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The Cerastoderma bead production at Franchthi (Greece): A case of apprenticeship?

Catherine Perlès, Patrick Pion

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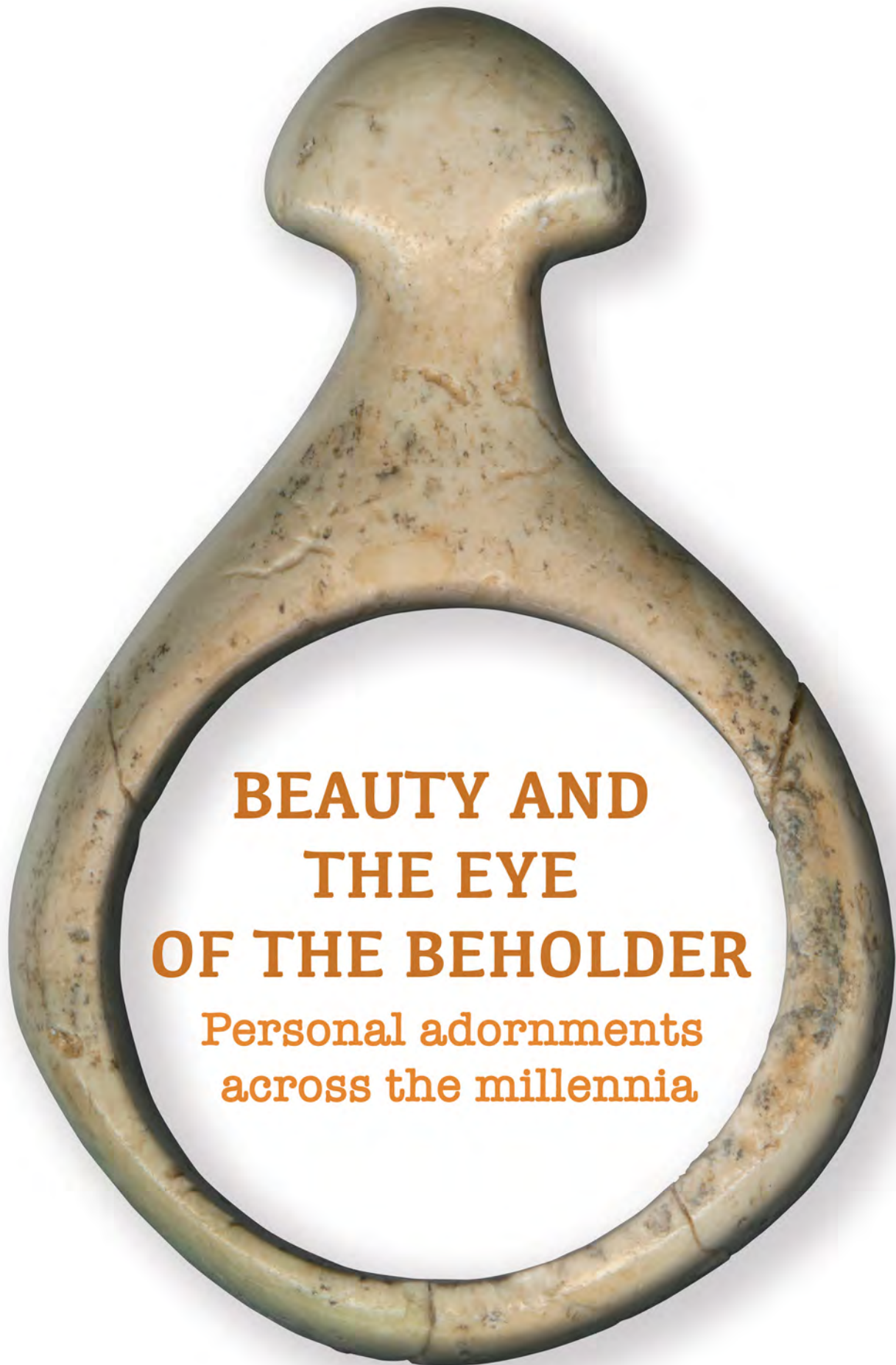
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**BEAUTY AND
THE EYE
OF THE BEHOLDER**
Personal adornments
across the millennia

Edited by Monica Mărgărit & Adina Boroneanț

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Cover: Dan Iulian Mărgărit

Photo cover: Bone piece with a ringlike morphology from the necropolis of Sultana-*Valea Orbului* (Romania) and *Spondylus* beads from the necropolis of *Urziceni-Vamă* (Romania) (photos: Monica Mărgărit)

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Beauty and the eye of the beholder: personal adornments across the millennia

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FOREWORD

The message of personal adornments is not an easy one to decipher. Nevertheless, they provide an insight to the many aspects (social, spiritual, economic, etc.) of human behaviour, personal expression, relationships and communication. Understanding the complicated social and technical aspects of adornments generally require a broad spectrum of technical and methodological approaches as well as a good knowledge of the state of research and numerous local case-studies.

Beyond the aesthetic impact, at times secondary in traditional societies, personal adornments represents a language in itself, a complex communication system, conveying clear messages on ethnic, gender and age class affiliation. They are associated to certain rituals (e.g. passage or marital), they can be amulets or talismans and they can act as currency or as symbols of the ritualistic trade (e.g. Sciana 1998; Trubitt 2003; Vanhaeren 2005, etc.).

Moreover, their manufacture can be related to complex territorial and economic organization helping to identify in certain cases crafts and specialized workshops, circulation paths of raw materials and the existing systems for inter-community exchange (e.g. Newell *et al.* 1990; Vanhaeren and d'Erico 2006; Rigaud *et al.* 2015). Further information can be extracted from their presence in funerary contexts, revealing whether they were exclusively created for the afterlife or had been part of the every-day life of the respective individual/community.

There is already an impressive literature dedicated to personal adornments, which analyses the most diverse aspects: from their possible social-cultural functions to the means of obtaining the raw materials, the techniques used for their transformation, the ways they were used/repared and their discard (e.g. Bar-Yosef Meyer *et al.* (eds.) 2017; Bar-Yosef Mayer and Bosch (eds.) 2019; Baysal 2019; Ifantidis 2019; Mărgărit 2019; to exemplify only with the latest publications). Nevertheless, as this volume also shows, the subject is a vast one and there is continuous need for further exploration.

The International Colloquium: “Beauty and the eye of the beholder: personal adornments across the millennia” took place at Valahia University, Târgoviște, Romania, between 12 and 14 September 2019. Bearing in mind the complexity of the subject, the participants were invited to discuss a variety of topics, expressing the views of various “beholders” both in the past and at the present moment: their meaning/symbolism within the prehistoric/historical societies (e.g. cultural tradition, social and spiritual organization and exchange systems), raw materials (identification of sources and acquisition), various methodologies of study (technological and usewear analyses, microscopy, SEM+EDS analysis, FTIR and RAMAN spectroscopy, etc.) and experimental approaches (creating experimental reference collections), etc.

At the end of the colloquium, following the discussions with our colleagues, it was decided to gather all presentations in a volume while also inviting other contributions dedicated to this topic, in an attempt to capture a broader spatial and temporal image.

The result is the present volume comprising 26 studies organized in three major sections related to regional studies on adornments, and their use and presence in everyday life and afterlife. Within one section, papers were organized in chronological order. The papers in the volume cover geographically the whole of Europe and Anatolia: from Spain to Russia and from Latvia to Turkey; it spans chronologically many millennia, from the Middle Palaeolithic to the Iron Age (2nd – 4th centuries AD).

The volume opens with ten regional studies offering not only comprehensive syntheses of various chronological horizons (Palaeolithic - Daniella E. Bar-Yosef Mayer, Neolithic/Chalcolithic - Emma L. Baysal; Fotis Ifantidis; Selena Vitezović and Dragana Antonović; Sanda Băcucă Crișan and Ancuța Bobîna; Andreea Vornicu-Țerna and Stansislav Țerna; Roberto Micheli) but also new data on the acquisition and working of various raw materials or specific types of adornments (*Columbella rustica*

shells - Emanuela Cristiani, Andrea Zupancich and Barbara Cvitkusić; wild boar tusk - Ekaterina Kashina and Aija Macāne; canid tooth pendants - Petar Zidarov). The unbreakable link between adornments of the everyday life and those of the afterlife it is also highlighted in some of the contributions.

