Exploitation of food-plants in the Early and Middle Holocene Blue Nile area, Sudan and neighbouring areas

Explotación de plantas comestibles durante el Holoceno Inicial y Medio en el área del Nilo Azul, Sudán

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ABSTRACT

Plant impressions were found on pottery from two Early Holocene (Early Khartoum) sites and one Middle Holocene (Shaheinab) site in the Blue Nile area in the Central Sudan. Identification of the specimens attests the presence of edible plants and other plant species. Analysis of the data indicates that a broad-spectrum subsistence strategies including exploitation of grain-foods (e.g. wild cereals and grasses) was initiated during the Early Holocene (2000 years earlier than previously thought) and continued to be practised during the Middle Holocene without significant change. These strategies were part of a general pattern of food-plants exploitation in the wider area of Northeast Africa during the Early and Middle Holocene. Although no direct evidence of cultivation was found, the possibility of its being practised is not excluded. Some of the recovered evidence indicates that climatic conditions were much wetter than today. An attempt is made to emphasise why and suggest how archaeobotanical research can be manipulated to help solving certain cultural and socio-economic problems in modern times.

KEY WORDS
Archaeobotany, Plant impressions on pottery, Early Khartoum, Shaheinab, Holocene, Central Sudan

RESUMEN

Estudio de las impresiones de plantas en cerámicas de dos yacimientos del Holoceno Inicial (Early Khartoum) y un yacimiento del Holoceno Medio (Shaheinab) de la zona del Nilo Azul en el Sudán Central. Las formas impresas demuestran la presencia de plantas comestibles (semillas de hierbas silvestres y huesos de frutos) así como de otras especies, con estrategias de subsistencia de amplio espectro desde el Holoceno Inicial (unos dos mil años antes de lo que se creía) que continuaron sin cambios en el Medio, al igual que en una amplia zona del NE de África (Sudán Central, Egipto y Libia). Aunque no se han registrado indicios de prácticas de cultivo, no se puede excluir su posibilidad. Algunas de las plantas indican que el clima era al menos tres veces más húmedo que hoy. También se resalta la necesidad de integrar los estudios históricos con las experiencias presentes para resolver ciertos problemas culturales y económicos actuales.

PALABRAS CLAVE
Arqueobotánica, Impresiones vegetales en cerámica, Early Khartoum, Shaheinab, Holoceno, Sudán Central

1. Objectives and methodology

The study of archaeological plant remains (archaeobotany) is a relatively recent development in archaeological research in the Sudan. The first studies were mostly auxiliary endeavours that were thought of too late in the process of archaeological research. Therefore, these studies were mainly based on a few, sporadic (mostly accidental) finds. Consequently, they provided superficial and fragmentary knowledge on the development of exploitation of food-plants (Magid and Caneva 1998: 79). This trend of random archaeobotanical research started to change towards more comprehensive studies during the last three decades. At present, there are many informative archaeobotanical publications, most of which focus on exploitation of food-plants and its development during the Early and Middle Holocene in the Central Sudan (e.g. Haaland 1987a; Magid and Caneva: 1998; Magid 1982, 1989, 1995a, etc.).

The present work is a modest attempt that aspires to furnish the reader with a comprehensive study on macrobotanical remains recovered from three archaeological sites in the Blue Nile area in the Central Sudan[1]. Two of these sites are Early Holocene sites and the third one is a Middle Holocene site. The main focus of the study is on the following issues:

1) the use and implications of plant remains recovered from the sites.

2) the technology used to exploit food-plants and its importance in the development of strategies related to food plants exploitation.

3) state and status of food-plants exploitation in the Blue Nile area as compared with that in the wider region of the Central Sudan and North Africa.

4) the socio-economic organisation related to exploitation of food plants and the effect of resource availability on the settlement pattern.

5) the relevance of the current study for applied research and the needs of the 21st century.

Macrobotanical evidence and material culture remains (that are thought to have been associated with plant-exploitation) are combined in the present work. We believe that archaeobotanical research based on both types of remains is more inclusive and has greater strength than that based on only one of these remains (Magid and Caneva: 1998: 85). In addition, climatic and environmental data, as well as ethnographic and ethnohistoric studies on exploitation of food-plants are seen as important catalysts in the process of analysis and interpretation of the archaeobotanical and archaeological data. Finally, in order to assess the strategies of food-plant exploitation in the Blue Nile area and define their position in the wider context of the Central Sudan and North Africa, Early and Middle Holocene sites excavated in these regions (and the data recovered from them) are examined and integrated in the present study.

2. The archaeological sites of the Blue Nile area and their association in the culture history of the Central Sudan

The archaeobotanical data presented in this paper was recovered from the archaeological sites of Sheikh Mustafa, El Mahalab and Sheikh el Amin situated in the area of the Blue Nile in the Central Sudan (Fig. 1). Detailed information on the area of the Blue Nile, excavations of the sites, the study of the material culture and faunal remains recovered are presented elsewhere in this volume (cf. Fernández *et al*. 2003a, b; Chaix 2003). However, in this paper, I shall highlight those parts of the information that are relevant to the objectives of the present study.

Two of these sites, namely, Sheikh Mustafa and El Mahalab belong to the Early Khartoum[2] culture and the third site, i.e. Sheikh el Amin belongs to the Shaheinab[3] culture. This interpretation is derived on the basis of radiocarbon dates and material culture remains excavated from the three sites. The radiocarbon dates indicate that the prehistoric occupation of the site of Sheikh Mustafa took place between 7900 and 7600 bp and that at the site of El Mahalab took place between 7700 and 6900 bp. Two radiocarbon dates, of 5550 $\pm$ 60 bp and 4590 $\pm$ 45 bp, were obtained from the site of Sheikh el Amin. The pottery material recovered from the sites of Sheikh Mustafa and El Mahalab include wavy-lines pottery (the characteristic pottery of Early Khartoum) and dotted wavy-lines. Shaheinab type of pottery was recovered from the site of Sheikh el Amin. All the pottery recovered from the three sites was in a form of potsherds (no complete or reconstructable vessel was found). The lithic artefacts recovered from the sites of Sheikh Mustafa and El Mahalab include blades,

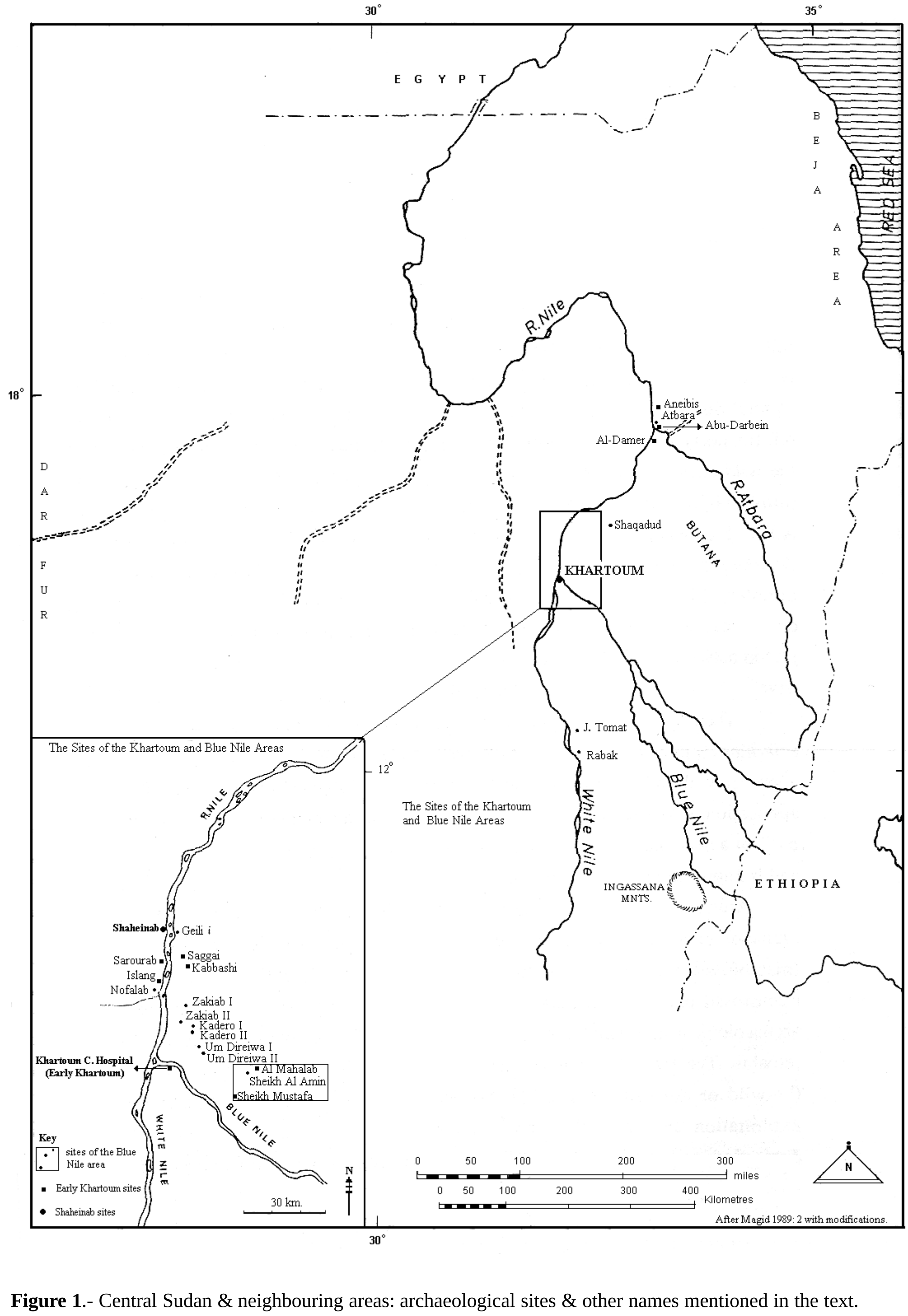


Figure 1.- Central Sudan & neighbouring areas: archaeological sites & other names mentioned in the text.

backed blades, lunates, and grinding equipment. Lithic artefacts similar to these were recovered from the site of Sheikh el Amin; moreover, gouges (which are considered to be the diagnostic/characteristic tool of the Shaheinab culture) were also excavated from this site.

On the basis of surface distribution of artefacts, the area of the Sheikh Mustafa is found to be c. 100 x 80 m and that of the El Mahalab (which is circular in shape) is c. 120 m in diameter and the size of the site of Sheikh el Amin is ca. 250 x 240 m. The average depth of the cultural deposit at the site of Sheikh Mustafa is 60 cm and 130 cm at both El Mahalab and Sheikh el Amin sites. However, no clear stratigraphy was distinguished in most of the excavated areas at the three sites and the cultural deposit at each of them is largely disturbed by, e.g. human burials and animals' burrowing that post-dated the prehistoric occupation of the sites.

On the basis of factors such as the location of the sites, their size, depth of cultural deposits, archaeological remains recovered, etc., the three sites are interpreted as being sedentary settlements (more discussion on this issue is presented on sections no. 6 and 8).

Other sites of Early Khartoum and Shaheinab type in the Central Sudan

Several sites of the Early Khartoum and Shaheinab types were excavated in the areas of Atbara, Khartoum, the Jebel-Tomat and Rabak in the Central Sudan**.** The sites of the Early Khartoum type which are excavated in the Atbara area (Fig. 1) are Aneibis, Abu- Darbein and Al-Damer (Haaland and Magid 1992a, 1992b, 1995; Magid 1989: 29-40, 96-99). In the Khartoum area (Fig. 1)**,** there is the site of Khartoum Chest Hospital, from which the term Early Khartoum is derived (Arkell 1949), the site of Islang (Magid 1981, 1982), the site of Sarurab (Khabir 1987; Mohammed-Ali 1982), and the sites of Saggai and Kabbashi on the east bank of the Nile north of Khartoum (Caneva 1983a).

