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TRACING THE STEPS IN THE FIELDWORK AT THE SITES OF ASPROS AND NISSI BEACH ON CYPRUS

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Abstract

The chapter provides an overview on the fieldwork that was carried out over the course of seven years at two early sites, Aspros and Nissi Beach, on Cyprus. It begins with an account of the motivation for the study and then outlines the new approach that we took in the field in order to find the missing pre-Neolithic sites on the island. The chapter then turns to the six main steps in the fieldwork: (1) the discovery of the new sites on formations of aeolianite for the first time on Cyprus, (2) the work of mapping the two sites (based on a combination of Quick Bird imagery, differential GPS and low-level overhead photograph) and the collection of scatters of lithics on the surface of each site, (3) the environmental studies that were done at the two sites, (4) the trial excavations that were then undertaken at both of them, (5) the systematic recovery of the fragments of beach rock during the 2009 excavation season at Nissi Beach in order to document the action of one or more tsunamis in historical times in taking lithics from submerged sites on the seabed and tossing them up on the land surface of the site and (6) the underwater archaeology that made it possible to trace the site of Aspros out in the water and to provide further documentation of the Epipalaeolithic age of the lithics at Aspros as well as their links, in the case of dive site C, with the south coast of Anatolia. The last section considers some of the wider implications of the results of the fieldwork, including a discussion of the Younger Dryas, the cold snap at the end of the Pleistocene, and the emergence of early voyaging on a regular basis in the Eastern Mediterranean at that time.

Key words: pre-Neolithic, Epipalaeolithic, coastal foraging, aeolianite, early voyaging, early seafaring, Younger Dryas

INTRODUCTION

The aim of this chapter is to provide an overview on the work that we conducted at Aspros and Nissi Beach, two early sites on Cyprus, over the course of seven years. The reconnaissance work, the excavations and the underwater archaeology that we did on the island, starting in September of 2003 and running through July of 2009, led to a series of discoveries of considerable interest. As mentioned by Ammerman (this issue), the primary goal of the project was to find the missing sites that go back to the time before the Neolithic period on the island. When I went out to Cyprus at the start of the project, there was only one good candidate for a site of pre-Neolithic age. It was the much debated site of Aetokremnos on the Akrotiri Peninsula, where a collapsed rock shelter rich in hippo bones had been excavated (Simmons, 1999; on the controversy that has swirled around the site in the literature since the time of the publication of *Faunal Extinction in an Island Society*, see Binford, 2000; Grayson, 2000; Mithen, 2003; Ammerman and Noller, 2005; Knapp, 2013; previously, Bunimovich and Barkai, 1996, had drawn attention to the lack of cut marks on the hippo bones; the debate is introduced by Ammerman in this issue). Accordingly, even in the case of Aetokremnos, there was still uncertainty in the minds of many archaeologists working on Cyprus when it came to the nature and the age of the site. What I learned when I first arrived on the island was that the shortage of other pre-Neolithic sites was itself one of the things that fanned doubts about Aetokremnos. Given that a fair number of archaeological surveys had been conducted on Cyprus by this time, one would expect that at least one other good pre-Neolithic site should have come to light by 2003. Here it is worth recalling that the shortage of pre-Neolithis site on Cyprus was part of a larger picture. They were likewise in short supply on the other large off shore islands in the Mediterranean Sea. Indeed, in 2003, there was still no known pre-Neolithic site on the island of Crete. Since there is good evidence on the mainland for Epipalaeolithic and Mesolithic sites in coastal areas from the Levant to the Iberian Peninsula, the lack of early sites on islands such as Crete, Malta and Majorca was a major puzzle (Ammerman, 2010). For some time, conventional wisdom had held that this was due to the reluctance of hunter-gatherers and foragers to go to sea as shown by the fact that sites older than the Neolithic period were hard to find on the large off shore islands (Cherry, 1990). It was in this context that many of my friends and colleagues thought that I was barking up the wrong tree in making the decision to go out to Cyprus.

In January of 2004, there was a welcome surprise waiting for us at Nissi Beach on the island's south coast (Ammerman *et al.,* 2006). This was the first early site to be found on one of the formations of aeolianite, which occur on or near the coast in many different places all around the island. At the time, we had just started doing reconnaissance work on the formations of aeolianite (old fossilized sand dunes in everyday language), since they offered good conditions of visibility for finding lithics of small size on the land surface. In other words, the whole story now began to change. Nissi Beach was just the first in a series of discoveries that we would make in the months to come on the aeoliante elsewhere on the island, including the site of Aspros in the Akamas on the west coast (Fig. 1). Thus, the pre-Neolithic sites were no longer missing on the island. They had been sitting on the aeolianite rock for years patiently waiting for the archaeologist to come along and find them. I had made the right choice in going out to Cyprus after all. Previously, we have published a number of reports and chapters, which often focus on selected aspects of the fieldwork in a given year. The purpose of this chapter is to bring together in one place the various strands of the work and develop a more synthetic account in which each of them has its contribution to make to the story as a whole. In other words, this chapter will be tale of two early sites – not a tale of two cities on opposite sides of the English Channel as told by Charles Dickens – but one with its own fair share of twists and turns and surprises.

In many respect, it would be difficult to choose a better time than 2003 to start the project. Good fortune was on our side from the beginning. Only a few of the elements in support of this idea will be touched on briefly in this paragraph. The economy of Cyprus was booming at the time. There was in the air a positive and expansive mood; it was a good time for the Cypriote to take the chance and do something new. In reality, the economy and the banking system, in particular, were in the process of becoming over-heated. Indeed, they were on the pathway to a bubble, which no one was prepared for. On the political side, there was a temporary thaw in the relations between the north and the south during the run up to the vote on the reunification of the island in the spring of 2004. For the last 30 years, the island had been a divided place, where those on the Greek side in the south could not visit their former villages in the north and vice versa. Now such visits were possible for the first time in many years. While Turkish Cypriotes in the north voted in favor of reunion, their counterparts in the south did not approve the UN plan, and Cyprus remained a divided island. On the archaeological side, Jean Guilaine was now completing his large-scale excavations at the site of Shillourokambos, which now provides a much better idea of the spatial layout of an Early Neolithic settlement as well as a more refined chronological framework for the Cypro PPNB (Guilaine *et al.,* 2011). The excavation of one of the deep wells at the site called Mylouthkia also documented the close affinities between the Early Neolithic in the Levant and the Early Neolithic on Cyprus (Peltenburg *et al.,* 2001). In addition, two major conference volumes were just coming out at the time (Guilaine and Le Brun, 2003; Peltenburg and Wasse, 2004). And in the summer of 2003, Tom Davis had moved to Nicosia where he now became the new director of the Cyprus American Archaeological Research Institute (CAARI). The co-editor of the proceedings of the workshop, Davis has long had an active interest in the island's prehistory and the Neolithic period in particular. We soon became close friends. At

Fig. 1. Map of Cyprus showing the location of the early sites of Aspros (Akamas), Aetokremnos (Akrotiri) and Nissi Beach (Agia Napa)

the same time, the Cyprus Fulbright Commission was still thriving in those days. Today it is barely ticking over. Indeed, not only had the Commission selected me to be a Senior Scholar for the academic year of 2003-2004, but it had also managed to select – in what, in retrospect, we have come to call "its infinite wisdom" – Jay Noller, a soil scientist and coastal geologist at Oregon State University, as the other Senior Scholar that year. Moreover, he had even done previous fieldwork in connection with landscape archaeology. As implausible as this may seem, serendipity was smiling benevolently on us. More will be said about Noller's major contribution to the project later in this chapter.