The following section - *Adornments in settlement archaeology* - includes nine studies, covering the archaeological evidence from specific settlement sites. Many studies focused on the adornments' iconographic designs, meaning, and exchange but also on raw materials, technologies of production and systems of attachment. Chronology-wise, this section brings together the most varied range of ornaments, raw materials and processing techniques from sites in Spain (Esteban Álvarez-Fernández), Turkey (Sera Yelözer and Rozalia Christidou), Greece (Catherine Perlès and Patrick Pion; Christoforos Arampatzis) and Romania (Adina Boroneanţ and Pavel Mirea; Ioan Alexandru Bărbat, Monica Mărgărit and Marius Gheorghe Barbu; Monica Mărgărit, Mihai Gligor, Valentin Radu and Alina Binţinţan; Gheorghe Lazarovici and Cornelia-Magda Lazarovici; Vasile Diaconu).

The last section - *Adornments of the afterlife* - focuses on ornaments identified in various funerary contexts allowing for a more detailed biography of ornaments through mostly use- and micro-wear studies, in order to reconstruct their production sequence and use life. Raw material availability and their properties, as well as contexts of deposition are also taken into account. In the seven studies of the section, different funerary contexts from Latvia (Lars Larsson), Ukraine (Nataliia Mykhailova), Hungary (Zsuzsanna Tóth) and Romania (Monica Mărgărit, Cristian Virag and Alexandra Georgiana Diaconu; Vlad-Ştefan Cărăbişi, Anca-Diana Popescu, Marta Petrunec, Marin Focşăneanu, Daniela Cristea-Stan and Florin Constantin; Dragoş Măndescu; Lavinia Grumeza) are discussed.

We would like to thank to all contributors who responded to our call and helped us complete this volume in less than a year. Each paper was submitted to external reviews. Therefore, we would like to also thank our colleagues who accepted to anonymously review the contributions, thus improved the overall content of the volume.

The Editors

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THE *CERASTODERMA* BEAD PRODUCTION AT FRANCHTHI (GREECE): A CASE OF APPRENTICESHIP?

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Abstract: In the rich Early Neolithic ornament assemblage from Franchthi (Greece), remains of *Cerastoderma glaucum* bead production consist of hundreds of roughouts, blanks and preforms, while complete beads are very rare. The high number of stone drills, which are closely associated with these production remains, suggest that a large number of finished beads left the site. The few that were uncovered demonstrate careful work and a good mastery of the manufacturing process; a number of roughouts and preforms correspond well to their shape and dimensions. Conversely, numerous other roughouts, blanks and preforms, often broken, differ from this norm and could never have been turned into finished beads. Many of these anomalies are incompatible with the work of skilled artisans, who would have never engaged in a manufacturing process that they knew impossible to conclude. We thus suggest that the assemblage corresponds to a mix between the remains of a skilled *Cerastoderma* bead production and of apprenticeship. Given the high proportion of accidental breakage, the latter would logically predominate. This would explain why, taken as a whole, the assemblage appears unstandardised and unskilled, leading to an underestimate of the skill exemplified in the few finished beads that remained on the site.

Keywords: Neolithic, beads, *Cerastoderma*, craft production, technology, apprenticeship, workshop.

Introduction

Franchthi is a near-coastal site comprising a vast cave, occupied during the Upper Palaeolithic, the Mesolithic and the Neolithic, as well as an open-air occupation, the 'Paralia', occupied during the Early, Middle and Final Neolithic (among others: Jacobsen and Farrand 1987; Shakleton 1988; Vitelli 1993, 1999). Since the beginning of the Palaeolithic, and even more during the Mesolithic, intensive ornament production took place in the cave. It mainly concerned three types of shells: tusk shells (*Antalis* sp.), Cyclopes (*Tritia neritea*) and dove shells (*Columbella rustica*), recovered by the thousands (Perlès 2018a). In addition to these perforated shells, a different set of ornaments was introduced in the Initial Neolithic (ca 6,700 – 6,500 cal BC), with a few

geometric beads made of shell and stone and a fragmentary *Spondylus* bracelet. From ca 6,500 onwards, with the Early Neolithic, the range of typically Neolithic ornaments expanded greatly, to include stone pendants and varied stone beads (Miller 1997; Perlès 2018b). Bead and pendant blanks demonstrate that some at least were locally produced, but the most impressive remains of local production by far concern *Cerastoderma glaucum* beads. The waste numbered hundreds of pieces, mainly concentrated in two clusters at either extremity of the Paralia.

The production of *C. glaucum* (cockle shell) beads has been interpreted in widely different terms. Given on the very small number of finished and complete beads and the high number of recorded waste (n = 516), M. Miller (1996) concluded in favour of a casual,

unskilled domestic production. Perlès, considering the very high number of drills associated with this production, concluded, to the contrary, in favour a specialized production and the exportation of the finished products (Perlès 2001).

We re-examined the material between 2006 and 2010 for the final publication of the Franchthi ornaments. In addition to the study of the catalogued pieces and already sorted cockle shell waste, we re-sorted the mixed bags of marine molluscs and land snails in selected trenches and recovered a few more worked cockle shell fragments. Unfortunately, for lack of time and funding, we could not study in detail all the Paralia trenches. Our study is therefore based on the catalogued pieces from all trenches, on all the material from trenches L5, L5NE and Q/R, and only selected units from the other Paralia trenches. It constitutes therefore only a subsample of the recovered cockle shell bead production waste (n = 468), but can be considered representative. This re-examination leads us to propose an alternative interpretation for the cockle shell bead production that seeks to take into account the two sets of arguments: i.e. the presence, alongside experts, of apprentices.

Apprenticeship has been mostly explored in the domain of stone tool production, allowing one to set forth a series of recurrent criteria that define several degrees of skill (Bamforth and Finlay 2008; Klaric 2018). It has also been successfully studied for the production of pottery (Roux 1989; Kamp 2001; Washburn 2001; Gandon *et al.* 2011). Much less attention

has been paid to apprenticeship for the production of ornaments. We are aware of only one publication that directly addresses the question: the remarkable analysis of J.E. Arnold (2012) on the bead-making industry of the Channel Island in California. By attempting to define different levels of skill at Merhghar (Pakistan), A. Vanzetti and M. Vidale (1994) also indirectly address the question. Conversely, the presence of apprentices is not alluded to for the European *Cerastoderma* bead-making workshops published so far (Bocqueten 1998; Pauc 2000; Pascual Benito 2003; Gruet *et al.* 2009; Laporte 2009).

A biased representation of the bead making production: drills and beads

Our basic assumption is that most of the finished products have left the site and are missing. The assemblage, as it was recovered, does not represent the actual production and the real levels of craftsmanship.

Hundreds of drills have been recovered in the Early Neolithic assemblages at Franchthi, and they show a close spatial and stratigraphic relationship with the bead-making remains. This demonstrates without ambiguity the direct relation between the drills and the production of beads, and this is further supported by traceological analyses.

(a) Spatial relations:

There is a close spatial correlation between the presence of cockle shell bead waste and drills. Drills are only present where *Cerastoderma* waste is present, and vice versa (Fig. 1).

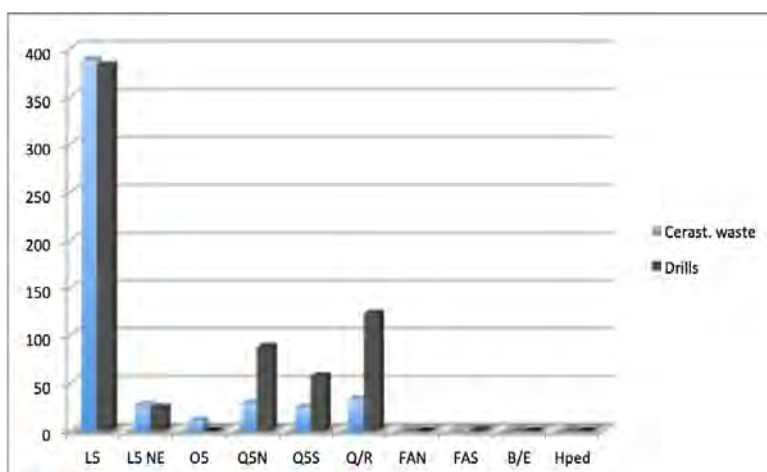


Figure 1. Number of *Cerastoderma* waste and drills in different trenches.

(b) Stratigraphic relations:

The stratigraphic relations, as exemplified here by trenches L5 and Q/R, is even more striking (Figs. 2, 3). In L5, both drills and *Cerastoderma* are absent from the top units (1-20, Final Neolithic) and at the base (early Early Neolithic). In Q/R they are virtually absent in units 10 to 20 (Middle Neolithic) and from the base (earliest Early Neolithic).

