Archaeology of Early Northeastern Africa
Studies in African Archaeology 9
Poznań Archaeological Museum 2006

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El Abadiya 3, Upper Egypt, a Late Palaeolithic site on the shore of a large Nile lake

1 - Site situation

During the 1985 survey, the Belgian Middle Egypt Prehistoric Project of Leuven University discovered several Palaeolithic sites in the Naqada area, Upper Egypt. One was at el Abadiya, near Danfiq (Fig. 1: 1). Several excavation campaign were organised to excavate an Upper Palaeolithic site, which now we call el Abadiya 1 (Vermeersch, Van Peer & Paulissen 2000). A new field campaign took place from February 18 to March 25, 2001[1]. In the 2001 campaign, we intended to continue the exploration of the Upper Palaeolithic of the region, but the survey of the area led to the discovery of el Abadiya 2, which was identified as a Naqada 1 site (Vermeersch, Van Neer, & Hendrickx 2005), whereas el Abadiya 3 proved to be a Late Palaeolithic site. As the excavation at El Abadiya 1 provided few new data, we decided to investigate el Abadiya 3.

Excavation procedure

El Abadiya 3 (25°50'26.89"N, 32°41'55.52"E) is located some hundreds of metres west of el Abadiya 1 (Fig. 1), just north of the Meri Girgis monastery,

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[1] The expedition members were Dr. Pierre M. Vermeersch, director, Patrick Bringmans, Tim Vanderbeken, Thomas Cardon de Lichtbuer, Thijs Van Thuyne, Caroline Ryssaert, Kathleen Verfaillie, Tuur Van Hove and the inspectors of the Antiquities department, section of Qena, Ahmed Ismail and Hakiem Ahmed El Sagir. The expedition members gratefully acknowledge the kindness of Mr. Hussein Ahmed Hussein El Afiuni, chief inspector at Qena.. The "Fonds Wetenschappelijk Onderzoek - Vlaanderen" and the "Katholieke Universiteit Leuven" provided funding. The "Netherlands-Flemish Institute in Cairo" provided care of the administrative support.

At the end of the excavations the material was prepared for conservation and registered in the register book # 59 of the Egyptian Museum. The artefacts have been put in an unsealed wooden box stored in the sealed storeroom of the Antiquities Department at Quft.

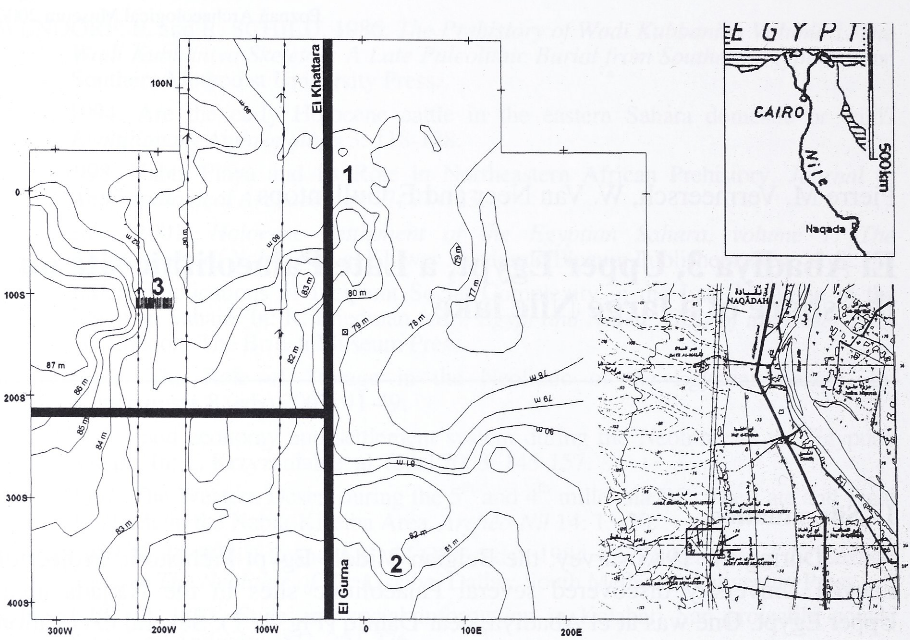


Fig. 1. General map of the Abadiya area with the position of the Isnan site (#3), the paved roads and the power pylones (↑) with their power lines. The Nagada 1 site (Vermeersch, Hendrickx, Van Neer 2005, #2) and the Shuwihkatian site (Vermeersch, Van Peer & Paulissen 2000, #1) are situated east of the desert road from Khattara to El Gurnah.

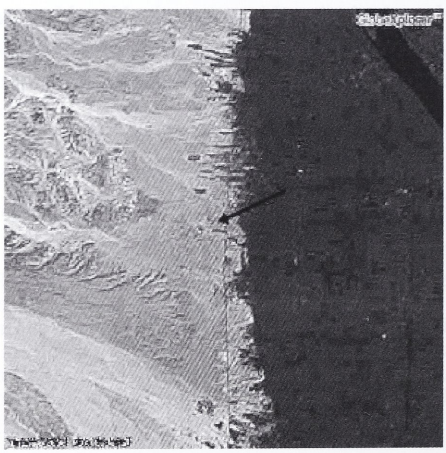


Fig. 2. Position of El Abadiya 3 on a satellite picture of the area (Satellite and aerial imagery provided courtesy GlobeXplorer.com and Partners. Copyright [2004]. All rights reserved.).

near Abu Diyab Shark, Danfiq, Upper Egypt, west of the new paved desert road between Taramsa and Gurnah (Fig. 2). The site is situated on the lower eastern slope of a small hill, which borders a large depression, west of the cultivated area.

A topographic plan (Fig. 1) indicating the position of the three sites was constructed using the base line initially established at the Shuwikhatian site of el Abadiya 1 (Vermeersch, Van Peer & Paulissen 2000). Within the grid system (in metres) of the el Abadiya 1 site (Fig. 4), the local grid point 20N10E is equal to 359.570S, 25.868E, and 82.696 m a.s.1.; point 20N30.16E to 361.7135S, 45.855E, 82.091 m a.s.1.

Geomorphology

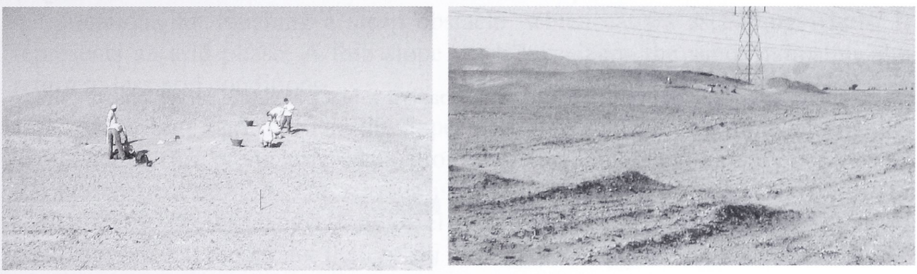


Fig. 3. View on the site from the east and from the south.

The site is located west of the cultivated plain at the rim of a flat embayment, which opens onto a large plain in the lower desert at an elevation of about 79m. Just south of power line pylon no. 220 the site leans against a flat, gravel covered, low hill (87m). The site was discovered because the surface of this concave slope was littered with artefacts and had a distinctly grey colour. To the south and to the east, the area had been extensively disturbed by the building of new desert paved roads. The geomorphologic evolution is illustrated by the schematic profile Fig. 5, based on all the excavation activities.

The hill is built up of coarse sand (thickness unknown) at its base (Fig.5: 8), covered by 2.3m grey layered sandy clay (Fig.5: 7), with several horizons of root drips and of calcrete formation. The top of this fluviatile deposit, apparently of Nilotic origin, is covered by 0.3m heterogeneous, rubified gravel (Fig.5: 6), wherein chert and quartz cobbles dominate. We interpret this profile as the remains of a Nilotic bed and flood plain deposit, eroded to an unknown extent by a local wadi. The weathering of the sediments of the Nile terrace is not as intensive as generally found in the Dendara Formation (Paulissen & Vermeersch, 1989). We therefore presume that these deposits are younger and tentatively correlate

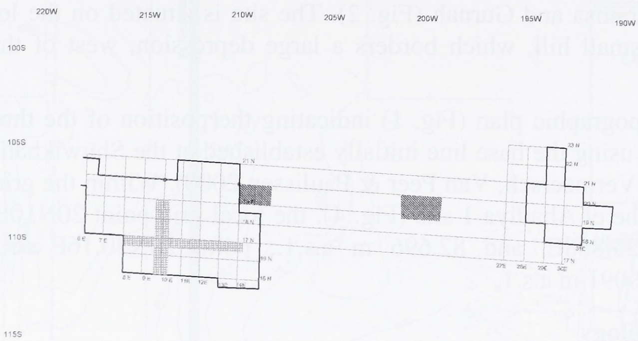


Fig. 4. Local grid inside the grid of El Abadiya 1; black areas are survey pits.

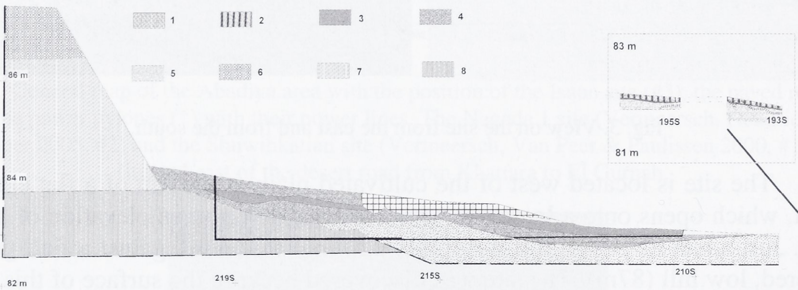


Fig. 5. General profile at the site; 1: zone disturbed by vehicles (DL); 2: black sandy clay attributed to the Sheikh Houssein Formation (SH); 3: Accumulation of prehistoric remains (GSL); 4: scree deposit; 5: aeolian sand (AS); 6: local gravel deposit; 7: Nilotic flood plain deposit; 8: Nilotic sandy bed deposit.

them with the Middle Pleistocene Kennisah deposits, near Nazlet Khater (Vermeersch 2002).

The wadi gravel may be thought of as part of a bahada, as numerous height points around 90m are figured on the topographical map (Fig.1). The movement of these cobbles supposes more humid conditions. We distinguish this phase as Danfiq Phase, a bahada around 14m above the actual flood plain of the Nile in the Danfiq area.

The Middle Pleistocene Danfiq bahada has been considerably eroded, following the incision of the Nile. The latest part of this erosion is discussed with the synthetic profile of the excavation pits, Fig. 5.

The bedrock presents a steep slope in the hillside, followed by a gentle dip under the plain. The nick point coincides with the appearance of the cohesive, more resistant clay. The interpretation as a pediment is reinforced by the presence of a thin slope wash layer with pebbles up to 7cm diameter, derived from the bahada cover. The pedimentation supposes less arid conditions than now. Our detailed levelling (Fig.1) shows that in the area extensive flat, gravel covered hillocks occur at 83m sloping down to 82m. This extension shows that it is an important pedimentation phase. On top of this, a loose, homogeneous sand body (Fig.5: 5) occurred, which is doubtless an aeolian patch. It shows the classic dunal situation, not touching a steep obstacle, which causes ascending winds. It represents an arid phase. A thin slope wash layer caps the sand, indicating the return to less arid conditions.

A striking dark layer in the upper part consists of archaeological remains and charcoal of a prehistoric occupation. It slopes down as dark silty clay in the flat embayment at 80m. The surface is here littered with *Corbicula consobrina* shells. In the nearby excavations of el Abadiya 1 these shells were covered by black silty clays, producing the typical constellation of the Sheikh Hoessein clay (Paulissen & Vermeersch 1989, 2000) deposited around 12,500 BP by very high Nile waters. In that excavation well developed river beach deposits of this inundation could be identified between 80.4 and 79.7m. *Corbicula consobrina* is a bivalve species that typically inhabits permanent waters of the Nile. It is able to colonise flooded areas, but will only survive there when the waters are permanent (Van Damme 1984). *Corbicula consobrina* has been attested at numerous Pleistocene and Holocene sites along the Nile and its presence is often related to sandy substrate of alluvial origin. Reworked shells occur at many archaeological sites in Egypt, but finds of animals in a living position are rare. This is the case at el Abadiya 3, where they indicate that permanent waters had been available for a sufficient time to allow the species to colonise the flood plain and to undergo a growth period that was much longer than the relatively short flood season of the normal hydrological behaviour of the Nile. In other words, *Corbicula* shells in a living position indicate a period of at least a few years of permanent water and can be found in both fluviatile and lacustrine environments (Van Damme 1984).

Finally the topography has been disturbed by the traces of numerous vehicles apparently related to the maintenance of the nearby power line.

Stratigraphy

Several profiles in the excavated area have been studied. Here we describe profile 20N7-11E (Fig. 6):

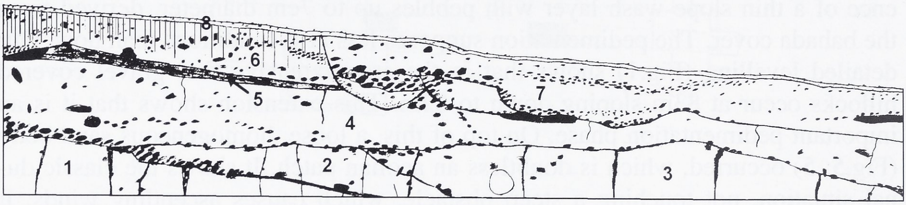


Fig. 6. Profile at 20N7-11E; for legend see text.

8: (DP: desert pavement): A thin layer of sand and pebbles is a lag deposit. It is conspicuous that no cracks originate from this surface.

7: (DL: disturbed layer): Disturbed layer due to the power line maintenance vehicles passing over this surface.

6: (US: upper slope wash): Very heterogeneous sandy and fine pebble deposit (2.5Y 7/8 in wet condition; 7.5YR 6/3 in dry condition). The sandy fraction is less important than in layer 4. Prehistoric remains occur but are rare. In this deposit a slight coloured desertic soil had developed.

5: (GSL: grey silty layer): Very heterogeneous dark grey coarse silty sand (7.5Y 4/1 in wet condition; 7.5Y 7/2 in dry condition) with small pebbles and prehistoric remains. Locally, its base is characterised by a thin veneer of black ash. Below layer 7, the layer is highly disturbed, but, occasionally preserved. Faunaturbation is very important. The silty fraction and the dark grey colour is apparently the result of a mixture of the deposits of the Sheikh Houssein clay, lower down the slope, and the local slope wash deposits. The mixture could have occurred when humans came out of the water and walked on the slope with muddy feet.

4: [LS: lower (scree - slope wash)]: Very heterogeneous loose sand (5YR 4/3 in wet condition; 10YR 6/2 in dry condition) with, mainly in the western part, scattered pebbles. Numerous crotovinas have been observed. Occasionally some fine charcoal particles are found. Below layer 7 the presence of some pebbles in a mainly vertical position are probably related to disturbance by vehicle movements. Shallow very fine cracks originate from the interface with layer 5.

3: (AS: aeolian sand): Compacted fine aeolian sand (5YR 3/3 in wet condition; 10YR 5/2 in dry condition) with, at its base and on top, some rare pebbles. Crotovinas are present and are filled with deposits from layers 4 and 5. Fine cracks originate from the interface with layer 4. Below layer 7 the same phenomenon is present as in layer 4.