As regards the sites of the Shaheinab culture, in the Khartoum area there is the site of Shaheinab, from which the term Shaheinab culture is derived (Arkell 1953), and the sites of Nofalab (Magid 1982), Kadero (Krzyzaniak 1978, 1979), Zakiab and Um Direwa (El-Mahi 1988; Haaland 1987a, 1987b) and Geili (Caneva 1988). In addition to these, there are the sites of Jebel Tomat and Rabak (El-Mahi and Haaland 1984; Magid 1989: 49-62) in the area south of Khartoum (Fig. 1).

Almost all the sites of Early Khartoum and Shaheinab types mentioned above (as well as those of the Blue Nile area) are similar in that they are sedentary sites, situated near permanent sources of water, they yielded large amount of pottery and grinders, and their economic strategies are based to varying degrees (i.e. fully or partly) on the exploitation of terrestrial and aquatic resources (Caneva 1983a; Haaland 1987 a, 1995; Magid 1989: 109-177, 1995a, 1995b; Magid and Caneva 1998: 82; Peters 1995). However, differences occur (between sites of the same culture and/or sites that belong to either of the two cultures) as regards the frequency, presence and/or absence of lithic artefacts, pottery types and some components of their economic strategies (e.g. food production, mainly herding of domesticated animals, is in evidence only at the sites of the Shaheinab type).

3. Plant remains recovered from the Blue Nile area

The leader and field-director of the Blue Nile Archaeological Project (abbreviated B.N.A.P) reported that their attempts to retrieve plant remains from soil samples by simple flotation method (i.e. bucket-flotation) did not yield any result (Fernández, V.M.: pers. comm.). On the basis of the information provided by him about the physical setting of the sites (see Fernández *et al*. 2003a, b), it seems that there are a number of natural and human factors that made the area of the sites unfavourable for the preservation and survival of plant remains. As the area of the sites (15°-20´ N and 15°-50´ N) is situated within the semi-arid zone, the soil composition is predominantly sandy with high carbonate and low moisture contents during most of the year and the contrast between the seasons is large. In addition, the microfauna and burrowing insects and animals are very active. As regards the human-factor, it has been reported that the sites are badly disturbed by burials that post-date the prehistoric occupation of the sites. Therefore, the preservation conditions are not particularly favourable for the survival of plant remains (especially those with starchy structures). Consequently, no evidence of carbonized/desiccated plant remains was found at any of the sites.

The present study is thus based mainly on evidence of plant impressions in pottery excavated from the three sites. In the present study, the methods and techniques used to examine and identify the plant impressions in pottery are based on those published by A. Magid (1989: 71-80, 1995a) and on the laboratory manual of making positive casts of plant impression in pottery published by A. Magid and K. Krzywinski (1995).

The procedure of making positive casts of plant impressions in pottery recovered from the three sites: A brief note

Preliminary gross-sorting of the pottery collection was carried out in the field by the team of the B.N.A.P. by means of visual inspection and hand-held magnifying glass (x10). The total number of potsherds examined from the site of Sheikh Mustafa is 7011, from El Mahalab 4680 and a total of 56761 from the site of Sheikh el Amin. The potsherds examined have different sizes, ranging from very small to relatively large ones. All those potsherds which bore cavities characterised by regular shape (elongated, rounded, oval, etc. were selected and taken to the laboratory for further cross-examination. Reflected stereomicroscope was used at this stage. Many potsherds were dropped out as a result of this cross-examination, and hence saved time, effort and rather expensive chemicals (Magid and Krzywinski 1995). The remainder of the potsherds, with impressions (Fig. 2) were subjected to a final treatment in which positive casts of the original impressions/cavities were made according to the laboratory procedure (ibid.) mentioned earlier.

The identification procedure of the positive casts

The procedure of identification was mainly based on the comparisons of the external morphological features (i.e. shape, size and surface pattern) of the positive casts with reference collection of extant plants and with results of experimental plots showing changes in dimensions of grain impressions as seen in their positive casts (published by Magid 1989: 80, 301-315). Manuals for seeds identification (e.g. Katz *et al.* 1965; Marten and Barkely 1973) and published

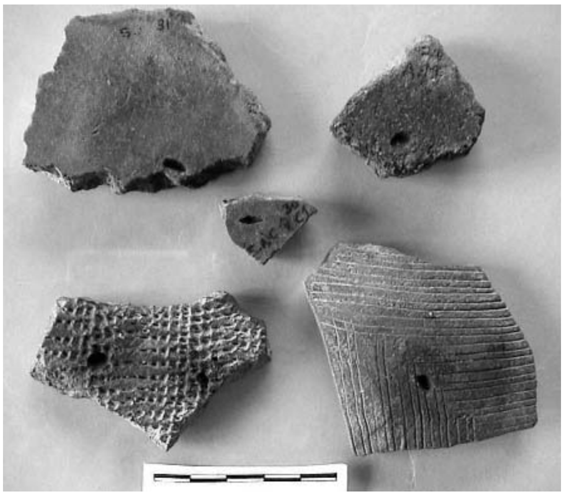


Figure 2.- Some of the potsherds with plant impressions.

work and illustrations on the flora of the Sudan (Andrew 1950, 1952, 1956; Crowfoot 1933; El-Amin 1990) were also used. In addition, the present author consulted with colleagues specialised on plant-taxonomy and macrofossil plant-remains (e.g. Ana Arnanz of the Spanish Higher Research Council, Madrid).

Despite the fact that plant impressions in pottery proved indispensable for obtaining evidence that is well and permanently preserved and contemporary with the material culture (as represented in the pottery), yet a few problems are encountered during the process of identification of the positive casts. One of these, is the difficulty of retaining all the details of the external morphology of the plant material in a form of impressions in pottery. This difficulty is particularly evident in basically coarse pottery, especially that in which the main component of the temper is inorganic, e.g. sand, quartz, mica, etc., (Magid 1989: 95). Another difficulty is the extraction of positive casts of impressions embedded along the edges or on sections of the walls of the potsherds. Moreover, in the present work, we were not able to find and use a vacuum-apparatus in order to release the micro bubbles of air that are created while making the casts. We also observed that the process of coating the samples for Scanning Electron Microscopy often erases the minute details of the external morhology of the positive casts. The presence of air bubbles and the ruination of details of the external morphology of the casts led to the reduction of the quality of the final product. All these factors made the task of identifying the plant remains beyond their family/taxa or determining their status (e.g. wild or domesticated) arduous (and sometimes impossible).

Results of identification of the positive casts

The positive casts obtained belong mainly to seeds/grains of annuals and perennials, a few stones and seeds of fruits-tree/shrubs and some leaves and small fragments of twigs. As shown on table 1, the results of the identification of these positive casts attested the presence of a number of family/taxa and species at the site of Sheikh el Amin and a few ones at the sites of Sheikh Mustafa and El Mahalab. As the total number of potsherds from the sites of Sheikh Mustafa and El Mahalab examined for plant impressions is small (about 1/5 of that examined from Sheikh el Amin), only a few plant-impressions in pottery were found.

Name of the site	**Identification of positive casts of plant impressions in pottery**		**Label of potsherds with plant impressions**		**Type of decoration on potsherds**
	Identified positive-casts	*Unidentified*	*Trench / Sq.*	*Level*	
Sheikh Mustafa	Setaria sp.		C	N.D.	P.
	Wild Sorghum sp.		G	N.D.	S.T.S.D.D.
	Wild Sorghum sp.		J	1	P.
	Wild Sorghum sp..		J	3	R.K.
		unidentified	J	1	S.T.S.D.D.
El Mahalab	Cassia sp.		A20	N.D.	P.
	Wild Sorghum sp.		N.D.	N.D.	P.
	Grewia sp. (seed)		N.D.	N.D.	A.P.S.
		unidentified	B?	N.D.	S.T.S.D.D.
Sheikh el-Amin	Cassia sp.		A	2	P.
	Wild Sorghum sp.		A1	2	I.
	Wild Sorghum sp		A1	6	I.R.
	Wild Sorghum sp		A1	6	I.
	Wild Sorghum sp		A2	1	I.R.
	Celtis integrifolia		A2	2	R.R.
		unidentified	A2	6	I.
		unidentified	B	1	R.S.
		unidentified	B2	N.D.	R.R.
	Cassia sp		B2	1	P.
	Wild Sorghum sp		C1	1	R.R.
	Leave (?) fragment		C1	2	R.P.
		unidentified	C1	2	I.R.
	Solanum dubium		C1	2	R.R.
	Wild Sorghum sp		C1	N.D.	R.R.
	Cucurbitaceae		D1	N.D.	P.
	Setaria sp.		E1	N.D.	P.
	(flattened) ? glume		H1	N.D.	R.S.
		unidentified	I	1	I.R.
		unidentified	J-1	N.D.	I.R
	Echinochloa sp.		J- B1	2	I.
	Solanum dubium		J-B1	2	P.
	Carex		J-B1	N.D.	A.P.S.
	Grewia tenax (stone)		J-B1	N.D.	R.S.
	Setaria sp.		J-B5	N.D.	R.R.
		unidentified	N.D	N.D.	R.S.
	Cassia sp.		N.D.	N.D.	R.S.
	Solanaceae		N.D.	N.D.	P.
		unidentified	N.D.	N.D.	R.P.
		unidentified	N.D.	N.D.	R.P.

Legend. Decoration types: P.: Plain; A.P.S.: Alternated Pivoting Stamp; I.: Incised; I.R.: Irregular Rocker; R.P.: Rocker Packed, R.S.: Rocker Spaced. S.T.S.D.D.: Sherd Too Small to Distinguish Decoration. N.D.: No Data.

Table 1.- Positive casts of plant-impressions from the sites of Sheikh Mustafa, El Mahalab and Sheikh el Amin.

Some difficulties were encountered while identifying the status of some of the grains/ seeds. Nevertheless, the final analysis indicates that most of the identified specimens (e.g. of seeds of grasses) exhibit morphological characters similar to those of the naturally (wild) growing species. Most of the specimens identified belong to edible grains/seeds of wild grasses and edible fruits. In addition to these edible plants, evidence of other plant species/taxa was identified. The presence of edible grains of wild grasses and seeds/stones of fruits at the sites indicate that two distinct, yet interrelated strategies of exploitation of food-plants were pursued and maintained since the period of occupation of Sheikh Mustafa and El Mahalab and throughout the occupation of Sheikh el Amin. One of these strategies is based on gathering of immediately eaten food plants without processing or preparation (e.g. fruits) and the other is based on the exploitation of food plants that require processing and preparation before being served as food (e.g. grains/seeds of wild grasses). Strategies of food-plant exploitation and the types of edible plants exploited in the area of the Blue Nile reflect a general pattern that existed during the Early and Middle Holocene in the wider region of the Central Sudan and North Africa. This interpretation is derived on the basis of archaeobotanical evidence obtained from (almost) all the Holocene sites excavated in these regions and the botanical evidence presented in table 1 and discussed in the following pages.

Figure 3.- Positive cast of an impression of a grain of wild *Sorghum* sp. (ventral side).

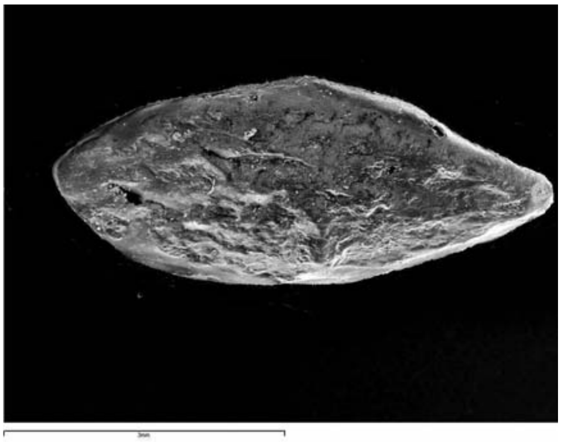


Figure 4.- Positive cast of an impression of a grain of wild *Sorghum* sp. (dorsal side).