(c) Functional analyses:

P. Vaughan performed unpublished wear traces analysis on a number of drills. Although drill tips need to be regularly rejuvenated (Ricou and Esnard 2000), many still showed a mix of crushing and rounding on the tip that corresponds perfectly to their use as drills on a hard material (Fig. 4).

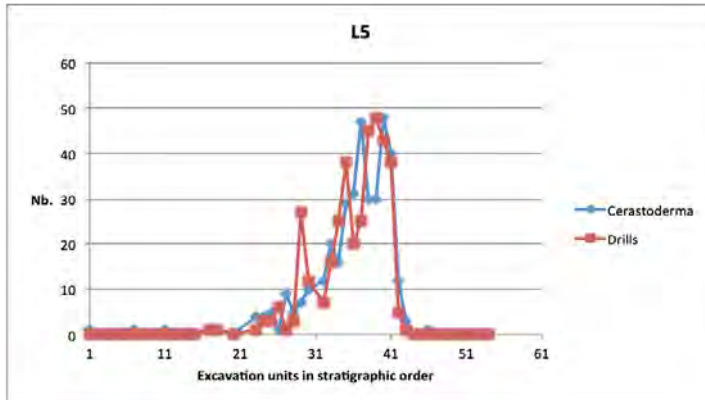


Figure 2. Stratigraphic distribution of drills and cockle shell beads production waste in L5.

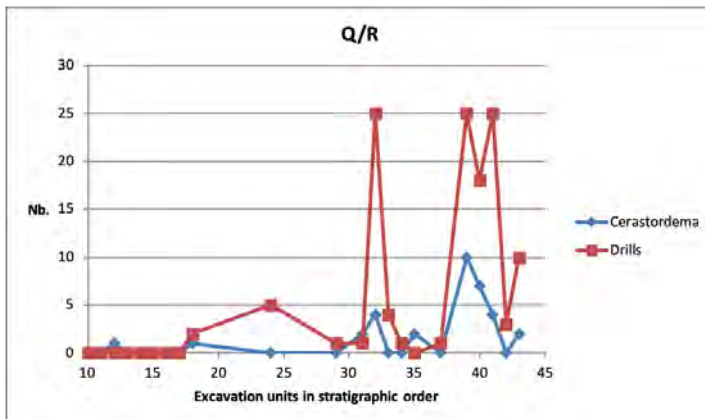


Figure 3. Stratigraphic distribution of drills and cockle shell beads production waste in Q/R.



Figure 4. Drills from L5 and details of their tip.

The number of stone bead and pendant blanks in Q/R and L5 is far too small (respectively 1 and 9) to account for the massive presence of drills, which can therefore be attributed to the production of cockle shell beads. Large-scale experiments on the use of drills to perforate cockle shells concluded that each drill could be used, as a mean, to perforate between 50 and 60 beads. Even if we assume that some of the drills were also used to shape the roughouts, the 725 drills and microborers recovered on the Paralia should correspond to several thousand perforated 'preforms' and beads, when only 97 have been recovered. It can be concluded that the vast majority of the finished beads have left the site, and that what remains consists of a few lost, broken or failed specimens. One would undoubtedly wish that the presence of cockle shell beads in contemporaneous inland sites would confirm the exportation of beads from Franchthi. Unfortunately, there are very few inland Early Neolithic sites in the Peloponnese, and the latter were excavated decades ago without sieving. As for inhumations, they are also very rare in the

Neolithic of Greece, and devoid of funerary goods (Perlès 2001).

The production sequence

Despite the presumed export of most of the production, there remain enough examples of each stage of the production sequence to reconstruct it in its broad lines and main variants. The successive stages of the production sequence are broadly similar to those described in other archaeological *Cerastoderma* workshops and in experimental replications (Pauc 1997, 2000; Bocquet 1998; Ricou & Esnard 2000; Pascual Benito 2003; Gruet *et al.* 2009; Laporte 2009). They are also similar to the broad lines of traditional shell money making that were observed recently at LangaLanga in the Solomon Islands (Goto 1996; Guo 2006).

The targeted products are discoid beads, with a regular circular contour and a well-centred perforation. These are poorly represented in our assemblage, but appear to come in two sizes: one around 5 to 6 mm in diameter, the other between 9 and 11 mm (Fig. 5, Pl. 1).

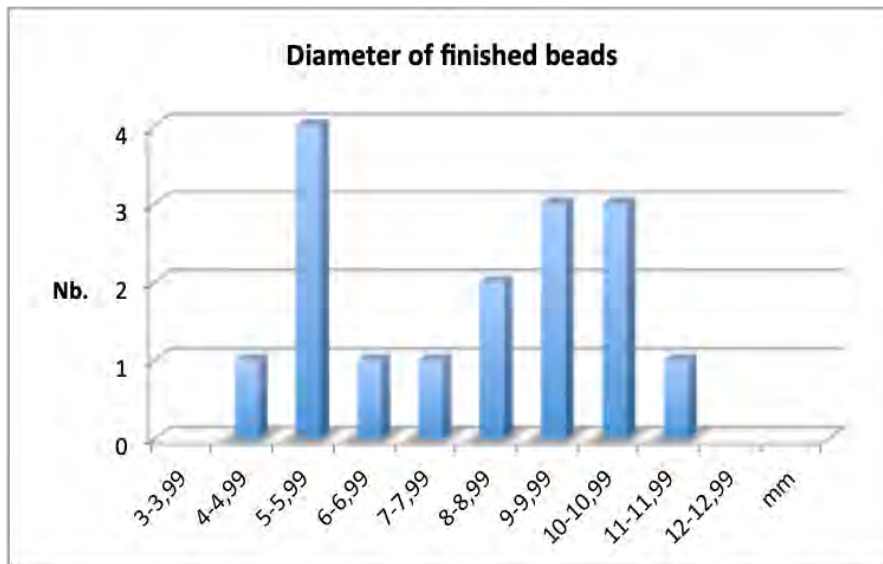


Figure. 5. Diameter of finished beads (all trenches).



Plate 1. Finished *Cerastoderma glaucum* beads. Ca. 3x.

To define the standard production sequence and its main variants, we shall refer to Trench L5, where the most intensive production took place. The following steps define the standard procedure:

- (a) Collection of the shells in the nearby lagoons and mud shoals, located, according to the reconstruction of the past shorelines, at less than 2 km from the site (Van Andel 1987: fig. 17).
- (b) Breakage of the shells by percussion and selection of the appropriate fragments (Table 1).
- (c) Shaping of the fragments to reach a shape as close as possible to a finished bead, in

order to diminish the amount of subsequent abrasion. This operation defines the roughouts.

- (d) Abrasion of the dorsal face, and eventually partial abrasion of the ventral face, producing what we call blanks.
- (e) Perforation from the ventral face: production of what we call preforms.
- (f) Abrasion of the sides to obtain a perfectly circular shape. When the side is incompletely abraded and asymmetries remain, we call the piece an unfinished bead. The finished beads, besides having a circular shape, often underwent a second phase of fine grinding of the faces.

Table 1. Distribution of the material in trench L5 according to the actions performed.

Stage	Action	Roughouts	Blanks				Preforms		Unfinished beads	Beads	
b	Breakage of shell	X	X	X	X						
c	Shaping and regularisation	X	X	X	X	X	X	X	X	X	
d	Abrasion of dorsal face		X	X	X	X	X	X	X	X	
	Abrasion of ventral face			X	X		X	X	X	X	
e	Perforation					X	X	X	X	X	
f	Fine abrasion of sides							X (partially)	X	X	
	Fine abrasion of dorsal face								X	X	
	Fine abrasion of ventral face									X	
	Total	157	53	4	74	29	39	3	1	6	

The distribution of these different classes of production waste in the assemblage is extremely uneven (Fig. 6). The first three stages decrease regularly while beads, even unfinished, are extremely rare. As noted earlier, the number of beads compared with the number of drills indicates that most beads have left the site.

Within this general framework, variants can be observed at each stage.

- *Roughouts* (n = 202):

Miller suggested that the roughouts were directly manufactured by striking the ventral side of a valve with a simple hammer stone on an anvil, just under the umbo (Miller 1996, 1997). This technique would have produced a roughout of appropriate shape and left a perforated cockle shell. We do not subscribe to this hypothesis for a number of reasons: perforated *Cerastoderma glaucum* are extremely rare in the Early Neolithic (n = 6,

none from L5 or Q/R); they concentrate in the Middle Neolithic, when cockle shell beads were no longer produced. Second, measurements of the perforations on these cockle shells show that the fragments produced, if they had remained intact, would have mostly been under the minimum size of the roughouts, as illustrated by the distribution of the width (Fig. 7).

