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Kharimat Khor al-Manāhil and Khor Āl Manāhīl — New Neolithic sites in the south-eastern desert of the UAE

HEIKO KALLWEIT, MARK BEECH & WALID YASIN AL-TIKRITI

Introduction

This paper presents important new evidence for human occupation recently discovered in the Umm al-Zumūl region, an area located in the south-eastern desert of Abu Dhabi in the United Arab Emirates. It is near this point that the UAE meets the borders of both the Sultanate of Oman and Saudi Arabia. Historically this has always been a focal point because of the presence of a sweet-water well. The area is sparsely populated and human activities today are largely confined to camel breeding and related occupations, although development of an oilfield is now under way.

Situated at the north-eastern edge of the Empty Quarter or Rub^{c} al-Khālī, the region today is characterized by flat plains interspersed with linear mega-dunes and local patches of sabkha, some of which cover several square kilometres. These plains and sabkhas act as interdunal corridors and they are generally oriented north-west to south-east. Some of these interdune areas have a thin covering of smaller aeolian dunes, which are locally covered with scrub vegetation. These generally cross the interdune areas obliquely and are the result of recent erosion of the older mega-dunes.

The typical vegetation of this area includes the perennial *Calligonum comosum*, which can occasionally be seen growing on the false crest of high dunes. *Cornulaca arabica* and *Cyperus conglomeratus* can often be seen, along with occasional *Tribulus arabicus* (Roshier, Böer & Osbourne 1996: 60, pl. 4/1 and 4/2; 62). Despite the paucity of vegetation there is a range of wildlife present in the region. Desert hares (*Lepus capensis*) are common, as are Cheesman's gerbils (*Gerbillus cheesmani*). Lesser jerboas (*Jaculus jaculus*) are locally common on the interdune plains and the population of wild sand gazelles (*Gazella subgutturosa*) is the largest in the UAE. The region provides suitable habitat for two other species of concern in the UAE — Rüppell's fox (*Vulpes rueppelli*) and the sand cat (*Felis margarita*), although these two species are presumed to live at very low population densities. Characteristic birds seen here include the brown-necked raven (*Corvus ruficollis*), the hoopoe lark (*Alaemon alaudipes*) and, during the migratory season, the houbara bustard (*Chlamydotis macqueenii*). Although old camel droppings are visible in some of the interdunal plains, we only observed occasional stray camels during our fieldwork.

In October 2003, during the course of research on habitats in the south-eastern desert of Abu Dhabi, a team lead by Chris Drew from the Terrestrial Environmental Research Centre (TERC), part of the Environmental Research and Wildlife Development Agency (ERWDA) in Abu Dhabi, reported a number of archaeological finds to the Abu Dhabi Islands Archaeological Survey (ADIAS). Subsequently, the potential and character of the sites were evaluated by Dr Mark Beech during a short visit in November 2003. During this visit to the area, known locally as Kharimat Khor al-Manahil [Kharīmat Khawr al-Manāhil] (abbreviated site code: KHM),[1] numerous surface scatters of flint were observed. Consequently, an initial field season was planned and organized for January 2004 in co-operation with the Department of Antiquities and Tourism in Al Ain, which is responsible for all archaeological areas in the Eastern Province of Abu Dhabi emirate. This work was subsequently carried out by the present authors between the 24th January and the 6th February 2004.

Priorities of this first field campaign were:

1) To record and explore the extension and precise location of each single surface scatter. In the course of this work, a number of important single finds were collected as well as total find complexes.
2) To investigate neighbouring areas in order to explore the extent of the total area with archaeological finds.

To date, a linear area about 7 km long and 1 km wide of almost continuous flint scatters has been investigated. The borders of the archaeological area still remain uncertain.

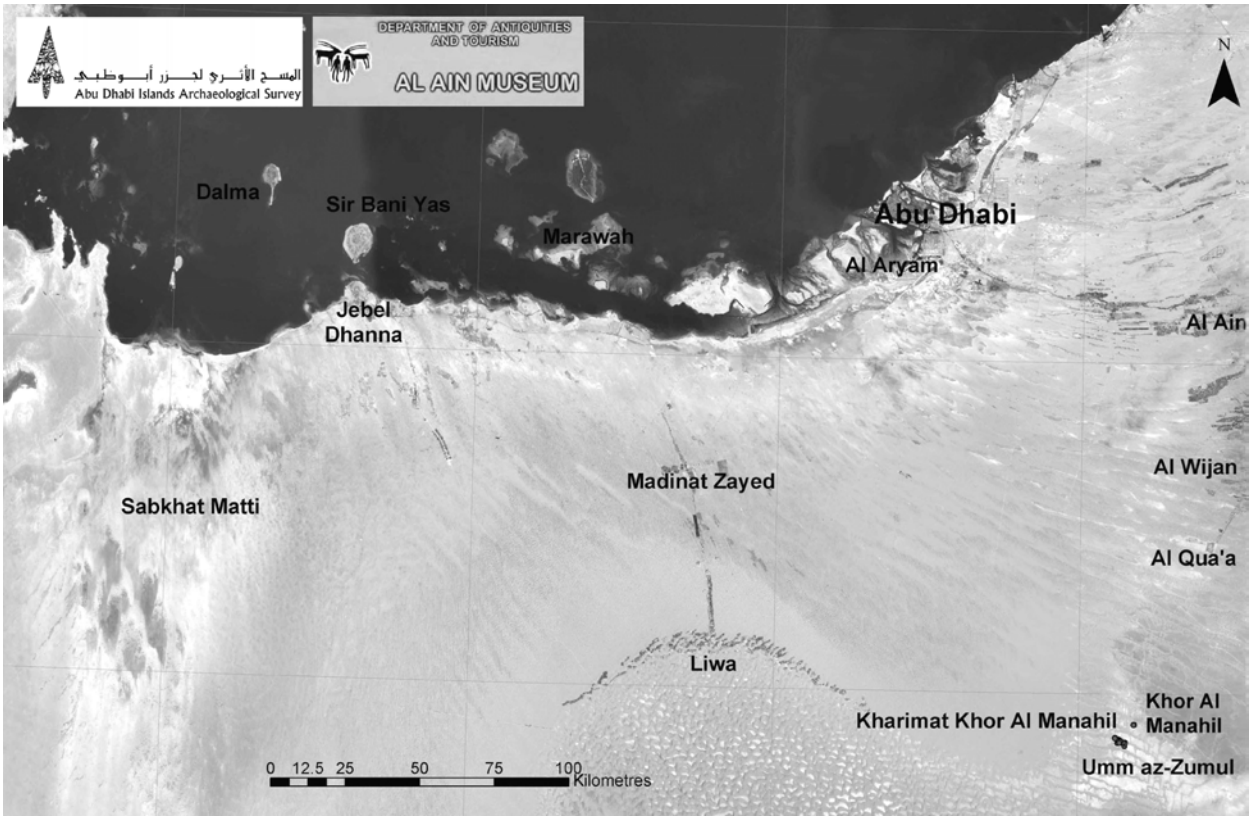
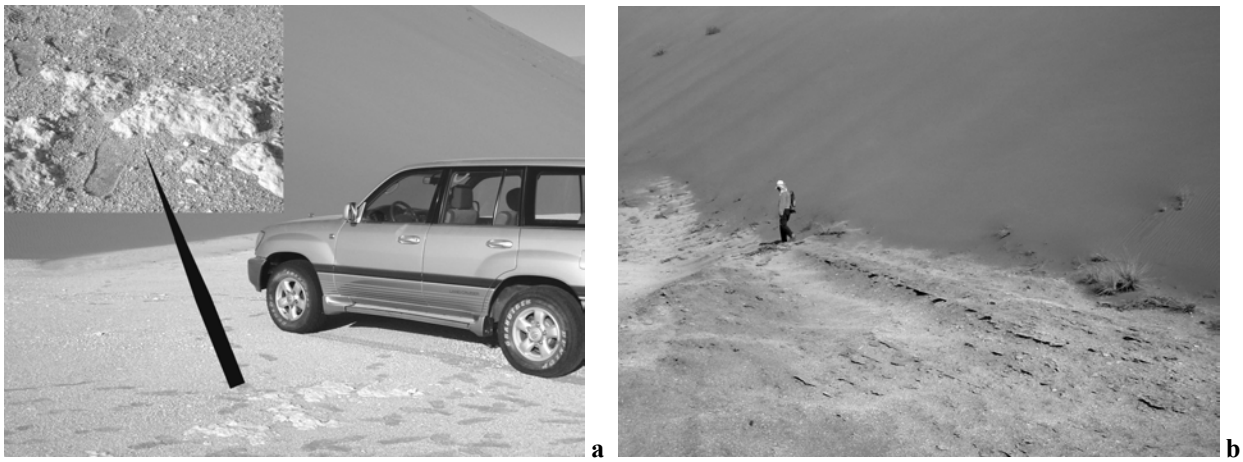