Evidence of food-plants

Wild ***Sorghum*** sp. Moench. (*Gramineae*). All the identified positive casts of grains of wild *Sorghum* sp. Moench. have elliptic-lanceolate caryoposes. Some of the positive casts show the ventral side of the original grain, others show the dorsal surface (Fig. 3 & 4). The average measurements of the original grains (as seen from their positive casts) are c. 5-6 mm long and up to 2.5-3.0 mm broad. The area of the sites being studied here is thought to have been part of the natural habitat of the wild growing *Sorghum* sp. Moench. (Fig. 5; Harlan 1977: 374) which extended mainly across the African savannas. Today rainfed cultivation of domesticated *Sorghum* sp. provides the main supply of this source of staple food in the Sudan. As it will be presented in the following pages, evidence of impressions of wild *Sorghum* sp. Moench. in pottery was recovered from most of the Early Khartoum and the Shaheinab sites in the Central Sudan (Magid 1989: 82-93, 1995a: 159-160; Magid and Caneva 1998: 82-83). Evidence of charred grains of wild *Sorghum* sp. Moench. was also found in the cultural deposits of the Early Holocene sites of Nabta Playa, Farafra and Abu Ballas in the Western Egyptian Desert (Barakat and Fahmy 1999: 33; Wasylikowa *et al*. 1995: 143). They were interpreted as being brought to the sites as a source of food (Barakat and Fahmy 1999: 33; Magid 1989: 82-93, 1995 a: 159-160; Magid and Caneva 1998: 82-83).

Setaria sp. Beauv. (*Gramineae*). Evidence of

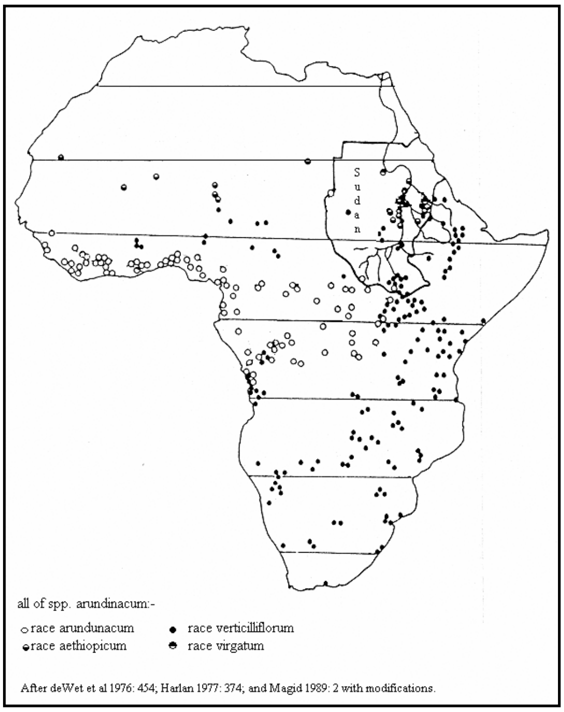


Figure 5.- Distribution of wild races of sorghum in Africa in general and in the Sudan in particular.

Setaria sp. was recovered from the sites of Sheikh Mustafa and Sheikh el Amin. All the replicas obtained show the dorsal side of original seed (Fig. 6) and indicate that the original seeds are oblong to ellipsoid in outline with average measurements of 2 mm long and 1.0 mm broad. *Setaria* sp. Beauv. has a wide distribution in tropical and warm temperate regions of the world (Barakat and Fahmy 1999: 33-34).

Positive casts of seeds of *Setaria* sp. Beauv. were also recovered from the sites of both the Early Khartoum and the Shaheinab type in the Central Sudan (Magid 1989: 82-93, 1995a: 159-160; Magid and Caneva 1998: 82-83) and were interpreted as being consumed as food (Magid 1989: 235-236). The finding of *Setaria* sp. Beauv. at the sites of the Blue Nile area is considered as indication that it was also used as a source of grain-food.

Evidence of charred seeds of *Setaria* sp. Beauv. is reported from the Early Holocene sites of Nabta Playa, Farafra and Abu Ballas in the Western Egyptian Desert (Barakat and Fahmy 1999: 37-40), and hence interpreted as being one of the grasses which were intensively gathered and used as a food-plant (ibid.: 44). The seeds of *Setaria* sp. are still widely consumed as food by the desert dwellers in Egypt and the Sahara (Uphof 1968: 481; Wasylikowa and Dahlberg 1999: 11).

Echinochloa sp. Beauv. (*Gramineae*). Evidence of *Echinochloa* sp. Beauv. was recovered from the site of Sheikh el Amin. It consists of an impression of the dorsal side (Fig. 7) of the seed (as seen from its replica). The seed is elliptical in outline, c. 3 mm long, 1 mm broad with the maximum width at the middle region of the seed.

Echinochloa sp. Beauv. is similar to wild *Sorghum* sp. Moench, and *Setaria* sp. Beauv, in that it is an annual herb that grows in a form of small tufts (Andrews 1956: 441). Its present distribution range from the tropics to the warm temperate regions (Barakat and Fahmy 1999: 33). No evidence of this plant was found –so

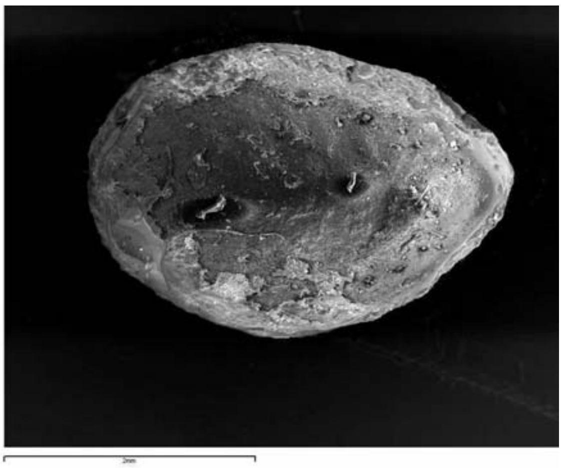


Figure 6.- Positive cast of an impression of a seed of *Setaria* sp.

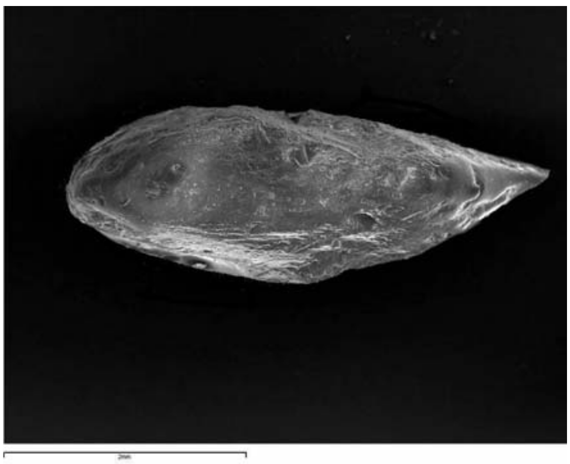


Figure 7.- Positive cast of an impression of a seed of *Echinochloa* sp.

far– at any of the sites of the Early Khartoum or the Shaheinab type in the Central Sudan. However, large number of charred seeds of *Echinochloa* sp. Beauv. were also recovered from the sites of Nabta Playa, Farafra and Abu Ballas in the Western Egyptian Desert (ibid.: 37-40). Statistically speaking, it was found to be the most abundant grass type at the site of Nabta Playa (ibid.: 41). It has been stated that the recovery of substantial quantity of charred seeds at these sites indicate that "the plant was gathered from the wild to be used as foodstuff" (ibid.).

Celtis integrifolia Lam (*Ulmaceae*). One impression of a small (most likely immature) seed of *Celtis integrifolia* Lam was found in a potsherd excavated from the site of Sheikh el Amin. As seen from its positive cast, the seed-impression is ovoid-ellipsoid in outline; and measures 5 mm long (Fig. 8). The average measurement of a mature seed is 7-8 mm long. *Celtis integrifolia* Lam is a tree species that grow up to 60 feet high (Andrew 1952: 251) in tropical regions that are characterised by annual rainfall of at least 500 mm (Magid 1989: 97, 102). It bears edible pale-brown fruits. Large quantities of desiccated seeds of this species were hand picked while excavating and/or retrieved by froth flotation from soil samples taken from the sites of Early Khartoum and the Shaheinab type in the Central Sudan (e.g. Arkell 1949: 108-110; Magid 1989: 82-93, 96, 1995a: 158-160). Many researchers (e.g. Arkell 1949: 108-110; Magid 1995a: 170, 1989: 102; Magid and Caneva 1998: 87) suggested that the fruits of this tree were eaten by the population of the Central Sudan during the periods of the Early Khartoum and the Shaheinab cultures (and are still eaten by the present population of Southern Sudan).

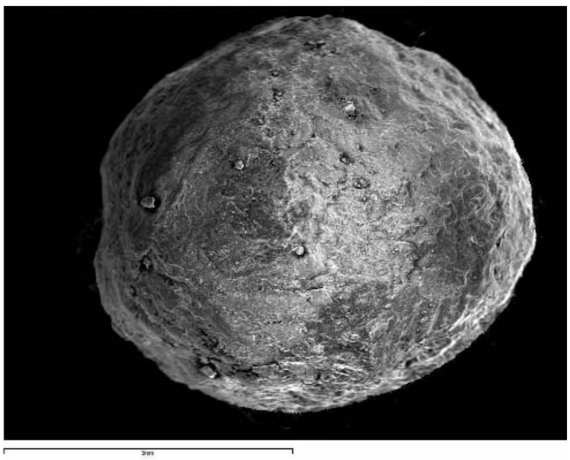


Figure 8.- Positive cast of an impression of a seed of *Celtis integrifolia*.

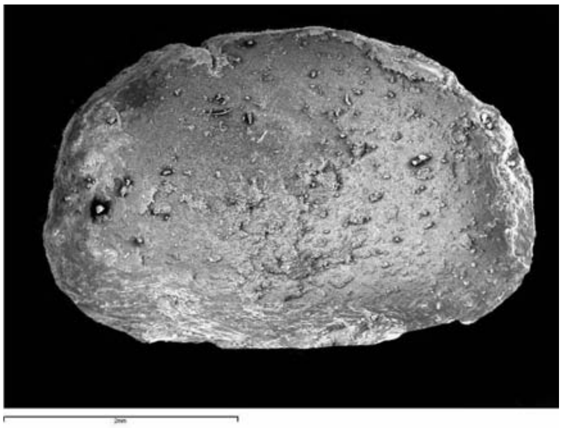


Figure 9.- Positive cast of an impression of a seed of *Grewia tenax*.