Third, many of the roughouts were manufactured on the distal part of the shell, which presents a lesser curvature than the dorsal section near the umbo. Finally, all roughouts show traces of microchipping on part of or on the entire periphery, which would not be expected if they had been detached by a single blow.

The production of workable fragments by breaking the shell, followed by a regularisation of selected fragments by microchipping, was actually observed in all other cockle-shell

workshops. The shaping can be done either by direct percussion with an elongated pebble or by pressure. In the latter case, hafted drills also can be used for this operation: our experiments show that the stigmata are close to those observed on the archaeological specimens, although difficult to distinguish from closely knapped repeated percussion. The pressure or the percussion is usually applied from the ventral to the dorsal face,

although some exceptions exist. On the thicker specimens, bidirectional shaping was sometimes be used.

The length of the roughouts ranges from 4 to 13 mm, with a mode between 7 and 8 mm that corresponds well to the dimension of the smaller finished beads after abrasion of the side (Fig. 8). Surprisingly, only very few roughouts correspond to the larger beads.

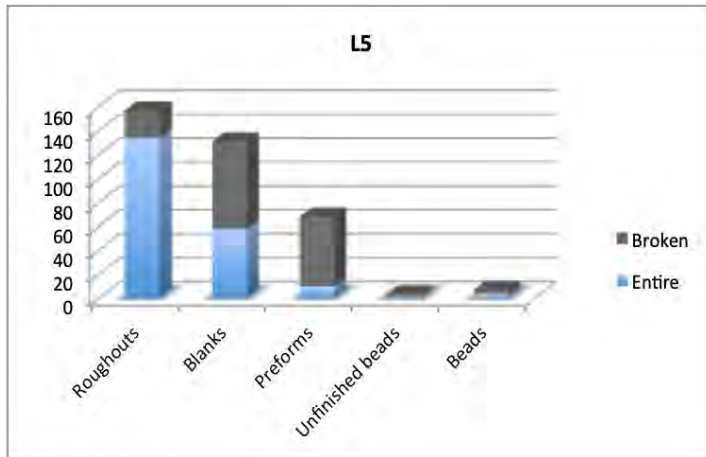


Figure 6. Distribution of the material by manufacturing stage in trench L5.

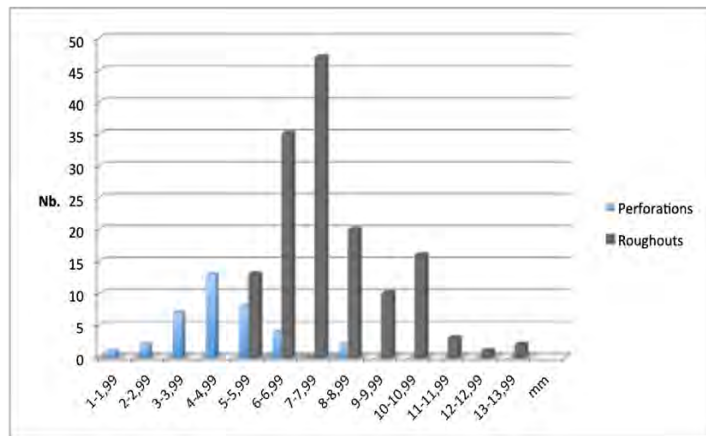


Figure 7. Width of the perforations on *Cerastoderma glaucum* from the Early Neolithic (n = 6) and from the Middle Neolithic (trench O5) and compared to the width of intact roughouts from L5 (there were no perforated *C. glaucum* in L5).

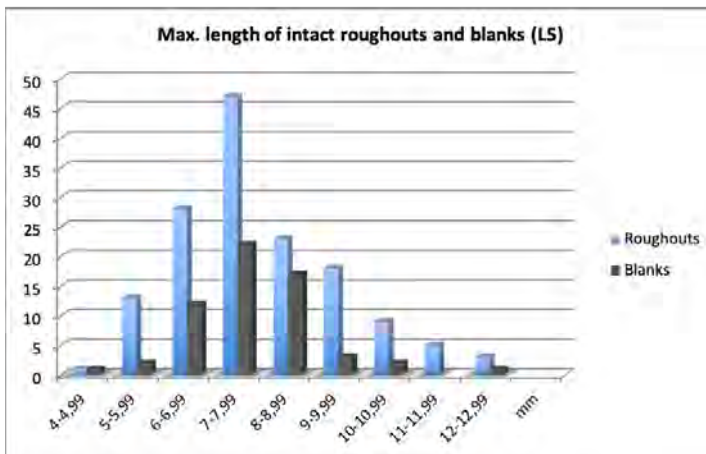


Figure 8. Distribution of the length of intact roughouts and blanks in trench L5.

Half of the resulting roughouts are almost perfectly circular (Pl. 2). In this case, the contour had been regularised by rough abrasion that removed the ridges between the negatives of the microchipping (Pl. 3). The others are polygonal, often retaining an original, unworked fracture on part of the periphery (Pl. 2 and 3). The lack of regularisation at this stage would entail, if work was continued, more intensive effort through abrasion to reach a circular shape.

- *Blanks* (n = 160):

The blanks are preferentially manufactured on circular roughouts. However, a fair number of polygonal blanks have also undergone abrasion (Pl. 5). Like the roughouts, the mode of the length is between 7 and 8 mm (Fig. 8), corresponding to the smaller beads, but the deficit in larger specimens is even more pronounced.

The abrasion of the dorsal face is quasi systematic, not only with aesthetic intention but for functional needs: it reduces the thickness before perforation and helps avoid breakage during the perforation (Ricou and Esnard 2000: 90). Abrasion of the ventral face, at least at this stage, only concerns blanks manufactured from the most convex part of the shell.

The abrasion of the dorsal face can be complete, leaving no visible traces of the original ribs. It can be incomplete, with ribs abraded but still visually perceptible, or partial, with ribs or grooves still present on the periphery (Pl. 5). The presence of faint grooves on some of the beads shows that this was not an obstacle to the completion of a bead provided the face was flat.

The abrasion was possibly done on successive grinding stones of different hardness (Wright *et al.* 2008), but the resulting surface is usually smooth, indicating a fine-grained grinding stone (see Stroulia 2010). The striations are usually oblique in relation to the ribs, sometimes in two overlapping directions.

On the whole, the abrasion of the face(s) substantially reduced the thickness of the piece: in L5, the mean maximum thickness drops from 2.25 mm on intact roughouts (sd = 0.59) to 1.5 mm on blanks (sd = 0.49).

- *Preforms* (n = 79): Preforms are mostly polygonal in shape. The few intact preforms have a larger maximum length than roughouts and blanks (m = 8.06, sd = 0.8) but their size actually varies far more, the distribution is not Gaussian, and several preforms have an unusually large size (Fig. 9). Similarly, they are often chosen from among the thicker blanks (m = 1,78 mm, sd= 0,4).

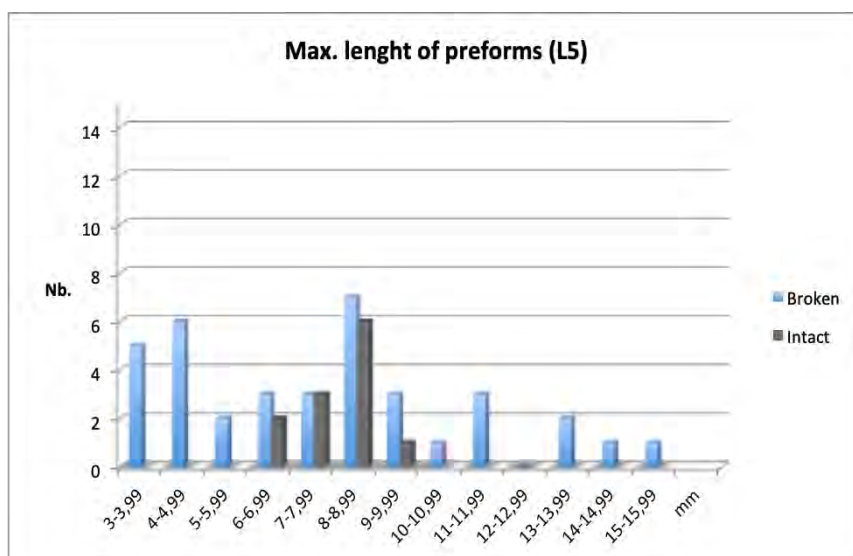


Figure 9. Maximum length of preforms in trench L5.

