Abstract
Comparative studies of ground stone artifacts have been limited, due to widely varying terminology and typological schemes restricted to material from one or two specific sites. Most interim site reports describe such artifacts only briefly. Yet ground stone has important implications for the development of prehistoric technology and therefore deserves at least as much attention as is routinely given to chipped stone tools. This article presents definitions of technological and morphological terms and a general classification applicable to prehistoric Levantine sites. While morphological typology should certainly not be the final goal of ground stone analyses, few would dispute the need for relatively standardized terminology that will permit communication of finds.

Résumé
Les études comparatives du mobilier en pierre sont restées limitées en raison d'une terminologie très variable ainsi que d'une typologie restreinte à du matériel provenant seulement d'un ou deux sites. La plupart des rapports préliminaires ne décrivent ces objets que très sommairement. Or, le mobilier en pierre joue un rôle important dans le développement de la technologie préhistorique et mérite autant d'intérêt que celui accordé aux outils taillés. Cet article présente des définitions de termes technologiques et morphologiques, ainsi qu'une classification générale applicable aux sites préhistoriques du Levant. La typologie morphologique n'est pas le but final des analyses de mobilier en pierre mais est nécessaire afin de permettre les comparaisons.

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A CLASSIFICATION SYSTEM FOR GROUND STONE TOOLS FROM THE PREHISTORIC LEVANT

K. WRIGHT

ABSTRACT. - Comparative studies of ground stone artifacts have been limited, due to widely varying terminology and typological schemes restricted to material from one or two specific sites. Most interim site reports describe such artifacts only briefly. Yet ground stone has important implications for the development of prehistoric technology and therefore deserves at least as much attention as is routinely given to chipped stone tools. This article presents definitions of technological and morphological terms and a general classification applicable to prehistoric Levantine sites. While morphological typology should certainly not be the final goal of ground stone analyses, few would dispute the need for relatively standardized terminology that will permit communication of finds.

RESUME. - Les études comparatives du mobilier en pierre sont restées limitées en raison d'une terminologie très variable ainsi que d'une typologie restreinte à du matériel provenant seulement d'un ou deux sites. La plupart des rapports préliminaires ne décrit ces objets que très sommairement. Or, le mobilier en pierre joue un rôle important dans le développement de la technologie préhistorique et mérite autant d'intérêt que celui accordé aux outils taillés. Cet article présente des définitions de termes technologiques et morphologiques, ainsi qu'une classification générale applicable aux sites préhistoriques du Levant. La typologie morphologique n'est pas le but final des analyses de mobilier en pierre mais est nécessaire afin de permettre les comparaisons.

Studies of ground stone assemblages from Near Eastern prehistoric sites have been hampered by inconsistent terminology (1). Many typologies are based on a diverse mix of criteria, often loose categories of shape and size (2); most are descriptions of (often small) samples from one or two sites, usually without general definitions that can be applied to different assemblages (3); others focus only on a few artifact classes (4); nearly all ignore ground stone debitage. Thus, comparisons of assemblages have been difficult to make. By contrast, chipped stone studies employ relatively standard terms useful for such comparisons (5). A standard descriptive classification is a prerequisite for addressing the significance of ground stone assemblage variations.

(2) Exceptions to this criticism include DORRELL, 1983; NIERLÉ, 1983; VOIGT, 1983; CLUZAN, 1984; MOUTON, 1984; ROODENBERG, 1986, though the typologies are still site-specific and emphasize different attributes. The studies by NIERLÉ, 1983; MOUTON, 1984 and ROODENBERG, 1986 are also outstanding in their emphasis on ground stone technology.

The purpose of this article is to present such a classification for application to the prehistoric Levant. Discussions of space-time systematics, specific assemblages and functional significance of the artifact classes are presented elsewhere (6).

The term “ground stone” is a misnomer (7). Such tools may be made on flakes detached from cores; some exhibit retouch; others are analogous to “core tools.” Here, the term refers to any tools made by combinations of flaking, pecking, pounding, grinding, drilling and incising. These include mortars, pestles, grinding slabs, handstones, grooved and perforated stones, axes and other types. However, figurines and beads are excluded. Although abrasion plays a prominent role in the technology, a few artifact categories included here need not have involved grinding (e.g. pounders, choppers).

Jelinek (8) suggests that chipped stone assemblages mainly reflect stages in progressive modification of an original “functioning” toolkit. A similar situation has been documented for Levantine ground stone assemblages (9). A morphological classification based on progressive lithic reduction is here considered the best way of describing assemblages (10). This approach avoids assumptions that

(7) RUNNELS, 1981 : 218f.
(10) MARKS, 1983 : xiii.
morphological classes primarily reflect either stylistic “norms” or tool functions as inferred from ethno- graphic analogy. Variations resulting from function or style will be better understood if technological criteria are addressed first (11).

The classification given here is regional in scope (12) and based on defined classes as distinct from individual samples (13). It gives definitions applicable to Levantine assemblages of the Upper Paleolithic through Chalcolithic time range (45,000 to 5,500 b.p.). It was derived from (a) direct examination of 22 Levantine assemblages from diverse environments, comprising 2,713 artifacts and (b) comparison with ground stone presented in site reports (14). The typology was constructed to meet three prerequisites:

(a) It must be hierarchical, composed of larger classes to which subclasses may be added. This facilitates addition of types when new assemblages are reviewed. The format is similar to that of widely-used chipped stone classifications (15);

(b) Classes must be based on explicit, easily-reproduced attributes.

(c) Wherever possible, type names should employ terms commonly used in the literature.

This typology depends on (a) definitions of raw material properties; (b) definitions of technological terms; (c) definitions of “anatomical” terms for describing individual tools; (d) definitions of variables; (e) a type list; and (f) definitions of classes (types). These are presented below.

RAW MATERIAL PROPERTIES

Ground stone involves diverse raw materials and there may be relationships between stone and tool types. Physical properties affecting these patterns may include hardness, density, brittleness and roughness. Some of the most common raw materials used in Levantine ground stone technology are as follows:

Flint. Flint is hard (Mohs = 7) and brittle with high compressive strength and low tensile strength (16). Low resistance to deformation by an impact, conchoidal fracture and fine texture permit predictability in flaking. These qualities make flint disadvantageous for grinding tools, unless the surface is roughened via battering. Flint would be best for pounding tools requiring an edge (“pecking stones”, “choppers”).

Basalt. Feldspar basalts are softer than flint (Mohs = 6); flaking is less controlled due to heterogeneous texture. Basalt has lower compressive and higher tensile strength than flint and is more resistant to deformation (17). Making vesicular basalt artifacts with stone tools requires “picks” of denser materials with greater compressive strength, but they need not be harder. Nonvesicular basalts have these qualities (18). Vesicular basalt has a natural, durable roughness that limits the need for re-pecking after grinding. Grits are not easily detached and basalt thus permits long use-lives for grinding tools.

Sandstone. Quartzitic sandstone is hard (Mohs = 7) and can be flaked (with less control than flint, as a result of its coarse, heterogeneous texture). Coarse sandstones erode quickly under abrasion, a drawback for long-lived grinding tools, since roughening will be required. Sandstone probably played a key role in manufacture (abrasion) of ground stone tools.

Limestone. Limestone is soft (Mohs = 1-3.5) but not brittle. Flaking is easily accomplished but edges are quickly dulled. Hard limestone resists deformation by an impact. These qualities make

(11) JELINEK, 1976; MARKS 1983 : xiii; TOOTH, 1985 : 107; OLSZEWSKI, 1986 : 79. Criticisms of chipped stone typologies such as those of Bordes center on the scope and interpretation of the types (BINFORD and BINFORD 1966; KERRICH and CLARKE, 1967; JELINEK, 1976; MARKS, 1981 : 371; BINFORD, 1982 : 25; DIBBLE, 1987). Recent research stresses technology, but no one disputes the need for classifications that permit consistent description of finds (BINFORD, 1983 : 96; DIBBLE, 1987 : 116). It should be emphasized that despite functional names here assigned to artifact classes, the classification is not an all-purpose functional typology. Indeed, it is unlikely that such typologies can be created (MARKS, 1983 : xiii). The classification presented here will be useful for subsequent functional interpretations if it is remembered that (a) establishing functional attributes depends entirely on the research questions asked; (b) functional interpretations are most reliable at the level of more inclusive tool classes (CLOSE, 1978 : 234; GORING-MORRIS, 1987 : 54); (c) general functions (e.g. “grinding”) must be distinguished from specific functions (“grain grinding”). Microwear and residue analyses may prove useful for ground stone (ADAMS, 1989; JONES, 1990). See WRIGHT, 1992.