FIGURE 1. *A location map of Kharimat Khor al-Manahil and Khor Al Manahil in Abu Dhabi emirate, UAE.*

Geographical setting and geomorphology

The site complex is located close to the border with Oman and Saudi Arabia, in the south-easternmost corner of the Emirate of Abu Dhabi (Fig. 1).[2] Major landscape features in that area are large intra-dunal plains, stretching roughly in a north-north-west to south-south-east direction. These plains are divided by dunes or dune chains, reaching an average elevation of about 30–60 m. Where gaps, or more precisely, lower dune ridges occur, the plain is divided again in a north-north-east to south-south-west direction by lower dune ridges. Clearly, these intruding low dunes have blown fairly recently into the plains. At least, they appear to be younger than the high dune chains (but for a cautionary note, see the discussion below concerning the dating of dunes). If one looks at aerial photographs or satellite images of these plains, known locally as Kharimat Khor al-Manahil, an irregular pattern of dune sands can be observed, dividing the plains into segmented patches. This impression is supported by the rather white colour of the plains in contrast to the sandy-beige colour of the dunes. The conspicuous white colour of the plains is a result of the aeolian erosion of the limestone bedrock, which outcrops at several locations on the plain (Fig. 2/a).

Samples of the limestone, including a gastropod fossil, were collected to determine the age and composition of the limestone. The surface of the plain is in actual fact covered by small limestone pellets, ranging up to a few millimetres in size. Other features of the surface morphology include escarpments, running in a north-easterly direction. These steps are about 2 m high, dividing the plain into sub-units of different elevations. At site KHM0002, a similar structure was observed partly covered by dune sand. Archaeological finds were mainly concentrated on the higher terrace surface. Only a few small flakes were found on the lower levels. Along the north-western fringes of the plain, partly running underneath the foot of the dune slopes, several fossilized dunes are exposed (Fig. 2/b). These structures are easy to identify by their visible layers and the fact



a **b**

FIGURE 2. a. *Limestone outcrops in Kharimat Khor al-Manahil;*
b. *Palaeodune outcrops at Kharimat Khor al-Manahil.*

that the sand is a different colour. The sand within these palaeodunes is not loose and has a relatively moderate degree of compaction. A series of large flint surface scatters was observed situated on similar outcrops throughout the area.

The archaeological sites

The archaeological sites recorded at Kharimat Khor al-Manahil vary in their composition and extent. They range from locations with single tools or groups of tools to large patches of debitage, as well as building structures. It is remarkable, however, that the spaces between the single sites are also well covered with sporadic scatters of debitage or tools. This area of more or less continuous lithic scatters spreads along the northern fringe of the plain, close to the foot of the southern slopes of the large dunes. It is by far the most extensive spread of lithics recorded in the United Arab Emirates, stretching for more than 3 km.

Two archaeological sites within this area will be discussed in more detail.

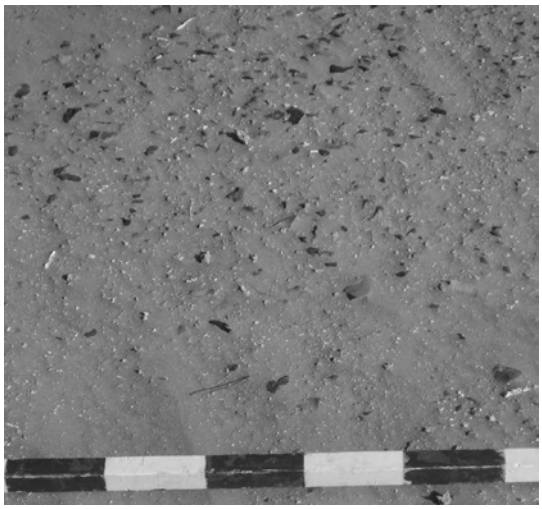
Site KHM0035

Site KHM0035 is situated in a small dune depression. Two flat dune ridges running roughly north–south enclose the site to the east and west (Fig. 3/a). The surface of KHM0035 is covered with flint debitage (Fig. 3/b), which extends over an area of about 15 x 8 m. The highest concentration of flakes was observed in the centre, at the deepest point of the site. This may, of course, be an effect of natural erosion. It is interesting to note that the surface of KHM0035 is uneven, with small ditches and ridges, in contrast to the dune depressions, which are purely covered by sand. Besides the flint flakes, white coloured limestone pellets form patches on the surface. To the west, where the dune depression opens its mouth into the plain, the typical rippled structures of palaeodunes are visible.

The following methodology was adopted at the site. A metre-grid square system was established after a 10 m long east–west baseline had been installed which bisected the edge of the major debitage concentration (Fig. 3/c). More than 1200 gm of flint flakes was subsequently collected and recorded. Each metre square was then divided into twenty-five sub-squares, each measuring 20 cm, using a standard wooden archaeological planning frame. Each of these sub-squares was then excavated to a depth of 10 cm, all the excavated sediment being dry-sieved with a mesh size of approximately 1 mm. To analyse the composition of the deposits, samples of pure sand as well as the organic content were also taken. The debitage was concentrated just in the first few centimetres down from the modern ground surface (Fig. 3/d).

