Island Archaeology and the Origins of Seafaring in the Eastern Mediterranean

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In memory of John D. Evans

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**LOWER PALAEOLITHIC ARTIFACTS FROM PLAKIAS, CRETE: IMPLICATIONS FOR HOMININ DISPERALS**

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**Abstract**

Lithic artifacts from eight findspots in the Plakias region of southwestern Crete are ascribed to the Acheulean of the Middle Pleistocene on the basis of morphotypological characteristics, geologic contexts, and OSL assays. Considered in a regional context, the Cretan Acheulean is similar to the Acheulean found on sites in both the eastern and western portions of the Mediterranean region that resulted from an “Out of Africa” adaptive radiation of hominins (probably *Homo erectus s. l.* ) that began ca. 0.8 – 1.0 mya. We suggest that hominins may have arrived on Crete in the Middle Pleistocene as part of this hominin dispersal and that open-water crossing, at least in the southern Aegean, may have been involved.

**Keywords:** Acheulean, Large Cutting Tools, Mediterranean seacrossings

**INTRODUCTION**

In his recent surveys of the evidence for early humans in the Mediterranean, Broodbank found the evidence for Upper and perhaps Middle Palaeolithic presence on some Aegean islands to be more persuasive than that for the western Mediterranean islands (Broodbank, 2006, 2013:93-96). The discovery in 2008-2009 of Lower Palaeolithic artifacts belonging to the Acheulean Industrial Tradition in southern Crete near the town of Plakias adds to this picture, as do early Palaeolithic finds reported from other Aegean islands. Here we review the current state of the research on the Cretan artifacts from Plakias along with the implications of this evidence for our understanding of early hominin dispersals.

Archaeologists and palaeoanthropologists have long argued that hominin dispersals to Eurasia in the Pleistocene followed land routes from Africa (e.g., Anton and Swisher, 2004; Bar-Yosef and Belfer-Cohen, 2001; Carbonell *et al.*, 2008), a hypothesis based on the assumption that early hominins lacked the cognitive ability to plan open-water crossings of any great distance, and/or the technology to build navigable water craft. The land-route hypothesis has been challenged with evidence from southeastern Asia suggesting that...
early hominins were capable of using boats to make planned, and perhaps repeated, crossings of large bodies of open water. In southeastern Asia, specifically the Indonesia archipelago, open-water crossings appear to have taken place as early as 0.8 million years ago (mya) if not earlier (Bednarik, 2003). In the Mediterranean evidence for such crossings at such an early date is less certain (Broodbank, 2006, 2013:93-96; Straus, 2001; Villa, 2001).

Here we contribute to the discussion with an assessment of recently discovered Lower Palaeolithic findspots from Preveli in the vicinity of Plakias (Fig. 1). The artifacts from the eight findspots discovered so far can be taken together as belonging to the Acheulean Industrial Tradition. As a result of our ongoing study, it is now possible to compare the Plakias Acheulean with the Acheulean from sites in other parts of the Mediterranean, which may be useful for evaluating the timing and the probable points of origin for the hominins who reached Crete in the Middle Pleistocene.

The Plakias Acheulean was found in the course of a surface reconnaissance in 2008 and 2009 targeting former and present wetland areas in the region in an effort to locate Mesolithic sites (Strasser et al., 2010). In addition to Mesolithic sites of early Holocene age, eight sites with Acheulean lithic artifacts were discovered near the mouth of the Preveli Gorge and the Megas Potamos River east of Plakias and elsewhere in the survey area (Fig. 1, Table 1). The open-air findspots are associated with geologic deposits, including raised marine terraces at 59 and 96 meters above sea level (masl) and paleosol outcrops (Strasser et al., 2011). Optically stimulated luminescence (OSL) dating of alluvial fan sediments in which the Acheulean lithic artifacts were found embedded corroborates the marine terrace chronology, indicating that the tools must be as old or older than the tectonically uplifted marine terrace and the alluvial fan deposits that they are incorporated in. The 96 masl marine terrace at Preveli is correlated to the global sea level high stand at 107 ± 2 thousand years ago (kya) (Strasser et al., 2011).

2011). Artifacts at Preveli 7 were found as clasts within a mature paleosol that formed in an alluvial fan at ca. 125 masl on a planation surface above the highest marine terrace correlated to the 123 ± 2 kya (oxygen isotope stage 5e) glacial sea level highstand (Fig. 2; Strasser et al., 2011). The fan does not extend to elevations below ~125 masl, suggesting that it pre-dates, and was truncated by, the rise in sea level at ~123 kya. The paleosol is > 3 m thick and is developed within weakly stratified and poorly sorted alluvial fan parent material with alternating zones that are clast and matrix supported. Clasts are predominantly angular sandstone and mudstone with minor quartzite and range in size from coarse pebbles to cobbles. Beneath a thin plow zone, the paleosol is a red (10R 4/6) sandy clay-to-sandy clay loam with moderate sub-angular blocky structure, common thin clay films, and a slightly sticky and slightly plastic consistency when wetted (Fig. 2). The surface of the fan slopes at 6 to 12 % and is well-drained.

We sampled two sandy silt lenses from the Preveli 7 alluvial fan in order to determine the timing of sediment burial using OSL. The dated sediments bracket the zone where artifacts were recovered (Fig. 2). Samples were analyzed at the Laber Scientific Luminescence Dating Laboratory. Standard field and laboratory preparation techniques were applied. The single aliquot regenerative-dose (SAR) protocol was adopted for equivalent dose ($D_e$) measurements on twenty-four aliquots per sample of the coarse-grained (90-125 µm) fast component quartz fraction (e.g., Rhodes, 2011). The final reported $D_e$ is the average of all aliquots and the $D_e$ error is the 1σ distribution. The cosmic ray dose rate was estimated as a function of depth, altitude, and geomagnetic latitude. Additional samples collected at each site were used to measure the concentration of U, Th, and K by neutral activation analysis in the laboratory and elemental concentrations were then converted into annual dose rate, taking into account the water content effect (Table 2).

