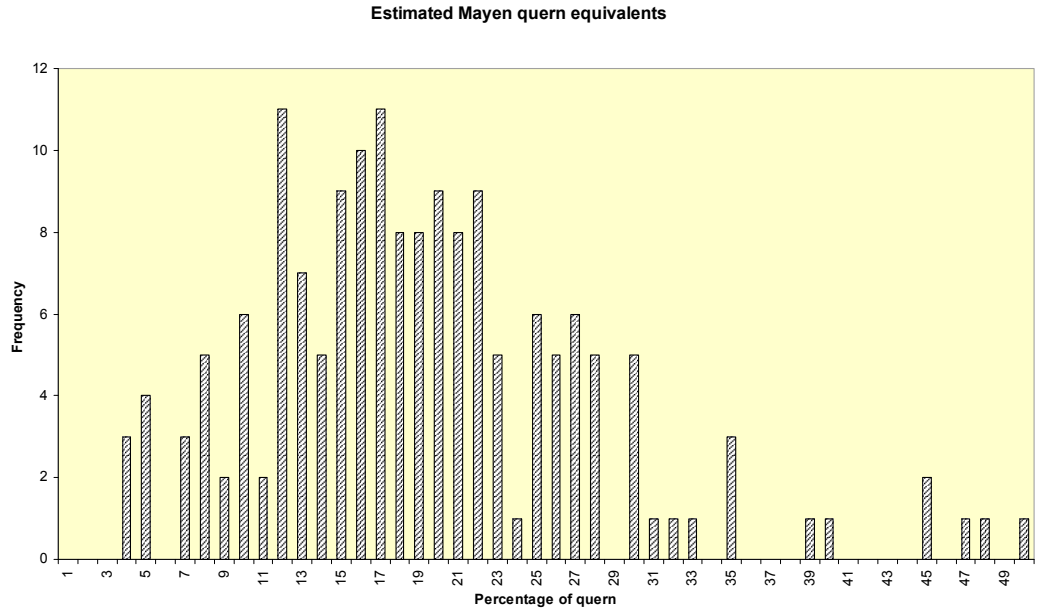



*Fig 3 Estimated Mayen quern equivalents*




A methodology for the basic recording of the querns was devised by the Museum of London Archaeology Service in association with the writers as part of a programme for the completion of the Field Archive phase of the Poultry excavations. The methodology included the production of a Quern Stone Recording Sheet designed to be compatible with the MoLAS single-context recording system and other types of MoLAS recording sheets. It became apparent during discussions that the recording

and assessment of all the 1,000 odd quern stones would be prohibitively expensive, and that a smaller sample would meet the requirements of assessing the potential of the assemblage. It was therefore decided to record and publish details of only c. 25% of the total quern fragments recovered. The selection of the stones recorded was not random, since a bias was used to include the best diagnostic examples in the sample.

A total of 225 individual quern stone fragments were recorded in detail and selected stones were photographed. The querns are identified by a sequential numbering system from 1 to 230 although numbers 62, 213, 214, 216, and 221 were not used. In view of the overwhelming preponderance of lava quern fragments in the assemblage, the following detailed descriptions and related graphs do not for the most part include the twelve non-lava pieces: nos. 31, 32, 33, 51, 121, 122, 147, 148, 158, 179, 180, and 181. Full descriptions and measurements for these can be found in the catalogue.

A small number of special features should be noted. Querns 107 and 164 had undergone unusual cutting or recutting.

Many of the querns were either soot or iron-stained. The soil matrix surrounding the cobbled surfaces from which the stones were recovered did not appear to contain any ferrous or burnt material. The staining may have resulted from secondary use prior to their employment in the cobbled surface.

## TERMS USED

*Table 1 terms used*

| | |
|---|---|
| Upper Stone | Collar |
| | Inner Collar Edge |
| | Upper Face |
| | Lower Face |
| | Outer Face |
| | Hopper |
| | Handle Socket. |
| Lower Stone | Upper Face |
| | Lower Face |
| | Outer Face |
| | Spindle Hole |

# TOOLING

*Fig 4 Tooling presence on upper Mayen Stones*

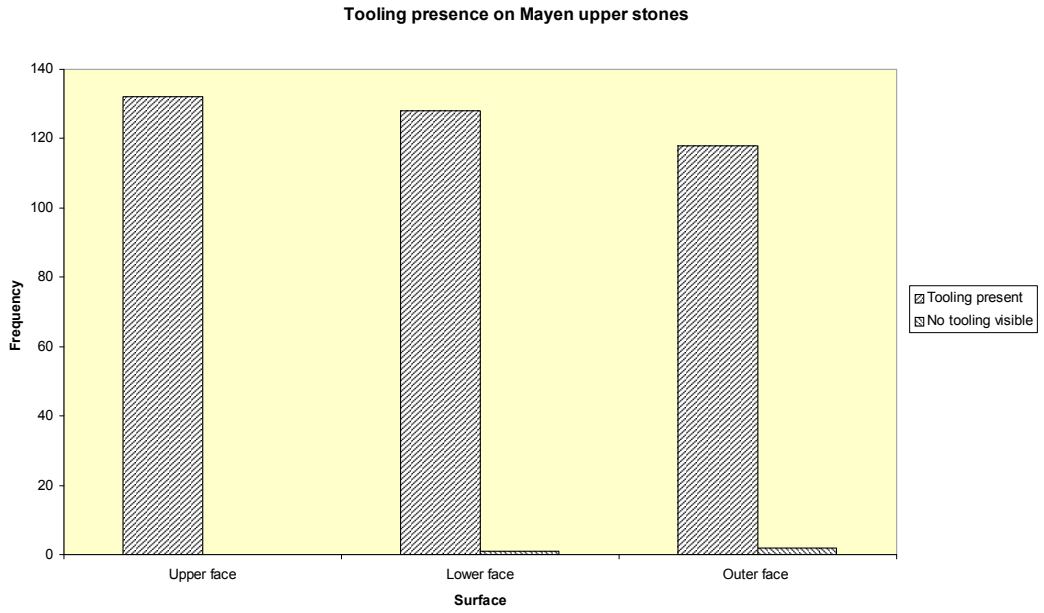
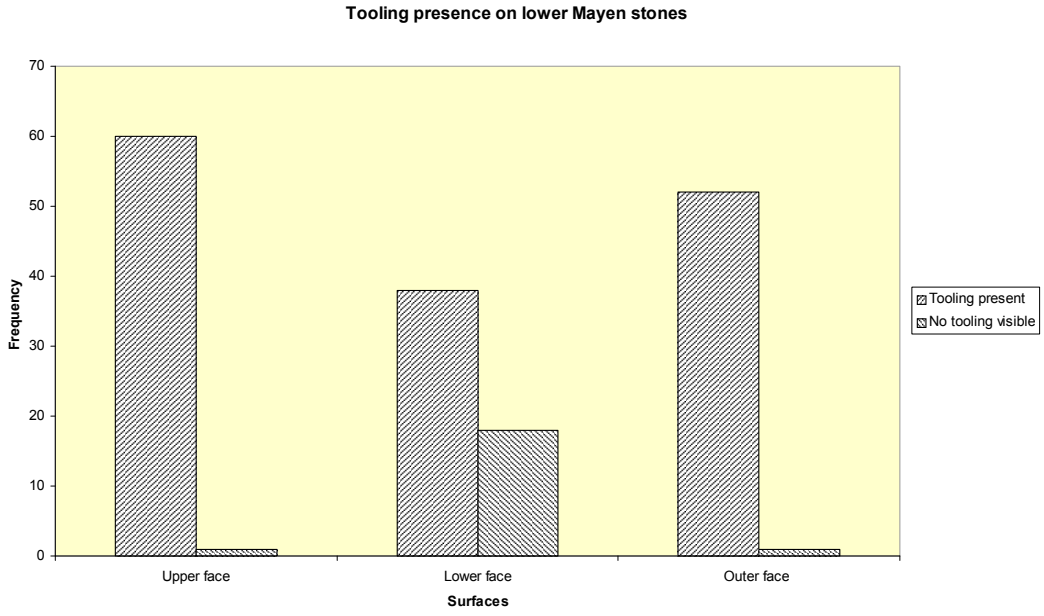



*Fig 5 Tooling presence on lower Mayen Stones*



# UPPER LAVA QUERN STONES

COLLAR

The standard tooling consists of opposing sets of parallel lines, referred to as "harp" tooling, but with the opposing patterns often set slightly off kilter, rather than at true right angles. For examples, see Nos. 72, 124, 128, and 198. The tooling tends at least in part to correspond with the inner collar edge, upper, and outer faces. The collar width varies from 30-50mm, with 40mm being about average (Fig 6). The depth ranges from 5-40mm, with 10-15mm being about average (Fig 7).

*Fig 6 Collar width of Mayen upper stones*

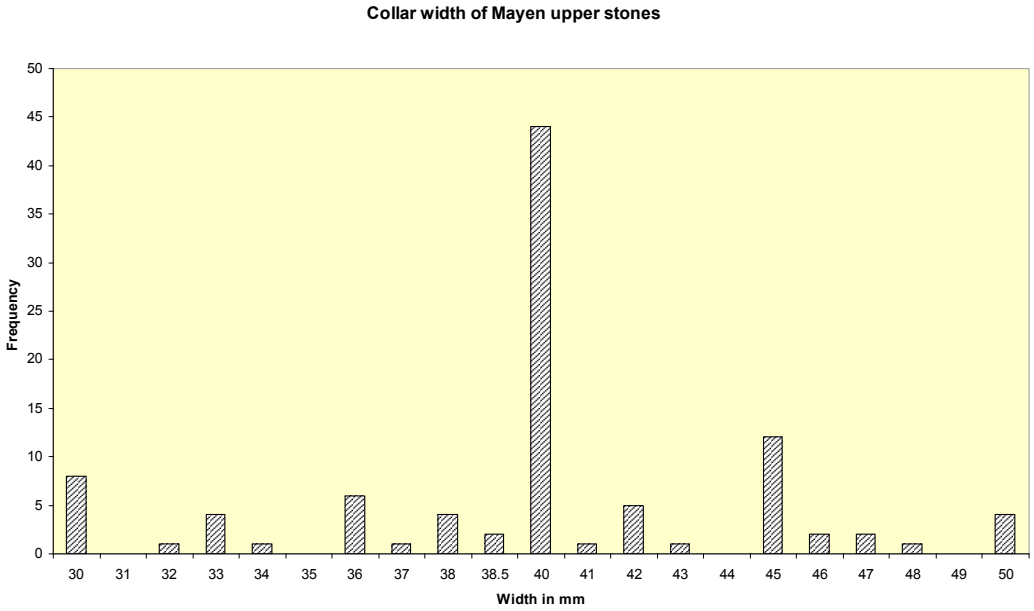
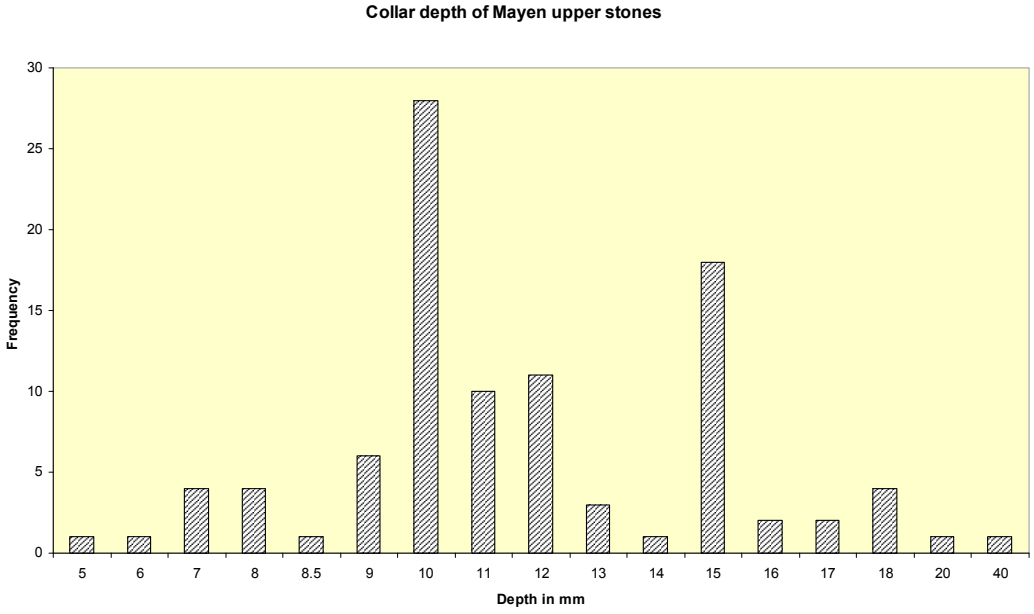



*Fig 7 Collar depth of Mayen upper stones*



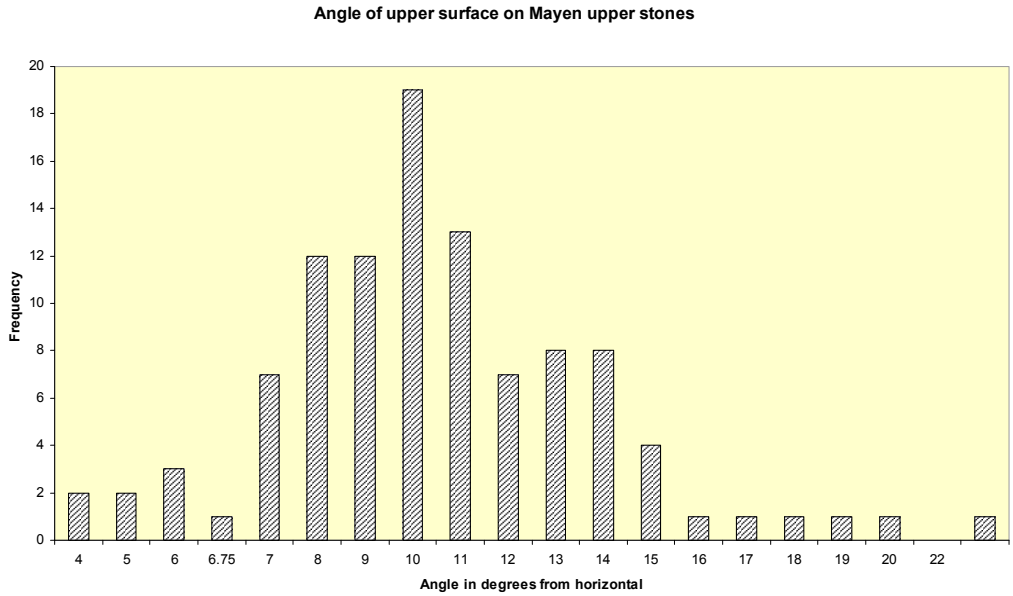
## INNER COLLAR EDGE

The tooling generally corresponds with the collar, and upper face markings, either with direct line tooling and/or angled tooling. For examples see Nos. 217 and 149, respectively. It is fairly common to see lined tooling of varying length following the circumference of the quern. This type of tooling tends to be quite crudely drawn "redressing". Sometimes the tooling is obviously intended, but the effect is also caused by redressing "blurring" together. For examples see Nos. 72, 167, and 82.

## UPPER FACE

The angle of the upper surface ranges from 4-22 degrees, with the majority falling between 7-14 degrees (Fig 8). Here the tooling occurs as the "harp" pattern and is absolutely standard.

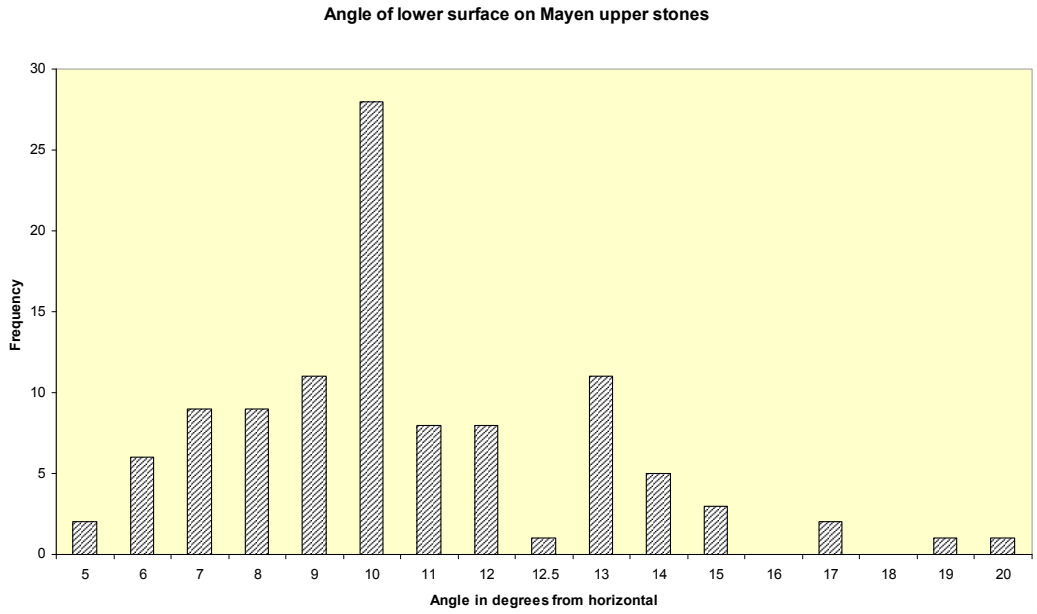
*Fig 8 Angle of upper surface of Mayen upper stones*




## LOWER FACE

The angle of the lower surface ranges from 5-20 degrees, with the majority falling around 10 degrees (Fig 9). The most frequent tooling pattern occurs as thinly spaced (usually around 2-4mm) parallel lines fanning out from the centre towards the rim. Good examples of this can be seen on Nos. 177 and 72. Another common pattern is a "herring-bone" effect, see Nos. 119 and 217. This type of marking appears to be crude form of redressing, which may be a poorly tooled variation of the "harp" pattern such as that seen on No. 171. Also fairly frequent is tooling which follows the circumference of the quern, see Nos. 152, 193, and 198. This tooling may be part of a more complex pattern, disguised by the quern's fragmentation - No. 128 being a possible example. Variations of pattern in somewhat crudely redressed stones suggests there may have been acceptable designs that were separate and varied, and that precision tooling was not necessarily required.

*Fig 9 Angle of lower surface of Mayen upper stones*




OUTER FACE

The standard tooling consists of vertical parallel lines. A close examination of a small sample showed that spacing on individual querns ranged from 2mm apart to 11mm. Quern 225 had the most narrowly spaced markings within the sample, possible an example of redressing. A comparison with the spacings on the outer face of the lower quern stones suggests that the lower spacings may be slightly narrower. A fairly common feature on the outer faces of upper quernstones are concave profiles, for example No. 124, which may point to wear and redressing. One possibility is that a metal belt was placed around the quern, acting as a reinforcement for the handle and providing for a steadier action during milling.

HOPPERS

The hoppers were generally very similar in diameter at both the top and bottom (Fig 10; Fig 11). A small sample showed a range in diameter of 35-90mm, but 55-65mm was about average. The same sample showed a range in height of 50-100mm, with the average being around 55-70mm. The tooling was quite standardised and consisted of vertical "pecked" and/or lined tooling, see Nos. 72 and 177. The dressing here was usually fairly crudely made. An exception was No. 169, which showed clearly tooled vertical and horizontal lines forming a pattern of squares. Correspondence with the tooling on the upper and lower faces was frequently visible. Some querns had a small tooled slot adjacent to or towards the hopper, see Nos. 82, 127, 165, 175, 211, and 225. This slot may have held a specific type of inner mechanism or perhaps served to enhance the passage of grain.