The purpose of this paragraph is to introduce the publications that have previously come out on our work at the two sites. In some cases, the results of the fieldwork have already been presented in some detail, and the plan is not to repeat here what is said elsewhere but instead to cite what is already in the literature and move forward in the argument with pace. In all, there are nine articles and chapters that are either in print or else in press. In addition, a monograph by Kaczanowska and Kozłowski on the analysis and the interpretation of the lithic materials at the two sites is in preparation. Here only the titles of the publications and a few brief words on the main focus of each one will be given to facilitate finding them in the literature. The first article is called "New light on Aetokremnos;" it stems from the two visits to the Akrotiri Peninsula in 2004 when we made several new observations on the environment setting of the site (Ammerman and Noller, 2005; more will be said about this below). Five of the publications are preliminary reports on the fieldwork written for the journal published by the Department of Antiquities, Cyprus. It is officially called *Report of the Department of Antiquities, Cyprus* (in shorthand, the *RDAC*). And while it does have a limited circulation, it has the virtue that all of the figures in an article can be printed in color. In my own case, I had agreed to publish a series of preliminary reports in the journal when arrangements were made to conduct the fieldwork at Aspros and Nissi Beach as a joint venture in collaboration with Pavlos Flourentzos, the Director of the Department of Antiquity from 2005 through 2009. In the next section of this chapter, more will be said about the clear advantages of this modus operandi. By the way, I had previously done joint ventures of much the same kind in Rome and Venice. So what I was doing on Cyprus was an extension of my prior experience in Italy. On the publication side, this now made it possible to get out rapidly a series of three preliminary reports of substantial length (each one 20 to 30 pages long) in 2006, 2007 and 2008. Then, since the economic downturn that began to arrive in 2009, things have, of course, slowed down to a crawl. In any event, the following list gives the titles of the five articles written for the *RDAC*: (1) "Two new early sites on Cyprus" (Ammerman *et al.*, 2006; the discovery of Nissi Beach and Aspros), (2) "More on the new early sites on Cyprus" (Ammerman *et al.,* 2007; it focuses on environmental studies); (3) "Third report on early sites on Cyprus" (Ammerman *et al.*, 2008; it includes preliminary reports on the trial excavations at the two sites and the underwater archaeology undertaken in front of Aspros), (4) "Fourth report: Excavations at Nissi Beach" (Ammerman *et al.*, 2012; a preliminary report on the excavations at Nissi Beach; it was accepted for publication in March of 2010) and (5) "Fifth report on the excavations at early sites on Cyprus" (Ammerman *et al.*, in press; more on the excavations at Nissi Beach). In addition, three chapters concerned with more specific topics or themes have come out: "The first Argonauts: Toward the study of the earliest seafaring in the Mediterranean" (Ammerman, 2010), "The paradox of early voyaging in the Mediterranean and the slowness of the Neolithic transition between Cyprus and Italy" (Ammerman, 2011a) and "Underwater investigations at the early sites of Aspros and Nissi Beach on Cyprus" (Ammerman *et al.*, 2011). The plan is for *The lithics at Aspros and Nissi Beach: Learning more about the forager-gatherers on the island of Cyprus*, the monograph in preparation mentioned above, to be published by the Polish Academy of Science.

Emphasis will be placed in this chapter on the new approaches and innovations that we brought to the fieldwork on Cyprus as well as the new things that came to light at Aspros and Nissi Beach. They are the "surprises" mentioned above. At this point, it is worth identifying four of them and making a few brief comments, by way of introduction, on their wider implications. More will be said about some of them in the discussion at the end of this chapter. They are respectively: (1) the discovery of the early sites on the aeolianite (where no one had taken a close look before), (2) the realization that one or more tsunamis have played a major role in what we see on the surface of sites such as Apros and Nissi Beach (tsunamis were previously off the radar of the archaeologist on Cyprus), (3) the discovery of lithics of Epipalaeolithic age on the seabed at the foot of a submerged cliff in front of Aspros (no one had attempted to do underwater archaeology at an early site on the island before) and (4) the working hypothesis that there is a connection between the cold climate event known as the Younger Dryas and the origins of voyaging on a regular basis in the Eastern Mediterranean (Broodbank, 2006: Ammerman, 2010; note that no one was in a good position to put forward the hypothesis prior to 2004 because of the shortage of pre-Neolithic sites on Cyprus and Crete). In fact, Broodbank drew upon the new and yet to be published sites of Aspros and Nissi Beach in writing the review article in which he puts forward the hypothesis (for more on the back story here, which includes the piece that John Noble Wilford wrote on November 22, 2005 in the Science Section of the *New York Times* reporting on the paper that I had just given at the annual meeting of the American Schools of Oriental Research and that drew attention to the connection between the two, see Ammerman *et al.*, 2007:20).

Some of these surprises are actually not so surprising when they are viewed in retrospect. For example, the idea that one should look for early sites in submerged places along the coast would seem to be a fairly obvious one. Putting the idea into practice is, of course, another matter. And much the same would hold in the case of looking for the sites of coastal foragers on the aeolianite. Looking back, this was the *natural* place to search for them. The real surprise in this case is how long it took before this was done. Thus, one of the things to think about is the need for a better fit between our ideas (theory) and what we do in the field (method and practice). In the case of archaeology, the weakness often turns out to be on the latter side. At the same time, it is clear from our experience at the two sites that having the right people on the team makes a big difference. If it had not been for Jonathan Benjamin, Duncan Howitt Marshall and Tim Turnbull, the underwater archaeology at Aspros would not have happened. Without the observations made by Ioannis Panyides on the fragments of beach rock at Nissi Beach, we might not have developed a better understanding of the role that tsunamis play in the site formation processes at the two sites. And one could go on and say the same in the case of the contributions made by Jay Noller, Roberto Gabrielli, Ken Thomas, Janusz Kozłowski and Małgorzata Kaczanowska. On the other hand, there is one implication of the innovations and the new results that they produced, which is much less obvious at first glance. It has to do with what are called "big events" in the language of the earth scientist and how we think about the past in the study of prehistoric archaeology. For the most part, we tend to adhere to a gradualist approach. Here we are following in the footsteps of geology in the 19th century and the first half of the 20th century. We, as archaeologists, tend to shy away from big events (we leave this sort of thing to journalists who are all too eager to write imaginative accounts about fires, floods and volcanic eruptions in the remote past). However, it is important to note that three of the four points listed above are linked in one way or another with "events" in the earth sciences. Using the same numbers as above, they are respectively: (2) the powerful seismic sea waves of a tsunami, (3) the marine transgression that took place at the end of the Pleistocene and (4) the cold snap of the Younger Dryas. Of course, each of them takes its own quite different form in nature. However, when we start to think about the three of them acting in combination with each other in our field of investigation, it may help to explain why the study of forager-voyagers got off to such a slow start. If our task is to study the voyaging foragers on Cyprus, then it is important for us to try to get our minds around each kind of event and incorporate our understanding of them in our research.

BACK STORY

Before we turn to the fieldwork itself, it would be good to say a few words about what was going on behind the scenes before we put on our boots. What led me to think about going out to Cyprus in the first place? Why would an archaeologist who had worked most of his life in Italy and also done some fieldwork in Greece (in the Agora of ancient Athens and at mound sites of Neolithic age in Aegean Thrace) now want to go out to the eastern end of the Mediterranean and attempt to do something new? In fact, as mentioned very briefly in Ammerman in this issue, I had once written a PhD dissertation on the Mesolithic in Italy under the supervision of John D. Evans at the Institute of Archaeology in London. So going back to the time before the Neolithic period would not be a completely foreign country for me. However, since 1985, the focus of my research had shifted from working on the Neolithic transition in Europe to doing studies involving landscape archaeology in the Forum of Rome, the Agora of Athens and Saint Mark's Square in Venice (for what we were trying to do in these three civic centers, see Ammerman, 2011b). As also mentioned in Ammerman in this issue, I had organized a previous Wenner Gren Workshop on the Neolithic transition in Europe, which was held in Venice in 1998. At the time, I thought that I was summing up the work that Cavalli-Sforza and I had done in this field of research for the last 30 years and perhaps even saying farewell to Neolithic studies. At one point in the workshop in Venice, Jean Guiliane asked me if he could give an extra talk one evening on the discoveries coming to light at his new excavation at Shillourokambos (Guilaine *et al.*, 2011). The results coming in from the field were of great interest. They were, in fact, the first seeds of the idea of going out to Cyprus. For such an early and rapid transition to the Neolithic to have taken place on the island, it was reasonable to think that there must have been a prelude. In other words, coastal foragers from the mainland may well have been making seasonal voyages to the island in the time well before the PPNB. Then, I had the chance to attend a second meeting, which further sparked my interest in Cyprus. This was the international conference on "Archaeological Field Survey in Cyprus," which was held at Nicosia in

2000. My role at the meeting was to bring to it the perspective of how, in terms of method and theory, survey archaeology had developed in Italy over the last three decades. The paper that I gave at the meeting was called "Farewell to the Garden of Eden: Survey archaeology after the loss of innocence" (Ammerman, 2004; for a recent overview and bibliography on the work of the Acconia Survey, see Ammerman *et al.*, 2013). Almost all of the surveys that had been done on Cyprus so far were multi-period ones. Few of them took a more problem-oriented approach to the recovery of sites dating to the early periods of the island's prehistory. In addition, from what I heard at Nicosia, there did not appear to be much interest in the ways in which site visibility plays a major role in the recovery of early sites on the island. My experience in Italy had taught me that this was a key factor. So I now began to realize that there might well be a good chance of finding the missing early sites on the island, if one took a new approach in the field. As mentioned before, some of my colleagues thought that I was struck by moonbeams when I mentioned this to them, and most of my friends thought that I would return home empty-handed.

