

GROUND STONE CELTS FROM FRANCHTHI CAVE A CLOSE LOOK

ABSTRACT

This article presents in detail the eighty-nine ground stone celts discovered in Neolithic levels at Franchthi Cave. The celts were fashioned primarily from local materials, using the techniques of pecking and grinding. No evidence for craft specialization in their manufacture has been detected. Only a small number of these tools are large or sturdy enough to have been used to cut down trees. Some of the celts could have been employed in lighter tasks (e.g., clearing shrubbery, working wood or bone), while others might have served in a ritual context.

The site of Franchthi Cave is located on the coast of the southern Argive peninsula in the northeastern Peloponnese, Greece (Figs. 1–2).¹ Excavations conducted from 1967 through 1976 under the direction of Thomas W. Jacobsen revealed a long sequence of human occupation from the Upper Palaeolithic through the end of the Neolithic period (ca. 25,000–3000 B.C.). Evidence for human activity came from two integral but distinct areas: the cave, a karstic formation 150 m long; and the so-called Paralia, a 15-m-wide zone extending along the modern shoreline (Fig. 3). During the Neolithic, Paralia was part of an open settlement that is now

1. The study of the ground stone celts from Franchthi Cave is part of a larger research project that comprises all the ground stone tools found at the site. The material is stored in the Nauplion Archaeological Museum, where I examined it in the summers of 1997, 1998, and 2000. My study was made possible by a Schrader Postdoctoral Fellowship, a Schrader Summer Grant, and a grant from the National Endowment for the Humanities (awarded to Thomas W. Jacobsen). Preparation of the illustrations was funded by a Schrader Summer Grant

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The following abbreviations are used for the phases of the Neolithic period: EN (Early Neolithic), MN (Middle Neolithic), LN (Late Neolithic), FN (Final Neolithic).



Figure 1. View of Franchthi Cave.

largely under water. The evidence suggests that in the course of the Upper Palaeolithic and Mesolithic periods various groups of hunter-gatherers used the cave as a base camp or as a habitation site at least on a seasonal basis. The introduction of domesticated plant and animal species (wheat, barley, sheep, goats) and the appearance of pottery mark the beginning of the Neolithic, ca. 6000 B.C. These changes coincide with the establishment of the settlement on Paralia. The presence of stone structures in that area has been interpreted as a sign of a more sedentary way of life and year-round occupation that continued at least until the end of the Middle Neolithic, ca. 4500 B.C.²

The excavations produced a plethora of cultural and environmental remains (e.g., pottery, tools, figurines, ornaments, human skeletal remains, faunal and botanical material) that shed light on the various aspects of life and death of the people who used Franchthi at different periods. In this article I provide a detailed analysis of the ground stone celts in an attempt to unravel and explain the range of choices made by the people who produced, used, and discarded them. A thorough presentation of the material is necessary to help fill the considerable gap in the literature regarding prehistoric Aegean ground stone celts and ground stone tools in general.

Celts are tools used to cut, chop, scrape, incise, or dig worked materials such as wood, bone, skin, meat, or soil. The diagnostic trait of a ground stone celt is an acute ground edge located on one of the two ends. Always a result of manufacture, this edge represents a conscious choice of the producers of these tools. During use, a celt acts through (direct or indirect) percussion or pressure of the working edge on the worked material. The celt can have a perpendicular or oblique orientation in relation to the worked material, whereas its working edge can move longitudinally or transversely through it. Most of the celts from Franchthi represent only the stone portions of original composite tools that also included hafting devices made of (primarily) wooden shafts, as well as perhaps some binding or adhesive material.

2. See *Franchthi* 1–10, 12; Jacobsen 1976, 1981.

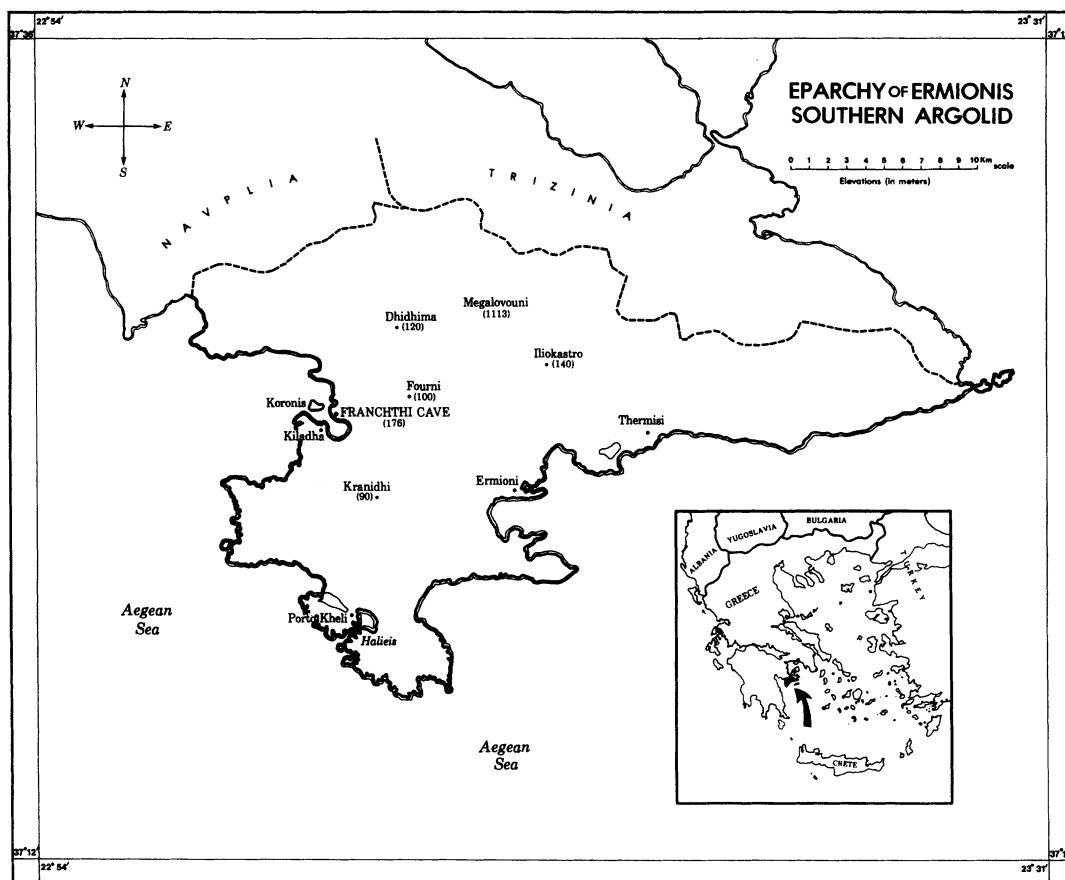


Figure 2. Franchthi Cave in the southern Argolid. After *Franchthi* 1, p. 3, fig. 1. Courtesy Indiana University Press.

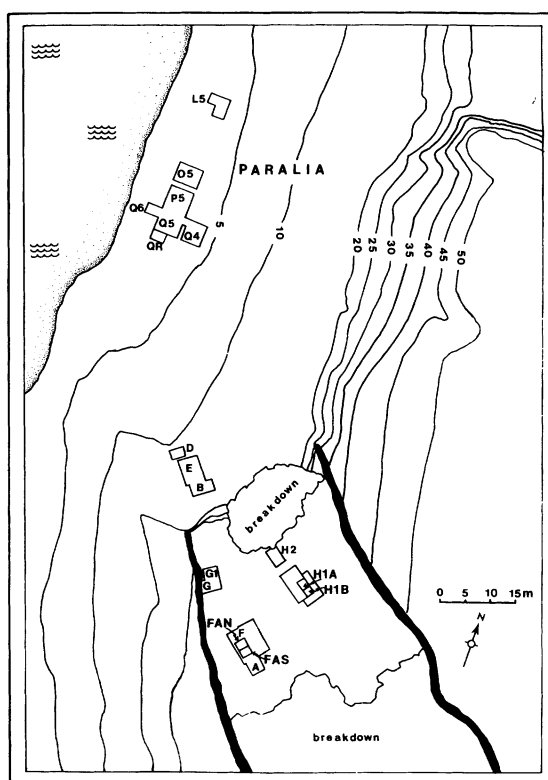


Figure 3. Plan of Franchthi Cave and Paralia showing excavated trenches. After *Franchthi* 7, p. 8, fig. 5. Courtesy Indiana University Press.

THE SAMPLE

The assemblage of celts from Franchthi consists of eighty-nine items: seventy-nine complete and fragmentary tools that exhibit an acute edge, and ten tools without an acute edge (Table 1). The latter tools fall into two groups: those that were left in a roughed-out form, the shaping of their edge having never taken place; and those whose edge was obliterated at some point in their use life when they were recycled to serve some function not usually associated with celts. In addition to these eighty-nine celts, the excavations uncovered fourteen fragments whose raw material and overall shape point to the likelihood that they once were parts of celts.³ Finally, four serpentinite specimens have been found that may represent early stages of the manufacturing process: one complete unworked cobble, which, as suggested by Catherine Perlès,⁴ might have been collected as a celt blank by people at Franchthi; and three cobble fragments that display evidence of pecking, and perhaps constitute the remains of accidents that occurred during celt manufacture.

Fifty-nine of the celts (66%) are considered complete, since they are either intact or missing a part too small to significantly affect the reconstruction of their original shape and dimensions. Twenty-eight celts (31%) are fragmentary. The percentage of celts represented by fragments is low compared to that for other Franchthi ground stone artifacts, such as millstones.⁵ This difference can at least to some degree be attributed to the small, closed, convex, and thus less vulnerable celt forms. The remaining two items listed in Table 1 (1 and 4) are celt preforms and thus neither complete nor fragmentary.

Celts were found in various trenches, both in the cave and on Paralia. Sixty-two (70%) were recovered from inside the cave, twenty-seven (30%) on Paralia (Table 1). These percentages are roughly proportionate to the volume of sediment removed from Neolithic levels in each area (76% from the cave, 24% from the Paralia).⁶ The Paralia deposits, however, produced a somewhat higher percentage of fragmentary celts: 44% of the celts recovered there are fragmentary compared to 25% of those found inside the cave. If not accidental, the relatively high percentage of fragmentary celts excavated on Paralia might indicate a possible preference for discarding broken celts in this part of the site. Given the nature of occupation on Paralia during certain phases of the Neolithic, however, it is equally possible that some fragmentary celts might have been deposited there as fill (e.g., floorings) or as secondary discard.⁷

No celts were found in pre-Neolithic deposits and there is no indication that the pre-Neolithic people of Franchthi produced or used such tools. All the celts were found in undisturbed or mixed Neolithic deposits. Association with dated ceramics⁸ allowed the assignment to specific Neolithic phases of only thirty-seven of the celts (42%). Twenty-two of these dates are relatively certain, the remaining fifteen probable.⁹ The chronological distribution of the thirty-seven dated celts shows a high concentration in MN deposits (see Table 1). This concentration cannot be considered the result of excavation biases,¹⁰ and may reflect a more intensive use (and subsequent discard) of celts during this particular period.

3. All references to celts below, however, are to the eighty-nine tools only. These tools are organized in Table 1 according to preservation, with complete celts followed by fragmentary examples.

4. Pers. comm., July 1997.

5. More than 75% of the Franchthi millstones are fragmentary (*Franchthi* 17, in prep.).

6. *Franchthi* 12, pp. 28–29; William R. Farrand, pers. comm., January 1998.

7. E.g., during the EN phase. See *Franchthi* 8, pp. 45–47.

8. See *Franchthi* 8, pp. 37–87; *Franchthi* 10, pp. 7–21.

9. In Table 1 the probable dates are given in parentheses.

10. According to Perlès (*Franchthi* 15, in press), the largest volume of excavated Neolithic sediments derives from EN levels, with sediments of MN date following closely behind.

A look at the distribution of the dated celts in the two portions of the site reveals interesting patterns. Paralia yielded sixteen of these celts, distributed evenly among the EN, MN, and FN periods.¹¹ If this distribution is representative, it suggests that there is no MN concentration of celts on Paralia. The twenty-one dated celts recovered from inside the cave come from MN, LN, and FN levels, with the majority coming from MN. The large number of MN celts found within the cave may suggest that during this period the activities involving celts tended to take place inside the cave. The fact, on the other hand, that no specimen from the cave predates the MN period (Table 1) is a possible indication that prior to this time these activities took place outside the cave on Paralia. This distribution of the dated celts by and large parallels the distribution of the dated millstones from Franchthi.¹² This similarity reinforces the impression that the two distributions, rather than being accidental, represent the behavior of the people who produced, used, and discarded the tools.

It has proven impossible to distinguish any chronologically meaningful morphological or functional groups within the celt assemblage. This might be due to the limited number of available dates or to the conservative nature of the material itself. If the latter is true, then this assemblage is not different from other Aegean Neolithic celt assemblages, which, as pointed out by Perlès, show little significant variation through time.¹³ Whatever the case, in this presentation all items in the celt assemblage are treated together regardless of their date. I distinguish, nevertheless, two groups on the basis of a cluster analysis of the three basic dimensions (length, width, and thickness) of the fifty-nine complete celts. The first group includes thirty-nine small specimens (length < 4.6 cm), while the second comprises twenty larger specimens (length > 4.6 cm). I will refer below to the members of the first group as “small celts” and to those of the second group as “larger celts,” but there is no evidence that this simple distinction corresponds to any *emic* classifications.