The reported OSL burial age of the sediments above and below the Acheulean-bearing zone from the Preveli 7 alluvial fan exposure are 113.6 ± 10.3 and 93.8 ± 8.9 kyr, respectively (Fig. 2, Table 2). Although these age determinations
Fig. 2. Photograph of the paleosol developed an alluvial fan at the site of Preveli 7 at ~ 130 masl, as exposed in the excavation for a building site (N 35.154473°, E 24.465264°). The soil is greater than 3 m thick with significant pedogenic clay accumulation and red (10R) colors, characteristic of soils that have been forming since at least the last interglacial period across the eastern Mediterranean. Acheulean artifacts were recovered as clasts intercalated with the alluvial fan sediments from the Bt3 – Bt5 zones.
are stratigraphically reversed, they nearly overlap at one standard deviation. Furthermore, the OSL SAR procedure has been reported to systematically underestimate the ages of Marine Isotope stage 5e sediment burial by about 15% (Murray and Funder, 2003; Murray et al., 2007). Thus we interpret them as minimum estimates of the timing of sedimentation on the Preveli 7 alluvial fan.

In addition to the radiometric determinations, we placed constraints on the age of the paleosol that has formed in these deposits by its maturity stage based on known ages for paleosols on Crete and the Greek mainland that have themselves been dated by radiometric means (including uranium-series, OSL, IRSL, and 14C; see van Andel, 1998 for a summary). For example, 75 km southeast from Preveli, Gallen (2013) and Gallen and colleagues (in press) used OSL dating to constrain the timing of alluvial fan sedimentation, and thus the maximum age of paleosol formation, along the Asterousia mountain front. There, beach-facies sediments from a marine terrace deposit were dated by OSL at 127 ±13 kya. This terrace is correlated with the ~123 kya (5e) glacial sea level highstand. The soil in the overlying alluvial fan that buries the dated beach deposits exhibits soil characteristics similar to those observed at Preveli 7. In contrast, stratigraphically inset (younger) alluvial fans that do not show the same amount of pedogenic maturity as either the soil developed on the 127 kya marine terrace or in the Preveli 7 alluvial fan, yielded two OSL burial ages of 35 ± 4 and 43 ± 4 kya. OSL dating of the alluvial fan sequences ~30 km to the west-northwest of Preveli at Sfakia by Pope and colleagues (2008) indicates that the final sedimentation and formation of the surface on which a soil developed with a similar maturity stage to that at Preveli 7 occurred after 144 ± 15 kya, but before 93 ± 9 kya. Based upon these limiting stratigraphic correlations, we argue that the Lower Palaeolithic artifacts at Preveli 7 are older than the dated geologic deposits that contain them and thus are likely to date to the Middle Pleistocene (> 126 kya).

Because the Palaeolithic artifacts from Preveli were collected chiefly from the surface and without

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### Table 2. Optically stimulated luminescence geochronology for alluvial fan sediments from Preveli 7

<table>
<thead>
<tr>
<th>Field Site</th>
<th>Lab No</th>
<th>K (%)</th>
<th>U (ppm)</th>
<th>Th (ppm)</th>
<th>Moisture (%)</th>
<th>Size (mm)</th>
<th>Depth (m)</th>
<th>Dose Rate (Gy/Kyr)</th>
<th>Equivalent Dose (Gy) mean ± 1σ</th>
<th>Age (kyr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P7-1</td>
<td>LS1368</td>
<td>1.02</td>
<td>0.7</td>
<td>6.7</td>
<td>15 ± 5</td>
<td>90-125</td>
<td>1</td>
<td>1.52 ± 0.09</td>
<td>171.6 ± 5.3</td>
<td>113.6 ± 10.3</td>
</tr>
<tr>
<td>P7-4</td>
<td>LS1369</td>
<td>0.91</td>
<td>0.72</td>
<td>8.7</td>
<td>15 ±5</td>
<td>90-125</td>
<td>3</td>
<td>1.47 ± 0.09</td>
<td>137.5 ± 4.7</td>
<td>93.8 ± 8.9</td>
</tr>
</tbody>
</table>

**Sample preparation:** For each sample pure quartz was extracted for De measurements. In the OSL lab, the sample was treated first with 10% HCl and 30% H₂O₂ to remove organic materials and carbonates, respectively. The 90-125 µm grain size was relatively abundant and thus was chosen for De determination. The grains were treated with HF acid (40%) for about 35 min, followed by 10% HCl acid to remove fluoride precipitates.

**Measurement techniques:** Quartz OSL measurements were performed using an automated Risø TL/OSL-20 reader. Stimulation was carried out by a blue LED (λ=470±20 nm) stimulation source for 40 s at 130 °C. Irradiation was carried out using a 90Sr/90Y beta source built into the reader. The OSL signal was detected by a 9235QA photomultiplier tube through a 7.5 mm thick U-340 filter.

**Equivalent dose (De) measurement and age calculation:** For De determination, SAR protocol was adopted. A preheat temperature of 260 °C for 10 s and cut-heat of 180 °C for 10 s were used. The final De is the average of Des of all aliquots, and the error of the final De is the standard error of the De distribution. For each sample, 20-25 aliquots were measured for De determination.

The Quartz OSL was fast component dominated. Recycling ratios were between 0.90-1.1. Recuperation is negligible. The cosmic ray dose rate was estimated for each sample as a function of depth, altitude and geomagnetic latitude. The concentration of U, Th and K was measured by ICP-MS. The elemental concentrations were then converted into annual dose rate, taking into account of the water content effect. The final OSL age is then: De/dose-rate.
excavation, the mixing of materials from different periods is a significant problem, exacerbated by the necessity to make our collections from findspots on sometimes steeply sloping surface where there is much disturbance from modern development. It should be noted that our collections were of limited size and non-random, precluding statistical analyses of the collection or detailed comparisons with assemblages from controlled stratigraphic excavations. Nevertheless, we believe that the collection is reasonably representative of what we observed on the surface, and that the technological and morpho-typological characteristics, which are similar for all the sites we encountered, permit comparisons.

THE ACHEULEAN FROM PLAKIAS

A total of 211 lithic artifacts was collected from marine terraces and paleosol outcrops where they were either embedded in the deposits or recently removed by erosion or other disturbance (see Strasser et al., 2010, 2011 for context details and collection methods). Circumspection was required in the selection of artifacts to be collected in order to satisfy the requirements of our research permit, and it should be emphasized that the artifacts in the collection are only a small sample of the artifacts that were observed in the study area (Table 1). Hundreds of other artifacts were observed, but not collected. An effort was made to collect all recognizable Large Cutting Tools (LCT), i.e. handaxes, cleavers, picks, choppers, massive scrapers, and protobifaces, as well as cores, retouched artifacts, and intact flakes and blades. For some classes of material, such as cores, expediently worked (“test pieces”), and debris, we collected only representative types. Very large cores (greater than 20 centimeters in length), incomplete artifacts, and other non-technical debris had to be left in the field.