2: (CS: colluvial sand): Compacted heterogeneous sand (5YR 3/3 in wet condition; 10YR 5/2 in dry condition) with some scattered small pebbles. At the sand base a continuous pebble horizon is thinning slope downwards (20 cm thick in the west; 7 cm in the east). Some cracks originate from the interface with layer 4. No cracks have their origin at the interface with layer 3. The deposit is composed mainly by sand from layer 1, mixed with some slope wash pebbles.

1: (NS: Nilotic sand): Compacted coarse sand (5YR 3/3 in wet condition; 10YR 5/2 in dry condition). The sand has several cracks, up to 3 cm wide, starting from the eroded top of the sand. In the cracks some small pebbles (max. 2 cm) have been incorporated. The cracks below layer 2 are somewhat larger than those from the contact with layer 4.

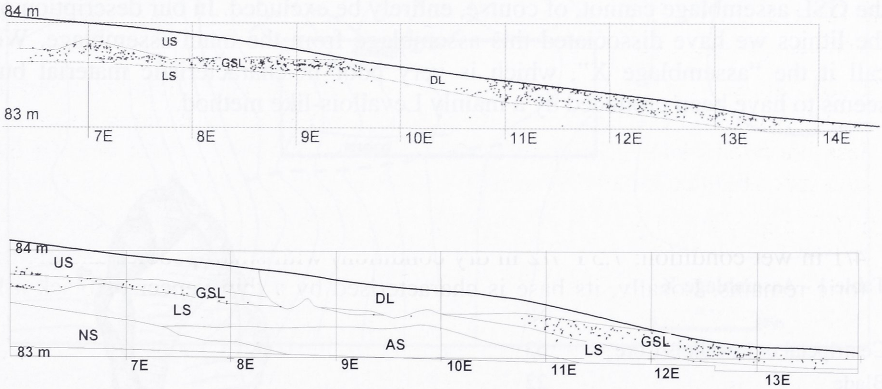


Fig. 7. Profile with plotted artefacts along profile 17N (upper) and 19N (lower).

The artefact-bearing grey silty deposits (GSL, layer 5) are incorporated in a stratigraphical context (Fig. 7) where the coarse Nile sand (NS) forms the base of the profile. These Nile sands are overlain by aeolian sand (AS). In between these deposits some slope wash had accumulated. Subsequently, the area was strongly eroded, causing a truncation of both the Nile and the aeolian sand and the deposition of a gravely slope wash deposit (LS). That slope wash thins towards the lower parts of the slope. The grey silty layer (GSL), containing the human remains, rests on top of this slope wash deposit and is thus clearly younger than the aeolian sand. It is covered by a new slope wash deposit (US) in which a desertic soil was formed, forming a reddish coloured weathered horizon (7.5 to 10YR6/3). In the centre of the artefact accumulation, tracks from trucks (DL) have partially disturbed the GSL. On the lower reaches (Fig. 5) of the site (27-30E), the silt-clay deposits of the Sheikh Houssein Formation (SH) cover the aeolian sand. There, at the interface between the aeolian sand (AS) and the Sheikh Houssein Formation (SH), we found a horizon with archaeological remains, which is the continuation of the GSL. The remains of the Sheikh Houssein Formation are less than 10 cm thick and are clearly eroded by the present surface. Between the eastern and the western part of the site no SH deposits are preserved.

In the slope wash (US and LS) deposits, clearly separated from the GSL, an assemblage of no longer fresh artefacts was found in 20N6E. We interpret this assemblage as the result of mass movements that, from higher on the slope, introduced an older assemblage onto the top of a younger one. A mixture with the GSL assemblage cannot, of course, entirely be excluded. In our description of the lithics we have dissociated this assemblage from the main assemblage. We call it the "assemblage X", which is very poor in characteristic material but seems to have been produced by a mainly Levallois-like method.

Table 1 - Assemblage X

	N
Centripetal or Levallois Core	63
Blade	22
Flake	135
Retouched piece	10
Chip	42
Convergent side-scraper	1
Total	273

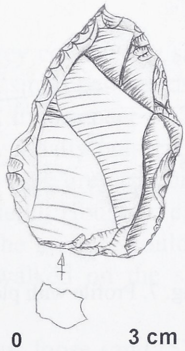


Fig. 8. Convergent side-scraper (assemblage X).

The assemblage has not been studied in detail but we consider it as belonging to an unspecified Middle Palaeolithic. A convergent side scraper (Fig. 8) seems to confirm this attribution. The artefacts of this assemblage X have not been integrated in the distribution plans of the main site.

The main assemblage was found in the GSL on the upper parts of the site and at the interface between the SH (Sheikh Houssein Formation) and the aeolian sand (AS) on the lower parts of the site. Excavation proceeded by trowelling in spits about 5 cm thick within surface units of 1 or 2 m². Artefacts were tridimensionally registered by a laser theodolite. MapInfo© was used to plot the plans. We were assisted by six local workmen in carrying away the excavation dump. All excavated deposits were washed through a 4 mm mesh sieve. Artefacts retrieved from the sieve have been plotted in a random way (using MS Excel©) in the squares from which the dump was collected. Some pits were dug to understand the local stratigraphy. In order to preserve stratigraphical profiles we did not excavate two perpendicular strips of the site (grey area on Fig. 4).

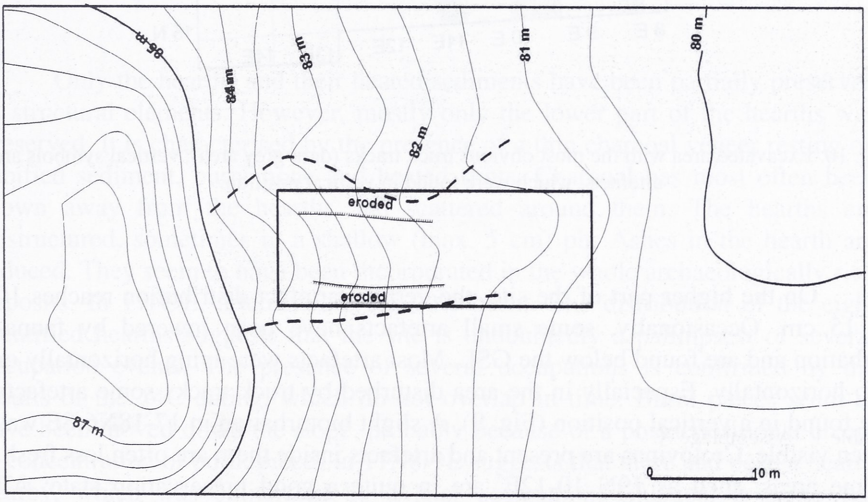


Fig. 9. Topography of the site area.

The squares 20N9 & 10E were not excavated but here a stratigraphical pit was dug at the beginning of the campaign. All the dump was sieved but not retrieved with regard to it exact position, which resulted in an overestimation of the material belonging to the GSL. In these squares material was thus not registered tridimensionally. From the plan of the plotted artefacts one observes that, apparently in squares 18 & 19N8E the excavation was done with less care, resulting in a probable under-representation of the archaeological material.

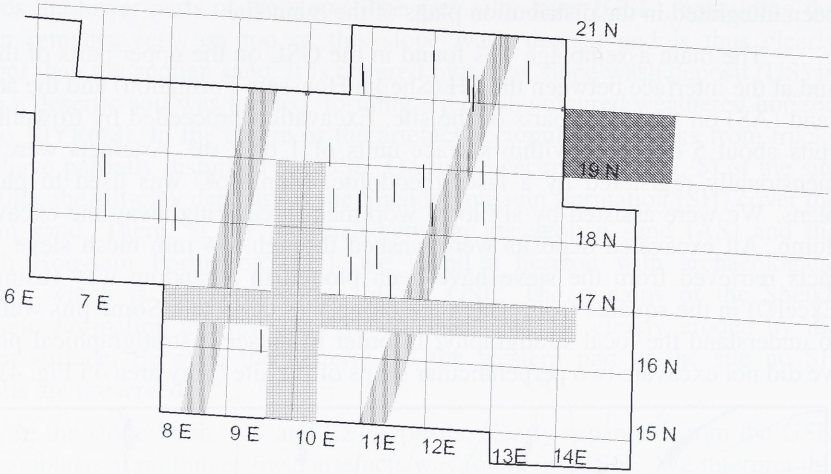


Fig. 10. Excavated area with the most obvious truck tracks (dark grey area); vertical symbols are artefacts, which were found in vertical position.

On the higher part of the site, the vertical artefact distribution reaches 10 to 15 cm. Occasionally, some small artefacts have been lowered by fauna-turbation and are found below the GSL. Most artefacts were lying horizontally or sub-horizontally. Especially in the area disturbed by truck tracks some artefacts are found in a vertical position (Fig. 9). A slight bioturbation in 17-18N6-8E was often visible. Crotovinas are present and artefacts inside them are often less fresh. Some areas, such as 19N 10-12E, are in quite a good preservation state: All artefacts were still in a horizontal position.

Structures

The general layout of the artefacts (Fig. 13) is of oval form. This is, however, mainly the result of the erosion history of the site. Its northern and southern parts were eroded by shallow gullies (Fig. 11, 12). In the east the concentration is eroded probably by a generalized aeolian activity, which caused an interruption of the archaeologically rich deposits between 15 E and 27E. In the eastern part of the site only a very thin veneer of archaeological deposits was preserved below the deposits of the Sheikh Houssein Formation.

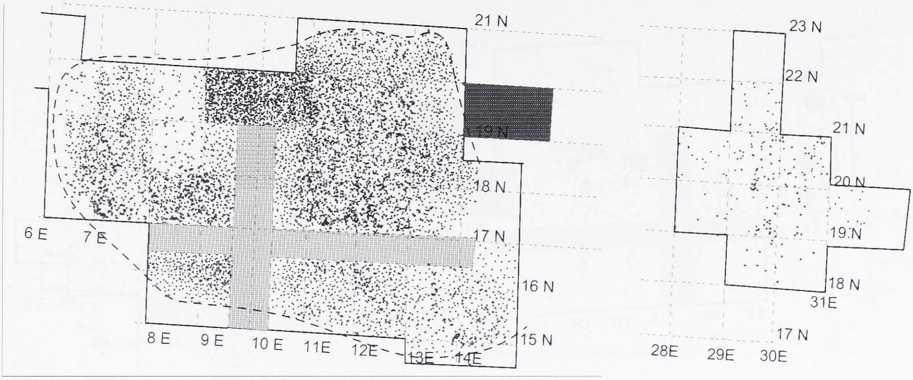


Fig. 11. Artefact distribution with registered (star) and sieved (point) artefacts.

Only the hearths and their heated sediments have been partially preserved as structural elements. However, mostly only the lower part of the hearths was preserved. It is characterised by the presence of a thin charcoal veneer resting on rubified sediment, burnt bone and heated flints. Charcoal has most often been blown away from the hearths and scattered around them. The hearths are unstructured, sometimes in a shallow (max. 5 cm) pit. Ashes in the hearth are reduced. They seem to have been incorporated in the whole archaeologically rich deposits. In 17N9E, artefacts are for 90% burnt. The distribution of the eight identified hearths suggests that the site is undoubtedly a palimpsest of several occupation events. The presence of several occupations is confirmed by the results of the 14C dating, which do not overlap in time. Burnt pieces seem to have been moved down the slope, probably because of a postdepositional creep. A concentration of burnt pieces in 17N8-9E suggests that there had been a hearth nearby, which was obliterated by a later occupation. Charcoal is somewhat concentrated around the hearths but no real charcoal remains in situ were found.

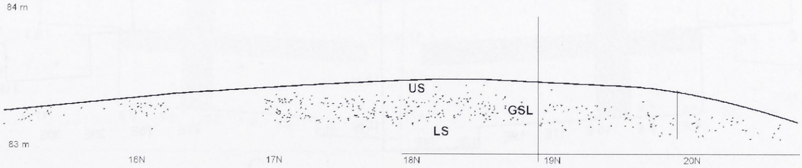
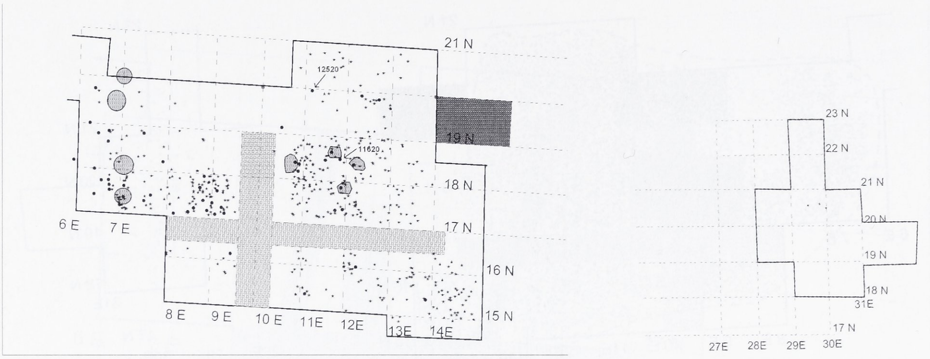
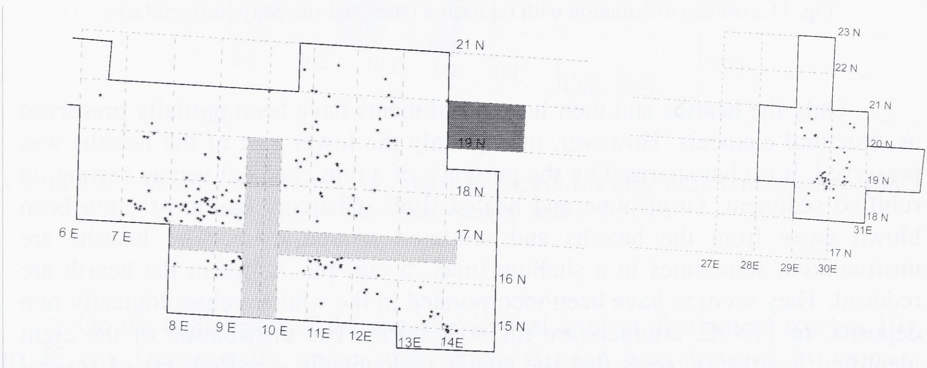


Fig. 12. South-North profile at 12E with plotted artefacts.



A



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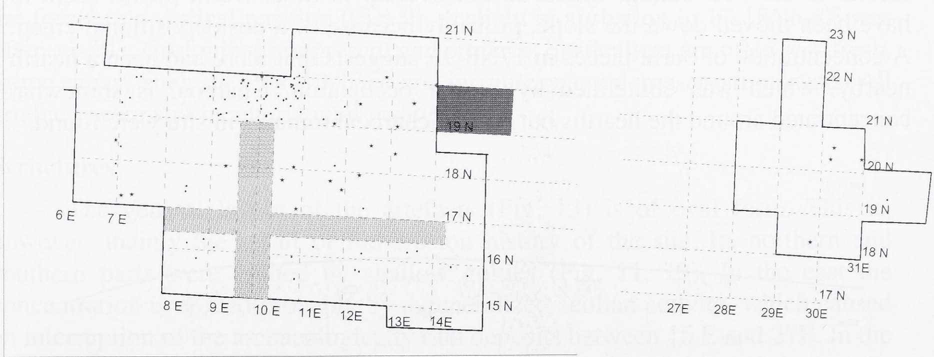

C

Fig. 13. A: distribution of hearths, charcoal (dot) and burnt artefacts (star) and position, ^{14}C samples; B: faunal remain distribution; C: core distribution, plotted (star) or from sieve (dot).