*Fig 10 Hopper diameter (top) on Mayen upper stones*

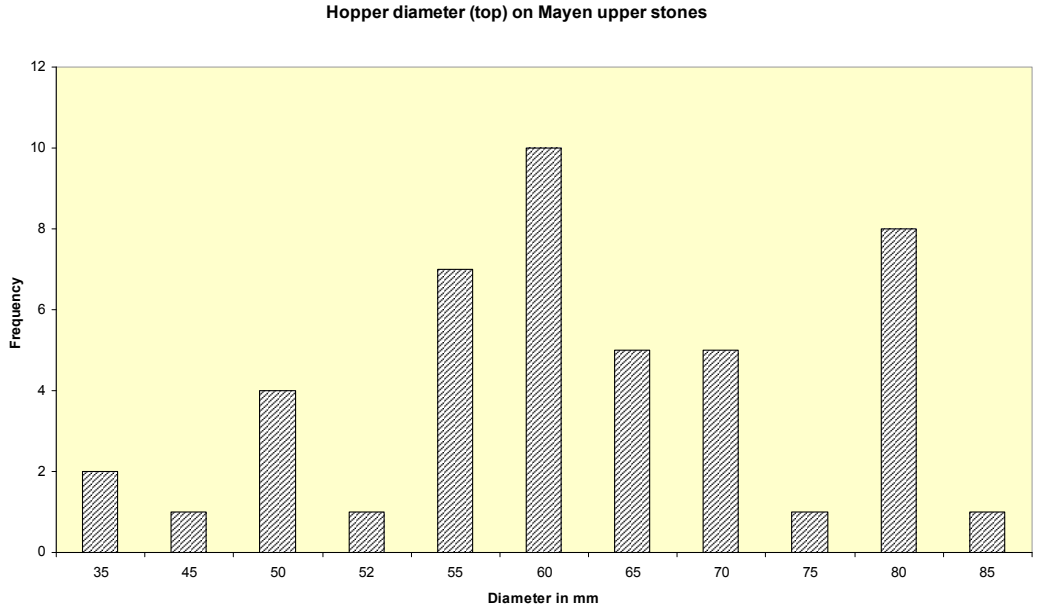
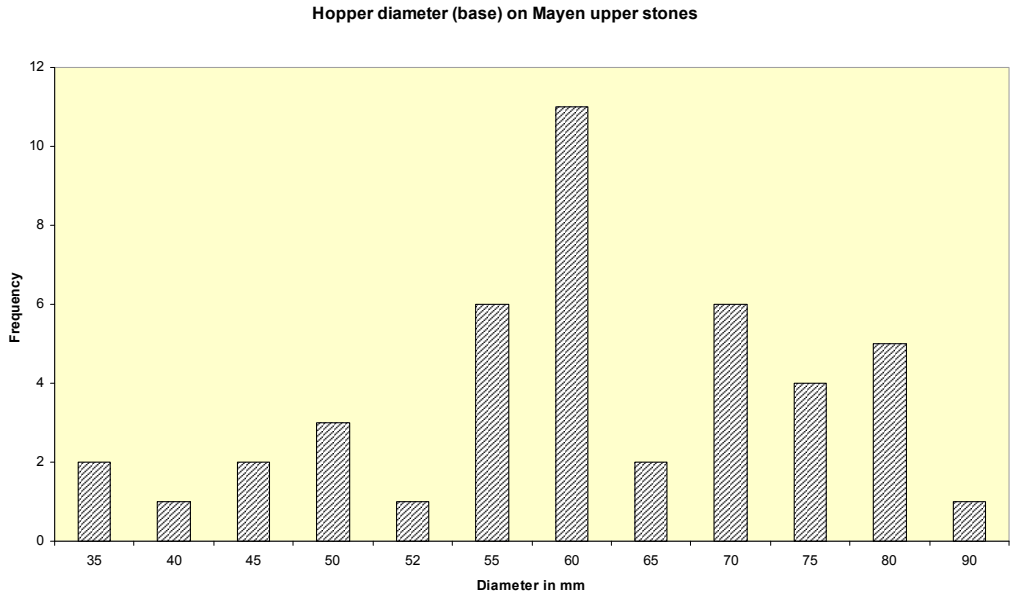



*Fig 11 Hopper diameter (base) on Mayen upper stones*



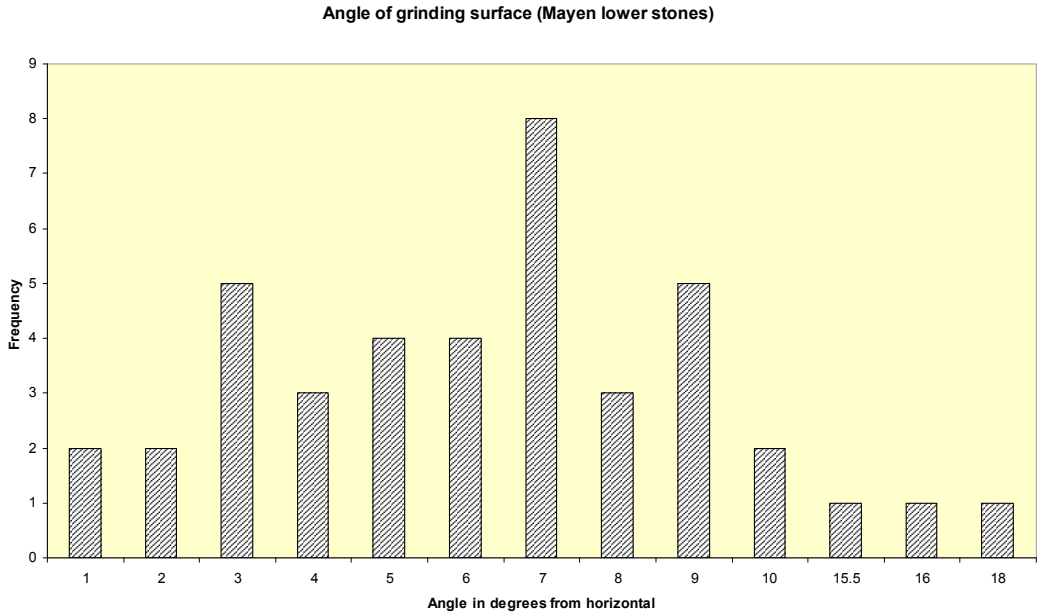

HANDLE SOCKET - The extant handle sockets show a standard form of the elbow-shaped perforation, with a broad drilled hole in the outer face and a slightly smaller hole in the upper face, see especially Nos. 90, 102, 167 and 217. The overall length of the socket ranges from 70-100mm, with the average being about 80mm, and with the outer socket hole tending to be slightly larger than the inner hole. The tooling on the inner socket is similar to that on the inner hopper, i.e. somewhat crude, "pecked" and/or lined. Quern 215 displayed a correspondence between the inner and outer socket tooling and the upper and outer faces. It is unclear whether this was normal practice, given that No. 215 seems to have been a rare example, although similar tooling on other querns may have been obscured by wear. See Nos. 72 and 177 for examples of tooling, and 223 and 215 for examples of intact handle sockets.

## LOWER LAVA QUERN STONES

UPPER FACE

The angle of the grinding surface ranged from 1-27 degrees, with the majority falling around 7 degrees (Fig 12). The tooling appears standardised, with narrowly spaced, parallel lines of varying length fanning out from the centre towards the outer edge. Good examples of this can be seen on Nos. 2, 125, and 162. Quern 2 may be an example of lined tooling, before wear would have caused the pattern to break up. The surface also shows that the tooling was composed of grouped parallel lines offset against each other. A sample group showed spacing between the lines ranging from 2-7mm, with an average of about 5mm. Occasional exceptions to the type of tooling described above were No. 138, which had an unusual mix of "pecked" and lined tooling, and No. 73, which showed a lined pattern following the circumference of the quern - similar to markings found on some of the lower faces of the upper querns.

*Fig 12 Angle of grinding surface of Mayen upper stones*




LOWER FACE

The only tooling found on the base of the lower stones were occasional crude, thick lined markings. These were generally short and were often irregular, although a small number appeared to follow the circumference of the quern. Quite often there were two or three parallel markings of similar length. The true extent of wear and damage to the lower face of the stones was not clear. The purpose of this tooling is uncertain. Examples are Nos. 160, 205, and 218.

OUTER FACE

The tooling here was fairly standardised, similar to the outer face of the upper querns. A small sample showed a range of spacings between the markings from 3-8mm up to 7-10mm.

SPINDLE HOLES

The lower stone spindle holes differed in form from the hoppers of the upper stones in that there is a distinct narrowing in the central area of the hole. The top diameter ranges from 40 to 80mm, with 45-50mm being about average for both the base and the top (Fig 13; Fig 14). The central areas had an average diameter of 25-25mm (Fig 15). The tooling was very similar to that seen on the hoppers of the upper querns,

consisting of quite crude, thick, lined and/or "pecked" markings. There was often a similarity with both the hopper and upper face tooling. The average height of the spindle holes was 90-100mmm, see Nos. 138, 160, 161, 206 and 227.

*Fig 13 Spindle hole diameter (base) on Mayen lower stones*

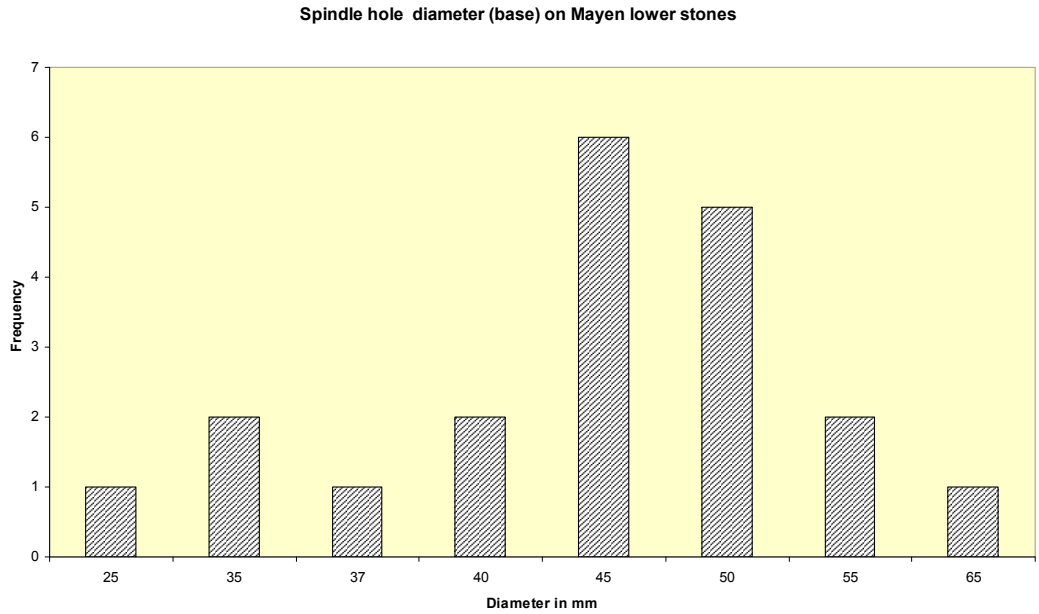



*Fig 14 Spindle hole diameter (top) on Mayen lower stones*

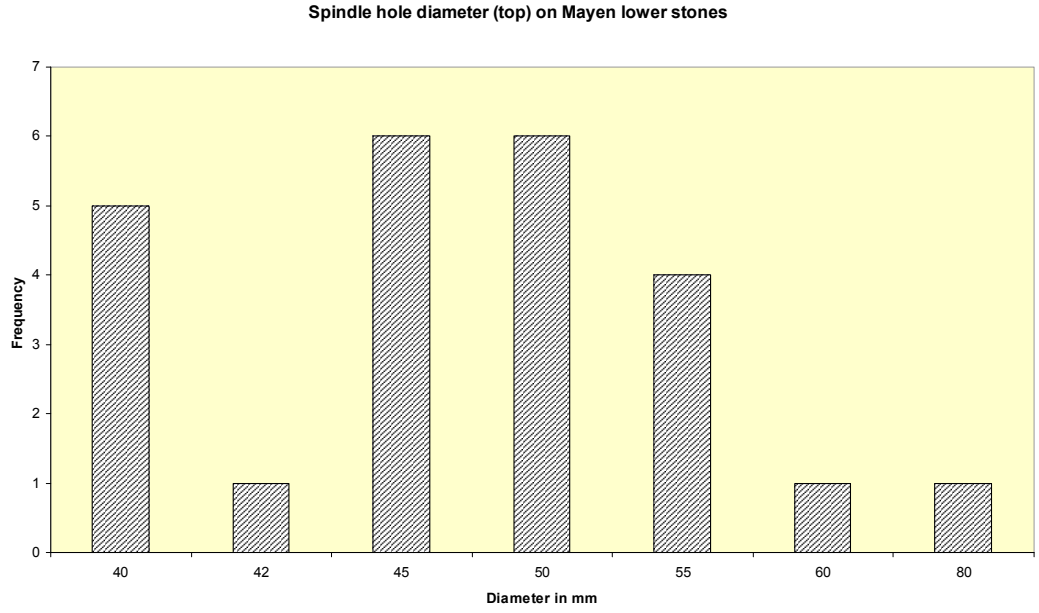
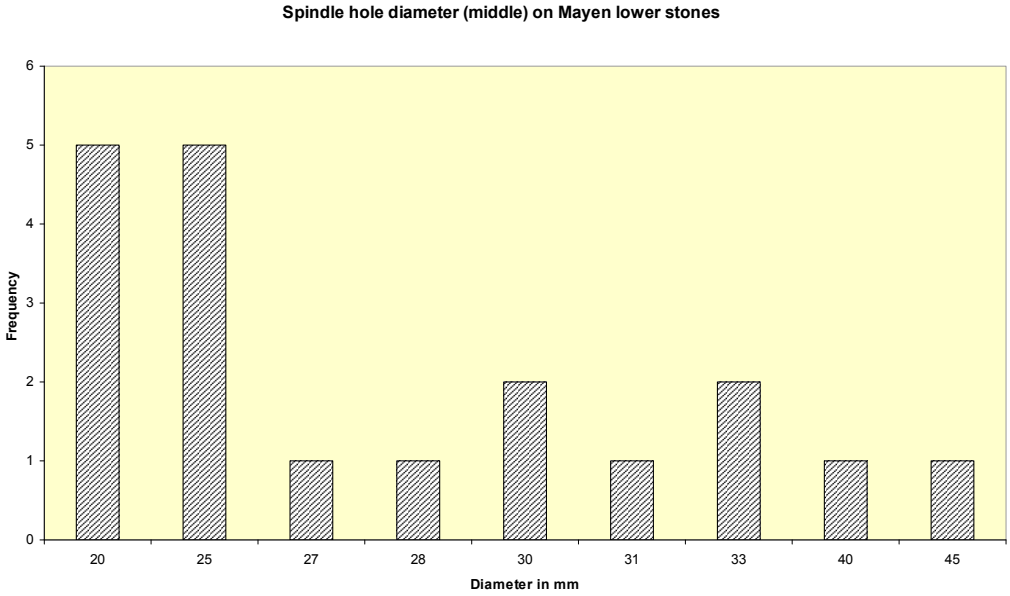


*Fig 15 Spindle hole diameter (middle) on Mayen lower stones*




# THE TYPOLOGY OF THE QUERNS

Almost all of the fragments of lava belong to rotary hand-mills/querns, which consist of a circular slightly concave upper stone resting on a slightly convex lower stone of the same diameter. The external diameter of upper and lower stones centres around 400mm (Fig16; Fig 17) with the outer edge of the upper stones centering between 120-130mm (Fig 18) against 90-100mm with the lower stones (Fig 19). The inner edge height of the upper stones centres around 50-70mm (Fig 20) against 90-100 in the lower stones (Fig 21).

*Fig 16 External diameter of Mayen upper stones*

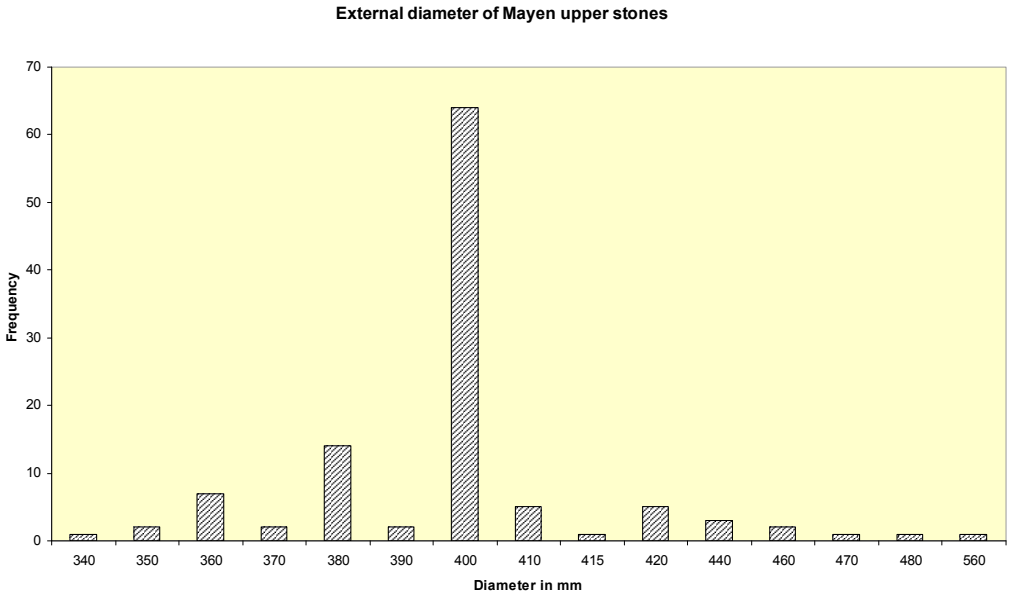


*Fig 17 External diameter of Mayen lower stones*

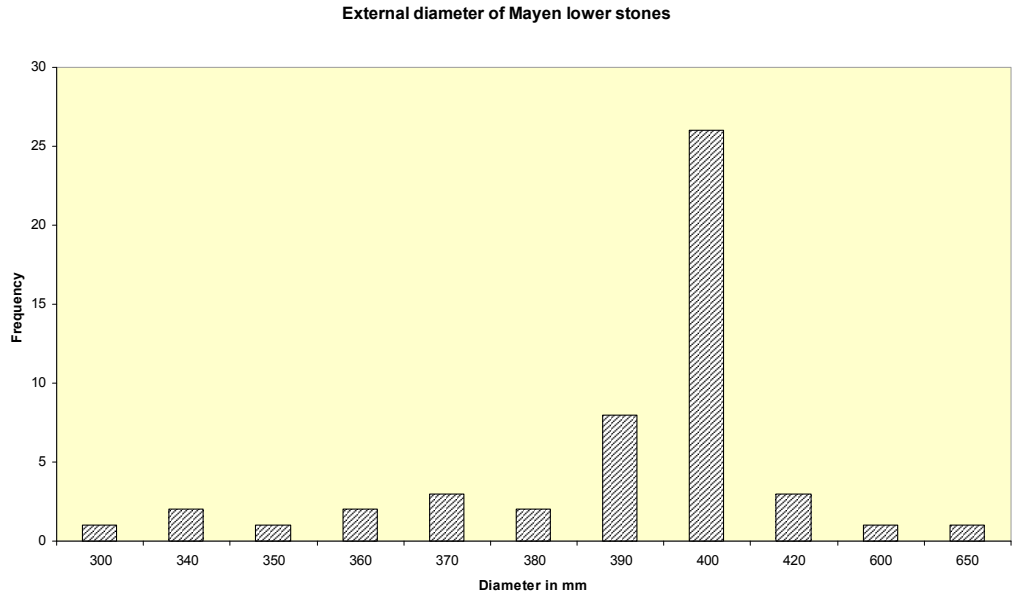



*Fig 18 Outer edge height of Mayen upper stones*

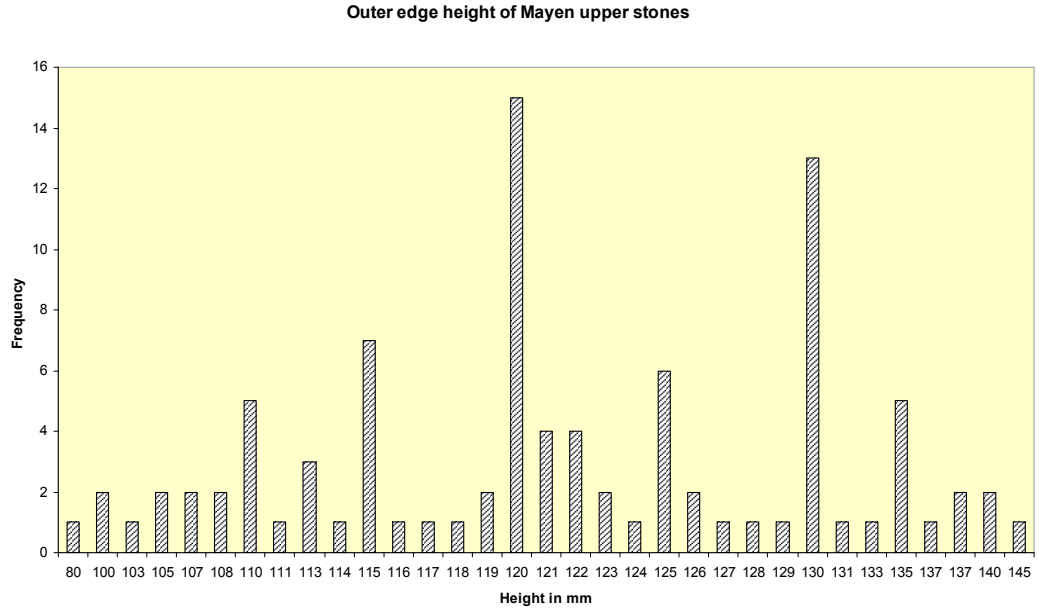


*Fig 19 Outer edge height of Mayen lower stones*

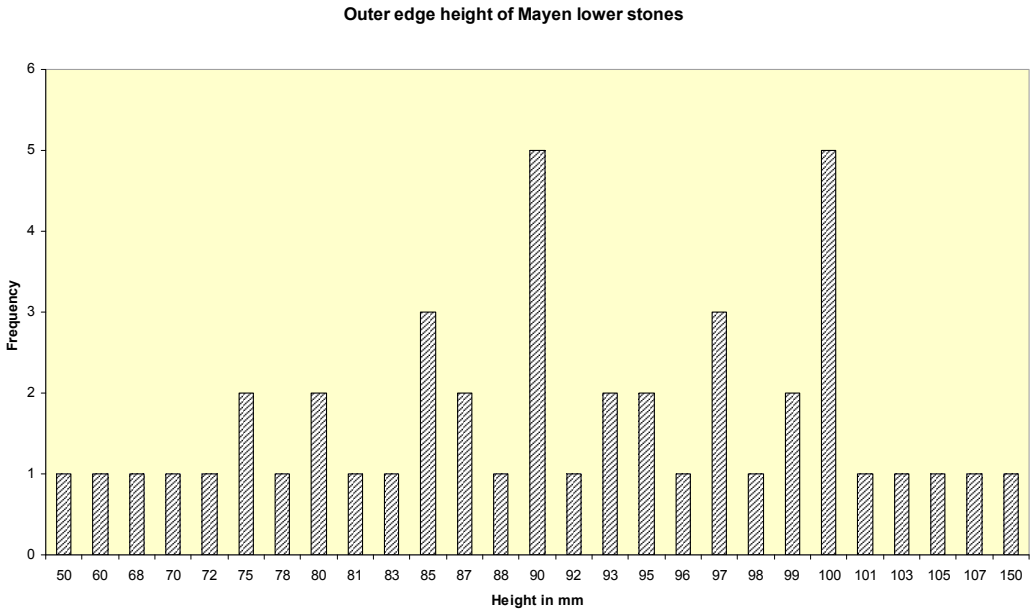



*Fig 20 Inner edge height of Mayen upper stones*

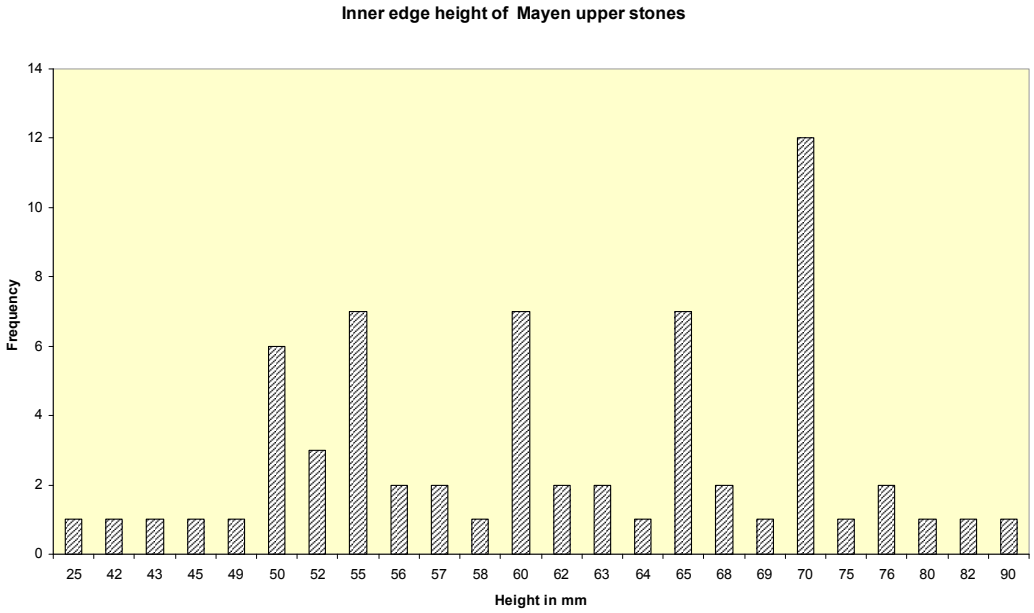
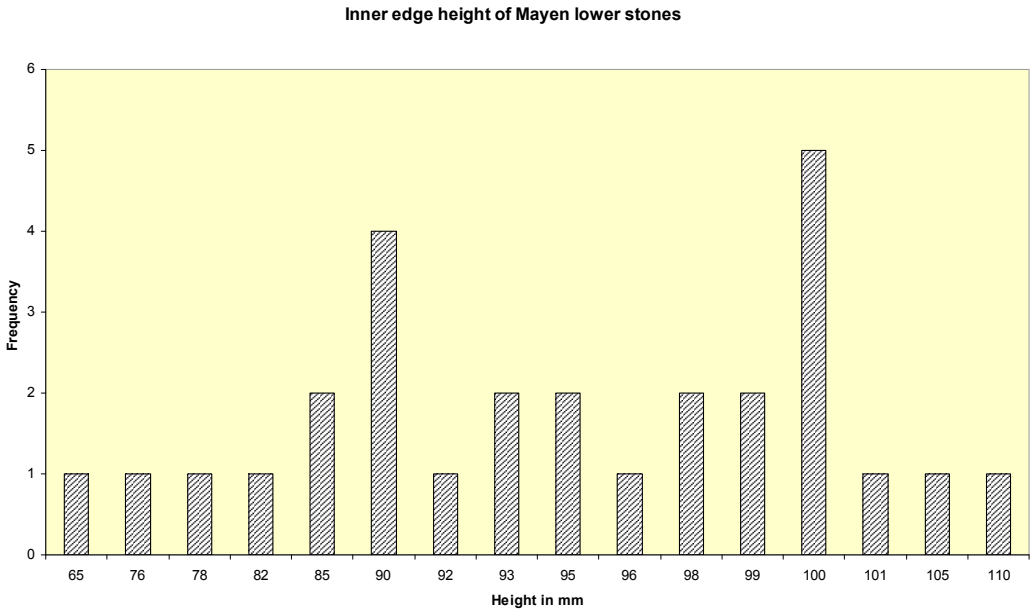