It should also be noted that the description that follows is based on a new analysis of the complete collection that was carried out in June, 2011, which included new measurements and drawings by a different artist and the construction of a database with more complete descriptions of each morphotype. The re-drawing of the artifacts involved using new sources of light in order to more accurately render the flake scar patterns, and in some cases the re-examination of the artifacts led to new classifications of some of the morphotypes. The new technical drawings included here are flake removal plans intended to show the positions, orientations, and relative depths of the flake scars and not to depict the appearance of the objects. The rough quartz is very difficult to draw as the flake scars are only clearly visible under raking light conditions. Thus the drawings have to be built up by constantly turning the artifacts in the light to see the scars, and as a consequence these line drawings show what we believe is actually there, rather than what meets the eye in a photograph or in poor light.

Earlier drawings that were published with the preliminary reports (Strasser et al., 2010, 2011) were made in the field in Crete with poor lighting conditions. Therefore, the the classification and drawings completed during the 2011 analysis in Athens supersede earlier reports. Three-dimensional models of some of the bifaces have been made using AgiSoft Photoscan software and are available on the following website for examination (http://blogs.providence.edu/plakias/). The advantage of these models is that artifacts can be rotated and the lighting can be manipulated by the viewer in order to enhance the flake removal scars.

Morphotypes in the collection include Large Cutting Tools, (handaxes, cleavers, and trihedral picks Fig. 3; Table 3), retouched flakes, scrapers, denticulates, and notches (Figs 4-8; Table 4). The primary raw material used was massive milky quartz (approximately 95%), but other raw materials such as quartzite, chert (tectonized radiolarite), and igneous greenstone also were used. All of the raw materials are locally available. Cores are often very large (greater than 20 cm in length). Reduction was expedient and opportunistic and was aimed at the removal by direct percussion of large flakes from unprepared cores, as is evidenced by the large plain platforms that resulted. Centripetally-worked cores, sometimes discoidal and bifacially-reduced, used as well for the production of flakes. Thick blades with rectangular cross sections were noted (Fig. 8b; Table 1). The flakes range from 8 to 15 cm in length, with platforms that are ca. 4 cm wide. Corner-struck and side-struck flakes are
Fig. 3. Large Cutting Tools from the Plakias survey. a) Cleaver from Preveli 2; b) Biface from Preveli 7; c) Trihedral pick from Preveli 8. All are on quartz. (Photographs by Nicholas Thompson.)

<table>
<thead>
<tr>
<th>Site</th>
<th>Biface</th>
<th>Cleaver</th>
<th>Pick</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preveli 2</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Preveli 3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Preveli 7</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Preveli 8</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Kotsiphos 1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Timeos Stavros 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Timeos Stavros 4</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Gianniou 1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15</td>
<td>4</td>
<td>6</td>
<td>25</td>
</tr>
</tbody>
</table>

*Table 3. Lower Palaeolithic bifaces (handaxes), cleavers, and trihedral picks from Plakias*
common, and were frequently retouched bifacially in an effort to regularize the edges or to thin bulbs of percussion.

Where the type of blanks used for the production of LCTs can be identified (some are obscured by covering bifacial retouch and others are hard to identify in quartz), it can be seen that the knappers produced corner-struck or side-struck flakes. Fifteen handaxes were found at six sites and are roughly amygdaloid or triangular in form (Figs 3, 5-6; Table 3). They were shaped by bifacial retouch that rarely covers the entire surface on either face, often working around imperfections in the quartz that was used as a raw material. Six trihedral picks from four sites are similar to the handaxes except for their thick triangular sections (Figs 3c, 5c; Table 3). Four flake cleavers collected from two sites (Fig. 3a; Table 3) are of particular interest. Following Jacques Tixier’s definition of Acheulean cleavers as flakes with usually unretouched transverse cutting edges, and consulting Vincent Mourre’s exhaustive tabulation of cleavers from Africa, Europe, and southwestern Asia, the Plakias cleavers fit comfortably within the range of variations of this form (Tixier, 1956:916; Mourre, 2003). Mourre demonstrates that Acheulean cleavers average 11.4 to 17.5 cm in length, and are typically made on tough rocks such as quartzite, sandstone, quartz, flint, and basalt (Mourre, 2003). Three of the Plakias cleavers are made on quartz and one example was manufactured on a large flake of unidentified igneous greenstone; their lengths range from 11 cm to 20 cm.

Fig. 4. Scrapers from the Plakias survey. a-b) Simple convex scrapers from Preveli 2 and Preveli 3; c) Transverse scraper from Timeos Stavros 4; d) Bifacial scraper from Timeos Stavros 1. All are on quartz. (Photographs by Nicholas Thompson.)
Scrapers (Figs 4, 7, 8c; Table 4) are the predominant morphotype (ca. 50 per cent), followed by atypical retouched pieces, and smaller numbers of denticulates (Fig. 8a), notches, bifacial pieces, truncations, becs/perçoirs, burins, and rabots. These types were produced by minimally retouching one or more edges of flakes. While bifacial retouch is not uncommon on the scrapers (approaching 20 per cent; Figs 4d, 7a-b), on some other morphotypes bifacial retouch is less frequent. When retouch is present, it is often invasive, low, scalar, and discontinuous. The selection of edges for retouch and the shaping of the blanks before retouch or after retouch (resharpening)
are unsystematic and often constrained by the irregular outlines or edge shapes of the quartz flakes that responded to flaking in unpredictable ways. Scrapers are diverse in form. They are simple and convex, although bifacial, transverse, and convergent scrapers (Fig. 8c), often steeply retouched, are also present. It is possible to infer that scraper use-life was short and resharpening was uncommon. As Dibble (1987) has argued, resharpening of scrapers can create a series of scraper “forms” over time. Resharpening can be inferred when a high frequency of convergent, transverse, and déjeté scrapers are present, and/or when overlapping rows of retouch with a progressive steepness of edge exist. While the proportion of transverse scrapers is high, it is clear that the distal edges were chosen for subsequent retouch from the outset and that the shapes are not the result of continued reduction from resharpening. The expedient and uncurated nature of the scrapers is not surprising given the poor quality and wide availability of massive quartz as a lithic raw material in the region.