RAW MATERIAL AND MANUFACTURE

According to several geologists who have conducted macroscopic analyses,¹⁴ serpentinite is by far the dominant raw material used in the manufacture of celts at Franchthi (sixty-six cases, or 74% of the sample).¹⁵ It appears in a variety of tones of green and gray. Peridotite, basalt, and diabase are represented by four or five specimens each, while steatite is represented by two specimens. A variety of other raw materials (andesite, felsite porphyry, argillite, diorite, magnetite, limestone, and sandstone) are represented by one specimen each (Table 1). Apart from the medium-grained peridotite of 1 and 2, all the stones used are fine-grained. They generally measure no more than 4 on the Mohs hardness scale, although three exceptions exist: the hardness of the diabase used in 3 is 7, while that of the andesite of 4 and the peridotite of 2 is 5. The softness of the raw material suggests that the celts were relatively easy to shape but quite vulnerable in the context of any use that involved high pressure or percussion. It should be noted, though, that most of the other stones used are generally tougher,

11. No trace of LN activity has been found on Paralia (*Franchthi* 10, p. 18).

12. *Franchthi* 17.

13. Perlès 1992, p. 141; 2001, p. 236. For specific assemblages, see Moundrea-Agrafioti and Gnardellis 1994, p. 197; Perlès 1981, p. 199; Warren 1968, p. 239, n. 1.

14. As recorded in the Franchthi Cave inventory notebooks.

15. The preference for serpentinite is not limited to Franchthi. Serpentinite (and greenstone in general) has been widely used for the manufacture of Aegean Neolithic celts (see Moundrea-Agrafioti 1996, p. 104; Perlès 2001, p. 232).

TABLE 1. CELTS FROM FRANCHTHI CAVE

<i>Cat. No.</i>	<i>Inv. No.</i>	<i>Prov.</i>	<i>Pres.</i>	<i>Material</i>	<i>Date</i>	<i>L</i>	<i>W</i>	<i>Tb</i>	<i>L/W</i>	<i>W/Tb</i>
2	FS 227	C	c	peridotite		6.9	4.0	2.8	1.72	1.42
3	FS 185	C	c	diabase		5.5	3.5	2.3	1.57	1.52
5	FS 589	P	c	steatite	FN	4.6	2.2	1.1	2.09	2.00
6	FS 755	P	c	diabase	EN	4.4	3.6	2.3	1.22	1.56
7	FS 116	C	c	serpentinite	(MN)	9.6	4.5	2.7	2.13	1.66
8	FS 117	C	c	serpentinite		7.6	4.8	2.5	1.58	1.92
9	FS 118	C	c	serpentinite		5.9	3.8	1.8	1.55	2.11
10	FS 1	C	c	diabase		6.9	4.2	2.8	1.64	1.50
11	FS 33	C	c	serpentinite	(MN)	6.5	4.1	3.0	1.58	1.36
12	FS 600	P	c	serpentinite	FN	7.0	4.2	2.9	1.66	1.44
13	FS 212	C	c	serpentinite		6.2	4.0	3.1	1.55	1.29
14	FS 23	C	c	serpentinite		6.1	4.0	2.0	1.52	2.00
15	FS 201	C	c	serpentinite		2.5	1.0	0.7	2.50	1.42
16	FS 11	C	c	serpentinite		2.2	1.1	0.7	2.00	1.57
17	FS 289	C	c	serpentinite		3.2	2.7	1.1	1.18	2.45
18	FS 363	P	c	serpentinite		2.4	2.2	0.9	1.09	2.44
19	FS 21	C	c	serpentinite	(FN)	5.8	4.0	2.2	1.45	1.81
20	FS 826	C	c	serpentinite		6.1	4.3	2.0	1.41	2.15
21	FS 153	C	c	serpentinite		4.5	3.7	2.4	1.21	1.54
22	FS 159	C	c	serpentinite	(MN)	7.1	4.5	3.1	1.57	1.45
23	FS 837	C	c	serpentinite		9.1	4.9	2.6	1.85	1.88
24	FS 893	P	c	serpentinite	EN/MN	4.0	3.7	1.8	1.08	2.05
25	FS 884	P	c	basalt	EN/MN	3.3	1.1	0.4	3.00	2.75
26	FS 226	C	c	serpentinite		7.4	4.7	3.0	1.57	1.56
27	FS 37	C	c	argillite		4.0	2.0	0.9	2.00	2.22
28	FS 902	P	c	steatite	MN	3.1	2.9	1.2	1.06	2.41
29	FS 221	C	c	felsite porphyry	FN	3.2	2.7	1.1	1.18	2.45
30	FS 52	C	c	serpentinite		4.6	3.4	1.9	1.35	1.78
32	FS 899	P	c	serpentinite	MN	3.9	3.4	1.9	1.14	1.78
33	FS 44	C	c	serpentinite		2.0	2.6	0.9	0.76	2.88
34	FS 680	P	c	serpentinite		2.4	1.5	0.8	1.60	1.87
35	FS 157	C	c	serpentinite	(MN)	2.2	1.5	0.9	1.46	1.66
36	FS 779	P	c	serpentinite	MN	4.0	2.9	1.4	1.37	2.07
37	FS 398	C	c	serpentinite	(MN)	2.6	2.3	1.2	1.13	1.91
38	FS 505	C	c	serpentinite	(MN)	3.9	3.0	1.5	1.30	2.00
39	FS 883	P	c	serpentinite	MN	2.7	1.0	0.6	2.70	1.66
40	FS 278	C	c	serpentinite		3.4	2.3	1.4	1.47	1.64
41	FS 24	C	c	diabase		3.1	2.4	1.3	1.29	1.84
42	FS 222	C	c	serpentinite		4.3	2.8	0.9	1.53	3.11
43	FS 12	C	c	serpentinite		3.8	3.0	1.2	1.26	2.50
44	FS 207	C	c	serpentinite		2.9	2.4	1.1	1.20	2.18
45	FS 219	C	c	serpentinite		4.1	2.3	1.2	1.78	1.91
46	FS 428	C	c	basalt	(MN)	4.2	3.2	1.3	1.31	2.56
47	FS 22	C	c	serpentinite		2.8	2.5	1.0	1.12	2.50
51	FS 229	C	c	serpentinite		8.4	4.9	3.7	1.71	1.32

TABLE 1—Continued

<i>Cat. No.</i>	<i>Inv. No.</i>	<i>Prov.</i>	<i>Pres.</i>	<i>Material</i>	<i>Date</i>	<i>L</i>	<i>W</i>	<i>Th</i>	<i>L/W</i>	<i>W/Th</i>
57	FS 210	C	c	serpentinite		5.3	4.0	1.8	1.30	2.22
59	FS 374	C	c	serpentinite	MN	7.1	4.3	3.0	1.65	1.43
67	FS 142	C	c	basalt		2.8	1.7	0.8	1.64	2.12
68	FS 149	C	c	serpentinite	MN	3.0	2.7	1.1	1.11	2.45
71	FS 239	C	c	serpentinite		2.2	1.1	0.5	2.00	2.20
72	FS 32	C	c	diabase		4.5	3.7	1.8	1.21	2.05
73	FS 34	C	c	serpentinite	FN	7.3	4.2	3.2	1.73	1.31
79	FS 693	P	c	diorite		6.6	3.7	2.3	1.78	1.60
81	FS 726	P	c	serpentinite	(MN)	2.2	0.8	0.7	2.75	1.14
83	FS 885	P	c	basalt	FN	4.1	1.1	0.8	3.70	1.37
84	FS 90	C	c	serpentinite		2.9	2.9	2.0	1.00	1.45
85	FS 93	C	c	serpentinite		3.0	2.8	1.2	1.07	2.33
86	FS 94	C	c	serpentinite		3.5	1.3	0.7	2.69	1.85
89	Q5S:91/19	P	c	magnetite		2.8	3.2	1.0	0.87	3.20
31	FS 751	P	f	basalt	EN/MN	5.1	3.7	2.5	n/a	n/a
48	FS 767	P	f	serpentinite		1.8	2.5	1.3	n/a	n/a
49	FS 789	P	f	serpentinite		2.0	1.4	9.0	n/a	n/a
50	FS 178	C	f	serpentinite	(MN)	2.2	1.8	1.7	n/a	n/a
52	FS 98	C	f	serpentinite	(MN)	3.5	6.0	3.3	n/a	n/a
53	FS 430	P	f	peridotite	EN	7.2	4.8	3.3	n/a	n/a
54	FS 112	C	f	serpentinite		7.1	4.2	3.2	n/a	n/a
55	FS 160	C	f	serpentinite	(MN)	4.5	4.7	2.1	n/a	n/a
56	FS 6	C	f	serpentinite		3.3	4.3	2.3	n/a	n/a
58	FS 38	C	f	serpentinite	(MN)	6.4	5.7	2.2	n/a	n/a
60	FS 737	P	f	sandstone	FN	6.3	5.2	0.6	n/a	n/a
61	FS 715	P	f	serpentinite		6.2	5.2	1.5	n/a	n/a
62	FS 838	C	f	serpentinite		6.3	5.0	2.0	n/a	n/a
63	FS 577	P	f	serpentinite		1.6	1.4	0.8	n/a	n/a
64	FA WB:28	C	f	serpentinite		3.2	1.5	0.4	n/a	n/a
65	FAN:129	C	f	serpentinite	MN	1.2	0.4	0.2	n/a	n/a
66	FF1:29	C	f	serpentinite		3.5	3.3	0.7	n/a	n/a
69	FS 180	C	f	serpentinite	MN	4.3	0.8	0.6	n/a	n/a
70	S 57	C	f	serpentinite		3.9	3.2	1.8	n/a	n/a
74	FS 385	C	f	serpentinite	LN	4.2	2.0	1.0	n/a	n/a
75	FS 425	C	f	serpentinite	MN	4.0	3.5	0.8	n/a	n/a
76	FS 436	P	f	serpentinite	(EN)	3.6	1.3	0.5	n/a	n/a
77	FS 617	P	f	peridotite		1.3	0.7	0.3	n/a	n/a
78	FS 666	C	f	limestone		3.3	2.5	0.6	n/a	n/a
80	FS 714	P	f	serpentinite		3.1	3.8	0.8	n/a	n/a
82	FS 772	P	f	serpentinite		1.2	1.1	0.6	n/a	n/a
87	H:17(A)	C	f	serpentinite		6.3	3.9	2.2	n/a	n/a
88	O5:84	P	f	serpentinite	(EN)	1.7	1.2	0.4	n/a	n/a
1	FS 311	C	n/a	peridotite	FN	7.0	4.5	3.2	n/a	n/a
4	FS 36	C	n/a	andesite		7.4	4.1	2.5	n/a	n/a

All measurements are in centimeters. Abbreviations: Prov. = provenience, Pres. = preservation, L = length, W = width, Th = thickness, L/W = length/width ratio, W/Th = width/thickness ratio, C = cave, P = Paralia, c = complete, f = fragmentary. Dates in parentheses are tentative.

and thus less brittle, than serpentinite. The thirteen complete tools made of material other than serpentinite represent both small and larger celts; no particular concentration is detectable in either group.

The main rocks used in the manufacture of celts (serpentinite, diabase, basalt, peridotite) are found in the ophiolite complex of the Franchthi-Ermioni region as well as in volcanic bodies in the Discouria hills, southwest of Ermioni, and at Vourlia, northwest of the Franchthi embayment. These rocks, however, are everywhere deeply weathered and the acquisition of large pieces of fresh material from outcrops must have been very difficult. Stream pebbles or cobbles concentrated in the float by natural processes are a more likely source.¹⁶ Such pebbles and cobbles could also have been obtained at the beach located near the site during the Neolithic.¹⁷

The hypothesis that waterworn pebbles and cobbles were used as raw material for the manufacture of celts is reinforced by the mainly curvilinear appearance of the tools. The problem with this hypothesis, as van Andel and Vitaliano have pointed out, is that sound pebbles and cobbles are now rare in the streambeds around Franchthi.¹⁸ The ancient beach, on the other hand, is today under water and thus difficult to explore. One can argue, however, following Perlès, that pebbles or cobbles suitable for the manufacture of celts might have been more abundant in the past, having been subsequently depleted by human exploitation.¹⁹ This idea seems to be supported by the findings of the Argolid Exploration Project (AEP). The project covered a much larger area than that covered by the Franchthi geological survey and located in the beds of seasonal streams cobbles that appear macroscopically to be of the same raw material as that used for the Franchthi celts.²⁰ If such stream cobbles occur today in the wider region, their scarcity in the area of Franchthi might very well be the outcome of intensive exploitation by different groups over a few millennia. Moreover, the cobbles located by AEP were small, matching the generally small dimensions of the celts from Franchthi. If the inhabitants of Franchthi collected raw materials locally, it is reasonable to assume that these materials were adequate for the purposes for which the tools were intended.