*Fig 21 Inner edge height of Mayen lower stones*




The Poultry hand-mills appear to belong to a single form, with some minor differences in size and dressings. The upper stone has a wide-mouthed central perforation which passes through the stone, the eye, and performs two roles. Firstly, to centre the upper stone over the lower one, through a spindle passing up from the lower stone. Secondly, it forms the hopper or food-shoot through which the cereal grains pass to the lower stone for grinding. The upper stone is rotated with the aid of a handle which is attached by means of a socket set in the outer face of the stone. The lower stone has a central spindle hole, narrower than the eye, and in the case of the Poultry querns it is entirely perforated.

The condition and frequency of the Poultry querns allow for some interesting observations to be made. On many Roman hand-mills the eye on the upper stone also incorporates a rynd, of wood or iron and often rectangular or hour-glass in shape, which is used for the spindle attachment and allows the upper stone to be raised or lowered for different grinding positions [Runnels, 1990]. No traces of a rynd cutting can be found on the Poultry upper stones and it may be that a small piece of wood was wedged directly into the lower eye area, as seems to be the case with a modern example from North Uist illustrated by Curle [1937, Fig. 39]. As the spindle hole on the Poultry lower stones are always completely perforated, it suggests that the spindle, perhaps of ?wood, may have been firstly fixed to a base, passed through the lower stone and then through the upper stone. This must also have incorporated an arrangement for highering or lowering the upper stone and also for allowing the cereal grains to pass through to the upper surface of the lower stone. This appears to be very similar to the bridge-tree arrangement in the North Uist quern mentioned above and a somewhat similar system for raising and lowering the upper stone may have been applied to the Poultry hand-mills.

The handle sockets on the Poultry upper stones are all of the elbow-shaped perforation type, with a broad hole in the outer face leading through to a slightly smaller hole in the upper face. The broken quern fragment No. 102 is a good example of this type of socket, since the break has occured at the point of the socket hole, showing the cut in section. This shows that the perforation consists of two wedged or funnel-shaped holes cut in from the outer face and upper face and narrowing at the centre. On the face of it, with a narrow centre and wider openings, it seems most unlikely that a wooden handle or metal which many handmills seem to

have had, could have been made to fit. It has been suggested that an "iron spike-loop" would have been used for this type of socket [Welfare, 1986, 157]. However, to the best of the writers knowledge, no iron spike has ever been found in this type of handle-socket or indeed any form of iron-staining. Instead, the actual handle was probably made of rope and threaded through from side to top [cf. Oliveira et al, 1983, Pl. 16/17 for a modern example from North Africa]. In addition, it might have been twisted around a length of wood for ease of turning the upper stone, while the wider openings at the outer face and upper surface would have meant less friction on the sections of rope that rubbed against the sides of the hole.

The three pieces of donkey mill recovered from the Poultry assemblage consis of two hopper fragments belonging to the upper stone [catillus] and one from the lower stone [meta]. Both of the upper stones also contain squarish handle slots which would have been part of the elaborate yoke pole attachment [cf. Curle, 1937, Fig. 2; Sebesta, 1976, 85-86]. All three are from Period 301.

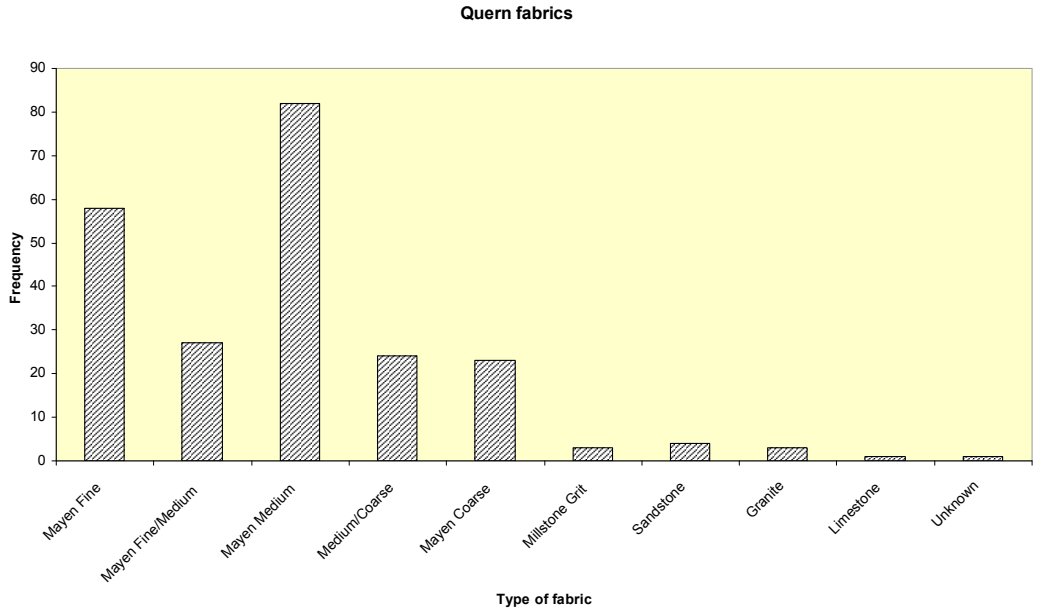
The general form of the Poultry lava hand-mills can be paralled at other first century A.D. Roman sites. For instance at Usk [Wellfare, 1994, Figs. 61-65] and Strageath [Frere and Wilkes, 1989, Figs. 95-97]. However, it is significant that, on the whole, the Poultry handmills, both upper and lower stones, appear to be considerably thicker, and therefore heavier, than the lava hand-mills at those two sites. This may not be too surprising, since both of these sites are military and it might be expected that the querns there would lighter and more mobile.

## THE PETROLOGY OF THE QUERNS

The vast majority of quern fragments are in a dark grey fine-grained rough vesicular lava. In the hand-specimen conspicuous dark phenocrysts of pyroxene can normally be made out and a difference was noted between finer, medium and coarser textures in the stone (

Fig 22). A large number of querns were thin sectioned and studied under the petrological microscope. This revealed that the most prominent minerals are frequent grains of green and colourless clinopyroxene, mainly augite, together with a little olivine, set in a groundmass of small lath-shaped crystals of andesine/labradorite felspar, opacite, leucite and some xenomorphic nepheline. There are some slight differences in the texture of the groundmass which equate with the textures noted in the hand-specimen, but overall the fabric of the rock appears fairly homogeneous for the group as a whole.

*Fig 22 Quern fabrics*




The composition of this vesicular lava is particularly distinctive and it can be classified as a nepheline-tephrite. This type of rock is commonly found in the lavas of the Mayen-Mendig area of the Eifel Hills of Germany, a region well-known in both Roman and later times for supplying querns and millstones (Parkhouse, 1976; Kars, 1980; Peacock, 1980). In an effort to try to tie down the source or sources, for the Poultry lava querns, the writers collected a wide range of samples from the major quernstone quarries in and around the Mayen-Mendig-Daun area of the Eifel region (Horter, 1994; Bockius, 2000). Preliminary petrological examination of this material and comparison to the Poultry querns, suggests that the source area is most probably limited to the area located immediately to the north-west of Mayen itself or alternatively in the northern part of the lava flow to the north of Kottenheim [Horter, 1994; Bockius, 2000]. It is hoped that further work will enable the source area to be more closely defined.

In addition to the above, there are twelve non-Mayen lava quern fragments in the assemblage. These comprise four of sandstone [Nos. 31, 32, 179 and 181], three of Millstone Grit [Nos. 33, 121 and 122], three of granite [Nos. 147, 148 and 158], one of limestone [No. 180] and one undesignated [No. 51]. At the present time the source of these stones has not been studied in detail. However, it is clear that at least half, if not more, represent imports from some distance away. The Millstone Grit querns probably came from the Derbyshire/Yorkshire region. The granites are more difficult to suggest a likely source for. They may, for example, have come from Devon or Cornwall, or perhaps even further afield, such as the Channel Islands or the Brittany/Normandy region of France. Without detailed analysis a source cannot as yet be suggested for the sandstones and the limestone quern.

## DISCUSSION

The Poultry quern assemblage is without doubt the most remarkable collection of querns or millstones from Roman Britain. It demands an explanation although it is hard to satisfy all the parameters. The salient points to emerge from the above record are as follows: The assemblage comprises about 1000 fragments, all but a few of Mayen lava. The lava has characteristics which enable production to be located immediately to the north-west of Mayen itself, where fieldwork has revealed indications of Roman working, or less probably in the northern part of the lava flow to

the north of Kottenheim [Horter, 1994; Bockius, 2000]. Almost all the fragments are of querns or hand mills. The exceptions are two pieces from donkey mills, one from a catillus [No. 144 - upper stone] and the other from a meta [168 - lower stone]. There are no traces of water mills in this assemblage. The majority of the fragments seem to be worn indicating use before breakage. Many seem to have remarkably fresh tooling on some of the surfaces.

There are a number of possible explanations for this assemblage, all of which have flaws: As the site is not far from the Thames frontage the assemblage could represent the detritus from an importer's yard or possibly discarded ships' ballast from vessels crossing the North Sea from the Rhine to London. This might account for the overwhelming predominance of Mayen material, but is difficult to reconcile with the use wear. Nor can the uniform petrology be taken as an indication that the assemblage arrived as a single consignment, because current field evidence suggests that Roman quarrying at Mayen was concentrated in a limited area [Horter, 1994; Bockius, 2000]. The debris could be from a millwright's yard to where hand querns were being brought from all over London for re-milling when they became worn. Querns are normally associated with domestic flour production, but the vesicular Mayen lava was probably favoured because it did not wear smooth and need re-working. Thus, this explanation seems improbable.

However, it could be that the Walbrook - Poultry area was the major bakery area of London and the debris represents the accumulated debris from flour production. In the Roman world it appears that milling and baking were practised together in the same premises. A site near to the Thames frontage would be an advantage as the grain would not have far to travel between the ship and the processing area. It may also be significant that the insect assemblage from the Poultry site reveals species that are associated with grain (see p.00). It is worth noting here that the Poultry hand-mills appear to be somewhat thicker, and therefore heavier, than the norm. This suggests that they may have been intended to be used in one place rather than moved around from dwelling to dwelling. Also, if the writers are correct in thinking that the upper stone was rotated using string/rope wound through the handle socket and attached to a long rod [cf. Oliveira et al, 1983, Pls. 20-21; Figs. 12 and 15], it may have been possible to fix a number of rods to a single pulley and work the rotation of several upper stones arranged [with their lower stones] in a row in tandum.

There is further evidence that this was a flour production area because the complete donkey mill from London was found in Princes Street, which abuts the Poultry site, and smaller fragments of the same type of mill have been recovered from other parts of the site in previous years [Merrifield, 1965]. Moreover, three of the Poultry quern fragments came from donkey mills [Nos. 137, 144 and 168] and two others have been found in residual and later contexts from the site [Site 1 94 Area 12 and Site 1 94 3067]. Furthermore, large flat millstones have been recovered from the bed of the Walbrook, suggesting that it was used to power water mills [Hall and Merrifield, 1986, 37]. This concentration of finds leaves little doubt that this part of the town was concerned with grain processing.

The main problem with this hypothesis as an explanation for the assemblage, is that the fragments are almost exclusively hand mills, which have their place in a domestic rather than a commercial context. However, hand mills are present in bakeries of the towns such as Ostia, Pompeii and Herculaneum and it seems that they were an adjunct of commercial as well as domestic grain processing [Peacock, 1989, 205; Moritz, 1958]. It is true that their numbers are limited, but being smaller than power mills, which comprise large heavy pieces of stone, it is probable that they would break more frequently thus needing replacement. Thus, while the donkey or water mills might have a long life, the hand mills would not and a relatively short life might explain the fresh appearance of the milling on many of the Poultry querns.

It is particularly important to note that five potential donkey mills have been recovered from the Poultry site. Previous to this only three donkey mills were known from Roman Britain as a whole, the one from London mentioned above, and the other two from Corfe Mullen and Hamworthy [Williams-Thorpe and Thorpe, 1988]. The Hamworthy mill was made of lava from Sardinia and the other two of lava from central France [ibid.]. The Poultry evidence clearly shows that the Mayen region was after all an important source for donkey mills [cf. ibid., 275].

## ACKNOWLEDGEMENTS

This work owes much to Jez Taylor, Richenda Goffin and Mark Burch, who with Tony Grey and Grahame King carefully undertook the recording of the querns. Penny Copeland gave invaluable assistance, especially with the catalogue and graphs and Jill Phillips gave technical assistance with the production of the many thin sections.

## REFERENCES

**Bockius, R. et al** [2000] *Steinbruch und Bergwerk. Denkmaler Romischer Technikgeschichte Zwischen Eifel und Rhein*, Mainz.
**Bradley, R., Meredith, P., Smith, J. and Edmunds, M.** [1992] "Rock physics and the Neolithic Axe Trade in Great Britain", *Archaeometry*, 34[1992], 223-233.
**Brown, E.T**. (ed) [1981] *Rock Characterisation, Testing and Monitoring: International Society for Rock Mechanics Suggested Methods*, London.
**Curle, J.** [1937] "Querns", *Antiquity,* 11[1937], 133-151.
**Frere, S.S. and Wilkes, J.J**. [1989] *Strageath*, Britannia Monograph Series No. 9.
**Horter, F.** [1994] *Getreidereiben und Muhlsteine aus der Eifel*, Mayen.
**Kars, H**. [1980] "Early-Medieval Dorestad, an archaeo-petrological study", *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 30[1980], 393-422.
**Merrifield, R**. [1965] *The Roman City of London*, London**.**
**Hall, J. and Merrifield, R**. [1986] *Roman London*, London.
**Mortiz, L.A.,** [1958] *Grain-Mills and Flour in Classical Antiquity*, Oxford.
**Oliveira, E.V., Galhano, F. and Pereira, B.** [1983] *Sistemas de Moagem*, Lisbon.
**Peacock, D.P.S.** [1980] "The Roman millstone trade: a petrological sketch", *World Archaeology*, 12[1980], 43-53.
**Peacock, D.P.S**. [1989] "The Mills of Pompeii", *Antiquity,* 63 [1989],205-14.
**Parkhouse, J.** [1976] "The Dorestad quernstones", *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 26[1976], 181-188.
**Runnels, C.** [1990] "Rotary querns in Greece", *J. Roman Archaeology*, 3[1990], 147-154.
**Sebesta, G.** [1976] *La Via Dei Mulini*, Trento.
**Spain, R.J**. [1992] *Roman Water-Power: A New Look at Old Problems*, Ph.D. Thesis, Imperial College, University of London.
**Turflinger, J. and Drummond, C**. [1966] "Analysis of bubble sizes in vesicular lava", *J. of Geoscience Education,* 44[1966], 22-26.
**Watson, K.L.** [1980] "Autoclaved aerated concrete from slate waste. Part 2: some property/porosity relationships", *Int. J. of Lightweight Concrete*, 2,3[1980], 121-123.
**Watson, K.L.** [1981] "A simple relationship between the compressive strength and porosity of hydrated Portland cement", *Cement and Concrete Research,* 11[[1981], 473-476.
**Welfare, A.T.** [1986] "The objects of stone and tile", in P. Bidwell, *The Roman*
*Fort of Vindolanda at Chesterholm, Northumberland*, London, 152-165.
**Welfare, A.** [1995] "The milling-stones", in W.H. Manning, *Report on the Excavations at Usk 1965-1976. The Roman Small Finds*, Cardiff, 214-237.
**Williams-Thorpe, O.** [1988] "Provenancing and Archaeology of Roman millstones from the Mediterranean area", *J. Archaeological Science*, 1[1988], 253-305.
**Williams-Thorpe, O. and Thorpe, R.S.** [1988] "The provenance and of donkey mills from Roman Britain", *Archaeometry*, 30,2[1988], 253-305.

# CHARACTERISATION OF THE MECHANICAL BEHAVIOUR OF VESICULAR LAVA SAMPLES TAKEN FROM QUERN FRAGMENTS FROM NO. 1 POULTRY

Keith L Watson
(Department of Civil Engineering, University of Portsmouth)

## 1. RATIONALE

Vesicular lava fragments from broken querns were subjected to a variety of test procedures with a view to characterising their mechanical properties. Since this involved the destruction of archaeological evidence, the work was programmed to extract the maximum amount of information from the minimum quantity of material.

Standard rock mechanics tests were used to determine compressive strength, compressive stiffness and tensile strength using simple cylindrical test pieces 25 mm in diameter. The same test pieces were also used for hardness measurements and for the determination of density and porosity. (The structure of these materials consists of a solid matrix containing about 25-30% vesicles, so density and porosity were expected to be significant factors in determining their mechanical characteristics.)

## 2. METHODOLOGY

### 2.1. Preparation of test pieces

The original quern diameters were estimated from their fragments using a rim chart (Table 1 on page 2).

Test pieces were prepared from 25 mm diameter cores. The shapes and sizes of the fragments precluded cutting all the cores in the same direction: those from fragments 340 and 391 were cut perpendicular to the plane of the original quern grinding faces, while those from 350 and 622 were cut parallel. SW1 and SW2 had been excavated from a domestic hearth from a mid C3rd site at Somerton Way, Thamesmead and included for comparative purposes. These two samples were much weaker than the other materials. SW1 provided one compression specimen of unknown orientation

relative to the grinding faces, and SW2 broke into several pieces during the coring operation.

The cores were trimmed and lapped to form cylindrical test pieces of nominal height:diameter ratios of 2:1 for compression testing and 1:2 for tensile testing.

Water cooling was used during the core cutting operation, so the test pieces were allowed 7 days to dry under ambient laboratory conditions.

Table 1. Test piece schedule

| Ref no. | Quern diameter | Remarks |
|---|---|---|
| 340 | 540 mm | Cores perpendicular to original grinding face<br>No. of test pieces: 2 compression, 3 tensile |
| 350 | 460 mm | Cores parallel to original grinding face<br>No. of test pieces: 1 compression, 2 tensile |
| 391 | 340 mm | Cores perpendicular to original grinding face<br>No. of test pieces: 1 compression, 2 tensile |
| 622 | 400 mm | Cores parallel to original grinding face<br>No. of test pieces: 3 compression, 2 tensile |
| SW1 | ? | Plane of original grinding face unknown<br>No. of test pieces: 1 compression |
| SW2 | ? | Broke during the coring operation |

2.2. Density and porosity

The 'test density' of each quern fragment was obtained as the mean of its respective test piece densities calculated from their weights and dimensions immediately before testing. (Coefficients of variation[1] ranged from 0.6 to 1.8%.)

Moisture contents - hence 'dry density' values $\rho_d$ - were obtained by weighing fragments of the broken test pieces before and after drying at 105 $^{o}$C for 24 hours.

[1] (standard deviation ÷ arithmetic mean) × 100%

'Solid density' values[2] $\rho_s$ were estimated volumetrically from specific gravity measurements on crushed, dried test piece fragments using distilled water in calibrated 50 ml specific gravity bottles. (The fragments were saturated by water immersion under a vacuum of 40 torr for 4 hours.)