In September of 2003, I went out to Cyprus and spent the academic year as a Fulbright Senior Scholar. The Director of the Department of Antiquities at the time gave me a permit to do reconnaissance work in any place on the Greek side of the island. Apparently, such a generous permit had not been given out before. Indeed, he gave it to me in the belief, as I later learned from Tom Davis, that there were no sites to be found on the island that date to the time before the Neolithic period. He too, in other words, had his doubts about what had been found at Aetokremnos. When I innocently asked him about the situation in the north and whether it might be possible to take a look there, he shrugged his shoulders and said that he himself had recently been there out of curiosity and visited an area where he had once done a survey as a young staff member at the Department. Yes, one could perhaps take a peak, he replied in a truly Mediterranean fashion, but one could not touch anything on the ground. It was just like hearing an oracle at Delphi in the 5th century BC. As it turns out, there are – even without touching them – early sites on the formations of aeoliaite in the north. But there is absolutely no way of publishing them. In the late spring of 2004, the director would start to move towards retirement, and there was a good chance that he would be replaced by Pavlos Flourentoz, who had studied prehistory in Prague. Furthermore, Flourentzos had a real interest in the study of the Neolithic. But, as always, it was still far from clear whether he would be chosen to be the next director. In the end, this did happen, and it would now open a wide door since we had talked informally about doing a joint project. Once he saw that I could find Nissi Beach, Aspros and other new early sites, he began to realize that this was not such a bad idea – even a good one. It now meant that it would be possible to continue doing the reconnaissance work on the landscape and also conduct trial excavations at Nissi Beach and Aspros with the logistic support of the Department of Antiquities. In the case of Nissi Beach where the site is located in the middle of a large tourist complex, the Department was in a better position to deal with matters concerning the its heritage and preservation.

During the first three months, it was still hot and dry on Cyprus. The conditions of visibility on the ground are not good at this time of year, and so I spent most of my time studying geological and topographical maps and making short trips in the field to check out promising places on the landscape – with the idea that we would examine the best of them more closely when conditions of visibility were better. While I waited, there was the chance to see Jean Guilaine and visit his excavations at Shillourokambos. At the same time, Jay Noller and I began to make trips out on the landscape. He had done fieldwork on Cyprus before, and I had much to learn from him. This was also the time when I looked into some of the claims in the literature for other pre-Neolithic sites on Cyprus (none of them other than Aetokremnos was very promising on paper; Ammerman *et al.*, 2006) and made visits to places such as Zygi and Petrati to check on what could be seen on the ground there. Without going into the details here, few lithics were observed in the field in either case, and none of them clearly went back to the time before the Neolithic. The two visits to Aetokremnos – access to the site is tightly restricted since it is located inside a large British air base – would be made in February and March of 2004. The problem with the other proposed sites was that their lithic materials were either not abundant enough to make a good case for a pre-Neolithic site or else their chipped stone tools lacked the diagnostic features that would place such an attribution on a sound footing (Ammerman *et al.,* 2006:2; Simmons, 1999:21-25). The real challenge for me was then that of selecting the most promising places to cover on the landscape out of a very wide range of different possibilities. On one of our forays in the countryside in November, Noller and I visited an area near Mazaotos on the south coast, and I had the chance to see for the first time a formation of aeolianite on the landscape. It immediately sparked my interest. I recalled the years that I had once spent doing survey work and excavations on the system of paleo-dunes at Acconia in the toe of Italy, which often offered places with good conditions of visibility for finding Neolithic sites (Ammerman *et al.*, 2013). On the geological maps of Cyprus, the term aeolianite is not used; instead such landforms are classified as calcarenite. And according to Noller, not much interest had previously been taken in the aeolianite by those working for the Geological Survey of Cyprus. One would have to use the morphology of the aeolianite formations in order to recognize this landform on a map. I learned how to do this, and the rest is prehistory as one might paraphrase the old cliché.

FIRST STEPS ON THE AEOLIANITE

The purpose of this chapter is to review the main steps in the fieldwork at the two sites. In this section, the plan is to cover the first four steps: (1) the discovery of the sites, (2) the collection of lithics and the mapping of them, (3) the environmental studies done at them and (4) the trial excavations at Aspros and Nissi Beach. In subsequent sections, we shall turn to the fieldwork done in connection with the innovative steps called respectively: (5) the tsunami story and (6) taking the plunge (underwater archaeology). A few words have already been said in the previous sections about the approach we took in the field at the first step. To begin with, we would not do the usual multi-period survey but a problem oriented one. As mentioned before, the aim was to find the missing pre-Neolithic sites, and this would call for wide-ranging reconnaissance work and not a survey whose task was to cover a given area and to identify the full range of sites in it. In order to have the best chance of seeing early lithics on the land surface, most of the fieldwork at this stage of the project would be done in the months between November and April. And the team would consist of just a few archaeologists who had experience in seeing small pieces of chipped stone on the ground. Putting inexperienced students out on the landscape was not the way to go from my experience in Italy and Greece. Previously, we have described the approach that we took in the field and the importance of thinking in terms of landscape archaeology at this step (Ammerman *et al.*, 2006; Ammerman, 2010). Three considerations of special interest will be highlighted here. The first one concerns the visibility of early sites on the landscape. This involves covering places on the landscape with a combination of the right kinds of geomorphology and a minimum of vegetation on the land surface. We had to keep both of these factors in mind. Secondly, we chose to place emphasis on looking in areas on or near the coast, since the forager-voyagers coming over to Cyprus from the mainland would have had to step ashore somewhere. If we were able to examine enough different places along the coast, there should be a good chance of finding traces of the coastal foragers who went to sea. Thirdly, it would be a good idea to direct our attention to landforms that had been skipped over or ignored before. As we would soon learn, the aeolianite provided a good example of this. Ideally, the reconnaissance work should be both diverse in scope and comprehensive in its coverage of the landscape. In a nutshell, our strategy was a pro-active one. Of course, this all sounds good on paper in retrospect. However, at the time, it was still unclear what we would find when we tried to implement this new approach in the field. In fact, we were on the right track. If one could identify an area on the coast with a formation of aeolianite and also see on the map a watercourse coming down to the sea in the same place, there was a good chance that one would find an early site when one went out in the field. This was the case of the early site of Aspros in the Akamas. Here it is worth adding that the rapid development of tourism on the island since 1970 has actually worked against the archaeologist finding early sites today. A fair number of hotels in the Pafos area have been built just in those places on the landscape where one finds a drainage from the interior in combination with a raised formation of aeolianite overlooking the sea. Had it not been for the law declaring much of the Akamas to be a conservation area for sea turtles, a tourist hotel would have been built on the site of Aspros long before we managed get there.