There are two celts, however, for which the use of nonlocal raw material seems likely. The first is 4, a tool made of nonporphyritic andesite. This material, used also to make two millstones at Franchthi, is not found in the Franchthi area and, as argued by Runnels, must have been imported from sources outside the region, probably in the Saronic Gulf.²¹ Interestingly enough, 4 lacks a working edge, having been left in a roughed-out state. If the raw material of 4 indeed has an exogenous origin, it is possible that the early stages of shaping (consisting of pecking and some grinding) took place at the source area away from the site. The resulting preform might have been taken to the site for the rest of the manufacturing process, which for some reason never occurred. It is significant that, as mentioned earlier, the andesite of 4 is harder (Mohs scale, 5) and tougher than the raw material used for the majority of celts. These are probably the qualities that created the incentives for importing andesite to the site.

The second example of a celt of nonlocal raw material is 5 (Fig. 6, below), whose material is macroscopically similar to that used for the large number of LN and FN opaque white beads discovered at Franchthi. The

16. See van Andel and Vitaliano 1987, p. 20; Vitaliano 1987, pp. 13–14.

17. Vitaliano n.d., p. 11.

18. See van Andel and Vitaliano 1987, p. 20.

19. Perlès, cited in van Andel and Vitaliano 1987, p. 20.

20. Kardulias and Runnels 1995, p. 111.

21. Runnels 1981, p. 104.

raw material used for these beads (and I assume also for 5) is, according to Michèle Miller, steatite that was fired.²² One of the reasons the technique of firing might have been employed, she argues, was to increase the steatite's hardness. Miller believes that the fired steatite beads were imported to Franchthi from a considerable distance.²³ It is likely that 5 was imported to the site too, especially given its FN date and unique angular plan.

Additional evidence that most celts were manufactured from waterworn pebbles or cobbles comes from examples retaining rounded waterworn cortex in their proximal area (e.g., 6). The cortex was retained as this area was left untreated, not interfering with the intended shape of the tool. Furthermore, as mentioned earlier, excavation inside the cave uncovered one small unworked water-rolled serpentinite cobble, which might have been collected and brought to the site to be converted into a celt. Finally, if the three fragments of serpentinite cobbles with traces of pecking indeed represent remains of accidents that occurred during the celt manufacturing process, they may also constitute evidence for the use of waterworn cobbles as celt blanks.

Several concerns must have informed the selection of particular pebbles or cobbles as celt blanks, the most crucial of which was to find stones with physical properties adequate for the intended finished products. Probably another concern was to use stones with shapes and dimensions close to those of the desired tools—a rational choice that could save time and energy during manufacture.²⁴ It is also likely that some effort was put into finding blanks that during manufacture would acquire a glossy appearance. The lack of uniformity in the appearance of the Franchthi celts reflects not only a wide range of functional variation, but also the uniqueness of each pebble or cobble used. Moreover, it suggests that the tools were not produced by specialists and that strict norms as to how the celts should look did not exist.

The pebbles or cobbles were transformed into tools (or at least their stone components) by the use of two manufacturing techniques: pecking and grinding.²⁵ With the exception of 7 (Fig. 4), no celt shows evidence of flaking. Celt 7, the longest tool in the group, has a flake scar on one face in the area of the working edge. Light flaking is also responsible for the creation of a kind of waist in the proximal part of the tool, a unique trait in this collection. These deviations from the “norm” might be signs of an exogenous origin, although, it must be stressed, the raw material of this tool is serpentinite with the same appearance and hardness as most other Franchthi celts. Theoretically, it is possible that flaking was a technique used regularly in the manufacture of celts at Franchthi and that flake scars were obliterated by the subsequent treatment of the surface of these tools. I consider this hypothesis unlikely, however, given that the raw material used does not lend itself easily to flaking. Moreover, its softness makes flaking unnecessary.²⁶

The initial shaping of celts thus involved pecking, for which hammerstones must have been used. It appears, however, that pecking was not employed universally. The lack of evidence for pecking on most small celts, rather than being the result of obliteration by subsequent grinding, most likely reflects the omission of a pecking stage. Such a choice can be easily

22. Miller 1998.

23. Miller 1998.

24. For ethnographic support of this hypothesis, see, for example, the account of stone celt manufacture among the Héta Indians of southern Brazil (Kozák 1972, p. 18).

25. These two techniques have been commonly used in the manufacture of Aegean Neolithic celts (Moundrea-Agrafioti 1996, p. 104; Perlès 2001, p. 233).

26. Celts at Franchthi are not atypical of Aegean Neolithic celt assemblages in this aspect either; flaked celts have rarely been detected in Aegean Neolithic samples (Perlès 2001, p. 233).

explained: grinding alone would have been sufficient to give the desired size and shape to the small, soft pebbles used for small celts. Moreover, pecking small pebbles must have been inconvenient, since they would have been hard to hold and strike with hammerstones larger than themselves.

Unlike the small celts, most of the larger celts were pecked into shape, a technique to be expected given that grinding alone would have been very time-consuming in shaping a larger pebble or a cobble. A combination of pecking and grinding would have offered a labor-saving advantage. The extent of the evidence for pecking on the surface of the larger celts varies. In a small number of celts the pecking marks are almost undetectable, having been largely eliminated by the subsequent treatment of the tools' surface (see, e.g., Fig. 4: 8). In one celt, 7 (Fig. 4), pecking traces related to the original manufacturing process cover almost all of one face. The majority of the larger celts, however, exhibit pecking marks mainly on their proximal area or their sides (e.g., Fig. 4: 9, 10, 11). The presence of pecking marks on the proximal part or the sides has to do with the fact that these areas were often left only partially ground or unground. The differential treatment of the distal and proximal parts of the larger celts saved time without jeopardizing the tools' efficacy, since it was only the area of the working edge that had to be ground in order to reduce friction against the worked material.²⁷ Moreover, the makers of these tools may well have decided not to grind an area that would be inserted into a handle and thus invisible, a decision that would not diminish the aesthetic appeal of these objects. Finally, this treatment may have had a specific technical purpose: to leave a rough or semirough surface that would allow a more secure attachment of the stone blade to its handle.²⁸ One wonders, though, why the proximal part was left in a rough or semirough state in some tools but not in others. Did this differential treatment have to do with time pressure, personal preference,²⁹ or the kind of hafting device used?

Grinding was the second manufacturing stage for the larger celts though the sole method used for the vast majority of the small ones. This process served to create an acute edge at one end of the celt as well as a smooth and often glossy body texture. As experimental work and ethnographic research suggest,³⁰ grinding must have taken place with the help of water on passive abrasive surfaces. The water is essential in this process: on the one hand, it washes away the detritus formed during grinding and, on the other, it prevents overheating that can cause edge chipping and flaking.³¹ At Franchthi, passive abrasive surfaces could have been provided by millstones, a substantial number of which were excavated. As I have

27. See Dickson 1981, pp. 33, 99; O'Hare 1990, p. 130.

28. See Dickson 1981, p. 32; Kozák 1972, p. 21; O'Hare 1990, p. 130. Cf. Ricq-de Bouard and Buret (1987, pp. 178–180), who, on the basis of their study of celts from Mediterranean France, argue that the presence of "residual" pecking probably has more

to do with the raw material used each time than with hafting.

29. According to Blackwood (1950, p. 16), the differences in the extent of grinding of "adzes" among the Kukukuku of New Guinea "appear to be due more to the personal equation rather than to the kind of stone used."

30. E.g., Blackwood 1950, p. 15;

Dickson 1972, p. 208; 1981, pp. 42–44, 151–156; Hampton 1999, pp. 93–97; Nami 1984, p. 104; Pétrequin and Pétrequin 1993, pp. 181–194; Toth, Clark, and Ligabue 1992, p. 91; Townsend 1969, p. 200; Vial 1940–1941, p. 159.

31. Dickson 1981, p. 41; Nami 1984, p. 104.

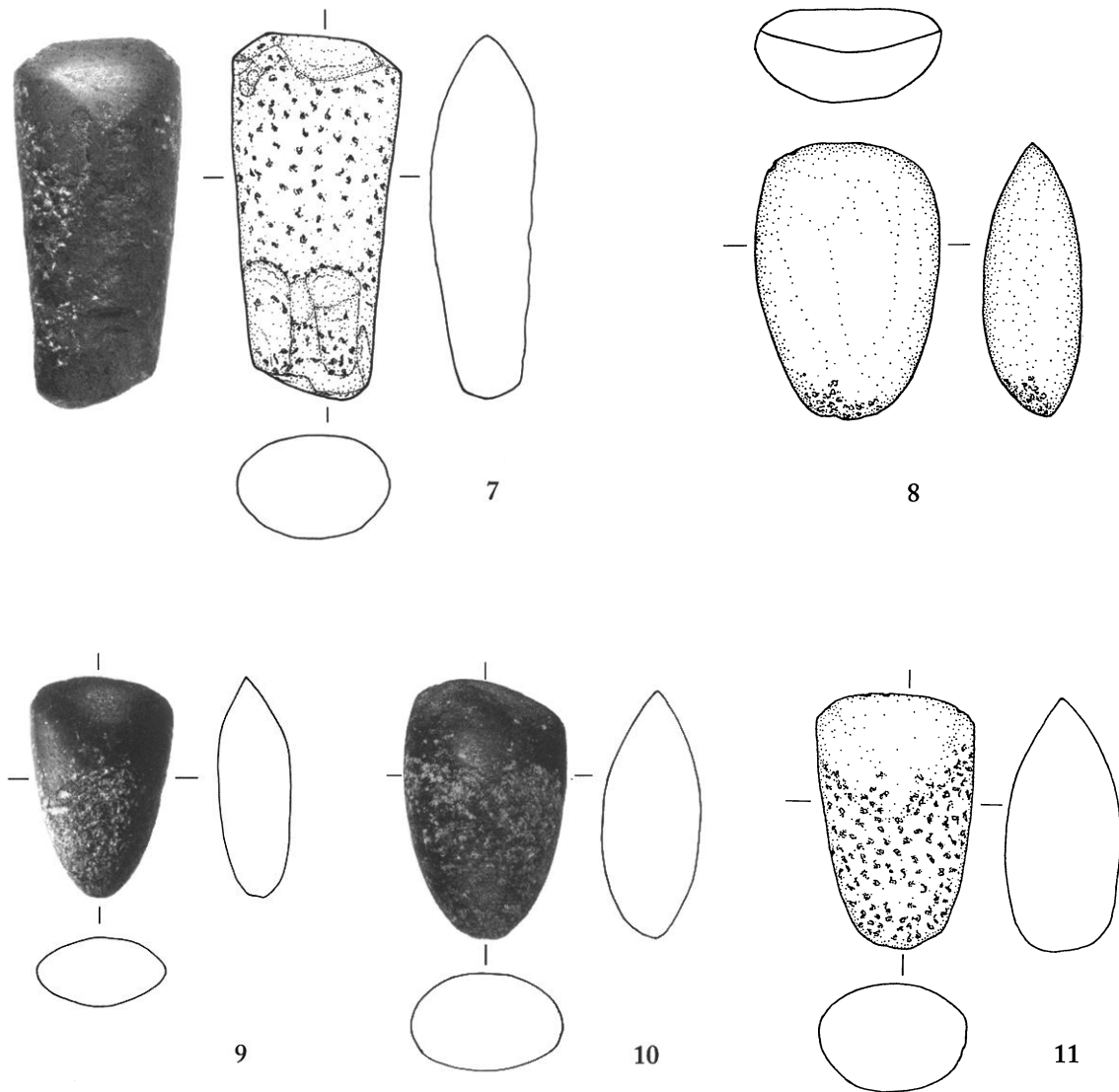


Figure 4. Large celts 7, 8, 9, 10, 11.
Scale 1:2

argued elsewhere,³² the size of the Franchthi millstones seems inadequate for processing cereals, but is suitable for grinding stone tools and other artifacts. Moreover, the use wear on certain millstones points to the possibility of their use in grinding celts.³³ Only one example of a spatial association between a celt and millstone is known, however, and even in that case a functional association between the two is doubtful.³⁴ No bedrock grooves or “cup marks” that might be linked with grinding celts have been identified at Franchthi.³⁵

32. Stroulia 1999. See also Runnels 1981, pp. 148–154; 1985, pp. 33–34.

33. See Runnels 1981, pp. 148–154; 1985, pp. 33–34.

34. Cf. Runnels (1981, p. 149), who finds a functional association between the two likely.

35. Such cup marks or grooves are often mentioned in the literature (see Anderson 1890, p. 74; Dickson 1972, pp. 208–209; 1981, pp. 42–44; Hampton 1999, pp. 69, 93–97). At Franchthi, circular cup marks were found on a natural boulder at the

mouth of the cave but, according to Curtis Runnels, who examined them (pers. comm., April 2002), these features are not suitable for the manufacture or resharpening of celts.