Surprisingly, a huge quantity of tiny flint chips, sized less than 1 cm, were preserved. Many larger cortical pieces, knapped from different coloured and textured raw material, were also noted, suggesting that it was a knapping site. All of the pieces could be classified as debitage, as they had no traces of further work on them. It seems that only the unusable pieces remaining from primary production were left at the site. The presence of so many cortical pieces, a limited number of different types of raw material, and the preservation of even the

a



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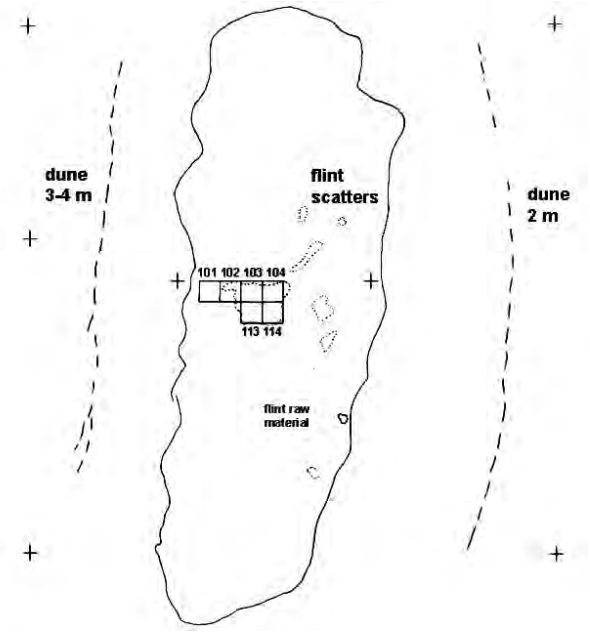

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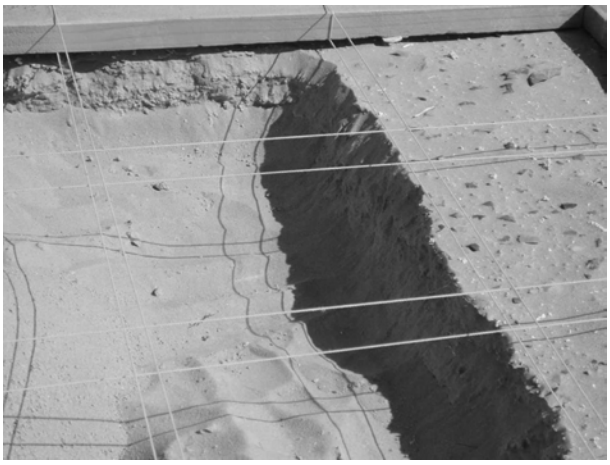

d

FIGURE 3. a. *Site KHM0035, looking to the north with the east–west grid line established;* **b.** *The surface flint scatter at site KHM0035 (Scale: 10cm intervals);* **c.** *A sketch map of site KHM0035 with the grid system of flint collection;* **d.** *Detail of the composition of the deposits in square 103 at KHM0035.*

tiniest pieces offers a rare opportunity to study details of dismantling techniques. In this respect, KHM0035 is a unique Neolithic site of great interest. It may even be possible to refit single cores, or at least to determine the original core size. One core found at this site was a reddish opaque flint pebble with a red-brown cortex. This had traces of work that had been started on one of its edges, providing additional hints about the nature of the raw material. It confirms the impression, conveyed by initial analysis of the cortical pieces, that the original raw material may have originated as approximately fist-sized pebbles.

FIGURE 4. *A view of the building structures at Kharimat Khor al-Manahil looking to the north-east.*

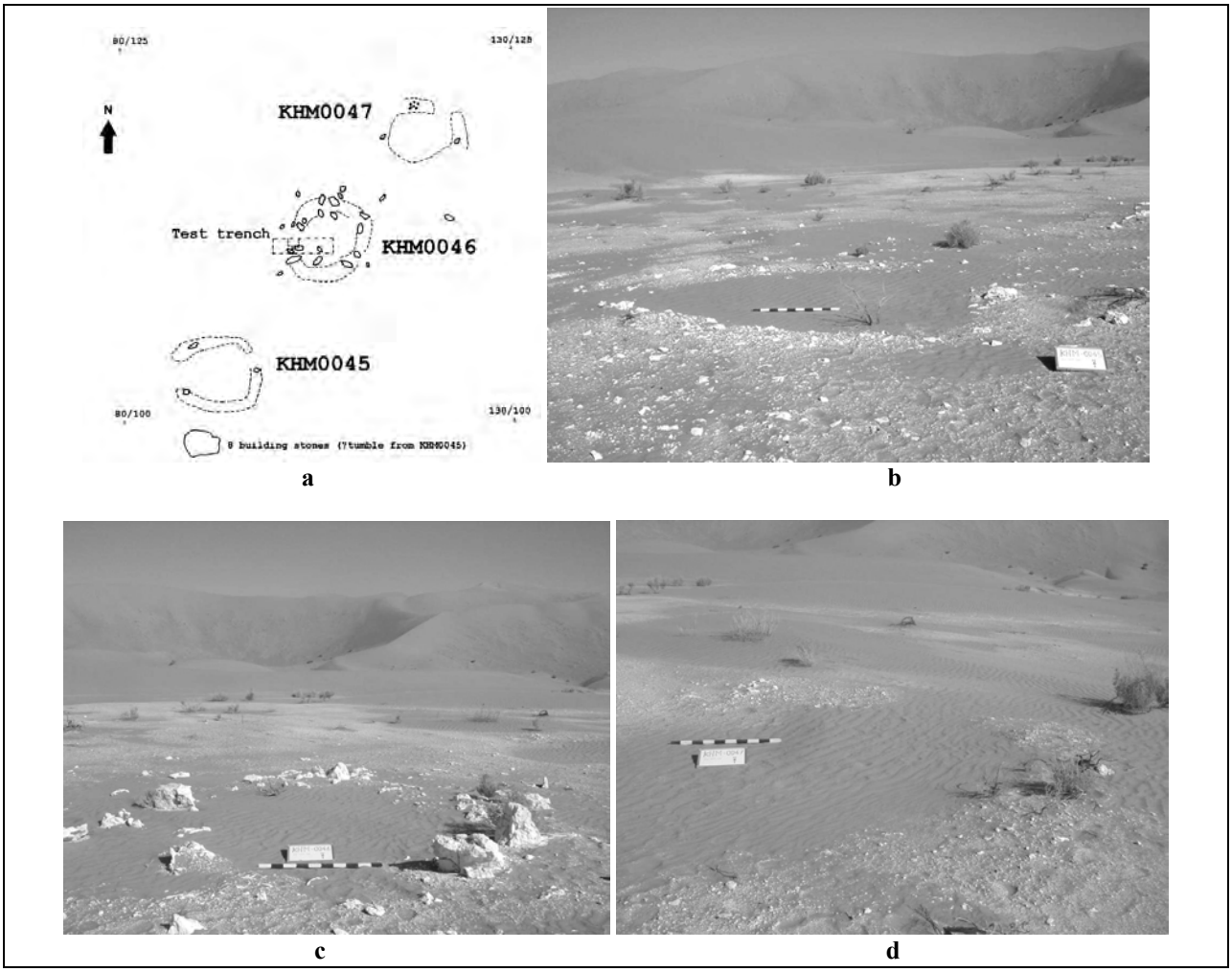

FIGURE 5. a. *A plan of the building structures KHM0045–KHM0047;* **b.** *Structure KHM0045;* **c.** *Structure KHM0046;* **d.** *Structure KHM0047.*

