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ARCHAEOBOTANY OF THE EARLY NEOLITHIC SITE E-75-6 AT NABTA PLAYA, WESTERN DESERT, SOUTH EGYPT
(PRELIMINARY RESULTS)*

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ABSTRACT. Settlement traces belonging to the Middle Level of the early Neolithic site E-75-6 at Nabta Playa, dated to ca. 8000 yrs ago, include several huts and storage pits located near the centre of the lake playa. Location of the settlement and its stratigraphy indicate seasonal and repetitive occupations. Abundant charred plant remains (seeds, fruits, tubers, other parenchymatous fragments and charcoal) evidence extensive exploitation of vegetal resources. Several wild plants, preserved in the form seeds and fruits, were collected, including the oldest sorghum hitherto known.

KEY WORDS: early Neolithic, settlement, archaeobotany, plant gathering, sorghum, Egypt, Sahara

INTRODUCTION

During several field seasons (1974–1977 and 1990–1992) the Combined Prehistoric Expedition conducted extensive archaeological excavations at site E-75-6, one of the most interesting early Neolithic localities of Nabta Playa. Nabta Playa is a large, internal drainage basin in the southern Western Desert of Egypt (Wendorf & Schild 1980). Most likely it is the largest basin south of the Kharga Oasis, receiving in the early Holocene the run off waters from a surface exceeding one thousand square kilometres.

The basin was cut by the Pleistocene deflation into the sandstones and shales of the Nubia Formation and related Basement rocks (Fig. 1). The centre of the basin is partially filled by lacustrine and alluvial deposits showing gravitationally sorted lateral sequence with a suspended load of lacustrine silts and clays in the very centre. The sequence is accompanied by the deposition of phytogenic dunes. Because of the lithological setting, the central part of the Nabta Playa was able to store large quantities of subsurface water providing relatively lush conditions for vegetation in the dry seasons during early Neolithic wet phases.

At present it is the driest part of the Sahara, with mean annual precipitation below 1 mm, rare and very irregular rains and no true rainy season. Water is available only in a few springs and wells scattered throughout the desert (Wendorf & Schild 1980). The area lies between the belts of winter rains to the north and summer rains to the south (Fig. 2). It is included by Bornkamm and Kehl (1990) into their vegetational zone V described as extreme desert 3, practically void of vegetation, which is limited only to the nearest surroundings of wells or springs and places where geological situation favours runoff water accumulation after occasional rains. In six small uninhabited oases nearest to the Nabta Playa Bornkamm (1986) has found individual speci-

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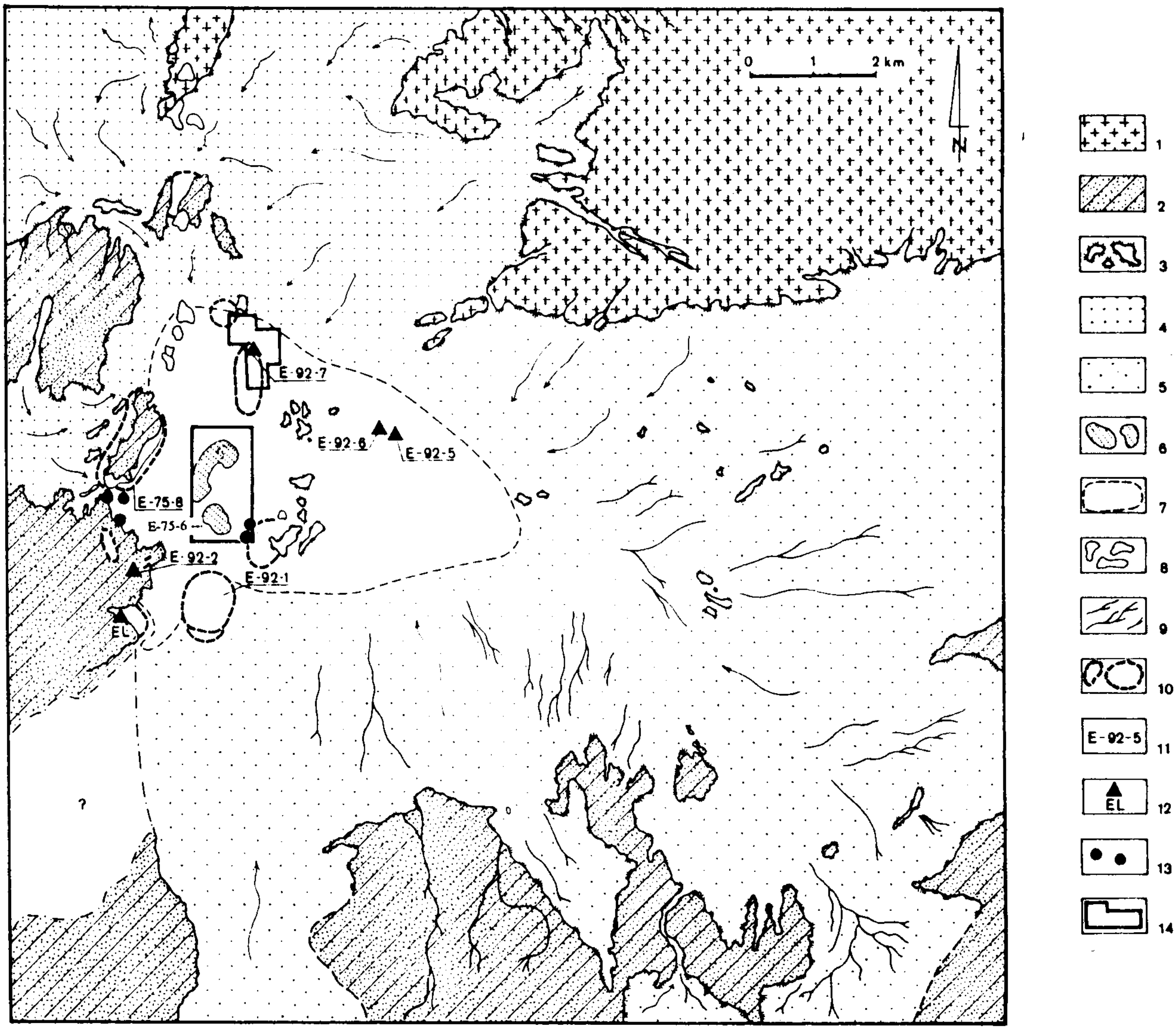