Fig. 6. Bifaces from the Plakias survey from Preveli 7. The top biface is also in Figure 3 (b). Both are on quartz. (Drawings by Dimitra Bakoyiannaki.)
For comparative purposes, we reviewed Acheulean sites from other Mediterranean areas, specifically the Near East, Turkey, Greece, the Balkans, Italy, Iberia, and North Africa. The aim was to formulate working hypotheses about the geographic origins of the Plakias Acheulean and suggest its age within reasonable limits. The Acheulean Industrial Tradition is of long duration (ca. 1.7 – 0.1 mya) and of considerable geographic extent, being found in Africa and Eurasia (Lycett and Gowlett, 2008). Although the Acheulean is variable in composition, as well as in spatial and temporal distribution, it is usually identified by the co-occurrence of bifacially-flaked LCTs, along with a variety of morphotypes such as scrapers, denticulates, notches, truncations, and becs. Despite the established use of the concept “Acheulean,” some scholars have questioned whether it is a true “tradition,” or only a loose compilation of locally-devised or adapted industries that are related only by the
rather simple concept of LCTs with differing modes of production and function. We prefer to sidestep this question and to use Lycett and Gowlett’s concept (2008:307) of an Acheulean *Bauplan* (“essential concept of elements and form”) forming a coherent tradition. The Bauplan concept allows for considerable variation and may embrace a great deal of regional variability. Finally, we note that it is widely acknowledged that there are “large areas of overlap in the form of handaxes from different sites and regions [and also] evidence that distinct patterns may appear at very broad geographic levels (e.g. Europe vs. Africa)” (Lycett and Gowlett, 2008:307); it is within these “large areas of overlap” that we seek to identify the affinities of the Plakias materials.

The origin of the Acheulean is in East Africa ca. 1.7 mya (Mourre, 2003:tome 3:250-267).

**Fig. 8.** Denticulate, blade, and convergent scraper from the Plakias survey. a) Denticulate from Preveli 7; b) Blade from Preveli 7; c) Convergent scraper from Timeos Stavros 1. All are on quartz. (Drawings by Dimitra Bakoyiannaki.)
Although more than one species of hominin may have made or used the new Acheulean technology, it is widely assumed that the chief maker was *Homo erectus*. In the Early Pleistocene, the Acheulean was at first a localized phenomenon in East Africa, while in other parts of Africa and Eurasia hominins continued to employ variants of the Oldowan Industrial Tradition. The Acheulean became widespread in northern and southern Africa later, towards the end of the Early Pleistocene. As Vincent Mourre’s research (Mourre, 2003:tome 3:250-267) has shown, the Acheulean appeared for the first time outside of Africa more or less simultaneously in Spain (e.g., Parfitt *et al*., 2005; Scott and Gibert, 2009) and in the Levantine Rift Valley (e.g., Bar-Yosef and Belfer-Cohen, 2001; Carbonell *et al*., 2008) at the beginning of the Middle Pleistocene.

To this we add the view that there has been more than one expansion of hominins from Africa to Eurasia in the Early and Middle Pleistocene, although the timing and composition of these movements remain matters of considerable debate (Anton and Swisher, 2004; Carbonell *et al*., 2008). These expansions may have involved more than one hominin species – *inter alia*, *Homo erectus*, *H. ergaster* (a.k.a. African *H. erectus*), *H. antecessor*, and *H. heidelbergensis*, and more than one industrial mode, *viz.* the Oldowan pebble core, and the Acheulean with LCTs (Aguirre and Carbonell, 2001) (Fig. 1).

For much of western Europe at sites such as Boxgrove in England, Fontana Ranuccio in Italy, Kärlich-E in Germany, and Ambrona and Atapeura-Galeria (Beds TG 6-8, or GII) in Spain the Acheulean dates at ca. 0.6-0.5 mya (Aguirre and Carbonell, 2001:15), while new evidence from Pakefield in England (Parfitt *et al*., 2005) at ca. 0.7 mya, and La Solana del Zamborino and Estrecho del Quípar in Spain at ca. 0.9-0.8 mya would push the date back to the early Middle Pleistocene (Scott and Gibert, 2009). That said, in a summary of the evidence for the chronology of western European hominins, Roebroeks (2006) argues that the presence of early hominins in Europe between 1 and 0.6 mya is “thin” and “occasional,” and a more “permanent” presence is detectible only after ca. 0.6-0.5 mya.

For those parts of Africa geographically related to the Mediterranean, or potential sources of the earliest Mediterranean Acheulean, sites are mostly known from surface collections or older excavations lacking secure contexts and dating. There are Acheulean sites in Morocco and Algeria such as the Casablanca sequence (Thomas Quarry 1, Rhino Cave, Sidi Abderrahman-
Extension), Ternifine, Ourarzazte, Lake Karar, and Ouzidane, in northwestern Tunisia at Sidi Zin, and at a number of scattered surface sites in northeastern Algeria (e.g., Mansoura, Cap de Fer, and Mechea Kléber) (Mourre, 2003: tome 2:159-180; Fig. 1). In Morocco, the Casablanca sequence has deposits covering the last 5.5 mya with Thomas Quarry 1, Unit L, marking the earliest appearance of Acheulean technology in northern Africa (ca. 1.5–1 mya), as well as the first secure evidence of hominin activity in Morocco.Dating of the Casablanca sequence relies on three complementary sources: biochronology (specifically the presence of the early Pleistocene murid rodent *Paraethomys cf. mellahe*), the primitive nature of the earliest Acheulean material, and supporting evidence from a series of stratigraphically consistent OSL dates (Geraads et al., 2004:752; Rhodes et al., 2006). Manufactured on local quartzite and, to a lesser extent, flint, the assemblage is described as containing flakes struck from discoidal cores and polyhedrons, chopping tools, cleavers, trihedrons, and bifaces (Raynal et al., 2001:69). Nearby, Rhino Cave in the Oulad Hamida 1 Quarry and Sidi Abderrahman-Extension, both younger in age than Thomas Quarry 1, demonstrate the variability of the Acheulean techno-complex and document its long duration in the region. Rhino cave has been assigned a minimum age of 0.4 mya and Sidi Abderrahman-Extension is thought to be more recent. While cleavers do not disappear, their occurrence becomes rare relative to other large bifacial forms (Raynal et al., 2001:69-71), with the inference that the function of the cleavers were, at least in part, replaced by large bifacial technologies. As Raynal and colleagues have shown, the lithic assemblages at Casablanca are highly variable, alternating between industries with many bifacial artifacts and those that are relatively poor in bifacial technology (Raynal et al., 2001:73). Libya provides only scant indications from surface collections from the Fezzan oases (Fig. 1) that have been assigned to an evolved Acheulean (van Heekeren and Jawad, 1966).