The building structures (KHM0045–KHM0047)

A major surprise during the 2004 season was the discovery of building structures (Fig. 4). This is the first time that such sites have been found deep in the desert interior of Abu Dhabi. A series of three structures was located at the eastern edge of the investigated area. These three units were aligned close together in a north-north-east to south-south-west direction (Fig. 5/a).

KHM0045 is the southernmost unit and consists of a circular structure marked by bright white stones, encircling a purely windblown sand-filled centre (Fig. 5/b). There are two apparent gaps in the circle, about 2 m wide, which face roughly west and east.

Immediately to the north-east there was a second structure, KHM0046, again circular and of a similar size (Fig. 5/c). This structure is easy to recognize due to the presence of large boulders standing upright, mainly on the northern part of the circled "wall". Again we find what appears to be some kind of entrance on the eastern and western sides of the "wall". In this case, they are marked by two large limestone blocks, standing upright. All of the stones found in the wall are highly weathered, with a thick desert varnish on their surface. The northernmost structure KHM0047 seems to be the most affected by weathering (Fig. 5/d). There is nothing left other than a circular of stone debris enclosing a patch of clean reddish sand. It has an entrance that faces roughly to the north-east. All three circles are about 5 m in diameter, and are spaced about 4 to 5 m apart. Inside the circled buildings, the sandy surface looked clean, without any remains of weathered stones. Around the complex, the ground surface was littered with the patchy remains of highly weathered and fine-grained limestone gravel. Apart from a few pieces of rusty, almost completely decomposed tin cans, only flint flakes and several flint tools were found on the sites themselves and in their immediate vicinity. The tin cans did not appear to be modern and were probably refuse from a Bedouin camp of the pre-oil era.

In order to obtain further information about the foundations of the upright boulders found at KHM0046, and to investigate the stratigraphic profile of the site, a test trench was opened at the western entrance of the building (Fig. 6). This test trench revealed that the boulders were set on a soil matrix different to the loose sand covering the surface. This layer was more compacted, with traces of calcareous concretions, and comprised a fine-grained brownish sediment. The limestone itself looked identical in terms of texture and colour to samples collected from the local bedrock outcrops.

FIGURE 6. *A test trench at the western entrance of structure KHM0046. (Scale 0.5 m.)*

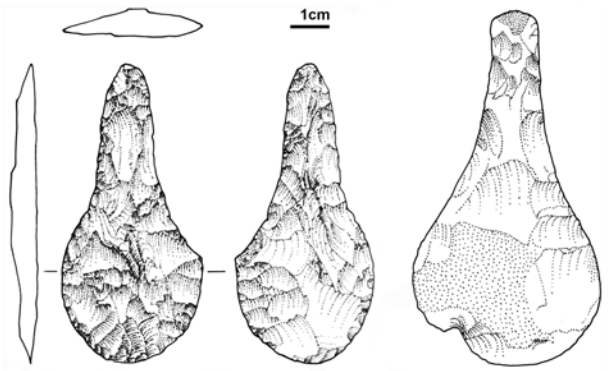

FIGURE 7. Left: *A bifacial tool from Kharimat Khor al-Manahil KHM0005;* **Right:** *A "hoe" from Ur.*

An interesting artefact (KHM0005)

The lithics from Kharimat Khor al-Manahil are currently under study by Heiko Kallweit. One very interesting artefact was found during the November 2003 survey, just a few hundred metres to the west of the building structures (KHM0045–KHM0047). This was a curiously shaped bifacial tool (Fig. 7). Other authors have described similar tools as being "hoes". It is known that heavy flaked-stone implements mounted in wooden shafts with bitumen were used in Mesopotamia in the fifth millennium BC. They sometimes occur together with flint-bladed sickles and grinding stones, these artefacts being taken to indicate the presence of farming settlements. Flint hoes were noted in ᶜUbaid levels at Ur. One of the authors (HK) recently had the opportu-

nity to study the stone implements stored in the British Museum which were recorded by the expeditions of Leonard Woolley between 1919 and 1924 (Kallweit, in preparation). The examples from Ur are similar in shape to the UAE specimen, but the latter is made of a different type of stone. Whereas the Ur examples are made from limestone, our example is made of reddish flint. Flint or chert hoes have also been found in ᶜUbaid 2 levels at Warka Sur 051 (OIM A34550), as well as ᶜUbaid 4 levels at Warka Sur 137 (OIM A34555) and Warka Sur 411 (OIM A34551). These are on display in the Mesopotamia gallery at the Oriental Institute in Chicago. Flint "hoes" are also reported from the ᶜUbaid site of Tell Madhhur in Iraq (Roaf 2002: 54). Some authors have taken the presence of "hoes" to indicate evidence of desert-fringe agriculture. It was noted by Masry that fragments of hoes were recovered at Dosarīyah on the Saudi Arabian Gulf coast, although he stated that "…agriculture must have been practised on a very small scale and only as a marginal subsistence resource" (Masry 1997: 114). We prefer, however, to err on the side of caution in our interpretation. Such implements may have been used as more general multi-purpose digging tools.

In fact, these artefacts are rarely found in the Arabian Peninsula and an interpretation as an agricultural tool seems to be inappropriate at this stage. In any case, the technical details of the KHM0005 "hoe" seem to point to its use as an adze rather than as an agricultural hoe. A similar size and shaped artefact has been reported from the site of Al-Akhdar near Ibri in the Sultanate of Oman (Pullar 1985: 58, Fig.6, no.8). This site was found and sampled by the Danish Archaeological Expedition (Pullar 1985: 59). The artefact was described as being a borer with a heavily battered/weathered point made out of good red chert (Pullar 1985: 76).

More sites at Khor Al Manahil [Khor Āl Manāhīl] (abbreviated site code: KAM)

About 7 km to the north of the Kharimat Khor al-Manahil sites, another important archaeological site was reported to the ADIAS team by John Newby, head of the Terrestrial Environmental Research Centre (TERC) at ERWDA. An initial reconnaissance by the authors, together with Mohammed Niyadi (Head of Al Ain Museum, Department of Antiquities and Tourism), revealed another series of heavily weathered "building structures" as well as many surface scatters of lithics. The limited time available during the 2004 season precluded detailed mapping of the sites or the digging of sondages to examine the stratigraphy of the site. Both these activities are planned, however, for the forthcoming January 2005 field season.

