LITHIC INDUSTRY FROM THE ACERAMIC LEVELS AT KNOSSOS (CRETE, GREECE): AN ALTERNATIVE APPROACH

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Abstract

The paper deals with lithic artefacts from aceramic levels excavated by J. Evans at Knossos (layer X) and offers an alternative interpretation to that proposed by J. Conolly (2008). A series of 376 artefacts from the collection of the British School in Athens (Stratigraphic Museum in Knossos) has been analyzed in terms of raw materials, technology (notably: reduction sequences and their stages carried out on-site and off-site), also morphological structure of retouched tools.

The assemblage from layer X at Knossos is compared with Mesolithic industries and the Initial Neolithic in the Peloponese (especially phase X in Franchthi Cave), with the Mesolithic of the Aegean islands and with the Pre-Neolithic flake industries from Cyprus. Moreover, the relation of the Aceramic assemblage (Initial Neolithic) to the chipped stone industry from Early Neolithic I from Knossos has been examined and a number of common features of technology and tool morphology are pointed out.

Key words: Aceramic Neolithic, Initial Neolithic, Early Neolithic, Eastern Mediterranean, Aegean Mesolithic.

INTRODUCTION

The investigations by J. Evans at Knossos revealed that below the Ceramic Neolithic layers there were Aceramic layers which yielded a series of lithic artefacts. In the works of J. Evans (1964, 1968, 1971) these artefacts were cursorily mentioned, whereas J. Conolly (2008) published a monographic study of chipped stone artefacts from the Aceramic (Initial Neolithic) layers. In the present work we would like to re-appraise these materials kindly placed at our disposal by J. Evans and the British School of Athens, however our methodological premises are somewhat different than those of J. Conolly.

The chipped stone artefacts in the ceramic layers come from the trenches in the Central Court of the Palace namely: trenches AC, X and ZE. The thickness of the aceramic level is different in the various trenches: in trench AC it is very thin, while in trench X it is very thick. At first, J. Evans thought that the site from the Aceramic Phase was the remains of a short-term camp. Subsequently, however, remains were discovered of a structure from clay, stones and sundried bricks, which compelled J. Evans to revise his opinion. The aceramic settlement is situated on the culmination of the hill, and in subsequent ceramic phases are spread to the northern slope of the hill.

RAW MATERIALS STRUCTURE

In the inventory from layer X – 376 artefacts have been examined. The most important raw material is Melian obsidian (262 – 69.7%), siliceous rocks are next (114 – 30.3%) (Fig. 1). Analysis of trace elements shows that obsidian from the island of Melos in the collection from J. Evans’s investigations comes from deposit areas near Adamas (Cann and Renfrew, 1965). Recent analysis of the few artefacts from the aceramic layer at Knossos, from the investigations by N. Efstratiou et al.
(2004) has indicated that some obsidians may also come from the deposits near Demenegaki.

Among the siliceous rocks there are various types of radiolarite (red, yellow, greenish, grey), weakly transparent, bluish chalcedony, black menilithic shales, quartz and quartzite, and single items of flints: brownish and yellow-brownish. The obsidian is obviously extralocal, but we were unable to identify the location of deposit areas of siliceous rocks. Some rocks such as quartzes and radiolarites come from alluvial deposits, most probably in the vicinity of the site. It should be stressed, that the site itself is situated on Eocene sediments; to the east and west there are Mesozoic limestones where one might expect to find radiolarites or other siliceous rocks.

THE STRUCTURE OF MAJOR TECHNOLOGICAL GROUPS

The structure of major technological groups is given in Fig. 2. The small frequency of cores is characteristic. Together with the relatively low index of flakes 29.0% (calculated without chips; flakes and splinters taken together – 46.8%) it indicates limited on-site production. It is uncertain whether splinters were intentional blanks or merely waste from utilizing splintered pieces as tools. Splintered pieces (19.1%) are more numerous than cores. The frequency of blades, both obsidian (8.0%) and from siliceous rocks (7.9%), is relatively low. If we consider the presence of fairly large blade tools, we can assume that blades were produced off-site or that blade tools were brought to the site from elsewhere.

The structure of major technological groups departs from standard of on-site production. This implies that either access to raw materials was difficult (the acquisition of obsidian from Melos was unsystematic, while the knowledge of local sources of siliceous rocks was poor) or – finally – that specific activities at the site required the use of small splintered pieces and splinters.

One may presume that the group of settlers arrived at the site with completed tools and a small store of obsidian; only a small number of non-standardized tools was produced at the site, and splintered pieces functioned as tools.

It should be emphasized that there are no major differences in the scatter pattern in relation to the frequency of the types of artefacts in the different zones of the Aceramic settlement. Only obsidian in trench X and siliceous rocks in trench AC, show a slightly higher proportion.

Coring techniques

In the Aceramic layers at Knossos a small number of cores was registered: in trench X – 4 specimens and one modified into a splintered piece (all of obsidian), in trench ZE – 2 specimens (from radiolarite), and in trench AC – 2 specimens (one from chalcedony and one from obsidian). We can assume that most blanks were produced off-site,
whereas debitage products made on-site were the result of the splintered technique which was broadly applied in the Aceramic Neolithic.