The second step in the fieldwork was to map each sites once it had been identified and to collect the chipped stone artifacts that occur on its surface. The land surface of the aeolianaite rock is a rough and uneven one. It does not lend itself to the kinds of mapping that one commonly does at an archaeological site. To add a further challenge, the numerous scatters of lithics encountered at each site cover an area of some size – one roughly the area of a football field. In mapping an early site, one would obviously like to record the locations of the respective scatters at a fine grain of spatial resolution. None of this appeared to be easy when we initially began to work at Nissi Beach. At both sites, it would be difficult to establish and work on a grid-based system of collection over such a large, rough area. Through the Geological Survey of Cyprus, Jay Noller had access to Quick Bird imagery. For the archaeologist, Quick Bird was still a fairly new and expensive form of satellite imagery – one producing high-resolution maps that are geometrically corrected and geo-referenced. Again, we had great good fortune here. Without going into the details, there was the opportunity to use Quick Bird imagery in combination with differential GPS in mapping the collection of the lithic scatters at the two sites (for the initial maps in color of the two sites, see Ammerman *et al.*, 2006:fig. 5-6). Starting in June of 2006, Roberto Gabrielli and Daniella Peloso then went on to use low-level overhead photography together with differential GPS to document in even greater detail the land surface at the two sites (Ammerman *et al.*, 2007:8-13). The system of collection itself was based for the most part on the use of circles with a radius of either 1 m or else 2 m (the center of a given circle was painted in red directly on the exposed aeolianite bedrock itself). At Nissi Beach, we repeated the collection of selected circles from one field season to the next and compared the results for different years (Ammerman *et al.*, 2008:11). In all, the collections at each site covered about one-quarter of its area and yielded some 2,000 pieces of chipped stone in each case. The preliminary study of the lithic material was made by Carole McCartney (Ammerman *et al.*, 2006, 2008). The flake-based lithic tradition and chipped stone tools recovered at both sites were clearly different than the PPNB tradition on Cyprus, and the chipped stone material recovered at Aspros, in particular, was quite similar to that found at Aetokremnos. As mentioned in Ammerman (this issue), Kozłowski and Kaczanowska have recently re-examined the lithic assemblages at both sites. Their study, which will appear in a separate monograph, now replaces the preliminary work done by McCartney. Located about 200 m north of the Aspros site, there is a smaller satellite site that is called Alimann (Ammerman *et al.*, 2008:3-4). And its lithics are much the same as those found at Aspros. In addition, there are several other places within a radius of 1 km of Aspros where small scatters of lithics were observed during the course of reconnaissance work.

This brings us to the third step: the environmental studies that were done at the two sites. This aspect of the fieldwork is the main topic covered in our second report to the *RDAC* (Ammerman *et al.*, 2007). Only a few of the results will be summarized here. To begin with, we were starting from scratch since fieldwork had not been done on the formations of aeolianite before. Indeed, it appears at first glace to be an austere and inhospitable place – both for the coastal forager who lived in the remote past and the archaeologist who is trying to work there today. But, as we shall see, it does have its positive sides for the forager-voyager. In any event, there was in our case not real choice in the matter. Whether we liked it or not, we would have to start learning how to do "aeolianite archaeology." Most of the work on the environmental setting of the two sites was done by Jay Noller, a soil scientist and coastal geologist, as mentioned before. He began by making detailed descriptions of the thin soils at the two sites, which are much the same (Ammerman *et al.*, 2007:23-26). At both sites, the soil does not occur as a continuous mantel on the landscape, the common situation in the study of soils, but as a patchwork of soil pockets and places where the aeolianite bedrock is exposed on the surface. And at both sites, the soil has very low agricultural or woodland productivity. In effect, there would have been little in the way of human exploitation of the land over the centuries: that is, for the cultivation of cereals and other forms of agriculture. And this helps to explain why some parts of Nissi Beach – the swale area, in particular – have managed to survive so well down to the present day.

Noller then turned to the aeolianite itself (Ammerman *et al.*, 2007:3-5). Aeolianite is the name for a formation of rock that began its life as a sand dune and that, over the course of geological time, was subsequently lithified: in other words, cemented and consolidated as a rock. As can be seen in the exposed cliff on the south side of Nissi Beach (Ammerman *et al.*, 2007:fig. 2), the degree of lithification is more advanced in the upper part of the formation (the top 3 m) than it is lower down. In addition, one can see there the kinds of bedding that formations of aeolianite commonly have: cross-stratified beds of wind-blown sand, which occur within larger sets of beds that have variable orientation. High angle alpha sets are the hallmark of aeolianite. At both sites, the genesis of this landform probably goes back to Oxygen Isotope Stage 5 (that is, to some 70,000 to 128,000 years ago). In short, the aeolianite is far older than the lithics recovered at Aspros and Nissi Beach.

At Aspros, Noller prepared a map of the geomorphology of the area near the site and also a map, based on bathymetric charts, showing the position of the shoreline at two times in the past (Ammerman *et al.,* 2007:fig. 3). One line gives the position of shoreline at 6,000 years ago, when sea-level rise was slowing down in the middle Holocene, while the other line reconstructs the shoreline at 12, 000 years ago, when sea level was some 70 m lower than it is today (Fig. 2). The site of Aspros – the one that we see on land today – once stood at a distance of ca. 1.5 km from the shoreline where coastal foragers at that time would have exploited marine resources. In the case of Nissi Beach, the bathymetry indicates that the shoreline at 12,000 years ago was well over 2 km from the site on land today. The implication here is that there are, in all likelihood, other sites now submerged because of sea-level rise that once occurred closer the shoreline at that time. In short, what we find on land today is just the tip of the iceberg: the site of Aspros, as we now see it on land, should be seen then as just a rather minor place in the interior. In order to find out whether or not this is the case, we would have to take the plunge and do underwater archaeology (Ammerman *et al.*, 2011), which we shall turn to in a separate section below. The date of 12,000 years ago was chosen, in part, because it fits with the Epipalaeolithic age of the lithics recovered at Aspros. At Aetokremnos where layer 2 has much the same chipped stone assemblage, there is a series of C-14 dates, which goes back to the 11th millennium cal. BC (for many years, there was ambiguity in the literature with regard to the actual age of layer 2; this was then clarified by the first calibration of the C-14 dates for Aetokremnos, see Ammerman *et al.*, 2007:fig. 9; for a more recent analysis of the calibrated ages of the C-14 dates at Aetokremnos, see Manning in the next issue).

At this point, a few words need to be said about the environmental settings of the two early sites in a broader sense. The land surface of the aeolianite is invariably a dry and well-drained one. Even after it rains for a few hours, the exposed aeolianite rock soon dries out. Since there is little in the way of vegetation to clear on the aeolianite, it offers a good place for the coastal forager to make an instant campsite. In addition, there would have been the opportunity for the forager-voyager to take advantage of the raised upper part of a formation of aeolianite to look up and down the coast and out to sea. At the same time, there are clear drawbacks to life on aeolianite. In general, this landform has a modest and rather narrow ecology. Above all, its thin soils are of poor quality, as mentioned before. Thus, the aeolianite itself does not have much to offer when it comes to human subsistence; instead, the forager had to turn to the shoreline where it was possible to exploit shellfish, fish and sea birds on a seasonal basis. On the down side too are the strong cold winds in the winter months, which make the coastal formations of aeolianite a rough place to live (or to conduct an excavation) at that time of year. Accordingly, the aeolianite does not constitute an environmental setting that has good

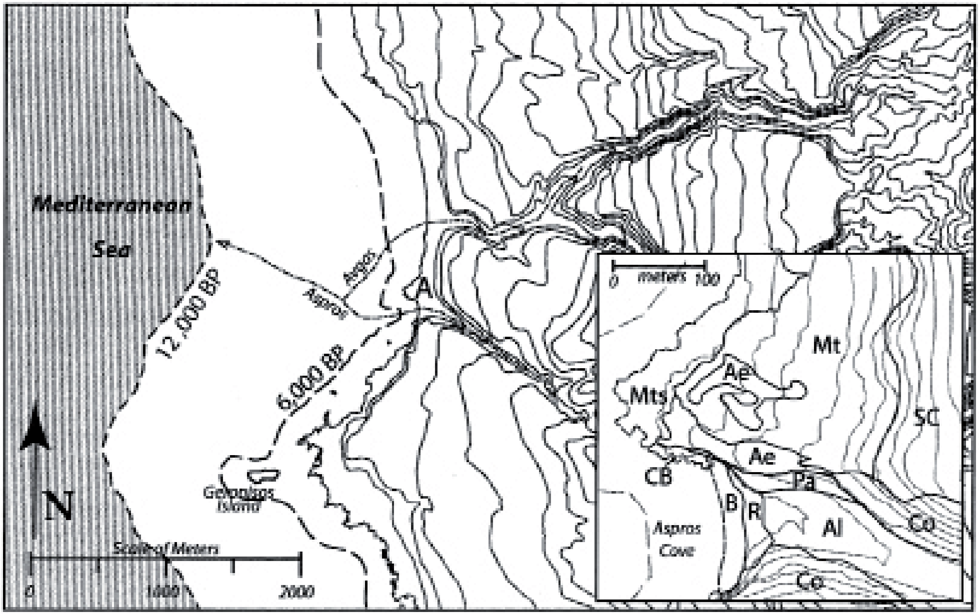

Fig.2. Two maps placing the site of Aspros in environmental context. The main map show the Aspros site (A) located above the confluence of the Avgas and Aspros rivers together with the reconstructed palaeoshorelines for respectively 6,000 and 12,000 years ago. For the land above sea level today, the contour lines are at an interval of 20 m. The inset map on the right gives the surficial geological units in the vicinity of the Aspros site (for the explanation of the various symbols, see Ammerman *et al.*, 2007:fig. 3)