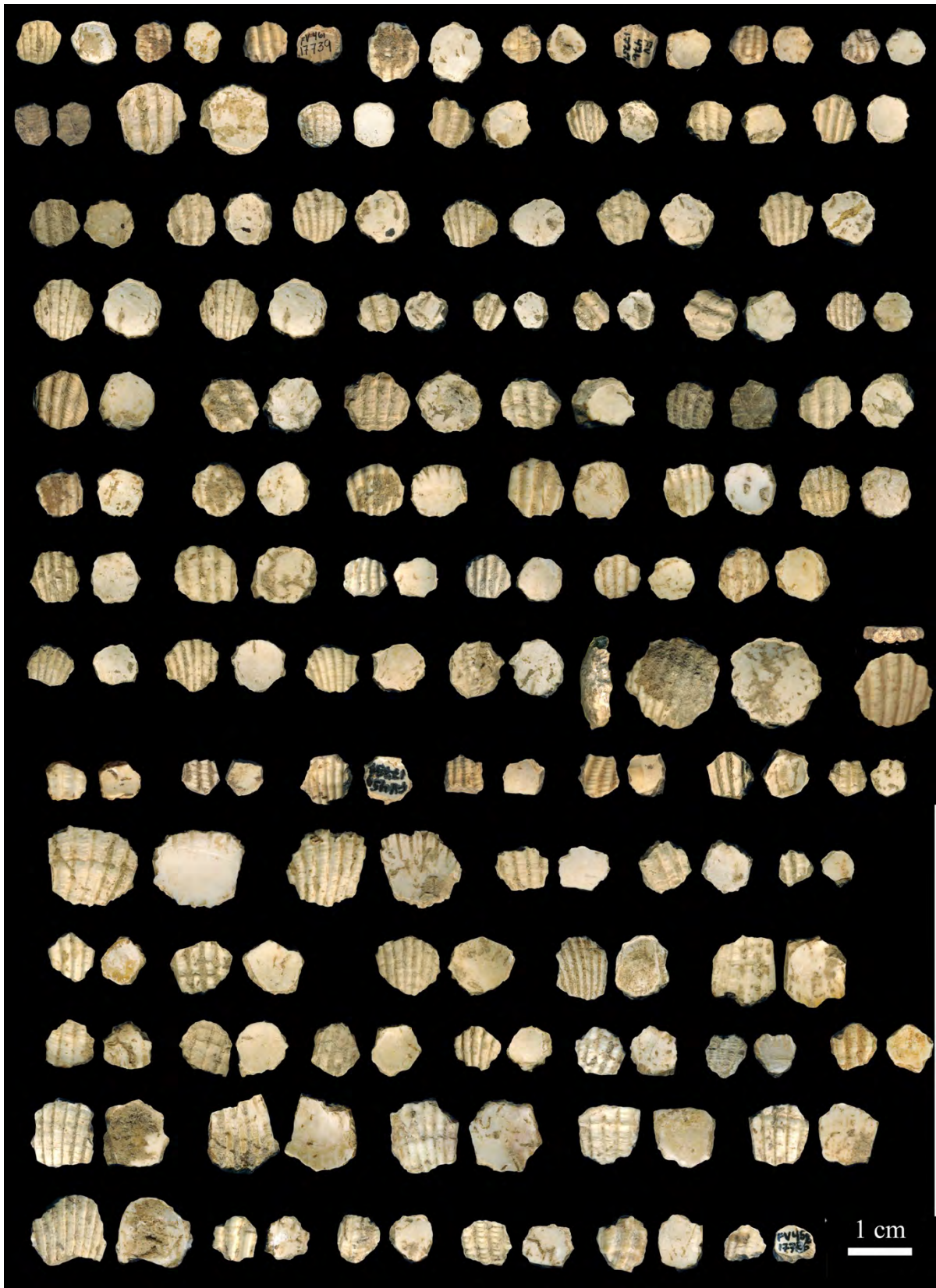


Plate 2. Circular and polygonal roughouts from trench L5.



Plate 3. Details of roughouts from trench L5. Ca. 3x.

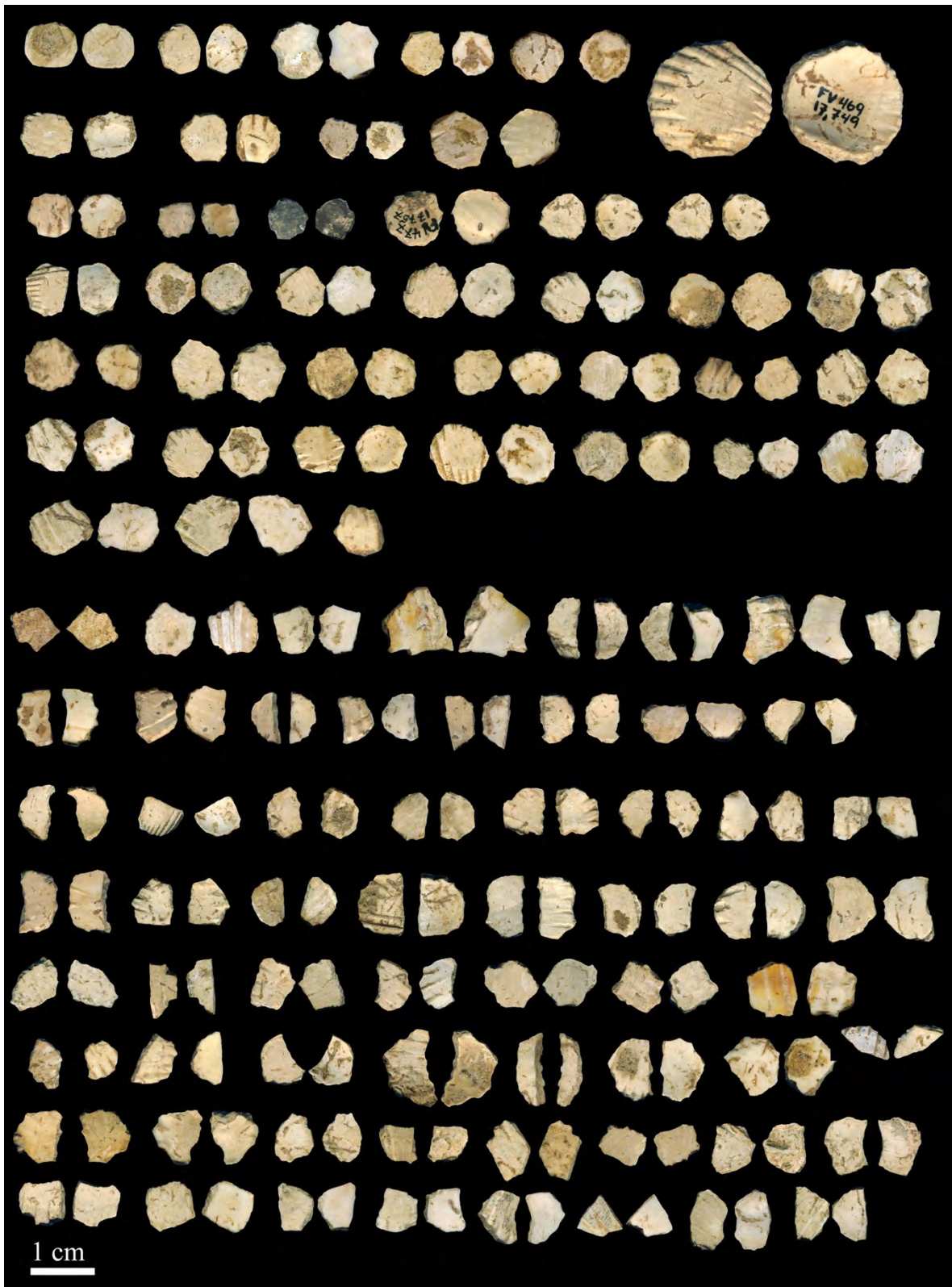


Plate 4. Blanks from trench L5.



Plate 5. Details of blanks from trench L5. Ca. 3x.

The perforation is done with a mechanical drill—oscillatory hand-held drill, bow drill or pump drill— from the ventral face, sometimes initiated by pecking. The perforation is usually unifacial. It frequently provokes some chipping around the hole on the dorsal face, which can be erased by reaming (Pl. 6, 7).

There are too few intact preforms in L5 to document the diameter of the perforations, and the following graph is based on intact preforms for all trenches. The diameter of the hole of the perforation varies from 1,1 to 2,2 mm (Fig. 10). It is not correlated with the diameter of the preform, and only weakly correlated with its thickness (corr. 0,5).