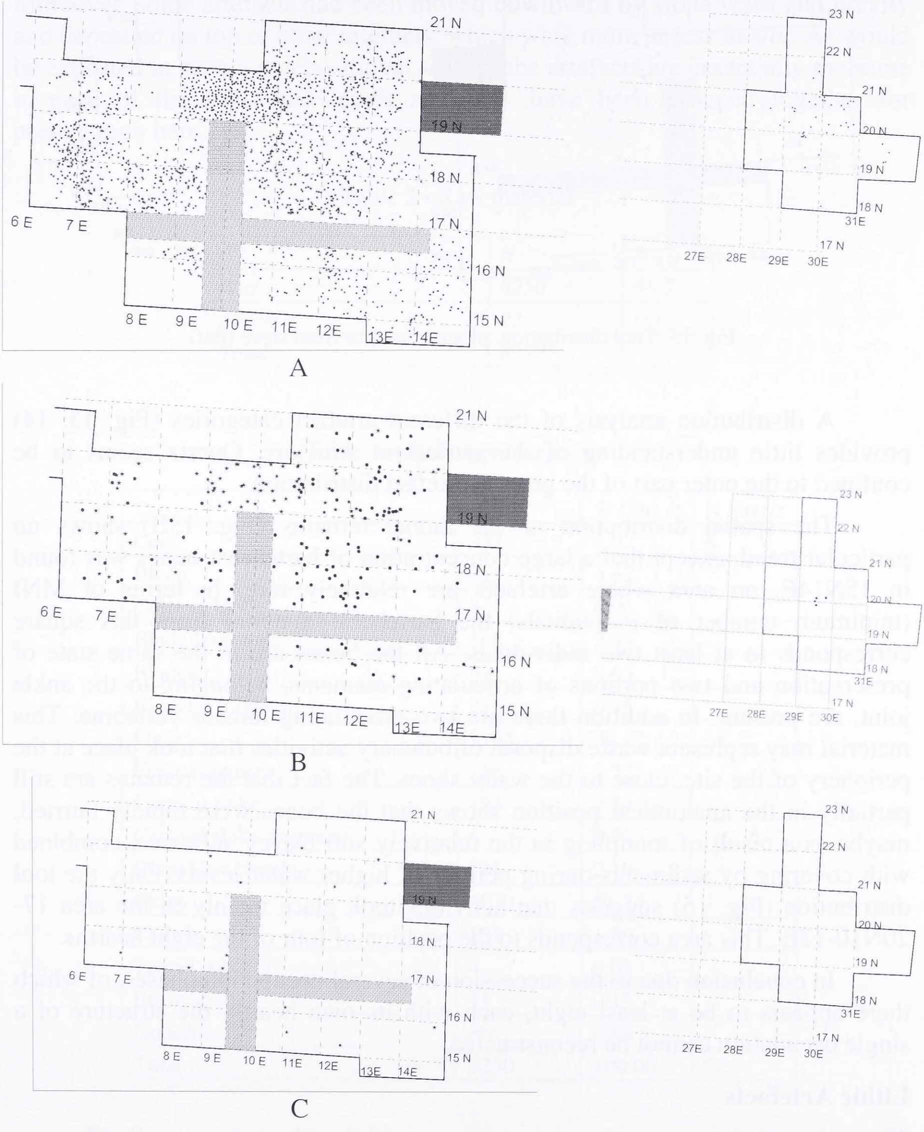

Fig. 14. A: Flake distribution, plotted (star) or from sieve (dot); B: blade distribution plotted (star) or from sieve (dot); C: quartz distribution.

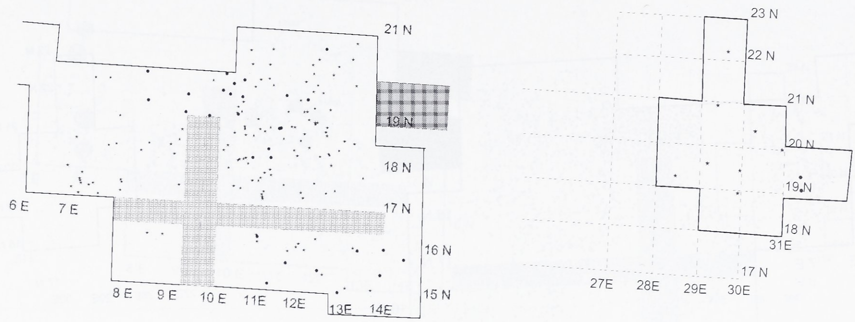

Fig. 15. Tool distribution, plotted (star) or from sieve (dot).

A distribution analysis of the different artefact categories (Fig. 13, 14) provides little understanding of the settlement structure. Quartz seems to be confined to the outer part of the general artefact distribution.

The spatial distribution of the faunal remains (Fig. 13B) shows no particular trend, except that a large concentration of hartebeest bones was found in 15N14E, an area where artefacts are relatively rare. In terms of MNI (minimum number of individuals) the hartebeest material from this square corresponds to at least two individuals. All the bones are in the same state of preservation and two portions of articulating elements, belonging to the ankle joint, are present. In addition there are two articulating lumbar vertebrae. This material may represent waste disposal of butchery activities that took place at the periphery of the site, close to the water shore. The fact that the remains are still partially in the anatomical position shows that the bones were rapidly burried, maybe as a result of trampling in the relatively soft clayey substrate, combined with covering by sediments during periods of higher water levels. Only the tool distribution (Fig. 15) suggests that activities took place mainly in the area 17-20N10-12E. This area corresponds to the position of four of the eight hearths.

In conclusion due to the succession of several occupation phases, of which there appears to be at least eight, each with its own hearth, the structure of a single occupation cannot be reconstructed.

Lithic Artefacts

The major artefact categories

A rich assemblage consisting of 8250 lithic artefacts was recovered. These undoubtedly represent many occupation events on the shore of the high water lake in the Nile valley. However, they are treated here as a single unit because the stratigraphic study gave no arguments for splitting up the collection. Moreover, some artefacts had been moved downward by slope wash and gravity and deposited on top of other artefacts, which were more or less *in situ*. As would be expected in such a redepositional setting, the artefacts are essentially the same in each of the excavated levels and they have been grouped together for presentation here.

Table 2 - Raw material.

	N	*%*
flint	*8250*	*99.7*
quartz	*22*	*0.3*
Total	*8272*	

Table 3 – Debitage categories.

	N flint	% flint	N quartz
Core	332	4.02	6
Blade	381	4.62	
Cortical blade	5	0.06	
Blade fragment	168	2.04	
Bladelet	52	0.63	
Bladelet fragment	37	0.45	
Flake	2155	26.12	14
Flake fragment	266	3.22	
Cortical flake	185	2.24	
Cortical flake fragment	6	0.07	
Burnt flint chunks	181	2.19	
Chips	4270	51.76	1
Chunk	131	1.59	
Tested cobbles	4	0.05	
Burin spall	11	0.13	
Undefined	66	0.80	
Total	8250	100.00	22

Finding good quality lithic raw materials was not a problem for the occupants of el Abadiya 3. The most frequently used lithic material was a good quality grey-brown flint, abundantly available as cobbles in the nearby Wadi Al-

Hamdaniyya, north of the site. Flint was used for over 99% of the debitage. Quartz cobbles were used for the production of some small flakes. The artefacts recovered from below the site surface are fresh with cutting edges and unpatinated. Freshly excavated artefacts obtain, some time after the excavation, a white patina. Artefacts recovered from the surface or from the slope wash deposits are sometimes less fresh. Some aretefacts, from the lower slope wash deposit of 20N6E are sometimes rolled and probably belong a to a Middle Palaeolithic occupation remain. They have not been considered in this study. 23% of the artefacts had suffered fire damage.

Cores

Cores (Fig. 20) were manufactured on wadi chert gravel derived from the chert nodules of the Eocene limestone in the area and on small quartz cobbles. Most of the cores show relics of the cortex, especially on the posterior surface. The platform is generally unfaceted and consists of a split surface.

Table 4 – Frequency of identified core classes.

Single platform core	7
Opposed double platform core	6
Crossed platform core	13
Discoid core	24
Total	50

Some of the cores were measured and the results are summarised in tables 4 and 5. Discoid cores (Fig. 20: 5, 8, 9) dominate the assemblage, but they are generally small and entirely exhausted. Crossed (Fig. 20: 6) and opposed (Fig. 20: 3-4) platform cores are numerous, and they occur at much higher values than do the flakes and blades from this type of core. The reason for this is probably that the opposed platform cores began as single platform cores. Near exhaustion they were finally transformed into opposed platform cores. Whatever the cause, single platform cores (Fig. 20: 1, 4) are significantly under-represented in this assemblage. Indeed, flaking scars on the dorsal side of a sample of artefacts (N= 256, mainly tools) are for 87.5% unipolar and 12.5% bipolar, suggesting a clear preference for the use of blanks produced from single platform cores. Core trimming elements are rare: only ten rejuvenation flakes have been found. Cores were exploited with a hard hammer technique.

The measured (all flint) single platform, opposed platform, crossed platform and discoid cores (table 5) have average lengths of 50.5, 54.3, 48.5 and 53.2 mm respectively, with standard deviations of 13.8, 12.4, 13.3 and 17.0 mm; the average width is 40.4, 37.5, 47.0 and 79.1 mm, with standard deviation of 11.2, 12.0, 15.4 and 14.8 mm; while the average thickness is 29.0, 30.0, 33.2 and 23.0 mm, with a standard deviation of 7.8, 2.5, 6.9 and 6.6 mm. Most cores have no back preparation. Core trimming elements are scarce. Most cores are entirely exhausted.

Table 5 – Attributes of the cores.

	N	Average length	σ	Average width	σ	Average thickness.	σ
Single platform cores	5	5.08	1.38	4.04	1.12	2.90	0.78
Opposed platform core	4	5.43	1.24	3.75	1.20	3.00	0.25
Crossed platform cores	12	4.85	1.33	4.70	1.54	3.32	0.69
Discoid cores	17	5.32	1.70	4.91	1.48	2.30	0.66

Debitage

Absolute and percentage frequencies of the types of debitage by raw material are given in Table 2. Cortical pieces (2.4%) are not common in this assemblage. In general the lithic flaking process aimed at the production of blades and elongated flakes (Fig. 21-22). Bladelets occasionally occur but were not produced systematically. Most blanks were obtained from single platform cores as shown by the flaking direction observed on the dorsal surface (Table 6). Burin spalls and other debitage are less numerous. Two Kombewa flakes have been identified. The collection is rich in chips and unretouched flakes. The Levallois method has not been used.

Table 6 - Flaking direction of the dorsal surface.

Dorsal surface attests	N	%
Cortical surface	1	0.5
Bipolar flaking	28	12.8
Unipolar flaking	190	86.8
Total of analysed items	219	100.0

The dimensions of the complete and identifiable debitage are summarized in Table 3. Average blade length (for 44 entire items measured) is 5.7 ± 1.4 cm, average blade width is 2.2 ± 0.8 cm. The length to width ratio is 2.8 ± 0.8 and the thickness to width ratio is 2.9 ± 1.6. Blades are thus rather short and wide. They are rarely symmetrical (Fig. 22:7-8) and often pointed (Fig. 21: 2, 4-6, 11-15; 22: 2-4). Bladelets (Fig. 22: 11-12) are rare. Blades a nd elongated flakes have been

Table 7 - Butt type.

	N	%
Cortical butt	9	4.8
Flat butt	125	67.2
Filliform butt	7	3.8
Dihedral butt	4	2.2
Faceted butt	2	1.1
Pointed butt	39	21.0
Total items analysed	186	100.0

been used as blanks for most tools. Most of them have been obtained from single platform cores. Pointed blades have often been retouched as to obtain retouched points. The thickness to width ratio for all blades (N> 200), complete or fragmented, is 3.1 ± 1.4.

The butt of flakes and blades is mostly flat or punctiform. Dihedral or faceted butts are scarce. Butt length has an average of 13.72 ± 8.21 mm with a mode of 8 mm. Butt thickness has an average of 5.76 ± 3.62 mm with a mode of 6 mm. The bulb of percussion and the ripples are generally well developped in most specimens, suggesting a hard hammer approach.

The debitage and cores clearly indicate that the lithic technology at Abadiya 3 emphasizes the production of flake and elongated blanks. All debitage characteristics point to a very simple lithic production method with a much reduced preparation of the cores. elongated blanks could easily be obtained by selecting elongated flint cobbles from the wadi. Few of the cores found at Abadiya 3 had been extensively prepared. The scarcity of cortical flakes (flakes with more than 50% cortex on their dorsal surface) indicates that many of the cores were not shaped at the site but were imported from the nearby wadi after an initial shaping. Final shaping and debitage of the cores took place at the site as is suggested by the high number of chips (nearly 52% of all flint artefacts). A few flakes were obtained from smaller quartz pebbles, which served as cores for the production of a very limited number of flakes. The manufactural aspects of the artefacts in the collections studied can be summarized as follows: The Levallois flake tradition is absent. Blade production is the purpose of the debitage. Bladelets were not aimed at. Microburin technique was not used. Production was generated mainly from single platform cores. Faceting of butts on both flakes and blades is very low.

Retouched tools

The most important tools category is the end-scraper (tab 8, 9). Retouched flakes and blades are very numerous. Some burins are present. The production of

Table 8 - General composition of the tool categories.

	N	%
End scraper	48	26.67
Side scraper	8	4.44
Burin	7	3.89
Borer	1	0.56
Composite tools	3	1.67
Retouched pointed blade	17	9.44
Denticulated blade	18	10.00
Notched pieces	6	3.33
Retouched blade	8	4.44
Retouched blade fragment	22	12.22
Retouched flake	39	21.67
Varia	3	1.67
	175	100.00

pointed blades generates a tool category of retouched pointed blades. Microliths are entirely lacking. The microburin technique has not been used.

End scrapers

End-scrapers represent the most common tool class, averaging 25.3 per cent of all tools. Most of these are simple end-scrapers on a blade (Fig. 23: 4, 9, 11; 24: 2, 6, 9, 10; 25, 3, 8, 10). Occasionally cortical blades have been used (Fig. 23: 9, 11; 24: 6; 25, 3). Sometimes the left scraper head has been resharpened by a ventral retouch ((Fig. 23: 9; 25: 10). End-scrapers with one or two retouched edges are numerous (Fig. 23: 6-7, 10, 12; 24: 8; 25: 1, 5, 7, 9). Retouches of the edge are irregular, partial or even denticulated and en écaille (Fig. 23: 6). Ventral retouch as well as normal retouch occur. Some of the end-scrapers lack their proximal end due to a fracture or a retouch (Fig. 24:2). End-scrapers on a flake (Fig. 23: 1; 24: 1, 3, 5; 25: 2), most often elongated, have often been made from heavy, large blanks. Occasionally they have an ogival scraping head (Fig. 25: 2). Often one or two edges have been retouched (Fig. 23: 2-3, 5, 8; 24: 1, 4, 5; 25: 4). Cortical patches are frequent. Some of the end-scrapers are keeled with a high scraping head (Fig. 23:5, 10). The scraper heads have predominantly rounded outlines.