potential for a more permanent form of occupation or settlement. On the other hand, it represents a good place for coastal foragers leading a mobile and seasonal way of life to make a short-term campsite. When the archaeologist makes a visit to Aspros or Nissi Beach, the site is situated right on the coastline today. It is, however, important to remember, as discussed in the previous paragraph, that the site's location was different 12,000 years ago: the place was situated in the interior at some distance from the sea and a large expanse of aeolianite once ran down towards the coastline at that time. And in front of Aspros, there would have been the confluence of the Aspros and the Avgas, in a part of the landscape that finds itself submerged position today (Fig. 2). The Avgas has water flowing in it even in the summer months because of the natural springs in its steep-sided valley. In addition, there is a local source of chert in the Avgas valley. All in all, the environmental setting of the area, in its earlier configuration, was an attractive and promising one for those who lived on the basis of hunting and gathering. In short, the best places to look for early sites are not on land today but those closer to the confluence of the Aspros and Avgas and closer to the shoreline. In contrast, for the first farmer, the Aspros area was a poor place in environmental terms.

The fourth step in the fieldwork was to conduct excavations at the two sites. Of course, the challenge here was to dig in the context of the thin soils on the aeolianite. This work was carried out over the course of three years: 2007, 2008 and 2009. We intentionally chose to dig in February and March when conditions are favorable in terms of soil moisture and when there are comparatively few tourists at Nissi Beach. Three preliminary reports on various aspects of the excavations have been written for the *RDAC* (Ammerman *et al.*, 2008, 2012, in press). Again, only a few highlights can be given in the space that is available here. In the case of Aspros, the four small trial trenches excavated in 2007 all yielded a number of pieces of chipped stone in the context of a well-developed reddish-brown paleosol. And the lithics – in terms of their raw materials, reduction technology and tool types – were essentially the same as those recovered on the surface of the site. In quantitative terms, the material recovered from a given trench was always quite modest, however. The two new areas that we excavated in 2008 yielded much the same picture. For example, the excavation in Area V, where the local outcrop of aeolianite made it a good place to sit, yielded a total of 16 pieces in a small, enclosed space and half of them were tools. There was now the realization that such small numbers were probably to be expected since the places where we were digging were not located on or near the shoreline at the time but a fair distance from it. Where we were digging was at a place on the landscape – once situated well back from the shoreline and visited only occasionally – where one or a few curated pieces of chipped stone were discarded from time to time. Thus, the results coming in from the excavations at Aspros began to make their own separate case that the main place where the coastal foragers had made their campsites was closer to the shoreline at the time. As we shall see below, this was confirmed by the work that we did at dive site C.

Turning to Nissi Beach, the work in the swale area of the site has produced results of considerable interest, including a development that was totally unexpected when the excavation began. Over the course of three years, there was the opportunity to excavate a contiguous area of 27 square meters in the swale area (Ammerman *et al.*, 2012:fig. 2). In the context of a well-developed paleosol (up to 40 cm thick in some places), which rests directly on the aeolianite bedrock, we recovered several good features, a fair number of marine shells (used both for food and for decorative purposes) and chipped stone tools that involved the use of a blade technology – one affiliated with the PPNB tradition on Cyprus. Several C-14 dates, which date to the 8th millennium cal. BC, are in full accord with the PPNB character of the lithic assemblage (Ammerman *et al.*, 2012:fig. 11). In addition, there were a few places in the excavation where small local outcrops of the aeolianite bedrock were used as good places to sit or recline (Ammerman *et al.*, 2008:fig. 7; Ammerman, 2010:88). In other words, there was on the landscape itself what we have called built-in, stone-age furniture. But what took us by complete surprise was something else. The oldest lithic material at Nissi Beach (in a pebble-and-flake tradition) occurs on the surface of the site. In effect, what one is dealing with at the site is an inverted stratigraphic sequence (Ammerman *et al.*, 2008:29; Ammerman *et al.*, 2012). The best way to explain this remarkable state of affairs is by means of the action of one or more tsunamis. As mentioned in the opening section of this chapter, the connection between tsunamis and the processes of site formation at sites on the coast had never been made in the literature on prehistoric archaeology of Cyprus before. Since there would be archaeologists who would have doubts about such a claim, we would have to show by multiple lines of evidence that this is what had actually happened at Nissi Beach. In turn, this now meant that we would have to make changes in the way that we were digging the site in order to document more fully the occurrence of one or more tsunamis at Nissi Beach. Thus, it is time to move to the fifth step in the fieldwork.

THE TSUNAMI STORY

We first began to recognize the tsunami story, as we now call it in shorthand, in working with Ioannis Panyides at Nissi Beach in 2008. An account of how the research unfolded is given in the second section of our fourth report to the *RDAC* (Ammerman *et al.*, 2012). One of the major gains of the 2008 excavation season was a better understanding of the many fragments of beach rock that occur on the site's surface (Ammerman *et al.*, 2008:12). This arose from our collaboration with Ioannis Panayides of the Cyprus Geological Service. Along the coast in a position just above sea level, beach rock forms in the exposed aeolianite. The rich biological life of the tidal zone gives the beach rock its distinctive dark color. Previously, we had interpreted the many small dark fragments of rock on the site's surface as burnt pieces of aeolianite (Ammerman *et al.*, 2007:12). Panayides now took a closer look at them and realized that most of them were actually pieces of beach rock. The inference to draw was that a major natural event, such as a tsunami or a major storm surge, had dislodged the pieces of beach rock from the cliff face and tossed them up on the site. An event of this kind would also have swept up pieces of chipped stone resting on the seabed (that is, archaeological material at one or more early sites that had once stood on land but over the course of time had become submerged because of sea-level rise) and re-deposited them on the top of Nissi Beach. Accordingly, we now made plans to conduct a more quantitative study of the beach rock fragments as part of the 2009 excavation season. At the same time, we planned to make a study of the uppermost soils in the excavation based on grain-size analysis.

A tsunami results from the massive displacement of water caused by a geological event such as an earthquake, a volcanic eruption or offshore slumping. The seismic sea wave produced by such an event moves at a high velocity over the sea and builds into a "wall" of water as it approaches the land. In contrast, storm waves are gravity and wind driven; they have cyclical patterns and move more slowly over the sea. Tsunamis have longer wavelengths than storm waves, and they can make a much more devastating impact on the coast. On Cyprus, one of the main lines of evidence that the earth scientist have used to document tsunamis involves what are called "tsunami blocks" – large angular masses of rock thrown up on the coastline in a position where they are no longer in geological context (Whelan and Kelletat, 2002; Noller *et al.*, 2005). In fact, such tsunami blocks can be seen at Nissi Beach standing on top of the coastal cliff on the south side of the site (Ammerman *et al.*, 2012:fig. 1). All along the coast to the east of the site for a distance of 400 m., one sees large, irregular-shaped "blocks" of this kind jumbled up on top of the coastal cliffs (at elevations as high as 8-9 m above sea level). Even the strongest storm surge in the Mediterranean does not have enough force to accomplish this. Here it is worth adding that Jay Noller had observed the tsunami blocks on the south side of the site at the time that Nissi Beach was discovered in January of 2004 (Ammerman *et al.*, 2007:8). Previously, we had not properly understood their wider significane for the site formation processes involved in re-depositing pieces of chipped stone from sites on the seabed on the surface of Nissi Beach. By the way, there is, in fact, good evidence in the historical record for a major tsunami that struck the southeast coast of Cyprus on May 20, 2012 (Guidoboni and Comastri, 2005:219-231; note that tsunami blocks are also observed at Aspros, and a major tsunamis that took place on the west coast of Cyprus is also recorded in the historical sources, see Ammerman *et al.*, 2012).