- *Unfinished and finished beads* (n = 15 and 13): beads, finished and unfinished, are defined by the abrasion of the side (also called edge or periphery). This was done with a finer grinding stone than the coarse and partial

abrasion at the roughout stage on circular specimens. When the abrasion of the sides is incomplete or leaves asymmetries in the contour, the piece is defined as an unfinished bead. Finished beads show a complete abrasion of the side and perfectly circular contour. Striations indicate a transverse motion. Remnants of facets on unfinished beads and the absence of standardisation of the diameters point to an individual, hand-done abrasion. The dorsal face also usually receives a final abrasion, sometimes leading to a polish. This is less systematic for the ventral face.

The diameter of the hole of the perforation on complete beads varies from 1,1 to 1,9 mm (Fig. 11). It is not correlated with the diameter, but contrary to preforms, it is correlated to the thickness of the bead (corr. = 0,76 with one outlier excluded).

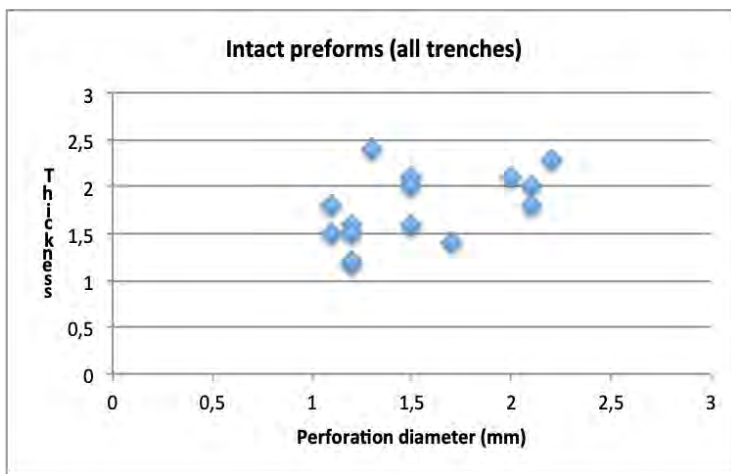


Figure 10. Relation between the thickness of the preform and the diameter of the hole in the perforation.

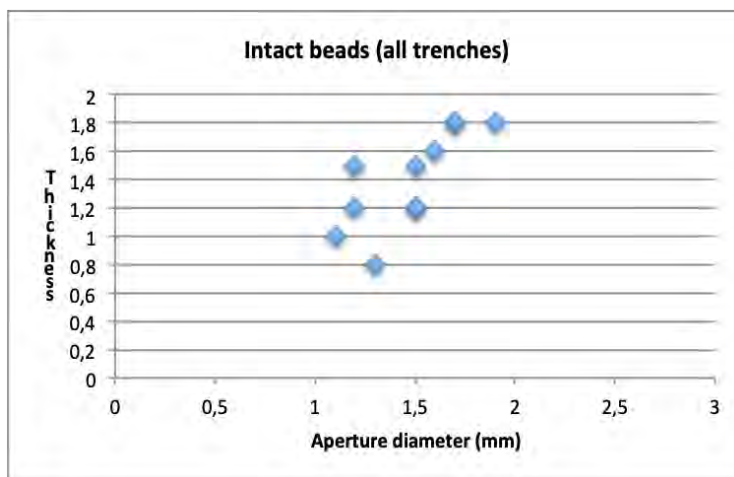


Figure 11. Relation between the thickness of the bead and the diameter of the hole in the perforation.



Plate 6. Preforms from trench L5.

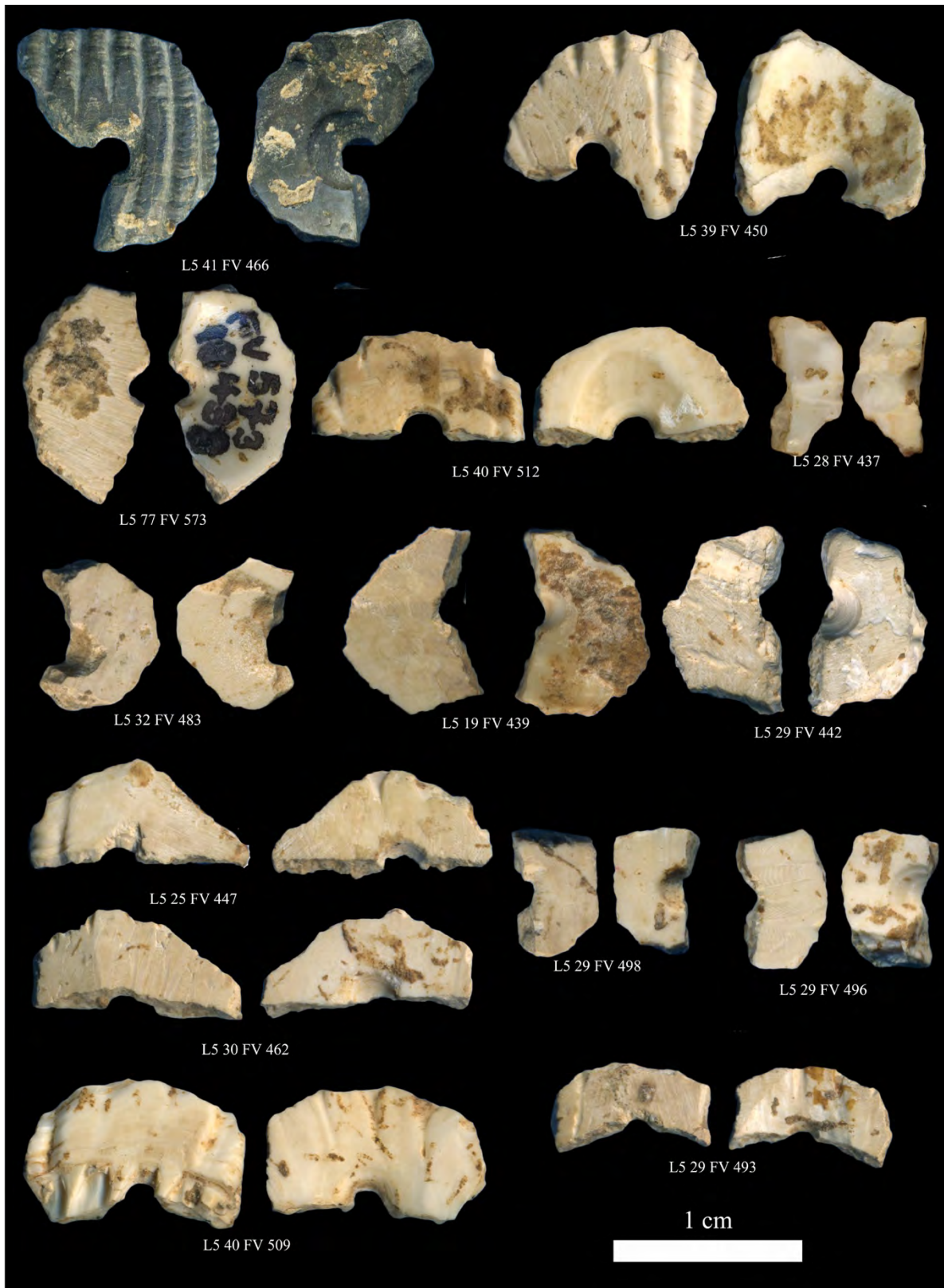


Plate 7. Details of preforms from trench L5. Ca. 3x.

Deviant specimens

Within this broad operational framework, the examination of the whole assemblage reveals, at all stages, a number of anomalous specimens that either do not follow the normal sequence of operations, or could never have been turned into a finished bead.

Some of the roughouts are too small compared to the final dimension of the finished beads. A few appear too large and would have entailed considerable work of abrasion even for the larger beads. Similarly, some are very irregular in shape and do not meet the standards of well-manufactured roughouts. The same applies to some of the blanks that were nevertheless abraded, and would have required a tedious phase of abrasion of the side to become circular (Pl. 4, 5). In a few cases, the ventral face was abraded, not the dorsal one. In rare cases, the side was polished before the blank was perforated, despite a high risk of breakage during the perforation.

All these problems appear even more acutely on the preforms: whereas regular circular roughouts and blanks are numerous, no regular circular preform was recovered. Basically all preforms were made from blanks that could never have been turned into a bead of standard shape and dimensions: they are too small, too large, irregular, very far from a circle, and, as a whole, rather thick (Pl. 6, 7). A few were perforated when the dorsal face had not been abraded, or are too curved to produce a bead with parallel faces (Pl. 8). To this should be added the problem of frequent off-centre perforation that made it impossible to turn the preform into a bead of normal dimensions. Furthermore, the diameter of the perforation is very variable, and, as we have seen, only weakly correlated with the thickness of the preform.

Unfinished beads also reveal a few complete outliers: they are too large or too thick, and again, too far from a circle. A particularly thick one was awkwardly polished before perforation, and broke during perforation (Pl. 9).