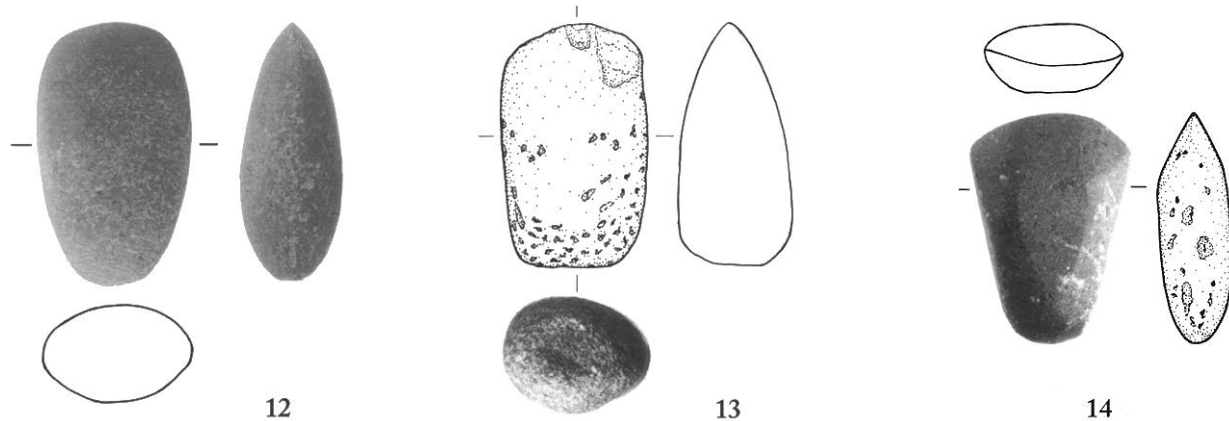


Figure 5. Large celts 12, 13, 14.
Scale 1:2

If we leave aside the angular-looking and possibly exogenous 5, grinding in general created rounded faces that meet the sides of the celts smoothly (see Figs. 4–5: 10, 12, 13). In a few cases, however, it formed light facets (as in Fig. 4: 8) or stronger facets (as in Fig. 5: 14). In particular, strong faceting is evident on some of the smallest celts (see Fig. 6: 15, 16). The faceting in these tools probably has to do with their small size: only a small surface could at any one time be exposed for grinding.

Given the glossiness that characterizes most of the celts, it is likely that the last stage of grinding involved a fine abrasive: fine, soft sandstone, clay, or ocher.³⁶ In fact, one of these tools, 17, has a subtle reddish coloration on its body, which may represent traces of clay or ocher used in this last stage.³⁷ The makers of these tools might have also rubbed them with a piece of leather to achieve the same effect.³⁸

Apart from serving as an indispensable stage in the celt manufacturing process, grinding also served to rejuvenate a dull edge after a tool had been utilized. Grinding in this case resulted in unifacial or bifacial beveling next to the edge—the diagnostic trait of resharpening (see Fig. 6: 5, 15, 16, 18). It is also possible, if untraceable, for the whole tool to have been reground in the course of resharpening the edges, especially if there was a need to redefine the tool's proportions.

Pecking was also sometimes used after grinding (and utilization) of the celt had already taken place. It is possible to distinguish two cases of this secondary pecking. In the first case, pecking removed the smooth ground surface in an area beginning at the proximal end of the tool and reaching up to the middle of the body or even higher (see Figs. 7, 9: 19, 20, 21, 22). This kind of pecking might have been intended to redefine the shape or proportions of a tool that for one reason or another had become dysfunctional or to make it fit a particular handle.³⁹ In the second and rarer case, pecking roughened up the smooth ground surface of only the sides of the celt, perhaps again as part of an effort to facilitate its secure adjustment to the handle (see Figs. 5, 8: 14, 23).

In a single case, 24 (Fig. 9), the grinding of the tool and the creation of a sharp working edge were followed by an intentional unifacial retouch that formed a serrated edge. The retouch was most likely accomplished by pressure rather than percussion.

36. For sandstone, see Dickson 1981, p. 156. My own experiments indicate that clay is a quite good polishing agent. For an ethnographic example of clay used in this context, see also Kozák 1972, p. 20.

37. Red pigment, though, could also have been used for strictly decorative purposes (see Hampton 1999, p. 87).

38. See experiments by M'Guire (1892, p. 169) and Nami (1984, p. 104).

39. See also Moundrea-Agrafioti 1981, p. 183.

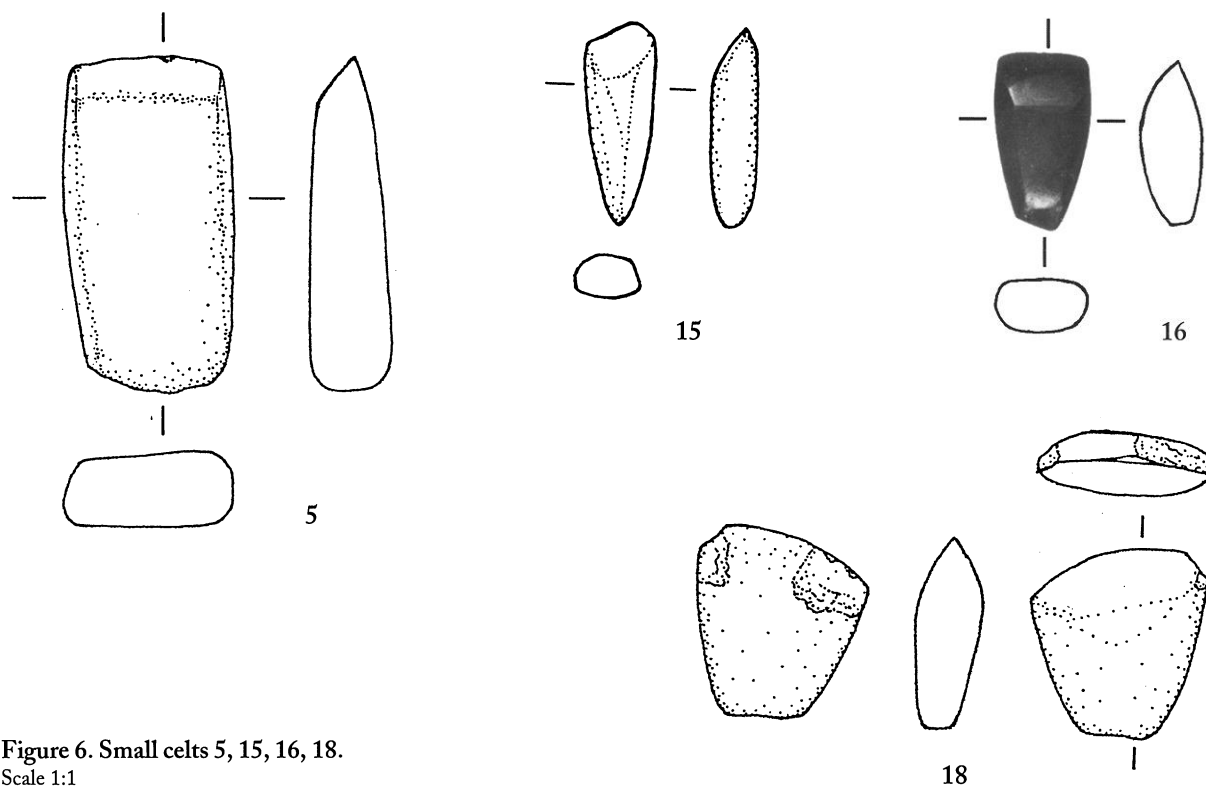
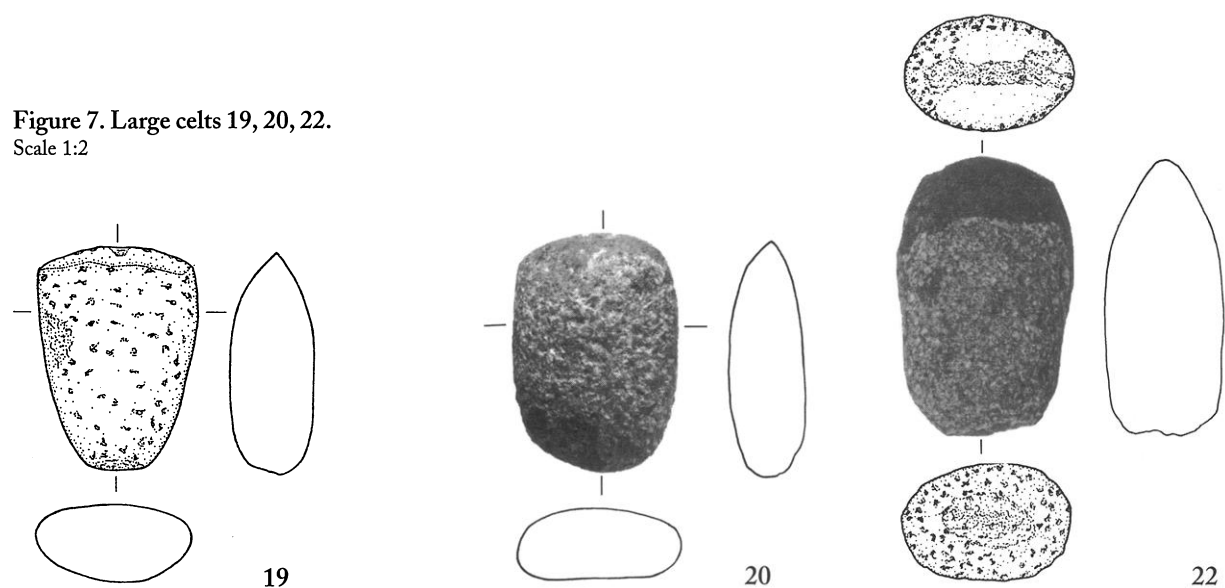


Figure 7. Large celts 19, 20, 22.
Scale 1:2



The process of making a celt must have been completed with the manufacture of a haft and the adjustment of the stone blade into it. Four antler sleeves constitute the only direct evidence of hafting recovered at Franchthi.⁴⁰ Three of them, however, are not preserved well enough to be useful in this discussion. The fourth indeed has a socket, but it is too small to fit even the smallest celt and must then have been used for other kinds of tools (e.g., chipped stone or bone tools). The scarcity of antler sleeves in the archaeological record at Franchthi indicates that this hafting device was not commonly used at this site, and by extension that the hafts of the celts (and other tools) were most often made of wood. The stone blades could have been adjusted to the hafts directly or with the aid of some binding material (e.g., leather, vine strips) or adhesive substance (e.g., resin, beeswax), all perishable materials and thus presently inaccessible.⁴¹

For reasons explained above, the following configurations can be considered indirect evidence for hafting larger celts: an unground or semi-ground surface in the proximal area (see Fig. 4: 10, 11); or, in the same area, a ground surface roughened by secondary pecking (see Figs. 5, 7–9: 14, 19, 20, 21, 22, 23).⁴² We do not know the mode of hafting but we can assume that the handle was placed in the long axis of the stone head, parallel or perpendicular to it.

If the raw material for celts was indeed found locally, I would suggest that the manufacture of small celts—requiring, with three or four exceptions, only the grinding of a small pebble—took place on the site; the large number of millstones discovered and the availability of water resources at Franchthi make this a likely scenario.⁴³ The hypothesis is further supported by evidence of a particular kind of celt grinding—resharpening—which, as a tool maintenance technique, had to have taken place on the site. For the same reasons, the grinding of larger celts also probably occurred locally, a likelihood strengthened by the discovery of two preforms (1 and 4) that were probably intended to go through a grinding stage on the site.

But where was the pecking of larger celts taking place? Pecking of celt blanks could have been done on the site, as indicated by hammerstones discovered during the excavations.⁴⁴ The one complete, unworked serpentinite cobble, if it is a celt blank, may suggest that cobbles were taken to the site to be transformed into celts. If the three fragments of pecked serpentinite cobbles (see above) are remains of accidents that occurred during the pecking stage, they too may support the hypothesis that pecking was carried out at Franchthi. Finally, the evidence of secondary pecking (which, like resharpening, must have taken place at the site), suggests that pecking was probably a manufacturing stage that occurred on site.

The discovery of only one complete unworked cobble perhaps attests to a tendency to collect celt blanks only when needed, and thus to an expedient technology. Otherwise one would expect to find a number of pebbles or cobbles waiting to be converted into celts. There is, of course, the possibility that a specialized celt production area existed at Franchthi and that the excavations did not uncover it. The lack of morphologically homogeneous groups and standardization in the context of the celt industry, however, argues against this hypothesis.