Side-scrapers

Some side-scrapers are present (Fig. 26: 10-13; 27: 1-3) but much fewer thanthe end-scrapers. Single ones(Fig. 27: 3) are present, but most are double.

They have flake blanks, sometimes cortical (Fig. 27: 1). Sometimes the flake presents also an important retouch of the proximal edge (Fig. 26: 10-11), a bilateral double side-scraper and a transverse side-scraper. The scraper-retouch is sometimes more or less denticulated.

Table 9 – Tool list.

	N	%
End-scraper		
End-scraper on a blade	6	3.33
End-scraper on a blade fragment	7	3.89
End-scraper on a blade with a retouched edge	6	3.33
End-scraper on blade with two retouched edges	3	1.67
End-scraper on cortical blade	2	1.11
Double end-scraper on blade	1	0.56
End-scraper on a flake	15	8.33
End-scraper on a flake with two retouched edges	1	0.56
End-scraper with ventral thinning of scraping edge	1	0.56
End-scraper with lateral central notch	1	0.56
End-scraper fragment	1	0.56
Keeled scraper	2	1.11
Keeled scraper with retouched edges	2	1.11
Side scraper		
Single side-scraper	2	1.11
Double side-scraper	5	2.78
Transverse side-scraper	1	0.56
Burins		
Angled burin on snap	4	2.22
Double angled burin on snap	3	1.67
Borer		
Borer	1	0.56
Composite tools		
End-scraper - side-scraper	1	0.56
End-scraper-burin	1	0.56
End-scraper-borer	1	0.56
Retouched pointed blade		
Retouched pointed blade	8	4.44
Retouched pointed blade fragment	5	2.78

Denticulated pointed blade	3	1.67
Denticulated pointed blade fragment	1	0.56
Denticulated piece		
Denticulated blade	6	3.33
Denticulated blade fragment	1	0.56
Denticulated cortical flake	1	0.56
Denticulated flake	8	4.44
Denticulated flake fragment	2	1.11
Notched pieces		
Notched flake	3	1.67
Notched flake fragment	2	1.11
Notched flake with ventral thinned bulb	1	0.56
Retouched blade		
Retouched blade	7	3.89
Blade with two retouched edges and a notch	1	0.56
Retouched blade fragments		
Retouched blade fragment	6	3.33
Blade (fragment) with utilisation retouches	3	1.67
Blade fragment with one retouched edge	4	2.22
Blade fragment with two retouched edges	9	5.00
Retouched flake		
Retouched flake	21	11.67
Flake with utilisation retouch	10	5.56
Flake with two retouched edges	1	0.56
Retouched flake fragment	6	3.33
Ventrally retouched flake	1	0.56
Denticulated flake (not fresh)	1	0.56
Retouched flake (not fresh)	1	0.56
Convergent side scraper (not fresh)	1	0.56
Total	175	100.00

Burins

Burins (Fig. 26: 2-5, 7-8) constitute a characteristic element in the assemblage. Their frequency is, however, much lower than that of end-scrapers with 4.0 per cent. Most have been made on blade blanks. Others have been made on heavily retouched flakes (Fig. 26:7-8). Typologically, they all belong to the category of angled burins on snap (*burin d'angle sur cassure*). Double burins on snap are present.

Borer

A single borer is present (Fig. 26:9), but it is not really sharp and should rather be considered as a retouched pointed flake.

Composite tools

Composite tools are found. They are characteristic but not numerous. There is the combination between an end-scraper and an angled burin on snap (Fig. 26:1), an end-scraper and a borer (Fig. 26:6) and an end-scraper and a side-scraper.

Retouched pointed blade

The production of blades generated most often pointed blades. Some of those blades have been retouched. We have the impression that the toolmaker had a clear intention of making pointed tools by applying a retouch to one or both edges of the pointed blades. We thus dissociate such artefacts from the more general category of retouched blades and consider it as a special tool category. Some of the retouched pointed blades have been obtained by a very regular retouch on both edges of the pointed blade (Fig. 28:3, 6). The point itself seems not to have received special attention because it was not made sharper. Other retouched pointed blades (Fig. 27:14; 28:4-5, 7-9) display a more irregular retouch, sometimes dorsal, sometimes ventral. The retouch is often not entirely continuous. The point is often broken away. Occasionally an edge display an intense visible use wear (Fig. 28:5).

Notched pieces

The notches are predominantly located on the lateral edges (Fig. 27: 7), but sometimes on the distal end (Fig. 28:10). The kind of blanks used and the way they are produced show a great variability.

Denticulated pieces

The denticulates are made on both flakes (Fig. 28: 15) and blades (Fig. 28:1). The denticulated edge is generally located laterally (Fig. 28:12). They are also predominantly dorsal. The notches defining the denticulated edge are usually small (less than 10 mm.). Denticulates with large notches (Fig. 29:7) are uncommon.

Retouched pieces

Retouched pieces are the most common "tools" next to endscrapers, forming an average of 38.3% (Table 8). The retouched pieces suggest an intensive use of the blanks. It is not excluded that some of the retouched pieces are the result of postdepositional activities, such as trampling, but we believe that most of the retouched pieces are the result of an intensive utilisation. The fact that many pieces have been broken, is an indication of intensive use. In most cases, flakes (Fig. 29: 1) outnumber blades (fig; 27: 12, 15; 28: 2). The retouch is sometimes continuous (Fig. 28: 11), mainly partial and non continuous (Fig. 27: 11, 13; 28: 14) but often on both edges. The retouch is dominantly dorsal (Fig. 38) but a ventral or an alternating (Fig. 28: 13) retouch is not uncommon.

Varia: We presume that these intensely weathered artefacts are intrusive.

Dating

Two charcoal samples from layer GSL, one from 19N11E (ME01/09/-1943) and another from 18N11E, between two hearths (ME01/09/2108), have been submitted for ^{14}C dating. The following results were obtained:

11620 ± 55 BP (KIA-14812) for ME01/09/2108

12520 ± 70 BP (KIA-14813) for ME01/09/1943.

The two dates are statistically different, confirming the occupation of the site at different times. It is probably not a coincidence that the youngest age corresponds with hearth structures that were still visible while the older date corresponds to an area where no such structures could be observed, because they probably were obliterated by later occupation accitivities.

Faunal remains

About 550 faunal remains were found during the excavations of Abadiya 3 of which approximately 200 specimens were identifiable (Table 10). The assemblage is characterised by preferential preservation of robust skeletal elements of large species. The material is heavily fragmented and often specimens are observed that had clearly fallen apart *in situ* whereby the fragments of a single element were only slightly displaced and cemented together in a calcareous matrix.

Among the mollusc remains, two species occur - *Valvata nilotica* and *Bulinus truncatus* - that can be considered intrusive within the substrate on which human habitation took place. *Bulinus truncatus* inhabits a wide range of aquatic habitats, from running to stagnant water, even of a seasonal nature whereas *Valvata nilotica* occurs in slow running rivers and lakes with rather dense vegetation (Brown 1994). These two small freshwater gastropods have been recorded in numerous Late Pleistocene and Holocene sites along the Nile (Van Damme 1984). *Valvata nilotica* no longer lives in Middle and Upper Egypt, but its presence is attested at several archaeological sites, showing that it occurred previously as far south as the second Nile Cataract. It is not clear whether these two small gastropod species are contemporaneous with the human habitation or whether they were already present in the substrate on which people settled. In any case, since both species can occur in slow running or stagnant waters, their habitat requirements do not exclude contemporaneity. All the other faunal remains are probably anthropogenic.

Seven remains of *Unio abyssinicus*, a medium-sized Nile bivalve easily recognizable by its heavy hinged teeth (Van Damme 1984: 56), were found. This species no longer occurs in the Egyptian part of the Nile and is presently only found in Ethiopia (Van Damme 1984). However, during the Late Pleistocene and early Holocene its distribution was much larger. This edible species does not occur on flood plain s and typically inhabits permanent waters; for reasons of ac-

Table 10 - Faunal list of Abadiya. Figures indicate NISP (number of identified specimens).

Valvata nilotica	1
Bulinus truncatus	1
Unio abyssinicus	7
unidentifiable bivalves	5
clariid catfish (Clariidae)	15
unidentifiable fish	2
goose *(Anser sp.)*	1
ducks and geese *(Anatidae)*	8
coot *(Fulica atra)*	1
raven *(Corvus sp.)*	1
unidentifiable birds	29
hare *(Lepus capensis)*	2
wild donkey *(Equus africanus)*	2
dorcas gazelle *(Gazella dorcas)*	14
barbary sheep *(Ammotragus lervia)*	1
hartebeest *(Alcelaphus buselaphus)*	110
aurochs *(Bos primigenius)*	24
large bovids	18
unidentifiable mammals	308
total identified	208
grand total	552

cess, harvesting must have been restricted to periods when the water levels were relatively low. *Unio* may have been collected for food, but, like other large Nile bivalves (Gautier 1983: 60), they can also have been used as small containers or as raw material for the production of objects. Five additional bivalve remains were found that could not be identified with certainty, but their overall dimensions correspond to those of *Unio*.

All the identifiable fish remains belong to the catfish family of the Clariidae of which two genera (*Clarias* and *Heterobranchus*) occur in the Nile. The well-preserved articulation of a pectoral spine has the typical shape of *Clarias* (cf. Gayet & Van Neer 1990) which is still today the most common genus in Egypt. Clariids are typical flood plain dwellers that can easily be captured during their spawning run at the beginning of the floods and, later on during the year, when the waters are lowering and the fish occur in residual pools (Bruton 1979). Using the reconstructed sizes of the fish it is often possible to establish the fishing season since the average dimensions of the specimens are larger during the early-flood than during the late-flood season (Van Neer 2004). The catfish from Abadiya 3 are relatively small: the specimens that allowed a size reconstruction measured 10-20 cm standard length (SL) (1 specimen), 20-30 cm SL (1 spec.), 30-40 cm SL (1 spec.) and 40-50 cm SL (2 spec.).

Forty bird remains were found, but due to the poor preservation only 11 of them were identifiable to some extent. The majority of these belong to the Anatidae family and one of these remains - a humerus - could be assigned with certainty to a goose. The other duck and goose remains were not further identifiable due to their fragmentary nature and because a large number of species can occur in the Nile Valley. A tibiotarsus of a Rallidae could be identified as coot (*Fulica atra*), a bird visiting the Nile only during winter (Hollom et al. 1988). The dimensions of an incomplete carpometacarpus of raven fall within the variation of *Corvus corone* and *Corvus ruficollis*, two resident species with a wide distribution that are much attracted to human habitations where they act as scavengers (Hollom et al. 1988).

The mammal fauna from Abadiya 3 consists mainly of medium-sized and large ungulates. The only smaller mammal found is hare (*Lepus capensis*), represented by a radius and a pelvis fragment. The proximal width of the radius (Bp 8.1 mm) illustrates the smaller dimensions of the North African hare compared to *Lepus europaeus*. The presence of wild donkey (*Equus africanus*) is indicated by a patella and a first phalanx. Finds of this species in the Late Palaeolithic of Upper Egypt are rare: thus far the wild donkey has only been attested before at Kom Ombo (Churcher 1972). The same site is also the only one of its kind where barbary sheep (*Ammotragus lervia*) were found, a species that is represented at Abadiya 3 by a calcaneus with the typical morphological characteristics described scribed in Gabler (1985). Dorcas gazelle (*Gazella dorcas*) is represented by 14 remains originating from various parts of the skeleton (teeth, vertebrae, ribs, long bones, foot elements). The only measurable fragments are two distal tibiae (Bd 22.0mm and 23.0mm). The numerically most important species at the site is har-

Table 11: Measurements of the hartebeest postcranial remains. All the measurements are in millimetres and have been taken according to the standards described by von den Driesch (1976).

humerus		
BT	52.2	51.3
Bd	56.5	-
radius		
BFp	52.8	
Bp	58.3	
ulna		
BPC	27.8	
metacarpus		
Bd	41.7	
tibia		
Bp	76.1	
astragalus		
GLl	52.6	
GLm	49.4	
Dl	29.4	
naviculocuboid		
GB	44.2	
phalanx 2		
Bp	21.6	
phalanx 3		
DLS	56.0	
Ld	48.0	

tebeest (*Alcelaphus buselaphus*). It is represented by skeletal elements of all body parts and, as mentioned above, three portions of still articulating bones were found. The individual elements are cemented together by a calcareous matrix. One of the clusters consists of an astragalus, calcaneus, naviculocuboid, ectomesocuneiform and proximal metatarsal (Fig. 21), the other one is also an ankle joint comprising an astragalus, naviculocuboid, ectomesocuneiform and a small fragment of a calcaneus. Two lumbar vertebrae in articulating position were also recovered. Each of these clusters was counted as one specimen in the species list. The measurable hartebeest elements are indicated in Table 11 and the data on the slaughtering ages are listed in Table 12. Ageing criteria exist for the dentition of hartebeest (Mitchell 1965) but not for the fusion date of their long

Table 12 - Ageing data obtained on the bone fusion and tooth eruption of hartebeest and wild cattle. NF=non fused; F=fused.

fusion data	hartebeest		wild cattle	
	NF	F	NF	F
1-1.5 years				
distal humerus	-	3	-	-
proximal radius	-	3	-	1
1.5 years				
proximal phalanx 1	-	2	-	1
proximal phalanx 2	-	1	-	-
2-2.5 years				
distal metacarpus	-	1	-	-
2.5-3 years				
distal metatarsus	1	-	-	
2-3 years				
distal metapodal	1	2	-	-
3-3.5 years				
proximal calcaneus	-	1	-	
3.5-4 years				
radius & ulna	-	2	-	
proximal ulna	1	1	-	1
distal femur	-	1	-	
proximal tibia	-	3	-	1
4.5 years				
pelvis	1	-	-	-
5 years				
thoracic vertebra	1	-	-	-

tooth eruption data	hartebeest	wild cattle
2-2.5 years		
M3 erupted	1	
2-5 years		
M3 erupted		1

bones. As an alternative, the fusion dates of domestic cattle were used (Silver 1963).

It appears that the majority of the hunted animals were subadults and adults. They were killed when older than 1-1.5 years, and a relatively large number of bones indicates animals hunted at an age of at least 3.5-4 years. The remains of wild cattle (*Bos primigenius*) are mostly in a poor state of preservation, but their identification was facilitated by their large size that distinguishes them from those of hartebeest. Several tooth fragments, however, could not be securily identified and have been lumped in a 'large bovid' size category, including hartebeest and wild cattle. The poor preservation also explains why only one aurochs element was measurable (an astragalus, GLm 75mm and GLl 81.5mm). The few indications for the age at death, based on tooth eruption and long bone fusion of domestic cattle (Silver 1963), suggest that mainly subadult and adult animals were hunted (Table 12).

The number of traces that could be observed on the faunal material is very limited. Fine, more or less parallel cutmarks were seen on a distal metapodal of hartebeest, and among the unidentified material three burnt fragments of large mammal bone (hartebeest or aurochs?) occur. The faunal remains also included a worked bone, probably made from hartebeest or wild cattle bone. This double point, with a length of 32.4 mm, probably represents a fish gorge, a primitive form of fish hook to which a rope was tied in the middle. The bait is attached so as to ensure that the gorge is parallel to the rope. The gorge takes a transversal position in the mouth or branchial cavity when the bait is swallowed by a fish (von Brandt 1984). Set out for the night, bottom lines with baited gorges may have been suitable for capturing *Clarias,* which effect daily inshore movements for feeding. Similar objects have been found at sites where fishing was an important subsistence strategy, such as loci E-78-3, E-78-4, and E-81-1 at Wadi Kubbaniya (Gautier & Van Neer 1989) and Makhadma 4 (Van Neer et al. 2000).