Learning the skill: novices practicing

All these anomalies are incompatible with the work of artisans that produce beads in large number and are familiar with the production of cockle-shell beads. Conversely, they demonstrate a lack of know-how and skill that corresponds well to what J. Arnold expected to find in the work of apprentices.

The criteria used by J.E. Arnold (2012: 286) to characterize the work of apprentices, considered mostly children, on the hard *Olivella* shells, are not all applicable to the simpler production of cockle-shell beads. Several, nevertheless, are and have indeed been observed in our sample:

- “Substandard shell raw material is selected (should occur occasionally)”: this applies to the few instances of very convex portions of shells.

- “Asymmetries in blank chipping (should occur with some frequency; perimeters with notable flaws)”: cf. irregular roughouts, blanks and preforms.

- “Poor placement of the perforation”: cf. off-centre perforations on preforms and unfinished beads.

- “Incomplete first and/or subsequent perforations (should occur with some frequency; failed to finish perforation)”: contrary to this expectation, we only observed five or six definite examples of incomplete perforations. It appears, on the contrary, that many perforations went too far and broke the piece.

- “Blanks too small (should occur occasionally)”: this was observed on ca 27% of our roughouts and blanks, as defined here, which, if the work had continued, would have been under the minimum dimension of the beads recovered. It would also have been difficult to polish the side by hand. However, the small dimension is not the only problem we observed on the choice of blanks for perforation: many, as stated before, are irregular in shape, too large or too thick. It seems that many were picked up to practice perforation, with no intention of producing a finished bead.

- “Breakage during chipping or drilling (should occur at a very high frequency; drilling is the most difficult step)”: in the waste recovered, 19% of the roughouts, 53,5 % of the blanks and 73% of the preforms are broken. The percentage for the roughouts is undoubtedly underestimated, since broken roughouts can easily be confused with unworked fragments. The very high rate of broken preforms confirms that this stage entailed the highest risk of breakage, and the rate is close to that given by Arnold for Olivella beads (Arnold 2012: 299).

- “Specimens not finished and perimeters not ground (should occur at a very high frequency) and the ratios of unfinished beads to completed beads should exceed 4:1”: in the Franchthi Early Neolithic cockle-shell bead production, finished beads only represent 3,6%. We are far from a ratio of 4/1, but actually close to the figures observed by

Arnold herself (1 to 18% in the different houses studied).

- “Apprenticing routinely occurs in proximity to skilled adult mentors at and around domiciles”. The mix of anomalous specimens and well-prepared roughouts and blanks, together with the few complete beads, confirms the presence of both skilled and unskilled producers. Both can be detected in all trenches where cockle-shell bead production took place but, if we refer again to the number of drills, a difference can be observed at the two extremities of the Paralia. In L5, the number of drills roughly equals that of *Cerastoderma* waste. In Q/R, the number of drills is much higher than the number of waste (Fig. 3). In addition, the proportion of intact roughouts compared to broken ones is lower in Q/R than it is in L5 (Figs. 6 and 12), suggesting that more roughouts went through the whole process to finished beads.

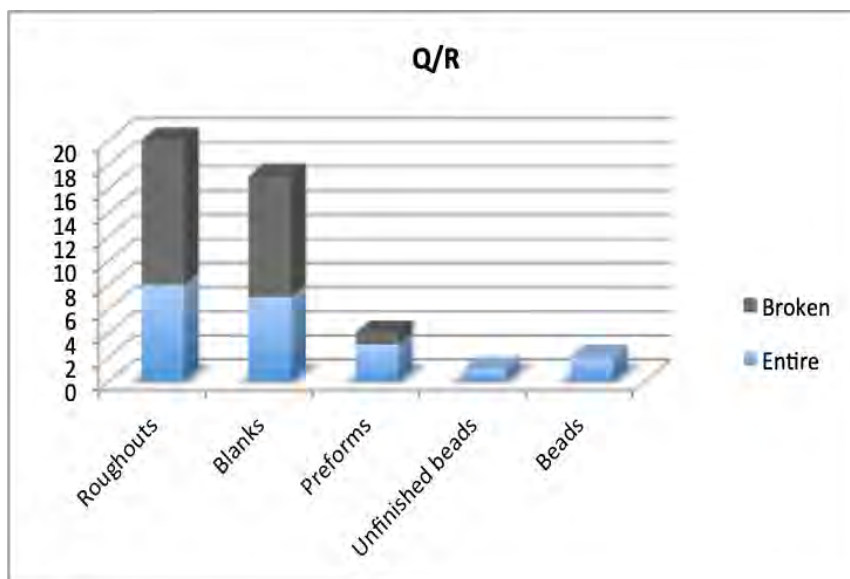


Figure. 12. Distribution of the material by manufacturing stage in trench Q/R.

Although the sample from Q/R is small, the two observations taken together suggest that a proportionally higher number of finished beads were produced in Q/R and left the site. In other words, skilled producers would have done most of the work in Q/R. Conversely, the

work of novices would be proportionally more important in L5. This spatial segregation between specialists and apprentices has been occasionally observed in flint knapping (Pigeot 1987).

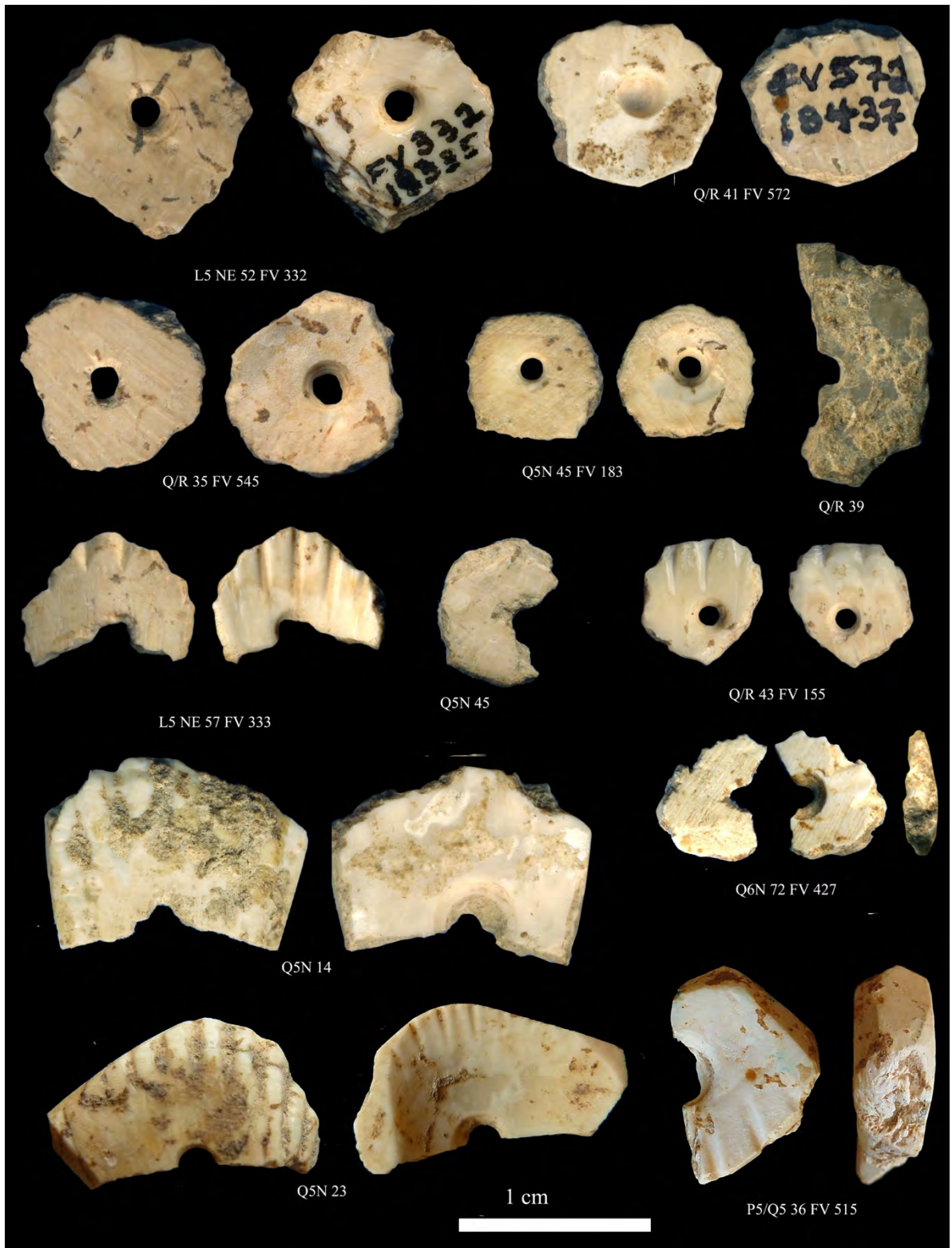


Plate 8. Details of preforms from trenches other than L5. Ca. 3x.