There are at least five "building structures" at the site (sites KAM0003–KAM0007), as witnessed by the presence of concentrations of weathered limestone rocks on the ground surface. These seem not to be as well preserved as at KHM0045–KHM00047. GPS co-ordinates were taken of the main find-spots and visible structures, the most important small finds being collected from the surface of the site. This was done primarily because there was a genuine fear that the site might succumb to the visits of amateur flint collectors, which would destroy valuable archaeological evidence.

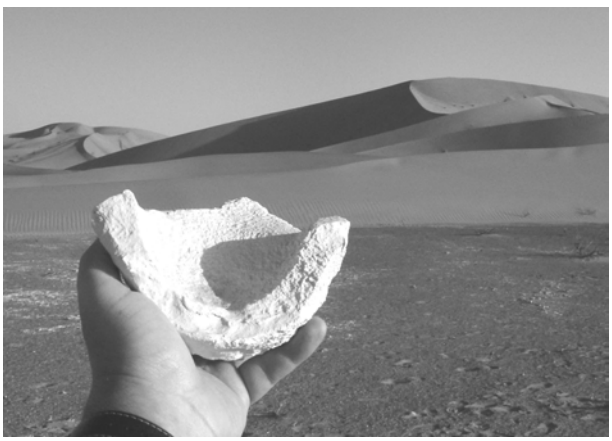

FIGURE 8. *A limestone vessel found at Khor Al Manahil.*

Amongst the lithic assemblage retrieved were some very well preserved pieces of weaponry as well as a fragment of a large limestone vessel, KAM0008 (Fig. 8). The walls of the limestone vessel are about 3 cm thick and it is preserved to a height of about 17 cm. The fragment weighs nearly 900 gm. Subsequently a second, more complete, limestone vessel was discovered by John Hoolihan (ERWDA) less than 25 m to the south of the first. These can be interpreted as being mortars, used for the crushing and processing of food. A similar vessel was discovered at the ᶜUbaid-related settlement on Dalma island (UAEinteract 2004; Popescu & Beech, in preparation). Other similar vessels have also been reported from a number of sites throughout the region including Khor F.B. in Qatar (Inizan 1988*a*: 72, fig. 30), Ibn Hammuda [Ibn Ḥamūdah] located near the Yemen border in Dhofar, Oman, as well as at Ḥabarūt and other sites in the Omani and Saudi Arabian Rubᶜ al-Khālī (Zarins 2001: 45, figs 17 and 48). At Naqdan, 110 km east of Jabrīn, on the edge of playa lake deposits proba-

bly dating to the mid-Holocene, two limestone nodules were noted, which had been flattened on one side (Edens 1988: 30). Another example is known from the so-called "western Rubᶜ al-Khali Neolithic" identified by Edens (1982: 118 and pl. 104/10.). From Yemen, more examples are reported from the western fringe of the Rubᶜ al-Khālī (Di Mario 1989: 137 and fig. 14/5), and from the Central Highlands (Kallweit 2001: 126, Abb. 5/18 and Tafel 22–24). Stone vessels of different size and shape appear generally to be part of Neolithic assemblages throughout the Arabian Peninsula, but seem to have been missed in the records of the earlier collections made by amateur collectors.

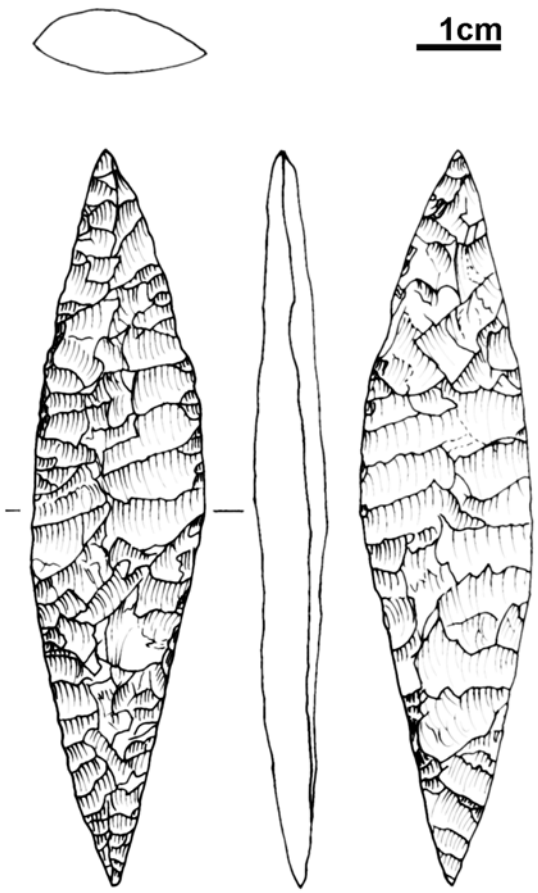

FIGURE 9. *A complete 9-cm-long willow-leaf-shaped projectile point found at Khor Al Manahil (KAM0009, no.16).*

Among the weaponry, the discovery of a complete willow-leaf shaped point, more than 9 cm long, is quite remarkable (Fig. 9). The point weighs 17 gm and therefore seems rather too heavy to serve as an arrowhead. Both its faces have been carefully worked by parallel pressure retouch. It is manufactured in a reddish brown, fine-grained flint, rather similar to natural sources known around Jabal Ḥafīt near Al Ain.

In terms of their typology, the bifaces found at Khor Al Manahil (Fig. 10/1–5) match well the "broad foliate" type described earlier by Edens (1982: 111, pl. 102/1–9; 1988: 18, fig. 1/8–9) from sites in south-western Saudi Arabia. Similar types from the Buraymī Oases have been referred to as "foliates" (Copeland & Bergne 1976: 44–48; fig. 1/1–3, fig. 2/1–3, 8). In a more recent study by Margarethe Uerpmann, comparable objects from Oman are called "simple foliates" (1992: 84–85). R.H. Spoor has analysed the geographical and chronological distribution of different types of armature in south-east Arabia. He has discussed similar types from different sites inside the UAE which he identified as "Huwayyan slugs" or "Huwayyan foliates", and divides them into various sub-types (Spoor 1997: 146).

The total number of finds from the Khor Al Manahil and Kharimat Khor al-Manahil sites is still small, nevertheless it is interesting to see the range of types present. The arrowheads recorded at Khor Al Manahil are all either stemmed and barbed (Fig. 10/6–7), or diamond-shaped with a tendency towards a triangular cross-section (Fig. 10/8–9). Stemmed bifacial points, especially the barbed variety, are very typical of the mid-Holocene bifacial industry throughout the Arabian Peninsula (Edens 1982: 1988). Taking into account confidence intervals, radiocarbon dating places the Arabian Bifacial Tradition (ABT) between 6000/5800 and 3700/3500 BC (Edens & Wilkinson 1998: 63), although some local variants of the ABT in coastal south-east Arabia may have been of shorter duration (Uerpmann M. 1992).