The reconstruction of the relative importance of the various food procurement strategies (harvesting of molluscs, fishing, fowling and hunting) is hampered by the poor preservation conditions of the faunal material. Fragile remains such as those of fish, birds and molluscs are no doubt underrepresented and also among the mammal fauna it is obvious that smaller species, such as hare, are rare. Even within the bovids it is not excluded that the abundance of the smallest species, the dorcas gazelle, was affected by this phenomenon of differential destruction. Sampling procedures involved the use of 4mm mesh sieves and this may be an additional factor explaining the low number of small bones, for instance of fish.

In any case, the bovids seem to have been the major providers of animal protein. By taking into account the number of remains and the total weights of dorcas gazelle (35 kg), hartebeest (150 kg) and wild cattle (500 kg) suggested for these species (Gautier & Van Neer 1989), a rough estimate can be made of their relative contribution to the diet. The gazelles would have yielded 2% of the bovid meat, followed by aurochs (41%), and the major contributor would have been hartebeest (57%). These three species are the typical, major components of the terrestrial fauna exploited during Late Palaeolithic times in the Egyptian NileValley (Gautier 1984; Gautier & Van Neer 1989: 154-155). If the number of specimens identified is taken as a measure of the proportions in which these species were hunted, it appears that hartebeest was the most frequently exploited bovid throughout prehistoric Nubia and Egypt (Table 13). Also at Abadiya 3 this is the case, and hartebeest is even more common here than at all the other considered sites; there may, however, be a slight bias due to the concentration of well preserved hartebeest bones in one area of the site.

Table 13 - Relative frequencies of wild cattle, hartebeest and dorcas gazelle at Abadiya 3 (present study) and at other Late Palaeolithic sites in Nubia and Egypt (from Gautier & Van Neer 1989: 155). The proportions are based on number of identified specimens.

	% wild cattle	% hartebeest	% gazelle	sample size
Abadiya 3	16.2	74.3	9.5	148
Wadi Kubbaniya	17.8	66.3	16.0	940
Fayum	13.1	60.7	26.2	84
Isna & Idfu	37.2	56.7	6.1	635
Kom Ombo	39.9	51.8	8.3	591
Wadi Halfa	50.6	40.6	8.8	1120

The analysis of the artefact distribution, and of the structures and stratigraphy of the site suggests multiple occupation phases, whereas the faunal material yields some evidence regarding the seasonal exploitation of resources that may be indicative of the season(s) during which the site was visited. For the reconstruction of the resource scheduling it is worth underlining that, even in the lake environment postulated below, fluctuations in water levels occurred that had an influence on the accessibility of species. In late spring or early summer, lake levels must have been relatively low as a result of evaporation and reduced influx of water. The presence of *Unio abyssinicus* shells indicates mollusc harvesting when the water levels were low enough to permit access to the permanent water body to which this species is confined. The fish remains suggest exploitation, of relatively shallow waters, probably during the same season. The fish bones belong exclusively to clariid catfish of small to medium size which seems to exclude representing specimens captured during the yearly spawning season when the inflow of nutrient-rich water triggers inshore movement and reproduction. The absence of tilapia, a taxon also often encountered when shallow waters are exploited, could be due to a combination of small sample size, poor preservation conditions (its bones are smaller and less sturdy) and sampling procedures

(4mm mesh). Alternatively this absence may be a result of the fishing techniques employed. Baited fish gorges attached to bottom lines are very effective for capturing clariids whereas tilapia fishing with such gear would require the use of gorges attached to rod and line or to drift lines. Finally, the local hydrological or topographical conditions may for some reason have been less suitable for tilapia. Despite the presence of only a few identifiable taxa, the birds provide important information. Ravens are resident species and may have been captured all year round, but the coot, the goose and the other anatids are winter visitors. The traditional fowling season defined by Butzer (1976) for the period AD 1000-1800 extended from October to March, but during the late glacial period it may have been longer. Combination of the information provided by the molluscs, fish and aquatic birds shows that the site must have been occupied for at least part of the winter into the spring or early summer, when the water levels were seasonally lowered (cf. Fig. 10 in Van Neer 2004).

The terrestrial fauna can also be interpreted to some extent in terms of seasonal availability and abundance. It consists mainly of ungulates some of which may have been captured at a distance from the Nile. The barbary sheep is a typical inhabitant of rocky and dry montaineous areas and also the wild donkey climbs and moves with ease among rocks and cliffs, especially during the day (Dorst & Dandelot 1976). At night they come down to the valleys to graze and can hence also have been captured in broken, flat country and open grass plains. Dorcas gazelles are also typical inhabitants of desert and semi-desert environments that can occasionally, or seasonally, venture into the Nile Valley. At Wadi Kubbaniya, it was noticed that dorcas gazelles were more frequent during the low-water season when they may have penetrated farther in the Nile Valley (Gautier & Van Neer 1989). It was suggested that snares laid on tracks used by dorcas gazelle coming to water may have been an effective capturing method. Taking into account the ecological requirements of hartebeest and wild cattle, we believe that these herbivores were hunted in the Nile Valley or at its margins. Both species are bulk-roughage feeders, mainly on grasses, and therefore probably displayed an overlap in their econiches. Hartebeest seems to prefer habitats between open grassland and woodland or shrub and is a rather mobile species: it more readily moves away from waterlogged areas than wild cattle that was probably more restricted to wetter habitats. However, when conditions were seasonally drier they may both have been abundant close to the main channel and thus maybe more accessible to hunters (cf. Gautier 1988: Figure 1). Here, capturing these large herbivores can have been more effective if they were driven into shallow water where they could be impeded before attacking them with bow and arrow, spears or other wounding or striking gear (Gautier & Van Neer 1989: 159). It is therefore unlikely to be a coincidence that a concentration of hartebeest remains was found near the former water edge.

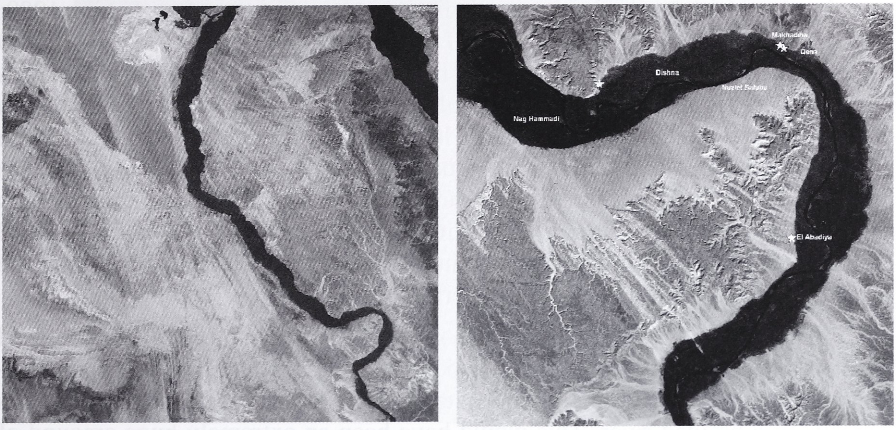

Fig. 16. Left: Satellite picture of the western desert in Middle Egypt (Satellite and aerial imagery provided courtesy GlobeXplorer.com and Partners, All rights reserved). Right: Landsat 1 (USGS, LM1188042007231490) picture of the Qena bend.

Discussion and Conclusion

The Late Palaeolithic Nile Valley in Upper Egypt

The el Abadiya 3 site is a late Palaeolithic site situated at the elevation of about 4 m above the present flood plain, in a stratigraphic context of the Sheikh Houssein Formation, the highest Nile deposits of the Late Pleistocene. Similar sites have already been studied in the Dishna plain and the Makhadma area (Vermeersch Paulissen & Huyge, 2000a and 2000b) where the deposits have been correlated with an event of the "Wild Nile". We now believe that another interpretation of the physical environment better fits the observation of the Late Palaeolithic high Nile deposits (Gullentops et al. submitted).

Wendorf and Schild (1989:769; Schild & Wendorf 2002-2004) have stressed that, with reduced stream competence and an increased sediment load during the Late Pleistocene, the Nile downstream from its headwaters changed from a massive stream following a single channel and became a much smaller river flowing in numbers of braided channels across a flood plain, which rose continuously as more and more sediment was deposited. This rise in the flood plain and filling of the valley occurred in spite of the fact that, at least during the Late Palaeolithic period of alluviation, the Mediterranean was more than 100 m lower than it is today. The level of the sea had no impact on the flood plain level in Upper Egypt and Nubia. The authors proved that the Late Palaeolithic Alluviation began well before 20,000 B.P. There are indeed 64 radiocarbon dates associated with this alluviation at Wadi Kubbaniya (Wendorf & Schild 1989: Table 13.1); the oldest is about 20,600 B.P. and the youngest is about 12,400 B.P. There, a series of exceptionally high floods, which may correlate with renewed flow from the White Nile, resulted in a final phase of silt accumulation on top of the sediments of the seepage lake, with a maximum elevation at 27 m above the modern flood plain. This upper silt has not been dated at Kubbaniya but is estimated to be about 12,000 years old. Schild and Wendorf imagine this river as a comparatively small stream with a flood plain cut by several ephemeral braided channels, with little or no flowing water, but with a large flood after the seasonal rains each year at the headwaters.

This view is however difficult to maintain. Another model should be used to interpret the Late Palaeolithic Nile behaviour in Egypt. There are no indications that the whole Nile Valley over its entire width has even been filled with deposits of a braided river. This would have been an extremely huge amound of deposits. From a hydrodynamic point of view it must be stressed that high inundations necessitate extreme discharges, tens of times stronger than the pre-dam floods, which would change the valley in a channel, preclude all sedimentation of suspension charge and result in strong erosion both vertical and lateral (Gullentops et al. submitted). There are no geomorphologic signs of this. Indeed, according to Schild and Wendorf (1989: 91) the Late Palaeolithic, Nilotic sediments in Wadi Kubbaniya are all overbank; there are no channel or near-channel deposits. In the given context, only one mechanism is possible: sedimentation in local, temporary lakes produced by ephemeral damming. Huge alluvial cones of tributary wadi are not present because of the unsuitable climatic conditions. Dunal damming by strong aeolian activity is the only possibility. It supposes simultaneous local hyperaridity to mobilise the sand sources and extreme drought in the upper Nile to realise practically a seasonal endorheic regime, which would allow the gradual built-up of a dunal barrier. Such conditions are well known and low discharges of the White Nile have been proposed (Livingstone 1976; 1980) and are now generally accepted for parts of MIS2 and especially the end (Barker & Gasse 2003). The channel of the White Nile was partially or completely blocked by dunes south of Khartoum until sometime between 12,500 and 11,500 B.P., when the Terminal Pleistocene Early Holocene transgressions of the White Nile buried the dunes beneath a mantle of alluvium (Williams and Adamson 1980: 297-298). At the same time the Eastern Sahara and the Red Sea area (Moeyersons e. a. 1999) suffer highest aridity.

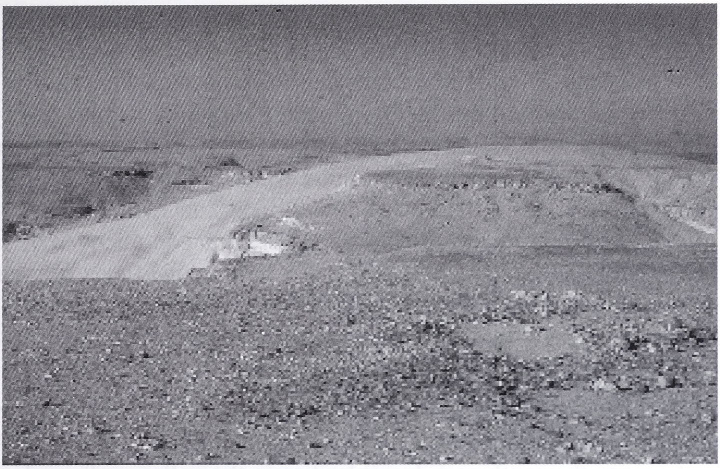

Fig. 17. Dune sand crossing the crest of the Gebel El Gir, south of Nazelet Safaha, providing the sand at El Abadiya 3 (layer AS).

In the Western Desert of Egypt, long sand streaks are visible on satellite documents (Fig. 17). Along the Middle Nile (Dariut) edge, such streaks show dramatic sand movement that even now is sometimes active. The satellite images show the presence of important longitudinal dunes that developed nearly parallel to the Nile valley, as is the case of the Dairut area with the South Wadi el-Rayan dune field (Fig. 17 & 18). Even now some of the longitudinal dunes make ingressions into the Nile valley itself (Embabi 2004: 112) imposing the need for measure against the destruction of agricultural activities in those areas. The dune field takes the form of linear dunes, while their orientation varies between 133° and 173° with a mean direction of 157.7°. Said (1993:143) has pointed out that in numerous texts from the pharaonic period around 2200 BC there is mention of the frequency of sand storms and the accumulation of sand. This may be understood if we assume that, with the advent of aridity, dunes started to form along the western fringes of the river. Ordinarily these dunes, which form during the winter storms, are flushed during the summer floods when these are high enough to wash the sand out. When the floods are low, dunes accumulate and encroach on the agricultural land. This seems to have been the case during the period when the longitudinal Khefoug dune field, which stretches for 175 kilometres (Said 1993: Fig. 1.24) along the western bank of the middle latitudes of the Nile (29°N to 28°N), was probably formed. In this stretch, aeolian sand and dune remains from the el-Khafoug formation (Said, 1981) inter-finger both the Prenile deposits of the Middle Pleistocene and the Neonile sediments of Late Pleistocene (Said, 1981). Even in modern times, wind-driven sands from the large fetches of the Western Desert were deposited on the flood plain and the river bed itself. Before the building of the High Dam most of the sand that was deposited on the bed of the river was flushed out into the Mediterranean Sea by the annual flood of the river. On the other hand, the sand, which accumulated over the western banks of the river, was ordinarily inundated by the flood waters and was incorporated into the sediments of the river. At times of low floods and extraordinary aridity, however, the dune and wind-driven sands remained uncovered, slowly encroaching on the flood plain of the river and forming dune fields of great areal extent over the western bank (Said 1993: 248). At present, this dune field is stabilized and covered by a thin layer of Nile mud which may have been formed by a temporary lake.

The Saharan dunes show the slightly curved stream flow of the prevailing northern wind in winter (Fig. 17), which is clearly funnelled by the wide incised valley from Asyut to the south east. Irregularities in the valley wall produce individualised wind cells, which give clear cut parallel streaks over tens of kilometres. In hyperarid conditions of the LGM and a natural, non irrigated, Nile valley this funnelling wind will deflate the Nile sediments and moreover, in addition to the sand introduced from the desert, find coarser sands in all the wadi cones. Huge amounts of sediment must have been brushed up the valley. At the sharp bend at Nag Hammadi the material continues its south eastern direction and a suspension charge invades the limestone plateau (Fig. 17). Individual streaks can be followed over 50 km, crossing the plateau and falling in the valley upstream of Luxor (Vermeersch, 2005). A similar dune was formed south of Nazlet Safaha and, in crossing the crest of Gebel el Gir (Fig. 7), it provided the sand that accumulated at el Abadiya 3 (layer AS). It is evident that the Nile bend at Nag Hammadi is a suitable place for abandonment of the traction load and building up of a dune field. In 1980 sandpits, just outside the actual flood plain, showed a succession of more than 10 m dune sands prograding westwards.