In the eastern Mediterranean the principal Acheulean sites are Gesher Benot Ya’aqov (ca. 0.8 mya), Ubeiida (ca. 1.3 mya), and Evron Quarry in Israel, and Latamne (ca. 1.0 mya) in Syria, and Kaletepe Deresi 3 (ca. 0.7 mya) (see below and Bar-Yosef and Belfer-Cohen, 2001; Goren-Inbar and Saragusti, 1996; Saragusti and Goren-Inbar, 2001; Shea, 2013:47-80). The older sites are possibly part of the first movement of hominins out of Africa at the end of the Early Pleistocene (Bar-Yosef and Belfer-Cohen, 2001). Gesher Benot Ya’aqov is significant because the excavators of the site stress the African affinities of the LCTs in particular, which are made on sidestripped flakes produced by the Kombewa, the Levallois, and other methods of flake production. The inference is that at Gesher Benot Ya’aqov, the Acheulean assemblage is an offshoot of the African tradition of LCTs that accompanied a dispersal of hominins into southwestern Asia towards the end of the Early Pleistocene, and that Acheulean assemblages similar to Gesher Benot Ya’aqov can be used as proxy evidence for the dispersal of African hominins.

Despite its evident attraction as a land passage from southwestern Asia to southeastern Europe, Turkey has a thin record of Lower Palaeolithic activity (Kuhn, 2002; Shea, 2013:47-80). Unexcavated and undated open-air sites with Acheulean assemblages are known from the terraces of the Euphrates River in the east (Kuhn, 2002), the Anatolia plateau (Slimak et al., 2008), and the Bosphorus at the site of Göksu (Runnels and Özdoğan, 2001). Few Lower Palaeolithic sites have been excavated, e.g. Yarimburgaz Cave (Kuhn et al., 1996), Karain, Dursunlu, and Kaletepe Deresi 3 (Slimak et al., 2008), and only Kaletepe Deresi 3 yielded a stratified Acheulean assemblage, the first such known in Turkey (Slimak et al., 2008). That assemblage, although as yet not dated precisely, may be late Early Pleistocene. Cleavers are few in number and are made on flakes, which places them within the tradition of the “large flake” LCTs that emerged from Africa sometime before 0.8 mya (Bar-Yosef and Belfer-Cohen, 2001). Of particular interest is the location of Kaletepe Deresi 3 at one of the higher elevations found in Turkey suggesting that even at this early date the rugged topography of Turkey was not a barrier to early hominin dispersals. Further complicating the picture, Turkey, as much of the rest of Eurasia, also has Lower Palaeolithic sites with pebble core assemblages with few bifaces, making it difficult, in the absence of chrono-stratigraphic
data, to relate them to Mode 2 sites (Runnels, 2003). Fossils here, as throughout the wider Mediterranean, are rare, but a recently discovered fossil *calvaria* has been attributed to *H. erectus sensu lato* (Kappelman et al., 2008).

In neighboring Greece, Lower Palaeolithic sites are both few in numbers and poorly dated (Runnels, 2001; Tourloukis, 2010). There are some scattered hominin fossils, including a Neanderthal at Lakonis Cave (Panagopoulou et al., 2002-2004) and two specimens of *H. heidelbergensis* or possibly a Neanderthal at Apidima Cave in the Mani (Harvati et al., 2009, 2011), and *H. heidelbergensis* in the Chalkidiki peninsula from Petralona Cave (Harvati et al., 2009). Pebble core assemblages (Runnels, 2003) are known from open-air sites in Thessaly and Epirus, and Acheulean handaxes have been found at Kokkinopilos in Epirus (Runnels, 2001). Radiometric dates suggest that the Thessalian site of Rodia and the Epirote site of Kokkinopilos (Fig. 1) are Middle Pleistocene in age, or even earlier in the case of Rodia (Tourloukis, 2010:94-108). Kokkinopilos is the only site where handaxes are associated with geologic strata that can be dated by a combination of sedimentation rates, paleosol age assessments, and radiometric means (IRSL and OSL). The minimum age of the sediment outcrop at Kokkinopilos that has produced two in situ handaxes is ca. 250 kya (Runnels and van Andel, 1993, 2003; Tourloukis and Karkanas, 2012).

Lower Palaeolithic sites in Albania are only now coming to light. While Gajtan and Baran (Fig. 1) in the northern uplands produced small collections of undated materials consisting of cores and flakes (Darlas, 1995), our lack of knowledge for the Lower Palaeolithic elsewhere in Albania is due to a lack of research, as is demonstrated by the recent discovery of Lower Palaeolithic sites in the southern district of Fier (Runnels et al., 2009). Until more systematic research and excavation have been undertaken in Albania, however, we can only surmise that the hominin presence there was perhaps as early as the Middle Pleistocene, as it is in neighboring Greece (e.g., Runnels and van Andel, 2003).

Lower Palaeolithic sites elsewhere in southeastern Europe are also rare, scarcely a dozen in number (Valoch, 1995). The best documented sites are Beroun, Prezletice, Brno, Stránska skála, and Vértesszöllös, but the vast empty areas between the known sites on the available distribution maps (e.g., Valoch, 1995:fig. 1) are evidence of the lack of systematic prospecting and research, especially the application of targeted survey methods that have been used to effect elsewhere in the region (e.g., Runnels and van Andel, 2005). The lithic industries are hard to characterize, with only simple, atypical bifaces at some (e.g., Beroun and Prezletice) or small scale pebble core assemblages (e.g., Vértesszöllös). The only notable feature of the available data is the dominance of the assemblages by pebble core tools (choppers and chopping tools) and retouched flakes, a pattern that extends to northwestern Turkey and northeastern Greece (Runnels, 2003).