(13) DUNNELL, 1971.

(14) WRIGHT, 1991, 1992 in press. The classification is intended primarily for Levantine material, but parallels are cited from elsewhere in the Near East. The ground stone assemblages from which this classification was developed come from the following sites: UWAYNID 18, JILAT 6, JILAT 8, AZRAQ 17, JILAT 22, AZRAQ 32, WADI HAMMEH 27, AZRAQ 18, BEIDHA (NATUFIAN), BEIDHA (PPNB), JILAT 7, JILAT 32, JILAT 26, BA'JA, AZRAQ 31 (PPNB), DHIWEILA (PPNB), AZRAQ 31 (LATE NEOLITHIC), DHIWEILA (LATE NEOLITHIC), JILAT 25, JILAT 13, AIN GHAZAL (PPNC + YARMOUKIAN), ABU HAMID. Unpublished material from AIN MALLAHA, BASTA and AIN GHAZAL (PPNB) was also made available to the author. Direct examination of ground stone artifacts from these sites was supplemented by examination of published assemblages. The classification used here was developed from these sources. Forthcoming reports by this author on specific Levantine assemblages employ a slightly briefer version of the typology given here (e.g. WRIGHT, 1992).


(16) Discussion of raw material properties is based on SPETH, 1972 : Table 1. (17) SPETH, 1972 : Table 1. (18) HAYDEN, 1987 : 18.
limestone useful for pounding tools, if long-term durability is not needed. Most limestones are easily smoothed and require much repecking if used for grinding.

**Granite.** Granite is a hard (Mohs = 6-7), porphyritic igneous rock composed largely of silica quartz and alkali feldspars. Under abrasion, some granites easily lose surface roughness and would require repecking if used for grinding tools. Particles are not easily detached, however, and thus ground products would remain relatively free of grit.

**Quartzite.** Quartzite is a hard (Mohs = 7) metamorphosed sandstone. Flaking of fine-grained homogeneous quartzites can be almost as easily controlled as flint. Coarser quartzites of heterogeneous textures permit less control in flaking; but the coarseness may be desirable if the intended use of the tool is for grinding.

An important determinant of tool forms is the size of raw material blocks available for tool production (19). Variations in the form of an original nodule or block exerted a strong influence on sizes and shapes of ground stone tools at certain Levantine prehistoric sites (20).

**TECHNOLOGICAL TERMS**

Terms for ground stone reduction follow many of the definitions used for chipped stone. Where they are identical, previously published definitions are cited. Figure 1 illustrates reduction techniques and the traces they produce on artifacts. The usages in this study differ slightly from previous ones (21). The scheme below encompasses a variety of possible reduction alternatives and is intended to be general enough to account for the reduction of most artifact types. Table 1 shows a working scheme for describing reduction stages. Detailed discussion of ground stone technology is given elsewhere (22); only a summary of relevant terms is given here.

**Nodule** = raw material from which reduction begins.

**Source**
- Waterworn, riverine ("wadi")
- Loose surface boulder
- Bedded outcrop (quarried)
- Bedrock outcrop (in situ)

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(20) WRIGHT, 1992.
(22) WRIGHT, 1992.
TABLE 1

Stages in the reduction of ground stone tools and their products
(adapted from Bar-Yosef 1981a: Fig. 3)

<table>
<thead>
<tr>
<th>BASIC TECHNOLOGY</th>
<th>Selection of Raw Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock type</td>
<td>Basalt, Sandstone, Granite etc.</td>
</tr>
<tr>
<td>Source type</td>
<td>Bedrock, Bedded, Surface boulder etc.</td>
</tr>
<tr>
<td>Size of block</td>
<td>Pebble (4-64 mm); Cobble (65-256 mm); Boulder (256+)</td>
</tr>
</tbody>
</table>

**Primary Reduction**: Initial Preparation and Blank Production

<table>
<thead>
<tr>
<th>None</th>
<th>Unmodified raw block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splitting from bedded source</td>
<td>Quarried blank</td>
</tr>
<tr>
<td>Flaking</td>
<td>Core, Flake, Debitage</td>
</tr>
</tbody>
</table>

**SPECIFIC TECHNOLOGY**

Selection of Blanks

<table>
<thead>
<tr>
<th>Chosen blanks</th>
<th>Discarded blanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unprepared (raw blocks)</td>
<td>Prepared</td>
</tr>
<tr>
<td>Cores</td>
<td>flakes</td>
</tr>
<tr>
<td>Secondary Reduction/Roughout</td>
<td>Debitage</td>
</tr>
<tr>
<td>Coarse flaking</td>
<td>Medium flakes</td>
</tr>
<tr>
<td>Pecking</td>
<td>Pecking fragments</td>
</tr>
<tr>
<td>Retouch/Thinning</td>
<td>Edge/margin retouch, microflakes</td>
</tr>
<tr>
<td>Pecking</td>
<td>Pecking fragments</td>
</tr>
<tr>
<td>Grinding</td>
<td>Bricking</td>
</tr>
<tr>
<td>Coarse grinding</td>
<td>Particles</td>
</tr>
<tr>
<td>Fine grinding</td>
<td>Particles</td>
</tr>
<tr>
<td>Incising</td>
<td>Particles</td>
</tr>
<tr>
<td>Finishing</td>
<td>Polishing</td>
</tr>
<tr>
<td>Incising</td>
<td>Particles</td>
</tr>
<tr>
<td>Relief Decoration</td>
<td>Particles</td>
</tr>
<tr>
<td>Rim/Base finishing</td>
<td>Particles</td>
</tr>
<tr>
<td>Tools (&quot;retouched&quot; pieces)</td>
<td></td>
</tr>
<tr>
<td>Perforated Tools</td>
<td></td>
</tr>
<tr>
<td>Grooved Tools</td>
<td></td>
</tr>
<tr>
<td>Grinding slabs, Handstones</td>
<td></td>
</tr>
<tr>
<td>Mortars, Pestles</td>
<td></td>
</tr>
<tr>
<td>Axes</td>
<td></td>
</tr>
<tr>
<td>Vessels</td>
<td></td>
</tr>
<tr>
<td>Outils a posteriori</td>
<td>Use</td>
</tr>
<tr>
<td>Pounders</td>
<td>Grinding</td>
</tr>
<tr>
<td>Polishing Pebbles</td>
<td>Pounding</td>
</tr>
<tr>
<td>Worked Pebbles, Cobble</td>
<td>Battering, Chopping, Cutting, Chiseling, Polishing</td>
</tr>
</tbody>
</table>

MORPHOLOGICAL TYPOLOGY

<table>
<thead>
<tr>
<th>Tools</th>
<th>Flakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>&quot;retouched&quot; pieces</td>
</tr>
<tr>
<td>Perforated Tools</td>
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<tr>
<td>Worked Pebbles, Cobble</td>
<td>Battering, Chopping, Cutting, Chiseling, Polishing</td>
</tr>
</tbody>
</table>

Resharpening = edge rejuvenation, repecking, flaking
Transformation = modification to new tools
Post-depositional fragmentation

Size
- Pebble = diameter between 4 and 64 mm.
- Cobble = diameter between 64 and 256 mm.
- Boulder = diameter greater than 256 mm.

Blank = "initial form" = product of primary reduction, prior to thinning and shaping of preform.

Core (23)

Flake (24)
Blade (24)
Unmodified boulder/cobble/pebble = surface nodule; no primary reduction.

Flake Morphology

Ventral Surface (25)

(25) Tixier, 1974: 5. Hayden’s (1987) usage of “ventral surface” for the side opposite a metate use surface is not the same as that used here. Some ground stone artifacts made on large flakes exhibit the grinding surface on the ventral side (Wright, 1992).

Dorsal surface (26)
Platform = butt (27)
Bulb of Percussion (28)

**Percussion**
- Direct (29)
- Hard-hammer (30)

**Primary Reduction** = blank production
None = selection of raw nodule for use.
Splitting = quarrying (via wedging and pounding) from bedrock.
Flaking = detachment of flakes either for use as blanks or as debitage from a core to be used as a blank.

**Secondary Reduction/Roughout** = shaping of preform (31)
Coarse flaking = removal of medium to large flakes (ca. 30-200 mm).
Pecking = removal of amorphous pecking fragments ("pecking shatter") from a stable target blank, via short percussions directed at random angles to the blank (see fig. 1).