Porosity *n* was calculated from

$$n = \frac{100(\rho_s - \rho_d)}{\rho_s} \%$$

2.3. Tensile strength

The determination of the tensile strength of many inorganic, non-metallic materials is difficult in direct tension because of brittleness, which leads to problems with gripping and alignment of the test pieces. However there are indirect methods, including the Brazil Test (Brown 1981, 120-1) which was used for the work discussed here.

In the Brazil Test a steadily increasing compressive load, *P*, is applied across the diameter of a cylindrical test piece of the material. This results in a more or less uniform tensile stress, σ, which is at right angles and proportional to the compressive load. When the value of *P* reaches the point where σ is equal to the tensile strength of the material, then the cylinder will fail in tension. The tensile strength $\sigma_t$ (in MPa) can then be estimated using the formula:

$$\sigma_t = \frac{2P_f}{\pi d l}$$

where

$P_f$ is the compressive load at failure (in N),

*d* is the diameter of the cylinder (in mm), and

*l* is the length of the cylinder (in mm).

The theory behind the Brazil Test assumes a homogeneous, isotropic material. Nevertheless it is widely used for rock materials and concrete, and,

[2] i.e. density of the solid matrix.

of particular interest in the present context, it has already found an archaeological application in characterising the mechanical properties of stone used for making Neolithic axes (Bradley, Meredith, Smith and Edmonds 1992).

2.4. Compressive strength and deformation

The determination of compressive strength is less susceptible to the problems associated with tensile testing, and can be regarded as inherently more reliable.

A steadily increasing longitudinal compressive load is applied between the flat ends of a cylindrical test piece (Brown 1981, 113-4), and a continuous record is made of the applied load against the relative displacement of the loading platens. The load/displacement data is converted into plots of stress (load ÷ cross-sectional area of the test piece) against strain (fractional length change)[3].

Compressive stress at failure is recorded as compressive strength.

Stiffness of the material is determined by measuring the slope of the stress/strain plot. This is a simple matter with linear stress/strain plots and provides values of 'Young's modulus' for materials that obey this type of relationship. However, with materials showing non-linear behaviour, it is necessary to resort to less straightforward measures (Brown 1981, 115-6). One of the most common of these is the 'tangent modulus' measured at a given fraction of the compressive strength, typically 50%, which is the method adopted for this work.

2.5. Hardness

The hardness of a particular rock material may vary considerably throughout its structure depending on the distribution of minerals present, and other features such as vesicles (as in this case).

The Shore Scleroscope is ideally suited to this type of material (Brown

[3] This procedure compensates for variations in test piece dimensions and allows direct comparisons to be made between different materials.

1981, 102-103). A small diamond-tipped weight rebounds after falling through a fixed height onto the surface of the test material (in this case, the flat ends of a cylindrical test piece). Any yielding of the material under the tip will absorb energy and reduce the height to which the weight rebounds. The rebound height therefore provides a measure of the local hardness of the material. By taking a series of readings spread over the surface of the specimen, it is possible to obtain a distribution of 'Shore Hardness' values which reflects the structure of the material.

## 3. RESULTS

The density and porosity results are given in Table 2 and the mechanical test results are summarised in Table 3.

Table 2. Density and porosity values

| | 340 | 350 | 391 | 622 | SW1 | SW2 |
|---|---|---|---|---|---|---|
| Test density/kg $m^{-3}$ | 2114 | 1953 | 2006 | 2078 | 1940 | - |
| Dry density/kg $m^{-3}$ | 2108 | 1948 | 1998 | 2073 | 1920 | - |
| Solid density/kg $m^{-3}$ | 2824 | 2759 | 2818 | 2781 | 2771 | 2783 |
| Porosity/% vol. | 25.4 | 29.4 | 29.1 | 25.5 | 30.7 | - |

Table 3. Summary of mechanical test results

| | 340 | 350 | 391 | 622 | SW1 |
|---|---|---|---|---|---|
| Compressive strength/MPa | 88.9<br>66.2 | 33.2 | 33.3 | 61.3<br>73.0 | 10.1 |
| Tensile strength/Mpa | 5.73<br>9.02<br>10.32 | 6.58<br>5.66 | 5.02<br>6.54 | 9.47<br>5.70 | - |
| Tangent modulus/GPa | 3.29<br>3.14 | 2.33 | 2.29 | 3.98<br>3.53 | 0.46 |

The relationship between dry density $\rho_d$, density of the solid matrix $\rho_s$ and porosity $n$ is plotted in Figure 1 for each quern fragment. These

relationships are of the form

$$\rho_d = \rho_s - mn$$

where $m$ is the rate at which dry density decreases with porosity from the density of the solid matrix $\rho_s$ (at 0% porosity) to zero (at 100% porosity).

Figure 1 shows that the porosities of 340 and 622 are very similar to each other but lower than the porosities of 350 and 391, which are also very similar to each other. 340 and 391 have very similar solid density values. SW1[4] has higher porosity and lower bulk density values than the other materials, although its solid density falls within the same range.

Figure 2 shows the compressive stress/strain curves. One of the curves for 340, which are both plotted from a common origin, shows an initially high strain increase which soon lessens so that, by about the 20 MPa stress level, the curves are more or less parallel. Examination of the broken test pieces did not help to explain the difference and it is assumed that both results are valid.

One of the test pieces from 622 failed at a much lower load than the other two (again plotted from a common origin). This was thought to be due to a roughly circular inclusion, about 15 mm in diameter, which was visible in the curved surface of the test piece; this particular result was therefore rejected.

The curves from 350 and 391 are very similar. Figure 1 suggests that their lower strength, compared with 340 and 622, may be associated with their higher porosity. Since 340 and 622 have very similar porosities it is tempting to suppose that the apparently greater strength of 340 is associated with its higher solid density. However, 350 and 391 also have similar porosities and differing solid densities; and the very similar solid densities of 340 and 391 suggest that their strength difference is primarily associated with their different porosities.

The compressive stress/strain curve for SW1 is much shallower than all the others, giving much lower strength and modulus values.

---

[4] X.R.F. has shown that the elemental compositions of SW1 and SW2 are very similar to each other (see appendix).

Inspection of Tables 2 and 3 shows that, not very surprisingly, strength and stiffness generally increase with increasing bulk density and decrease with increasing porosity.

Porosity plots have proved to be helpful in analysing the mechanical properties of autoclaved aerated concrete (Watson 1980). This is a material that has a very similar pore structure to vesicular lava, which suggests that the same approach may be appropriate in the present work. Mechanical properties of autoclaved aerated concrete were plotted against the solid/pore volume ratio ($V_s/V_p$), which stemmed from a simple physical model of the material, and were found to obey linear relationships. The ratio can be obtained from the relationship

$$\frac{V_s}{V_p} = \frac{100 - n}{n}$$

where $n$ is the porosity expressed as a volume percentage.

The compressive strength[5] of each of the vesicular lavas is plotted against solid/pore volume ratio ($V_S/V_P$) in Figure 3. The solid line represents the linear regression equation for all five points. The dashed line omits SW1 from the analysis, acknowledging the possibility that it may not belong to the same population because of its thermal history.

The remaining lines represent linear regression equations obtained with other types of porous materials (Watson 1980 and 1981): autoclaved aerated concrete (A.A.C.), with a similar vesicular structure to the present materials, and ordinary Portland cement (O.P.C., cured for 2 and 28 days respectively) which has a pore structure that is invisible to the naked eye.

Table 4. Properties of the regression lines

| | A.A.C. | O.P.C. (28 days) | O.P.C. (2 days) | Vesicular lavas | |
|---|---|---|---|---|---|
| | | | | + SW1 | - SW1 |

[5] The average of the two values in the cases of 340 and 622 (Table 3).

| r | 0.996 | 0.9995 | 0.999 | 0.982 | 0.985 |
|---|---|---|---|---|---|
| $(V_S/V_P)_{crit}$ | 0.230 | 0.195 | 0.710 | 2.074 | 1.985 |
| $n_{crit}$ | 81% | 84% | 58% | 33% | 34% |

Table 4 shows that the correlation coefficient r for all the regression lines is high; in fact, the coefficients of determination (i.e. $r^2$) for both the vesicular lava lines show that over 95% of the variation in compressive strength is related to $V_S/V_P$. $(V_S/V_P)_{crit}$ is a notional 'critical' value of the solid/pore volume ratio that is obtained by extrapolating the regression line down to the $V_S/V_P$ axis, where the compressive strength would be zero; $n_{crit}$ is the corresponding critical porosity.

The autoclaved aerated concrete has a critical porosity of 81%. The ordinary Portland cement has a critical porosity of 84% at 28 days, by which time it has achieved roughly 80% of its final strength (depending on curing conditions); even at 2 days, when the hardening process is still in the early stages, its critical porosity is 58%. By contrast the vesicular lavas appear to have a critical porosity of only about 33-34%.

The apparently low critical porosity of the vesicular lavas, and the relatively high sensitivity of their strength to porosity[6], raises a number of questions.

First, are the measured porosity values too low? For example, are there isolated vesicles that are inaccessible to water (used for the specific gravity measurements)? The porosity of both the autoclaved aerated concrete and ordinary Portland cement samples was measured by helium pycnometry; the chemical inertia and non-polar nature of the helium atom avoids problems of interaction that occur within the microstructures of these particular materials when water is used as the pycnometric medium. It is probable that helium would give different porosity values from water with the vesicular lavas and, indeed, the solid density values obtained with water appear to be slightly on the low side; published specific gravity values for

[6] As evidenced by the steepness of the strength vs $V_S/V_P$ plot compared with the autoclaved aerated concrete and ordinary Portland cement.

non-vesicular basalts range from about 2.85 to 3.00. Assuming the worst case (i.e. a solid density of 3000 kg $m^{-3}$) gives an estimated porosity range of 29.7-36.0% for the present materials, which is not greatly different from the measured values of 25.4-30.7%. The measured values are therefore acceptable for our purposes provided that we recognise that they are 'effective' porosities and not absolute values.

Is the strength of the vesicular lavas really as sensitive to porosity as Figure 3 suggests? Omitting SW1 from the regression analysis, on the assumption that it may not belong to the same population as the other materials[7], reduces the slope of the line and raises the critical porosity value, but not by very much.

X.R.F. gives very similar analyses for 350 and 622 (see appendix) and there is no other evidence - so far! - to suggest that the difference in their mechanical behaviour stems from anything other than the difference in their porosity. Hopefully thin section analysis will help to confirm this, or suggest what other factors might be relevant.

Figure 4 shows the hardness results, which seem to reflect the similarities between 340 and 622, and between 350 and 391. The hardness distribution extends to higher values for 340 and 622, whereas it tends to be concentrated at lower values for 350 and 391 possibly because of their greater porosity. The hardness distribution of SW1 appears to confirm a tendency towards lower values associated with lower strength and higher porosity.

The X.R.F. analyses (see appendix) show that all the present materials fall into or very close to the envelope of Mayen materials in a bivariate plot of zirconium vs. vanadium (Williams-Thorpe 1988, Figure 5). Furthermore, they fall close to Niedermendig tephrite and West Eifel tephrite samples in plots of MgO vs. $SiO_2$ and CaO vs. $Al_2O_3$, however they also lie within the

---

[7] Thermal cycling in a domestic hearth is unlikely to bring about significant mineralogical changes, though there is the possibility of physical damage - perhaps due to differential thermal expansion within the microstructure, or devitrification of glassy phases - hopefully visible in thin sections or in the scanning electron microscope.

envelope of materials from the Chaîne des Puys (Williams-Thorpe and Thorpe 1988, Figure 2); SW1 and SW2 remain within the Chaîne des Puys envelope for $K_2O$ vs. $SiO_2$ while the other materials fall outside but still close to the Niedermendig tephrite and West Eifel tephrite samples. The X.R.F. analyses also show that SW1 and SW2 have higher $Na_2O$ and lower $K_2O$ values than the other materials.

## 4. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

Porosity appears to be the dominant factor in determining variation in the mechanical behaviour of the materials discussed here. Higher strength and stiffness are associated with lower porosity, which appears to be reflected in the Shore hardness distributions.

The model developed for autoclaved aerated concrete appears to be applicable to the vesicular lavas discussed here and provides a basis for the characterisation of their mechanical behaviour. However, this needs to be fitted into an archaeological framework. More samples of archaeological material are needed to fill the gap in the present data and to extend it to higher densities[8] - also to explore any differences between samples from different sources and post-depositional environments. At the same time, it would be helpful to determine the characteristics of freshly quarried material with a range of porosities[9], also to examine the effects of thermal cycling and any other relevant factors that may become apparent.

## 5. ACKNOWLEDGEMENTS

I would like to thank members of the School of Earth, Environmental

---

[8] Mayen lava recently quarried from the same strata used by the Romans was found to have a density of 2114 kg $m^{-3}$, compared with values of 2034 and 2227 kg $m^{-3}$ obtained from two Roman lava millstones in the Museum of London (Spain 1992).

[9] It is worth checking whether vesicular size-frequency distribution is relevant since marked variations can occur over small vertical distances (Turflinger and Drummond 1996) - well within the dimensions of a quern.

and Physical Sciences at the University of Portsmouth, in particular Dr David Hughes (Head of School) and Roger Pulley (Laboratory Manager) for making the necessary facilities available, and Graham Spiller (Senior Technician) for his help in the laboratory. I am especially grateful to Derek Weights (Principal Technician) for the X.R.F. analyses.

7. APPENDIX

| Major elements, percentages | | | | | | |
|---|---|---|---|---|---|---|
| | 340 | 622 | 350 | 391 | SW1 | SW2 |
| $SiO_2$ | 48.02 | 49.25 | 49.05 | 47.15 | 47.51 | 47.70 |
| $Al_2O_3$ | 16.30 | 17.04 | 17.17 | 16.61 | 16.69 | 16.79 |
| $Fe_2O_3$ | 8.41 | 7.40 | 7.36 | 8.41 | 8.18 | 8.11 |
| MgO | 5.04 | 4.32 | 4.32 | 4.88 | 4.64 | 4.63 |
| CaO | 9.13 | 7.98 | 7.86 | 9.22 | 8.92 | 8.96 |
| $Na_2O$ | 4.26 | 5.13 | 5.17 | 4.53 | 6.32 | 6.90 |
| $K_2O$ | 4.06 | 4.56 | 4.57 | 4.36 | 1.37 | 1.33 |
| $TiO_2$ | 2.00 | 1.76 | 1.74 | 1.95 | 1.91 | 1.87 |
| MnO | 0.15 | 0.15 | 0.15 | 0.16 | 0.16 | 0.16 |
| $P_2O_5$ | 0.53 | 0.40 | 0.45 | 0.60 | 1.03 | 1.00 |
| L.O.I. | 0.76 | 0.81 | 0.80 | 1.03 | 2.63 | 2.36 |
| Total | 98.66 | 98.80 | 98.64 | 98.90 | 99.36 | 99.81 |
| Trace elements, parts per million | | | | | | |
| Ni | 46 | 40 | 34 | 35 | 39 | 37 |
| Cu | 35 | 29 | 28 | 31 | 20 | 26 |
| Zn | 84 | 87 | 85 | 86 | 94 | 108 |
| Zr | 332 | 411 | 406 | 372 | 385 | 384 |
| Y | 26 | 21 | 21 | 25 | 27 | 26 |
| Sr | 1031 | 857 | 859 | 1125 | 1048 | 1054 |
| Rb | 123 | 152 | 151 | 131 | 49 | 50 |
| Cr | 59 | 45 | 43 | 37 | 45 | 43 |
| V | 250 | 211 | 219 | 239 | 235 | 239 |
| Nb | 95 | 98 | 98 | 106 | 103 | 103 |
| U | 1 | 5 | 3 | 4 | 4 | 5 |
| Th | 9 | 12 | 11 | 11 | 15 | 12 |

Figure 1. Dry density vs. porosity

Figure 2. Compressive stress/strain curves

Figure 3. Compressive strength vs. $V_S/V_P$

Figure 4. Variations in Shore hardness distribution

FIG.1

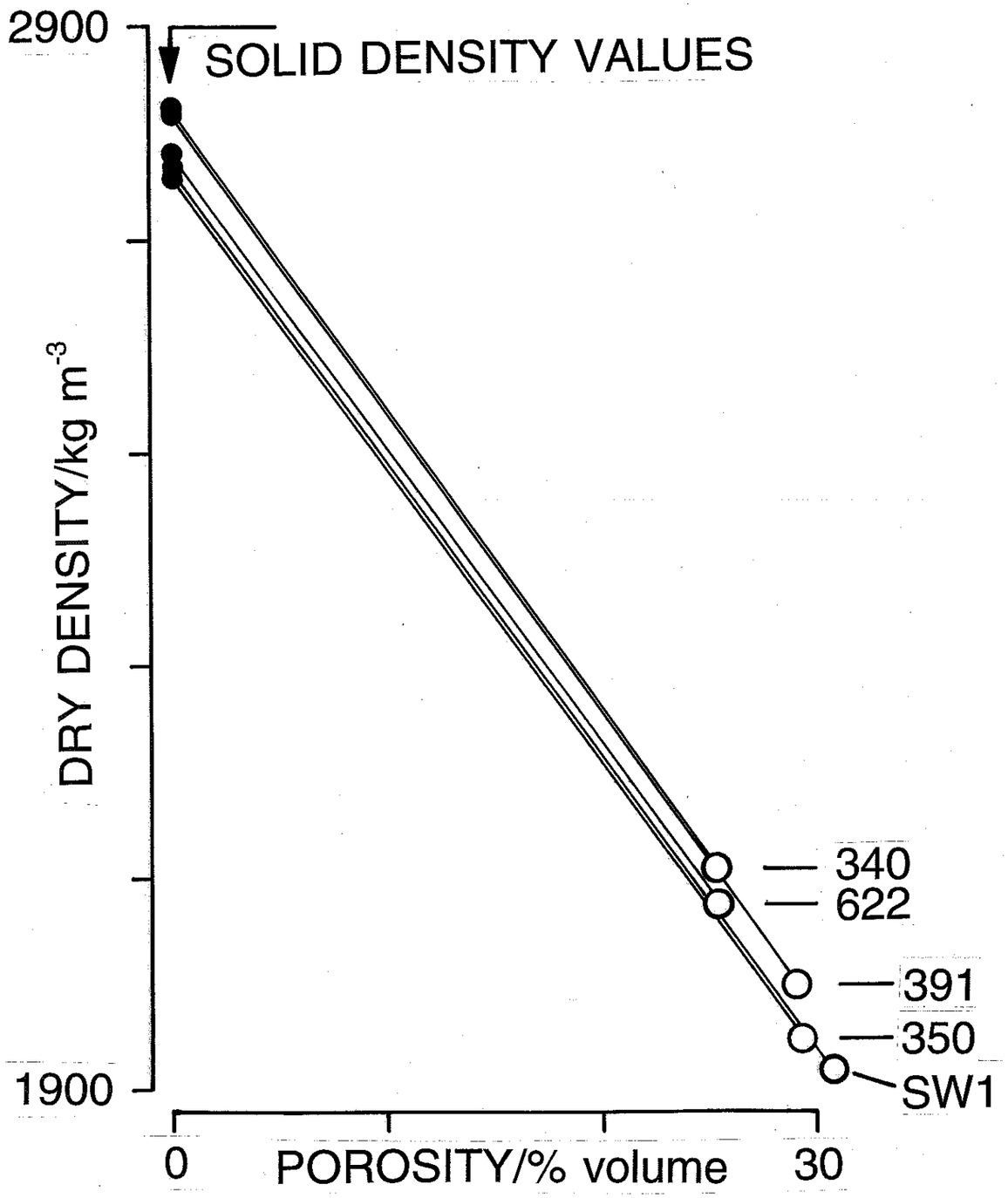

2900
SOLID DENSITY VALUES
DRY DENSITY/kg m-3
1900
0
POROSITY/% volume
30
340
622
391
350
SW1

FIG.2.