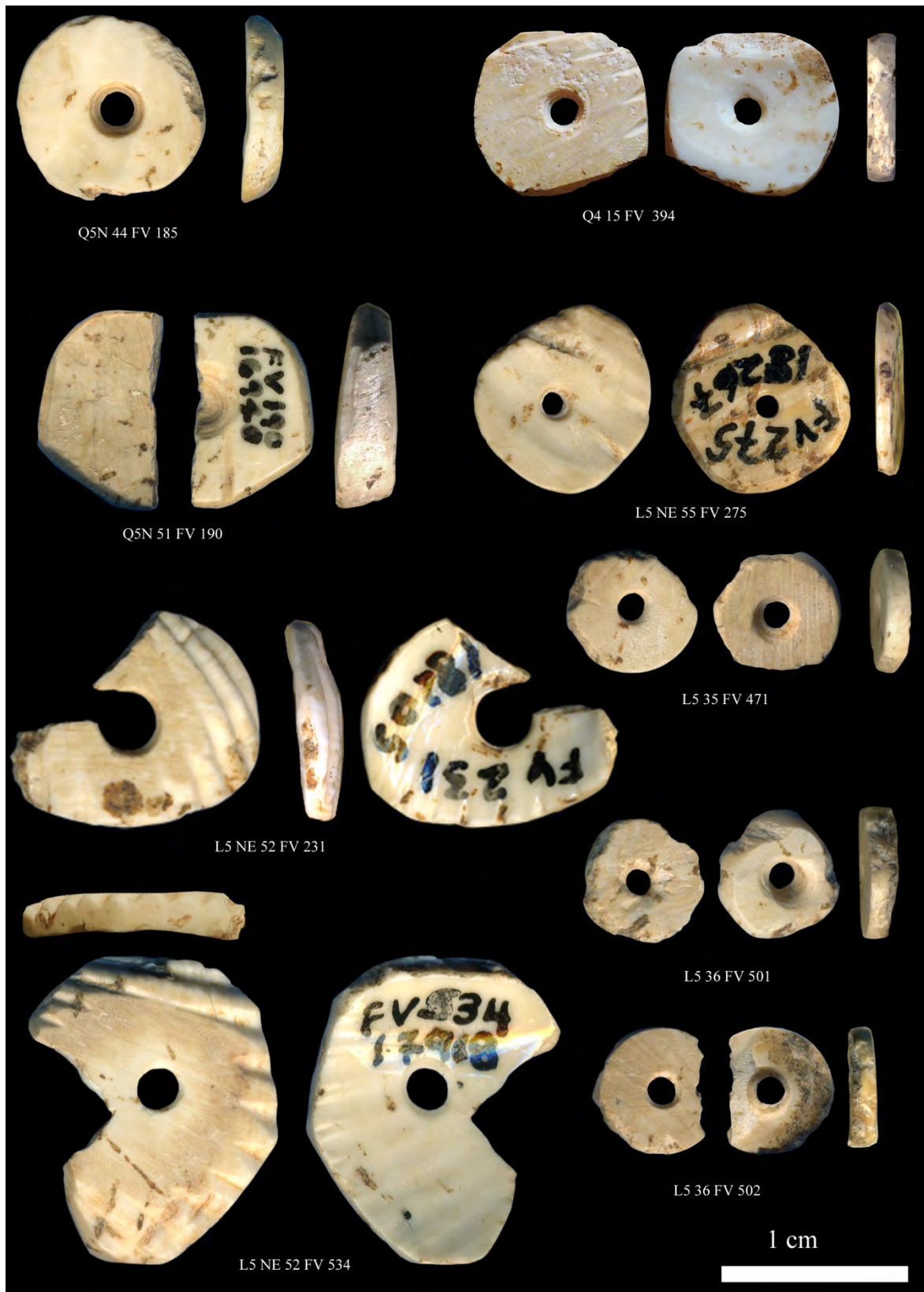


Plate 9. Unfinished beads from various trenches. Ca. 3x.

Conclusion

The cockle shell bead production waste clearly exemplifies very different levels of know-how and skills. More than half of the roughouts (55%) and a third of the blanks (30%) are unbroken and circular in shape, demonstrating a good control of the manufacturing process. These can be attributed to skilled artisans, together with the few remaining finished beads. The very high number of beads that, according to the number of drills, are missing, leads us to consider their makers as specialists, essentially producing for exchange. The hypothesis of a specialised production in an Early Neolithic context should not be considered anachronistic: it has already been put forward for obsidian flaked tools in Greece (Perlès 1990) or, for instance, for flint blades in Italy (Guilbeau 2011) and Western Europe (Allard 2012; Denis 2017).

Other roughouts, blanks, and especially the preforms show a mediocre or low level of craftsmanship. There is no doubt that among the artisans some may be less skilled than others, or occasionally paid less attention to their work. However, adults that know the operational sequence and its technical constraints would not engage in a manufacturing process that they know impossible to conclude. Alternately, the production of small discoid beads, which necessarily need to be produced in large numbers to be visible when strung, requires a standardisation of procedures that, in turn, requires an apprenticeship. The material remains of apprenticeship should be best looked for where competent artisans practice their skill regularly (Arnold 2012 and refs. therein; Klaric 2018 and refs. therein). In this respect, the deviant or awkward waste from Franchthi meets all the expectations of J. Arnold to define the work of apprentices.

There are reasons to think that the latter did not initially try to realise the complete operational sequence from fragment to bead, but practiced each stage independently and concentrated on the motions rather than the

end product. This is the case, in particular, when roughouts or blanks were worked beyond the what was necessary for the manufacture of a bead, or when inadequate blanks were nevertheless perforated and, in most cases, broken. The use of inadequate raw materials or blanks for practicing is not restricted to bead manufacture, but, on the contrary, is one of the most frequent aspect of apprenticeship in lithic production (Bamforth and Finlay 2008; Klaric 2018).

However, beyond this common feature, the process of apprenticeship must have differed importantly between the two domains. First, the production of cockle shell beads is much simpler than the production of stone blades or Levallois flakes, for instance. It does not rest on particular know how and skills and was undoubtedly much faster to learn: a few weeks versus several years. It may, on the other hand, have started at a more advanced age than flint knapping. Certain stages of the operational sequence, in particular the shaping of the roughouts by percussion and the drilling of the perforation, require good neuro-motor coordination. Controlled experiments with children of different ages, as implemented for stone flaking (e.g. Stout and Chaminade 2007; Stout *et al.* 2008; Geribas *et al.* 2010), would shed light on the potential timing of the initiation to the different stages of production. Even young children could practice breaking the shells to produce usable fragments, and, as soon as they are strong enough, on abrading the blanks. If, as argued here, they have to wait longer before they can learn how to shape roughouts and drill perforations, the idea of a segmented learning process is reinforced.

A second difference, at least from Palaeolithic flint knapping, pertains to the context of apprenticeship: every member of the group in the Palaeolithic had to learn how to produce the basic flaked tools needed in everyday life. A specialised production, on the other hand, can be restricted to a few members of the group. At Franchthi, the number of waste and drills does not suggest a large number of artisans: Ricou and Esnard (2000) produced

several thousand finished beads during their experiments. A restricted number of specialists would go hand in hand with a limited number of apprentices and explain why, besides the fact that an apprentice of the right age would quickly become a competent artisan, the amount of deviant waste can be considered low: the majority of roughouts are well made, and unsatisfactory specimens only predominate in the preforms, the most difficult stage of the operational sequence that required the most intensive practice. This leads us to see the production of cockle-shell beads at Franchthi not as specialised craft that concerned the whole community, or even many villages, as was the case in the Channel Islands, but as a part-time activity restricted to a few individuals. The fact that no sign of specialised production can be detected in the other types of ornaments supports this perspective and reinforces the idea that the organisation of production, within a single Early Neolithic community, was more diversified and subtle than traditionally assumed (Perlès and Vitelli 1999).

All crafts must be learned, and novices leave traces behind them. This has long been forgotten, and it took even longer to realise the full implications of this simple statement. Taking into account the potential presence of apprentices leads to a reassessment of the levels of skills in a given assemblage, opens up perspectives on transmission processes and sheds new light on the socio-economic organisation of past societies.

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