The Italian early Palaeolithic record is richer than neighboring Greece’s. Lower Palaeolithic open-air sites are associated with paleo-lake margins and river terraces for the most part and date to ca. 0.6-0.3 mya. They include, among others, Rosaneto, Cimitero di Atella, Venosa Notarchirico, Fontana Ranuccio, and Venosa Loreto (Moure, 2003; Roebroeks, 2006; Villa, 2001; Santonja and Villa, 2006; Fig. 1). The earliest occurrence of the Acheulean, signaled by the presence of bifaces, is at the Middle Pleistocene site of Venosa Notarchirico (ca. 0.6–0.5 mya) (Mussi, 2002). Cleavers and trihedral picks are absent, and cleavers are rare for the entirety of the Italian Acheulean. Two flake cleavers were found on the surface in the Venosa Basin in the same general area as Notarchirico, but their provenience is uncertain (Santonja and Villa, 2006:455; Ferrara and Piperno, 1999). Two other flake cleavers, on sandstone, along with two bifacial flint cleavers, have been reported from the open-air site of Rosaneto, located on terraces two kilometers from the Castrocucco River in southern Italy (Piperno, 1974). There have also been reports of flake cleavers from Sicily, primarily from the southwest at the sites of Pergole and Maddaluso, but unfortunately the precise findspots are unknown (Bianchini, 1973). In the absence of firm evidence for a Palaeolithic occupation of Sicily, Villa’s assessment that the peopling of the Italian Peninsula is currently best explained by a movement of individuals from the north may be correct, and the timing (ca. 0.6 mya)
and lack of standardized technology and many formal tool types argue against direct contact with northern Africa. But there is some evidence for the Lower Palaeolithic on the islands of Sicily, Sardinia, and Corsica that is controversial both in terms of the nature of the lithic artifacts and the dating. Many scholars question the value of these finds as evidence for a Lower Palaeolithic presence on the mid-Mediterranean islands (Villa, 2001; Broodbank, 2006, 2013:93-96). If a Lower Paleolithic presence was clearly documented on the islands, this would strengthen the possibility of a hominin crossing of the Mediterranean.

As noted above, some of the earliest Lower Palaeolithic sites in the Mediterranean area are in Iberia, particularly in Spain at El Sartalejo, Torralba, Ambrona, Atapuerca, La Solana del Zamborino, and Estrecho del Quípar (Mourre, 2003; Scott and Gibert, 2009). Apart from the complex of findspots associated with the Atapuerca site with their unusual and significant collections of early hominin fossils attributed to *H. antecessor* and *H. heidelbergensis* (Aguirre and Carbonell, 2001; Carbonell et al., 2008), Spanish sites are predominantly open-air locations on fluvial or lacustrine terraces and shores. Especially significant is the possibility that hominins may have crossed the narrow Strait of Gibraltar from Africa. The evidence for crossings includes faunal remains said to be from African suites, and artifacts, both pebble core types as at Orce, and Acheulean as at La Solana del Zamborino and Estrecho del Quípar. Only recently have some researchers leaned towards a cautious acceptance of this hypothesis (e.g., Santonja and Villa, 2006; Sharon, 2011), although the possibility of such crossings still faces challenges (e.g., Straus, 2001). Central to this position are the early dates obtained for Fuentenueva 3 and Barranco León (Orce), ca. 1.2–1.3 mya (Santonja and Villa 2006). Assemblages at both sites, however, have been characterized as Acheulean.

The earliest Spanish Acheulean sites, Estrecho del Quípar and La Solano del Zamborino, have been dated by palaeomagnetism (Scott and Gibert, 2009), Estrecho del Quípar (0.9 mya), a rockshelter on the northeastern margin of the Baza Basin, produced a single limestone handaxe, along with smaller lithics made on chert, which include denticulates, side-scrapers, and protolimaces. The younger of the two sites, La Solano del Zamborino, is on the margin of a palaeo-lake, and is thought to date to 0.76 mya. Its assemblage contains handaxes, cleavers, and trihedral picks made on locally available materials such as quartzite, quartz, chert, mica, schist and silicified limestone (Scott and Gibert, 2009). Further evidence for a direct connection with northern Africa has been proposed by Sharon (2011) who notes the similarity of the *entame* core method for large flake production from quartzite cobbles present at the Algerian site of Ternifine (Fig. 1) with that used in the Iberian Peninsula. While convergence cannot be ruled out, especially for such a generalized method of flake production, Sharon argues that the technique, which produces cortical flake blanks and favors side-struck or corner-struck removals, is geographically limited, and occurs only sporadically beyond the Pyrenees.

If the early dates for Solano del Zamborino are confirmed, they would push back the earliest appearance of the Acheulean in Europe to ca. 0.9 mya, and indicate that its initial occurrence was geographically far from, and contemporary with, the supposed Levantine corridor followed by Acheulean-using hominins. Even ignoring the growing evidence that Iberia has been continuously colonized from at least 1.3 mya on (e.g., Garcia et al., 2011), these new findings suggest that the assumption that the Mediterranean was an insuperable barrier during the Early and Middle Pleistocene to hominin dispersals should be reconsidered.

**DISCUSSION**

Based on this brief review, it is clear that generalizations concerning the Acheulean in the Mediterranean are limited by the small number of sites, the paucity of excavations, and poor chrono-stratigraphy. Despite these problems, we discern patterns in the data. For example, the majority of the known sites are open-air stations, and evidence of cave and rockshelter use remains ambiguous, e.g., at Yarimburgaz Cave (Stiner et al., 1996). It is possible also to detect two different geographically-distributed traditions or industries, only one of which can
be described as Acheulean with LCTs. The other, hardly a “tradition” in any sense, has some of the same morphotypes, but lacks LCTs. This so-called pebble core industry results from a simple technological approach to producing edged tools and lacks distinctive characteristics. At least in the eastern Mediterranean the pebble core and Acheulean industries are found in the same region, while in other areas, e.g., northeastern Greece and northwestern Turkey, the two have little geographic overlap. The discontinuous distribution of the Acheulean has often been remarked upon and remains unexplained, although there have been many attempts to do so by invoking cultural, cognitive, chronological, and environmental explanations (e.g., Runnels, 2003). Finally, we note the weak chronological distribution of the earliest Mediterranean Acheulean. We see the earliest sites at the extreme eastern and western limits of the Mediterranean, while the Acheulean appears later, and is more variable, in the middle in Italy and the Balkans. This may well result from a “pincer-like” pattern of hominin movements that brought humans into Europe beginning as early as 1.4 myr and at more or less the same time from the east via SW Asia and the west from Africa through the Iberian peninsula in the context of “multiple, multidirectional, multistage dispersals” (Rolland, 2013:10, fig. 1).