Neolithic sites in the Arabian Peninsula

The presence of lithic scatters in the Rubᶜ al-Khālī has been well known for at least fifty years (Field 1955; 1960*a*; 1960*b*; Zeuner 1954). Up until now, however, Neolithic sites with preserved building structures or archaeological layers were known only from island sites in the United Arab Emirates (Beech and Elders 1999; Beech *et al* 2005), along the coast of Qatar (De Cardi 1978; Tixier 1980; Inizan 1988*a*) and Saudi Arabia (Masry 1997), as well as from the recently excavated site H3 As-Sabiyah (Carter *et al.* 1999; Carter & Crawford 2001; 2002; 2003) in Kuwait. On Dalma island, a settlement area was identified, with preserved layers and traces of housing (Flavin & Shepherd 1994; Beech & Elders 1999; Beech, Elders & Shepherd. 2000; Popescu

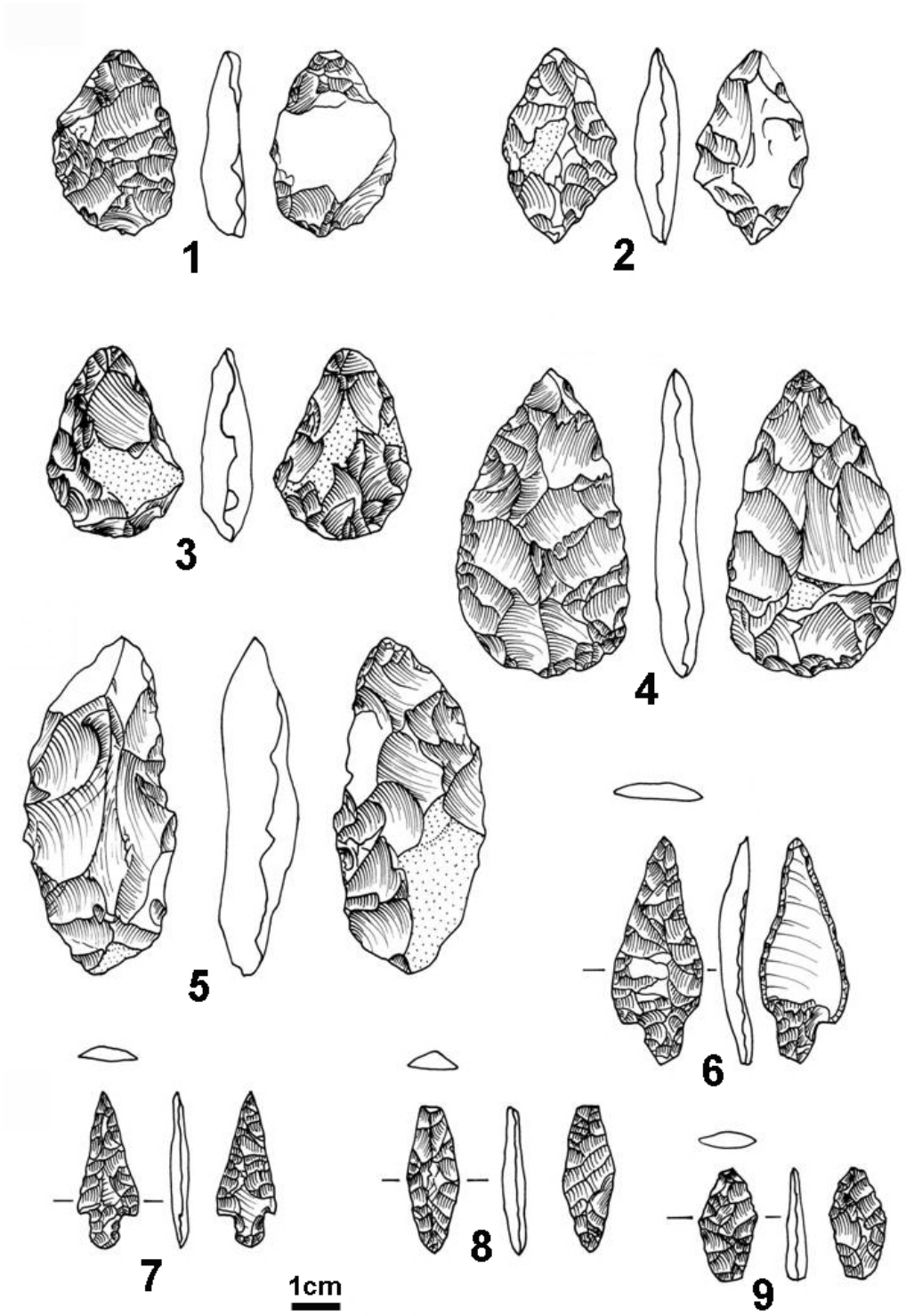

FIGURE 10. *Lithics found at Khor Al Manahil sites.* **1–5.** *Bifaces;* **6–9.** *Arrowheads.*

& Beech, in preparation). On Marawah island, some quite remarkable stone buildings have recently been discovered which date back to the mid-sixth millennium BC (Beech *et al.* 2005). An important Neolithic site located in the interior has been discovered, however, at Jabal al-Buḥaiṣ in the emirate of Sharjah in the United Arab Emirates (Uerpmann M., Uerpmann H-P & Jasim 2000). The site of al-Buḥaiṣ 18 was the first major Neolithic site with well-preserved organic matter to have been identified within the interior of the UAE. To date, the skeletal remains of almost 280 individuals have been retrieved from the site, as well as an important assemblage of animal bones. Apart from numerous fire pits, some of which were lined with stones, no evidence of building structures was observed, and the site does not seem to have been a permanent settlement (Uerpmann M & Uerpmann H-P 2000: 40; Uerpmann M., Uerpmann H-P & Jasim 2000: 229).

Our new discoveries at Kharimat Khor al-Manahil and Khor Al Manahil are remarkable in that this is the first time that building structures have been found in conjunction with what are clearly Neolithic stone tool assemblages within the desert interior. Questions still remain concerning the precise purpose of these buildings. They seem surprisingly regular in shape and in their configuration, with certain elements such as the alignment of east–west doorways common to several structures. Although the preservation of the building structures discovered at Khor Al Manahil does not appear to be as good as at Kharimat Khor Al Manahil, judging from their appearance on the surface, only further investigations will tell. No pottery has been found associated with the building structures. The presence of the characteristic lithics described above, together with other finds such as the limestone vessel fragments, tends to suggest that a range of settlement activities may have taken place in the vicinity. This provides a marked contrast with previous findings in the desert interior of Abu Dhabi, which generally consist of isolated surface scatters, mainly of weaponry and debitage. Examples of such sites include Yaw Sahhab at the eastern end of the Liwāʾ oasis (Harris 1998: 24–27), Bidaʿ al-Muṭawaʿ in western Abu Dhabi (Crombé 2000: 9–14) and Rumaythah, located close to the coast south of Abu Dhabi (Kallweit & Hellyer 2003: 1–7).