Grewia (?) ***tenax*** (Forsk) Fiori. (*Tiliaceae*). Evidence of *Grewia* sp. L. (most likely) *Grewia tenax* (Forsk) Fiori. was found as a seed-impression in pottery (Fig. 9) at the site of El Mahalab and also as a fruit-stone impression (Fig. 10) at the site of Sheikh el Amin. These finds represent the earliest evidence of *Grewia* sp. reported –so far– from archaeological sites in the Central Sudan. The previous archaeological record of *Grewia* sp. L. in the Central Sudan consists of

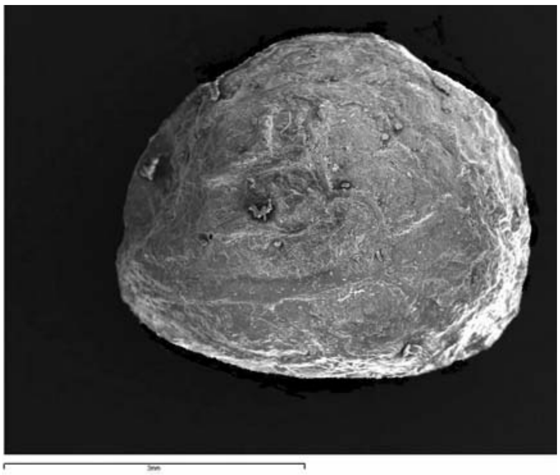


Figure 10.- Positive cast of an impression of a fruit-stone of *Grewia tenax*.

large amounts of charred and desiccated fruit-stones and charred seeds recovered from the cave-site of Shaqadud (Fig. 1) and radiocarbon dated to 4123 ± 86 bp. (Magid 1984, 1989: 85). *Grewia tenax* (Forsk) Fiori. is a shrub. Its mature orange fruits are often 2-3-4 lobed. At present, *Grewia tenax* (Forsk) Fiori. grows in the Central and Southern Sudan (Andrews 1950: 222-223) and its sweet fruits, both fresh and dry, as well as its seeds are favoured and extensively consumed by the Sudanese population residing in these areas. A popular drink is also made from its fruits.

Evidence of other plant remains

This is a group of plant remains that do not seem to have been used as direct or regular sources of food. Three specimens are identified to taxa and species level. The remainder is not identified beyond the family level. This group consists of the following plants.

Solanum dubium Fresen (*Solanaceae*). Two impressions of seeds of *Solanum dubium* Fresen. were found in potsherds recovered from the site of Sheikh el Amin (Fig. 11). Similar to the early date of evidence of *Grewia tenax* (Forsk) Fiori., the recovery of *Solanum dubium* Fresen from the site of Sheikh el Amin, represents the earliest evidence found –so far– in an archaeological context in the Central Sudan. Charred seeds of this species were found in the cave-site of Shaqadud and radiocarbon dated to 4123 ± 86 bp (Magid 1984, 1989: 85).

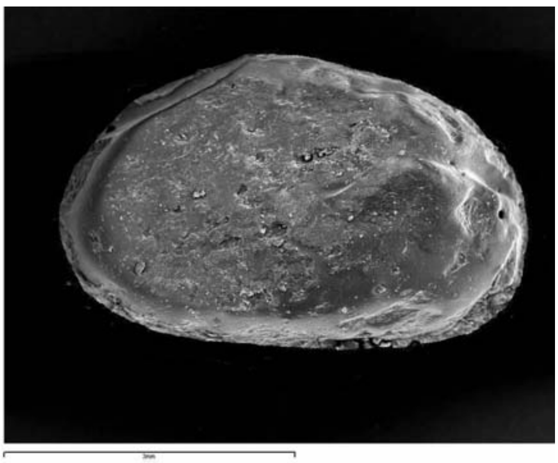


Figure 11.- Positive cast of an impression of a seed of *Solanum dubium*.

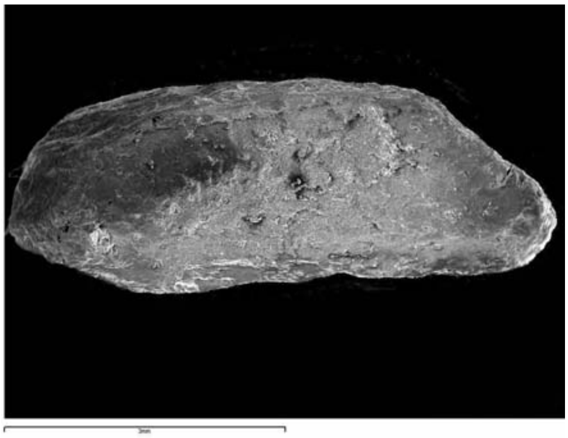


Figure 12.- Positive cast of an impression of a seed of *Cassia* sp.

Solanum dubium Fresen. is a woody herb that bears fruits characterised by their shiny yellow colour (when mature) and globos in shape, ca. 8 mm in diameter (Andrews 1956: 99). It is difficult to generate an interpretation as regards the existence and use of this plant species at the site of Sheikh el Amin. Nevertheless, it has been reported that one of the present uses of this plant in the Sudan is associated with removal of the hair from animal hides by soaking the hides in a liquid-mixture of the ground plant and water (Uphof 1968: 490). Evidence of domesticated animals (e.g. cattle) was found at the site of Sheikh el Amin (cf. the analysis of faunal remains by Louis Chaix 2003). It has also been reported that the contemporary nomadic groups of the Butana plains (Fig. 1) use the fruits of *S. dubium* Fresen as fermenting agent that is added to warm milk (Magid 1989: 100). However, this ethnographic data does not necessarily indicate that *S. dubium* Fresen. was used for similar purposes during the occupation of the site of Sheikh el Amin.

Cassia sp. L. (*Leguminaceae*). Three impressions of seeds of *Cassia* sp. L. were found in potsherds recovered from the site of Sheikh el Amin and one seed-impression found in a potsherd excavated from the site of El Mahalab. The external shape of the positive casts of these impressions (being oblong-ovate in outline and apiculate near the hilum) reflects striking similarities with that of extant seeds of *Cassia tora* L. (Fig. 12).

Cassia sp. are perennial herbs or under shurbs, 15-60 cm high (Andrews 1952: 116). Its

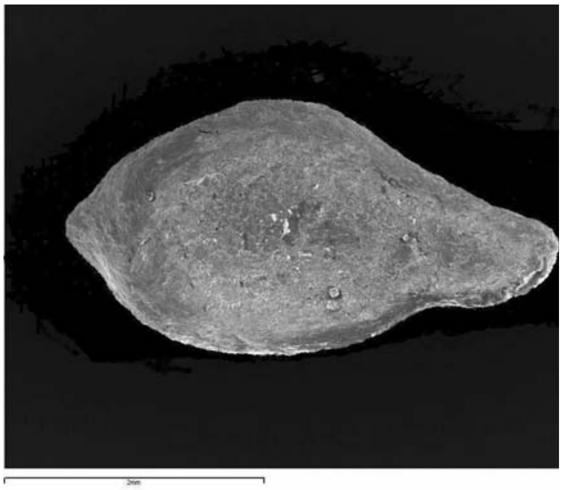


Figure 13.- Positive cast of an impression of a seed of *Carex* sp.

distribution extends from semi-desert zone to short grass savanna (Al-Amin 1990: 97). In the Sudan it is found in both the Central and Southern parts of the country (Andrews 1952: 116). At present, different parts of different species of Cassia are used in the Sudan for different purposes (e.g. purgative, food-flavour/ seasoning, dying cloth, etc.). Moreover, G. Kunkel (1984: 78-79) stated that the leaves of *Cassia tora* L. are eaten in soups and that its seeds are eaten at times of food scarcity. As it is not possible to identify with certainty the positive casts of the seed- impressions to the species level, it is untenable to draw any interpretation as regards its presence and use at the sites of Sheikh el Amin and El Mahalab.

Carex sp. L. (*Cyperaceae*). A potsherd with a seed-impression of *Carex* sp. was found at the site of Sheikh el Amin. The original seed (as seen from its positive cast) is oblong with lanceolate end and maximum width towards the base, c. 4 mm long and 2 mm broad at its maximum width (Fig. 13). No evidence similar to this is reported from the Early Khartoum and Shaheinab sites in the Central Sudan. At this stage of our knowledge, it is premature to suggest an explanation for the presence and use of *Carex* sp. at the site of Sheikh el Amin.

Carex is a perennial herb widely distributed mostly in moist regions (Kunkel 1984: 74). Its present distribution is mainly in the Equatoria region in the Southern Sudan (Andrews 1956: 330), and hence it probably can be used with other evidence as a climatic indicator for wet conditions. In this connection, it is worth mentioning that species of this plant are used at present in stables and fences for cattle to stand on (Uphof 1968: 107) in order to avoid soil-humidity which cause cattle hoof-disease. As mentioned earlier, evidence of domesticated animals was found at the site. But this does not inevitably imply such contemporary use of *Carex* sp. can be traced back to the period of the Sheikh el Amin. The rhizome of *Carex* sp. is used as diuretic (ibid.).

There are some positive casts of seed-impressions that are recovered from the site of Sheikh el Amin, but it was not possible to identify them beyond the family level. These include impressions of seeds of *Cucurbitaceae* and *Solanaceae*.

4. Plant remains from the Early and Middle Holocene sites in the Central Sudan and North Africa

Plant remains recovered from sites in the Central Sudan

Preservation conditions are not particularly favourable for the survival of carbonized/desiccated plant remains buried in prehistoric sites in the Central Sudan due to a number of natural and cultural (human) factors. Among these factors are the prevailing climatic conditions, geographical formation of the area, activity of microfauna and disturbances of the sites caused by human-beings and burrowing-animals (Magid 1989: 66-67, 1995a: 148-149). Thus, with the exception of a few plant remains (mainly with hard-woody structures), most of the evidence recovered from the sites of the Early Khartoum and Shaheinab[4] type in the Central Sudan was in a form of plant impressions in pottery. Positive casts were made of the impressions and the casts obtained together with evidence of a few desiccated/carbonized plant remains (mainly seeds) are identified and some suggestions are made as regards their presence in the archaeological sites mentioned earlier (in section 2).

Plant remains from the sites of the Early Khartoum culture

The archaeobotanical evidence recovered from the Early Khartoum sites belong to two types of edible plants: those which are immediately eaten without processing and/or preparation (e.g. the fruits and berries) and those which require processing and/or preparation before being served as food (e.g. grains and seeds of wild cereals and grasses). Accordingly, it has been suggested that the economic strategy related to food-plant exploitation during the Early Khartoum culture "was based on a complex and broad spectrum of vegetal foods" and was not restricted to gathering of food-plants that are immediately eaten without processing and preparation (e.g. berries and fruits) as it has previously been assumed (Magid and Caneva 1998: 87).

This interpretation is derived on the basis of archaeobotanical data recovered from the sites of Aneibis, Abu Darbein, El-Damer, Saggai and Al-Kabbashi (Fig. 1). The results of identification of the data attested the presence of impressions of grains/seeds of *Sorghum* sp. Moench, *Panicum* sp. L., *Setaria* sp. L., and stones/seeds of *Ziziphus spina-christi* L. (Willd) and *Celtis integrifolia* Lam at all the sites (Magid and Caneva 1998: 82-84; Magid 1995a: 168-169). In addition, impressions of seeds of *Echinochloa* sp. Beauv. were found in pottery sherds from the site of Saggai and Kabbashi (Magid and Caneva 1998: 83). The positive casts of the impressions of grains of *Sorghum* sp., Moench. exhibit external morphological characters similar to those of the naturally (wild) growing species. The presence of evidence of these edible plant species at the sites suggests that they were brought to the sites as food.

Plant remains from the sites of the Shaheinab culture

Similar to evidence of food plants recovered from the sites of Early Khartoum, that recovered from the sites of the Shaheinab culture consists of two types of edible plants: those which are immediately eaten without processing and/or preparation (e.g. the fruits of *Ziziphus* sp. Mill and *Celtis* sp. L.) and those which require to be processed and/or prepared before being served as food (e.g. grains/seeds of *Sorghum* sp. Moench, *Setaria* sp. L. and *Echinochloa* sp. Beauv., *Panicum* sp. L., etc.), which suggests that these plant species were brought to the sites as food. However, it has been suggested that it was during the period of the Shaheinab culture that the population of the Central Sudan started to cultivate wild cereals e.g. *Sorghum* sp. Moench (Magid 1989: 231) and *Pennisetum* sp. Rich (Haaland 1981: 215; Klickowska 1978: 42-43) "about 6000 years ago within a predominantly gathering type of economy" (Magid 1989: 231). That is to say, cultivation of wild grasses was practised but gathering of immediately eaten food-plants without processing or preparation (e.g. fruits and berries of *Ziziphus* sp. Mill. and Celtis sp. L.) was the primary strategy of food-plants exploitation.