The presence of macroblade technique has been confirmed by, in fact, only one fragment of an obsidian core transformed into a one-sided bipolar splintered piece. On the opposite side of the specimen there are the proximal parts of two large blade scars (2.0–2.2 cm broad) with the axis perpendicular to the axis of the splintered piece (Pl. I.1). In his study J. Conolly (2008: fig. 5.3a) interpreted this specimen as a simple splintered piece missing the core stage of its reduction.

A chunk of grey chalcedony with two long scars with blade proportions is an initial form of a core whose further reduction was practically impossible. The blade proportions of its scars are due to the shape of the chalcedony chunk (Pl. I.2).

Mediolithic blade-flake technique (2.5–4.5 cm) is represented by an initial double-platform core on a thick flake from red radiolarite; one of the platforms is single-blow and could have initiated lateral preparation (Pl. I.3). This is the only specimen that in J. Conolly’s study is correctly identified as a core (Conolly, 2008: fig. 5.1b).

Core reduction using flakes is represented by a small obsidian blade-flake single-platform core reduced perpendicularly to the flake axis (Pl. I.4).

An obsidian splintered piece, bipolar, with parallel scars was misinterpreted by J. Conolly (2008: fig. 5.1a) as a core.

Mediolithic flake technique is represented by only one change-of-orientation (90 degree) core in an advanced phase of reduction. It is fairly flat, with a Clactonian notch on one lateral side (Pl. I.5); made from red radiolarite.

Three obsidian, residual cores (all found in spit 24, trench X) were reduced by means of microlithic flake technique:

– a flat core on a flake, with an unprepared platform (Pl. I.6),
– a similar, flat core in the residual phase exploited as a splintered piece (Pl. I.7),
– a flake detached from a flat, single-platform core removing the entire flaking surface; the platform was only partially prepared (Pl. I.8).

A small fragment of a core from grey radiolarite also belongs to the Aceramic Phase.

Thus, core reduction in layer X combined the characteristic features of blade and of flake techniques. In order to produce blanks on-site splintered technique was the prevailing method. Cores on flakes and the use of splintered technique in the final phase of reduction are characteristic.

**Splintered pieces**

The Aceramic Phase layers contained 72 splintered pieces which is 19.2% of the inventory. Most splintered pieces are obsidian specimens (56). The proportion of obsidian in this inventory group is somewhat higher (77.7%) than the average for the whole assemblage (70%). Splintered pieces were produced from blades (6 specimens – Pl. I.9), flakes (15 specimens – Pl. II.1), from core fragments or cores in the final phase of reduction (two specimens); however, because most splintered pieces are entirely covered with scars the initial products could not be recognized.

Both among splintered pieces from siliceous rocks and those from obsidian the most frequent types are bipolar, two-sided items (Pl. II.1); one-sided splintered pieces are sporadic (Pl. II.2). Unipolar specimens, usually made on blades, are less frequent. Only one quadripolar specimen was registered (Pl. II.3).

The splintered pieces are from 14 to 36 mm long, and from 6 to 23 mm broad. Obsidian specimens are smaller; they are usually from 14 to 16 mm long and from 12 to 15 mm broad. These dimensions are consistent with the dimensions of obsidian splinters. The diagram of length of obsidian splintered pieces and splinters shows a tendency towards standardization (Fig. 3). However, the question as to the function of the splintered pieces still remains an open one. Were they tools or were they utilized to obtain blanks? Only few splinters were modified into retouched tools (three specimens). Residual splintered pieces are often prismatic. From the sides of such splintered pieces – at the final stage – splinters were detached that resemble a kind of “pseudo-burin spalls” (Pl. II.4).

**Flakes**

Flakes (together with splinters) account for 46.8% of all artefacts. Such a proportion and the very small number of cores rule out intensive on-site production. In all likelihood some flakes were brought to the site in a completed form. In the case of obsidian the high proportion of splin-
ters points to a major role of splintered technique applied on-site – more often on obsidian than on siliceous rocks. A number of authors suggest that the use of this technique does not express a knapping tradition but results from difficulties in raw materials procurement and the need for their thrifty exploitation. To what extent splinters in the analyzed series were the goal of production (i.e. blanks *sensu stricto*) or waste from utilizing them as tools cannot be established with certainty.

The length of obsidian flakes is from 13 to 42 mm, but about 60% of intact flakes are small from 14 to 19 mm long (Fig. 4). The dimensions of obsidian splinters are similar. In the group of splinters there are numerous specimens with slender proportions (as much as 70% show the width/

![Fig. 3. Knossos. Length (in mm) of splintered pieces and splinters in aceramic layer X](image)

![Fig. 4. Knossos. Length (in mm) of obsidian and non-obsidian flakes from aceramic layer X](image)

![Fig. 5. Knossos. Length: width ratios of flakes and splinters from layer X](image)
length index: 50–100); in the case of flakes only 47% of specimens (Fig. 5) Obsidian splinters often have blade proportions, especially when they were detached from the lateral side of a splintered piece with a polygonal cross-section; they are long, fairly thick (pseudo-burin spalls).