At Nissi Beach, what we now set out to show was that while the beach rock fragments occur in large numbers on the site's surface and also in fair numbers in the top few centimeters of the thin upper soil at the site, they fall off rapidly with further depth in the soil. And if such a high-energy event did place, we should expect to find coarser grain sizes in the recent soils horizons at the very top of the stratigraphic sequence, and the soil horizons there might even include exotic grains of large size, which had been transported to the site over some distance by the tsunami. Thus, all of the excavated soil for each of the new meter squares that we opened up in 2009 was kept separately for each of three thin stratigraphic units just below the surface of the site. Next all of the soil from a give unit was dry sieved (using a 4 mm mesh), and the material recovered in this way was washed and sorted. Finally, counts were made of the pieces of beach rock measuring 2 cm or more in length. In the case of the uppermost soil (0 to 1 cm depth in the ground), most of the squares yielded 20 or more fragments of beach rock, and the square with the lowest number had 12 fragments. On the other hand, the lower unit of the recent soil (1 to 4 cm depth in the ground) yielded numbers that were all much lower (only one of the squares had as many as 9 fragments). Then in the stratigraphic unit just below (the top 3 cm of the paleosol or a depth of 4 to 7 cm in the ground), there were at most only a few fragments of beach rock and some of the squares had none. It is likely that the fragments had locally moved down from the recent soil above into the upper part of the paleosol due to local processes of soil formation. Below this depth in the palaeosol, no fragments of beach rock were observed. Thus, the large quantities of beach rock fragments that occur on the site's surface and only in its uppermost soil horizon can only be explained by one or more tsunamis in historical times, and this result provides further support for the new interpretation of the nature of the lithics on the surface of Nissi Beach put forward by Panyides in 2008.

For the grain-size analysis, we used the Malvern Mastersizer in the Department of Geology at Colgate University. The work was done under the supervision of Bruce Selleck, a specialist in this field of research. In a nutshell, the results of the study confirmed that the upper part of the recent soil is notably coarser than the other samples in the sequence of upper soils that we examined at Nissi Beach (for the curves summarizing the grain sizes of the respective soil samples, see Ammerman *et al.*, 2012:fig. 5). As part of the study, a number of the larger grains of the coarser soil were examined individually by using a scanning electron microscope (SEM) in combination with an energy dispersive X-ray analyzer (EDS giving the chemical signature of a given grain). One of the results of this analysis was the identification an exotic volcanic clast of large size consisting of fine-grained potassium feldspar, quartz and magnetite with melt textures (Ammerman *et al.*, 2006:fig. 6, c-d), which indicates transport of the material over some distance by energetic storm or tsunami waves, since this kind material is not currently found in outcrops near the site.

To sum up, support for one or more tsunamis at Nissi Beach is now provided by three lines of evidence in the earth sciences: (1) the tsunami blocks resting on top of the coastal cliff on the south side of the site, (2) the systematic study of the fragments of beach rock recovered from the excavation of 15 grid squares in 2009, (3) the marked coarseness of the grain sizes in the upper part of the recent soil at the site (along with the presence of exotic grains that required transport over some distance). Thus, there is now good evidence for one or more tsunami at Nissi Beach. We have come a long way from the time of the initial discovery of the site in 2004. Here again we had the good fortune to work our way through the tsunami story. Given the bathymetry in front of Nissi Beach, there is a fairly large area that became submerged by the rise in sea level over the last 12,000. We have to allow for the possibility that there are several submerged sites there and that they may not all date to the same. The implication is that what is found on the surface of Nissi Beach may involve a composite or mixed picture in terms of chronology. In this respect, the tsunami is not the friend of the lithic analyst. On the other hand, the tsunami is the archaeologist's friend in the sense that its action on the seabed and what it tosses up on land gives the archaeologist a glimpse of what is out there at the submerged early sites – without having to get one's feet wet. In light of the large number of chipped stone pieces of the surface of Nissi Beach (an estimate of some 2,500 pieces has been made for the lithics on the surface of the swale area alone; Ammerman *et al.*, 2007:11), it is reasonable to think that some of the submerged sites may be quite rich. And sooner or later, the archaeologist will have to summon up courage and make the challenging decision to do underwater archaeology.

TAKING THE PLUNGE

This brings us to the sixth step in the fieldwork. A short preliminary account of the underwater archaeology done in front of Aspros is given in our third report to the *RDAC* (Ammerman *et al.*, 2008). A fuller account of the work is presented in our chapter in *Submerged Prehistory* (Ammerman *et al.*, 2011). What is written about the lithics at dive site C in these two publications is now out-of-date, as mentioned in Ammerman (this issue). The new results will be summarized briefly in this section (Fig. 3); they will be published in more detail in the monograph in preparation called *The Lithics at Aspros and Nissi Beach: Learning more about the forager-gatherers on the island of Cyprus*. The decision to get our feet wet was not an easy one. Again, there were colleagues and friends who thought that we were not making a good decision. In their view, the risks of spending a good deal of time, money and effort and then coming up with very little were simply too great. Finding an Epipalaeolithic site on land is hard enough on Cyprus. Finding one on the seabed is truly an adventure. Fortunately, we had beginner's luck at Aspros in July of 2007. The main discovery was made at dive site C, which is located at a distance of 120 meters from the shoreline today and at a depth of 12 meters in the water. It occurs at the foot of a cliff on the north bank of the Aspros River. With the help of

Duncan Howitt Marshall, the lead archaeologist in the water, and Tim Turnbull, the dive master, we were able to put together a dive team and also managed to come up with a local dive boat. In all, six dives were made at dive site C. The lithic recovery team had the task of collecting all of the pieces of chipped stone on the bottom: that is, any piece of chert that appeared to be worked. The aim was to avoid being too selective at the time of the fieldwork. Later lithic specialists would sort through the collected material, and the pieces of chipped stone would be classified. This turned out to be the right way to go. In her initial report on the lithics at dive site C, Carole McCartney was able to identify 38 pieces of chipped stone (Ammerman *et al.*, 2008:9). When the same set of material was re-examined in March of 2012, Kozłowski and Kaczanowska found a total of 60 pieces of chipped stone at dive site C. Of particular interest, they were now able to identify a number of small segments and backed pieces (Fig. 3), which had not been seen before. In fact, the work that they had to do in order to recognize and draw the small pieces in this hyper-microlithic tradition was quite demanding. And from what I saw at the time, they enjoyed every minute of it. The microlithics represent the key to working out the culture affiliation of the lithic material at dive site C. In their report on the material, they note the close parallels between the microlithic tools and the reduction technology observed at dive site C and those found in levels Ia and Ib at the Okuzini Cave in southern Turkey (Yalçinkaya *et al.*, 2002). These levels at Okuzini have been carbon dated to the time of the Younger Dryas. It is worth underscoring two main points here. First, there is now good evidence for a submerged prehistoric site of Epipalaeolithic age on Cyprus. It is also the first submerged site of this age for the wider region of the Eastern Mediterranean. The existence of a submerged site of this kind is no longer just an idea or a working hypothesis. It has now become a reality in empirical terms. Secondly, the set of material at dive site C happens to be more diagnostic in nature than the sets of lithics recovered from various places on land at Aspros. In order to learn more about the earliest forager-voyagers on Cyprus, we have to work closer to where the coastline was 12,000 years ago, which means going out in the water.

This may be a good place to add a few words on the chipped stone found on land at Aspros – in anticipation of what will be said about the material in the monograph. There is no evidence for the presence at Aspros of lithics either in the PPNA tradition or in the PPNB tradition. In marked contrast with the lithic material recovered on the surface of Nissi Beach, there are only two pieces with traces of gloss and no sickle inserts in the material at Aspros. And the first Natufian point has now come to light there. In short, the reduction technology and the tool types at the site clearly belong to the Epipalaeolithic tradition. In addition, as mentioned in the abstract to Ammerman (this issue), there are a few pieces that go back to the end of the Upper Palaeolithic. This takes us out to the time before 14,000 years ago. On the other hand, the re-examination of the material at Nissi Beach indicates that the lithics recovered on the site's surface are younger in age than those at Aspros. According to Kozłowski and Kaczanowska, most of the lithics on the site's surface need not go back further in time than the first half of the 9th millennium cal. BC (Ammerman *et al.*, in press). In short, these lithics have, on one hand, similarities with the lithic assemblage at the Mesolithic site of Maroulas on the island of Kythnos in the Aegean (Sampson *et al.*, 2010:42-62; with a cluster of C-14 dates between 8,900 and 8,600 cal. BC; see Kaczanowska and Kozłowski in the next issue). On the other hand, the lithics on the surface of Nissi Beach are more or less coeval with the PPNA assemblages at Klimons and Asprokremnos (references are given in Briois and Guilaine in this issue and Manning in the next issue).