The sand accumulation in the valley during the LGM would have started from West until, at Nag Hammadi, it reached the eastern and northern valley cliffs damming the entire Nile valley by dunes. The topography upstream from Nag Hammadi shows that a dune field of 15m high is sufficient to develop an endorheic basin and eventually a lake reaching upstream even far beyond Qena. The dam must be seen as a large dune field. It developed during the yearly low waters and overflow channels were then easily repaired. Seepage was minimalised as the suspension laden waters clogged the pores. The Sheikh Houssein Formation is indeed a typical suspension deposit, charcterised by a silty clay in which the sand fraction is less than 5% (Paulissen & Vermeersch 2000). If some Nile flow went through the dune field during high waters it was insufficient to

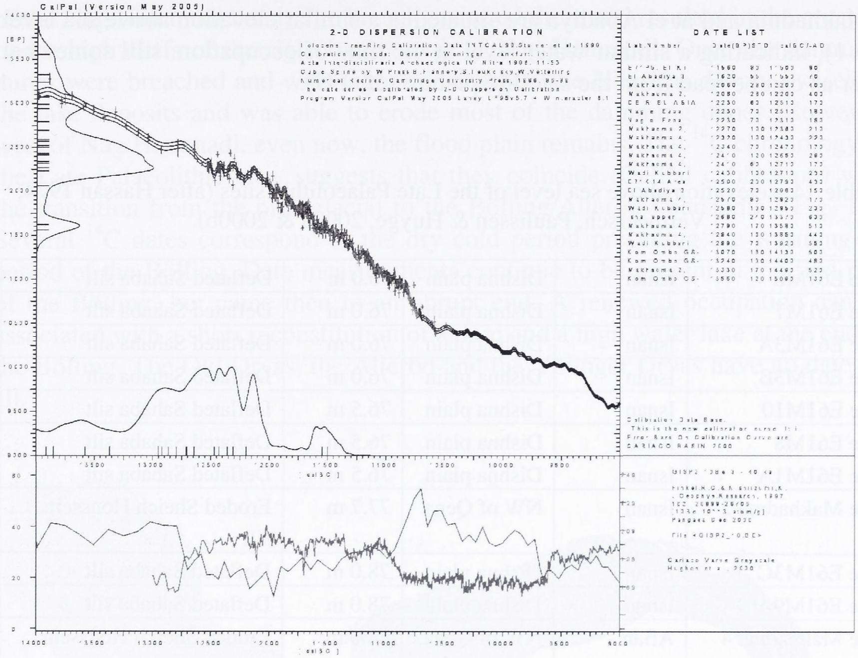

Fig. 18. CalPal calibration of the Late Pleistocene dates from the Egyptian Nile valley sites.

reach the sea. Sedimentation of the strong suspension load can be expected to be essentially in the (papyrus) rim of the lake. The position of the Late Palaeolithic sites upstream of Nag Hammadi is in agreement with the existence of a large lake during the late Palaeolithic, which we call the Makhadma lake. Indeed, numerous sites between Nag Hammadi and Naqada are situated in the Late Palaeolithic deposits, which correspond to suspension deposits around 80 m above sea level. If deposited as a flood plain, such as conceived in the Schild-Wendorf model, it would present a a hydraulic gradient, but the sites of the same age, more than 80 km apart from each other, are situated at nearly the same elevation (Table 10). The sites at Dishna occur near the eroded top of a thick bed of Nile silts, attributed to the Sahaba Formation (Hassan 1974), mostly embedded in what is believed to have been the crest of a silt levee near the edge of the flood plain. None of the archaeological sites at Dishna has been dated, but they are regarded as quarry or workshop facies of the Isnan industry (Hassan 1974), which at both Isna and Kubbaniya occurs in sediments of the final phase of the Late Paleolithic alluviation (Wendorf & Schild 1976: 121-149). However, Late Palaeolithic sites at Makhadma and at el Abadiya are situated at a similar elevation above sea level (tab 1), indicating a similar water level at the time of occupation. still somewhat dryer as can be read from the satellite picture (cfr FG).

Table 14 – elevation above sea level of the Late Palaeolithic sites (after Hassan 1974, Vermeersch, Paulissen & Huyge, 2000a & 2000b).

Site E61M6	Isnan	Dishna plain	76.0 m	Deflated Sahaba silt
Site E61M7	Isnan	Dishna plain	76.0 m	Deflated Sahaba silt
Site E61M3A	Isnan	Dishna plain	76.0 m	Deflated Sahaba silt
Site E61M3B	Isnan	Dishna plain	76.0 m	Deflated Sahaba silt
Site E61M10	Isnan	Dishna plain	76.5 m	Deflated Sahaba silt
Site E61M8	Isnan	Dishna plain	76.5 m	Deflated Sahaba silt
Site E61M1A	Isnan	Dishna plain	76.5 m	Deflated Sahaba silt
Site Makhadma 2	Isnan	NW of Qena	77.7 m	Eroded Sheich Houssein silt
Site E61M3C	Isnan	Dishna plain	78.0 m	Deflated Sahaba silt
Site E61M9A	Isnan	Dishna plain	78.0 m	Deflated Sahaba silt
Site Makhadma 4	Afian - Isnan ?	NW of Qena	78.0 m	Eroded Sheikh Houssein Formation
Site E61M9D	Isnan	Dishna plain	79.0 m	Deflated Sahaba silt
el Abadiaya 3	Isnan	Naqada	82.0 m	Sheikh Houssein Formation

The best interpretation for the position of these sites is the model presented here with an extensive Nile lake from Nag Hammadi to far upstream Qena. There is thus no need for catastrophic Nile floods with exceptionally high levels throughout the Valley (Butzer & Hansen 1968; Paulissen & Vermeersch 1987; Wendorf 1968; Wendorf & Schild 1976) to explain the high elevation of the Late Palaeolithic sites and the related Nile deposits.

Chronology of the Makhadma Nile lake

The series of twenty-five radiocarbon dates from the highest Late Pleistocene deposits in Upper Egypt calibrates very clearly with the Bölling period (Fig. 19). Such an observation can be understood when we presume that at the end of the LGM, the damming dune field was at its higest level. The warmer conditions coincide with higher discharge as well from the Blue Nile as from the White Nile. During the Bölling, this situation resulted in very high lake levels behind the Nag Hammadi dam until the discharge was able to breach the damming dunes. We presume that the damming dunes were the weakest at the northern part of the Nag Hammadi bend. The breach occurred there and resulted in the creation of the high cliffs of the right bank, north of Nag Hammadi. Once the damming dunes were breached and with higher discharges, the Nile was deeply incised in the lake deposits and was able to erode most of the damming dunes. However, west of Nag Hammadi, even now, the flood plain remains. The ^{14}C chronology of the Late Palaeolithic sites suggests that they coincide (CalPal calibration) with the transition from the pleniglacial to the Bölling/Alleröd interstadial (Fig. 19). Several ^{14}C dates correspond to the dry cold period preceding the warming up period of the Bölling. Date measurements continue to be present in the first part of the Bölling, but came then to an abrupt end. A renewed occupation can be associated with a short reconstitution of a dam and a high water lake at the end of the Bölling. The Old Dryas, the Alleröd and the Younger Dryas have no dates at all.

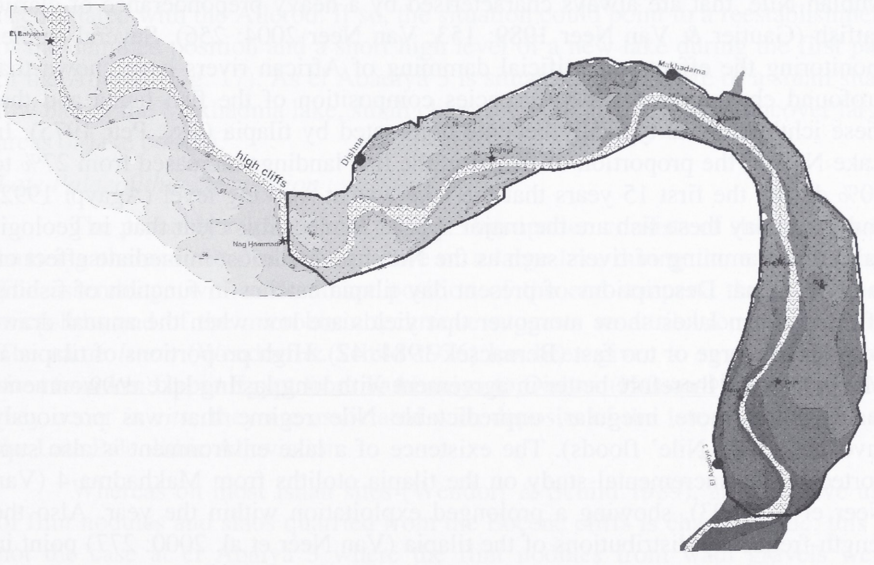

Fig. 19. Topography of the present day Nile valley with the possible extent of the Makhadma lake (dotted area).

We agree with Schild and Wendorf (2002-2004) who see the end of the Late Palaeolithic Alluviation and the beginning of the Late Paleolithic Downcutting as largely coeval with the opening of the overflow at Lake Victoria at ca. 12,500 radiocarbon years B.P. (Livingstone 1980), a major transgression of Lakc

Albert shortly after 13,000 ^{14}C years B.P. (Beuning *et al.* 1997: 276), and the increased flood discharge in the Blue Nile at about 12,000 radiocarbon years B.P., (Williams & Adamson 1980; Adamson 1982; Adamson, Gasse, & Street 1980; Adamson, Gillespie, and Williams 1982: 187), a series of events coeval with Bölling, thc early part of Greenland lnterstadial l of Walker et al. (1999: 1146).

The absence of late Pleistocene sites downstream from Nag Hammadi is explained by Schild and Wendorf (1998) as the result of the late Pleistocene low sea level in the Mediterranean, which should have caused a regressive erosion of the Nile. As far as we understand no positive arguments can be presented to sustain this hypothesis.

An additional argument for the lake hypothesis is provided by the fish fauna of Makhadma 4. The ichthyofauna of this site is composed of a very high proportion of tilapia (68% of the identified remains in the 2mm sieved residue), unlike the majority of the Late Palaeolithic fish faunas along the Egyptian and Nubian Nile, that are always characterised by a heavy preponderance of clariid catfish (Gautier & Van Neer 1989: 153; Van Neer 2004: 256). Several studies monitoring the effects of artificial damming of African rivers have shown that profound changes occur in the species composition of the fish fauna and that these ichthyofaunas typically become dominated by tilapia (e.g., Petr 1975). In Lake Nasser, the proportion of tilapia in the fish landings increased from 27% to 90% during the first 15 years that the lake was at working level (Agaypi 1992) and still today these fish are the major species landed. It is clear that, in geological terms, damming of rivers such as the Nile has an almost immediate effect on the fish fauna. Descriptions of present day tilapia catches in function of fishing efforts in dam lakes show moreover that yields are low when the annual drawdown is too large or too fast (Bernacsek 1984: 42). High proportions of tilapia at Makhadma are therefore better in agreement with long lasting lake environments than with a more irregular, unpredictable Nile regime that was previously invoked ('Wild Nile' floods). The existence of a lake environment is also supported by the incremental study on the tilapia otoliths from Makhadma 4 (Van Neer et al. 1993), showing a prolonged exploitation within the year. Also the length-frequency distributions of the tilapia (Van Neer et al. 2000: 277) point in the same direction: the expected bimodal distribution of the first two year classes is blurred due to an overlap between the cohorts. This overlap could be related to the extended period during which young fish were captured each season, but also to the length of the growth season that varied over successive years of fish exploitation as a result of variation in the lake levels.

The environmental conditions at the el Abadiya 3 site

The environmental conditions at that time of the occupation at the el Abadiya 3 sites correspond with an extensive lake that covered large parts of the

Nile valley. The water levels of that Makhadma lake were certainly subjected to seasonal changes. But with the onset of the Bölling, the clear warming up and increasing of precipitation in East Africa at the end of the Pleistocene, the Nile discharges started to become much larger, resulting in very high waters of the lake, up to 9 m above the present flood plain at Dishna, 7 m at Makhadma and 4 m at el Abadiya. Those deposits did not cover the higher part of el Abadiya 3 because it was situated on the shore of a bay at the Makhadma lake. A thin layer of deposits attributed to the Sheikh Houssein formation has covered the eastern part of the site. The analysis of the site layout suggests that the site is a palimpsest of several occupations on the same place. As the bone material is better preserved than in the higher part of the site we presume that the lower part was rapidly covered by deposits from the highest lake levels. The higher part of the site could then be somewhat later than the lower part, but the difference could also reflect only some seasonal occupation rather than a diachronical position of the site parts. It remains however possible that the youngest date of el Abadiya 3 is correlated with the Alleröd. If so, the situation could point to a reestablishment of the dammed position and a short high level of a new lake during the first part of the Alleröd (Fig. 17). As el Abadiya 3 is situated on the shore of a small shallow bay of the Makhadma lake, small changes in the lake level can uncover large areas of lake bottom.

Late Palaeolithic Occupation

The probably multiple el Abadiya 3 occupation consists of short camps of hunter-gatherer-fishers along the shore of a large lake during the early Bölling. The assemblage with a dominant position of the end-scrapers, the absence of microliths and of the microburin technique suggests an attribution to the Isnan. The name *Isnan* (Wendorf & Schild 1976) has been given to several groups of sites found in Upper Egypt from Kubbaniya to Dishna (Hassan 1974). Wherever they occur *in situ,* they are associated with deposits of the latest local phase of the Late Paleolithic Alluviation.

Whereas on most Isnan sites (Wendorf & Schild 1989), an extensive use of flint nodules and slabs quarried from the Eocene cliffs is characteristic, this is not the case at el Abaiya 3 where the flint nodules from wadi gravels were chosen. As at other Isnan sites, cores were exploited with a hardhammer technique. Globular cores are the most frequent type recovered but an analysis of the flaking remains clearly indicates that artifacts with unipolar flaking traces are by far the most important. This suggests that artefacts were produced mostly from single platform cores. Core and platform shaping did not receive much attention from the knapper. Most artefacts have thus a flat butt and core-refreshing elements are rare. At el Abadiya 3, the assemblage is clearly a (elongated) flake assemblage in which blades are not numerous. Bladelets are nearly totally absent.

A special attention has been given to the production of pointed elongated flakes. A pointed flake, very similar to those from el Abadiya 3, is illustrated by Wendorf & Schild (1989: Fig. 39.5: 6). Tools have preferentially been made on blade blanks. Some side scrapers on flake are present.

Table 15 – Major tool class frequency of the Isnan sites with more than 100 tools.