Among artefacts from the various siliceous rocks flakes are slightly larger – nearly 40% of the specimens are between 20 to 30 mm long. Splinters from siliceous rocks are smaller than flakes.

Obsidian flakes were detached from single-platform cores. Flakes from early phases of core shaping do not occur (only one cortical flake was recorded), whereas flakes with scars perpendicular to the flake axis are fairly frequent (25% – Fig. 6). They evidence change of orientation of cores in advanced phases of reduction. In the final phase of reduction obsidian cores were modified into splintered pieces.

Between platforms most frequent are single blow platforms. Less numerous are punctiform platforms; very rare are unprepared (particularly between obsidian specimens) and faceted platforms (Fig. 7).

Cores made from siliceous rocks were brought to the site in the early phase of exploita-

Blades

Blades (31 specimens) are only 8.1% of the Aceramic Neolithic series. The proportion of blades in the group of obsidian artefacts and in the group from siliceous rocks is the same. Most obsidian blades are irregular, and small. Their length
is from 15 to 24 mm, width from 3 to 7 mm. The specimens are fairly robust, the edges and the interscar ridges are irregular. Majority of the blades have unidirectional dorsal pattern.

Blade butts are single-blow or punctiform. The presence of tools made from relatively regular blades, more than 24 mm long, allows to assume that they were produced off-site and were brought to the site as completed items. Because the series of blades from siliceous rocks is small (9) we cannot draw overall conclusions as to the method of their production. Some of these blades must have been larger; unfortunately only fragments have been preserved such as, for example, a radiolarite specimen (trench X spit 24) longer than 34 mm. A blade with a prepared butt indicates the existence of cores whose preparation was more advanced.

Tools

Tools are, as a rule, mostly made from flakes, tools from blades, splintered pieces and splinters are next in number. The blanks used for the production of both blade and flake tools are larger than blanks commonly found. Blade tools length are between 21 and 45 mm long; majority are longer than 21 mm. Dimensions like this suggest that the tools were brought to the site as completed products. Only some flake tools, tools on splinters and splintered pieces could have been made at the site. The proportion of obsidian in the tool group is higher than in the entire inventory (76.1%).

Retouched tools (47 specimens) are represented by the following techno-morphological groups: backed pieces (7), truncations/microliths (2), a backed piece+end-scraper (1), end-scrapers (2), retouched blades and fragments (6), flakes and retouched splinters (21 – including specimens with notches), retouched splintered pieces (6), and sickle inserts (2).

Backed pieces

In trench X there were 4 backed pieces, in trench ZE – 2, and in AC – 1. Four specimens are made from obsidian, three from radiolarite. The backed pieces were made on blades; in respect of the shape of the blunted back we can distinguish:

– mediolithic arched backed pieces, with a slightly convex blunted back shaped by steep, marginal retouch. In two cases the retouch is unidirectional, obverse (Pl. II.5, 6), and in one it is obverse/inverse (Pl. II.7). In the last case the retouch cuts the blade up to its maximum thickness.

– the mesial part of a weakly convex backed piece on a macroblade; steep, marginal retouch. The blade was intentionally shortened by two fractures from the dorsal side. Partial inverse retouch on the lateral side (Pl. II.8),

– an arched backed piece on a mediolithic, fairly broad blade; inverse lateral and distal retouch (Pl. II.9),

– a backed piece with an angulated blunted back (dos anguleux) shaped by proximal, steep inverse retouch and fine, distal, semi-steep obverse retouch (Pl. III.1). This specimen could also be interpreted as an oblique proximal truncation,

– an asymmetrical backed piece à dos anguleux with steep lateral inverse retouch and inverse/obverse proximal retouch (Pl. III.2).

Truncations/microliths

They are represented by only two specimens:

– a microlithic double truncation from obsidian that can be ascribed to asymmetrical trapezes. The truncation is oblique, proximal, and distal on a transversal break (Pl. III.3).

– a double truncation on a blade from radiolarite. The truncations were shaped by steep denticulated retouch. It could be interpreted as a kind of an asymmetrical trapeze (?) (Pl. III.4).

A backed piece + end-scraper

A unique tool is an arched backed piece on an obsidian blade with a kind of end-scraper shaped in the distal part. Possibly, this had been an arched backed piece whose tip had been damaged and which was transformed into an end-scraper (Pl. III.5).

End-scrapers

The only two end-scrapers are atypical:

– a damaged end-scraper on a large obsidian flake detached from a double-platform core. The front was broken off: only its lateral fragment remained (Pl. III.6),

– a fragment of a small end-scraper on a core or on an obsidian splintered piece. The front is low and nosed (Pl. III.7).
Re touched blades

All the re touched blades (6) were made from obsidian:

– a blade detached from a double-platform core with partial lateral, mainly inverse, but also obverse, retouch (Pl. III.9),
– a distal fragment of a blade with fine, semi-steep obverse retouch on one edge (Pl. III.8),
– four small, mesial fragments of blades with lateral obverse retouch of one edge: one specimen has two fractures (Pl. IV.1), and the three others a fracture and a break (Pl. IV.2,3). One of them (on a macroblade) has partial retouch extending onto the distal break (possibly an end-scaper?).