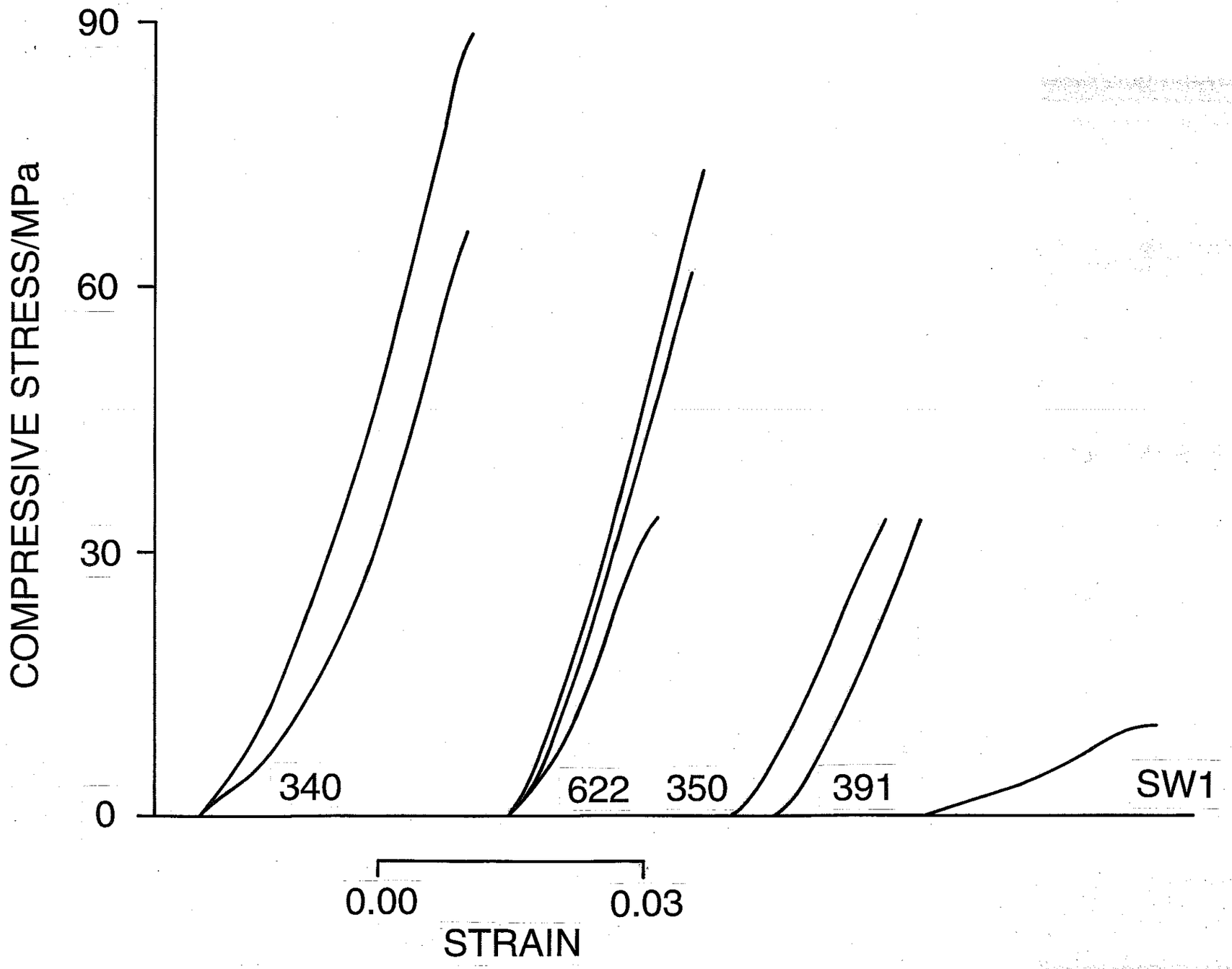

90
60
30
0
COMPRESSIVE STRESS/MPa
340
622
350
391
SW1
0.00
0.03
STRAIN

FIG.3

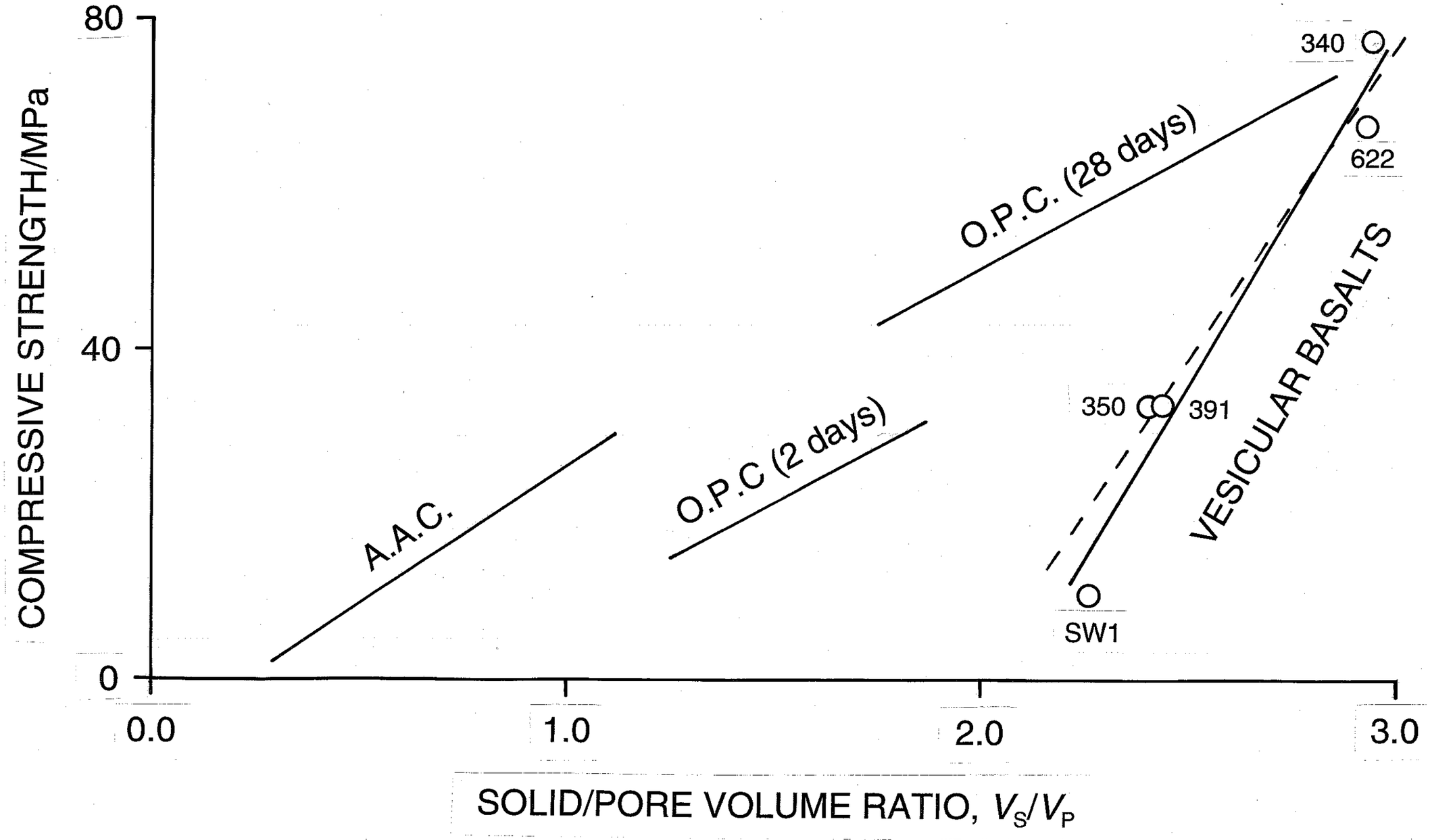
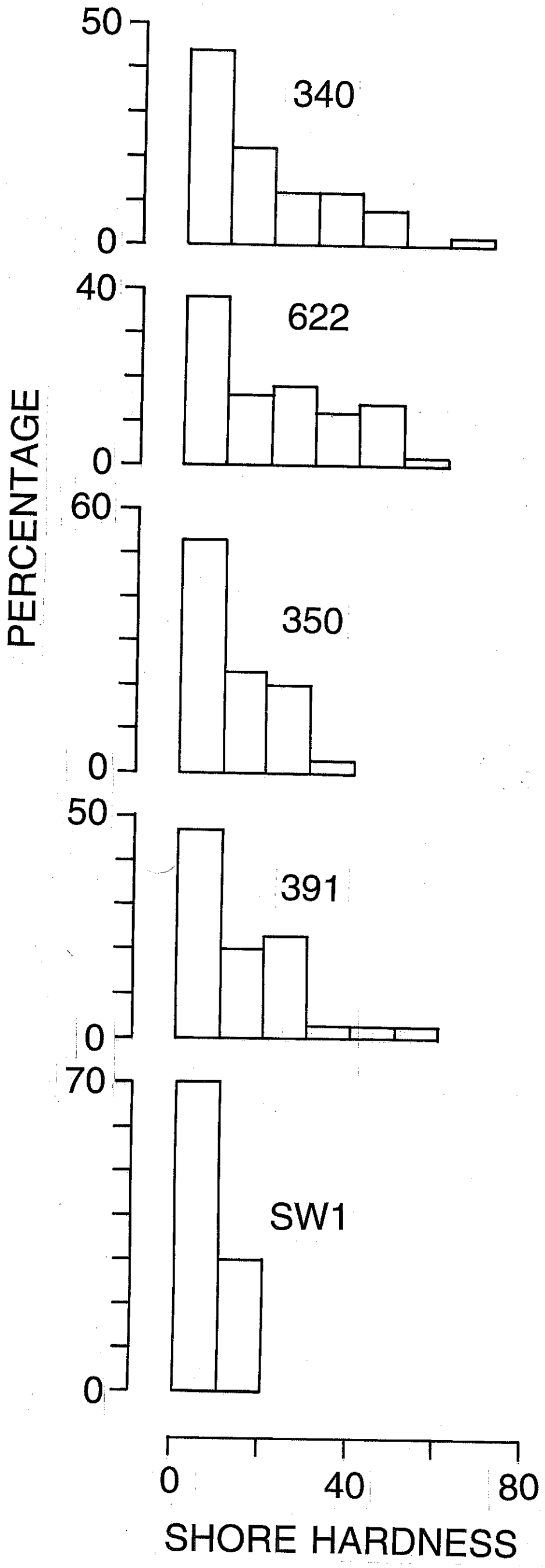

80
40
0
COMPRESSIVE STRENGTH/MPa
0.0
1.0
2.0
3.0
SOLID/PORE VOLUME RATIO, $V_S/V_P$
A.A.C.
O.P.C (2 days)
O.P.C. (28 days)
340
622
350
391
SW1
VESICULAR BASALTS

FIG. 4


50
340
0
40
622
0
60
350
0
50
391
0
70
SW1
0
0
40
80
PERCENTAGE
SHORE HARDNESS

**CATALOGUE:**

LAVA QUERNS:

No. 1
Lower stone
Estimated quern equivalent: 24%
Context: 18156
Group 495 OA43 period 301
External diameter: 390mm
Outer edge height: 93mm
Pattern: Deep parallel furrows around the outer edge, spaced 8-10mm apart. The raised concave grinding surface has some worn furrows. Upper face has markings fanning from centre to rim spaced 2-4mm apart.

No. 2
Lower stone
Estimated quern equivalent: 20%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Outer edge height: 99mm
Inner edge height: 101mm
Pattern: Deep parallel furrows around the outer edge 7-11mm apart. The raised concave grinding surface has some worn irregular furrows, 5-15mm. Upper face has a regular pattern with changes in direction.
Comments: Part of an entirely perforated spindle hole remains

No. 3
Upper stone
Estimated quern equivalent: 4%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Outer edge height: 120mm
Pattern: Harp tooling on the upper face and collar, 6-8mm apart. The outer face has vertical tooling 5-8mm apart. The worn grinding surface is roughly tooled nearly parallel to the outer edge or diagonal to it.

No. 4
Upper stone
Estimated quern equivalent: 19%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 80mm
Pattern: Harp tooling on the upper surface and deep parallel furrows around the outer edge. The grinding surface has a less distinct tooling. The outer edge tooling matches up with collar/upper face tooling.

Comments: Part of the collar remains.

No. 5
Small piece from a lower stone
Context: 18156
Group 495 OA43 period 301
Secondary use: Yes, this is suggested by wear marks on the base.
Pattern: Outer face has well defined vertical tool marks 4-8mm apart.

No. 6
Small piece from an upper stone
Context: 18156
Group 495 OA43 period 301
Inner edge height: 82mm
Pattern: Harp pattern on the upper surface, regularly spaced about 5-7mm apart. The lower surface grooves also well defined and 2-6mm apart.

No. 7
Small piece from an upper stone around the hopper
Context: 18156
Group 495 OA43 period 301
Inner edge height: 65mm
Pattern: Harp pattern on the upper surface, regularly spaced 5-7mm apart. Vertical markings irregularly spaced are also present 4-8mm apart. The lower surface has faint tooling marks 3mm apart.
Comments: The hopper is clearly defined as somewhat squarish in shape.

No. 8
Small piece from an upper stone
Context: 18156
Group 495 OA43 period 301
Pattern: Deep furrows on the upper surface, regularly spaced around 4-7mm apart. Lower surface marks are just visible.

No. 9
Upper stone
Estimated quern equivalent: 22%
Context: 18156
Group 495 OA43 period 301
External diameter: 460mm
Pattern: Deep parallel vertical furrows around the outer edge, 7-9mm apart. Collar markings are parallel, but irregularly spaced 2-8mm apart. There are traces of dressing on the upper surface

No. 10
Upper stone
Estimated quern equivalent: 17%
Context: 18156
Group 495 OA43 period 301
External diameter: 420mm

Outer edge height: 111mm
Secondary use: Some tooling marks may be secondary.
Pattern: Harp pattern on the upper surface, poorly defined, possibly 5-7mm apart. Deep upright furrows are visible around the outer edge, at 5-7mm intervals. Collar has diagonal parallel tool markings regularly spaced at 5-6mm, but is damaged.

No. 11
Upper stone
Estimated quern equivalent: 10%
Context: 18156
Group 495 OA43 period 301
Outer edge height: 120mm
Pattern: Deep upright furrows around the outer edge 5-8mm apart. Upper surface has well defined parallel markings 5-9mm apart. Collar has diagonal parallel tool markings regularly spaced at 5-9mm. The upper and outer surfaces seem to correspond together. The lower surface has poorly defined parallel markings.

No. 12
Upper stone
Estimated quern equivalent: 7%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Pattern: The outer face has vertical tooling, spaced at 7-10mm. The lower surface is crudely tooled.
Comments: Collar and upper face are missing.

No. 13
Small piece from an upper stone
Context: 18156
Group 495 OA43 period 301
Pattern: Harp pattern on the upper surface, with the grooves spaced at 8mm. Lower surface has poorly defined tooling marks 3-9mm.
Comments: Possibly from around the hopper.

No. 14
Small piece from a lower stone
Context: 18156
Group 495 OA43 period 301
Pattern: Only one surface remaining with poorly defined tool markings, 3-5mm apart, possibly the working surface.

No. 15
Small piece from an upper/lower stone
Context: 18156
Group 495 OA43 period 301
Pattern: Some vertical tooling down a concave face.

No. 16
Small piece from an upper stone
Context: 18156
Group 495 OA43 period 301
Secondary use: Secondary tool markings can be seen on one edge.
Pattern: Harp pattern on the upper surface, regularly spaced at 8-14mm and 6-10mm. Lower face is very worn with a few faint parallel grooves. Secondary, parallel, diagonal tool markings are visible on one edge of the fragment.
Comments: No outer edge surviving.

No. 17
Upper stone
Estimated quern equivalent: 20%
Context: 18156
Group 495 OA43 period 301
External diameter: 360mm
Pattern: Deep upright furrows around the outer edge, spaced at 5-8mm. Traces of dressing on the upper surface are visible but too worn to analyse. The collar has well defined grooves regularly spaced 7mm apart.

No. 18
Lower stone
Estimated quern equivalent: 8%
Context: 18156
Group 495 OA43 period 301
External diameter: 350mm
Outer edge height: 80mm
Secondary use: The outer edge is shallow and therefore possibly recut
Pattern: Deep upright furrows around the outer edge 4-7mm apart. Upper surface has faint markings only.

No. 19
Small piece from an upper/lower stone
Context: 18156
Group 495 OA43 period 301
Pattern: Radiate tooling on the grinding surface. The outer edge has vertical tooling 6-10mm apart.

No. 20
Small part of upper stone
Context: 18156
Group 495 OA43 period 301
Pattern: Parallel grooves on the upper? surface, average 8mm apart

No. 21
Upper stone
Estimated quern equivalent: 17%
Context: 18156
Group 495 OA43 period 301
External diameter: 420mm

Outer edge height: 108mm
Inner edge height: 49mm
Pattern: Harp pattern on the upper surface, with the pattern widening away from the collar (6-11mm apart). Worn traces of dressing are visible on the grinding surface, fanning from the hopper to the rim, approx. 3-4mm apart. Outer edge has vertical grooves. Collar has clear, parallel diagonal toolings 4-7mm apart. Some collar markings seem to correspond with the upper face markings.
Comments: A socket hole for a handle has been cut into the side of the stone

No. 22
Lower stone
Estimated quern equivalent: 26%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Outer edge height: 85mm
Pattern: Irregular radiate tooling seem to be present on the upper, grinding face. Outer face has vertical marks 7-10mm apart.

No. 23
Lower stone
Estimated quern equivalent: 22%
Context: 18156
Group 495 OA43 period 301
External diameter: 340mm
Pattern: Outer face has vertical parallel tooling marks spaced at 3-7mm. The upper face has poorly defined tool marks, parallel with the rim.
Comments: Base not surviving.

No. 24
Small part of an upper/lower stone
Context: 18156
Group 495 OA43 period 301
Pattern: Outer face has parallel tooling at 8-10mm

No. 25
Small part of a lower stone
Context: 18156
Group 495 OA43 period 301
Pattern: Faint Harp tooling is visible with varying spacing from 5-12mm.

No. 26
Upper stone
Estimated quern equivalent: 10%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 70mm

Secondary use: Tooling on a broken face.
Pattern: Clear harp tooling on the upper surface, spaced at 7-10mm but none on the collar. Outer face also has tooling at 7-10mm. Working lower face has radiate tooling showing wear.

No. 27
Upper stone
Estimated quern equivalent: 23%
Context: 18156
Group 495 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 70mm
Secondary use: Suggested by crude retooling.
Pattern: Rather crude harp pattern is visible on the upper face, collar face and collar's vertical face. Spacing varies from 5mm-12mm on the collar. Outer face has concave profile and vertical tooling 6-10mm apart. The lower surface is worn and possibly retooled with the harp pattern.
Comments: The handle socket is 40mm in diameter at the mouth, tapering to 10mm where it meets the diagonal hole from the upper surface (50-10mm).

No. 28
Lower stone
Estimated quern equivalent: 28%
Context: 18156
Group 495 OA43 period 301
External diameter: 380mm
Outer edge height: 95mm
Pattern: Outer face has vertical tool markings, regularly spaced at 5-7mm. Upper face has faint grooves cut in opposing directions, 3-5mm apart. Base has some wear markings.

No. 29
Small piece from an upper stone
Context: 18156
Group 495 OA43 period 301
Pattern: Traces of a harp pattern on the upper surface. Clear parallel tool markings on the lower surface, 5-10mm apart.

No. 30
Small part of an upper stone
Context: 18156
Group 495 OA43 period 301
Secondary use: Yes
Pattern: Harp pattern is visible on the upper face with tooling 8-14mm apart. Lower face is crudely and erratically tooled.

No. 34
Small part of an upper stone
Context: 18252

Group 461 S20 period 301
Inner edge height: 69mm
Pattern: The upper face has clear diagonal parallel tool marks, 5-7mm apart. Lower face has worn parallel diagonal markings 5-8mm apart.

No. 35
Lower stone
Estimated quern equivalent: 5%
Context: 18252
Group 461 S20 period 301
External diameter: 400mm
Outer edge height: 100mm
Inner edge height: 85mm
Pattern: Herringbone on the concave grinding surface with deep upright grooves on the outer edge spaced at 9-10mm. Lower surface is roughly dressed.
Comments: The spindle hole is seen in profile along the break.

No. 36
Upper stone
Estimated quern equivalent: 12%
Context: 18252
Group 461 S20 period 301
External diameter: 400mm
Outer edge height: 110mm
Pattern: Upper face and collar have matching parallel grooves 5-10mm apart. Outer face has vertical tooling 7-9mm apart. Lower face has worn irregular diagonal tooling 3-10mm apart, nearly parallel to the outer edge.

No. 37
Lower stone
Estimated quern equivalent: 11%
Context: 18252
Group 461 S20 period 301
External diameter: 400mm
Pattern: Clear but worn diagonal parallel tooling marks 4-7mm apart on the upper face. The outer face also has clear but worn vertical parallel tool marks, 5-7mm apart.

No. 38
Small piece from an upper/lower stone
Context: 18252
Group 461 S20 period 301
Pattern: A surviving outer face piece with vertical tooling spaced at 6-9mm.

No. 39
Lower stone
Estimated quern equivalent: 13%
Context: 18252
Group 461 S20 period 301

External diameter: 390mm
Pattern: Upper face has poorly defined tool marks at 5mm intervals fanning from centre to outer edge. The outer face has well defined parallel vertical tooling at 4-7mm intervals.

No. 40
Small piece from an upper/lower stone
Context: 18252
Group 461 S20 period 301
Pattern: Some equally spaced tooling is visible.

No. 41
Small piece from an upper/lower stone
Context: 18252
Group 461 S20 period 301

No. 42
Small piece from an upper/lower stone
Context: 18252
Group 461 S20 period 301

No. 43
Small piece from an upper stone
Context: 18254
Group 465 OA43 period 301
Pattern: Upper face has worn, parallel tooling 7mm apart. Lower face has very faint marks visible to outer edge.

No. 44
Small piece from an upper stone
Context: 18254
Group 465 OA43 period 301
Pattern: Worn parallel tool markings,from the centre to the outer rim visible at outer edge. Outer face has vertical parallel tool marks, 6-8mm apart.
Comments: Collar not surviving.

No. 45
Small piece of lower stone
Context: 18254
Group 465 OA43 period 301
Secondary use: The base has possibly been sheared off.
Pattern: Upper face has parallel toolings widely spaced at 8mm intervals. Outer face has vertical parallel tool marks at 5-7mm intervals.

No. 46
Small piece from an upper stone
Context: 18254
Group 465 OA43 period 301
Pattern: Upper face has parallel tool markings, 7-8mm apart.

No. 47
Lower stone
Estimated quern equivalent: 8%
Context: 18254
Group 465 OA43 period 301
External diameter: 370mm
Outer edge height: 98mm
Secondary use: Possible redressing of upper surface.
Pattern: Harp pattern on the upper surface with one set of markings crossed. The grooves are spaced at 2-6mm. The outer face has vertical tool markings, regularly spaced at 3-6mm. Base has no tooling.

No. 48
Lower stone
Estimated quern equivalent: 8%
Context: 18254
Group 465 OA43 period 301
External diameter: 340mm
Pattern: Upper face has tooling marks fanning out from the centre to the rim, spaced at 5-7mm. Outer face has vertical parallel markings 5-6mm apart. Possible vertical tool markings in inside edge of spindle hole.
Comments: Spindle hole profile visible.

No. 49
Small piece from an upper stone
Context: 18254
Group 465 OA43 period 301
Secondary use: The collar has been knocked off and dressings are crossed
Pattern: Harp pattern on the upper surface, regularly spaced at 5-9mm with some marks crossing. Lower face has worn markings fanning out form centre to rim, inner markings 3-5mm, outer markings 5-7mm.

No. 50
Upper stone
Estimated quern equivalent: 17%
Context: 18254
Group 465 OA43 period 301
External diameter: 380mm
Outer edge height: 110mm
Secondary use: Possible redressing of base.
Pattern: Harp pattern on upper surface, regularly spaced at 6-7mm. Collar has parallel, diagonal tool marks, 4-8mm apart. Lower face has very worn markings, 4mm apart. The outer face has vertical toolings 5-7mm apart. The collar, upper face and outer face tool marks correspond.

No. 52
Small piece from an upper stone
Context: 18224
Group 493 OA43 period 301
Pattern: Upper surface has parallel tool marks, regularly spaced at 6-8mm.