**Retouch/Thinning** = preform thinning and final shaping (32)
- Edge/Margin Retouch (33)
- Retouch of accomodation(34)
Retouch of shaping (34) = any gracile flaking which produces small flakes or microflakes (≤ 30 mm) in shaping the artifact.
Pecking = as above but more gracile and regular in spacing.

**Grinding** = preform abrasion = removal of microscopic rock particles.
Drilling = removal of particles via rotary motion of a pointed object directed at 90 degrees into a stable target (fig. 1).
Coarse grinding (35) (fig. 1).
Fine grinding (35)
Incising = cutting of narrow grooves (fig. 1).

**Finishing** = final, nonfunctional surface treatment.
Polishing = production of smooth surface which reflects light and is visible to the naked eye.
Incising = as above.
Relief decoration = additional grinding on a non-functional surface to produce decorative patterns in relief.

**Rim or Base finishing** = abrasion producing symmetrical rim or base.
Fire-treatment = any intentional firing of stone.

**Use** = reduction through use
- Grinding = as above.
- Pounding = percussion directed through a blunt surface (fig. 1).
- Battering = percussion of a mobile tool with angular edges blunted by impact against a stable target. Battering scars are internal fractures from percussion force directed into the moving tool. They are usually wedge-shaped and slightly hollow (fig. 1).
- Chopping = percussion directed through a sharp edge at 90 degrees to the target (fig. 1).
- Cutting = slicing with cutting edge perpendicular to the target, along a path parallel to the cutting edge (fig. 1).
- Chiseling = cutting with sharp edge at angle less than 90 degrees to target along a path perpendicular to cutting edge of the tool.

**Resharpening** = modification of working surface
Edge rejuvenation (36) = resetting an edge on a cutting tool using the same process as originally.
Repecking = rejuvenation of the roughness of a grinding surface.
Ridge reduction = marginal flaking to expose more working surface in an artifact with a heavily-used concave use surface.

**Transformation** = modification into new tools (37)
Outils a posteriori = tools made on raw nodules unmodified by primary or secondary reduction (38)

**Core tools** = tools made on core blanks.
**Flake tools** = tools made on flake blanks.

**Debitage** (39)
- Cores
- Flakes
- Blades
- Pecking fragments/"shatter" = byproduct of pecking
- Grits = byproduct of grinding

**ANATOMICAL** TERMS FOR DESCRIPTION OF INDIVIDUAL ARTIFACTS

An artifact is placed with the main (or most heavily worn) use surface either facing up (querns, handstones, perforated stones, "shaft straighteners")

(26) TIXIER, 1974 : 5. Note that HAYDEN'S (1987) use of this term to refer to a metate use surface is not the same as that used here.
(28) TIXIER, 1974 : 5.
(33) TIXIER, 1974 : 19f.
(34) BORDES, 1969.
(37) TIXIER, 1974 : 22.
(39) TIXIER, 1974 : 14.
FIG. 2. – Anatomical terms for description of selected artifact types.

(a) Grinding Slab:
A = Face (Use Surface)
B = Lateral Side
C = End
D = Dorsal Side (if unifacial)
E = Face (if bifacial)
F = Longitudinal Section

(b) Mortar:
A = Face (Use Surface)
B = Sides
C = Dorsal Side
D = Transverse Section

(c) Handstone:
A = Face (Use Surface)
B = Lateral Side
C = End
D = Dorsal Side (if unifacial)
E = Face (if bifacial)
F = Longitudinal Section

(d) Pestle:
A = Face (Use Surface)
B = Shaft
C = Transverse Section

or facing the observer at 90 degrees from the line of sight (pestles). Figure 2 shows the anatomy of several artifact types.

Face (also “active face;” “use surface”) = surface(s) showing use.

Side = surface showing no clear indications of use.

Limits = boundaries of a use surface.

Margins = long lateral sides of an artifact.

Ends = shorter sides of an artifact.

Edge = restricted to the working edges of cutting tools.

Base = resting side. A true base is only present if there are traces of intentional shaping to create a stable resting surface.

Ridge = a rim-like feature bordering a heavily used surface.

Rim = a true rim is only present if there is symmetry and finishing.

Shaft = the central part of a cylindrical tool such as a pestle.

Longitudinal axis = axis of symmetry along longer dimension.

Transverse axis = perpendicular to longitudinal axis; in same plane.

Opposed = faces on opposite sides of artifact, meeting nowhere.

Adjacent = faces are adjacent if they meet along one limit.

Polar = refers to the ends of an elongated artifact such as a pestle. If the artifact has evidence of use on only one end, it is called “unipolar;” if on two ends, “bipolar.”
FIG. 3. - Metric variables used in definitions of artifact classes.

KEY: L = Length of artifact; W = Width of artifact; T = Thickness of artifact; MT = Maximum thickness of artifact; LAF = Length of use surface; WAF = Width of use surface; d1, d2, d3 = depths of use surface; PD = Perforation diameter; BL = Bit length; EA = Edge angle; D = Diameter of artifact; HGT = Height from base to rim; RDI = Inner rim diameter; RDO = Outer rim diameter; DPTH = Depth (vessels); BD = Base diameter.
VARIABLES

The classification is based on variations in blank type; artifact shape in plan and section; presence/absence of secondary reduction, grinding, finishing and resharpening; the number, shapes, and distribution of working surfaces; and macroscopic wear patterns of the working surfaces. Metric variables used in construction of the typology are shown in figure 3. Of the nominal variables used in the typology, the most important are the following:

Blank Type
- Flake
- Flaked Core
- Flake or Core
- Umodified Boulder/Cobble/Pebble
- Indeterminate

Shape of Artifact in Transverse Section
- Irregular
- Piano-irregular
- Plano-convex
- Triangular
- Wedge
- Spherical
- Oval
- Tapered
- Lens
- Flat

Shape of Artifact in Plan
- Spherical
- Discoidal
- Ovate
- Loaf shaped
- Squared
- Irregular
- Other

Shape of Use Surface in Plan
- Subcircular
- Oval
- Squared
- Rectangular
- Other

Shape of Use Surface in Transverse Section
- Flat
- Concave, dished
- Concave, U
- Concave, V
- Convex, arc
- Convex, rounded
- Convex, beveled
- Sinuous
- Circular (perforations)

Number of Use Surfaces
- Unifacial
- Bifacial
- Unipolar
- Bipolar
- Multifacial

Shape of Use Surface in Long Section
- Flat
- Concave, dished
- Concave, U
- Concave, V
- Convex, arc
- Convex, rounded
- Convex, beveled
- Sinuous
- Biconical (perforations)
- Cylindrical (perforations)

Relationship of Use Surfaces
- Opposed
- Adjacent
- Superimposed

One variable measures the degree of concavity or convexity of use surfaces. The rationale is that concavity and convexity of certain tools would change with prolonged use (40). To measure curvature, the limits of the use surface were located. Using a profile gauge, the long cross-section of the surface was traced onto graph paper. A straight line from each end of the surface was drawn (= LAF, or “Length of Active Face”). Perpendiculars were drawn extending to the use surface (d1, d2, d3) (fig. 4). For a convex surface, the “depth” measurements d1, d2, and d3 were assigned negative values. For concave surfaces, d1, d2, and d3 were assigned positive values. From these, an index of concavity (CI) was created, such that:

\[ \text{Concavity/Convexity Index (CI)} = \frac{d_1 + d_2 + d_3}{LAF} \]

A surface perfectly flat in section has an index of zero. When the surface is concave, CI > 0; and when the surface is convex, CI < 0.

A study was made of concavity of use surfaces from Neolithic sites (41), to determine whether the variable CI would permit clear distinctions between

(40) Cf. BARTLETT, 1933; VOIGT, 1983: 247. Microwear studies may prove promising (ADAMS, 1989). For the moment, the need is for simpler morphological measures to permit communication of finds.

(41) WRIGHT, 1992.
use surfaces. The goal was to refine loose categories of surface curvature via a simple measurement. The results were promising and the means and standard deviations were used to construct the following classification:

**Concave surfaces**
(a) Flat: CI = 0-0.05
(b) Dished: CI = 0.10-0.40
(c) V-shaped: CI = 0.45-0.75
(d) U-shaped (shallow): CI = 0.80-1.10
(e) U-shaped (deep): CI = 1.15-2.00

**Convex surfaces**
(a) Flat: CI = 0-0.05
(b) Arc-shaped: CI = -0.10-0.40
(c) Beveled: CI = -0.45-0.75
(d) Rounded (gently): CI = -0.80-1.10
(e) Rounded (pronounced) CI = -1.15-2.00

These categories are used in definitions of querns, mortars, handstones and pestles (see below).