Fortuitously, the underwater archaeology at Aspros led to another discovery of some importance: the occurrence of sea salt on the coastline. Salt was, of course, one of the most precious things in the remote past, and this "surprise" – no one had previously mentioned the salt on the aeolianite in the literature on the prehistory of Cyprus – sheds new light on why the forager voyagers were interested in making seasonal visits to the island. The discovery of white crystals of salt in small "basins" in the aeolianite happened inadvertently when I was taking a photograph of the dive boat from the shore. In waiting for the boat to move into position, I looked down and high-quality sea

Fig. 3. Drawings of the chipped stone artifacts recovered at dive site C in from the site of Aspros

salt was there at my feet. It forms when the spray from the sea collects in the shallow depressions in the aeolianite, and the water standing in such "basins" then dries out in the sun during the summer months. In short, the salt on the shoreline is an annually renewable resource. Thus, the long stretches of aeolianite that are found on the coasts of Cyprus would have been a great attraction for those on the mainland who were ready to voyage to the island for high-quality sea salt. And remarkably no one had recognized this gift of the sea on the coastline before and put it in the literature (Ammerman *et al.*, 2008:27-28, fig. 10; Ammerman, 2011a:44-45, fig. 3).

DISCUSSION

Much has changed since 2003 when I first went out to Cyprus. At that time, there was only one good candidate for an Epipalaeolithic site on the island, and even the director of the Department of Antiquities at the time, as mentioned above, apparently still had doubts about Aetokremnos. Now on the coastal formations of aeolianite all around the island, there are early sites whose chipped stone tools are made in a pebble-and-flake based lithic tradition. The two sites studied the most so far are Aspros and Nissi Beach. In other words, we have begun to learn how to do "aeolianite archaeology." Of course, there is much that remains to be done. But a start has been made. What is presented in this chapter should be seen as work in progress. In recent years, several sites with a flake-based technology such as Roudias and Paleokamia have come to light in the interior of the island, and they have been interpreted as Epipalaeolithic sites as well (e.g., Efstratiou *et al.*, 2010; Knapp, 2013:63-66). This is not the place to review what has been found at these sites and their interpretation. Suffice it to say here that none of the sites has C-14 dates, and there are questions about the reliability of the lithic studies. The working assumption behind such studies is that if an assemblage has a flake-based reduction technology, it can be dated to the Epipalaeolithic. In the absence of more diagnostic material at a site, it might be better to speak more cautiously about it as a pre-Neolithic one. It is entirely possible that some or all of the flaked-based assemblages found at sites in the interior are not as old as the Younger Dryas. Indeed, some of them probably have much the same age as the flake-based lithic material found on the surface of Nissi Beach. Most of the lithic material recovered there is now seen as dating, as mentioned in the previous section, to the first half of the 9th millennium cal. BC. In short, it is premature at this time to draw conclusions about what is taking place in the interior in the years between 9,000 and 12,000 cal. BC.

In the last chapter of the proceedings, the plan is to discuss several conclusions of a broader nature as well as consider a few questions that call for further attention. Thus, in closing this chapter, no attempt will be made to take up the implications in a wider sense of what we have recently learned on Cyprus. Instead, what I would like to do here is to turn briefly to several topics that are more specifically related to the work at Aspros and Nissi Beach. One of them concerns our current understanding of the Younger Dryas. On the basis of the calibrated ages of the C-14 dates for layer 2 at Aetokremnos, it is clear that coastal foragers were frequenting the site in the time of the Younger Dryas. As Manning shows (in the next issue), the dates produced in the 1990's fall, for the most part, in this interval of time (that is, from ca. 10,800 through ca. 9,600 cal. BC). And even if one is skeptical about the "old" dates and accepts only the more recent AMS date run at Oxford, it too falls in the time before the end of the Younger Dryas (that is, with the boundary to the Holocene now placed at ca. 9,700 calendar years ago, based on the ice cores made on Greenland; Rasmussen *et al.*, 2006). In the case of Aspros, the new analysis of the lithic material (and what is seen at dive site C in particular) takes us back to the time of the Younger Dryas as well. Indeed, the oldest lithics recovered the site, as mentioned in the previous section (see also in the abstract of Ammerman in this issue), now go back even further in time to the end of the Upper Palaeolithic (that is, just before the Younger Dryas). Here it is perhaps worth noting that this is what I proposed in my paper called "The First Argonauts" in 2007: "the very first attempts at going to sea began in the preceding time of climatic amelioration known as the Allerod and the sudden climatic deterioration of the Younger Dryas acted as a catalyst to consolidate this new way of life" (Ammerman, 2010:88-89). On the other hand, it will be recalled that Simmons (1999), in his book on Aetokremnos, makes no mention of the Younger Dryas. And many other archaeologists working in the Eastern Mediterranean at the time – with a few notable exceptions (e.g., Moore *et al.*, 2000:479; Bar-Yosef, 2001:fig. 1) – had a rather limited appreciation of the break through that was taking place in the earth sciences as a consequence of the deep ice cores drilled in the Greenland ice sheet (Alley, 2000). For this reason, it is worth making a short digression on the history of the two parallel studies on Greenland.

The turning point in the study of the Younger Dryas was the joint American and European project to make two deep ice cores in the Greenland ice sheet. The fieldwork began in the summer of 1989 and ran through the summer of 1993. And it then required a number of years to complete the analysis of each of the annual layers of ice for the last 17,000 years. Accordingly, it took a vast amount of work to reconstruct in detail the patterns of climate change over such a long span of time. It will be recalled that the basic trends in temperature and the accumulation of snowfall as a proxy for precipitation on Greenland were set out for the archaeologist working on Cyprus in our second report to the *RDAC* (Ammerman *et al.*, 2007:fig. 1). In a more recent study, the boundary at the end of the Younger Dryas and the start of the warmer conditions of the Holocene is now put at 11,703 calendar years before AD 2000 (Rasmussen *et al.*, 2006). On the basis of the ice cores, there is today detailed evidence on the roller-coaster ride of climate change at the end of the Pleistocene. In turn, new ideas about abrupt climate change began to circulate more widely in the literature of the earth sciences in the second half of the 1990s.

At that time, most of the archaeologists in the Eastern Mediterranean were still not fully aware of the advances being made in this field of study. As best they could, some archaeologists interested in the question of the pathways leading to the domestication of plants and animals in the Near East began to pick up on the new ideas about climate change. Of course, the patterns of change in Southwest Asia have to be viewed as more attenuated than the ones observed on the Greenland ice sheet. What was missing in the literature, even as late as 2006, was a comprehensive and accessible account of the multiple lines of evidence for environmental change in the Mediterranean world written for the archaeologist who was not a specialist in environmental studies. Rosen (2007) now pulled things together in *Civilizing Climate*. And to bring the story rapidly up to date, this new perspective is incorporated in more recent archaeo-botantical studies (e.g., Willcox *et al.*, 2009; Rosen, 2010; Rosen, 2011), which would see agriculture coming fully into its own only around 8,500 cal B.C. Thus, it is only when climate settled down in the Holocene that agriculture really took off. In brief, in connection with the Younger Dryas, climate change can be viewed as acting as a catalyst both for early voyaging and for setting in motion multiple pathways that would lead, in time, to agriculture. On the other hand, the Younger Dryas can also be seen as working negatively in the sense of a changeful bottleneck that held back the full-fledged expression of agriculture. And the dust has yet settle when it comes to the question of why the Younger Dryas began circa 12,900 years ago, as we learn from reading Moore and Kennett in this issue. On a related front, when it comes to the question of the extinction of animals at the end of the Pleistocene (see Vigne in this issue; Ammerman gives background on the controversy in the literature over the claim that the hunting of pygmy hippos at Aetokremnos caused their extinction on Cyprus), the over-kill hypothesis is no longer in vogue in North America, as Grayson and Meltzer (2003) argue. Drawing attention to the shortage of evidence for the hunting of 33 of the 35 animal species in North America that became extinct at the end of the Pleistocene, they see the Younger Dryas as a more promising line of explanation. Even Simmons, in this issue, is now ready to acknowledge that the Younger Dryas may have played a role in what happened on Cyprus.