No. 53
Upper stone
Estimated quern equivalent: 12%
Context: 18224
Group 493 OA43 period 301
External diameter: 410mm
Outer edge height: 115mm
Pattern: Deep dressing on the upper surface, parallel and 4-6mm apart. Inner edge of collar has marks following the line of the collar. Collar has diagonal, parallel tool markings spaced at 3-4mm intervals. There are deep upright furrows around the outer edge. Lower surface has diagonal markings 3-5mm apart, and has possibly been redressed.

No. 54
Upper stone
Estimated quern equivalent: 25%
Context: 18224
Group 493 OA43 period 301
External diameter: 440mm
Outer edge height: 129mm
Secondary use: Possible retooling of lower face.
Pattern: Harp pattern is visible on the upper surface and on the collar, spaced 5-10mm apart. Deep parallel furrows around the outer edge are 5-8mm apart. The lower, grinding surface is tooled with parallel oblique marks.
Comments: The edge is concave and varies in thickness from 122-135mm.

No. 55
Upper stone
Estimated quern equivalent: 27%
Context: 18224
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 70mm
Pattern: Harp pattern has been used on the upper face, tooling lines spaced at 5-9mm. Collar lines sometimes agree and in other places run at angles. Outer face has vertical tool lines spaced at 5010mm. Lower face has faint radiate tooling, heavily worn.

No. 56
Lower stone
Estimated quern equivalent: 45%
Context: 18224
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 50mm
Inner edge height: 95mm

Pattern: Upper(grinding)face has worn radiate tooling spaced at 7-10mm at outer edge which matches the vertical tooling on the outer face. The lower face is roughly dressed with a few lines visible.

No. 57
Upper stone
Estimated quern equivalent: 21%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 115mm
Pattern: Harp tooling is just visible on the lower face, upper face has parallel tooling 6-9mm apart. Outer face is battered, but vertical tooling is 7-9mm apart.

No. 58
Upper stone
Estimated quern equivalent: 13%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Outer face has worn vertical tooling marks. Lower face shows worn radiate tooling.
Comments: Upper face missing. Handle socket penetrates horizontally tapering from 36mm at the mouth to 20mm at the centre.

No. 59
Small part of lower stone
Context: 18249
Group 493 OA43 period 301
Outer edge height: 90mm
Pattern: Upper surface has parallel tool markings regularly spaced at 3-6mm, going from rim to centre. The base has several indistinct marks. The outer face has vertical tool marks which appear to correspond with the upper tool marks.

No. 60
Lower stone
Estimated quern equivalent: 13%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Upper face is worn smooth with no tooling visible. Outer face has vertical tooling spaced at 6-10mm.

No. 61
Small part of upper/lower stone
Context: 18249
Group 493 OA43 period 301

Pattern: Tooling on the skirt at 7-10mm spacing. Grinding face has rough oblique tool marks.

No. 63
Small part of upper stone
Context: 18249
Group 493 OA43 period 301
Pattern: Outer face has clear vertical tooling at 4-6mm apart. Faint grooves are just visible in the lower face.

No. 64
Lower stone
Estimated quern equivalent: 16%
Context: 18249
Group 493 OA43 period 301
External diameter: 300mm
Outer edge height: 90mm
Pattern: Closely spaced vertical or radiate tooling on grinding surface, 2-5mm apart. Outer face has vertical tooling 3-8mm apart. The base is roughly dressed.

No. 65
Upper stone
Estimated quern equivalent: 12%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Outer face shows faint vertical tooling but the lower surface has none visible.
Comments: Upper face is missing.

No. 66
Upper stone
Estimated quern equivalent: 10%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Vertical tooling is visible on the outer face at 7-9mm spacing. Collar shows diagonal tool marks which match the outer face.

No. 67
Part of an upper/lower stone
Estimated quern equivalent: 13%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Vertical tooling marks are visible on the outer face at 6-10mm intervals. The grinding surface shows faint oblique tooling 2-5mm apart.

No. 68

Small part of an upper/lower stone
Context: 18249
Group 493 OA43 period 301
Pattern: Grinding surface has chisel tooling.

No. 69
Upper stone
Estimated quern equivalent: 7%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Collar has vertical and oblique tool marks 5-10mm apart. The outer face shows vertical equally spaced tooling.

No. 70
Ver small piece of upper stone
Estimated quern equivalent: 4%
Context: 18249
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Parallel oblique tooling is visible on the collar and vertical tooling is present on the outer face spaced at 2-7mm.

No. 71
Upper stone
Estimated quern equivalent: 16%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Outer edge height: 120mm
Secondary use: Two secondary holes made on the lower face.
Pattern: Harp pattern on the upper surface, at 5-7mm intervals, with tool marks following the circumference close to the collar, 4-5mm apart. Collar itself has diagonal markings spaced at 4-6mm intervals. The worn dressing on the grinding surface has three different sets of markings, 2-4mm, 3-5mm & 4-5mm. Deep parallel furrows are visible around the outside edge at 4-6mm. Part of the collar remains.

No. 72
Upper stone
Estimated quern equivalent: 48%
Context: 18265
Group 460 OA42 period 301
External diameter: 410mm
Outer edge height: 127mm
Inner edge height: 76m
Pattern: Harp pattern on the upper surface spaced at 5-8mm. Part of the collar remains with parallel tool markings changing at the outer edge and spaced at 2-6mm intervals. Markings also follow the circumference of the inner collar edge. Worn dressing on the grinding surface shows fanning out

from the hopper to the outer edge with spacing at 2-4mm. The deep parallel furrows around the outside edge are spaced at 4-7mm. There is directional correspondence between the outer face, upper face and collar tool markings. Hopper has vertical tooling on the inner face.
Comments: Handle socket is present in the side of the stone, 50mm in diameter at the mouth and penetrating 99mm, but the surface is broken,.

No. 73
Lower stone
Estimated quern equivalent: 22%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 95mm
Pattern: Upper face shows tooling following the stone's circumference and spaced at 3-7mm. Lower face has a few crude marks visible, 2-5mm thick. Outer face has clear vertical tooling spaced at 5-8mm apart.

No. 74
Upper stone
Estimated quern equivalent: 18%
Context: 18265
Group 460 OA42 period 301
External diameter: 410mm
Outer edge height: 123mm
Pattern: Upper face has parallel tooled grooves, 3-7mm apart. Collar has diagonal parallel tool marks spaced at 2-5mm apart. The lower face has marks following the stone's circumference, approximately 3-7mm apart and worn. Vertical markings are clearly defined on the outer face. The direction of the markings correspond with the exception of the lower face.
Comments: An oval-shaped handle socket is present in the side of the stone, 26mm high and 25mm wide at the mouth and extending inside at least 50mm.

No. 75
Small part of upper stone
Context: 18265
Group 460 OA42 period 301
Pattern: Harp pattern on the upper surface is regularly spaced at 5-10mm. Lower face also has harp pattern roughly tooled and not at right angles, 2-5mm apart.

No. 76
Lower stone
Estimated quern equivalent: 19%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 72mm
Inner edge height: 65mm

Pattern: Harp pattern radiating from centre and worn smooth in places. Tooling is also visible in the spindle hole. Outer edge has vertical tooling at 5-8mm and double horizontal parallel grooves. Lower face has irregular, crude tooling.

No. 77
Upper stone
Estimated quern equivalent: 20%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 125mm
Pattern: The collar of the upper face is obliquely tooled with parallel lines 4-6mm apart. The outer face has vertical tool marks matching the collar, 4-7mm apart. The lower face has faint harp patterning on it to lip and the socket hole also has some tooling.
Comments: The handle socket is squarish, measuring 45mm across.

No. 78
Upper stone
Estimated quern equivalent: 28%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height:125mm
Pattern: The upper face and collar have harp pattern tooling spaced at 7-10mm. Outer face has vertical tooling 4-9mm apart and is waisted. The grinding surface has narrowly spaced tooling 1-6mm apart.

No. 79
Lower stone
Estimated quern equivalent: 35%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 60mm
Inner edge height: 100mm
Pattern: The upper face has the harp pattern radiating from the centre. The outer face has vertical tooling to match grinding surface tooling at 3-8mm spacing. The lower surface is roughly dressed with faint grooves.

No. 80
Upper stone
Estimated quern equivalent: 30%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 140mm
Secondary use: Yes, mortar traces are visible.

Pattern: Harp patterning is visible on both the upper face and collar, 5-10mm apart. The outer face is tooled to match the collar. Lower grinding face is worn with faint radiate tooling.
Comments: Important handle features are still visible. Both socket still retain a lead plug/plate holding and iron?handle attachment.

No. 81
Upper stone
Estimated quern equivalent: 17%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 56mm
Pattern: tooling is indistinct on the upper face and collar. The outer face has tooling spaced at 3-9mm on a concave surface. The lower surface worn with circular marks parallel to the outer edge. The hopper is tooled.
Comments: Some of the hopper remains.

No. 82
Upper stone
Estimated quern equivalent: 17%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 121mm
Inner edge height: 64mm
Pattern: Upper face has clear parallel markings, spaced at 4-7mm. The collar has diagonal tooling marks with other marks parallel to the outer edge at its base. The lower face has a very few faint grooves and the outer face has vertical tooling approx. 3-6mm apart. There is possible correspondence between the collar and outer markings.

No. 83
Upper stone
Estimated quern equivalent: 18%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Pattern: Upper surface has parallel tool markings  at 3-6mm intervals but the collar has been sheared off. Lower face has poorly defined irregular grooves. The outer face has vertical tool marks regularly spaced at 3-7mm.

No. 84
Lower stone
Estimated quern equivalent: 17%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Outer edge height: 97mm

Pattern: Upper and lower faces have infrequent marks. The outer face has clear vertical tool marks spaced at 4-8mm. The spindle hole has tooling running towards the centre of the stone.
Comments: The spindle hole is entirely perforated.

No. 85
Lower stone
Estimated quern equivalent: 13%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 87mm
Pattern: Closely spaced radiate tooling is visible on the upper surface, 1-5mm apart. Tooling on the outer face is bolder and 5-8mm apart. The lower face has irregular tooling.

No. 86
Lower stone
Estimated quern equivalent: 39%
Context: 18265
Group 460 OA42 period 301
External diameter: 420mm
Outer edge height: 90mm
Pattern: Upper face has some poorly defined marks. Lower face has a few crude marks. The outer surface has vertical tooling at 3-6mm intervals and some tooling is visible on broken surfaces.

No. 87
Lower stone
Estimated quern equivalent: 19%
Context: 18265
Group 460 OA42 period 301
External diameter: 390mm
Outer edge height: 107mm
Inner edge height: 93mm
Pattern: Worn tool marks visible radiating from the spindle hole, spaced at 2-4mm intervals. The Lower surface has only a few crude markings. The outer edge has vertical tool marks regularly spaced at 3-9mm, possibly corresponding with those on the upper face.

No. 88
Upper stone
Estimated quern equivalent: 12%
Context: 18158
Group 493 OA43 period 301
External diameter: 390mm
Outer edge height: 120mm
Inner edge height: 70mm
Pattern: Upper face has parallel marks at 6-8mm, with a collar showing diagonal parallel marks at 4-6mm. The outer face has verticaltool marks

spaced at approximately 7-10mm which correspond with those on the collar and upper face. The lower face markings radiate from hopper to outer edge at 2-3mm intervals.
Comments: Part of the hopper remains.

No. 89
Upper stone
Estimated quern equivalent: 15%
Context: 18158
Group 493 OA43 period 301
External diameter: 380mm
Outer edge height: 122mm
Inner edge height: 70mm
Pattern: Parallel tool marks are just visible on the upper surface, 5-8mm apart and worn collar, 4-7mm apart. The lower face has worn diagonal, parallel gooves and the outer edge has deep vertical furrows on. There is possibly a correspondence between the markings on the collar, outer and upper faces.
Comments: A handle socket is partially present.

No. 90
Upper stone
Estimated quern equivalent: 35%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 110mm
Inner edge height: 57mm
Pattern: Upper face has deeply incised harp pattern, at 5-8mm intervals. The hopper face shows tooling and the outer face has vertical deep grooves spaced at 6-10mm. The lower face has radiate tooling.
Comments: There is a handle socket 25mm down from lip of the collar which is square (40mm in diameter). The corresponding opening on the upper surface is more circular (30mm in diameter).

No. 91
Upper stone
Estimated quern equivalent: 20%
Context: 18158
Group 493 OA43 period 301
External diameter: 440mm
Outer edge height: 130mm
Pattern: Harp pattern tooling is spaced at 5-10mm on the upper face with the collar eroded. The outer face is waisted with vertical tooling which matches up with the tooling on the collar. The lower face is tooled in cruder parallel lines spaced at 2-10mm.
Comments: The handle socket in the skirt tapers from 30mm diameter at the mouth to 10mm where it is broken off.

No. 92
Upper stone

Estimated quern equivalent: 26%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 58mm
Secondary use: There is some redressing.
Pattern: Harp pattern tooling has been used on the upper face, changing direction to make collar step. The outer edge has vertical tooling at 5-10mm spacing, sometimes doubles. The lower face has irregularly and narrowly spaced radiate tooling.
Comments: The handle socket in outer face is square/circular and 40mm in diameter, opening in upper face is circular and 25mm in diameter.

No. 93
Upper stone
Estimated quern equivalent: 25%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Pattern: Upper face has diagonal parallel tooling 7-11mm apart. Outer face is abraded but vertical tooled lines can still be seen 5-10mm apart. The lower face has worn diagonal tooling.

No. 94
Lower stone
Estimated quern equivalent: 25%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 70mm
Inner edge height: 96mm
Pattern: The upper face is abraded and only faint radiate tooling is still visible.
Comments: Very little of the upper face remains.

No. 95
Lower stone
Estimated quern equivalent: 12%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 85mm
Inner edge height: 90mm
Pattern: Radiate tooling marks are just visible on the upper face and tool marks are still visible in the spindle hole. The outer face has vertical tooling spaced at 6-12mm intervals, The lower face is roughly dressed flat.

No. 96
Upper stone

Estimated quern equivalent: 10%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 135mm
Inner edge height: 70mm
Pattern: Upper face has harp patterning spaced at 6-10mm intervals. The outer face has vertical tooling matching the collar tooling at 6-10mm intervals. The lower, grinding face is worn but shows radiate patterning.
Comments: There is a square handle socket mouth in the upper face of approx. 30mm diameter.

No. 97
Upper stone
Estimated quern equivalent: 16%
Context: 18158
Group 493 OA43 period 301
External diameter: 390mm
Outer edge height: 138mm
Pattern: The upper face has clear harp patterning but also has the tooling at the collar edge following the circumference of the stone. The collar also has parallel tool markings 6-8mm apart. The outer edge has vertical markings 7-9mm apart. The lower face also has the harp pattern with spacing between 3-9mm.

No. 98
Upper stone
Estimated quern equivalent: 15%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 108mm
Pattern: Harp pattern is present on the upper surface, lines 4-8mm apart, and on the collar, 4-5mm apart. The outer face has vertical tooling regularly spaced at 5-7mm. Lower face appears to have radiate tooling 2-3mm apart.
Comments: Lower surface has a small indentation on the base 15mm wide and 7mm deep.

No. 99
Lower stone
Estimated quern equivalent: 14%
Context: 18158
Group 493 OA43 period 301
External diameter: 390mm
Outer edge height: 105mm
Inner edge height: 105mm
Pattern: The upper face is worn but appears to have parallel tool markings on it, spaced at 2-5mm intervals. The lower face has a few crude markings. The outer face has vertical tool marks spaced regularly, 4-11mm apart. There is also tooling on the spindle hole walls.

Comments: Part of the spindle hole remains.

No. 100
Upper stone
Estimated quern equivalent: 16%
Context: 18158
Group 493 OA43 period 301
External diameter: 470mm
Pattern: Harp pattern on the upper surface, regularly spaced at 5-8mm. The Lower face has irregularly spaced vaguely parallel marks, 2-9mm apart. The outer face has vertical tool marked lines spaced around 3-7mm apart.

No. 101
Upper stone
Estimated quern equivalent: 15%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 115mm
Inner edge height: 60mm
Pattern: Harp pattern is visible on the upper surface with lines 6-12mm apart. Collar has parallel tool markings just visible 6mm apart, with some circumferential tooling just visible at the step. The lower face has radiating tooling spaced at 2-6mm intervals. The outer face has clear vertical tool marks at 6-9mm. There is some correspondence directionally between the outer and upper faces and collar markings.
Comments: The handle socket is visible in the outer face and is 30mm in height, and 5mm wide remaining due to the break of the stone.

No. 102
Upper stone
Estimated quern equivalent: 25%
Context: 18158
Group 493 OA43 period 301
External diameter: 380mm
Outer edge height: 118mm
Inner edge height: 65mm
Pattern: Harp pattern on the upper surface clear with 2-6mm spacing. The collar has parallel tool markings also spaced 3-6mm apart and corresponding with the above. Hopper has vertical tooling on its wall. Lower face has radiating tool markings from the hopper outwards and spaced at 2-6mm. The outer face has deep parallel furrows spaced at 7-10mm intervals corresponding with the upper face.
Comments: Small collar, part of hopper remaining. Part of handle socket is visible in the upper surface, approximately rectangular, 35mm by 22mm and in the outer face 38mm by 30mm.

No. 103
Upper stone
Estimated quern equivalent: 23%

Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 119mm
Pattern: Harp pattern on the upper surface spaced at 7-9mm between lines. Collar has parallel tool markings 6-8mm apart, with circumferential tooling where it joins the upper face. The lower face has indistinct tool marks. The outer face has deep parallel furrows, 5-8mm apart, which correspond with the upper face.
Comments: Small collar remains.

No. 104
Lower stone
Estimated quern equivalent: 22%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 100mm
Pattern: Upper face has radiate tooling marks from centre outwards at 4-7mm spacing. The lower face has a few crude marks. The outer face has vertical tool marks regularly spaced at 6-9mm.

No. 105
Lower stone
Estimated quern equivalent: 18%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Pattern: Worn dressing, harp pattern with irregular spacing (2-10mm) on the grinding surface. Lower face has a few marks with a few irregular lines 2-5mm apart. There are deep upright furrows on the outer edge at 4-9mm spacing.

No. 106
Lower stone
Estimated quern equivalent: 27%
Context: 18158
Group 493 OA43 period 301
External diameter: 390mm
Outer edge height: 99mm
Pattern: The upper face has radiate tooling from centre to edge at 2-5mm spacing. The lower face has a few crude tool markings and the outer face has regularly spaced vertical toolings at 5-8mm intervals.

No. 107
Lower stone
Estimated quern equivalent: 20%
Context: 18158
Group 493 OA43 period 301
External diameter: 600mm
Outer edge height: 150mm

Pattern: Worn dressing on the grinding surface, possibly harp pattern at 2-8mm intervals. Deep upright furrows on the outer edge are visible at 6-12mm intervals. Lower face has no tooling visible.
Comments: 50% larger than most quern stones, relief tablet end stands out from collar at height of 20 cm above face. This may possibly from a donkey mill but it is difficult to be certain.

No. 108
Upper stone
Estimated quern equivalent: 23%
Context: 18158
Group 493 OA43 period 301
External diameter: 440mm
Outer edge height: 145mm
Secondary use: Redressing on the upper face.
Pattern: Harp pattern on the upper edge only visible in places (2-10mm spacings). Collar is very worn but has pattern of opposing lines also at 3-6mm apart. Lower face has some circumferential tooling lines. The outer face has vertical tooling marks regularly spaced at 4-9mm intervals.

No. 109
Small part of the upper stone
Context: 18158
Group 493 OA43 period 301
Pattern: Harp pattern on the upper surface,some of it crudely done, with regular spacing 4-11mm. Worn dressing on the grinding surface indicates opposing directions at irregular spacing of 2-9mm.
Comments: A larger than usual stone.

No. 110
Upper stone
Estimated quern equivalent: 35%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Pattern: Harp tooling is visible on the upper surface, 5-10mm apart. Outer face has vertical tooling. Lower face is worn with circular grinding striations.
Comments: Most of collar is missing.

No. 111
Upper stone
Estimated quern equivalent: 28%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 122mm
Inner edge height: 68mm
Secondary use: Redressing on the upper face

Pattern: Harp tooling is visible on the upper face crudely done (sometimes repeating the cut), but regularly 5-10mm apart. Collar has parallel tooling with circumferential marks at the bottom of the step. Hopper and handle socket are peck tooled. Lower face has shallow radiate tooling.
Comments: The handle socket opening in outer face is square-circular and 40mm in diameter. Opening in upper face is rectangular and 30mm by 50mm.

No. 112
Lower stone
Estimated quern equivalent: 50%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 100mm
Inner edge height: 110mm
Secondary use: See below
Pattern: Closely spaced radiate tooling is visible on the upper face. Upper face has been recut (230 by 90mm area) and tooled longways and this has become worn. The spindle hole face has also been pecked. Deep upright furrows on the outer edge are regularly spaced at 5-10mm apart. Lower face shows signs of irregular tooling.

No. 113
Lower stone
Estimated quern equivalent: 9%
Context: 18158
Group 493 OA43 period 301
External diameter: 390mm
Outer edge height: 101mm
Inner edge height: 90mm
Pattern: Radiate tooling from spindle hole to edge spaced 2-3mm apart. The lower face has a few indistinct markings. Outer face has no tooling visible.

No. 114
Upper stone
Estimated quern equivalent: 21%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 122mm
Inner edge height: 60mm
Secondary use: Possible redressing of lower face.
Pattern: Harp pattern visible on the upper face, with 6-10mm spacing. The hopper face has been pecked. The outer face has clear vertical tooling marks at 4-8mm interval and is slightly waisted in profile. The lower grinding face is worn in rough herring bone fashion.

No. 115
Upper stone
Estimated quern equivalent: 20%

Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 60mm
Pattern: Harp tooling is clear on collar and upper face although not quite matching. Outer face has wear line obliterating vertical tooling. Lower grinding surface has faint radiate tooling still visible.
Comments: Small dressed collar and part of a wide hopper remains.

No. 116
Upper stone
Estimated quern equivalent: 22%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 105mm
Inner edge height: 63mm
Secondary use: Broken face has been tooled.
Pattern: Harp pattern shows on the upper surface, spaced at 1-11mm, with repeat etching in places. Collar has few tooling marks. Outer face tooling is oblique and spaced at 2-7mm. Lower grinding face has radiate tooling marks, some crossing.
Comments: Small dressed collar.