**TYPE LIST**

The following list gives names and numbers of the artifact classes. Nomenclature is discussed in the definitions. Figures 4 through 12 illustrate most but not all of the types.

### A. Grinding slabs/querns
1. Block Quern
2. Block Grinding Slab
3. Boulder Quern
4. Boulder Grinding Slab
5. Saddle-shaped Quern
6. Saddle-shaped Grinding Slab
7. Trough Quern
8. Trough Grinding Slab
9. Basin Quern
10. Basin Grinding Slab
11. Hollowed Quern
12. Hollowed Grinding Slab
13. Fragment
14. Miscellaneous

### B. Mortars
15. Pebble Mortar
16. Bowl Mortar
17. Boulder Mortar
18. On flaked/pecked boulder
19. Hollowed Mortar
20. Pillar Mortar
21. Bedrock Mortar
22. Fragment
23. Miscellaneous Mortar

### C. Handstones
24. Bifacial Discoidal/Oval
25. /Lens
26. /Tapered
27. /Planoconvex
28. /Flat
29. /Wedged
30. /Triangular
31. /Plano-irregular
32. Bifacial Ovate/Oval
33. /Lens
34. /Tapered
35. /Planoconvex
36. /Flat
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40. Bifacial Loaf/Oval
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43. /Planoconvex
44. /Flat
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51. /Planoconvex
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60. Unifacial Ovate
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DEFINITIONS OF ARTIFACT CLASSES

A. Grinding slabs/querns (fig. 4 : 1-12 b)

Lower, stationary stone in a pair of grinding tools. Most grinding is in a plane parallel to the side on which artifact rests. Blank : variable. Preform : variable. Use surfaces : broad, long in plan; concave or flat in section; may have striae. Heaviest wear from grinding is at deepest part of face. "Grinding slabs" have rectangular use surfaces or wear striae indicating lateral grinding in a linear path. "Querns" have oval use surfaces or wear striae indicating rotary grinding in an oval path (42). Each type includes subtypes (a) unifacial ; (b) bifacial ; (c) multifacial.

No. 1 Block Quern

Blank : unmodified tabular-stone boulder with naturally stable base. Preform : not applicable. Use surface : unifacial, oval in plan, dished or U-shaped in section. Surface is "closed" (surrounded on all sides) and small relative to blank (length of surface less than 50 % of length of artifact). No ridges; face is set into blank without other modification (43).

No. 2 Block Grinding Slab

As No. 1, but use surface rectangular; striae indicate lateral grinding.

No. 3 Boulder Quern

Blank : unmodified irregular boulder, no primary reduction ; lacks naturally stable base. Preform : not applicable. Use surface : unifacial, oval in plan, dished or U-shaped in section. Surface is "closed" (surrounded on all sides) and small relative to blank (length of surface less than 50 % of length of artifact). No ridges; face is set into blank without other modification (43).

No. 4 Boulder Grinding Slab

As No. 3, but use surface rectangular; striae imply lateral grinding (45).

No. 5 Saddle-shaped Quern

Blank : variable. Preform : pecked or flaked on side opposite use surface. Opposed lateral sides parallel; has concave/convex ("saddle") shape. Use surface : oval in plan, "dished" in long section. Surface extends to sides and ends of blank and is thus "open." No ridges (46).

No. 6 Saddle-shaped Grinding Slab

As No. 5, but use surface rectangular; striae imply lateral grinding (47).

No. 7 Trough Quern

Blank : core or unmodified boulder. Preform : flaked or pecked. Use surface : oval in plan, S-shaped in long section, curving downward from "shelf" at high proximal end to an opening at the thin distal end. Side walls may rise steeply from the use surface. May have flake scars on lateral ridges, for reduction of side walls. Surface is thus large relative to blank, "closed" on three sides, open on one side. Base usually unstable (48).

No. 8 Trough Grinding Slab

As No. 7, but use surface rectangular; striae indicate lateral grinding (49).
FIG. 4. – Artifact types: grinding slabs/querns.
(Numbers refer to those in the type list).
FIG. 5. - Artifact types : mortars.

No. 9 Basin Quern

Blank : variable. Preform : flaked or pecked on exterior; modification of ridges. Use surface : oval/concave, indicates rotary grinding, and is large relative to the blank (50).

No. 10 Basin Grinding Slab

As No. 9, but use surface rectangular; striae indicate lateral grinding (51).

No. 11 Hollowed Quern

Any quern with one oval use surface penetrating the side opposite it.

No. 12 Hollowed Grinding Slab

As No. 11, but use surface rectangular; striae indicate lateral grinding.

(50) Cf. HOLE et al., 1969 : fig. 74, c-d; NOY, 1979 : fig. 7-8; NIERLÉ, 1983 : Pl. 1, 1.
(51) Cf. NIERLÉ, 1983 : Pl. 5, 60.

No. 13 Slab/Quern Fragment

Fragment whose remaining use surface is concave; lacks evidence that it is from a vessel (s.v.). Fragment with flat surface is classed as No. 145.

No. 14 Miscellaneous Grinding Slab/Quern

Grinding slab/quern not meeting any of the above definitions.

B. Mortars (fig. 5: 15-21)

Lower, stationary stone in a pair of tools used for pounding and "vertical rotary grinding" on side walls of use surface. Blank : variable. Use surfaces : subcircular plan, concave in section (dished to U-shaped); deepest part is pitted from pounding. Grinding wear most pronounced on upper use surface near the opening. Formally distinct from vessels (s.v.) (52). Each type includes subtypes (a) unifacial; (b) bifacial; (c) multifacial.

(52) DORRELL (1983 : 52ff.) does not make this distinction. Under "Stone Vessels," his Types H, J, and L would be considered mortars according to the scheme presented here.
No. 15 Pebble Mortar

Blank: variable. Preform: may be flaked or pecked. Easily held in one hand. Use surface: subcircular in plan; variable in section (53).

No. 16 Bowl Mortar

Blank: variable. Preform: flaked or pecked. Exterior lightly pecked but lacks an intentionally fashioned rim or base. Use surface: subcircular in plan; U-shaped in section; large relative to the blank (54).

No. 17 Boulder Mortar

Blank: unmodified irregular boulder. Preform: not applicable. No modification except on use surface. Use surface: subcircular plan; variable in section (55).

(53) Cf. KIRKBRIDE, 1966: fig. 7, 9,12; PERROT, 1966: fig. 16, 11; fig. 20, 22; HOLE et al., 1969: fig. 77, a-b; NOY, 1979: fig.2; DORRELL, 1983: fig. 226, 1-2 (Types L1, L2).

(54) Cf. DORRELL, 1983: 524 (Type H1; some of Type L1).

(55) Cf. PERROT, 1966: fig. 10; HOLE et al., 1969: fig.76, b,d; NOY, 1979: fig. 3; DORRELL, 1983: 524 (Type J; some of Types L1 and L2).

No. 18 Mortar on flaked/pecked boulder

Blank: variable (boulder). Preform: reduced by flaking and/or pecking on the exterior. Use surface: as No. 17.

No. 19. Hollowed Mortar

Any mortar in which the use surface has penetrated the base (56).

No. 20 Pillar mortar

Blank: elongated boulder. Preform: flaked or pecked on exterior. Use surface: set into one end of boulder; small relative to the blank (57).

No. 21 Bedrock Mortar

Blank: in situ bedrock outcrop. Not to be confused with large, heavy boulder mortars. Use surface: subcircular in plan; variable in section.


(57) Cf. EPSTEIN, 1988: fig. 6, 41-3; fig. 7, 46.
FIG. 7. - Artifact types: handstones, pestles.

No. 22 Mortar Fragment

Fragment with concave surface indicating pounding but no finishing suggesting that it is from a vessel.

No. 23 Miscellaneous Mortar

Mortar not falling any of the above categories.