This interpretation is based on data collected from the sites of Shaheinab, Nofalab, Kadero, Um Direiwa, Zakiab, Jebel-Tomat and Rabak (Fig. 1). Similar to the nature of evidence recovered from the sites of the Early Khartoum culture, the evidence of plant remains recovered from the sites of the Shaheinab culture consisted mainly of plant impressions in pottery. A few sizeable desiccated remains were collected during the excavations and/or during the dry sieving. In addition, other desiccated finds were also retrieved by using the method of froth flotation (Magid 1989: 87-93, 102-107). With the exception of the site of Nofalab, all the sites mentioned above yielded evidence of impressions of grains of *Sorghum* sp. Moench in pottery (ibid.). Impressions of grains of *Pennisetum* sp. Rich were also found in pottery recovered from the sites of Um Direiwa. The external morphology of all the positive casts of these impressions resembles that of the wild Sorghum species (ibid.). Evidence of impressions of grains of *Setaria* sp. Beauv. and *Panicum* sp. L. were also recovered from most of the sites (ibid.: 87-93). In addition to these, desiccated seeds of *Celtis integrifolia* Lam. and their impressions in pottery were also found mainly at those sites situated in the Khartoum area (Fig. 1; ibid.: 102-107). One impression of a seed of *Sesamum* sp. L. was found in pottery recovered from the site of Jebel-Tomat and an impression of a seed of *Cucurbitaceae* sp. was found in a potsherd excavated from the site of Rabak (ibid.: 92-93). The evidence of gouges is interpreted as being used for soil-tilling[5] for cultivation (Haaland 1981: 121-122, 1987a: 76-77, 227). The grinding equipment and pottery recovered from the sites of the Shaheinab are presented as an indirect evidence for the beginning of cultivation of wild grasses, and hence the beginning of more intimate human-plants relationship (Haaland 1981: 214; Magid 1989: 235). However, evidence of grinding equipment and pottery recovered from the sites of the Early Khartoum was not interpreted in the same fashion. More discussion on tools that are thought to be associated with prehistoric exploitation of food-plant is presented later in a separate section in this paper.

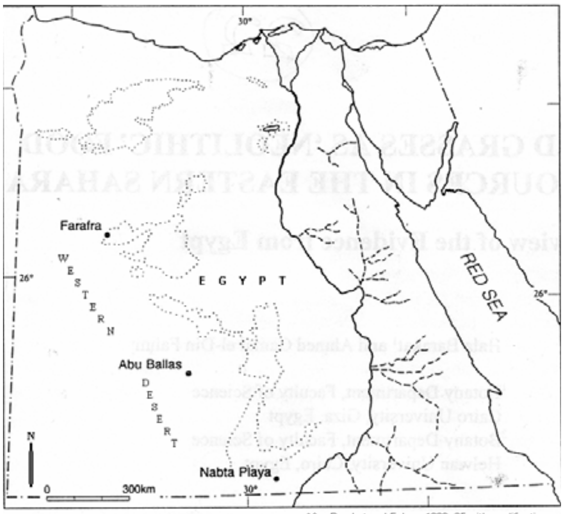
Plant remains recovered from the Early Holocene sites in North Africa

The archaeobotanical data presented below is recovered from Early Holocene sites in the Western Egyptian Desert and the Libyan Sahara. These sites are more or less contemporary with those excavated in the Central Sudan and the plant remains recovered from them bear some similarities and hence, also indicate similar strategies of food-plants exploitation. Therefore, examination of the plant remains recovered from these sites is both relevant and advantageous to the analysis of the archaeobotanical data from the Blue Nile area as regards its economic implications and the relation of these to strategies of food-plant exploitation in the wider context of North Africa.

Plant remains recovered from Early Holocene sites in the Western Egyptian Desert

Exploitation of food-plants in the Western Egyptian Desert during the Early Holocene was based on wild food-plants which are immediately eaten (e.g. fruits and berries) and those which require processing and preparation before being eaten (e.g. grain-foods). As mentioned earlier, this type of strategy of food-plants exploitation was also practised during the same period in the Central Sudan and the Blue Nile area. It thus supports our suggestion that there was a general pattern of food plant exploitation during the Early Holocene and Middle Holocene in North Africa including Central Sudan. In addition, the plant remains recovered from sites in the Western Desert provide further evidence for our interpretation that exploitation of wild grain-foods was started three thousand years early than previously assumed (Magid 1989, 1995a; Magid and Caneva 1998).

This interpretation is derived on the basis of evidence of plant remains recovered from three



After Barakat and Fahmy 1999: 35 with modifications.

Figure 14.- Location map of sites in the Western Egyptian Desert mentioned in the text.

sites situated in the Western Egyptian Desert. These sites are Nabta Playa (Wendorf *et al.* 1998: 71), Eastpans near the Abu Ballas ridge and Hidden Valley near Farafra Oasis (Barakat and Fahmy 1999: 33; also cf. Fig.14). The site of Nabta Playa is radiocarbon dated to 8100-7800 bp and classified as Early Neolithic (Wasylikowa *et al.* 1993: 154; Wendorf *et al.* 1998: 71) and the sites of Farafra and Abu Ballas are dated to 6700 bp and 6200 bp (Barakat and Fahmy 1999: 33) in their respective order. Thousands of plant remains (e.g. charred seeds, tubers, charcoal, etc.) representing over 40 varieties of plants were recovered (Wendorf *et al.* 1998: 71). The remains identified include several genus and species of wild grasses such as *Sorghum* sp. Moench, *Panicum turgidum* Forsk, *Echinochloa colona* (L.) Link., all recovered in fairly large numbers. Evidence of other (less frequent) wild grasses are represented by charred seeds of *Digitaria* sp. Haller, *Setaria* sp. Beauv., *Cenchrus* sp. L. and *Urochloa* sp. (Wasylikowa *et al.* 1995: 143). In addition to the wild grasses, evidence of fruit-trees and shrubs are also found including fruit-stones of *Ziziphus* sp. Mill and seeds of *Capparis* sp. L. (ibid: 143). The presence of wild *Sorghum* sp. Moench. in the Western Egyptian Desert 8000 years ago has some climatic and cultural implications as will be discussed later in relation to the environmental and climatic conditions during the Early Holocene period in North Africa (in section 6).

Detailed lists of all the plant remains recovered from the sites of Farafra and Abu Ballas (as well as some of the remains from the site of Nabta Playa) have been published by Barakat and Fahmy (1999: 37-39). Contrary to the poor state of preservation of plant remains in the Central Sudan, the plant remains recovered from the sites in the Western Egyptian Desert are all carbonized and well preserved (ibid.: 33). The good preservation of these remains is attributed to two interrelated factors in that carbonisation of the remains took place either during the food preparation or due to their being used as firewood (ibid.: 39) followed by their "burial in playas deposits which protected the sites from erosion" (ibid.).

As regards the implications of the presence of these plant remains at the sites, it has been suggested that all the eight identified wild grass taxa grew in dense stands in the vicinity of the sites (ibid.: 33) and have been brought to the sites for consumption as food (ibid.: 43; Wasylikowa *et al*. 1995: 150, 1993: 156; Wendorf *et al*. 1998: 71). It has been stated that the evidence of *Sorghum* sp. Moench found at the site of Nabta Playa has all the morphological characters of the wild race and that the context in which it was found indicates that it was not domesticated (Wasylikowa and Dahlberg 1999: 24). However, Infrared and MS Gas Chromatograph analyses suggest that it has closer genetic affinity to some varieties of domesticated sorghum (Wendorf *et al*. 1998: 71). Accordingly, it was assumed that its cultivation or intensive harvesting led to its modification towards the domestic varieties (ibid.).

An interpretation similar to this (suggesting cultivation activities) has been made in relation to the evidence of wild *Sorghum* sp. Moench recovered from the Shaheinab sites in the Central Sudan (cf. the previous section). However, no reference is made of any evidence of tools or equipment from the sites in the Western Egyptian Desert that can be associated with cultivation of these wild grasses. Moreover, with the exception of a few potsherds (9 in total) recovered from the site of Nabta Playa (Wasylikowa *et al*. 1993: 157), no evidence of tools or equipment that can be associated with processing and preparation of grain-foods was reported. In fact, it has been stated that pottery was not used in the preparation of food-plants and that the containers that were used in cooking "must have been of a perishable nature" (ibid.). But no further suggestions are proposed as regards the material(s) from which these cooking-containers were made. Nevertheless, in addition to the wild grain-foods, fruit/berries-foods were also consumed, as it is evident in the recovery of fruit-stones of *Ziziphus* sp. Mill and the seeds of *Capparis* sp. L. The evidence of crushed stones of *Ziziphus* sp. Mill. is taken as an indication of a "purposeful crushing of the fruit-stones in order to extract the seeds and use them for cooking" (Wasylikowa *et al*. 1995: 146).

Plant remains recovered from sites in the Libyan Sahara

The results of a preliminary analysis of the botanical remains recovered from the Early Holocene occupation of the cave site of Uan Afuda situated in the Tadrart Acacus in the Libyan Sahara, indicate that edible plants composed an important part of the subsistence strategy. Exploitation of food-plants is based on two distinct but interrelated strategies: gathering immediately eaten food plants (e.g. fruits and berries) and harvesting of food-plants that required processing and preparation (mainly grains of wild grasses). These strategies conform with the general pattern of wild food-plant exploitation in the Western Egyptian Desert, Central Sudan and the Blue Nile area during the Early Holocene. Being of, more or less, contemporary date to the early Holocene sites in the Western Desert and the Central Sudan (including the Blue Nile area), the cave-site of Uan Afuda furnishes us with more support of our interpretation that exploitation of wild grain-foods started in North Africa several thousands of years earlier than it has traditionally been assumed.

The stratigraphic sequence of the cave site of Uan Afuda provided substantial evidence for the transition between the Late Pleistocene and the Holocene (Castelletti *et al*. 1998: 91). The Early Holocene occupation of the site has been classified into two different cultural phases: the Early Acacus or "Epipalaeolithic" dated between 9800 and 8900 bp and the Late Acacus or "Mesolithic" dated between 8900 and 7500 bp (ibid.: 92). All the plant remains recovered from the site were found in well preserved condition (ibid.: 91). As the Early Acacus "Epipalaeolithic" phase is beyond the scope of the present study, we shall refer to it, only, when relevant to the objectives of this paper.

The interpretation presented above is based on analysis of the plant remains recovered from the cultural deposit of the Late Acacus "Mesolithic" phase. Many plant species were identified. Among these are charred seeds of wild grasses such as *Setaria* sp. Beauv. and *Panicum* sp. L. Impressions of seeds of *Setaria* sp. and *Panicum* sp. were also found in pottery recovered from the deposits of the Late Acacus phase (Magid 1999: 184-185). In addition, charred seeds of *Boraginaceae*, achenes of *Compositae* and charcoal and wood that belong to several tree and bush species, e.g. *Ficus* sp. L., *Grewia* sp. L., *Acacia* sp. Mill. and *Tamarix* sp. L. were also identified (Castelletti *et al*. 1998: 97). *Gramineae* was found to be the most frequent group of plant remains recovered from the Late Acacus deposits (ibid.).