Elsewhere in the coastal regions of the Arabian Gulf, a number of broadly contemporary settlement sites with traces of building structures have been discovered. Excavations by a joint Kuwaiti-British team at site H3 at Sabiyah [al-Ṣabīyah] in north-east Kuwait have revealed a whole series of stone-built chambers forming a multi-celled building complex (Carter *et al.* 1999; Carter & Crawford 2001; 2002; 2003). Mud and reed structures have been noted at Dosarīyah in Saudi Arabia, as evidenced by the widespread distribution of fragments of lime plaster with reed impressions used to strengthen the interior of reed-bundle walls (Masry 1997: 115). Circular structures of some kind are also known from Dalma island in the United Arab Emirates, as witnessed by the surviving post-holes (Beech & Elders 1999; Beech, Elders & Shepherd 2000). Stone structures have been identified, however, in the Ḥawār islands off Bahrain (sites 29 and 38 in Crombé, De Dapper & Haerinck 2001: 149), as well as in Qatar (see e.g. Ras Abaruk [Raʾs al-Burūq] 4b: de Cardi 1978: 182; and Shagra: Inizan 1988*b*: 101, 214–215, figs 47–48). In Oman a number of sites with Neolithic building structures have been investigated. These include the sites of Raʾs al-Ḥamrāʾ in the capital area of Muscat, which has been investigated by an Italian archaeological team (Biagi, Maggi & Nisbet 1989), and the site of Suwayḥ, further to the south. Suwayḥ SWY-11 is one of the most ancient habitation sites with stratified levels on the Oman coast. A number of man-made structures were identified, including one described as being delimited by large angular stones (Charpentier *et al.* 2000: 74). At the nearby site of Suwayh SWY-1 a circular stone structure was also noted (Charpentier, Marquis & Pelé 2003: 16, fig. 6). Are these sites comparable with the structures identified at Kharimat Khor al-Manāhil?

In order fully to understand the dating and context of these sites one has to consider the role played by the geomorphological history of the dunes in this region.

Dating the dunes

Comparatively little work has been undertaken on firmly dating the aeolian activity of the dunes of eastern Arabia. This is despite the fact that the large dunes of the Emirates often appear to be underlain by undated cemented carbonate dune sands. Although an episode of dune formation has been dated to between 42,000 and 34,000 years ago in Sharjah (Sanlaville 1992), most available data suggests that widespread dune formation took place in the time span 22,000–11,000 years ago (Glennie 1996).

Some optical dating has been carried out on linear dunes in Raʾs Al-Khaimah in the United Arab Emirates (Goudie *et al.* 2000). This work revealed that a 17-m-high dune at ʿAwāfī accumulated rapidly at a rate of about 3.3 m ka-1 about 10,000 years ago, whilst a 40-m-high dune at Idhn had accumulated over the past 1000 years with 20 m of sediment, accumulating in a time period of about 270 years. It was suggested that the

older dune may have accumulated in response to the transgression of the Arabian Gulf by rising sea levels during the late Pleistocene and Holocene period, and that the younger dune may have formed more rapidly due to intensive human activities, a short-lived climatic event, or because of reactivation by erosion from fluvial action at its base (Goudie *et al.* 2000: 1011).

From ᶜAin al-Faidah, a spring located close to Al Ain, palaeoenvironmental data was obtained from sections at different construction sites. They indicate the presence of more favourable climatic conditions with higher rainfall and increased vegetation cover during the period 9000–6000 BP (uncalibrated). Periods of higher fluviatile erosion activities along the western slopes of Jabal Ḥafīt were identified and dated in some cases by sub-fossilized organic matter such as wood or shells (Gebel *et al.* 1989: 13–22).

More recently some important work has been undertaken in the Liwāʾ region of Abu Dhabi emirate (Bray & Stokes 2004). Radiocarbon dating of lacustrine, travertine, and palaeogroundwater deposits has suggested that the climate was more humid between 35,000–25,000 and 10,000–6000 years ago. An optical dating study was implemented here in an attempt to establish ages for the intervening arid phases. A deep drill core provided an interesting insight into the style of barchan dune accretion in the Liwāʾ region.[3] The large dune accreted rapidly during the mid-late Holocene. The results suggest that the transitions from humid to arid conditions and the resulting accumulation of aeolian sediment as large bed-forms occurred abruptly around 6000 years ago. Further aeolian sedimentation has not been constant since that time, with initial gradual dune growth followed by rapid vertical accretion, and possible termination of accumulation around 2000 years ago.

The two latter studies demonstrate an important point, namely, that dunes cannot be dated purely on the basis of their size. Bigger does not necessarily mean older. In terms of clarifying the dating and geomorphological development of the sites at Kharimat Khor al-Manahil and Khor Al Manahil, it would be worthwhile in the future to undertake optical dating of the dunes directly associated with the archaeological occupation layers. Future archaeological excavation of the building structures, as well as further survey in the vicinity may, it is hoped, uncover traces of hearths or suitable organic material which might permit the use of radiocarbon dating.

Work which has already been done on the radiocarbon dating of lake molluscs and marls in the Rubᶜ al-Khālī indicates that rainfall, probably of a monsoon nature, filled the lakes during two intervals of around 32,000–20,000 and 10,000–6000 years ago. It is reported that the lakes lasted from a few years to hundreds of years and ranged in depth from about 2 to 10 m (McClure 1971; 1976; 1978; 1984; 1988: 9). Further survey work in the area of Kharimat Khor al-Manahil and Khor Al Manahil may reveal the presence of lake depressions and freshwater molluscs. Certainly some of the lithics observed seem to be resting on the edge of terrace-like features (e.g. KHM0002). Only by undertaking further surveys as well as geomorphological work will it be possible to confirm if these terraces are in actual fact the edges of ancient lakes.

Conclusion

The extensive lithic scatters at Kharimat Khor al-Manahil and Khor Al Manahil are clearly situated on the ridges of ancient palaeodunes. This is similar to the situation reported elsewhere in Abu Dhabi emirate from Bidaᶜ al-Muṭawwaᶜ (Crombé 2000: 9) and the Al Ghazal golf club at Abu Dhabi international airport (Beech, Kallweit & Hellyer 2004). Such sites may have been initially settled during the Climatic Optimum, between about 10,000 and 6000 years ago. This was a time of greater humidity in eastern Arabia when winds are believed to have been weaker than today, and rainfall higher. Sand dunes would have been largely stabilized by vegetation (Glennie 1996: 20). In the Rubᶜ al-Khālī, seasonal or permanent lakes were formed in some interdunal areas (McClure 1978). Whereas today we see arid desert in large parts of Abu Dhabi it is important to remember that this is a comparatively recent phenomenon. Are the newly discovered sites in the south-eastern desert of Abu Dhabi also located in an area with seasonal or permanent lakes?