C. Handstones (fig. 6: 24-47; fig. 7: 48-62)

Upper, mobile stone in a pair of grinding tools (58). Blank: flake, core or unmodified cobble. Use surfaces: broad, covering large areas of blank; elongated or constricted in plan; convex or flat in section; may have striae. Evidence of pounding is absent (see Multiple Tools). When such an artifact has a flat use surface it is distinguished from a grinding slab/quern if it can be easily manipulated. Handstones are named by number of faces, plan shape and transverse section shape (defined by convexity, as discussed above). Plan shape is separated from transverse shape by a slash (/). Thus “bifacial discoidal/oval” refers to a handstone with two use surfaces, discoidal in plan and oval in transverse section.

No. 24 Bifacial Discoidal/Oval


(59) For discoidal handstones, cf. KIRKBRIDE, 1966: fig. 9, 2-3; PERROT, 1966: fig. 19, 1,4-8; HOLE et al., 1969: fig.78, a-f; NOY, 1979: fig.14, b; DAVIS, 1982: fig. 3.5, 1,7; fig. 3.6; DORRELL, 1983: 537 (Types A1, A2, B); LECHEVALIER et al., 1989: fig. 4, 10. For ovate handstones, cf. QADI In: GEBEL et al., 1988: fig. 12, 6-7; VOIGT, 1983: 251. For loaf handstones, cf. KIRKBRIDE, 1966: fig. 9, 1; NIERLÉ, 1983: Pl. 4, 27,29. For rectilinear handstones, cf. DAVIS, 1982: fig. 3.5; fig. 3-6, 9.
No. 25 Bifacial Discoidal/Lens
As No. 24 but with use surfaces less convex (arc-shaped) in section and with straight sides, producing lens-shaped transverse section.

No. 26 Bifacial Discoidal/Tapered
As No. 24 but opposed use surfaces meet at the sides and are more convex. Transverse section thus has a tapered lenticular section.

No. 27 Bifacial Discoidal/Planoc convex
As No. 24 but opposed faces are flat and rounded and meet at the sides.

No. 28 Bifacial Discoidal/Flat
As No. 24 but both faces are flat and parallel; sides are straight.

No. 29 Bifacial Discoidal/Wedged
As No. 28 but opposed faces are not in parallel planes.

No. 30 Bifacial Discoidal/Triangular
As No. 24 but opposed faces are flat and beveled.

No. 31 Bifacial Discoidal/Planoirregular
As No. 24 but opposed faces are flat and irregular.

No. 32 Bifacial Ovate/Oval
Blank: variable. Ovate tool (see No. 60). Preform: often pecked. Use surfaces: two (opposed), with rounded transverse sections; rounded sides.

No. 33 Bifacial Ovate/Lens
As No. 32 but with use surfaces less convex (i.e. arc-shaped) in section and with straight sides, producing lens-shaped section.

No. 34 Bifacial Ovate/Tapered
As No. 32 but opposed use surfaces meet at the sides and are more convex. Transverse section thus has a tapered lenticular section.

No. 35 Bifacial Ovate/Planoc convex
As No. 32 but opposed faces are flat and rounded and meet at the sides.

No. 36 Bifacial Ovate/Flat
As No. 32 but both faces are flat and parallel; sides are straight.

No. 37 Bifacial Ovate/Wedged
As No. 36 but opposed faces are not in parallel planes.

No. 38 Bifacial Ovate/Triangular
As No. 32 but opposed faces are flat and beveled.

No. 39 Bifacial Ovate/Planoirregular
As No. 32 but opposed faces are flat and irregular.

No. 40 Bifacial Loaf/Oval

No. 41 Bifacial Loaf/Lens
As No. 40 but with use surfaces less convex (i.e. arc-shaped) in section and with straight sides, producing lens-shaped section.

No. 42 Bifacial Loaf/Tapered
As No. 40 but opposed use surfaces meet at the sides and are more convex. Transverse section thus has a tapered lenticular section.

No. 43 Bifacial Loaf/Planoc convex
As No. 40 but opposed faces are flat and rounded and meet at the sides.

No. 44 Bifacial Loaf/Flat
As No. 40 but opposed faces are flat and parallel; sides are straight.

No. 45 Bifacial Loaf/Wedged
As No. 44 but opposed faces are not in parallel planes.

No. 46 Bifacial Loaf/Triangular
As No. 40 but opposed faces are flat and beveled.

No. 47 Bifacial Loaf/Planoirregular
As No. 40 but opposed faces are flat and irregular.

No. 48 Bifacial Rectilinear/Oval
Blank: variable. Rectilinear tool (see No. 61). Preform: flaked or pecked. Use surfaces: two opposed surfaces with convex, rounded transverse sections and rounded sides.

No. 49 Bifacial Rectilinear/Lens
As No. 48 but with use surfaces less convex (i.e. arc-shaped) in section and with straight sides, producing lens-shaped section.
No. 50 Bifacial Rectilinear/Tapered
As No. 48 but opposed use surfaces meet at the sides and are more convex. Transverse section thus has a tapered lenticular section.

No. 51 Bifacial Rectilinear/Planoconvex
As No. 48 but opposed use surfaces meet at the sides.

No. 52 Bifacial Rectilinear/Flat
As No. 48 but opposed faces are flat and parallel; sides are straight.

No. 53 Bifacial Rectilinear/Wedged
As No. 52 but opposed faces are not in parallel planes.

No. 54 Bifacial Rectilinear/Triangular
As No. 48 but opposed faces are flat and beveled.

No. 55 Bifacial Rectilinear/Planoirregular
As No. 48 but opposed faces are flat and irregular.

No. 56 Handstone on Flake
Blank: large flake. Use surface: if unifacial, located on the ventral surface. If bifacial, the tool is plano-irregular or planoconvex in transverse section. May have flaked retouch on sides near use surface.

No. 57 Bell-Shaped Muller
Blank: variable. Preform is usually pecked; bell-shaped in plan and oval or circular in section. Length/Width ratio (L/W) < 2. Use surface: unifacial, with a flat or slightly convex (arc-shaped) use surface (60). No evidence of pounding (see No. 137).

No. 58 Irregular Handstone a posteriori
Blank: unmodified pebble or cobble of irregular shape. Use surface: single grinding surface.

No. 59 Unifacial Discoidal Handstone
Blank: variable. Final tool form is subcircular in plan (L/W = 1 ±) and variable in section. Use surfaces: one, with variable transverse section shape.

No. 60 Unifacial Ovate Handstone
Blank: variable. Final tool form is ovate in plan (L/W = 1.5-1.75 ±) and variable in section. Use surfaces: one, with variable transverse section shape.

No. 61 Unifacial Rectilinear Handstone
Blank: variable. Final tool form is square or rectangular in plan and variable in section. Use surfaces: one, with variable transverse section.

No. 62 Unifacial Loaf Handstone
Blank: variable. Final form is loaf-shaped (elongated oval) in plan (L/W = 1.75-2.0 ±), variable in section. Use surfaces: one, with variable transverse section shape.

No. 63 Handstone Fragment
A fragment is identified as a handstone if the ground surface is convex relative to what remains of the blank. Similar fragments with flat surfaces are classified as No. 145.

No. 64 Miscellaneous Handstone
Handstone which does not fall into any of the preceding classes.

D. Pestles (fig. 7: 65-72)
Upper, mobile stone in a pair of pounding tools. Blank: core or unmodified cobble. Preform often pecked to even elongated shape. Use surfaces: constricted in plan and confined to one or more of the ends of an elongated blank. Use surface: subcircular or slightly oval in plan, sometimes irregular; convex (arc-shaped), rounded, or flat in section. There are often flake scars on the sides, with the negative bulb of percussion near the use surface, showing the direction of use. Subtypes are defined by convexity categories (see above): (a) flat; (b) arc-shaped; (c) beveled; (d) rounded (gentle); (e) rounded (pronounced).

No. 65 Bipolar Cylindrical Pestle
Blank: elongated cobble. Preform: reduced by pecking to an even elongated shape, cylindrical in plan, subcircular in section. Use surfaces: two faces on opposing ends bear evidence of pounding, i.e. battering marks and/or flake scars struck off the shaft alongside the face. Faces are flat or convex (arc-shaped or rounded) and of similar diameters (61).

No. 66 Unipolar Cylindrical Pestle
As No. 65, but only one use surface has evidence of pounding (62).

(60) Cf. KIRKBRIDE, 1966: fig. 7, 2; HOLE et al. 1969: fig. 79, d-e; DORRELL, 1983: fig. 221, 10. The French equivalent is that of CLUZAN, 1984: 122 and fig. 76, 2. CLUZAN also calls this "à cône en champignon" (fig. 76: 2).