Flakes and re touched splinters

The majority are obsidian specimens (14), three from radiolarite, and others from black menilithic shale, chalcedony and quartz one each:

– 6 specimens are with lateral retouch: fine-continuous (possibly pseudo-retouch) (Pl. IV.4), fine, lightly notched, discontinuous (Pl. IV.5), proximal semi-steep (Pl. IV.6,7), continuous inverse (Pl. IV.8), or discontinuous, bilateral obverse/inverse (Pl. IV.9),
– a flake with concave proximal retouch and a thinned base (Pl. IV.10),
– a small flake with fine distal retouch (Pl.V.1),
– a distal part of a flake with fine, bilateral obverse retouch (Pl.V.2),
– a flake with denticulated lateral-transversal retouch; from black menilithic shale,
– three splinters with partial lateral retouch : fine inverse (Pl.V.3), partial obverse (Pl.V.4), and with two flat inverse scars (Pl.V.5),
– three re touched flakes: two flakes with ventral retouch of which one is from radiolarite and the other from obsidian; a fragment with dorsal retouch also from obsidian,
– four flakes with retouched notches: two with single notches (one is from chalcedony, the other from radiolarite), and two with double notches: a radiolarite flake and an obsidian flake which has not been found in the collection but which was published by J. Conolly (2006: fig. 17a),
– to this group was also ascribed a flake detached from a quartz pebble with a proximal notch (Pl. V.6).

Retouched splintered pieces

The three re touched splintered pieces were made from obsidian:

– three bipolar two-sided specimens with fine unilateral retouch (Pl. V.7,8),
– a small bipolar, two-sided splintered piece with bifacial retouch of one lateral side (Pl. V.9),
– a residual splintered piece with denticulated retouch (Pl. V.10), and a fragment of a similar splintered piece, also with denticulated retouch (Pl. V.11).

Sickle inserts

Two specimens could have been used as sickle inserts. A small bladelet from radiolarite had denticulated utilization retouch and oblique silica gloss (Pl. V.12). This is probably the only bladelet in the collection produced by pressure technique and could be an intrusion from younger layers. This bladelet was found in spit 26 trench AC. An obsidian blade could have been utilized in a similar way; it has flat dorsal retouch and semi-flat ventral retouch (Pl. V.14). The type of retouch allows as to assume that this specimen is an intrusion from the younger, Ceramic Neolithic layers; although it was found in spit 22 trench X.

DISCUSSION

The economy of the aceramic Neolithic at Knossos

The Aceramic Neolithic settlement settled at about 7000–6700 cal BC (Evans, 1994; Efstratiou, 2005) commanded a fully-fledged Neolithic economy and architecture of clay and stone i.e. a full Neolithic package – except for ceramics. This has been confirmed by detailed analyses of the lowest levels (spit 39,38), at a depth of up to 8.5 m, from a trial trench dug by N. Efstratiou in the Central Court of the Palace (Efstratiou et al., 2004; Efstratiou, 2005). The subsistence economy of the first inhabitants at Knossos relied on domesticated (elsewhere – not on Crete) livestock (ovicaprids, pigs, cows, dogs) imported from the Near East and on the cultivation of cereals (Triticum sp., also Triticum aestivum, investigations by J. Evans) and of legumes (Pisium sp.) that, too, had no local antecedents. Almonds (Amygdalus communis) and figs (Ficus carica) were also collected.
The study of the botanical remains recovered from the subsequent excavations directed by N. Efstratiou shows that the beginnings of occupation in the Kairatos valley – where Knossos is located – took place in the context of an evergreen forest with pine, cypress, juniper trees and oak. It also included some almond and strawberry trees, as well as some bushes.

In Greece, the presence of the Neolithic economic package in an aceramic context is quite rare: elsewhere is only well documented in lithic phase X at Franchthi (Perlès, 1987). Here one has to keep in mind that sites going back to the Early Neolithic in Thessaly where claims have been made for aceramics actually turn out to contain some ceramic (Perlès, 1989, 2001). It will be recalled that the Aceramic Neolithic layers at Franchthi are dated to ca. 6780–6580 cal BC and the species of cultivated cereals found there (emmer wheat and two row barley) and lentil (Lens nigri-cans ssp.) – as in the case of domesticated animals were not the consequence of domestication of local wild plants (Hansen, 1991).

It should be added that in the Aegean Islands (Maroulas on Kythnos, Giora in the Northern Sporades) a few components of the Neolithic package are found in connection with what appears to be a sedentary way of life namely: stone habitation structures on a round plan, pavements, grinding equipment connected with the increasing importance of plant processing, and semi-domesticated pigs, as well as possibly sheep/goat (if the stratigraphic context of these bones is correctly observed) (Sampson et al., 2010; Trantalidou, 2008, 2010). Thus one of the harbingers of the Neolithic package had already made its appearance on Kythnos as early as 8800–8600 cal BC.