A further point to bear in mind is that at Umm al-Zumūl there is a traditional sweet-water well, which was used until the pre-oil era. This area is at the lower end of the hydrological system emanating from the Wādī Ḍank, located in the Ḥajar mountains to the east in the Sultanate of Oman (Dr Mike Brook, ERWDA, personal communication). It may have thus been an attractive region for nomadic pastoralists in the past since it was a well-vegetated area with a reliable sweet-water supply. Neolithic communities would have required pasture grounds for their domestic animals and may well have moved around south-eastern Arabia between the coast, mountains, and interior (Kallweit 2001; Uerpmann M, Uerpmann H-P & Jasim 2000). The animal bone assemblage from al-Buhais [al-Buḥayṣ] included the bones of domesticated cattle as well as sheep and goat (Uerpmann M & Uerpmann H-P 2000: 40).

Bovids were quite common in the Rubᶜ al-Khālī Holocene lake deposits (McClure 1978: 262) and domesticated cattle bones have been found at a number of ᶜUbaid sites in the Eastern Province of Saudi Arabia (Masry 1997: 155–159). In south-western Arabia it has been suggested that cattle herders practised transhumance, with summers in the Rubᶜ al-Khālī and winters in the highlands to the west. In the case of Dhofar, the cattle herders would go to the Rubᶜ al-Khālī in the summertime and return to the Nejd in the winter (Zarins 2001: 50).

It is interesting to note that apparently very similar complexes of circular stone structures have been identified in Dhofar, Oman, in the Wādī Ghadūn at Matafah 93:151 (area F and H), and at al-Shiṣr, the "flint-knapper's house" 92:32 (Zarins 2001: 38–42, figs 11–14). Work by the Italian team in the Khawlān district, south-east of Ṣanaᶜāᵓ in the Yemeni highlands, has identified some interesting upland Neolithic sites described as the Qutran and Thayyilan industries. These are contemporary with the Arabian Bifacial Tradition (ABT). Both are characterized by bifacial elements such as foliates and stemmed bifacial points (in the case of the Qutran industry). Importantly, both industries occur on sites with architecture, which typically consist of small oval or circular "huts" (Edens & Wilkinson 1998: 64). A bifacial industry has also been identified in the Wādī Dhahr [Ḍahr], near Ṣanaᶜāᵓ, where several different Neolithic sites produced tools similar to those of the so-called "Rubᶜ al-Khali Neolithic". Sondages made at al-Akiya [al-ᶜAqīyah?] 1 revealed a dark ashy aceramic Neolithic layer, sealed by a sterile stratum from the uppermost Bronze Age layer. In this layer, tools and debitage mainly made of obsidian were associated with a rounded stone structure (Kallweit 2001: 33).

Recent fieldwork has increased our knowledge of early Holocene settlement in southern Arabia, demonstrating that it occurred within the environmental context of increased monsoonal moisture, which continued during the mid-Holocene (Edens & Wilkinson 1998).

> "What did the fifth-millennium population of south-eastern Arabia do during the parts of the year when it was not on the coast? Were they the ones who started cultivation of the date palm in Arabia? Did they have other cultivated plants? Were they able to build wells? Up to now it is only known that they flaked their stone tools and weapons in a special way. The sites to answer our questions must still be found" (Uerpmann M & Uerpmann H-P 1996: 136).

Are the building structures identified at Kharimat Khor al-Manahil and Khor Al Manahil perhaps traces of the seasonal camps of the nomadic pastoralists inhabiting the interior of south-eastern Arabia? They may form part of what Zarins has referred to as the "Southwest Asian Pastoral Technocomplex". He has noted that smaller sites may consist of "homesteads" comprising two or three joined circles or individual circles varying in size from 3 to 5 m in diameter, with walls composed of two to ten courses of stone, built in dry-wall fashion, and that vertical slabs were used for the definition of thresholds (Zarins 1992: 220). This description sounds remarkably similar to the structures identified at Kharimat Khor al-Manahil. It has been noted elsewhere in a study of nomads in the Dhofar region that, due to their high mobility, their houses were not very substantial (Janzen 1986: 133), and that smaller flimsier encampments may well be the summer camps of prehistoric nomadic pastoralists (Bar-Yosef 1984: 157). The seasonal mobility of the population from the al-Buhais site in the Emirates has been deduced from the slaughtering ages of the small ruminants found at the site, where very few young animals were killed (Uerpmann M & Uerpmann H-P 2000; 2003; Uerpmann M, Uerpmann H-P & Jasim 2000).

> "Al Buhais 18 is interpreted as a central place of a group of nomadic herders, who gathered there during the time of year when their animals had lambs, kids and calves. Other parts of the year, presumably the winter, they spent at the coast, where a number of sites of this period have been found. Their summer and autumn sites are not yet known. We believe that they were in the higher parts of the Hajar mountains. In any case the evidence available at al-Buhais 18 is sufficient enough to indicate large scale mobility of the herders of the 5th millennium BC in SE-Arabia". (Uerpmann M & Uerpmann H-P 2003: 256–7).

Thus, it is even possible to think of parts of a social group moving at specific times of the year to preferred grazing grounds in the interior of the Arabian Peninsula (Kallweit 2003: 62). Perhaps the Kharimat Khor al-Manahil and Khor Al Manahil sites represent seasonally occupied sites during these summer or autumn periods? They may have been regularly visited locations forming part of the annual cycle of movements around south-eastern Arabia, because of the presence of good grazing and sweet water in the vicinity.

Clearly research on Neolithic sites located in the interior of eastern Arabia still has some way to go. To date, most efforts have concentrated on the study of surface collections of artefacts. Unfortunately, many of

these studies have had to rely on rather biased samples of unprovenanced flint artefacts collected by amateur collectors (Gramly 1971). In this respect, the new sites discovered in the south-eastern corner of Abu Dhabi for the first time offer a unique opportunity to learn more about the Neolithic in the interior of the United Arab Emirates.

A further season of archaeological fieldwork is planned by ADIAS in collaboration with the Al Ain Department of Antiquities and Tourism in January 2005.

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Notes

1 The name Kharimat Khor al-Manahil [Kharīmat Khawr al-Manāhil] would appear to refer to an area in sandy tracts (*kharīmah*) in low ground between heights (*khawr*) — presumably referring to a corridor between dunes — with pools (*manāhil*). [Ed.]

2 The exact locations of single finds or surface scatters and sites were recorded using a Garmin 12-channel GPS. As such flint sites are becoming more and more disturbed by visitors and amateur collectors, we do not give the GPS co-ordinates here, since we wish to keep the archaeological sites protected, at least whilst we are still in the midst of ongoing research in this important area. During the January 2005 season it is planned that fencing will be put around some of the major areas to discourage people from driving over or damaging the sites.

3 The geological term *barchan* describes parabola-shaped dunes with the two "horns" facing downwind. They have a smooth slope of *c.* 15º on the windward side, and a steep, slip-face slope of *c.* 32º on the lee side. In the present case, the prevailing wind is from the north.

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