No. 117
Upper stone
Estimated quern equivalent: 20%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 116mm
Pattern: Harp pattern of the upper face spaced at 6-8mm, with circumferential across the step tooling and pecking. Lower face has faint radiate tooling marks.

No. 118
Lower stone
Estimated quern equivalent: 32%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 96mm
Pattern: Upper grinding face has a worn harp pattern with 5-8mm spacing. The lower face is roughly dressed.

No. 119
Upper stone
Estimated quern equivalent: 30%
Context: 18158

Group 493 OA43 period 301
External diameter: 340mm
Outer edge height: 128mm
Secondary use: Possible reconditioning of the lower face.
Pattern: The upper face and collar have harp tooling pattern with lines 6-9mm apart. The outer face has vertical tooling 3-8mm apart. The lower face is worn in the centre where a herring bone pattern appears.

No. 120
Upper stone
Estimated quern equivalent: 12%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 125mm
Inner edge height: 70mm
Pattern: Harp tooling is visible on the collar and upper face, with vertical tooling on the collar step. The outer face has some vertical tooling. The lower grinding face has rough radiate tooling around 3mm apart.

No. 123
Upper stone
Estimated quern equivalent: 21%
Context: 18158
Group 493 OA43 period 301
External diameter: 380mm
Outer edge height: 107mm
Inner edge height: 52mm
Pattern: Upper face has parallel tooling marks 7-8mm apart, corresponding with the diagonal marks on the collar, 8-10mm apart. The inner collar edge has some rough tooling following the circumference. Lower face appears to have a harp pattern of opposing parallel lines, but worn. Outer face has vertical tool markings regularly spaced at 2-7mm. There is some tooling on the hopper walls.
Comments: Part of the hopper survives.

No. 124
Upper stone
Estimated quern equivalent: 27%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 55mm
Secondary use: Retooling on the upper and outer faces.
Pattern: Harp is visible on the upper face with the collar apparently retooled with oblique lines. Outer face is battered with retooling in vertical lines, often twice, over wear, 5-11mm apart. Lower grinding face has faint radiate tooling marks.
Comments: Possible failed handle socket 40mm by 35mm.

No. 125
Lower stone
Estimated quern equivalent: 4%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 97mm
Inner edge height: 100mm
Pattern: Upper face has clear radiate tooling from spindle hole to outer edge, spaced at 2-5mm. The outer edge has vertical tooling lines spaced at 5-9mm. The lower face has a few crude markings. Spindle hole has tooling inside.
Comments: Part of spindle hole surviving.

No. 126
Upper stone
Estimated quern equivalent: 21%
Context: 18158
Group 493 OA43 period 301
External diameter: 460mm
Secondary use: Possible redressing of the lower face.
Pattern: Harp pattern just visible on the upper surface, spaced at 7-11mm. Outer face has vertical tooling spaced at 6-8mm. Lower face well worn with opposing markings.
Comments: Collar has sheared off.

No. 127
Upper stone
Estimated quern equivalent: 18%
Context: 18158
Group 493 OA43 period 301
External diameter: 380mm
Outer edge height: 113mm
Inner edge height: 50mm
Secondary use: Intrusive secondary tooling around the hopper.
Pattern: Upper face has parallel tool markings possibly corresponding with inner collar edge marks. Collar also has diagonal parallel tool markings at 3-5mm apart. The outer face has close vertical tool marks. The lower face has radiate tooling at 2-4mm apart. Hopper has some vertical tooling on the inner walls.
Comments: Hopper is partially present.

No. 128
Upper stone
Estimated quern equivalent: 25%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 70mm

Secondary use: Retooling is visible.
Pattern: Harp pattern is visible on the upper face, oblique to that on the collar. Collar step is tooled horizontally and vertically. Outer face has vertical tooling spaced at 6-10mm, doubling in some places. The lower face has faint herringbone style tooling.
Comments: The handle sockets are visible in the outer face (40mm by 50mm, rectangular) and in the upper face (50mm diameter, circular)

No. 129
Upper stone
Estimated quern equivalent: 17%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 90mm
Secondary use: See below.
Pattern: Harp pattern is tooled in to the upper surface, but the collar is smooth. The outer face has vertical tooling marks 5-13mm apart with some double lining. The lower surface has some faint radiate tooling visible.
Comments: There is a V shaped recut 50mm from the collar step - recut hopper?

No. 130
Upper stone
Estimated quern equivalent: 15%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 110mm
Inner edge height: 60mm
Secondary use: See below.
Pattern: Diagonal upper face tooling and collar interrupted by a longitudinal groove, 10mm deep, 40mm wide, with vertical tooling to the hopper where it becomes 5mm deep and 15mm wide. Outer face has diagonal tooling below the groove but otherwise vertical tooling. Lower face has radiate tooling.

No. 131
Lower stone
Estimated quern equivalent: 26%
Context: 18158
Group 493 OA43 period 301
External diameter: 390mm
Outer edge height: 90mm
Secondary use: Yes, some mortar is attached.
Pattern: Worn dressing on the grinding surface and lower surface with few tool marks. Deep upright furrows on the outer edge are spaced at 4-8mm. Some tooling is visible on the spindle hole remains.
Comments: Part of spindle hole remains

No. 132
Upper stone
Estimated quern equivalent: 30%
Context: 18158
Group 493 OA43 period 301
External diameter: 380mm
Outer edge height: 125mm
Pattern: Harp pattern is visible on the upper face, 5-10mm apart, and on collar. Outer face has vertical tooling sometimes doubled, with horizontal wear. Lower face has rough herring bone tooling.

No. 133
Upper stone
Estimated quern equivalent: 15%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 131mm
Pattern: Diagonal parallel markings are visible on the collar spaced at 5-7mm and continue across inner collar edge onto the upper surface where they widen out to 7-9mm spacing. Lower face has poorly defined parallel tool markings. Outer edge has vertical tooling marks regularly spaced at 5-8mm.

No. 134
Lower stone
Estimated quern equivalent: 18%
Context: 18158
Group 493 OA43 period 301
External diameter: 650mm
Outer edge height: 68mm
Pattern: Upper face has very faint parallel tooling from outer edge to centre 8-12mm apart. The outer face has vertical tooling spaced at 4-10mm. The lower face is very worn or damaged.
Comments: Exceptionally large quern.

No. 135
Upper stone
Estimated quern equivalent: 30%
Context: 18158
Group 493 OA43 period 301
External diameter: 360mm
Outer edge height: 124mm
Pattern: Harp pattern on the upper surface, 7-8mm apart. Collar has also parallel opposing marks regularly spaced at 5-7mm which partly correspond with the upper face and inner collar edge. Outer face has clear vertical tooling 2-7mm apart.

No. 136
Upper stone
Estimated quern equivalent: 14%

Context: 18158
Group 493 OA43 period 301
External diameter: 380mm
Outer edge height: 113mm
Pattern: Harp pattern on the upper surface (5-8mm apart), inner edge of collar and collar surface (6-7mm apart). Some grooves are double lined. Outer face has vertical tooling at 3-7mm intervals. Lower face has worn irregular markings.

No. 137
Section from a catillus of a donkey mill
Context: 18258
Group 493 OA43 period 301
Pattern: Tooling appears to radiate from the centre but grinding striations are also visible on the upper face. The hopper, handle socket and outer face also have tooling.
Comments: Outer face has a handle socket, 70mm wide and at least 70mm deep. Hopper is 120-150mm wide minimum.

No. 138
Small piece of the lower stone
Context: 18258
Group 493 OA43 period 301
Inner edge height: 95mm
Pattern: Radiate tooling is visible on the upper surface, 3-4mm apart, with picked tooling around the spindle hole 2mm in diameter. The lower face has a few crude tool marks. The spindle hole has vertical tooling.
Comments: Part of the spindle hole remains.

No. 139
Small piece of upper stone
Estimated quern equivalent: 8%
Context: 18258
Group 493 OA43 period 301
Secondary use: Some redressing is visible.
Pattern: Parallel tooling is visible on the upper surface, 3-4mm apart. Radiate pattern on the lower surface is unusually well defined, with spacing at rim of 8-12mm. Outer face has vertical tooling at 4-8mm intervals.

No. 140
Small piece from an upper/lower stone
Estimated quern equivalent: 11%
Context: 18258
Group 493 OA43 period 301
External diameter: 600mm
Pattern: Outer face has vertical tooling spaced at 3-9mm. Part of lower face is rough dressed.
Comments: Larger size of quern. Slot has been carved into lower face.

No. 141

Upper stone
Estimated quern equivalent: 12%
Context: 18258
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 120mm
Pattern: Parallel tooling in the upper face and collar matching spaced at 3-8mm. The outer face has vertical tooling, and the lower face has little visible tool marks.

No. 142
Lower stone
Estimated quern equivalent: 20%
Context: 18258
Group 493 OA43 period 301
External diameter: 360mm
Outer edge height: 85mm
Pattern: Parallel/radiate dressing is visible on the upper surface spaced at 4-9mm. The lower face has a few crude marks. The outer edge has clear vertical toolings, spaced at 5-10mm intervals, corresponding with the upper surface.

No. 143
Upper stone
Estimated quern equivalent: 18%
Context: 18258
Group 493 OA43 period 301
External diameter: 400mm
Inner edge height: 45mm
Secondary use: See below.
Pattern: Harp pattern visible on the upper face, but collar has broken off. The outer face has vertical tooling spaced at 5-11 mm with many double lines. The lower grinding face has deep radiate tooling, worn near the hopper.

No. 144
Section from a catillus of a donkey mill
Context: 18258
Group 493 OA43 period 301
Pattern: Radiate tooling is visible on the upper surface with some grinding striations. Outer face and handle socket has tooling.
Comments: Hopper is large. Handle socket is square, 80mm by 80mm.

No. 145
Upper stone
Estimated quern equivalent: 19%
Context: 18258
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 115mm

Pattern: Upper face and collar have matching diagonal tooling spaced at 3-6mm. The outer face has vertical tooling. Radiate tooling is visible on the lower grinding face.
Comments: Handle sockets are present in the outer face (25mm in diameter, tapering to 18mm inside) meeting the upper face (30mm). Both are circular.

No. 146
Upper stone
Estimated quern equivalent: 8%
Context: 18258
Group 493 OA43 period 301
External diameter: 410mm
Inner edge height: 63mm
Secondary use: Possible secondary tooling.
Pattern: Parallel tool marking can be seen on the upper face at 7-9mm intervals but the collar is sheared off. Lower face has radiate tooling 2-5mm apart. The outer face has vertical tooling regularly spaced at 6-10mm.

No. 149
Upper stone
Estimated quern equivalent: 10%
Context: 18258
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 135mm
Pattern: Upper face, collar and inner edge of collar have matchings diagonal tooling spaced at 5-8mm. This appears to correspond with the vertical tooling on the outer edge. The lower face also has parallel/radiate tooling which may correspond. Some unusual grooves are visible close to the centre.

No. 150
Lower stone
Estimated quern equivalent: 12%
Context: 18258
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 75mm
Secondary use: Possible redressing on the upper face.
Pattern: Upper surface has crude toolings approx 6-9mm apart. The lower surface has clear parallel tooling marks regularly spaced at 10-12mm. Outer face has poorly defined vertical tool marks spaced at 6-8mm.

No. 151
Lower stone
Estimated quern equivalent: 16%
Context: 18258
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 83mm
Secondary use: See below

Pattern: Very faint parallel tooling visible at 2-4mm intervals. Outer face has vertical tooling at 5-9mm intervals, some double lined. Lower face has a few crude marks.
Comments: Possible indentation with handle fragment or nail visible.

No. 152
Upper stone
Estimated quern equivalent: 14%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 121mm
Pattern: Arrowhead/harp pattern tooling can be seen on the collar which corresponds with the inner edge and the upper face harp pattern (5-8mm spacing).The outer face vertical tooling also corresponds with the collar marks. The lower face has rough opposing tooling with variable spacing 2-7mm apart.

No. 153
Upper stone
Estimated quern equivalent: 19%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 105mm
Inner edge height: 50mm
Pattern: Harp pattern has been tooled into both the collar and the upper face to match. Outer face has vertical tooling. Lower face has radiate tooling changing around a crack/flaw.
Comments: Handle socket in outer face has square cut diameter of 30mm, tapering to 16mm. The upper face opening is also square cut and has diameter of 25mm. Part of hopper survives.

No. 154
Upper stone
Estimated quern equivalent: 26%
Context: 18265
Group 460 OA42 period 301
External diameter: 420mm
Outer edge height: 125mm
Pattern: Parallel tooling on the collar and step. Outer face has vertical tooling and lower face has harp pattern still visible.
Comments: Upper face is missing.

No. 155
Upper stone
Estimated quern equivalent: 22%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm

Outer edge height: 130mm
Pattern: Harp pattern is clear on the upper face but collar is missing. Outer face has vertical tooling and lower face has faint herringbone tooling.

No. 156
Upper stone
Estimated quern equivalent: 12%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 121mm
Pattern: Harp pattern on the upper surface, regularly spaced at 4-6mm intervals, carries onto the inner edge of collar and rim. Outer face has vertical tooling again corresponding with the collar. The lower face tooling is rough and possibly radiate or parallel spaced at 2-5mm.
Comments: Hopper is partially present.

No. 157
Upper stone
Estimated quern equivalent: 28%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 65mm
Secondary use: Slot adjacent to hopper is possibly a recut.
Pattern: Harp tooling on both upper face and collar but does not match. Outer face has vertical tooling. Lower face is tooled with groups of rays radiating from hopper, which is peck tooled.
Comments: Hopper is partly present. Handle socket is visible in outer face (40mm in diameter tapering to 10mm) and on upper face (35mm).

No. 159
Small piece of an upper stone
Context: 18265
Group 460 OA42 period 301
Pattern: Harp pattern on the upper surface regularly spaced at 5-10mm with occasional double lines, corresponding to the inner edge of the collar. The lower face has very crudely drawn harp pattern with variable spacing and double lines, spaced at 2-11mm.

No. 160
Lower stone
Estimated quern equivalent: 35%?
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 87mm
Inner edge height: 93mm

Pattern: Both radiate (2-6mm spacing) and harp pattern (6-9mm spacing) show on the upper surface. Outer surface has vertical tooling spaced at 4-6mm. The lower surface has crude markings with opposing patterns just visible. The spindle hole has vertical tooling.
Comments: Half of the spindle hole is present.

No. 161
Small piece from a lower stone
Context: 18265
Group 460 OA42 period 301
Inner edge height: 100mm
Pattern: Radiate pattern very faint on the upper face. Lower face has very few cude markings possibly opposing patterns. Spindle hole has some tooling.
Comments: Part of spindle hole remains

No. 162
Lower stone
Estimated quern equivalent: 28%
Context: 18265
Group 460 OA42 period 301
External diameter: 420mm
Outer edge height: 103mm
Inner edge height: 99mm
Secondary use: Yes, see below.
Pattern: Radiate tooling is clear on the upper face with spacing from 2-4mm. Outer face has vertical tooling with spacing of 7-11mm, some double lining. The lower face has crude toolings with possible opposing patterns.
Comments: A small part of the spindle hole remains.

No. 163
Upper stone
Estimated quern equivalent: 33%
Context: 18265
Group 460 OA42 period 301
External diameter: 420mm
Secondary use: Yes, see below.
Pattern: Upper face has parallel diagonal markings spaced at 4-11mm with some double lining and crossing. Collar has sheared off but the inner edge show tooling at 3-6mm intervals. Outer face has vertical tooling at intervals of 4-9mm. The lower face has crude and thick tooling upto 4mm wide, with variable spacing 1-5mm apart.

No. 164
Upper stone
Estimated quern equivalent: 12%
Context: 18265
Group 460 OA42 period 301
External diameter: 560mm
Inner edge height: 76mm

Pattern: Upper face has harp pattern tooling with collar missing. Outer face has vertical tooling, and a wide slot which has been peck tooled. Lower grinding face has faint radiate tooling which has been redressed in one area.
Comments: Handle socket in upper face is rectangular (30mm by 38mm). The outer face opening is located in a slot 80mm wide, 60mm in length and 43mm deep in collar and is 15mm in diameter. Fragment extends to hopper.

No. 165
Upper stone
Estimated quern equivalent: 27%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Outer edge height: 113mm
Pattern: Harp pattern on the upper surface (5-9mm spacing), corresponding to pattern on the collar and inner collar edge. Outer surface has vertical tooling marks with some double lining. Lower face has radiate tooling at 2-6mm intervals.
Comments: A square handle socket/slot is present on the upper face 21mm wide and 17mm deep.

No. 166
Upper stone
Estimated quern equivalent: 19%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 135mm
Secondary use: Lower face is possibly reconditioned.
Pattern: Upper face has parallel tooling. Outer edge has vertical tooling and is concave. Lower face has grinding striations and a few tooling marks.
Comments: Square handle sockets are present in the upper face (40mm in diameter) and in the outer face (45 mm in diameter tapering to 15mm).

No. 167
Upper stone
Estimated quern equivalent: 16%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 138mm
Secondary use: Lower face is possibly redressed.
Pattern: Harp pattern on the upper surface (5-7mm) and on the collar (5-9mm) with some correspondence. Two circumferential lines at the inner collar edge. Lower face has poorly defined harp pattern at 2-7mm spacing. Outer face has vertical tooling 3-9mm apart, possible corresponding with collar.
Comments: Handle socket in outer edge is 38mm deep and rectangular, whereas the opening in the upper face appears to be circular and 30mm in diameter

No. 168
Part of the meta from a donkey mill
Context: 18265
Group 460 OA42 period 301
Pattern: Grinding striations only

No. 169
Upper stone
Estimated quern equivalent: 19%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 130mm
Inner edge height: 70mm
Secondary use: See below.
Pattern: Harp pattern tooling on the upper face, 3-7mm apart, possibly corresponding with the very faint tooling on the collar and inner edge. There is some double lining and two circumferential lines. The lower face has some radiate tooling with crossing, and variable spacing 4-9mm. Hopper tooling is unusual, in grid fashion.
Comments: Part of hopper is remaining

No. 170
Upper stone
Estimated quern equivalent: 5%
Context: 18265
Group 460 OA42 period 301
Outer edge height: 122mm
Pattern: Harp on upper surface but with wide grooves (5mm), having been recut upto 4 times. Outer face has vertical tooling. Lower face has 3 bundles of radiate tooling, similar to oblique harp pattern.

No. 171
Small piece from an upper stone
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Secondary use: See below
Pattern: Harp pattern on the upper surface with 7-10mm tooling and some correspondence with the surviving inner edge marks. There is some double lining. Lower face has clear opposing patterns of tooling lines with variable spacing at 2-10mm.

No. 172
Upper stone
Estimated quern equivalent: 12%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 137mm

Inner edge height: 55mm
Pattern: Harp pattern on the upper surface (3-10mm apart), collar (4-6mm) and inner edge of collar, possibly also corresponding with the outer edge vertical tooling where surviving (4-8mm). Lower face has radiate tooling marks at 2-4mm intervals. Some working on the hopper walls.
Comments: Some hopper remnant

No. 173
Upper stone
Estimated quern equivalent: 18%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 125mm
Pattern: Upper face has parallel tooling mark spaced at 5-8mm. Inner collar edge has two lines following the line of the collar. Collar has diagonal parallel tooling (4-7mm apart) with some correspondence with the upper face. Outer edge has vertical tooling spaced at 6-9mm intervals. Lower face has a few lines following the circumference of the stone.

No. 174
Lower stone
Estimated quern equivalent: 16%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 100mm
Pattern: Upper grinding face has faint radiate tooling. The outer face has vertical tooling and the lower face is rougly dressed.
Comments: Part of the spindle hole survives.

No. 175
Small piece of an upper stone
Context: 18265
Group 460 OA42 period 301
Inner edge height: 65mm
Pattern: Harp pattern on the upper surface at 5-9mm intervals but collar has sheared off. Hopper has vertical tooling and associated slot is also tooled. The lower face has radiate tooling with the external spacing at 3-9mm.
Comments: Part of hopper survives but no outer face

No. 176
Upper stone
Estimated quern equivalent: 16%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 115mm
Inner edge height: 55mm

Pattern: Parallel tooling on the upper face and matching those on the collar. The outer face has vertical tooling with much double lining. The lower face has grinding striations with possible reconditioning.
Comments: Possible discontinued socket attempt in outer face.

No. 177
Upper stone
Estimated quern equivalent: 47%
Context: 18265
Group 460 OA42 period 301
External diameter: 420mm
Outer edge height: 121mm
Inner edge height: 50mm
Secondary use: See below
Pattern: Harp pattern on the upper surface (3-7mm apart), inner edge of collar and possibly also corresponding with the collar rim (2-5mm), with some double lining or redressing. Lower face has radiate tooling with occasional opposing lines. Outer face has vertical tooling with correspondence to the collar and handle socket tooling.
Comments: Outer edge opening of the handle socket is 39mm deep. The socket protrudes 78mm and is 44mm wide on the upper surface.

No. 178
Lower stone
Estimated quern equivalent: 21%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 75mm
Secondary use: See below
Pattern: Upper face has opposing lined tooling with 2-6mm spacing. Outer face has vertical tooling with variable spacing, 28mm apart and some redressing in one area. Lower face has no tooling visible.

No. 182
Upper stone
Estimated quern equivalent: 10%
Context: 18286
Group 458 OA41 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 62mm
Secondary use: See below.
Pattern: Upper face has parallel tooling. Outer face has vertical tooling and lower face has possible redressing tooling.

No. 183
Small piece of an upper stone/semi-rotary quern
Context: 18265
Group 460 OA42 period 301

Pattern: Only tooling surviving is in socket, 2-7mm spaced lines.
Comments: Handle socket is rectangular and 65mm by 55mm, inlaid to a depth of 18mm.

No. 184
Upper stone
Estimated quern equivalent: 17%
Context: 18251
Group 465 OA43 period 301
External diameter: 360mm
Outer edge height: 80mm
Inner edge height: 25mm
Pattern: harp tooling on the upper face and collar with some pecking at the inner collar edge. Outer face has vertical tooling and lower, grinding face has faint radiate tooling but is otherwise worn thin.
Comments: Smaller quern, extremely worn in some places. Part of the hopper remains.