(61) Cf. KIRKBRIDE, 1966: fig. 7, 4; PERROT, 1966: fig. 17, 9,13-14; DAVIS, 1982: fig. 3.3, 1,5,6; DORRELL, 1983: fig. 226, 10-12 (Types C1, C2, CX); NIERLÉ, 1983: Pl. 8, 108,110; LECHEVALLIER et al. 1989: fig. 4, 7.

(62) Cf. PERROT, 1966: fig. 17, 12,17 (?); DAVIS, 1982: fig. 3.4, 1; NIERLÉ, 1983: Pl. 4, 44,49,50.
No. 67 Bipolar Conical Pestle
As No. 65, but plan is conical; use surfaces are of different diameters (63).

No. 68 Unipolar Conical Pestle
As No. 67, but only one use surface has evidence of pounding (64).

No. 69 Unipolar Knobbed Pestle
Similar to No. 68, but the end lacking evidence for pounding is shaped into a subspherical knob for grasping the tool (65).

No. 70 Unipolar “Collared” Pestle
Similar to No. 69, but the “knob” is elongated and narrower than the lower part of shaft near the use surface. The effect is of a use surface having a “band” or “collar” around it (66).

No. 71 Soft Mini-Pestle
Blank: small elongated cobble of soft stone, usually cylindrical, not intended for heavy pounding. Use surfaces: bipolar or unipolar; flat, rounded or pointed in section (67).

No. 72 “Figurine” Pestle
Any pestle in which either the shaft or proximal end has been carved or sculpted to an anthropomorphic, zoomorphic or other decorative form (68).

No. 73 Pestle Fragment
A fragment with a circular transverse section of an elongated shaft and/or evidence of pounding at an end.

No. 74 Miscellaneous Pestle
A pestle which does not fall into the above categories.

E. Pounders (fig. 8: 75-78)
Blank: core or angular nodule. Outils a posteriory, generally flint, with battering fractures. The latter are small wedge shaped internal fractures from pounding directed into sharp edges at a variety of angles. Easily held in one hand. Battered tools of materials other than flint are only classed as pounders if battering has dulled irregular sharp edges (69).

No. 75 Irregular Core Pounder
Blank: flint nodule or core. Irregular, angular polyhedron shape. Battering marks restricted to a small area (< 25%) of the blank.

No. 76 Spherical/Irregular
Blank: as No. 75. Battering marks cover between 25 and 90% of blank, but the tool is not completely spherical and there are angular edges remaining.

No. 77 Spheroid
Blank: as No. 75. Battering marks cover 90-100% of the blank and the overall shape is a nearly perfect sphere.

No. 78 Cuboid
As No. 77 but there are at least 2 flat facets and the shape is closer to a cube than a sphere. Has evidence of grinding on the facets.

No. 79 Fragment
Any broken flint core or nodule with battering marks.

F. Polishing pebbles (fig. 8: 80-81)
Pebble or cobble, often waterworn, with brightly polished surface(s). Usually flint or quartzite (other materials occasionally encountered). Use surface: broad, variable in plan, always slightly convex or flat in section (70).

No. 80 Unifacial Polishing Pebble
Blank: as above. Use surface: one.

No. 81 Bifacial Polishing Pebble
As No. 80, but two opposed use surfaces.

(63) Cf. KIRKBRIDE, 1966: fig. 7, 6; PERROT, 1966: fig. 17, 16; DAVIS, 1982: fig. 3.3, 4; DORRELL, 1983: fig. 226, 8-9 (Types B1, B2).
(64) Cf. DAVIS, 1982: fig. 3.3, 8; fig. 3.4, 1.5.
(65) Cf. KIRKBRIDE, 1966: fig. 7, 1.3; DORRELL, 1983: fig. 221, 14; fig. 226, 13 (Type Sp).
(66) Cf. NOY, 1979: fig. 14, c; DAVIS, 1982: fig. 3.2, 3-5; DORRELL, 1983: fig. 221, 12 (Type Sp); LECHEVALLIER et al., 1989: fig. 4, 3.
(67) Cf. DORRELL, 1983: fig. 221, 8 (Type H).
(68) Cf. PERROT, 1966: fig. 17, 4; DORRELL, 1983: fig. 221, 11 (Type Sp).
(69) Cf. HOLE et al., 1969: fig. 79, a-c.f.g; KOZLOWSKI, 1989: fig. 4. Other terms include “bolas,” “sling stones,” “stone balls,” “pecreteurs,” “pecking stones” and “hammerstones” (e.g. LEAKEY 1948: 48; WOODBURY 1954: 86; DORRELL 1983: 533; VOIGT, 1983: 261). Ethnographic and experimental studies show that these can be used for pecking ground stone tools (WOODBURY, 1954: 86; ABBES, 1991). Studies by WILLOUGHBY, 1985 and WRIGHT, 1992 indicate that forms of pounders reflect progressive reduction of a battering tool until it is no longer useful as such. Diameters of tools from Beidha decreased continuously from irregular to spheroid forms; cuboids appeared to be spheroids adapted for use in grinding (WRIGHT, 1992).
No. 82 Polishing Pebble Fragment
A fragment whose blank is as above and with visible traces of polish.

G. Worked pebbles and cobbles (fig. 8: 84-88)
Blank: unmodified cobble. These artifacts have traces of reduction by ad hoc use but with diffuse use surfaces.

No. 83 Ground Cobble/Pebble
Cobble or pebble with diffuse, irregular ground surface(s) (71).

No. 84 Ground Sphere
Cobble ground on all sides to form a nearly perfect sphere (72).

(72) Cf. DORRELL, 1983: fig. 228, 3.

No. 85 Pecked Cobble/Pebble
Cobble with irregular traces of pecking (73).

No. 86 Flaked Cobble/Pebble
Cobble with one or two flake scars.

No. 87 Ochred Cobble/Pebble
Cobble with traces of ochre.

No. 88 Small Slab Abrader
Small, irregular tool of tabular sandstone, with diffuse ground surface that is generally flat or concave ("sandpaper"). Sometimes has ochre (74).

H. Axes and celts (fig. 9)
Tool with a cutting edge, manufactured partly via abrasion (except Nos. 97-98). Blank: flake,

(73) Cf. HOLE et al., 1969: 200; fig. 84, e.
blade, or core of any stone other than flint. The exclusion of flint axes and celts from this typology is arbitrary. The chief technological difference between flint and non-flint axes/celts lies in the role of pecking and grinding/polishing in manufacture. Pecking is not used for flint celts and grinding is often limited to the bit (75).

The classification here modifies types defined by Roodenberg (76). Roodenberg distinguishes manufacturing striae on the bit (visible to the naked eye) from use-wear striae (visible at 40x), but it is not clear that this distinction can be consistently applied. Resharpening and reuse often obscure use-wear traces. Here, the categories of traces on the bit are all defined as visible to the naked eye. They include: presence/absence of polishing, grinding, flake scars and whether flake scars are superimposed on a polished bit (or vice versa). These may reflect manufacture, use or resharpening. Roodenberg's types also incorporate percussion traces on the butt. Here, these categories include flaking and pecking.

**No. 89 Trapezoidal Axe**

Blank: variable. Robust elongated axe (L/W > 2); trapezoidal in plan; oval or rectangular in transverse section. Butt: pecked or flaked. Bit: unifacially or bifacially ground and polished. Bit length equal to maximum width (i.e. tool is widest at the bit). Retouch: if present, flake scars generally semi-steep and squamous; may be either "under" the ground/polished surface (scars dulled by edge grinding); or superimposed on a ground edge (flaking rejuvenation). Edge angle: generally greater than 75° (77).

**No. 90 Trapezoidal Celt**

Blank: variable. Size medium to small, shape trapezoidal. Smaller than No. 89; L/W ≤ 2. Butt: traces of pecking or flaking. Bit: unifacially or bifacially ground and polished; symmetrical or asymmetrical in section. Bit length equal to maximum width of tool. Retouch: as No. 89. Edge angle:

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(75) Thus, terminology used here differs from that of MOR-TENSEN, 1970.

(76) ROODENBERG, 1986.

(77) HOLE et al., 1969: fig.82, a; CLUZAN, 1984: fig. 68, 2; fig. 89, 3; ROODENBERG, 1986: fig.55, 1 ("hache").
ca. 40-70° if resharpening has not been extensive (78).