The occurrence of potential or incipient elements of the Neolithic subsistence already in the Mesolithic of the Aegean Islands, the full Neolithic package on Crete and at Franchthi on the Greek mainland (with no evidence for local domestication in either case), document early contacts with the Near East and Cyprus. These contacts can be placed even before the period when in these territories the classical model of Neolithic economy in the Pre-ceramic Phase (PPNB) was functioning. The new excavations in Cyprus of the sites Klimonas and Agia Varvara, attributed to the PPNA, confirm the presence (similarly to the Aegean Mesolithic at Maroulas) of the wild boar on a pathway towards its eventual domestication (Vigne et al., 2011).

The aceramic Neolithic at Knossos and the question of Mesolithic occupation on Crete

In the 1960s and 1970s when the lower levels at Knossos on Crete were discovered and investigated no evidence for preneolithic sites on Crete had been recognized. It was only the recent field survey carried out in the area near Plakias on the inlands south coast that brought the discovery of the first sites attributed to the Mesolithic (Strasser et al., 2010). Regrettfully, the sites of Dammoni 1 and 3, Ammoudi 3 and Schinaria 1 yielded almost only quartz artefacts, and the pieces, furthermore, were only surface-collected ones. Preveli 2 was the sole site where artefacts were stratified in clay sediment that was taken to be as a soil of Early Holocene age. Thus, there were a shortage of chronological indicators that would make it possible to date these finds and to allow them to be interpreted as homogeneous assemblages. For example in the inventory from Schinaria 1 only one regular blade made from chert was found (Strasser et al., 2010: fig. 16g), which co-occurred with a laurel leaf shaped arrowhead made from quartz with a flat retouch, a hallmark of a more recent time; it cannot be interpreted as a “geometric microlith”. Similarly, most of the quartz artefacts that are claimed to be “geometric microliths” (Strasser et al., 2010: fig. 16 a–j) do not match the author’s definition of a microlith – even if the specific and limiting properties of quartz are taken into account. At the same time the artefacts from Ammoudi 3: flake side-scrapers, end-scraper-becs from quartz (Strasser et al., 2010: fig. 17) may not be diagnostic of the Mesolithic, although their attribution to the flake Mesolithic is possible. Similar flake tools occur at Damoni 1 in association with the alleged “geometric microlith” (Strasser et al., 2010: fig. 22a–e). In reality, only two artefacts can, possibly, be assigned to backed pieces with an arched blunted back (Strasser et al., 2010: fig. 22b) or with an angulated blunted back (Strasser et al., 2010: fig. 22e) and could be of pre-Neolithic age.

The interpretation of some sites on Crete as Mesolithic is based on the assumption that sites
with flake tools with denticulated-notched retouch are diagnostic of the Mesolithic. The high proportion of quartz at sites on Crete calls for particular caution when the artefacts from these sites are interpreted.

In any case, the technological and raw materials differences do not allow us to support the claim that the “Mesolithic” from southern Crete should be a possible predecessor of the Aceramic Neolithic from Knosos.

The aceramic Neolithic from Knossos – interregional relations

The presence of Melian obsidian at Knossos bears witness to contacts with the Aegean Sea Basin (Fig. 8, Table 1), also seen in technology and morphology of lithics. Sea-borne contacts and cultural transmission could have existed with the Peloponese where the Neolithic Aceramic Phase is recorded in the Franchthi Cave, and with the Aegean Islands of Kythnos, Ikaria, Chalkis, Naxos and Giura with the Pre-Neolithic industries of the “Aegean Mesolithic” (Kaczanowska et al., 2008; Kozłowski and Kaczanowska, 2009).

The aceramic industry from Knossos in comparison with the Mesolithic/Initial Neolithic of the Peloponese

The assemblage of lithic phase X at Franchthi, dated to ca. 6500 cal BC, is characterized by predominance of flints and local radiolarites and an increased proportion of obsidian in comparison with preceding Mesolithic assemblages (up to 9%; Perlès, 1990). The use of blade technique, too, increases in phase X to 10% of the debitage products (and among tools up to 30%). Another distinctive feature of this assemblage is its regular blades made by means of pressure technique (Perlès, 1990: fig. 24.1–9). Blades like this are absent in layer X at Knossos (with one exception). On the other hand, in the Initial Neolithic at Franchthi, splintered pieces are more numerous than they are in the Mesolithic layers, and, as in the case of Knossos, they are made exclusively from obsidian.