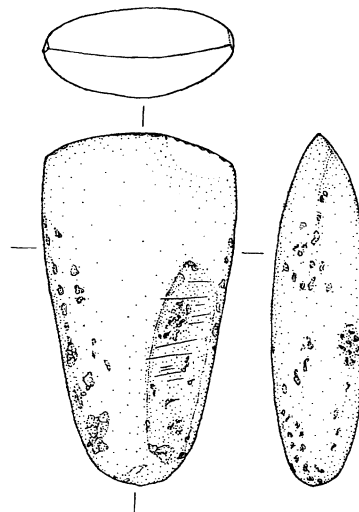


Figure 8. Large celt 23. Scale 1:2

40. This number refers to the inventoried specimens only.

41. For archaeological, experimental, and ethnographic information about different celt-hafting techniques, see Becker 1945; Blackwood 1950, pp. 21–22; Carneiro 1974, pp. 110–111; 1979, pp. 24–27; Dickson 1981, pp. 158–167; Godelier and Garanger 1973, pp. 198–200; Hampton 1999, pp. 72–88; Heider 1967, p. 56; Hellweg 1984, p. 98; Kozák 1972, pp. 21–22; Malinowski 1934, p. 191; Moundrea-Agrafioti 1987; Müller-Beck 1965, pp. 13–49; Pétrequin and Pétrequin 1993, pp. 43–59; Pond 1930, pp. 93–94; Schoen 1969, p. 18; Sillitoe 1988, pp. 43–50; Steensberg 1980, pp. 5–24; Toth, Clark, and Ligabue 1992, p. 92; Tsountas 1908, pp. 316–322.

42. According to Ricq-de Bouard and Buret (1987, p. 181), of the two treatments only the one involving secondary pecking is related to hafting.

43. The water could have been supplied by either the small pool at the rear of the cave or the now-submerged springs at the Franchthi shore (*Franchthi* 7, p. 5; van Andel and Vitaliano 1987, p. 18).

44. These tools, however, are likely to have served a variety of percussive purposes.

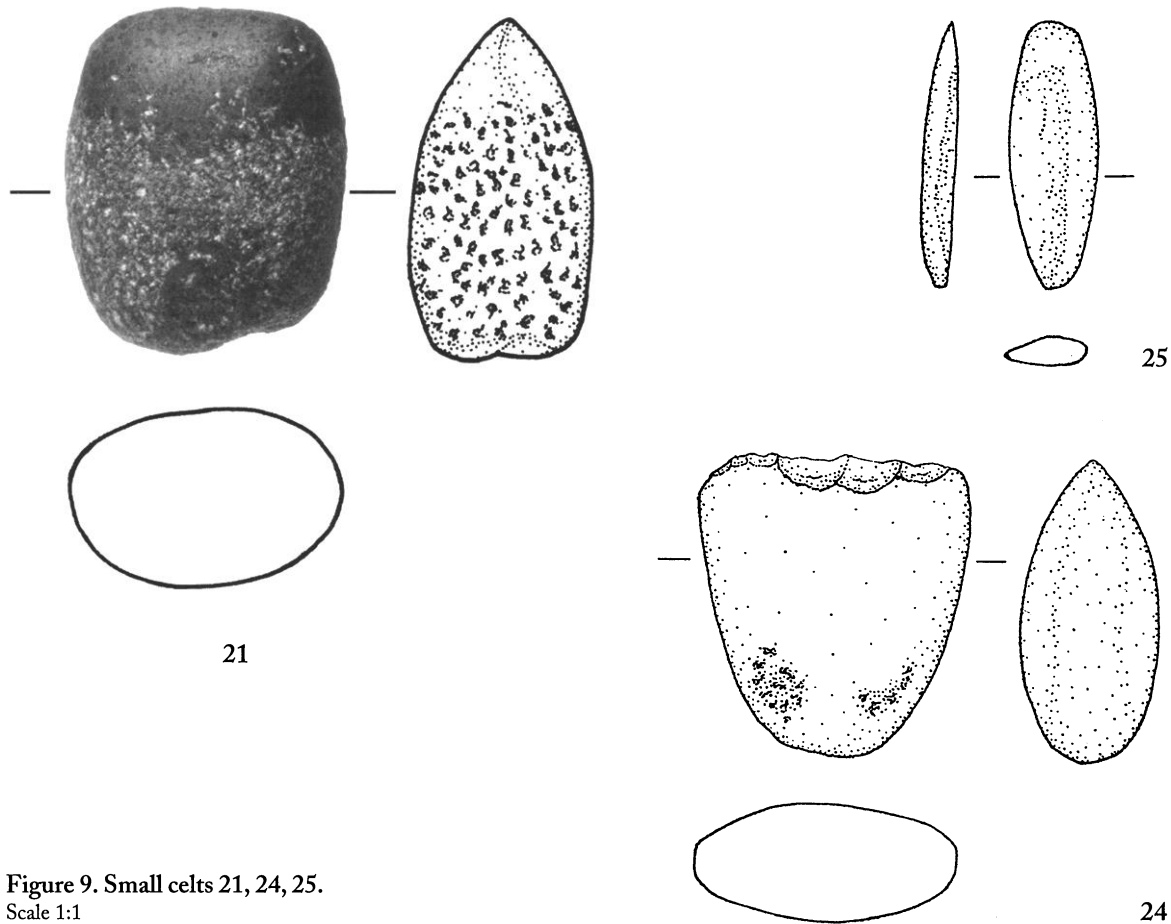


Figure 9. Small celts 21, 24, 25.
Scale 1:1

The absence of evidence for a celt workshop on the site does not necessarily imply a lack of specialization by gender in the manufacture or use of these tools; such specialization is known ethnographically in many contemporary New Guinea groups.⁴⁵ Such a hypothesis for Franchthi, though, is for the moment untestable. It is, moreover, possible that the Franchthi people who were involved in the production of celts were also involved in the manufacture of serpentinite ornaments and other serpentinite tools, although again evidence for or against such a hypothesis has not been identified.

Finally, the two tools made of nonlocal raw material deserve comment: 5, of fired steatite, was probably imported to the site in a finished state, perhaps through the same networks in which the opaque white beads noted above circulated. This suggests that a small number of celts entered the site in a finished form. A few others seem to have reached the site in a roughed-out form, as is suggested by 4, a celt preform made from a nonlocal, nonporphyritic andesite. The initial shaping of 4 could have been completed at the andesitic source by residents of Franchthi or by people who were in direct or indirect contact with them. This tool could have come to the site through the same trajectories as the two Franchthi millstones made of nonporphyritic andesite. This suggestion, however, can only remain tentative, since it is unknown if these two millstones and 4 are contemporary.

45. See Pétrequin and Pétrequin 1993, pp. 78–81; Sillitoe 1988, p. 43.

TECHNOMORPHOLOGICAL ASPECTS

The fifty-nine complete celts from Franchthi range in length from 2.0 to 9.6 cm. Sixty-six percent fall into the 2.0–4.6 cm range, 29% are between 5.3 and 7.6 cm long, and 5% fall between 8.4 and 9.6 cm. The heavy concentration of tools in the shortest range is reflected in the average length of 4.54 cm ($\sigma = 1.95$) (Fig. 10:a). The above distribution indicates that the celts from Franchthi are on the whole shorter than other Aegean Neolithic celt assemblages.⁴⁶ There are, nevertheless, two fragments that may have been part of complete celts measuring 10.0 cm long or longer,⁴⁷ leaving open the possibility that a few celts longer than those represented among the complete tools were at some point used at Franchthi. A comparison of the lengths of the complete celts recovered inside the cave with those of celts found on Paralia shows a high concentration of longer celts in the cave; 90% of celts longer than 4.6 cm were excavated there (Table 1). This distribution might reflect differential use of the cave and Paralia in relation to these tools.

The complete celts range in width from 0.8 to 4.9 cm. The majority (59%) fall into the 2.2–4.0 cm range. Of the remaining celts, half are between 0.8 and 2.0 cm wide and the other half are between 4.1 and 4.9 cm wide. The average width of the complete celts is 3.01 cm ($\sigma = 1.15$), less than that of other celts in Aegean Neolithic celt assemblages⁴⁸ (Fig. 10:b). Five fragmentary celts are wider than any of the complete celts,⁴⁹ however, which suggests that the widths of the complete celts might not be representative. Only 6% of the complete celts found on Paralia are wider than 4.0 cm, in contrast to 25% of those found inside the cave. In general, smaller tools appear to have been used on Paralia.

The complete celts from Franchthi range in thickness from 0.4 to 3.7 cm. Sixty-four percent are between 0.4 and 1.5 cm thick. The rest have a thickness ranging from 1.8 to 3.7 cm. The average thickness is 1.67 cm ($\sigma = 0.85$) (Fig. 10:c). The celts from Franchthi are in general thinner than other Aegean Neolithic celts.⁵⁰ Half of the complete celts found inside the cave have a thickness of 1.5 cm or less versus two-thirds of those found on Paralia.

How can the small size—as expressed especially in length—of a large number of the celts be explained? This trend seems even odder in light of the tools' generally good condition and sharp working edges, features that imply that the celts entered the archaeological record when they were still functional. It is tempting to see the small size of these tools as a result of repeated resharpening, which seems to be suggested by their generally low length/width ratio (average length/width ratio: 1.59 ($\sigma = 0.55$) (Fig. 10:d). There are, however, at least three problems with this hypothesis. First, there are highly significant correlations among the three basic dimensions (length, width, thickness) of the complete celts (Table 2), suggesting that resharpening was not practiced intensively enough to have a dramatic impact on the proportions of these tools. Second, the correlation between the length and length/width ratio is not significant (Table 2), which explains why some relatively long celts (e.g., Fig. 7: 22) have a very low length/width ratio while some very short celts (e.g., Fig. 9: 25) have a very high

46. Moundrea-Agrafioti (1981, pp. 199–200) notes that 63% of the Thessalian celts studied have a length between 4.0 and 8.0 cm, while 13% of the sample are longer than 8.0 cm. Of the forty-five complete celts reported from Neolithic Knossos (Evans 1964), only a third are equal to or less than 4.6 cm in length. Of the sixty-five celts listed from Olynthus, only 11% are 4.6 cm or less long, the rest ranging in length from 4.9 to 13.0 cm (Mylonas 1929, pp. 71–72). Of the forty-four celts listed from Dikili Tash, 43% have a length equal to or less than 4.6 cm (Séfériades 1992, pp. 87, 93). The average length of the seventy-two complete or almost complete celts from Servia is over 7.5 cm (Mould, Ridley, and Wardle 2000, pp. 129–136). See, however, the eight celts from Kitsos, seven of which are between 2.8 and 3.8 cm in length (Perlès 1981, p. 198).

47. I am referring here to 53 and 54 (Fig. 15).

48. For example, the average width of the Thessalian celts studied by Moundrea-Agrafioti is ca. 4.0–4.5 cm (Moundrea-Agrafioti 1981, pp. 200–201).

49. I am referring here to 52, 58 (Fig. 15), 60, 61, and 62.

50. For example, only 41% of the Thessalian celts examined by Moundrea-Agrafioti have a thickness of 1.5 cm or less (Moundrea-Agrafioti 1981, pp. 201–202).

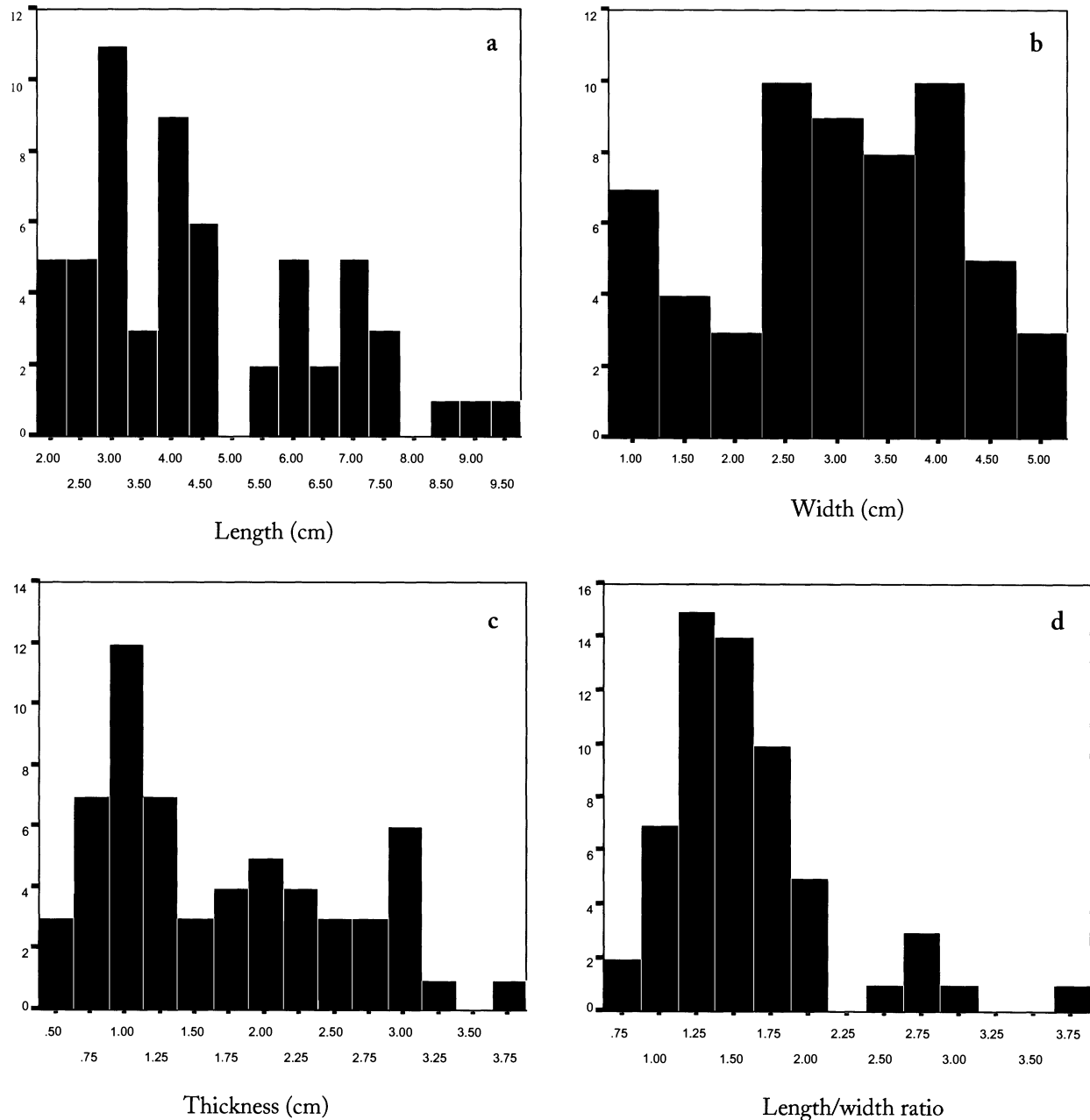


Figure 10. Frequency distributions of complete celts ($n = 59$) by (a) length ($\sigma 1.95$, mean 4.54); (b) width ($\sigma 1.15$, mean 3.01); (c) thickness ($\sigma 0.85$, mean 1.67); and (d) length/width ratio ($\sigma 0.55$, mean 1.59)