Further analysis may yet reveal additional patterns. For example, Vincent Mourre’s careful study of one classic Acheulean type, the flake cleaver, is particularly helpful for our interpretation of the affinities of the Cretan Acheulean. After evaluating the chronological and geographical distribution of flake cleavers, Mourre found that in the Early Pleistocene from ca. 1.7-1.6 mya to ca. 1.0-0.8 mya, they are found concentrated in eastern Africa (Mourre, 2003:tome 3:250-267, fig. 307). Flake cleavers became more widespread in Africa only later, by the beginning of the Middle Pleistocene in southern and western Africa and in the northwest (Mourre, 2003:tome 3:250-267, fig. 308). His analysis indicates that more or less at this time (ca. 0.7 mya) flake cleavers appear in Iberia and southwestern France (Mourre, 2003:tome 3:250-267, fig. 308; see also Raynal et al., 2001). In the Arabian Peninsula, as in the Levantine Rift Valley, a pebble core industry indicates the presence of hominins as early as ca. 1.7 mya, but after ca. 0.9 mya the African-style Acheulean becomes relatively widely distributed. The two industries are also found in Arabia and confirm the picture from Gesher Benot Ya’aqov and Ubeidiya that there was more than one “Out of Africa” event, which in the Arabian Peninsula may have included crossing the Bab al Mandab straits (Petraglia, 2003; Lambeck et al., 2011).

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Although we must be cautious when dealing with individual morphotypes for demonstrating cultural connections, the significance of the flake cleaver should be noted. As part of the Mediterranean Acheulean it fits the Acheulean Bauplan, and in light of this, Mourre’s analysis of the chronological and geographical distribution of flake cleavers is interesting. While the cleaver was part of the African Bauplan from the beginning, it has only a limited distribution outside that continent and for this reason it is useful for aiding in the tracing of possible routes of hominin dispersals. It may also be a means for determining the affinities of the Mediterranean Acheulean. As Santonja and Villa (2006:466) note, all known African Acheulean assemblages with cleavers also include other LCTs, while other LCT-bearing assemblages may lack cleavers. Thus, when combined with Mourre’s spatial distribution of flake cleavers (Mourre, 2003:tome 3:250-267), we posit that the Acheulean tradition of LCTs including cleavers is a distinct and relatively conservative tradition that may be a useful proxy for African origins. Mourre (Mourre, 2003:tome 3:250-267) argues that the distribution of flake cleavers in Europe and southwest Asia is the result of diffusion from Africa of hominins using the Acheulean beginning about one million years ago. This is significant when we consider the evidence from Iberia and the Aegean islands. In the case of Iberia, this dispersal required a crossing of the Strait of Gibraltar from northwestern Africa. A second open-water crossing may also be proposed from the northern coast of Africa to Sicily and Italy, although the available evidence for a cleaver tradition in Italy is limited, and argues against a
direct connection to the African Acheulean. The situation in the Aegean islands is also suggestive of Middle Pleistocene sea crossings. Unfortunately, any consideration of the distribution of the Acheulean in the Aegean is hampered by the incompleteness of the archaeological record in this period, which if we consider the Greek mainland – the most completely studied area – is the result of a number of factors, the magnitude of which was previously unknown (Tourloukis, 2010). Although a lack of systematic research is also at fault, Tourloukis’ review suggests that the greatest factors contributing to the obfuscation of the archaeological record are the dynamic physical processes that have altered and continue to alter the Greek landscape. He makes a convincing case that the scale of the effects of these processes on the Lower Palaeolithic record has been severely underestimated and that the loss of an area nearly equal to the total contemporary landmass of Greece to the submergence of coastal shelves by eustatic sea level rise (Tourloukis, 2010:201) greatly skews our perceptions of the period. The submergence of such a large landmass obscures the richest and most desirable Pleistocene habitats that would have attracted early hominins. Tourloukis notes also that large scale erosional processes in this tectonically-active landscape have severely biased the remaining, unsubmerged archaeological record, leaving perhaps less than 40% of the country’s total present surface with any chance of preserving in situ archaeological materials (Tourloukis, 2010:202). And it is in these disturbed, and sometimes reworked, “sediment traps” that we are likely to find Lower Palaeolithic sites (Tourloukis and Karkanas, 2012). In other words, something like three-quarters of the Lower Palaeolithic record in Greece has been wiped out, or at least put out of range of detection for the foreseeable future. In the absence of similar studies in neighboring regions, any estimate of the impact of geologic and geomorphic processes on the archaeological record can only be a guess, but it is likely that the loss of the Lower Palaeolithic record is a significant problem biasing interpretive results everywhere.