Among the tool types at Franchthi, the most frequent ones are denticulated-notched tools followed by perforators/beccs, truncations and micro-liths. Some of microliths include symmetrical
specimens (i.e. these are different from the microliths at Knossos; Perlès 1990: fig. 15) as well as flèches tranchantes (or armatures à tranchant transversal, according to Perlès, 1990: 104) that are typical of the Mesolithic in the western part of the Mediterranean Basin. The assemblage at Franchthi combines the traditions of the local Mesolithic and of the influence with some elements of Late Mesolithic tradition in the western part of the Mediterranean Basin. We must, therefore, disagree with J. Conolly (2008) who claims that “the IN assemblage from Knossos has much in common with the IN Franchthi Cave assemblages.” The common elements in the two assemblages are simply rather banal forms (splintered pieces and denticulated/notched tools), whereas there are marked differences between the more diagnostic tool classes. On the other hand, we can concur with Conolly’s position that Franchthi and Knossos do not belong to “the same Mesolithic tradition” and that “any Mesolithic elements in the assemblage seem unlikely to be the product of cultural continuity with mainland Aegean indigenous hunter-gatherers” (Conolly, 2008: 85).

The Aceramic Industry at Knossos in Comparison with the Lithic Assemblages of the “Aegean Mesolithic”

In terms of their raw materials, the Mesolithic assemblages occurring at sites on the Aegean Islands vary widely from one to the next, they commonly have a fairly large extra-local component (that is, not coming from a given island itself). For example, at Maroulas on Kythnos, Melian obsidian accounts for 31.1%, imported white flint (from the Peloponese?) for 10.6% and local quartz for the rest (56.0%). At Kerame on Ikaria, Melian obsidian comprises 30.0% of the assemblage, and this is complemented by obsidian from Ghiali (15.0%) and white patinated flints (48.8%) of unknown origin. The availability of different raw materials on different islands called for tech-
niques – notably, of *chaînes opératoires* – that were adapted to working the various rocks. In turn, this enhanced the variability among the islands’ Mesolithic assemblages. It should be added that all of the raw materials were actually worked on-site, and the final products of the full production cycle were tools that were used at the site. As in the case of Knossos, one of the distinctive features of the Maroulas assemblage is the fair number of tools produced by means of the splintered technique. While this is an indicator of thrifty raw material exploitation, it may represent a cultural or stylistic trait as well.

The major tool groups in the Aegean Mesolithic included end-scrapers, perforators/becs, truncations, backed implements and denticulated and notched tools. Their frequencies exhibit only minor variations. At Maroulas, for example, denticulated-notched tools comprise the most frequent ones (25.9%), but the proportion of end-scrapers, perforators/becs, and retouched flakes are all fairly high ranging between 15 and 18%. At Kerame, retouched flakes (22.2%) and denticulated/notched tools (19.5%) predominate, while truncations, backed pieces, perforators/becs have values again between 5 and 18%.

In terms of morphology, the common elements of the Aegean Mesolithic and the Initial Neolithic at Knossos are, of course, denticulated-notched tools and retouched flakes as well some specific types or variants of tools (see Pl. III.7) such as nosed end-scrapers (compare Sampson *et al.*, 2010: pl. XIV.1–6), small arched backed pieces from Maroulas (Sampson *et al.*, 2010: pl. XVIII.1–6) and from Kerame (Sampson *et al.*, 2008: fig. 2.2–6). However, they are thicker at Maroulas than at Knossos. Moreover, some trapezes/double truncations from Maroulas (Sampson *et al.*, 2010: pl. XVII.12–14) resemble what is found at Knossos (Pl. III.4). At the Aegean sites, the frequency of blades is low (only 1.9% at Maroulas and 3.2% at Kerame) but some laterally retouched blades and bladelets do occur at these two sites (Sampson *et al.*, 2010: pl. XX.17–23).

Thus, some of the techno-morphological features of the assemblage recovered from layer X at Knossos share much in common with assemblages of the Aegean Mesolithic. In short, it is fair to say that, in broad terms, they belong to the same cultural tradition. Nevertheless, there are also differences between them, which stem, in part, from the broader variety of raw materials in the Aegean Mesolithic. At the same time, some of the variability may be due to different functional tool types that were called for in doing specific tasks and activities associated respectively with coastal foraging (the Aegean Mesolithic) and first farming (the Aceramic Neolithic at Knossos).

**The Aceramic Neolithic at Knossos in comparison with the Aceramic Neolithic on Cyprus**

The common elements of the subsistence economy at Aceramic Neolithic settlement on Cyprus and the “Neolithic package” at Knossos provide a premise for comparing of lithic assemblages in the two places. On Cyprus up until quite recently, there was a gap of about two thousand years between the Epipalaeolithic as seen at Aetokremnos (Simmons, 1999) with $^{14}$C dates in the eleventh millennium cal BC and the Aceramic Neolithic (PPNB). Today this gap is smaller with the PPNA at Klimonas and Agia Varvara (Knapp, 2010; Vigne *et al.*, 2011). The classical PPNB features, as seen at Shillourokambos, goes back to ca 8400–8000 cal BC – Guilaine and Briois, 2008). The PPNB tradition than continued to evolve on Cyprus, as documented by multi-phase settlements such as Shillourokambos (*phase ancienne* B et *moyenne/récente*), Miloukhtia (pit 133) and Kala-vassos-Tenta (phases 4–2), ascribed to the time interval of 8000–7000 cal BC. The final phase of this evolution is the Late Aceramic Phase as seen for example at Khirokhtia which is dated to 7000–6200 cal BC (Guilaine and Le Brun, 2003).