length/width ratio (Table 1). Third, and most important, the resharpened tools account for only about half of the thirty-nine small celts and there is no difference in the average length/width ratio between those that were resharpened and those that were not.

Among the small celts, the resharpened tools are as a rule the shortest (average length of resharpened small celts: 2.9 cm; average length of those not resharpened: 3.7 cm). Though it might thus be argued that the very short length is the result of resharpening, the proportionately small width and thickness make it unlikely that these specimens were initially much longer. It is, therefore, more reasonable to assume that the size of the small celts is primarily a manufacturing choice, presumably determined by the

TABLE 2. PEARSON CORRELATIONS OF DIMENSIONS OF COMPLETE CELTS

		<i>Length</i>	<i>Width</i>	<i>Thickness</i>	<i>L/W Ratio</i>	<i>W/Th Ratio</i>
Length	Pearson Correlation	1	0.845*	0.877*	0.085	-0.418*
	Sig. (2-tailed)	—	0.000	0.000	0.522	0.001
	N	59	59	59	59	59
Width	Pearson Correlation	0.845*	1	0.896*	-0.424*	-0.186
	Sig. (2-tailed)	0.000	—	0.000	0.001	0.158
	N	59	59	59	59	59
Thickness	Pearson Correlation	0.877*	0.896*	1	-0.184	-0.557*
	Sig. (2-tailed)	0.000	0.000	—	0.164	0.000
	N	59	59	59	59	59
L/W Ratio	Pearson Correlation	0.085	-0.424*	-0.184	1	-0.371*
	Sig. (2-tailed)	0.522	0.001	0.164	—	0.004
	N	59	59	59	59	59
W/Th Ratio	Pearson Correlation	-0.418*	-0.186	-0.557*	-0.371*	1
	Sig. (2-tailed)	0.001	0.158	0.000	0.004	—
	N	59	59	59	59	59

* Correlation is significant at (at least) the 0.01 level (2-tailed).

ways in which these tools were used. Equally interesting is the scarcity of evidence for resharpening the larger celts, which suggests that these tools were not used intensively enough to require resharpening. It also suggests that the small celts are not the last stage in the history of use of larger celts; in other words, there is no continuity between larger and small celts.

It is possible to construct small groups of tools with similar shapes and sizes, although at present no chronological significance can be attached to these groups. The preferred shape in plan view for the celts is (sub)triangular, with thirty-two instances among the fifty-nine complete celts (54%). In these tools the maximum width coincides more or less with the working edge. Celts of all sizes were made in this shape (see, e.g., Figs. 5, 8, 12, 13: 14, 23, 26, 33). The next most popular shape among the complete specimens is (sub)rectangular, with sixteen instances (27%) (see, e.g., Fig. 13: 27). Six complete celts (10%) have a (sub)trapezoidal shape (e.g., 28), whereas five (8%) have an ovoid shape (see, e.g., Fig. 5: 12). A preference for a (sub)triangular shape, at least as far as the larger celts are concerned, may be explained by the fact that during use a tapered stone blade wedges itself more tightly, and thus more securely, into the handle than stone blades of other shapes.⁵¹ It must be noted, however, that this is not true for all hafting devices.⁵²

The width/thickness ratio of the complete celts ranges from 1.14 to 3.20 with an average of 1.93 ($\sigma = 0.47$) (Table 1, Fig. 11). The majority of complete celts (56%) have a width/thickness ratio between 1.84 and 3.20, and thus are flattish. The remaining complete celts have a ratio of 1.81 or less, and thus are massive. Most of the small celts are flattish (e.g., Fig. 13: 27, 29), while most of the larger celts are massive (e.g., Fig. 5: 12).

Only seven celts from Franchthi have strongly asymmetrical profiles (see, e.g., Figs. 5–6, 12–13: 5, 14, 15, 30, 31). Five of these are, or come

51. See Dickson 1981, p. 60.

52. C. Perlès (pers. comm., September 2000).

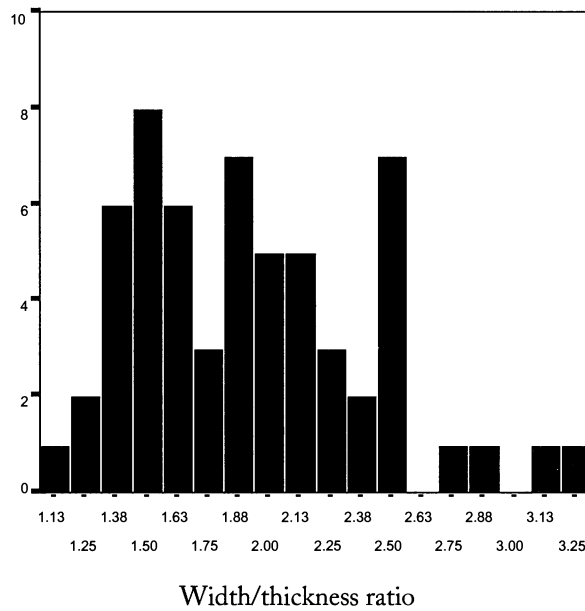


Figure 11. Frequency distribution of complete celts ($n = 59$) by width/thickness ratio ($\sigma 0.47$, mean 1.93)

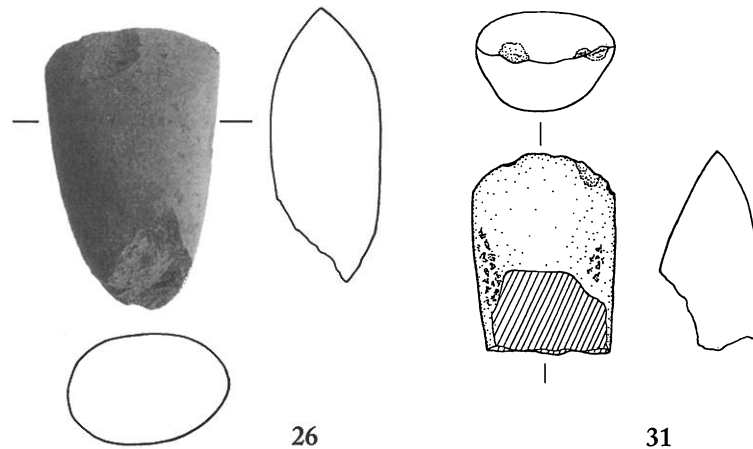


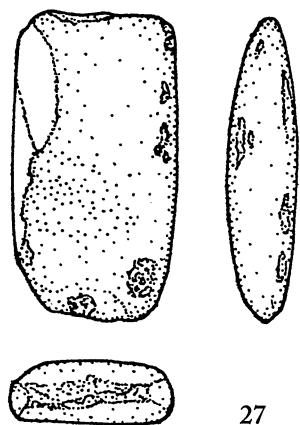
Figure 12. Large celts 26, 31.
Scale 1:2

53. According to this definition, an axe has a symmetrical profile and a haft fixed parallel to its working edge, while an adze has an asymmetrical profile and a haft fixed perpendicularly to its edge. On the inadequacy of this definition, see accounts of modern New Guinea groups who haft their stone blades indiscriminately as adzes or axes, depending on what is needed at the time or in such a way that they can be rotated within the handle (Heider 1967, p. 56; Malinowski 1934, p. 191; Sillitoe 1988, pp. 43–44).

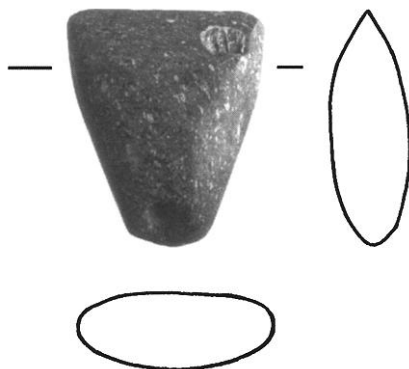
54. Dickson 1972, p. 209; 1981, pp. 45, 102.

from, larger celts. On the other hand, only three celts have an absolutely symmetrical profile: 11 (Fig. 4), 12 (Fig. 5), and 32 (Fig. 13). Most celts are indeed slightly asymmetrical in profile (see, e.g., Fig. 4: 9). Very few celts, therefore, fit perfectly the classic definition of “axe” and “adze.”⁵³ On this basis, I would assume that most of the time there was no great concern with celt profile symmetry on the part of the Franchthi people.

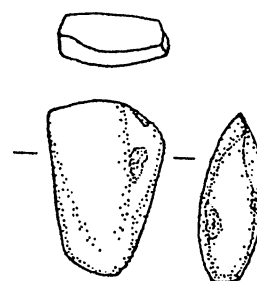
The majority of celts have a convex working edge in plan view (e.g., Figs. 4–5, 8–9: 8, 14, 21, 23). The predominance of this edge shape can be traced to the raw material itself: a convex edge follows the curvilinear shape of the pebbles or cobbles that served as celt blanks. More importantly, however, the convex edge offered a significant technical advantage, since an angular connection of the working edge to the sides of the celt could have created fatal points of stress during use.⁵⁴ A few celts have a straight edge in plan view. All of them belong to the group of small celts (e.g.,



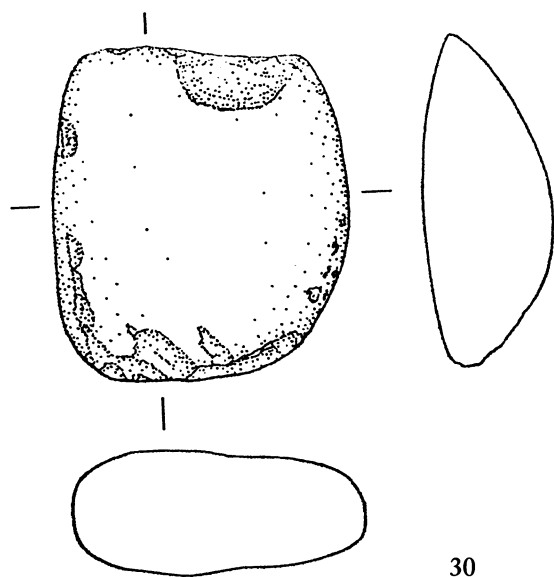
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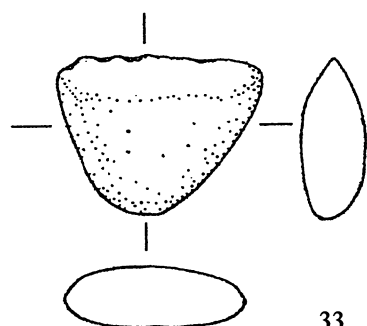
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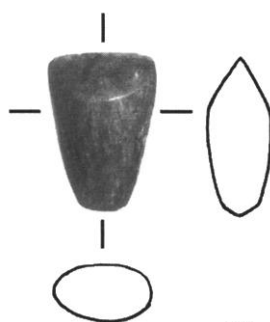
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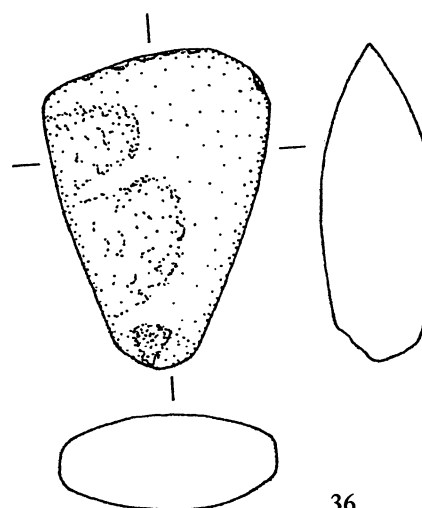
32



33



35



36

Figure 13 (*opposite*). Small celts 27, 29, 30, 32, 33, 34, 35, 36. Scale 1:1

Figs. 6, 13: 16, 29, 33, 35). Finally, four celts have an edge that is lopsided in plan view (Figs. 4, 6, 13: 10, 18, 34, 36). The lopsidedness of edges has been interpreted in the literature as the result of resharpening part of the edge after localized damage.⁵⁵ This interpretation applies to at least one of these tools, 34 (Fig. 13), but not to at least one other, 36 (Fig. 13).