In addition to the charred plant remains, evidence of different glumes of *Gramineae* species was found in human and herbivore coprolithes (Castelletti *et al*. 1998: 98). Among these, glumes of *Brachiaria* sp. (Trin) Griseb seems to be present (Ibid.). The presence of *Gramineae* glumes in human coprolithes indicates "quite a rough cereal treatment by hand-grinding" (ibid.: 100). These findings also provide one of the earliest direct botanical evidence of human consumption of seeds of wild grasses in North Africa during the Early Holocene. In this connection, large amount of seeds of *Echinochloa colona* (L.) Link were also found in the intestines of a mummy at Nag' el-Deir in Egypt but they are of a younger date, 4000-3500 BC (Barakat and Fahmy 1999: 41). In addition to glumes in coprolithes, evidence of caryopsides of *Gramineae* were found adhered to fragments of basketry (Castelletti *et al*. 1998: 98) recovered from cultural deposits of the Late Acacus phase. This evidence was taken as indication that containers made from perishable materials (e.g. of vegetal origin) were used for storage and harvesting of seeds of wild grasses (ibid.).

To sum up, the results of the study of the plant remains –obtained so far– indicate that food-plants were an important component of the subsistence strategy at both the Early and Late Acacus phases (Castelletti *et al*. 1998). However, the plant remains together with evidence of material remains and faunal analysis suggests "a greater selectivity of resource-exploitation during the Early Acacus and a marked broadening of subsistence spectrum during the Late Acacus phase" (ibid: 91). Although there is no evidence –so far– that implies any kind of contact between the Early Holocene population of the Late Acacus and those of the Early Khartoum in the Blue Nile area and the Central Sudan, yet there are striking similarities between these two populations as regards their adoption of broad subsistence spectrum (including exploitation of edible grains/seeds of wild grasses).

5. Archaeological artefacts associated with the exploitation of food-plants

One of the objectives of this paper is the study of the technology (knowledge, technical skills and equipment) used and its impact on the development of economic strategies based on exploitation of food-plants.

Analysis of the plant remains (presented above) indicates that strategies of food-plants exploitation during the occupation of the (Early Khartoum) sites of Sheikh Mustafa and El Mahalab and the (Shaheinab) site of Sheikh el Amin are based on immediately eaten food-plants and those which required processing and preparation before being consumed. Therefore, one would expect to find some evidence of or indications for tools that were used to exploit, process, prepare and store these food-plants. Accordingly, examination of the material culture remains, mainly lithic artefacts and pottery, was made and the results are presented in the following pages.

Results of examining the lithic artefacts

The main focus in this study is on six types of lithic tools that are thought to have been functionally related to the exploitation of food-plants. These are: lunates, knife (sickle?)-blades, grinders, stone-rings, rubbers and gouges. An elaborate analytical study has previously been made on similar tools that are recovered from sites of the Early Khartoum and the Shaheinab types in the Central Sudan (Magid 1989: 129-177, 1995b: 60-72). As the sites of Sheikh Mustafa and El Mahalab are of an Early Khartoum type and that of Sheikh el Amin is of a Shaheinab type, I shall only compare the results of the previous study with the tool-types recovered from these sites (for more information see Magid 1989: 129-177, 1995b: 60-72).

Lunates. It has been suggested that hafted lunates were probably used as harvesting tools (Wendorf and Schild 1976: 276-277). Therefore analysis of microwear use pattern of these tools were made (Magid 1989: 135-142). The results obtained indicate that these tools were not used in activities (e.g. cutting) related to exploitation of food-plants (ibid.: 135, 140).

(? Sickle-)blades. Microwear use pattern analysis was also made on blades and backed blades to examine the possibility of their being used as harvesting tools. The results did not show any wear pattern corresponding to that resulting from harvesting of plants (Magid 1989: 142-144).

Grinders. Results of a study of the archaeological remains and a survey of the historic, ethnohistoric and ethnographic literature show that use of grinders can be traced back to the period of the Early Khartoum culture in the Central Sudan and continued to be used to the present day (Magid 1989: 144-153). Almost all researchers studying the culture history of the Central Sudan (e.g. Arkell 1949, 1953; Caneva 1983a, 1988; Clark 1984, 1989; Haaland 1987a; Haaland and Magid 1995; Magid 1989; Zarattini 1983; etc.) agree that grinders were used during the periods of the Early Khartoum and the Shaheinab cultures to prepare wild food-plants. They were used, for instance, to crush nuts and/or fruit-stones to extract the seeds and to grind grains of wild cereals and grasses. But it is unlikely that they were directly associated with the process of domestication of these wild food-plants (Magid 1989: 153).

Rubbers. Almost all the rubbers recovered from the sites are from sandstone. A review has been made on the different interpretations offered for the probable use of sandstone rubbers (Magid 1989: 154). One of these proposes that rubbers were used for polishing stone tools, e.g. stone-axes and chisels (Semenov 1970: 68). Another interpretation implies that they were used (in a manner similar to sandpaper) for polishing wood or bone (Arkell 1949: 64; Clark *et al*. 1975: 333). A third interpretation suggests they were used for polishing handles and shafts of wooden tools that were used in cultivation activities (Magid 1989: 154) or that they were used for polishing interior walls of dry fruits which were probably used as containers (ibid.). In the light of these interpretations, it has been concluded that sandstone rubbers were probably used in activities indirectly related to exploitation of food-plants (ibid.).

Sandstone rings. Sandstone rings of different sizes were recovered, mostly, as broken pieces or small fragments. Different interpretations have been suggested for the function of the big[6] ones. Most of these interpretations associate the big sandstone rings with one activity or another that is related to exploitation of food-plants (Magid 1989: 157). For instance, A.J. Arkell (1949: 63, 64) suggested that sandstone rings were mounted as weight for sticks. Another more specific interpretation suggests that they were mounted as weight on digging stick used by plant gatherers (Haaland 1981: 141) or as weight on hoes used for breaking up the soil for cultivation (ibid.). On the basis of these interpretations, the present author suggests that the broken pieces (mentioned above) are products of split or broken sandstone-rings due to heavy pressure exerted on them to help pushing digging sticks deep in places/patches where the soil is compact/hard.

Gouges. Twenty-six gouges were recovered from the site of Sheikh el Amin. As mentioned earlier (in section 2), the gouge is considered the characteristic tool of the Shaheinab culture (Arkell 1953: 25, 31). That is to say, evidence of gouges was not found at the sites of the Early Khartoum. Two interpretations were suggested as regards the function of the gouges. One proposes that gouges were used as adzes for digging up trunks of trees used as canoes (ibid.: 31). The second interpretation suggests that they were used for tilling the soil for cultivation (Haaland 1981: 121-122, 1987a: 76-77, 221). In light of these interpretations, a study (including microwear use pattern) was carried out on a random sample of one hundred gouges. The study was intended to test whether the gouges were hafted, the manner in which they were hafted and to examine the wear pattern expected on gouges if they were used for tilling the soil or used as adzes (Magid 1989: 157-177). The results obtained indicate that the gouges examined were not used as hoes for tilling the soil and that their microwear use pattern bear traces (parallel groves) similar to those found on carpentry tools (ibid.: 175). However, these results raise other questions such as does the microwear use pattern found on the gouges confirm Arkell's interpretation (1953: 31)? If yes, what were the canoes used for during the Shaheinab period? As the sources of raw-material (i.e. rhyolite) for making gouges are relatively far away from the sites: Was the purpose for making canoes worthy of travelling such long distances?

Concluding Summary

The study of the lithic artefacts recovered from the sites of Sheikh Mustafa, El Mahalab and Sheikh el Amin (as projected from the Early Khartoum and Shaheinab lithic industries) indicates that none of the artefacts can be directly related to cultivation of wild food-plants or their domestication. Tools of perishable nature (wooden tools, branches, etc.) were probably used to perform certain cultivation activities (as discussed in section 7 and 8). However, some of these lithic artefacts are interpreted as being used in activities that are indirectly associated (e.g., rubbers) or directly related (e.g. grinders) to processing and/or preparation of food-plants (Magid 1989: 177).

Pottery

In this study, I shall focus on the introduction of pottery, development of its production and the impact of these on strategies related to exploitation of food-plants in the Central Sudan during the occupation of the sites being studied here.

The pottery of Sheikh Mustafa and El Mahalab

The earliest evidence of pottery in the Central Sudan was recovered from the site of Sarurab 2 and is radiocarbon dated to 9339±110 bp and 9370±110 bp (Khabir 1987: 378) which conform with the Early Khartoum culture (Magid and Caneva 1998: 86). The characteristic decorative features of this type of pottery are the incised wavy lines and rocker impressed and dotted wavy lines, but other decoration types were also used (Arkell 1949: 81, 87; Khabir 1987: 378). The pottery collection recovered from the sites of Sheikh Mustafa and Al Mahalab bear decorative features (i.e. mainly incised wavy lines and rocker impressed patterns) similar to those of the Early Khartoum type. Its presence at these sites represents one of the earliest evidence of pottery in the Blue Nile-area.

Generally speaking, pottery is characterised by two basic advantageous properties: tolerating heat and retaining liquids. Therefore, it's introduction as a new technological innovation have many positive consequences. For instance, it broadened existing cooking recipes, refined the quality of taste and promoted storage facilities (Magid and Caneva 1998: 86). Obviously, the introduction of pottery in the Blue Nile area (as represented in the evidence found at the sites of Sheikh Mustafa and El Mahalab) had similar consequences. Building on J.E.G. Sutton's interpretation on the introduction of pottery, its uses and impact (Sutton 1974: 540), it is most likely that pottery enabled the occupants of the Sheikh Mustafa and El Mahalab to cook different porridges, soups and stews including those of vegetal (grass-food) origin. However, it did not seem to have contributed any tangible role in the process of domestication of food-plants.

The pottery of Sheikh el Amin

As mentioned previously, the pottery types excavated from the site of Sheikh el Amin (and the radiocarbon dates obtained) conform to those of the Shaheinab culture. The pottery of both Early Khartoum and Shaheinab seem to be bowl shaped (Magid 1989: 113). But there are some basic differences between the two types as regards the surface treatment and tempering material. For instance, while the pottery of Early Khartoum is unburnished and the clay is mixed with mineral temper that of the Shaheinab type is burnished and its clay is mixed with organic temper (ibid.). It has been suggested that the degree of burnishing (e.g. well, slightly, or poorly burnished) correlated with the diameter of the rim and thickness of the walls and indicates different functions of the pottery (Magid 1989: 118). For instance, highly burnished pots with thin walls and rim-diameters < 30 cm. were used for cooking and slightly or poorly burnished pots with thick walls and rim-diameter > 30 cm. were used as containers of liquids and solid substances (ibid.). On the basis of this interpretation, it seems most likely that the pottery excavated from the sites of Sheikh Mustafa and El Mahalab was multi-function while the pottery recovered from Sheikh el Amin is more specialized in that the degree of burnishing, wall thickness and rim-diameter determine the function of the pot.

W. Handwerker (1983: 19) suggested that the introduction and use of pottery made it possible to boil food and that boiled food would both increase women fertility and substitute mother's milk. The period of breast-feeding and the duration of post-partum amenorrhea will be reduced. Consequently, the birth spacing would be shorter and the survival rate of children would be higher (ibid.). That is to say, pottery made it possible to cook boiled food, and hence indirectly contributed to an increase of the population. However, it has also been suggested that the introduction of pottery implied "constraints on mobility which might have operated as one of the factors favouring sedentism" (Haaland 1995: 116). In other words, material items, such as pottery, would reduce the inconvenience of frequent migration (Rafferty 1985) and increase tendency towards sedentary life as it was probably the case at the sites of Sheikh Mustafa, El Mahalab and Sheikh el Amin.

Concluding summary

The introduction of pottery in the Blue Nile area during the Early Khartoum period (as represented in the sites of Sheikh Mustafa and El Mahalab) led to significant development in the cooking choices and storage facilities of food materials, including food-plants. However, at this stage, pottery vessels are multi-function. Technical quality and functional efficiency of pottery were developed further during the Shaheinab period (as represented in the site of Sheikh el Amin) by introducing new production techniques and/or replacing old ones (e.g. burnishing, using organic temper instead of the mineral one). Consequently, it became possible to make specialized types of pottery meant to serve different functions and purposes. The introduction of pottery also seems to have been one of the main factors that encouraged sedentism and one of the indirect factors that led to increase of population. Both sedentism and population increase have direct bearing on broadening and intensifying subsistence spectrum based on food-plant exploitation.