	Aba 3	E61M 4B	E61M 4C	E61M 6A	E61M 6C	E61M 7A	E61M 7C	E61M 9A	E61M1 0B	E61M 10C	E61M 10D	E71K 14D	E71K 14A	E71 K22
N	175	264	188	260	164	145	138	138	238	182	222	?	?	?
End scraper	26.7	32.2	30.9	31.9	37.8	26.9	29.0	19.5	18.1	25.1	31.1	63.5	54.8	45.0
Side scraper	4.4											1.7	1.2	1.3
Burin	3.9	8.3	7.5	9.2	7.9	12.4	21.0	3.6	3.8	10.4	3.2	2.7	12.5	16.9
Borer	0.6											0.8	1.0	0.1
Notched piece	3.3	18.9	18.6	15.0	18.3	21.4	20.3	25.4	26.5	25.5	23.0	18.6	11.4	14.4
Denticu-lated piece	10.0	9.5	13.3	11.9	8.5	13.1	5.1	11.6	14.0	9.3	12.2			
Compo_site tools	1.7	2.7	4.3	6.9	3.7	1.4	0.7	0.7	4.2	2.2	0.9			
Re-touched pointed blade	9.4													
Re-touched piece	38.3	23.5	23.4	13.1	22.6	20.0	17.4	34.1	29.0	25.7	27.9	5.2	7.4	4.1
Varia	1.7	4.9	2.1	11.9	1.2	4.8	6.2	5.1	2.5	3.8	1.8	2.2	1.8	7.8

Burins are never numerous but always present. The overwhelming presence of retouched pieces, notches and denticulates characterises the Isnan at all sites. Backed elements-including arch-backed bladelets, backed bladelets with two perpendicular truncations, and a few trapezes-occur occasionally occur in the Isnan, but not at el Abadiya 3.

Wendorf and Schild (1989) have stressed the complexity of the Final Palaeolithic in the Nile Valley. In Upper Egypt it is characterised by the Afian and Isnan. These industries had similar adaptations to the lake environment, with seasonal emphasis on fishing and ground plant foods plus some hunting of large mammals. Backed bladelets, so characteristic at the earlier Late Palaeolithic, are no longer dominant. Grinding stones were present in most of the sites at Isna and at el Kilh but were absent from the Dishna sites and from Makhadma - 2. This may indicate a different season of use for the sites at Isna. If the grinding stones there were used for processing mature tubers, then the sites were occupied at least during the winter. However, there is no other evidence (such as winter birds) to support this suggestion.

The site of el Abadiya 3 is best understood as a place where prehistoric people came regularly on a visit. These visits to the border of the large lake of Makhadma had been undoubtedly intended for the exploitation of the fish of the lake but also as a base camp for hunting bovids and water fowl. The level of the water of the lake was undoubtedly very dependent on the season. We assume that the water level was highest during the late summer months and lowest in late spring. There were, of course, large level differences from year to year depending on the upper Nile discharge. Since several occupations succeeded each other, no real occupation structures were preserved. Indeed, each new occupation destroyed the remains of older ones. There is no doubt that all kinds of domestic activities were performed here. This must be inferred from the presence of numerous tools. Whether certain lithic artefacts were used as hunting weapons or as fish gear is uncertain, as long as no micro wear-analysis has been performed.

Acknowledgements

The field work was sponsored by the "National Fonds Wetenschappelijk Onderzoek – Vlaanderen". The contribution of Wim Van Neer to this paper presents research results of the Interuniversity Attraction Poles Programme - Belgian Science Policy. Ruth Rigolle (K.U.Leuven) is thanked for help during the sorting and the identification of the faunal remains.

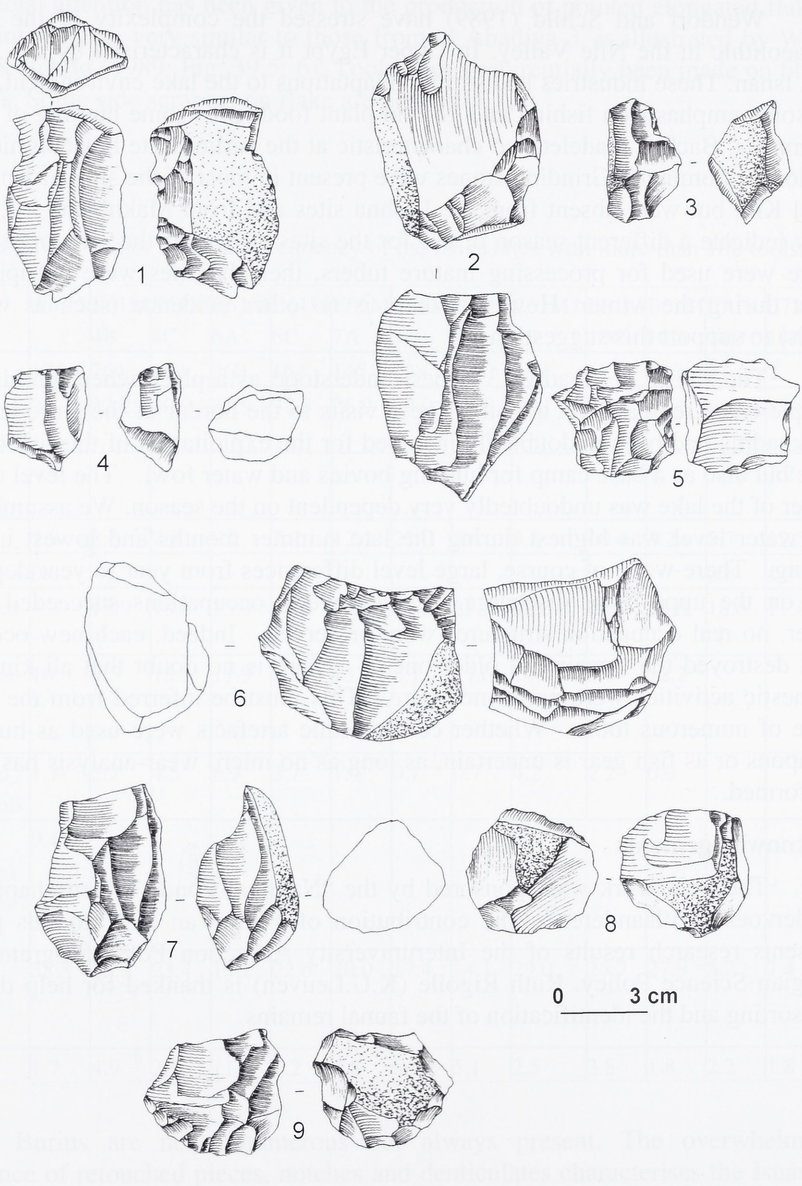

Fig. 20 . Cores from El Abadiya 3.

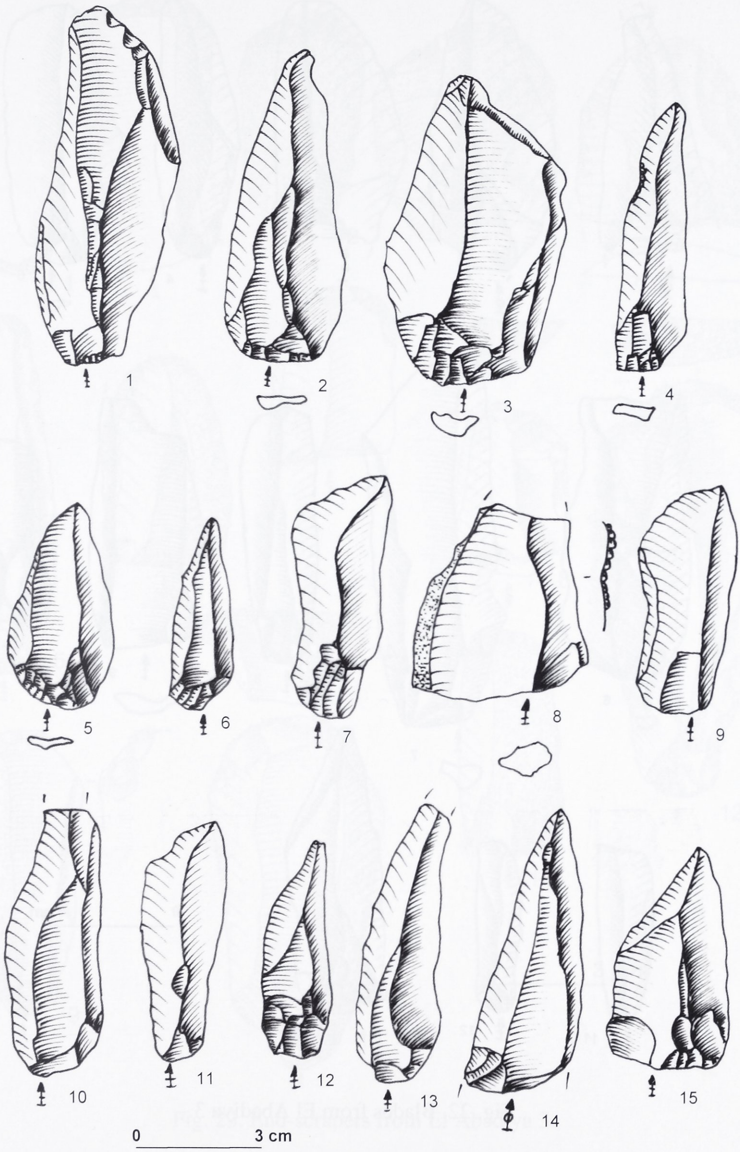

Fig. 21. Blades from El Abadiya 3.

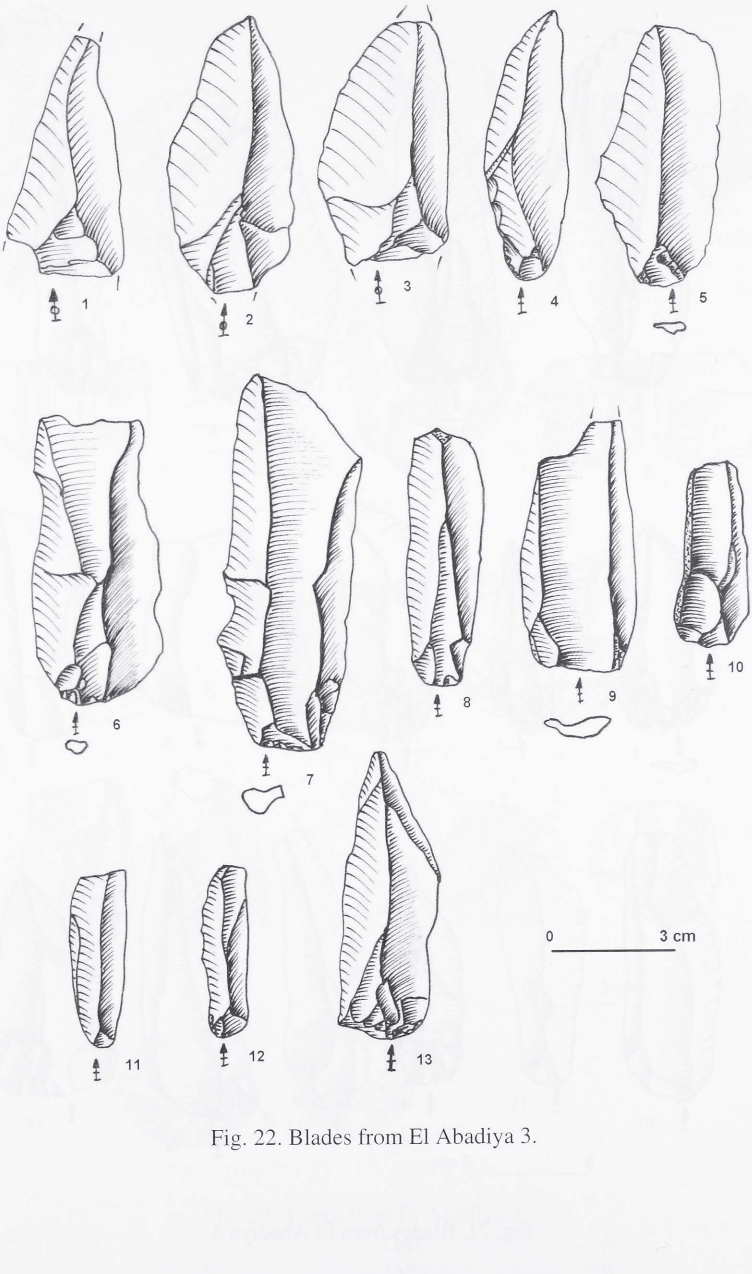

Fig. 22. Blades from El Abadiya 3.

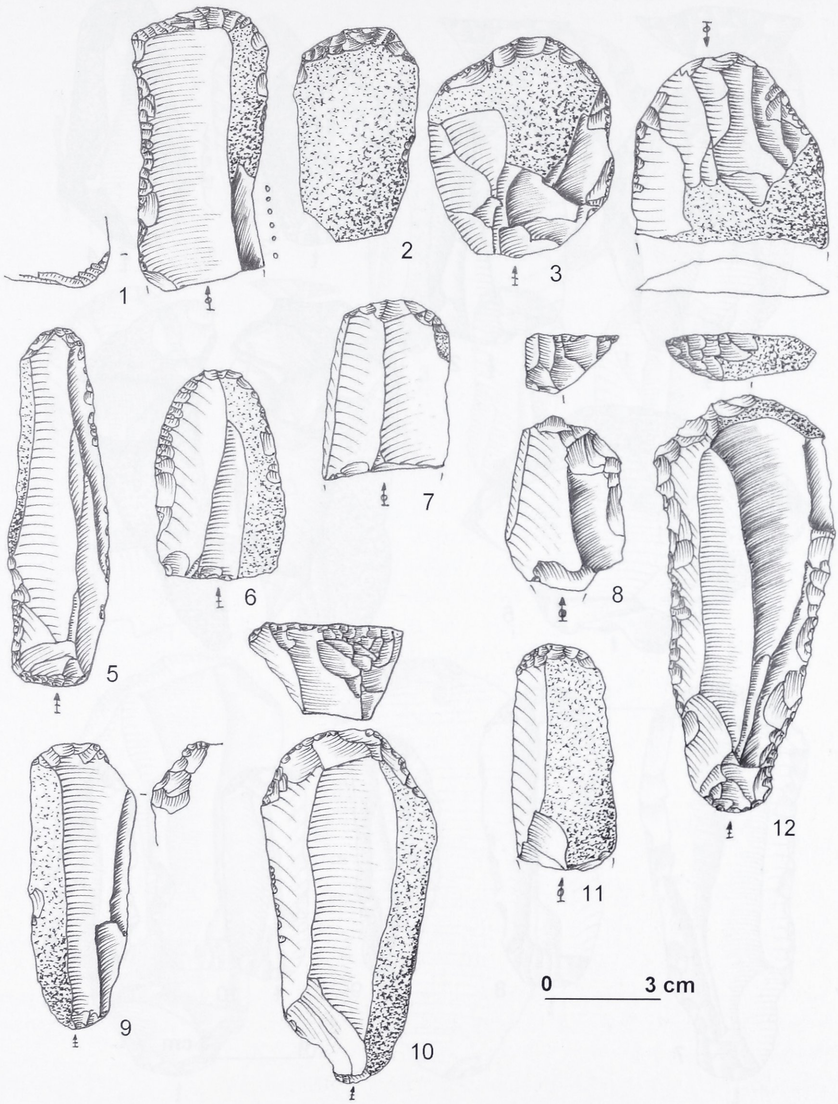

Fig. 23. End-scrapers from El Abadiya 3.