All but five of the celts from Franchthi have edges that are straight when viewed frontally. The edges of the five exceptions—all larger celts—are convex (see Figs. 4, 5, 8, 12: 8, 9, 14, 23, 31). These edges are sharp and thus beyond doubt represent a manufacturing choice, rather than the product of use with the faces (for perhaps polishing or scraping). Tools with a strongly convex edge in front view also tend to have more asymmetrical profiles than other tools.⁵⁶

USE-WEAR ANALYSIS

SMALL CELTS

As discussed above, there is a surprisingly large number of small celts (39) at Franchthi.⁵⁷ The small size coupled with a generally glossy appearance makes one wonder whether these celts were made not to be used as tools but rather to serve as miniatures, objects of status, articles of personal attire, or even toys. Such a hypothesis, however, is hard to promote for these celts, given the abundant evidence of use wear or resharpening visible on their edges.⁵⁸ All but one of the celts exhibit use wear, and about half of them were resharpened on one or both of their faces (e.g., Fig. 6: 5, 15); a few (e.g., Fig. 6: 16, 18) have been resharpened twice on the same face. The combined evidence of resharpening and use wear in some of the smallest celts indicates that they were used after they were resharpened and when they had a very short length (e.g., Fig. 13: 33, 35). There is no doubt then that the small celts were used. How they were used is a much more complex matter, especially in the absence of microscopic use-wear analysis or experimental studies. I will offer some suggestions as I discuss the use wear of the small celts below.

The edge of a celt enters the worked material through pressure exercised on the tool's haft or through (direct or indirect) percussion. Given the small size of the tools in question, however, I assume percussion was practiced rarely. Four kinds of use wear are macroscopically visible on the edges of small celts: chipping; a combination of chipping and scoring; a combination of chipping and rounding; and flattening, with or without chipping.

Some tools exhibit unifacial edge chipping, while others show bifacial edge chipping. The differential location of the chip scars might have to do with a specific use or hafting technique that exposed one or both faces of the working edge to the resistance of the worked material. In the case of bifacial edge chipping, the two faces might have been exposed to the resistance of the worked material simultaneously or alternately. The presence of bifacial edge chipping on tools with different profiles and edge shapes (see, e.g., 35 [Fig. 13], 37, 38) suggests that no clear correlation exists

55. Spenneman 1987, p. 22; see also Semenov 1964, pp. 129–130.

56. A few celts with this particular edge configuration have been reported from Neolithic Thessalian sites (Moundrea-Agrafioti 1981, p. 186) and from Dikili Tash (Séfériadès 1992, pp. 88–90, 94). I have seen many such celts in Neolithic assemblages from the vicinity of Kozani and Kastoria.

57. The sample size becomes even larger if the fourteen fragments of small celts are also taken into account.

58. For a similar situation, see Perlès 1981, p. 199, on the celts from Kitsos; and Sugaya 1993, p. 443, on the smallest celts from Tharrounia.

between this particular use wear and a certain set of technomorphological characteristics.

Unifacial edge chipping occurs more rarely among the small celts (e.g., 39 [Fig. 14], 40, 41). The appearance of this kind of use wear implies that primarily one face was meeting the resistance of the worked material. It has been impossible to detect any pattern connecting the unifacial chipping to specific technomorphological features. Celt 42 (Fig. 14), a small tool exhibiting unifacial edge chipping, should be mentioned separately. Here the chip scars extend in different directions, suggesting that different parts of the edge were at different times exposed to the resistance of the worked material. This kind of use wear is expected, if not exclusively, in the case of an indirect percussive function. This hypothesis is reinforced by percussion scars visible on the proximal end of the tool. The fact that percussion was used indicates that the worked material was relatively hard, perhaps wood or bone. Celt 24 (Fig. 9), a sturdy, stubby tool, should also be mentioned in relation to unifacial edge chipping. It is unique in that it has a serrated edge produced by unifacial retouch. The chipping of the edge in this case represents a manufacturing choice rather than an unintended result of use. A tool with such a working edge could have been used for cutting skins or meat.

In a second kind of use wear represented by three tools, 29 (Fig. 13), 43, and 44, the chipping is accompanied by very fine, short (about 1 mm long) scoring marks. This scoring is perpendicular to the edge and visible with or without low magnification on one or both faces. The short length and direction of the scoring marks suggest that they are due to use rather than manufacture or resharpening, since it is very hard to grind the edge transversely for only a millimeter without risking flattening it out. Given the small size of tools showing this scoring and the generally good condition of their edges, it is likely that the scoring occurred from pressure exercised transversely on the worked material. No specific pattern connecting this form of use wear with specific technomorphological characteristics is detectable in this case either. On 29 and 44, however, the chipping appears on one face of the edge, and the scoring on the other, raising the possibility that the two kinds of use wear are the result of different uses.

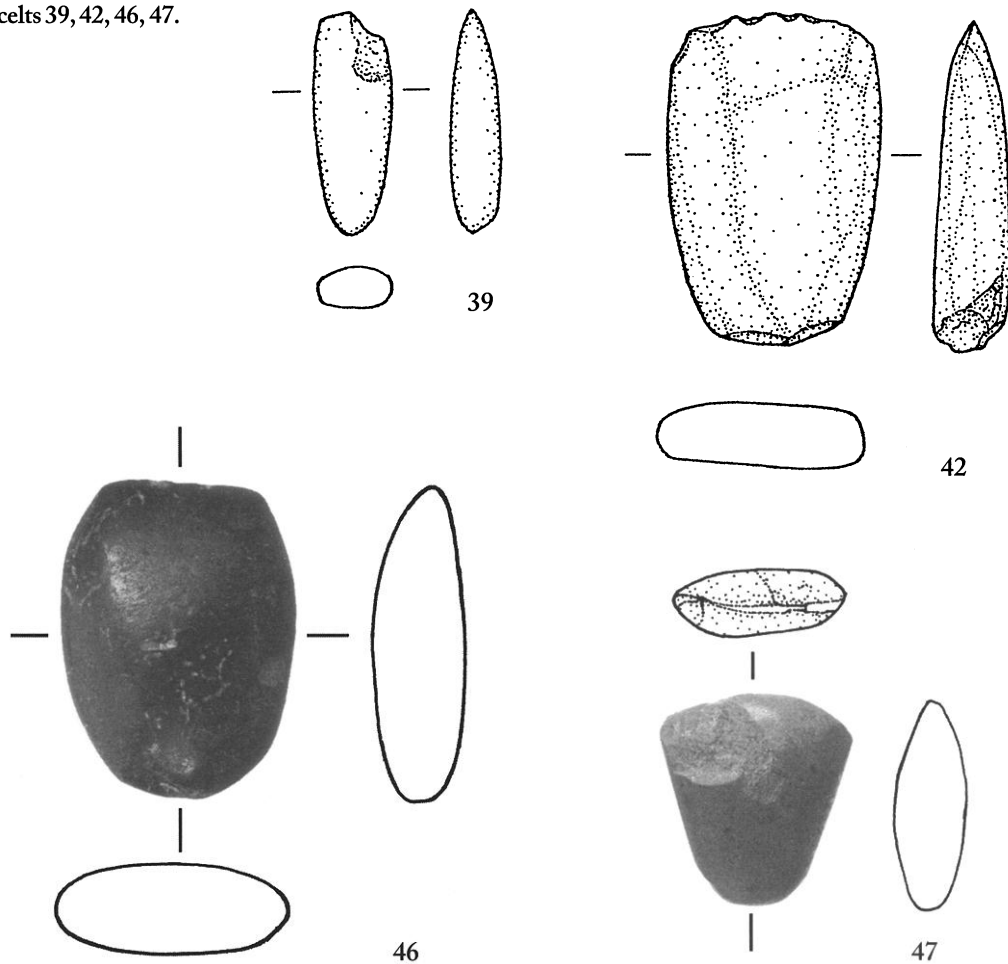
In a third kind of use wear, represented by 6 and 46 (Fig. 14), chipping appears on one face of a blunt or rounded edge. Are the dullness and chipping of the working edge the results of the same use or do the two kinds of use wear reflect different uses? I tend to believe that they are the result of the same use. The dull edge in both tools might be the result of dressing hides or perhaps scraping or burnishing the interior of ceramic vessels. Interestingly, the chip scars on 6 are consistently angled obliquely in relation to the edge. This pattern points to a transverse and oblique movement of the edge over the worked material.

The last and most unexpected kind of use wear that I was able to identify macroscopically on small celts is a very narrow flat zone covering the entire edge or a part of it. Three tools display this use-wear pattern. On two of them (Figs. 6, 14: 18, 47), chipping followed the formation of the flat zone and is also apparent on the edge.⁵⁹

Celt 16 (Fig. 6), one of the smallest examples, should also be mentioned here. The edge of this tool has been sharpened twice on one face

59. See also O'Hare 1990, p. 131, for two examples of flat-edged celts from Neolithic southern Italy.

Figure 14. Small celts 39, 42, 46, 47.
Scale 1:1



but shows no evidence of use. It is possible that the tool was lost or abandoned after it was resharpened, or it could have been curated to be ready for use when needed.

If some of the small celts were used in the ways suggested above, others might have been involved in more intriguing processes, suggested by a group of fourteen fragments of small celts (e.g., 48, 49, 63) not touched upon in the previous section. These fragments account for half of all celt fragments. This percentage is curiously high for these tools, which, because of their small size and softness, could not have been systematically exposed to forces great enough to break them during use. If, in fact, that had been the case, one would expect the edges of these tools to be quite worn. Yet, these edges, although displaying some use wear, are generally in very good condition, indicating that they were exposed to a destructive force only once: the time at which they were broken. Moreover, the breakage of these tools does not seem random. All fourteen fragments retain part of the edge and indeed ten of them represent edge corners consisting of part of the edge and one side. It is hard to see how the normal use of small celts could have caused such a peculiar breakage pattern without any substantial wear of the edges. On the other hand, the complete absence of body parts from the sample of fragments makes it equally hard to attribute the breakage to accidents that took place between episodes of use or after

the discard of these tools. On this basis, I consider it likely that some small celts at Franchthi were deliberately broken. Indeed, several fragments consist of typical or atypical flakes. Such a hypothesis might explain the lack of fragments with body parts: if small celts were deliberately broken, the body parts could have been deliberately removed and deposited in some undiscovered part of the site or even away from the site.

Deliberate breakage of wholes and deliberate removal of certain parts of these wholes constitute elements of a ritual treatment. It is possible that small celts were sometimes ritually “killed” to mark specific events in the life of the community or rites of passage in the lives of producers or users (owners?) of these tools. It is also possible that the ritual destruction of celts was only one part of a long and repeated ritual manipulation that produced use wear along the edges—often enough to call for resharpening. The archaeological context is not of much help in testing this hypothesis, since with one exception all fragments of small celts—as is the case with most Franchthi celts—came from disturbed Neolithic deposits. The exception (50) was found close to a hearth. A hearth, however, is a kind of neutral place regarding this hypothesis, since it can be the focus of both everyday domestic and extraordinary ritual activities.

Ritual activity is not only expected to have taken place at Franchthi Cave, as in any other community (prehistoric or otherwise), but has indeed been postulated by K. D. Vitelli from at least the Middle Neolithic through the Final Neolithic on the basis of her analysis of the ceramic assemblage.⁶⁰ According to Vitelli, ritual activity must have been crucial—if not necessary—initially (MN) in negotiating the tensions constantly arising in the midst of the Franchthi community, and later (LN and FN) in maintaining relations among small, scattered, mobile groups.⁶¹ The intentional breakage of objects at Franchthi is also not a new idea. Vitelli has suggested it for the exceptional MN Urfirnis pottery, Lauren Talalay for MN split-leg figurines, and I myself for some of the millstones; Catherine Perlès also hints at an unusual destructive process (involving breaking and burning) for some FN foliate points.⁶² Moreover, deliberate fragmentation of a variety of artifacts (e.g., pots, figurines, prosopomorphic lids, altar tables, objects with incised signs) and manipulation of their fragments was part of a widespread social practice in the Balkan Neolithic that, according to John Chapman, was aimed at the creation and maintenance of a lasting bond between individuals or groups.⁶³

If some of the celts at Franchthi had a ritual function, they would not be the first to be recognized as such in the Neolithic Aegean. This interpretation has already been proposed for the two oversize celts excavated at the so-called shrine of Nea Nikomedeia and the four (one oversize) found among other objects inside a phiale near the village of Anemodouri in the Peloponnese.⁶⁴ Interestingly enough, use wear has been identified on all of these specimens.⁶⁵ There is still much to be learned about the ordinary and extraordinary uses of celts, but the combination of use wear with a ritual function suggests that the picture of Neolithic celts in the Aegean is more complex than is often assumed. Most importantly, it unsettles our classificatory schemes and requires that we be more careful both in defining criteria to distinguish between utilitarian and ritual objects and in assuming that this is a legitimate distinction in the first place.