6. Environmental and climatic conditions during the occupation of the sites

The occupation of the sites being studied here may generally be dated to two periods: an older period between ca. 8000 to 7000 bp and a younger one between 6000 to 4500 bp. These periods may broadly be related to those of the Early and Middle Holocene, in their respective order. That is to say, the sites of the Early Khartoum type (i.e. Sheikh Mustafa and El Mahalab) were occupied during the Early Holocene and the site of the Shaheinab type (i.e. Sheikh el Amin) was occupied during the Middle Holocene. There are several studies on the palaeoclimatic conditions of the Eastern Sahara and the Sudan (e.g. Brewer 1992; Haynes *et al*. 1989; Williams and Adamson 1982), which indicate that during the occupation of these sites, the climatic conditions in the Central Sudan were much wetter than the prevailing semi-arid conditions. More frequent and higher floods were in evidence in the area of the Blue Nile and the Nile River during the Early Holocene (Lario *et al*. 1997; Hassan 1998: 43-51). Recovery of evidence of wild *Sorghum* sp. Moench, *Celtis integrifolia* Lam. and *Carex* sp. L. from the sites being studied here indicate that the annual rainfall was at least 500 mm, at least three times wetter than the prevailing arid conditions in the area. Pollen analytical studies carried out in Western Sudan (Khalafalla 2002) and in the area of the Dinder river in the Central Sudan (Abrahim 1993) indicate that during the Early Holocene, the area of the Central Sudan was characterized by a savanna ecosystem in which grasses and herbaceous taxa predominated in the vegetation structure. (Abrahim 1993: 81; Khalafalla 2002: 42). Moreover, these studies suggest that there was a wet period between 8000 and 6500 bp. in North Africa where palaeolakes were found in what is now an hyperarid region (ibid.: 42). This is further supported by palynological studies from the Libyan Sahara which indicate that until Middle Holocene (around 6900-5000 bp.), a savanna type of vegetation was in evidence (Mercuri and Grandi 2001: 162). The period between 6500 and 3000 bp (though wetter than the present time, yet it) can be considered as one with increasing aridity (ibid.). Further evidence of wet conditions in North Africa is presented in the work of A.B.

Smith (1998: 18) who stated that around 7000 years ago, the northern Sahelian frontier was at 24° N, some 500 to 600 km north of its present latitude. Mary M.A. McDonald (1998: 135) added that about 7000 years ago a northerly shift of the monsoon belt resulted in increased rainfall and the Sahelian vegetation expanded to 25° N in Southern Egypt. She also referred to sedimentological studies, which show that the climate was more humid in the Eastern Sahara during the Early and Middle Holocene (ibid.: 133). Other documentation on the expansion of the Sahelian belt to Southern Egypt consists of evidence of wild sorghum, *S. verticilliflorum* (Steud.) Stapf. recovered from the site of Nabta Playa in the Western Egyptian Desert (Wendorf *et al*. 1998: 71). The occurrence of wild *Sorghum* sp. Moench at Nabta Playa around 8000 bp (ibid.), when compared with the present belt of this species, indicates a shift of its natural habitat and movement of the savanna vegetation 600 km to the north during the Early Holocene (Wasylikowa 1995: 143).

In short, the foregoing account on the palaeoclimatic conditions clearly indicates that the climate of the Central Sudan was at least 3 to 4 times wetter during the Early and Middle Holocene than the present arid conditions. Consequently, dense stands of wild grasses and fruit trees and shrubs grew in the Central Sudan (including the area of the Blue Nile) and were intensively exploited by the prehistoric population.

7. Ethnographic examples of wild food-plant gathering and their relevance for interpreting archaeological data

Some ethnohistoric and ethnographic examples demonstrating exploitation of wild food-plants and the technology used to exploit them are presented in this section. These examples represent some of the (contemporary and past) practises of food-plants gathering (with special emphasis on harvesting of seeds/grains of wild grasses) in different parts of the World. Relevance of ethnographic data (as represented in these example) to the analysis and archaeobotanical interpretation of the data recovered from sites in the Blue Nile area is discussed.

Examples of ethnographic and ethnohistoric data on exploitation of wild food-plants

More than 60 species of wild grasses are exploited for their grains in Africa (Harlan 1989: 79). Most of these grasses are exploited during periods of food scarcity but they are also often harvested casually and opportunistically (ibid.). Nevertheless, several species of these are massively exploited on regular basis to provide staple food for many communities (ibid.). For instance, *Aristida pungens* Desf. is a staple of the northern Tuareq. It was reported that the ripe fields of *A. pungens* Desf. are protected (sometimes by fencing) until the harvest is reaped. *Panicum turgidum* Forsk. is a basic food-plant in the Sahara and *Cenchrus biflorus* Roxb. is a major food in the Sahel (ibid.). Several species of *Eragrostis* N.M. Wolf, *Dactyloctenum* sp. Willd and *Brachiaria* sp. (Trin) Griseb provide staples for most of the communities living in the area between Bornu and Kordofan (ibid). In Darfur region in West Sudan (Fig. 1), *Dacytyloctenum aegytiacum* (L.) Beauv. and *Echinochloa colonum* (L.) Link are considered the best substitutes when millet and sorghum harvest fail (Magid 1989: 183). In addition to these wild grasses, fruits of *Grewia tenax* (Forsk.) Fiori, *Ziziphus spina-christi* (L.) Willd. and *Capparis decidua* (Forsk.) Edgew., are gathered and eaten or prepared in a form of loaf-like food or as sweet drinks (ibid.: 186-187).The seeds of some of these fruits are extracted and eaten raw or cooked (ibid.). Fruits are picked from the trees by hand, by using hooked long wooden rods or by throwing stones at them or by collecting them from the ground (ibid.).

Several methods and techniques are used to harvest seeds of wild grasses. These include beating the seeds into containers, threshing them with sticks, using swinging basket/calabashes, rubbing with the hands into baskets/calabashes or sweeping and/or raking them off the ground (ibid.: 183-188; Harlan 1989: 79). As it may have been noticed, all the tools and equipment used in harvesting are of vegetal origin (i.e. of perishable nature). Some of the tools used in harvesting, e.g. branches and sticks, are picked along the way to or from the vicinity of the fields of the wild grasses and abandoned after harvesting. It should be emphasised that none of the harvesting-methods stated above involve any ”cutting” of any part (whole ears, whole heads, etc.) of the grass harvested. The seeds/grains are threshed using sticks or branches and the winnowing is done by using open-flat baskets or the bare hands.

The seeds-harvest is prepared and consumed in many ways; roasting or boiling the seeds and serving them are two of the most simple ways of cooking the seeds. The seeds may also be pounded (using a mortar and pounder) or ground (using upper and lower grinders) then cooked and eaten in a form of porridge, flat bread or beer (Harlan 1989). Dishes made from pottery or wood, e.g. among the Beja of East Sudan, or calabashes, e.g. among the Ingassana of the Southeast Blue Nile area, Sudan (Fig. 1), are used for serving food and drinks. Huge clay jars are used in Darfur (West Sudan) for the storage of the harvest (Magid 1989: 127). Females (often helped by children) do the harvesting, processing and preparation of wild grain-foods.

The Aboriginal population of Australia are widely known as food-gatherers. It was reported that they collect more that 70 plant species (Cane 1989: 99). About 42 of these produce edible seeds of which 15 belong to grasses (ibid.). Females are responsible for all the activities (harvesting, threshing, winnowing, grinding and cooking) related to exploitation of wild grain-foods (ibid.: 104-7, 113). Harvesting, threshing and winnowing methods, e.g. rubbing between the hands, stripping the seeds into containers (ibid.: 105) are more or less similar to those described earlier in connection with exploitation of wild grasses in Africa. Processing and preparation of the seeds consist mainly of grinding them into flour. The seeds are often soaked (to soften them) before being ground (ibid.: 105-106). The paste produced is eaten raw or shaped into small dampers, which are baked in a campfire (ibid.: 106). Discarded (broken or worn-out) grinders are often used for crushing bones and/or as heat retainers to cook termites or (infrequently) meat “and also to grind ochre for non-sacred” purposes (ibid.: 113). Each married woman has her own set of grinders (ibid.: 112). When she dies, her grinding equipment is deliberately discarded (ibid.: 113). Storage of seeds is one of the most important practises undertaken each year to secure food-stock during the last few months before the rainy season (ibid.: 104).

Ethnohistorical record from the Great Basin in North America show that some of the groups of the Shoshoni Red Indians exploited wild grasses, such as *Eragrostis* sp. Beauv., *Echinochloa* sp. Beauv. and *Oryzoposis* sp., L. for food. Seed-harvesting methods consist mainly of beating the mature plant with a wooden or basketry paddle in order to knock the ripen seeds into a conical basket (Harris 1984: 66). Harvesting wild seeds was performed mainly by women who worked in groups (ibid.) collecting different types of seeds in the same basket. After harvesting, the seeds-mixture was separated by sifting them through a twined basket (ibid.). Grinding equipment, mainly millstones were used to grind the seeds. The seeds were often roasted before they were ground (ibid.). The flour was eaten dry but they sometimes boiled it in pottery vessels to make a mush to which meat was added (ibid.). Seven out of the Shoshoni groups were reported to have deliberately sown (most likely by broadcasting) seeds of wild grasses (ibid.). The surplus harvest was stored in pits dug in the ground that were lined with grass and covered with grass and earth (ibid.). Until two decades ago, storage pits similar to the Shoshoni’s were used for storage of harvest of grain-foods in areas of rainfed cultivation in the Sudan.

The ethnographic and ethnohistoric examples presented in the foregoing account emphasised the following issues:

1. Most (if not all) plant-gatherers adopt, more or less, the same strategies and use similar technologies for exploiting and processing wild food-plants despite the complete lack of contacts between them due to differences in the period of time when they existed, geographical barriers, and environmental differences between their areas.

2. The relationship between gatherers and the plants they exploit seem to differ from one group to another. Several groups devote more effort into caring, protecting and even reproducing the wild plants they exploit. Other groups focus only on reaping the harvest of food-plants available in their environments. This difference of attitudes, towards the food-plants exploited, may partly be attributed to the essence of wild food-plants in the diet and/or availability of or preference to other sources of food.

3. Almost all the tools used in harvesting wild food-plants are of (perishable) vegetal origin. In addition, not all the tools used in harvesting wild food-plants are specifically made for that purpose. Branches and sticks (picked from the vicinity of the fields of wild plants) are often used and abandoned after the harvest. Bare hands are also often used in harvesting and threshing seeds of wild grasses.

4. Edible wild seeds/grains are often harvested in the same container and the mixed harvest is separated at a later stage (e.g. after the harvesting is completed). This is probably done to minimise the number of containers used in harvesting in order to:

a. achieve light and free-movement in the field while harvesting wild grasses,

b. avoid inconvenience and difficulty of transporting the harvest to the settlement area.

5. Roasting and soaking of seeds/grains before grinding them are two different methods used by different and far apart groups of gatherers, yet they yield similar results; namely softening the seeds to facilitate finer, faster and easier grinding (when compared with the coarse, slow and difficult grinding of dry and hard seeds).

6. All the socio-economic activities and tasks related to the exploitation of wild food-plants are in the domain of females.