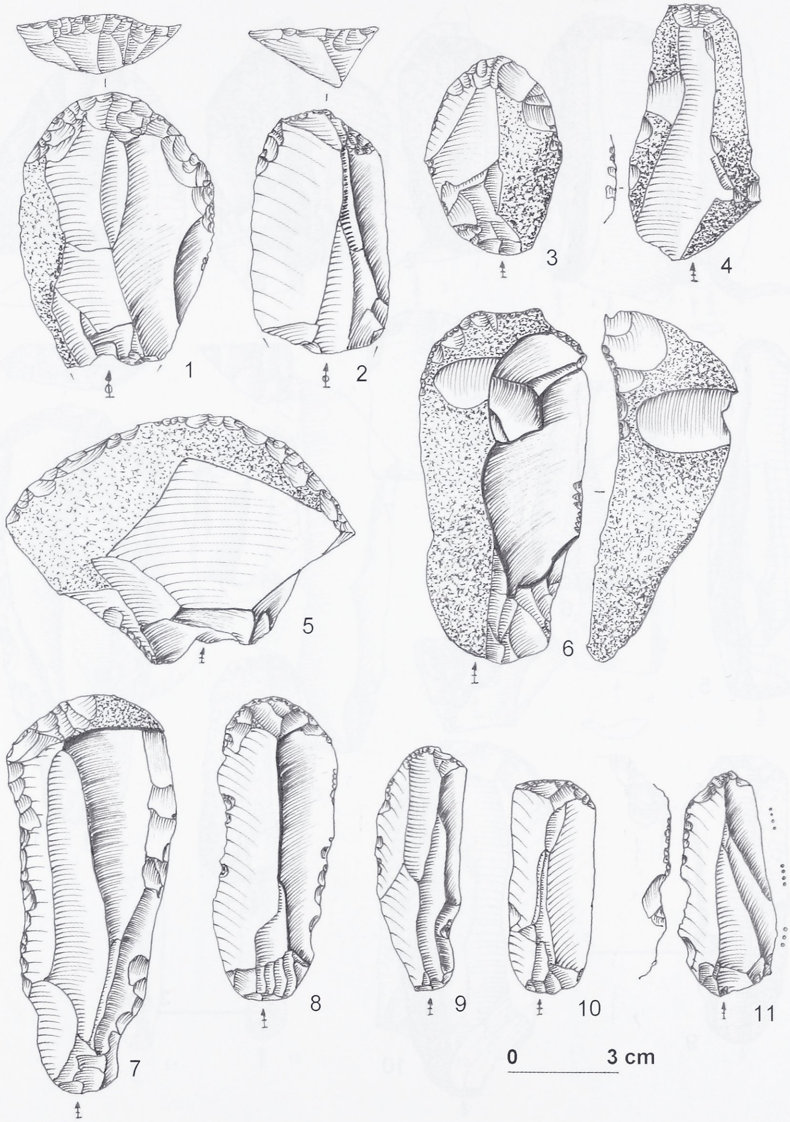

Fig. 24. End-scrapers from El Abadiya 3.

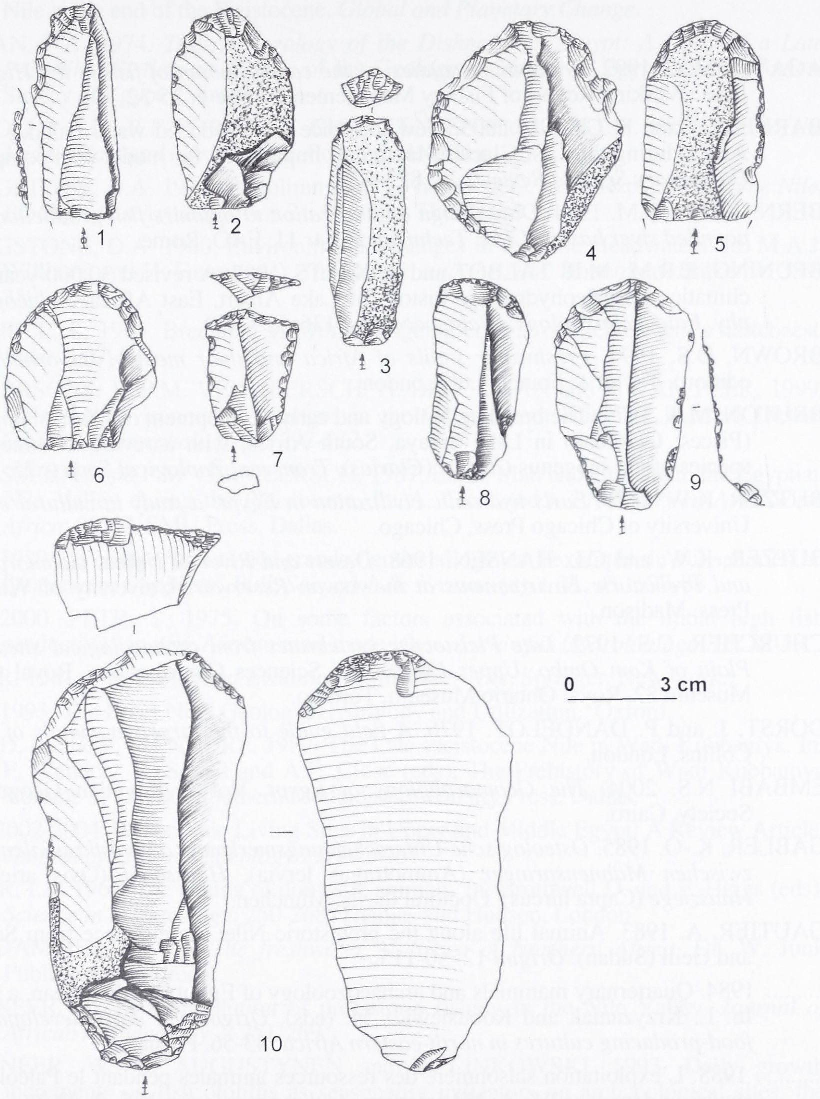

Fig. 25. End-scrapers from El Abadiya 3.

References

AGAYPI, M.Z.. 1992. *Preliminary studies on the catch amount of fish in the High Dam Lake*. Working Report of Fishery Management Centre 1: 25-32.

BARKER, P. and F. GASSE. 2003. New evidence for a reduced water balance in East Africa during the Last Glacial Maximum: implication for model-data comparison. *Quaternary Science Reviews* 22: 823–837.

BERNACSEK, G.M. 1984. *Dam design and operation to optimize fish production in impounded river basins. CIAF Technical Paper* 11, FAO, Rome.

BEUNING, K.R.M., M.R. TALBOT and K. KELTS. 1997. A revised 30,000-year paleoclimatic and paleohydrologic history of Lake Albert, East Africa. *Palaeogeography, Palaeoclimatology: Palaeoecology*, 136: 259-279.

BROWN, D.S. 1994. *Freshwater snails of Africa and their medical importance* (2nd edition). Taylor & Francis Ltd. London.

BRUTON, M.N. 1979. The breeding biology and early development of *Clarias gariepinus* (Pisces: Clariidae) in Lake Sibaya, South Africa, with a review of breeding in species of the subgenus *Clarias* (*Clarias*). *Transvaal Zoological Society* 35: 1-45.

BUTZER, K.W. 1976. *Early hydraulic civilization in Egypt: a study in cultural ecology*. University of Chicago Press, Chicago.

BUTZER, K.W. and C.L. HANSEN. 1968. *Desert and River in Nubia. Geomorphology and Prehistoric Environments at the Aswan Reservoir*. University of Wisconsin Press, Madison.

CHURCHER, C.S. 1972. *Late Pleistocene vertebrates from archaeological sites in the Plain of Kom Ombo, Upper Egypt*. Life Sciences Contributions, Royal Ontario Museum 82. Royal Ontario Museum, Toronto.

DORST, J. and P. DANDELOT. 1976. *A field guide to the larger mammals of Africa*. Collins, London.

EMBABI N.S. 2004. *The Geomorphology of Egypt*. Vol 1. Egyptian Geographical Society, Cairo.

GABLER, K.-O. 1985. *Osteologische Unterscheidungsmerkmale am postkranialen Skelett zwischen Mähnenspringer* (Ammotragus lervia), *Hausschaf* (Ovis aries) *und Hausziege* (Capra hircus). Doctoral thesis, München.

GAUTIER, A. 1983. Animal life along the prehistoric Nile: the evidence from Saggai 1 and Geili (Sudan). *Origini* 12: 50-115.

.... 1984. Quarternary mammals and archaeozoology of Egypt and the Sudan, a survey. In: L. Krzyzaniak and Kobusiewicz M. (eds), *Origin and early development of food-producing cultures in north-eastern Africa:* 43-56. Poznan.

.... 1988. L'exploitation saisonnière des ressources animales pendant le Paléolithique supérieur dans la vallée du Nil égyptien. *Anthropozoologica* N.S. 2: 23-26.

GAUTIER, A. and W. VAN NEER. 1989. The animal remains from the Late Paleolithic sequence in Wadi Kubbaniya. In: F. Wendorf, R. Schild & A.E. Close (eds.), *The Prehistory of Wadi Kubbaniya, Vol. 2, Stratigraphy, paleoeconomy and environment*: 119-161. Southern Methodist University Press, Dallas.

GAYET, M. and W. VAN NEER. 1990. Caractères diagnostiques des épines de quelques silures africains. *Journal of African Zoology* 104: 241-252.

GULLENTOPS F., P.M. VERMEERSCH and W.VAN NEER. Submitted. An endorheic Nile at the end of the Pleistocene. *Global and Planetary Change*.

HASSAN, F.A. 1974. *The Archaeology of the Dishna Plan, Egypt: A study of a Late Paleolihic Settlement*. Papers of the Geological Survey of Egypt, 59. Geological Survey of Egypt, Cairo.

HOLLOM, P.A.D., R.F. PORTER, S. CHRISTENSEN and I. WILLIS. 1988. *Birds of the Middle East and North Africa*. Poyser Ltd, Calton.

LIVINGSTONE, D.A. 1976. Paleolimnology of headwaters. In: J. Rzpsla (ed.), *The Nile, Biology of an Ancient River*: 21-30. Junk, The Hague.

LIVINGSTONE, D.A. 1980. Environmental Changes in the Nile Headwaters. In: M.A.J. Williams and H. Faure (eds), *The Sahara and the Nile*. Rotterdam, Balkema: 339-359.

MITCHELL, B. 1965. Breeding, growth and ageing criteria of Lichtenstein's hartebeest. *Puku* 3: 97-104.

MOEYERSONS, J., P.M. VERMEERSCH, H. BEECKMAN and P. VAN PEER. 1999. Holocene environmental changes in the Gebel Umm Hammad, Eastern Desert, Egypt. *Geomorphology 26: 297-312*.

PAULISSEN, E. and P.M VERMEERSCH. 1987, Earth, Man and Climate in the Egyptian Nile Valley during the Pleistocene. In: A. Close (ed.), *Prehistory of Arid North Africa*: 29-67. SMU Press, Dallas.

.... 1989. Le comportement des grands fleuves allogènes: l'exemple du Nil saharien au Quaternaire Supérieur. *Bull. Soc. géol. de France.* (8), t. V., n° 1: 73-88.

.... 2000. PETR, T. 1975. On some factors associated with the initial high fish productivity in new African man-made lakes. *Archiv für Hydrobiologie* 75: 32-49.

SAID, R. 1981. *The Geological Evolution of the River Nile*. Springer, New York.

.... 1993. The River Nile. Geology, Hydrology and Utilization.. Oxford.

SCHILD, R. and F. WENDORF. 1989. The Late Pleistocene Nile in Wadi Kubbaniya. In: F. Wendorf, R. Schild and A.E. Close (eds), The Prehistory of Wadi Kubbaniya Volume 2: 15-100. Southern Methodist University Press, Dallas.

.... 2002-2004. Palaeolithic Living Sites in Upper and Middle Egypt: A Review Article. *Journal of Field Archaeology* 29: 447-461.

SILVER, I.A. 1963. The ageing of domestic animals. In: Brothwell D. and E. Higgs (eds), *Science in archaeology*: 250-268. Thames and Hudson, London.

VAN DAMME, D. 1984. *The freshwater Mollusca of Northern Africa*. Dr. W. Junk Publishers, Dordrecht.

VAN NEER, W. 2004. Evolution of prehistoric fishing in the Nile Valley. *Journal of African Archaeology* 2: 251-269.

VAN NEER, W., S. AUGUSTYNEN and T. LINKOWSKI. 1993. Daily growth increments on fish otoliths as seasonality indicators on archaeological sites: the tilapia from late Palaeolithic Makhadma in Egypt. *International Journal of Osteoarchaeology* 3: 241-248.

VAN NEER, W., E. PAULISSEN and P.M. VERMEERSCH. 2000. Chronology, subsistence and environment of the Late Palaeolithic fishing sites of Makhadma-2 and 4. In: P.M. Vermeersch (ed.), : 271-287*t*. Leuven University Press, Leuven.

VERMEERSCH, P. M. (ed.). 2000. *Palaeolithic living sites in Upper and Middle Egypt.* Leuven University Press.

VERMEERSCH, P.M. 2002. Geomorphology of the Nazlet Khater Area. In: Vermeersch P.M. (ed.), *Palaeolithic Quarrying Sites in Upper and Middle Egypt:* 21-26. Leuven University Press.

VERMEERSCH, P.M. 2005. La vallée du Nil et le Sahara oriental : une population préhistorique fluctuante sous l'effet des variations climatiques. *Comptes Rendus Palévol*, Corrected Proof, Available online 28 November.

VERMEERSCH, P.M., PAULISSEN E. and W. VAN NEER. 1989. The Late Paleolithic Makhadma sites (Egypt): environment and subsistence. In: L. Krzyzaniak and M. Kobusiewicz (eds), *Late Prehistory of the Nile Basin and the Sahara*, Poznan: 87-114.

VERMEERSCH P. M., W. VAN NEER and S. HENDRICKX. 2004. El Abadiya 2, A Naqada I Site near Danfiq, Upper Egypt. In: S. Hendrickx, R.F. Friedman, K.M. Ciałowicz and M. Chłodnicki (eds.), *Egypt at its Origins. Studies in Memory of Barbara Adams. Proceedings of the International Conference "Origin of the State. Predynastic and Early Dynastic Egypt", Krakow, 28th August - 1st September 2002.* Orientalia Lovaniensia Analecta 138. Leuven, Peeters Publishers: 213-276.

VON BRANDT, A. 1984. *Fish catching methods of the world.* Fishing News Books, Farnham, Surrey.

VON DEN DRIESCH, A. 1976. *A guide to the measurement of animal bones from archaeological sites.* Peabody Museum Bulletin 1. Harvard University Press, Cambridge, Massachusetts.

WENDORF, F. 1968. *The Prehistory of Nubia.* Fort Burgwin Research Center and Southern Methodist University Press, Dallas.

WENDORF F. and R. SCHILD. 1976. *Prehistory of the Nile Valley.* Academic Press, New York.

.... 1989. Summary and Synthesis. In: F. Wendorf, R. Schild and A.E. Close (eds), *The Prehistory of Wadi Kubbaniya Volume 2.* Southern Methodist University Press, Dallas: 768-824.

WILLIAMS, M. A. J., and D. A. ADAMSON. 1980. Quaternary Depositional History of the Blue and White Nile Rivers in Central Sudan. in Martin A. J. Williams, and Hugues Faure, eds., *The Sahara and the Nile.* Rotterdam: Balkema, 281-304.