No. 185
Lower stone
Estimated quern equivalent: 40%
Context: 18252
Group 461 S20 period 301
External diameter: 400mm
Outer edge height: 80mm
Inner edge height: 100mm
Pattern: Upper face has harp pattern, very faint in places. Outer face has vertical tooling and the lower face is roughly dressed flat
Comments: About half of the spindle hole remains.

No. 186
Upper stone
Estimated quern equivalent: 21%
Context: 18151
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 65mm
Pattern: Very coarse harp pattern tooling, up to 6mm wide. Outer face has vertical tooling and lower face has radiate tooling with short lines and closely spaced.
Comments: Some hopper remains.

No. 187
Upper stone
Estimated quern equivalent: 14%
Context: 18158
Group 493 OA43 period 301
External diameter: 350mm
Outer edge height: 123mm

Inner edge height: 57mm
Pattern: Harp pattern on the upper surface (4-9mm apart), corresponding with the inner collar and collar (7-9mm apart). This also corresponds with the outer face which has vertical tooling, 4-10mm apart). The inner collar also has two circumferential tooling lines. The lower face has radiate tooling at 2-4mm intervals. The hopper has vertical tooling on its wall.
Comments: Part of the hopper remains.

No. 188
Upper stone
Estimated quern equivalent: 20%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Outer edge height: 130mm
Inner edge height: 60mm
Pattern: The upper face has harp pattern tooling. Outer face has vertical tooling and the Lower grinding face has faint radiate tooling.
Comments: There is a wide hopper hole (70mm). The handle socket is unbroken. The outer opening is rectangular, 35mm by 45mm, travelling 50mm to the upper face opening which is 25mm by 30mm.

No. 189
Upper stone
Estimated quern equivalent: 45%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 115mm
Inner edge height: 43mm
Pattern: Harp pattern on the upper surface(4-8mm apart), corresponding with hopper tooling but not the collar. The collar has opposing parallel markings spaced at 3-9mm, which correspond to the outer face vertical toolings at 4-8mm apart. The lower face has radiate tooling at 2-5mm spacing.
Comments: Approx. half the hopper survives. The handle socket openings are ovoid and are 27/35mm in diameter in the outer face, travelling in 80mm to the upper face opening which is 30mm in diameter.

No. 190
Lower stone
Estimated quern equivalent: 15%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 90mm
Inner edge height: 85mm
Pattern: Radiate pattern on the upper face has altering angles (harp-like)and is narrowly spaced. Outer face has vertical tooling and the lower face is roughly dressed with what appears to have been a 10mm wide chisel. Spindle hole is also tooled.

No. 191
Upper stone
Estimated quern equivalent: 14%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 140mm
Secondary use: See below
Pattern: Harp pattern is visible on the upper surface and multiple lines are common, as on the outer face which has vertical tooling. Lower face is redressed with rough harp patterning using a broad point (5mm).

No. 192
Upper stone
Estimated quern equivalent: 17%
Context: 18265
Group 460 OA42 period 301
External diameter: 370mm
Outer edge height: 107mm
Inner edge height: 52mm
Pattern: Harp pattern on the upper surface (4-7mm apart) corresponding with the collar. The lower face has faint radiate tooling. Outer face has vertical tooling spaced at 4-10mm, and hopper is also roughly tooled.
Comments: Part of hopper remains.

No. 193
Upper stone
Estimated quern equivalent: 22%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 133mm
Inner edge height: 70mm
Pattern: Harp pattern on the upper surface has spacing of 5-9mm possibly corresponding with tooling on the inner collar edge and the hopper. Collar has parallel diagonal toolings which correspond with the vertical tooling of the outer face (5-9mm apart). Lower face has poorly defined diagonal tooling across fragment.
Comments: Quarter of the hopper remains

No. 194
Small piece from an upper stone
Context: 18265
Group 460 OA42 period 301
Inner edge height: 60mm
Secondary use: Secondary tooling on a broken face.
Pattern: Harp pattern on the upper surface at 4-10mm intervals. Inner edge has worn markings and collar has been sheared off. Lower face has radiate tooling at 3-5mm apart.

Comments: Part of handle socket remains 35mm in diameter in upper face.

No. 195
Upper stone
Estimated quern equivalent: 31%
Context: 18265
Group 460 OA42 period 301
External diameter: 360mm
Outer edge height: 114mm
Inner edge height: 56mm
Pattern: Harp pattern on the upper surface (spaced at 4-8mm) corresponding with hopper tooling and collar marks which are also parallel lines (4-7mm apart). Outer face has vertical tooling with double lining (4-9mm apart), corresponding with the collar marking. Lower face also has a pattern of opposing lines with spacing varying from 2-4mm to 2-8mm.
Comments: Small part of hopper remains.

No. 196
Upper stone
Estimated quern equivalent: 9%
Context: 18265
Group 460 OA42 period 301
External diameter: 480mm
Outer edge height: 135mm
Secondary use: Redressing, see below.
Pattern: Upper face and collar have harp tooling with rough pecking on the collar step. Outer face has vertical tooling, but rough and irregular. The lower face has wide (5mm) tooling following the outer edge and grinding striations.
Comments: Larger than standard quern.

No. 197
Upper stone
Estimated quern equivalent: 17%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 55mm
Secondary use: Possible redressing on all the faces.
Pattern: Harp pattern tooling on the upper surface and collar is rough with a pecked collar step. Outer face has vertical tooling which is also possible redressed. The lower face has faint radiate pecking or short line tooling.
Comments: Small amount of hopper.

No. 198
Upper stone
Estimated quern equivalent: 21%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm

Outer edge height: 126mm
Inner edge height: 75mm
Pattern: Harp pattern on the upper surface (5-10mm) corresponding with rough opposing pattern on inner coller edge. Collar has opposing tooling also with 2-5mm spacing and possible correspondence with the outer edge vertical tooling at 5-11mm spacing. The lower face has crudely redressed tooling following shape of the stone. Hopper is roughly tooled.
Comments: Third of hopper remains

No. 199
Small piece of the lower stone
Context: 18265
Group 460 OA42 period 301
Pattern: Radiate tooling clear on the upper face with spacing of 2-5mm. Possibly some correspondence with spindle hole tooling. The lower face has a few crude markings.
Comments: Approx. half of spindle hole remains.

No. 200
Upper stone
Estimated quern equivalent: 26%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Outer edge height: 100mm
Inner edge height: 50mm
Pattern: Harp pattern on the upper face and collar with pecking on the collar step. Outer face has vertical tooling with some double lining. The lower grinding face has faint radiate tooling.
Comments: Part of the hopper remains.

No. 201
Upper stone
Estimated quern equivalent: 23%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 100mm
Inner edge height: 60mm
Secondary use: Possible redressing on the lower face.
Pattern: Parallel tooling on the upper face although most of collar missing. Outer face has vertical tooling and lower face has closely spaced shallow radiate tooling.
Comments: Part of the hopper remains.

No. 202
Upper stone
Estimated quern equivalent: 27%
Context: 18265
Group 460 OA42 period 301

External diameter: 400mm
Outer edge height: 110mm
Inner edge height: 55mm
Secondary use: Lower face has possibly been redressed.
Pattern: Harp pattern tooling on the upper face and both collar step and hopper are tooled. Outer face has vertical tooling and lower face has closely spaced radiate tooling.
Comments: Part of the hopper remains.

No. 203
Lower stone
Estimated quern equivalent: 13%
Context: 18265
Group 460 OA42 period 301
External diameter: 420mm
Outer edge height: 97mm
Inner edge height: 90mm
Secondary use: Occasional redressing is visible.
Pattern: Very irregular tooling on the upper surface, in some lines which correspond with tooling in the spindle hole. Upper surface is also irregular but well defined and wide (5mm). Outer face has vertical tooling spaced at 4-9mm with some double lining.
Comments: Part of the spindle hole remains.

No. 204
Lower stone
Estimated quern equivalent: 23%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 92mm
Inner edge height: 90mm
Secondary use: See below
Pattern: Upper face has radiating dressing, 2-4mm apart, with some opposing tooling/ redressing. Outer face has vertical tooling spaced at 7-10mm withsome redressing. Lower face has a few crude tool marks as does the spindle hole wall.
Comments: Part of the spindle hole remains.

No. 205
Lower stone
Estimated quern equivalent: 22%
Context: 18265
Group 460 OA42 period 301
External diameter: 370mm
Outer edge height: 78mm
Inner edge height: 99mm
Secondary use: see below
Pattern: Upper face has radiating tooling with some opposing lines. Outer face has vertical tooling with some redressing, spaced at 3-7mm intervals. Lower

face has crude thick lines following the shape of the quern. Spindle hole has some tooling.
Comments: Part of the spindle hole remains.

No. 206
Small piece from a lower stone
Context: 18265
Group 460 OA42 period 301
Inner edge height: 92mm
Pattern: Radiating pattern of tooling on the upper surface with spacing at 2-4mm. Lower face has crude tool markings. Spindle hole tooling corresponds with both faces.
Comments: Part of the spindle hole remains.

No. 207
Upper stone
Estimated quern equivalent: 16%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Inner edge height: 50mm
Secondary use: Possible redressing.
Pattern: Harp pattern on the upper surface at 4-9mm intervals, corresponding to hopper tooling but collar missing. Outer face has vertical tooling at 4-6mm intervals. Lower face has clear radiating tooling at 2-5mm intervals with some opposing lines.
Comments: Some hopper remnant.

No. 208
Small piece from a lower stone
Context: 18265
Group 460 OA42 period 301
Inner edge height: 98mm
Pattern: Upper surface has only a few faint marks, and there is no tooling on the lower face visible. The spindle hole has some short marks.
Comments: Some spindle hole remnant.

No. 209
Upper stone
Estimated quern equivalent: 15%
Context: 18265
Group 460 OA42 period 301
External diameter: 400mm
Outer edge height: 120mm
Inner edge height: 55mm
Secondary use: See below.
Pattern: Upper face and collar have harp pattern. Outer face has vertical tooling, roughly done with double lining. Lower face has very faint radiate tooling. Hopper has pecked tooling.
Comments: Part of the hopper remains. Small depression in the outer edge.

No. 210
Upper stone
Estimated quern equivalent: 16%
Context: 18265
Group 460 OA42 period 301
External diameter: 380mm
Outer edge height: 115mm
Inner edge height: 70mm
Secondary use: Yes
Pattern: Harp pattern on the upper surface (4-8mm spacing) corresponding with that on the collar (5-7mm) and inner collar edge. Outer face has vertical tooling spaced at 5-9mm which possibly corresponds with that on the collar. The lower face tooling is radiating from the hopper, with some opposing lines/ redressing. Hopper tooling corresponds with lower and possibly upper faces.
Comments: Part of the hopper remains.

No. 211
Upper stone
Estimated quern equivalent: 17%
Context: 18265
Group 460 OA42 period 301
External diameter: 370mm
Outer edge height: 120mm
Inner edge height: 65mm
Pattern: Parallel diagonal tooling on the upper face (7-8mm apart) possibly corresponding with the inner collar edge and the collar rim (5-7mm apart). Outer face has vertical tooling regularly spaced at 5-10mm. Lower face marks are extremely faint.
Comments: Some hopper remains with an adjacent tooled slot.

No. 212
Upper stone
Estimated quern equivalent: 27%
Context: 18158
Group 493 OA43 period 301
External diameter: 350mm
Inner edge height: 68mm
Secondary use: See below
Pattern: Harp pattern on the upper surface, spaced at 8-11mm, but collar sheared off. Outer face has vertical tooling redressed, 6-9mm apart. Lower face has crude radiating marks 2-4mm apart. Hopper is also tooled vertically.
Comments: Some of the hopper remains. The handle socket is exposed in a deliberate indentation in the upper face, and measures 80mm by 30mm in plan.

No. 215
Upper stone
Estimated quern equivalent: 15%
Context: 18158

Group 493 OA43 period 301
External diameter: 415mm
Outer edge height: 120mm
Inner edge height: 70mm
Pattern: The upper face has clear harp tooling at 6-10mm intervals. It is crudely lined/redressed at the collar step. The socket tooling corresponds with this. Collar has parallel lines 5-7mm apart which correspond to some on step and on the outer edge which has vertical grooves 7-9mm apart. The lower face has radiate tooling at spacings of 2-5mm, and the hopper also has tooling.
Comments: Part of the hopper remains. Handle socket is unbroken and the outer opening is sub-rectangular measuring 40 by 45mm. The upper face opening is 93mm away and is 40 by 44mm.

No. 217
Upper stone
Estimated quern equivalent: 21%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 135mm
Inner edge height: 52mm
Secondary use: Possible redressing of the lower face.
Pattern: Harp pattern on the upper surface with tooling lines 4-8mm apart corresponds with the tooling on the inner collar edge and collar where the lines are 2-4mm apart. Outer face has vertical tooling spaced at 4-8mm. The lower face has crude opposing pattern lines 2-4mm across. The hopper tooling probably corresponds with both the upper and lower faces. The handle socket also has tooling.
Comments: Part of the hopper remains. Handle socket is circular and approx. 25mm in diameter at the outer edge travelling in 80mm and opening again with 35mm diameter.

No. 218
Lower stone
Estimated quern equivalent: 30%
Context: 18158
Group 493 OA43 period 301
External diameter: 360mm
Outer edge height: 100mm
Inner edge height: 82mm
Pattern: Radiating pattern on the upper face spacings 2-6mm apart but rough looking. Outer face has vertical tooling regularly spaced at 3-8mm. Lower face has few crude tool marks just visible. Spindle hole also has vertical tooling.
Comments: Some of the spindle hole remains.

No. 219
Upper stone
Estimated quern equivalent: 25%
Context: 18158

Group 493 OA43 period 301
External diameter: 360mm
Outer edge height: 119mm
Inner edge height: 62mm
Pattern: Harp pattern on the upper surface with tooling 6-8mm apart, with some double lining and off-kilter lines. Some correspondence with hopper, inner edge markings and collar which also has opposing parallel lines 4-8mm apart. Lower face has radiate tooling poorly defined with spacings at 2-4mm. Outer face has vertical tooling is well worn and 5-8mm apart.
Comments: Some fo the hopper remains.

No. 220
Small piece from a lower stone
Context: 18158
Group 493 OA43 period 301
Pattern: Radiating tooling lines from spindle hole, roughly cut with occasional opposing lines. Lower face has a few wide marks, and spindle hole is also tooled.
Comments: Some of the spindle hole remains.

No. 222
Upper stone
Estimated quern equivalent: 19%
Context: 18158
Group 493 OA43 period 301
External diameter: 410mm
Outer edge height: 126mm
Inner edge height: 65mm
Pattern: Upper face and collar have parallel tooling lines (4-9 and 4-7mm apart respectively). There is some correspondence between them and the inner collar diagonal tooling (4-7mm apart), as well as the hopper tooling. The lower face has radiating tooled lines. Outer face has vertical tooling spaced at 5-8mm.
Comments: Some of the hopper remains.

No. 223
Upper stone
Estimated quern equivalent: 22%
Context: 18158
Group 493 OA43 period 301
External diameter: 360mm
Outer edge height: 117mm
Inner edge height: 55mm
Secondary use: See below
Pattern: Harp pattern on the upper surface, 4-10mm apart. The inner collar edge is extremely faint diagonals. The collar has opposing patterns of parallel lines just visible, with 3-8mm spacing, which correspond with the outer faces's vertical grooves, 6-11mm apart. The lower face has radiating tooling marks spaced at 2-7mm intervals. Hopper tooling seems to correspond with upper and lower faces. All faces show redressing.

Comments: Part of the hopper remains. Handle socket is unbroken and both openings are rectangular. The opening in the outer face is 40mm by 43mm, penetrating 70mm to the upper face opening which is 29mm by 30mm.

No. 224
Lower stone
Estimated quern equivalent: 15%
Context: 18158
Group 493 OA43 period 301
External diameter: 400mm
Outer edge height: 93mm
Inner edge height: 98mm
Secondary use: Some redressing is visible
Pattern: Upper face has a faint radiating tooling pattern. Outer face has vertical tooling, well worn, 5-9mm apart. Possible correspondence between spindle hole and upper face markings.
Comments: Some of the spindle hole remains.

No. 225
Upper stone
Estimated quern equivalent: 18%
Context: 18158
Group 493 OA43 period 301
External diameter: 360mm
Outer edge height: 103mm
Inner edge height: 42mm
Pattern: Harp pattern on the upper surface is regularly spaced at 4-8mm, which corresponds with the inner edge tooling and the diagonal parallel tooling on the collar. Outer face has vertical tooling at 2-4mm which may correspond with the collar. The lower face has parallel marks which are barely visible. The hopper is tooled corresponding with the upper and lower tooling. There is also a tooled socket.
Comments: Part of the hopper remains. A handle socket is also visible next to the hopper. It is irregularly shaped and measures 31mm by 25mm with 11mm in depth.

No. 226
Small piece from a lower stone
Context: 18158
Group 493 OA43 period 301
Inner edge height: 100mm
Pattern: Extremely faint radiating pattern on the upper face. There is tooling on the spindle hole wall.
Comments: Part of the spindle hole remains.

No. 227
Lower stone
Estimated quern equivalent: 13%
Context: 18158
Group 493 OA43 period 301

External diameter: 390mm
Outer edge height: 81mm
Inner edge height: 76mm
Pattern: Upper face has radiating tooling, possibly redressing, spaced at 3-8mm. Outer face has vertical tooling, spaced at 3-8mm which corresponds with the upper face. Spindle hole also has tooling.
Comments: Some of the spindle hole remains. No lower face is present.

No. 228
Small piece from an upper stone
Context: 18158
Group 493 OA43 period 301
Inner edge height: 50mm
Secondary use: See below
Pattern: Harp pattern on the upper surface regularly spaced at 9-11mm with some double lining. Remnant of the inner collar edge with some dressing, and there is also tooling in the hopper. Lower face worn completely smooth.
Comments: Some of the hopper remains.

No. 229
Lower stone
Estimated quern equivalent: 7%
Context: 18158
Group 493 OA43 period 301
External diameter: 370mm
Outer edge height: 88mm
Inner edge height: 78mm
Pattern: Radiating pattern is extremely faint on the upper surface, Lower face is worn with a few marks visible. Outer face has vertical tooling spaced at 3-7mm but well worn. There is also tooling on the spindle hole wall.
Comments: Some fo the spindle hole remains.

No. 230
Upper stone
Estimated quern equivalent: 5%
Context: 18158
Group 493 OA43 period 301
Pattern: Parallel tooling on the upper surface, collar and inner collar edge which correspond, 5-7mm apart. Outer face has vertical tooling regularly spaced at 3-7mm.
Comments: The handle socket on outer face is rectangular and 25mm by 28mm. It penetrates 93mm and the upper face opening is 28mm wide.

NON-LAVA QUERNS:

No. 31
SANDSTONE upper stone
Estimated quern equivalent: 21%
Context: 18085
Group 857 OA77 Period 22
External diameter: 600mm
Pattern: Harp pattern is clearly cut, 6-8mm apart. Outer face is dressed by pecking. Lower face has no tooling but may have some peck marks.
Comments: Collar is missing.

No. 32
SANDSTONE upper stone
Estimated quern equivalent: 16%
Context: 18085
Group 857 OA77 Period 22
External diameter: 400mm
Outer edge height: 50mm
Inner edge height: 35mm
Pattern: Harp pattern is tooled from the outer edge to the hopper, spaced at 8-11mm. Outer face is pecked and the lower face shows no tooling.
Comments: Collar is missing.

No. 33
MILLSTONE GRIT upper stone
Estimated quern equivalent: 15%
Context: 8984
Group 182 B8RB Period 3
External diameter: 600mm
Secondary use: Possibly as building stone or for sharpening as no pattern survives.
Pattern: The only tooling mark on this piece is one horizontal cut on the outer face.

No. 51
UNKNOWN FABRIC, small piece from an upper/lower stone
Context: 18224
Group 493 OA43 period 301

No. 121
MILLSTONE GRIT lower stone
Estimated quern equivalent: 25%
Context: 18158
Group 493 OA43 period 301
External diameter: 560mm
Outer edge height: 150mm
Pattern: Upper face has few chisel marks visible. Outer face is vertically tooled but lines are faint. The lower face is dressed flat.
Comments: This quern is twice the normal size.

No. 122
MILLSTONE GRIT upper stone
Estimated quern equivalent: 18%
Context: 18158
Group 493 OA43 period 301
External diameter: 520mm
Outer edge height: 190mm
Inner edge height: 130mm
Pattern: There is no tooling visible on the collar and only barely visible on the upper face. The outer face is vertically tooled and the lower face has faint radiate tooling.
Comments: The hopper is angular in design, not circular. This quern is substantially larger than the rest of the assemblege.

No. 147
GRANITE, small piece from a lower stone
Context: 18258
Group 493 OA43 period 301
Outer edge height: 60mm
Pattern: Upper and outer face has tooled parallel lines but the lower face has been peck tooled.

No. 148
GRANITE, small piece from an upper/lower stone
Context: 18258
Group 493 OA43 period 301

No. 158
GRANITE, small piece of an upper/lower stone
Context: 18265
Group 460 OA42 period 301
Pattern: One side has crude marks, the other peck tooled with lines.
Comments: One side shows a slot 60mm deep, 27mm on one side.

No. 179
SANDSTONE lower stone
Estimated quern equivalent: 33%
Context: 18349
Group 857 OA77 Period 22
External diameter: 500mm
Outer edge height: 115mm
Inner edge height: 50mm
Pattern: Upper side has clear harp pattern, spaced at 8-11mm. The outer surface has pecked marks and the surviving lower face shows faint radiate tooling.
Comments: Some of the spindle hole survives

No. 180
LIMESTONE lower stone

Estimated quern equivalent: 10%
Context: 18349
Group 857 OA77 Period 22
External diameter: 400mm
Outer edge height: 160mm
Inner edge height: 70mm
Pattern: No tooling visible on the upper side and the underside is roughly dressed.

No. 181
SANDSTONE lower stone
Estimated quern equivalent: 35%
Context: 18085
Group 857 OA77 Period 22
External diameter: 500mm
Outer edge height: 90mm
Inner edge height: 100mm
Pattern: Harp pattern is visible on the upper faca with striations around spindle hole. Outer face has short irregular toolings lines. The lower face is peck tooled all over.
Comments: There is a shallow channel in the lower face from part of spindle hole.