The evolution of the PPN on Cyprus was marked by strong links with the Syro-Palestinian and Eastern-Anatolian coast. They can be traced in economy and architecture, as well as in lithic technology (the dominant macroblade technique employed initially on a double-platform naviform cores) and tool morphology (e.g. pedunculated/tanged points of Byblos and Amuq type). The links between the mainland and Cyprus appear to have persisted as late as the Late Aceramic Phase.

Before and parallel to the evolution of the PPN, in the littoral zone of Cyprus lithic industries appear with flake technology and tools dominated by retouched flakes and side-scrapers. Backed pieces, perforators and end-scrapers also
occur. The dating of the flake lithic tradition on Cyprus is based on its stratigraphic position in relation to the Late Phase of the PPNB industries at the site of Nissi Beach (Ammerman et al., 2006, 2007, 2008; Ammerman, 2011). But the stratigraphy at Nissi Beach is likely to have been reversed by tsunami (Ammerman et al., 2007). If such is the case the flake industry distributed on the surface of this site would be older than the dates obtained on the “blade assemblage” from the Holocene soil (dated on shells at of 7750–7100 cal BP; Ammerman et al., 2008). This “blade assemblage” testify the occupation on a seasonal basis. The flake industry on the surface exhibits a number of similarities with the “ Aegean Mesolithic” both of technology and tool morphology. Consequently, similarities can also be established with the assemblage from layer X from Knossos, particularly of arched backed pieces and retouched splintered pieces. It should be emphasized, however, that arched backed pieces occur also in the younger assemblages of the PPNB (McCartney, 2003: fig. 8, 9) or even in the Ceramic Neolithic of Cyprus (Florentzos et al., 2008: fig. 2.2).

The chronology of layer X at Knossos corresponds to the transition of the 8th/7th and first quarter of the 7th millenium cal BC, thus, in comparison with Cyprus, this industry could be synchronous with the Late Phase of the Aceramic “Blade assemblage” and, at the same time (assuming the reversal of stratigraphy at the site), later than the flake industry from the Nissi Beach. Therefore we suggest that Crete owes its full Neolithic package including economy and elements of blade technique (note the splintered piece on a blade core; Pl. I.1) to contacts with the Near East via Cyprus. The blade technique can be seen first of all on blanks for the production of most arched backed pieces (Pls II.5–9, III.1). While layer X at Knossos is younger than the sites of the Aegean Mesolithic dated at 9th/8th millenium BC (Maroulas, Ikaria – Sampson et al., 2010), yet the tradition of flake technology as co-occurring with the splintered technique, is apparent at Knossos and in the flake industry from Nissi Beach on Cyprus. On these grounds we suggest the presence of a common littoral tradition of the Eastern Mediterranean foraging peoples. Elements of the Neolithic package were superimposed on the basis of this common substratum by the elements of the full Neolithic package and the blade technology. Sea-faring practiced since the Pre-Neolithic time, allowed for the diffusion of this traditions and cultural influences that is evidenced by lithic raw materials circulation, notably the obsidian, across the eastern part of the Mediterranean Sea Basin. In the present state of investigations a parallel evolution cannot be ruled out wherein coastal foraging and early agro-pastoralism would have constituted “alternative and complementary ways of life” – as A. Ammerman (2010) proposes.

The Aceramic versus the Early Neolithic I at Knossos

The blank reduction technology, the composition of the raw materials and the morphology of retouched tools all document continuity between the Aceramic Neolithic and the Early Neolithic I at Knossos. The same raw materials were exploited, although the frequency of obsidian increases in Early Neolithic I, whereas that of siliceous rocks, which now become less varied, declines.

Production of artifacts in siliceous rocks (mainly radiolarite) – done on-site – was even smaller than in the Aceramic Phase (Fig. 1); it is shown by the absence of cores and smaller proportion of debitage products (flakes and chips). Off-site production in the case of siliceous rocks was concerned mainly with tool production. On the other hand, obsidian was still worked on-site at Knossos, although the frequency of obsidian cores is lower. However, in order to produce obsidian blanks, the splintered technique could have been used – just as in the Aceramic Neolithic. However, chaînes opératoires of obsidian processing were more advanced than in the Aceramic Phase as indicated by the presence of tablets showing the intentional adjustment of core angle during the course of reduction. In the Early Neolithic I assemblage, longer blades make their appearance, which may indicate a more regular or better supply of raw material as well as a more advanced chaînes opératoires. From the Early Neolithic I, there are only two blades that probably reached the site by means of exchange and that show unquestionably the use of the pressure technique. Thus, longer blades are the result of the off-site use of pressure technique.

Although the same major tool groups were used in both times, their frequencies change mar-
kedly. In the Aceramic Neolithic, one finds that flakes, splintered pieces and denticulated-notched tools predominated (Pl. VI.1.2); in the Early Neolithic I blades with lateral retouch (Pl. VI.13–17), which was usually discontinuous, became more important, and retouched flakes came next (Pl. VI.4.5). In addition, the frequency of arched backed pieces changes; they are less common in the Early Neolithic I (Pl. VI.6,7). Other tool groups – end-scrappers (Pl. VI.8,9), truncations (Pl. VI.10) and perforators (Pl. VI.11) – now fall off.