**No. 91 Ovate Celt**

Blank : variable. Thick, ovate tool with lower L/W ratio than Nos. 89-90. Butt : traces of percussion. Bit : unifacially or bifacially ground or polished. Bit length less than maximum width of the tool (i.e. tool is widest at a point between the butt and the bit). Retouch : as in No. 89. Edge angle : 70-85° if resharpening has not been extensive (79).

**No. 92 Chisel**

Blank : thick blade. Elongated, with parallel lateral sides and oval or triangular transverse section. L/W ratio > 2. Butt : percussion traces. Bit : unifacially or bifacially ground/polished; symmetrical or asymmetrical in section. Bit length less than or equal to maximum width of tool. Retouch : as No. 89. Edge angle : 60-75° if resharpening has not been extensive (80).

**No. 93 Ebauchoir**

Blank : thick blade. Similar to No. 92, but thinner and without percussion on butt. May be faceted on shaft. L/W ratio > 2. Butt : no percussion traces. Bit : narrow, thin, bifacially ground and polished; symmetrical or asymmetrical in section. Bit length less than or equal to maximum width of tool. Edge angle : less than 60° (81).

**No. 94 Miniature Celt**

Any celt of which length is less than 70 mm. May have traces indicating that it is a long-used, resharpened stage of a once-larger celt (82).

**No. 95 Axe/Celt Preform**

Axe or celt which lacks an edge or is otherwise unfinished. Distinguished from dulled axes by absence of any tapering from the butt to the opposite end; and from small pestles by the preparation of the butt and the asymmetrical (non-circular) distal end (83).

**No. 96 Flaked/Ground “Knife”**

Elongated (L/W ≥ 2) non-flint tool ground on sides but flaked along the long lateral edges. No evidence of polishing or grinding on the edges (84).

**No. 97 Flaked “Hoe”**

Blank : non-flint flake or thin core. Thin, pear-shaped tool with flaking around widest end forming a cutting edge and sometimes with a groove at the narrow end (85).

**No. 98 Miscellaneous Flaked Chopper**

Any robust chopping tool with an irregular flaked bit but no evidence of grinding or polishing. Includes pebble choppers (86).

**No. 99 Axe/Celt Fragment**

Fragment with a flaked, ground or polished edge and/or a butt fragment.

**I. Grooved stones (fig. 10 : 100-102)**

Any tool with a groove, i.e. a concave use surface over 3 times longer than it is wide; lenticular in plan; V- or U-shaped in transverse section.

**No. 100 Shaft Straightener**

Blank : variable. Use surface : long relative to width and depth; lenticular in plan; flat, convex, or concave in long section; dished or U-shaped in transverse section. Width of groove rarely exceeds 15 mm. Interior of surface often highly polished through use; may have traces of residue (87).

**No. 101 Cutmarked Slab**

Any stone with a long, narrow cut mark, lenticular in plan, always sharply angled V shape in transverse section (cf. “slicing slabs”) (88).

**No. 102 Patterned-Incised Pebble/Cobble**

Any pebble or cobble with patterned incisions (parallel, crossed, other) but lacks other use surfaces. Excludes anthropomorphic or animal figurines (89).
No. 103 Miscellaneous Grooved Stone
Any grooved or incised stone not falling into the above categories (90)

J. Perforated stones (fig. 10 : 104-112)
Characterized by a perforation (which connects two sides of an artifact), or drill marks (which do not fully penetrate opposing sides). Perforation is always subcircular or circular in plan and biconical or cylindrical in section. (Note: beads and pendants are excluded.)

No. 104 Counterpoise Weight
Blank: large pebble or cobble, generally pecked and ground to symmetrical shape. Use surface: a single large off-center perforation set into the narrower end of the blank. Has no cutting edge (91).

No. 105 Perforated Axe-head
Flaked and/or pecked cobble with single large off-center perforation and a ground cutting edge at the end opposite the perforation (92).

No. 106 Perforated Post-Socket
Blank: cobble or boulder, unmodified or flaked/pecked into subcircular preform. Perforation set into center of blank and is large relative to the blank. Perforation diameter suggests “posthole” but functions may vary (93).

(90) Includes grooved or notched “waisted” pebbles (cf. “poids à pêche”, PERROT, 1966 : fig. 20, 1-4.)
(91) Cf. KIRKBRIDE, 1966 : fig. 9, 5-6; FROST, 1984 : 125 and fig. 11.
(92) Cf. MALLON et al., 1934 : fig. 25; PERROT et al., 1967 : fig. 14.5; CAUVIN, 1963 : fig. 11.
(93) HOLE et al., 1969 : fig. 85, d.
No. 107 Perforation on Disk

Blank: cobble or pebble, flaked/pecked to discoidal shape but irregular in thickness from one end to another. Small perforation or drill mark, may be central or off-center (94).

No. 108 Spindle Whorl

Blank: pebble, ground to small (ca. 30-60 mm diameter) discoidal preform and even in thickness (about 5-15 mm). Perforation always centrally placed. May be incomplete and have two opposed drill marks. A “preform” for a spindle whorl has the same size and shape characteristics but neither perforation nor drill marks (see No. 112) (96).

No. 109 Loomweight

Blank: pebble or small cobble. Preform: pecked and ground to symmetrical biconical or spherical shape. Perforation always centrally placed. Artifact size usually 40-80 mm diameter; perforation about 15-25 mm diameter. No stress breaks at perforation openings (see No. 110). Some of these artifacts may have actually functioned as spindle whorls (96).

No. 110 Macehead

Similar to No. 109 but often piriform, wider at one end than the other; usually polished; stress breaks at one perforation opening (97).

No. 111 Perforated “Pendant Palette”

Perforation on one end of an elongated blank finely ground to rectangular plan shape and of even thickness (about 10-15 mm) across the entire artifact. Generally rectangular in long and transverse sections (98).

No. 112 Unperforated Disk

Any small subcircular object without perforation. May often be preforms for spindle whorls, if diameter is less than about 70 mm and if thickness is even across the artifact (99).

No. 113 Miscellaneous Perforated Stone

Any perforated or drilled stone not of the above categories.

(94) Cf. PERROT, 1966: fig. 20, 18-20; DORRELL, 1983: fig. 227, 2-4; CLUZAN, 1984: fig. 71: 5.
(95) Cf. HOLE et al., 1969: fig. 85, e-f.
(96) Cf. VOIGT 1983: fig. 177, h.
(99) Cf. DAVIS, 1982: fig. 3.13, 12-13; DORRELL, 1983: fig. 228, 4.

K. Stone vessels (fig. 11)

Vessels must have (1) a well-defined, uniform rim; (2) a well-defined base; (3) a continuous exterior surface; (4) consistent (or gradually changing) thickness of walls; (5) exterior finishing. A vessel fragment must have a definite rim or base, or walls of continuously changing thickness and exterior finishing. Classifications are based on relationships between vessel height (HGT), outer rim diameter (ROD), inner rim diameter (RDI), depth (DPTH) and the openness of the walls (see figure 4 for definitions of metric variables). These are considered to reflect lithic reduction and possible ranges of function. Each vessel category may exist in (a) “fine wares” (maximum wall thickness ≤ 20 mm) or (b) “coarse wares” (maximum wall thickness > 20 mm). These can be refined for specific assemblages (100).

No. 114 Platter

Shallow vessel with large ratio of outer rim diameter to height (ROD/HGT > 3) and large ratio of inner rim diameter to depth (RDI/DPTH > 3). Base flat or rounded; walls splayed or upright. Size variable, but RDI exceeds 100 mm. Variants may include (i) oval platters with convex walls; (ii) oval platters with upright walls; (iii) rectangular platters with convex walls; (iv) rectangular platters with upright walls, etc (101).

No. 115 “Potlid” Platter

Vessel with large ratio of outer rim diameter to height (ROD/HGT > 3) and little or no depth, i.e. a circular or rectilinear slab with only a slight depression. Base is flat and sides upright or slightly convex (102).