Fig. 1. Geomorphological sketch of the Nabta Basin based on air photographs. 1 – basement rocks; 2 – sandstones and shales; 3 – sandstone hills; 4 – gravelly alluvia grading into fine-grained alluvia; 5 – fine-grained alluvia; 6 – fossil phytogenic dunes; 7 – silts and clays; 8 – recent dunes; 9 – shallow wadi channels; 10 – Neolithic archaeology on surface; 11 – archaeological sites; 12 – elephant site; 13 – megalithic tumuli; 14 – location of detailed maps (map by Schild)

mens of a few trees and shrubs (*Hyphaene thebaica, Acacia ehrenbergiana, Tamarix mannifera, Capparis decidua, Phoenix dactylifera*), grass stands of *Stipagrostis vulnerans, Phragmites australis, Sporobolus spicatus, Cynodon dactylon* and *Imperata cylindrica*, as well as *Typha domingensis* and *Cornulaca monacantha*. In a survey of this same area El-Hadidi (1980), in addition to the above enumerated taxa, has recorded also *Panicum turgidum, Stipagrostis ciliata, Astragalus vogelii, Fagonia arabica, F. indica, Tribulus pentandrus, Euphorbia granulata, Citrullus colocynthis, Aerva persica, Crotalaria thebaica, Salsola baryosma* and *Francoeuria crispa*. In his opinion, *Sorghum sudanense* collected at Bir Kiseiba in 1978 by Mehringer, was probably introduced by camel route. On the pan of the Nabta Playa El-Hadidi has observed a dead specimen of *Salsola baryosma,* which probably started to grow around 1960–61 (estimation based on ^{14}C content). During the archaeological field season in 1990 a living specimen of *Zygophyllum coccineum*, with green leaves and flowers, grew on the playa, half way between sites E-75-6 and E-75-8 (by 1993 the plant had already dried). Not far from site E-75-6, a stand of dead plants of *Astragalus vogelii* existed in 1990–91–92 with many fruits buried in the sand beneath each shrublet. Other dry plants recorded in 1992 on the playa were *Fagonia indica* and *Tribulus longipetalus* ssp. *macropterus*.