The most significant difference between the Aceramic Neolithic and the Early Neolithic I is the appearance of tools with surface retouch: for example, a small triangular arrowhead with a convex base (Pl. VI.19), a splintered piece with surface retouch shaping a segmentoidal tool (used possibly as an insert; Pl. VI.20) and a sickle insert on a blade with bilateral retouch of the edge and the tip (Pl. VI.21). These artefacts were made from radiolarite.

In the Early Neolithic I, there is now the presence of a double truncation (or a robust trapeze) on an obsidian macroblade, and a sickle insert with a thick, concave distal truncation, also from radiolarite. In the Aceramic Neolithic, such tools are absent, although double truncations – both fine (Pl. III.3) and robust (Pl. III.4) – are observed.

CONCLUSIONS

On Crete so far, no local Aceramic Neolithic predecessor to Knossos has been discovered on the island. Nor is there at the present time a well documented site that is contemporary with the Aceramic Neolithic at Knossos. In our view, the question of Mesolithic sites remains an open one. In any case, the artifacts collected from the surface of sites near Plakias are almost all in quartz and they involve different lithic reduction technology, so they cannot be interpreted as giving rise to what is found in the Aceramic Neolithic at Knossos. The sequence of occupations comprising layer X at Knossos is, in all likelihood, the sum of relatively brief sojourns by groups with farming-stock breeding economy, who visited Crete as part of “causal sea-movements in the Aegean” (Efstratiou, 2005: 83).

These groups belonged to a systematic network of sea-goers who since the time of the Mesolithic embraced the entire Aegean Sea Basin together with Cyprus. This was a region where several different cultural traditions met and interacted with one another:

– the tradition known as the “Aegean Mesolithic,” which derived from the eastern Mediterranean Epigravettian and developed simultaneously with the first post-glacial frequenting and eventual settling of the Aegean Islands (Cyclades, Dodecanese, Sporades). The formation of this tradition coincided with intensification over time in the exploitation of obsidian on Melos and Ghiali;
– We can put forward the hypothesis that the formation of the “Aegean Mesolithic” brought as a result maritime expansion to the east – probably along the coasts of Anatolia – as far as Cyprus where a specific variation of this cultural tradition evolved, represented by the flake industry from Nissi Beach (Ammerman, 2008). The contacts between the Aegean Islands and the eastern basin of the Mediterranean Sea – where food producing economy appeared at the very beginning of the Holocene – had born fruit in the form of premises of Neolithization in the Aegean Sea Basin: among others stability of settlement, first semi-domesticated animals, stone architecture. Nonetheless, these phenomena took place in the conditions of prevailing coastal foraging economy. There is now also the PPNA on Cyprus (first half of the 9th millenium cal BC and coeval with Maroulas) but there is no evidence for it in the Aegean so far.
– the arrival of the PPNB on Cyprus with its very close parallels (over a full range of different cultural and then economic domains and not just a few selected ones) to the PPNB in the Near East and its long and steady evolution over time (8500–6200 cal BC). This development was facilitated by the on-going “growth” of early seafaring as reflected by circulation of obsidian now seen on Cyprus (for the first time) and by the new animals now reaching the island, as now documented by Vigne et al. (2011). This economic package was adapted by the local foragers. The above mentioned cultural traditions that emerged from the multidirectional sea-born contacts contributed to the emergence of a unique Aceramic Neolithic culture units represented in layer X at Knossos.

In this process, the dominant role was played the crossing traditions of the Aegean and Cyprus. On the other hand, the rather unique Aceramic
Neolithic at Franchthi in the Peloponese arose from the traditions of the Epigravettian Mesolithic and the stylistic influence of the Late Western Mediterranean Mesolithic (that is, elements of the Castelnovian technology and fléches tranchantes; Perlès, 1987: fig. 24.1–8, 26.7,8) upon which the Near East Neolithic package was superimposed. Whether Crete played a role in the transmission of this package remains an open question.

The hypothesis put forward here finds support in the results of genetic research – notably on chromosome Y. On Crete, the haplogroup J2b-M410 is dominant, common with Anatolia, whereas, in the Peloponese, just as in the Balkans, the dominant group is J2a-M12. However, the possibility cannot be excluded that some earlier relations existed between Crete and the Argolide, where haplogroup E3ba-VI 13 dominates (King et al., 2008).

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Pl. I. Knossos, Initial Neolithic: 1–8 – cores, 9 – splintered piece
Pl. II. Knossos, Initial Neolithic: 1–4 splintered pieces, 5–9 – tools
Pl. III  Knossos, Initial Neolithic: 1–9 – tools
Pl. IV. Knossos. Initial Neolithic. 1–10 – tools
Pl. V. Knossos. Initial Neolithic. 1–13 – tools
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Pl. VI. Knossos, Early Neolithic I: 1–21 – tools