Furthermore, for the analysis of the possible movements of early hominins, whether by longer open-sea crossings, short island hops, rafting, or the crossing of now submerged land bridges, it is essential to have a more complete understanding of the marine geophysical history of the Aegean basin in the Middle Pleistocene. As recent work by V. Lykousis has shown, this history is very complex and at times part of the northern and central Aegean basin may have been dry land crossed by numerous rivers and dotted with lakes (Lykousis, 2009). In his consideration of the palaeogeography of the Aegean, Tourloukis notes that this lost habitat would have been rich in resources and attractive to early hunter-gatherers (Tourloukis, 2010:162-166). Lykousis’ data do not apply to the southern Aegean basin and it is not possible as yet to reconstruct the configuration of the mainland and Crete in order to estimate the number or length of crossings that would be necessary to reach Crete from Anatolia or mainland Greece. Such reconstructions will require considerably more data than are presently in hand, particularly the kind of fine-grained isostatic and tectonic data such as those that have been applied recently to provide a more detailed reconstruction of the configuration of the Red Sea enabling a first-order estimate of the magnitude of the open-water crossings that would have been required to move from Africa to the Arabian Peninsula (Lambeck et al., 2011). It should be noted, however, that Crete has been an island since the Messinian Salinity Crisis (MSC) of ca. 5.6 mya, and that the endemic fauna isolated on the island throughout the Plio-Pleistocene indicates the oceanic nature of Crete. The available evidence suggests that the arrival of any animals on Crete after the MSC was the result of episodes widely separated in time and known as “sweepstakes colonization.” Thus the separation of the island from the mainland was at all times sufficient to serve as a filter to some terrestrial fauna such as predators, but could at times – if only rarely – be crossed by swimming mammals such as large herbivores (in the case of Crete, hippopotami, elephants and deer). Large herbivores that had migrated and become isolated became nanized over time as a result of limited island resources, the lack of predators, and the lack of subsequent colonizations introducing mainland genes. Consequently, Crete was an “oceanic-like” island throughout the Pleistocene. It should be noted that there is evidence of one as yet poorly
understood change in the fauna sometime in the Middle Pleistocene when a number of species, again only swimming herbivores, may have reached Crete (van der Geer et al., 2010:15–30, 44–61).

In addition, a growing body of evidence for the presence of the Palaeolithic on some Greek islands may go some way towards supporting the view that Middle Pleistocene hominin sea crossings were possible. Middle Palaeolithic artifacts of Late Pleistocene age have been identified in the last decades on a few Greek islands (e.g., Kephalonia, Melos, and Alonnisos), suggesting to some (Carbonell et al., 2008:210) that the Mediterranean was not an insuperable barrier to hominin dispersals from Africa. The lithics from Alonnisos can be broadly described as Mousterian (Middle Palaeolithic) (Panagopoulou et al., 2001), as can the undated sites reported from the Ionian island of Kephalonia (Kavvadias, 1984). The evidence from Melos is especially interesting (Chelidonio, 2001), as the artifacts from the Triadon Bay site are Middle, if not Lower, Palaeolithic in character, and notably do not utilize any of the local obsidian sources for raw materials. We have also noted rhyolite LCTs at Sta Nychia on Melos (Runnels, 1981:94-95, fig. 33), which suggests that the further investigation of the island would be very useful. Similar materials have been found recently at the site of Stelida on Naxos, suggesting that this industry may be more widespread in the Cycladic islands than has been heretofore recognized (Tristan Carter personal communication 2013). Finally, a marine geophysical study of the Ionian island of Kephalonia (Ferentinos et al., 2012) has confirmed that the island has always been separated from the mainland by open water passages.

CONCLUSIONS

For the western Mediterranean islands, questions about the artifactual nature of purported Lower Palaeolithic finds (e.g., Villa, 2001) and the lack of secure chrono-stratigraphic contexts for them have required archaeologists to reserve judgment concerning hominin seagoing activity before the end of the Pleistocene (Broodbank, 2006:202-205, 2013:129-156; Straus, 2001; Villa, 2001). Support, however, for “island hopping hominins” may be found elsewhere around the Mediterranean. Acheulean sites from North Africa (Raynal et al., 2001) to the Arabian Peninsula (Petraglia, 2003) cluster in age around the Early Pleistocene/Middle Pleistocene boundary, and in the succeeding half million years, spread to Eurasia. From the first, Acheulean sites have been predominantly associated with coastal margins or marine beach fronts, a pattern that can be discerned widely from western Europe to the Arabian Peninsula (Petraglia, 2003:171–172). This association of open-air stations with water or wetlands, whether coastal margins, lakes, river terraces, or springs, encourages us to assume that wetlands attracted early hominins because they were places where large game animals congregated and plants for food, fuel, and tools could be readily procured. They were also dependable sources of water during dry Mediterranean summers, and thus were key depositional environments providing the high probability that early archaeological materials would be rapidly buried and preserved (Runnels and van Andel, 2005).

Above, we underscored the major gaps in the archaeological, paleontological, and chrono-stratigraphic records and noted the broad patterns that can be delineated in the existing data. Beyond that we enter the realm of speculation. Which hominins were moving from Africa to Europe? Were these movements sustained, resulting in permanent occupation of Europe, or were they sporadic and discontinuous? Were the movements primarily from east to west, across Anatolia via the Bosphorus land bridge into southeastern Europe (e.g., Kuhn, 2010)? Did hominins cross the Strait of Gibraltar (Straus, 2001) into Spain, and perhaps cross from Tunisia to Italy through Sicily, despite the apparent lack of evidence for the latter route (e.g., Villa, 2001)? And what part was played by the now-submerged coastal shelf of the Mediterranean or in the Aegean as corridors for hominin dispersals (Bailey and Carrion, 2008; Lykousis, 2009)? We cannot address these questions here, and for the moment, our working hypothesis is simple: the Cretan Lower Palaeolithic was part of the third “Out of Africa” event ca. 1.0-0.8 mya that marks the dispersal of hominins (probably Homo erectus s.l.) utilizing the African Acheulean Industrial Tradition (Bar-
Yosef and Belfer-Cohen, 2001). Beginning late in the Early Pleistocene or early in the Middle Pleistocene, and for reasons that remain elusive, the bearers of the Acheulean spread across north Africa, towards the Atlantic façade, and into the Iberian Peninsula and SW Asia. They perhaps also crossed the Mediterranean to the islands, whence ultimately they crossed over to the mainland through Greece.

Unfortunately, we do not have enough evidence to follow this dispersal of Acheulean makers in more detail. Did hominins cross to Crete from Africa and then into Greece and Turkey? Or was the movement sometimes in the other direction, from Turkey and Greece to Crete? Perhaps in both directions? Will a Lower Palaeolithic presence be confirmed on Cyprus, Sicily, Malta, or the Balearics? To answer these and other questions raised by the discovery of the Cretan Acheulean, new research must be directed towards the elucidation of the Palaeolithic record on that island as well as on other large islands that were separated from the mainland during the Pleistocene and accessible to early hominins only by boat. The presence of Lower Palaeolithic artifacts on Cyprus, the Cycladic islands, and, farther west on Malta and the Balearics appears to us to be likely, and we would also urge the reconsideration of the evidence from Sicily, Sardinia, and Corsica.

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