7. Rituals and rules are observed as regards the use and function of tools associated with food-plant exploitation.

Relevance of Ethnographies for archaeological interpretation: Validity and limitations

As I mentioned at the beginning of this section, the ethnographic/ethnohistoric examples presented in this study show some of the practises of wild plant-gatherers in different parts of the World. In other words, they represent different groups of gatherers living at different periods of times in different geographical areas with different climates and environments. It is not our intention to use this data as basis for a framework in which parallels and comparisons with archaeological data are made and interpretations are drawn. Rather use these examples in order to draw our attention to practises and activities that are not possible to account for in the archaeological record (as demonstrated in the seven points above). Thus, the study and analysis of ethnohistoric/ethnographic data often draw our attention to and broaden our knowledge of the resource exploited and improve our understanding of the ways and socio-economic network by which this resource may have been exploited in the prehistoric times. Moreover, by demonstrating areas of similarity and diversity of contemporary systems of exploitation and use of wild plants, archaeologists and archaeobotanists would be better equipped to develop and/or suggest new interpretative approaches to archaeobotanical data. That is to say, ethnographies often lend clues to questions that should be asked about the archaeological and archaeobotanical data and its interpretation.

Concluding summary

The foregoing account draws attention to patterns and practises for which no evidence is found in the archaeological record. Therefore, by demonstrating their existence and emphasising their essence and meaning, archaeological research (e.g. such as the current one on plant remains) has a potential resource. This resource can be manipulated to achieve better processing of the data and to obtain better clues for generation of questions, and hence draw more dynamic interpretations.

8. Interpretation of the archaeobotanical evidence

Problems of interpreting the archaeobotanical data

Interpretation of the evidence of plant impressions in pottery recovered from archaeological sites is almost always challenged with several scientific and technical realities that make the interpretation process a difficult undertaking. As the archaeobotanical data dealt with in this work consists only of plant impressions in pottery, the evidence recovered does not necessarily represent all the plants (e.g. tubers, roots, large seeds/fruit-stones, seedless plants, etc.) which were brought to the site for human consumption. Moreover, not all the evidence recovered represents edible food-plants. Such occurrences of inedible plants pose several questions as regards the presence and use of these plant species at prehistoric sites. Disturbance of the cultural deposit (as in the case of the sites being studied here) negate the requirements and conditions necessary for analysing, and hence interpreting trends of change and/or development of strategies related to exploitation of food-plants. Finally, quantitative and other statistical analysis are inapplicable because plant impressions are not always comparable (e.g. seed-impressions can not be compared with leave-impressions) and that the recovered number of comparable plant-impressions (e.g. seeds of wild grasses) is almost always too small to allow making any reading on their relative frequencies. Nevertheless, one of the great advantages is that there is direct association between the plant-impressions and the material culture remains (i.e. pottery). Thus, the dates of the impressions and their positive casts are secured if the date of the pottery-type and the context in which it is found are firmly established. Consequently, the information obtained from one impression is often more reliable and less biased than that obtained from a large number of carbonized/desiccated plant-remains (Magid 1989: 74).

General conclusions about the archaeobotanical data

The results obtained from the analysis and interpretation of the botanical evidence recovered from the sites of Sheikh Mustafa, Al Mahalab and Sheikh el Amin can be summarised in the following points:

1. The sites of Sheikh Mustafa, El Mahalab and Sheikh el Amin indicate –in agreement with other Early Khartoum and Shaheinab sites in the Central Sudan– a sedentary mode of life. The optimum climate, size of the sites, the depth of their cultural deposits, their proximity to sources of water, availability of aquatic and terrestrial food-sources (including wild food-plants) and the presence of pottery and grinders were probably some of the pointers that indicate sedentary mode of life.

2. The archaeobotanical evidence recovered from the three sites (i.e. plant-impressions in pottery) indicates that exploitation of food-plant was based on two distinct, yet interrelated strategies. One of these is gathering of immediately eaten food plant (e.g. edible fruits) and the other is harvesting of food-plants that required processing and preparation before being served as food (e.g. seeds/grains of wild cereals and grasses). Edible roots, tubers, etc were probably also brought to the sites as food. Since this type of food-plants are too large to (accidentally or intentionally) be incorporated in the clay while shaping the pottery, no evidence of impressions of these type of plants was found.

3. Inseparable part of point no. 2 is that the basic knowledge (comprising experience, skills, tools, ideas, etc.) required to process and prepare such food-plants as grain-foods, have already been obtained and utilised during the period of Early Khartoum culture as represented in the sites of Sheikh Mustafa and El Mahalab. This knowledge does not seem to have undergone substantial change during the subsequent period of the Shaheinab culture as represented in the site of Sheikh el Amin. The evidence of pottery and grinding equipment recovered from the three sites correlated with the botanical evidence support this interpretation.

4. Strategies of food-plant exploitation similar to the ones described in point no. 2 are reported from other contemporary sites in the neighbouring area of the Central Sudan. They have also been reported from sites in the wider region of North Africa as represented in the sites of the Western Egyptian Desert and the cave-site of Uan Afuda in Libya. That is to say, there was a general pattern in the strategies related to food plant exploitation during the Early Holocene and Middle Holocene in North Africa including Central Sudan (and the Blue Nile area). In addition, the plant remains recovered from sites in the Western Egyptian Desert and Libya provide further evidence for our interpretation that exploitation of wild grain-foods was started several thousands years earlier than previously assumed.

5. Evidence of wild cereals and grasses correlated with evidence of material culture remains (pottery and grinders) recovered from the Early Khartoum sites (including Sheikh Mustafa and El Mahalab) mark the beginnings of a new type of utilisation of food-plants. This new utilisation defined a new relationship between the occupants of the sites and plants they were already familiar with and had the knowledge to exploit them. Until recently, it has been assumed (on basis of similar botanical evidence and material culture remains) that new utilisation and hence, new human-plant relationship was initiated during the Shaheinab period.

6. On the basis of point 5, it may be suggested that protective tending was probably under-

taken in order to secure adequate supply of the potential harvest (e.g. of seeds of wild grasses). Basketry containers (similar to those found in the cultural deposits of the Late Acacus at the cave-site of Uan Afuda) were probably used for harvesting the seeds of wild grasses. Although such activities as protective tending during the Early Khartoum period were probably irregular and limited in scale, yet, they (together with harvesting activities) represent, in their general trend, an initiation of some of the early stages of cultivation[7] of wild cereals. These activities were continued during the period of the Shaheinab but on more intensive and wider scale. There is no direct evidence (from the Early Khartoum or Shaheinab) of tools which can be associated with cultivation activities. However, in light of the ethnographic data presented earlier, one may suggest that cultivation activities could have been performed in the past using knowledge and technologies without traceable evidence in the archaeological record.

9. Relevance of the present study for applied research of the 21st century

Many changes have taken place, during the last few decades in the lives and livelihood of most of the rural populations in Africa, Asia, South America and several undifferentiated communities in North America and Australia (e.g. the Aborigines). These changes are accelerated in recent years due to some or all of the following factors:

1. unplanned urbanisation of remote and isolated areas coupled with ill-planned education policies;
2. outbreak of civil/tribal wars and/or escalation of political instability;
3. repetitive occurrences of rainless years and extended periods of droughts resulting in food shortages and famines.

Rural and undifferentiated communities are exposed only to (random) consumption of end- and by-products of urbanisation without being urbanised or provided the means and ways to assume an urban life (e.g. institutions of civil-society, infrastructures, etc). In addition to this, education was introduced without clear policies of its objectives and benefits, to communities that are basically pastoral-nomads or peasants. Moreover, outbreak of civil wars and rise or escalation of political instability in many parts of the world led to worsening an already bad and deteriorating socio-economic conditions of communities still dependent on subsistence economies, incipient cultivation and traditional pastoral mode of life. All these factors led to emergence of hybrids "or distorted forms" of rural and undifferentiated communities which are not fully urbanised yet no longer able to maintain their traditional economies and ways of life.

Before these changes were imposed, rural and undifferentiated communities were efficiently able to cope with annual food-shortage that often occur shortly before the new year's harvest and with emergency-situations of e.g. rainless years, droughts, famines, etc. Their survival strategies during such periods of hardship were mainly based on their indigenous knowledge of their environments, experience and technology. These assets were used to locate, exploit, process and prepare food-plant (and other food-sources e.g. birds, wild animal species) available in their environments. For hundreds (or probably thousands) of years, the indigenous knowledge was passed over from older to younger generations, and hence it was continuously maintained, skilfully developed and well preserved.

Nowadays, these communities completely failed to sustain themselves during the recent and current droughts and periods of food shortages. The main reason for their failure to survive is that the indigenous knowledge they possessed and used to exploit their environments at times of food-shortage is largely forgotten or completely lost due to the reasons mentioned earlier. Consequently cultivation fields were deserted, live-stock perished and mass migration took place to towns and cities. Upon arrival in towns and cities, new realities emerged and more problems are added due to their failure to cope with city-life to which they are neither accustomed nor qualified/competent to earn a living. Many tragic stories (e.g. prostitution, crime, addiction to alcohol and drugs, etc.) have been filed in the NGOS' reports.

The foregoing account explicitly emphasises that restoration of indigenous knowledge is a central issue when addressing the current crises and a crucial component in policies made to avoid similar experiences in future. It also impliciltly underline the role of indigenous knowledge as one of the tools used to resettle displaced communities in their home areas. But a question may rise here: How can we restore a lost knowledge? In answer to this question, I believe that the findings of archaeobotanical research as the one presented in this study (together with the findings of other related fields of research) can provide an indispensable tool for understanding the background against which restoration and application of traditional interventions can be launched. This can be done in the following manner:

1. provide a means to collect data which is not available for other research instruments and offer researchers and authorities concerned an interpretative tool and an understanding of a field situation that may help creative problem solving;

2. reformulate and present the archaeobotanical and ethnohistoric data and the technological knowledge (i.e. material culture remains) used to exploit natural resources in such a fashion that demonstrates the possibility of locating and exploiting contemporary potential plant resources;

3. re-assemble and integrate interpretative historic studies with contemporary experience. This can be done by launching archaeobotanical research (combined with ethnographic methods) in order to recover fragmented pieces of past traditional knowledge and experience that are scattered over different sources. For instance, accounts of early travellers, geographers, historical documents, etc. In addition, collection of oral history and tradition by interviewing older generations (no longer able to practise);

4. reverse the role of schooling and education of young generation from one that leads to abandonment, disintegration and loss of traditional knowledge to one that revives, restores and accumulates this knowledge. This can be pursued by designing and teaching oriented-courses in archaeobotany and ethnography leading to this end. Similar programmes can be designed and made available to the general public through media, museums and guides. Substantial parts of the indigenous knowledge are embedded in tribal and regional languages that are now rapidly disintegrating. Revival and/or analysis of these languages should, therefore, be part of educational and research programmes;

5. (in connection with the previous point), archaeobotanical and ethnographic research institutions and centres can also undertake joint surveys and studies to accumulate and preserve traditional knowledge in marginal areas which are potentially exposed to droughts and food shortages. In addition, assessments and documentation of places and natural and cultural resources should be made. The findings should be made accessible to communities living in those areas and elsewhere.

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Notes

1 Geographically speaking, the Blue Nile area is situated in the Central Sudan. However, presentation, analysis and interpretation of the data in the present work sometimes require presenting it as a distinct part of the Central Sudan.

2 The present author is reserved as regards the current usage and implications of the terms Mesolithic and Neolithic for the Early Khartoum (Early Holocene) and the Shaheinab (Middle Holocene) type of sites in the Sudan.

3 See footnote no. 2.

4 Most of the archaeobotanical data (from prehistoric sites in the Central Sudan) presented in this section was recovered and analyzed by the author of this paper. He was also given permission to examine and publish results of his study of plant impressions in pottery excavated from other sites in this region.

5 Interpretation of the function of gouges as soil-tilling tools has been evaluated in a previous study of the present author (Magid 1989: 157-177). The results of this study are presented in the following pages of this paper (section 6).

6 No interpretation is made –so far– as regards the function of the small sandstone-rings.

7 Detailed description and discussion on different types of cultivation are presented in Harlan *et al*. 1976b: 9; Magid 1989: 228-9.

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