60. *Franchthi* 8, pp. 213–219; *Franchthi* 10, pp. 96–104.

61. *Franchthi* 8, p. 217 (MN); *Franchthi* 10, pp. 99–104 (LN–FN).

62. For pottery, see *Franchthi* 8, p. 216. For figurines, see *Franchthi* 9, pp. 45–46; Talalay 1987. According to Talalay (*Franchthi* 9, p. 45), split-leg figurines may have “served as economic contracts or identifying tokens.” Her interpretation, however, does not preclude the splitting of figurines within a ritual context. For lithics and ground stone tools, see the forthcoming volumes *Franchthi* 15 and 17, respectively.

63. Chapman 2000, pp. 1–104.

64. Sugaya 1992, pp. 71–75.

65. Sampson and Sugaya 1988–1989, p. 18; Sugaya 1992, p. 72.

LARGE CELTS

With a few exceptions, the edges of the larger celts from Franchthi are in relatively good condition and, moreover, not resharpened. This implies that larger celts were not used for a long time or intensively enough to cause substantial damage to the tools and require frequent resharpening. In the absence of evidence for overuse or exhaustion of the larger celts, it is reasonable to assume that their users probably did not need more than a small number.

Although most of the complete larger celts could (and must) have been used in shrub clearing and woodworking, only three of them are massive enough to be considered candidates for felling trees: 7 (Fig. 4), 23 (Fig. 8), and 51 (Fig. 15). Four fragments seem to come from very large celts: 52, 53 (Fig. 15), 54 (Fig. 15), and 55. For three of these seven celts some qualification is required. Celt 23 has a convex edge in face view; this edge shape, however, does not necessarily make the tool unsuitable for tree cutting, as is suggested by ethnographic examples of similar celts used to fell trees.⁶⁶ Two others, 51 and 53, were recycled at some point in their life and used in a way that obliterated their working edge. Thus, we can only hypothesize that they were used in a tree-felling task.

The scarcity of celts that could have served to cut down trees might imply that this was not an important activity at Franchthi during the Neolithic. This idea is supported by palynological evidence, according to which the vegetation of the southern Argolid for most of the Neolithic was very open, deciduous oak forming woodlands only at higher elevations.⁶⁷ Land clearance for farming, on the other hand, could have been carried out by burning. Indeed, experiments show that the resulting ash acts as a fertilizer.⁶⁸ Additional tree-felling techniques not involving the use of celts are described in the ethnographic literature: ring-barking, the driving tree fall or "windrow felling," and the controlled use of fire.⁶⁹

Theoretically, it is possible that the users of the largest celts took them along when they abandoned the site. In that case, however, one wonders why they left behind other celts that were in a good and usable state. It is also possible that the larger tools were discarded away from the site, where they were used and eventually damaged. I find it hard to believe, however, that the users of these heavy-duty, and thus probably precious, tools did not care to retrieve them and bring them back to the settlement for repair or recycling into other smaller tools or objects. Nor does any ethnographic evidence support this scenario.⁷⁰

As already mentioned, a few larger celts have a convex edge in face view: 8, 9, 14, 23, and 31 (Figs. 4, 5, 8, 12). These tools are characterized by an asymmetrical profile, in which one face is more rounded and the other flatter. This particular edge shape might have been convenient for hollowing out logs—possibly with the technique of charring—to create wooden bowls, ladles, and tools.⁷¹ The above celts show some unifacial or bifacial chipping on the edges. In two cases, 9 (Fig. 4) and 14 (Fig. 5), the chipping is accompanied by scoring that is a result of use. Most of these tools were probably hafted with the handle perpendicular to the edge. This does not seem to apply to 31 (Fig. 12), however, which has a strongly asymmetrical profile as well as oblique scars extending in various direc-

66. See Hampton 1999, pp. 59–92; Pétrequin and Pétrequin 1993, pp. 60–67.

67. Bottema 1990, p. 124; *Franchthi* 7, p. 18.

68. See Iversen 1956, p. 39.

69. See, e.g., Brass 1941, p. 561; Carneiro 1974, p. 114; Steensberg 1980, pp. 58–61.

70. There is, instead, ethnographic evidence from the Langda of New Guinea for a practice of returning the fragmentary and worn-out celts to the village because their users "feel sorry" for their handiwork" (Toth, Clark, and Ligabue 1992, p. 92).

71. Such wooden objects are known from the lacustrine Neolithic sites of eastern France and Switzerland (Müller-Beck 1965, pp. 103–119; Pétrequin and Pétrequin 1988, pp. 121–123).

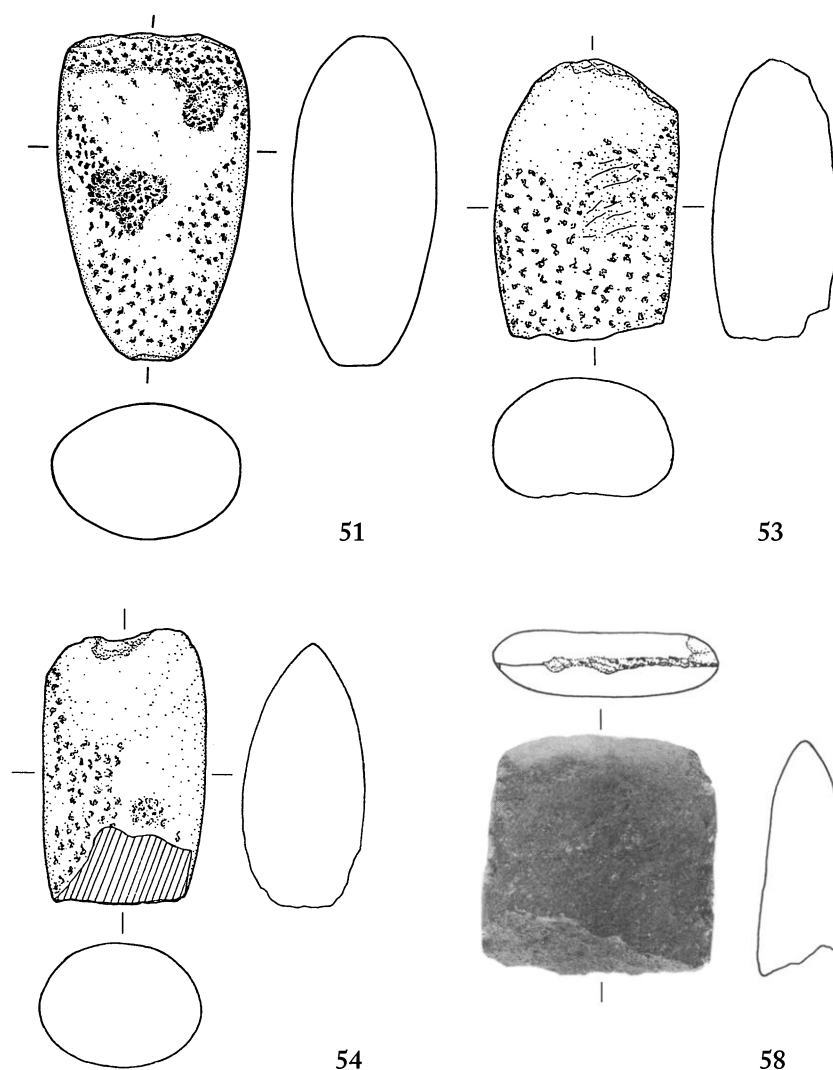


Figure 15. Large celts 51, 53, 54, 58.
Scale 1:2

tions on both faces. This use-wear pattern indicates that the edge moved in different directions at different times and thus probably in an indirect percussive mode.⁷²

The majority of the larger celts have straight edges in front view. These tools have symmetrical or asymmetrical profiles (see, e.g., Figs. 5, 12: 12, 26) and exhibit unifacial or bifacial edge chipping (Figs. 7, 12: 19, 26). In two tools, 2 and 57, one edge corner is flaked off. On the remaining part of the edge of 57 one can see a narrow flat zone, similar to those identified on a few small celts.

A small number of large celts have a dull, rounded chipped edge (e.g., Figs. 4, 5, 15: 7, 13, 58). One celt, 58, has a long edge,⁷³ which is rounded for 3.3 cm and sharp for the remaining 1.5 cm. Both edge parts show some chipping as well as polish, although there is no doubt that they were used differently. With its long edge and very low width/thickness ratio, 58 might have been suitable for dressing hides, a task for which hafting would not have been necessary. Celt 10 (Fig. 4), with a lopsided edge in plan view, must have been used with pressure (rather than percussion) and moved at

72. C. Perlès (pers. comm., July 2000).

73. Of the entire assemblage of celts from Franchthi, 58 has the longest edge.

an oblique angle (rather than perpendicularly) in relation to the worked material. Otherwise, only a few millimeters of the edge could have been in contact with the worked material.

Finally, there are a few instances at Franchthi of the recycling of larger celts. In two cases, 51 and 53 (Fig. 15), the cutting edge was (re)used as a hammerstone. This use destroyed the celt bit and created a rounded edge with percussive wear. It is hard to understand why these sharp-edged tools were turned into hammerstones. Perhaps their users no longer needed sharp-edged tools or perhaps later users turned them into hammerstones. In two other cases, 13 and 26 (Figs. 5, 12), the proximal end seems to have been (re)used in an active percussive mode. Last, in some celts both the cutting edge and the proximal end were reused in that way (see, e.g., Fig. 7: 22).

EPILOGUE

The excavations at Franchthi yielded eighty-nine ground stone celts from undisturbed or, in most instances, mixed Neolithic deposits. No ground stone celt has been found in a Palaeolithic or Mesolithic layer and there is no indication that such tools were made or used prior to the Neolithic period. Serpentine, the material from which most of the celts were made, was rarely used for pre-Neolithic tools or ornaments.⁷⁴ The techniques of pecking and grinding were known to the pre-Neolithic inhabitants of Franchthi, but apparently not used in the *chaîne opératoire* later used for celts. If so, then the Neolithic ground stone celt assemblage at Franchthi represents a new industry that employs essentially new raw materials and a new *chaîne opératoire*. These innovations can be used to support the argument—formulated on the basis of other materials and especially geostratigraphy—that the Neolithic culture at Franchthi is not a local evolution from a Mesolithic background but rather an exogenous development probably related to the arrival of a new group.⁷⁵

The introduction of a new tool and the employment of new materials and a new technology point to an activity first undertaken at the beginning of the Neolithic. The activity usually associated with ground stone celts is tree-felling, the assumption being that celts were necessary to sedentary communities for clearing the land to farm.⁷⁶ At Franchthi, however, the dimensions of the celts, the properties of the raw materials used, and the reconstruction of the palaeoenvironment do not in most cases support such a hypothesis. A number of celts could have been used to clear shrubbery, work wood or bone, process hides or meat, or for tasks related to pottery production. Nevertheless, there are quite a few celts too small even for these tasks. The Franchthiotes were certainly able to procure raw materials of better quality and larger dimensions through their own expeditions or through the exchange networks that brought obsidian and honey flint, andesite, and marble to the site.⁷⁷ That they chose not to suggest that the properties of the raw material were adequate for the uses intended for these tools.

74. For tools, see *Franchthi* 17; for ornaments, see Miller 1997, pp. 129–133.

75. See *Franchthi* 7, pp. 174–183; *Franchthi* 12, pp. 96–97; Perlès 2001, pp. 39–41.

76. For a critique of this hypothesis see Perlès 2001, pp. 231–232.

77. Obsidian and honey flint were used for chipped stone tools (Perlès 1989; *Franchthi* 15); andesite for millstones, handstones, and one celt (see Runnels 1981, pp. 103–105; *Franchthi* 17); and marble for figurines and vases (*Franchthi* 9, p. 12; van Andel and Vitaliano 1987, p. 20).

The ways in which some of the small celts were used remain elusive. If these tools were intentionally broken, as I suggested above, it is possible that they functioned within a ritual context. The ritual use and “killing” of small celts at Franchthi might be an isolated phenomenon that was related to a specific function of the site⁷⁸ or an instance of a more general practice within the Aegean. Which of the two is more likely may be clarified with the completion of the Franchthi Cave publication series⁷⁹ and with the publication of more thorough studies of other Aegean Neolithic celt assemblages.

78. See *Franchthi* 15.

79. In addition to the eleven fascicles already published in the series *Excavations at Franchthi Cave, Greece*, another nine are projected.

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