(100) Stone vessel typologies vary significantly. For a detailed review, see WRIGHT, 1992. Most typologies are based on a mixture of criteria, e.g. profile shape, base shape, artifact size (ADAMS, 1983; DORRELL, 1983; MOUTON, 1984; ROODENBERG, 1986; EPSTEIN, 1988), but employ different definitions and terminology. This is because they are in reality groupings of artifacts from one or two sites, instead of true classifications (DUNNELL, 1972). The classification given here is intentionally general and does not attempt to be comprehensive for all variations. Many artifacts called mortars in the literature are more accurately described as vessel-mortars, since they exhibit fine finishing, rims and bases, and continuous or gradually changing wall thickness. Many Kebaran through Natufian artifacts found in archaeological association with pestles, or with other evidence suggesting their use as mortars, should be classified as such. Here, these artifacts would be classified according to the vessel typology, but with the name “vessel-mortar.” For example: PERROT, 1966: fig. 15, 14; fig. 16, 1 (No. 124, Solid-foot Vessel-Mortar); RONEN et al, 1975: fig. 9 (No. 119, V-shaped Bowl-Mortar). Note that the more general category of “bowl mortars” (No. 16) refers to small mortars lacking fine finishing, rims, bases and continuous or gradually changing wall thickness.

(101) Cf. KIRKBRIDE, 1966: fig. 7, 8; PERROT, 1966: fig. 16, 13; DORRELL, 1983: fig. 224, 1-12; MOUTON, 1984: fig. 57, 1-4; fig. 59; ROODENBERG, 1986: fig. 77, 7-9; fig. 81, 1-7; NOY, 1989: fig. 4, 6.
(102) Cf. MOUTON, 1984: fig. 62, 1.
No. 116 Drill-marked Platter

Any platter with a central drill-mark (103).

No. 117 Globular Bowl

A bowl is any vessel in which $1 \leq \text{RDO/HGT} \leq 3$. Exterior walls convex; rim varies. Outer rim diameter less than the maximum width of vessel. Base flat or rounded (104).

No. 118 Upright Bowl

Bowl in which the outer rim diameter, the base diameter and maximum diameter are approximately equal ($\text{RDO} = \text{BD} = \text{W}$) (105).

No. 119 V-shaped Bowl

Open bowl ($\text{RDO/HGT} < 3$) with flat base and walls flaring outward toward rim. Outer rim diameter exceeds base diameter. Rims tapered or rounded; walls thin relative to base. Generally deep ($\text{HGT/DPTH} \leq 2$) (106).

No. 120 Carinated Bowl

Any bowl with a carinated wall or shoulder (107).

No. 121 Miniature Vessel

Any vessel with rim diameter less than 100 mm and height less than or equal to 100 mm. Varieties may include any of the other types listed.
No. 122 Vase

Open form in which the ratio of outer rim diameter to height is less than 1 (RDO/HGT < 1). Generally deep (RDI/DPTH ≤ 3, HGT/DPTH ≤ 2). Walls straight or flared, base is variable.

No. 123 Fenestrated Vessel

Any vessel on a stand of three or more legs which terminate in a ring-shaped pedestal; the stand thus forms small “windows.” The pedestal is a true ring (not to be confused with a ring base) (108).

No. 124 Solid-foot Vessel

Any vessel resting on a solid pedestal. Pedestal walls may be straight or flared. Base may be flat, concave, or a ring base (109).

No. 125 Hollow-foot Vessel

Any vessel resting on a foot which has been hollowed out; similar to a fenestrated foot but without “windows” or legs.

No. 126 Tripod Vessel

Vessel resting on a stand of three legs.

No. 127 Quadripod Vessel

Vessel resting on a stand of four legs (110).

No. 128 Spouted Vessel

Vessel with any kind of spout (111).

No. 129 Lugged/Handled Vessel

Vessel having any kind of lug or handle (112).

(109) WRIGHT, 1992 : fig. 5-63c.
(110) Cf. ROODENBERG, 1986 : fig. 75, fig. 76, fig. 79.
(111) Cf. MOUTON, 1984 : fig. 58, 5-9,11,16
(112) Cf. MOUTON, 1984 : fig. 58, 10.
No. 130 Miscellaneous Vessel
A vessel not falling into any of the above categories (113).

No. 131 Rim Fragment
Any fragment clearly belonging to a rim.

No. 132 Base Fragment
Any fragment of a base or foot.

No. 133 Body Fragment
Fragment exhibiting continuous change in wall thickness and exterior finishing, but not clearly part of a rim or base.

No. 134 Unfinished Vessel
Vessel with partially-obliterated traces of manufacture.

L. Multiple tools (fig. 12: 135-138)
Any artifacts falling into more than one of the above categories.

No. 135 Quern/Mortar
Any quern with mortar surface set into grinding surface (114).

No. 136 Grinding Slab/Mortar
Any grinding slab with mortar surface set into grinding surface (115).

No. 137 Pestle/Bell Muller
As No. 57 but with flake scars on shaft near grinding surface (116).

No. 138 "Baguette" Pestle/Handstone
Elongated (L/W ≥ 3) rectangular cobble ground on all sides; subrectangular or oval transverse section. Use surfaces diffuse.

No. 139 Other Pestle/Handstone
Any combination of the other categories of pestle and handstone.

No. 140 Miscellaneous Multiple Tool
Any multiple tool not falling into the above categories.

M. Debitage (fig. 12: 140-142)

No. 141 Pecked Preform
Nodule pecked to symmetrical shape suggesting preform of a tool. Identification depends on manufacture patterns observed in an assemblage.

No. 142 Flake Core
Nodule with at least three flake scars. Includes cores from which primary flakes were detached to serve as blanks; and blanks for "core tools".

No. 143 Flake (111)

No. 144 Miscellaneous Indeterminate Spalls
Spalls that may be flakes but do not retain bulbs or platforms.

N. Unidentifiable ground stone fragments

No. 145 Possible Handstone/Grinding Slab
Fragment with flat ground surface from handstone or grinding slab.

No. 146 Possible Vessel
Fragment suggesting a vessel but too small to determine finishing.

No. 147 Unknown
Unidentifiable ground stone fragment (UGSF).

CONCLUSION
Ground stone artifacts are an underused source of information about technology, subsistence and social relationships in the prehistoric Levant. It is hoped that the foregoing will encourage better, more consistent descriptions of ground stone artifacts, especially in preliminary site reports. It is also hoped that excavators will preserve such artifacts without washing them (since residue studies may prove successful in determining tool functions) (118) and that possible debitage (e.g. non-flint flakes and nodules) will be conserved when encountered in archaeological deposits.

(113) For this classification, it was considered preferable to keep vessel categories simple. Thus, the "miscellaneous" category here includes types that can be added as separate categories for specific assemblages.
(114) Cf. HOLE et al., 1969: 176, fig. 75; NOY, 1979: fig. 6; NIERLÉ, 1983: fig. 11, 76,95; Pl. 6, 76; Pl. 7, 95. Variants may include saddle-shaped, basin, etc.
(115) Cf. HOLE et al., 1969: 176, fig. 77; NOY, 1979: fig. 9; NIERLÉ, 1983: Pl. 2, 23,24. Variants may include saddle-shaped, basin, etc.
(116) cf. DAVIS, 1982: fig. 3.2, 1; GORING-MORRIS, 1987: 328; WRIGHT, 1992: fig. 5-25. Note that the French term "broyeur" is reserved for multiple tool handstone/pestles.
(117) TIXIER, 1974: 14.
(118) JONES, 1990.
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BIBLIOGRAPHY

ABBÈS F.

ADAMS J.

ADAMS R. MCC.

BANKS K.

BARTLETT K.

BAR-YOSEF O.

BINFORD L.

BINFORD L.R. and BINFORD S.

BORDES F.

CAUVIN J.

CLOSE A.

CLUZAN S.

DAVIS M.

DIBBLE H.

DOLLFS G.
1985 Le travail de la pierre à Mallaha. Dossiers Histoire et Archéologie 100: 69.

DOLLFS G., KAFASI Z., REWERSKI J., VAILLANT N., COQUEUGNIOT E., DESSE J. and NEEF R.

DORRELL P.

DUNNELL R.

EPSTEIN C.

FUJIMOTO T.


FROST H.
ROUX V.

RUNNELS C.

SOLECKI R.L.

SPETH J.

STEKELEIS M. and YIZRAELY T.

SUMNER W.

TIXIER J.
1974 Glossary for the description of stone tools with special reference to the Epipaleolithic of the Maghreb.

Translated by M. Newcomer. *Newsletter of Lithic Technology Special Publication No. 1*.

TOOTH N.

VOIGT M.

WILLOUGHBY P.

WOODBURY R.
1954 Prehistoric stone implements of northeastern Arizona. *Papers of the Peabody Museum of Archaeology and Ethnology* XXXIV.

WRIGHT K.
in press Early Holocene Ground Stone Assemblages from the Levant. *Levant* XXV.