This is a good point to return to Aetokremnos, the collapsed rock shelter on the Akrotiri Peninsula (for background on the controversy concerning the hippo bones in layer 4, see Ammerman in this issue; Simmons sticks with his previous interpretation of the site in this issue). As explained in Ammerman (this issue), my own position on the hippo bones in layer 2 has changed from the one that I held a decade ago (Ammerman and Noller, 2005). In short, the hippo bones in layer 2 are natural bones just like those that occur in the rich bone bed of layer 4. To reiterate briefly what is said in Ammerman (this issue) (see the references cited there), the fact that the wild boar bones can now be dated (even if only approximately) to the middle of 10th millennium cal. BC (Vigne *et al.,* 2009; note that the wild boar dates seem to be somewhat younger in age than the charcoal dates for layer 2) and yet the hippo bones both in layers 2 and 4 have not yielded viable dates implies that the hippo bones are probably much older. In addition, there is now evidence for a rich deposit of natural hippo bones at the rock shelter called Agia Napa (see Ammerman in this issue), which provides a parallel showing that a rock shelter such as Aetokremnos was just the sort of place that pygmy hippos went to die a natural death. This then is the best interpretation for layer 4 at Aetokremnos. In Vigne (in this issue), who began his career as a palaeontologist, now takes this position as well. At the workshop, there was agreement among the participants that more attention should be paid to the reconstruction in three dimensions of the original rock shelter and the dynamics of its collapse over the course of time. Given the "die-back" of trees that occurred on the coast at the time of the Younger Dryas (Watkins, 2005:fig. 6.1;

Ammerman, 2010:87), it is reasonable to think that the coastal foragers who frequented the site extracted fossil hippo bones there and used them as a fuel for their campfires. In the process of extracting the hippo bones, it is likely that the foragers themselves created local disturbances in the stratigraphy of the site, and the best way to see the hippo bones in layer 2 is to have them derive from layer 4. To put it another way, there may never have been pygmy hippopotamus hunters at Aetokremnos. This is, of course, a working hypothesis or an alternative scenario – one to be tested by dating the hippo bones themselves at some time in the future when new dating methods become available.

Here in the role of the devil's advocate, it may be productive to make a few more observations on what is found at Aetokremnos as a means of developing further an alternative line of interpretation to the one given in Simmons in this issue. On the slopes below Aetokremnos and all along the south coast of the Akrotiri Peninsula, there were actively forming dunes at the end of the Pleistocene and on into the early Holocene. The paleo-dunes on the slopes are fairly easy to recognize on the landscape (Ammerman and Noller, 2005). There are two implications that follow from this: (1) the actively forming dunes would not have been conducive to the growth of trees on the steep slope where the site is located (12,000 years ago when sea level was in a lower position, the slope would have been some 60-70 m taller) and thus heightened the "die back" of trees there as a consequence of the Younger Dryas and (2) the grains of sand in the air would not have made it an attractive place to live at those times of year with high winds. It might be a positive experience to visit Aetokremnos when the winds were low but it was not a good site to live at on a year-round basis. The scenario that I would like to propose, which involves no hippo hunting, would see coastal foragers making seasonal visits to the site from time to time to take advantages of the fossil bones there (at a time when wood for their fires was in short supply) but not living there on a regular basis. Indeed, forager-voyagers visiting the site may well have stocked up on fossil bones as a source of fuel to take with them as they continued their voyages. And if one turns to the quantities of lithics recovered from the excavation at Aetokremnos, one finds support for this line of interpretation. In all, layer 2 yielded a total of only 69 chipped stone tools (Simmons, 1999:table 6-1). And if one is generous and includes those tools recovered from the mixed strata identified by the excavators as 1/2 and 2/4, the total would rise to 96 tools. Now if one takes the site to have been frequented for a span of 400 years or the equivalent of 16 human generations (for quantitative treatment of the C-14 dates on samples of charcoal in an attempt to establish the start and end boundaries of the phase of human activity in the case of layer 2 see Manning in the next issue), this would mean that, on average, 6 chipped stone tools entered the archaeological record per human generation. This number implies a rather low level of human activity at the site. And even if one is prepared to be far more generous and make the assumption that all of the pieces of debitage of any real size (secondary flakes, bladelets and so forth; see table 6-1) were somehow used as "tools," one then comes up a value of 18 pieces of chipped stone per human generation. Again, even under this most generous and unrealistic treatment, one is still dealing with a limited picture of human activity at the site. Of course, by means of special pleading, Simmons will try to argue that such low numbers are perfectly fine and that they even support his interpretation of the site. In my view, the limited number of chipped stone tools in layer 2 indicates a modest level of human presence at the site. In a given year, perhaps only two or three short visits were made to Aetokremnos. And this scenario would fit in with the site's environmental setting: its exposed position near the top of a tall steep slope on a rugged stretch of coastline and the actively forming dunes in the site's immediate vicinity, which made it a tough place to live at the time.

Living on the aeolianite during the Younger Dryas was no picnic either. For the forager-voyager, it too constituted a mixed picture of positive features and negative ones. On the plus side, the aeolianite offered a good vantage point for looking up and down the coast, as mentioned before. Its land surface was a dry one, and there was little in the way of vegetation to clear so a group of coastal foragers, on the move, could quickly set up a campsite. And if one happened to choose a favorable spot on the aeolianite, there might even be the comforts of built-in furniture. In the summer months, there was the chance to collect sea salt on the shoreline. And for those who were voyaging in a small boat, the best place to stop along the coast would have been a small-sized embayment where a drainage from the interior ran down to sea. There, in a protected cove with the aeolianite rock on two sides, one could pull a small boat up on a narrow strip of sand. The coasts of Cyprus, from my experience, have no shortage of places of this kind. On the down side, there is the "thin" ecology of the aeolianite and the exposure to the elements, including high winds and storms in the months from November through March. In addition, there was not much wood available on the aeolianite (above all at the time of the "die back" of trees on the coast in the Younger Dryas mentioned above) except for driftwood on the shoreline and perhaps a few trees growing in a drainage. Viewed in this context, the deposit of fossil bones at Aetokremnos did have something special to offer. In terms of the big picture, what we are dealing with at Aspros and Aetokremnos, when we go back to the Younger Dryas, are rather modest campsites of coastal foragers leading a mobile way of life. On Cyprus, there are still no rich sites with more permanent forms of occupation of the kind that one finds at Natufian sites and Abu Hureyra on the mainland. The point that I wish to make here is that neither Aspros nor Aetokremnos had the potential in ecological terms for occupation of this kind. We shall have to wait and see if richer sites dating to this time can be found in places that have more diverse and productive ecologies on Cyprus. So far they have not. On a positive note, we are finally beginning to get some idea of the cultural affiliations of the forager-voyagers who made their campsites at Aspros: the geometric microliths at dive site C (pointing in the direction of the southern coast of Anatolia) and the Natufian point (signposting the Levant). For comparative purposes, what is still missing on the mainland is fieldwork at contemporary sites on the aeolianite there. For example, formations of aeolianite occur on the west coast of Syria, and at some of them, one can find early sites whose chipped stone tools are made by means of a flake-based reduction technology. The investigation of such places should be a high priority in the study of forager-voyagers in the Eastern Mediterranean.

If we now move forward in time to the Neolithic period, the aeolianite was important for the trader-voyager precisely because it was of so little use for purposes of agriculture. The thin soils and exposed bedrock on the formations of aeolianite have low agricultural productivity. The aeolianite represents one of the last places where the first farmer would have chosen to live. For this reason, it was a great place for a group of traders moving along the coast in a small boat to stop and take a break on a voyage to its trade partners. The aeolianite now became a safe haven where the trader-voyagers could avoid running into local people who, no doubt, outnumbered them and who may have had less than kind intentions. This may explain the archaeological features and the artifacts dating to the PPNB that we recovered in the swale area at Nissi Beach (Ammerman *et al.*, 2012). The crest of the aeolianite ridge just in front of the swale offered a commanding view on all sides. And when the voyagers were seated or sleeping in the swale itself, they were completely out of sight. There during a short stop, they could rest, repair their equipment and collect shells such as cowries (objects to be exchanged or traded with others) while foraging for shellfish on the shoreline for their lunch. It is worth recalling that the Siassi voyagers of the Vitiaz Strait were cautious and did not want to end up in the wrong places (Harding, 1967:26). Early voyaging meant keeping an eye out for places where one could take refuge. Above all, the first Argonauts of the Eastern Mediterranean did not want their boats to end up in the hands of strangers (the equivalent of piracy in historical times or what is called "predation" in the study of Roman seafaring). This was one of the risks of being an early voyager, and the seemingly inhospitable aeolianite had, in this respect, a long history of being the voyager's good friend.

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