Geological evidence from the region around

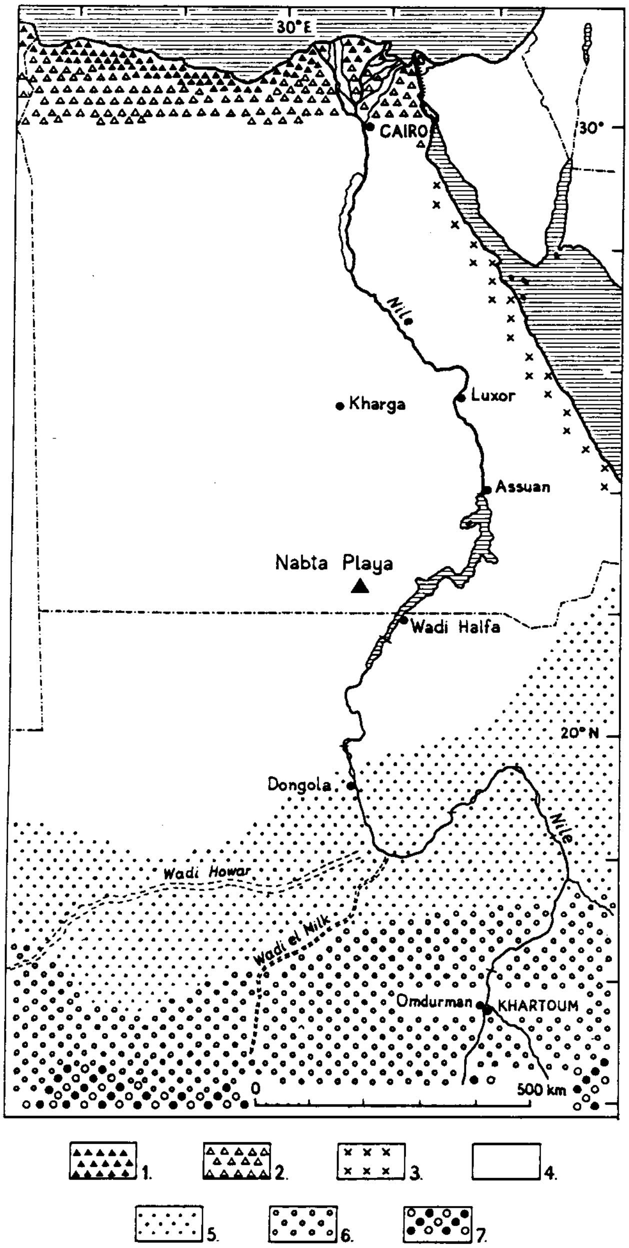

Fig. 2. Vegetation zones in north-west Africa and the location of Nabta Playa. 1 – sub-mediterranean vegetation changed by man; 2 – contracted desert vegetation of northern type in the winter rain region; 3 – desert vegetation of Red Sea coast; 4 – extreme desert with ephemeral vegetation and oases; 5 – contracted desert vegetation of southern type in summer rain region; 6 – semi-desert with *Acacia-Commiphora* scrub; 7 – thorn savanna with *Acacia mellifera* and *A. senegal* dominant (from Neumann 1989, simplified)

Gebel Nabta shows that more favourable environmental conditions existed in this area in the early and middle Holocene, ca. 10000–5000 yrs bp (Wendorf & Schild 1980, Wendorf et al. 1991).

SUMMARY OF ARCHAEOLOGY AT SITE E-75-6

SITE LOCATION

Site E-75-6 is positioned on an early Neolithic phytogenic dune and covered by lacustrine playa silts. Toward the centre of the basin, the dune interfingers with fine-grained playa sediments. In stratigraphically lower sections, the dune contains earlier Neolithic occupations, for example, of the El Adam Type. Extensive archaeological excavations revealed the complex startigraphy of the site as well as a large number of man-made features associated with the upper archaeological levels.

ARCHAEOLOGICAL STRATIGRAPHY AND CHRONOLOGY

Site E-75-6 contains three archaeological levels. The Lower Level is embedded in the upper part of the dune, some 25 to 50 cm below the Middle Level. The associated lithics probably indicate the El Kortain type of the early Neolithic. There is only one radiocarbon measurement associated with this occupation. It is of 8270 ± 80 (SMU-257) ^{14}C yrs bp (Haas & Haynes 1980).

The Middle Level is deposited over a thin sandy silt, called the Stabilisation Zone, a thin, hardened surface resulting from a combination of pedo- and anthropogenic processes. It rests over the top of the dune. Man-made features (huts, pits and wells) cut through the Stabilisation Zone into the dune. In the areas of the site where the deposits are well preserved, the pits and features are covered by a very thin lens of lacustrine silt and a rewashed horizon of charcoal and cultural material derived from the original cultural bed of the Middle Level.

A series of 28 radiocarbon age estimates (on charcoal, seeds/fruits and ostrich eggshells) comes from pits and features of the Middle Level. They range from ca. 8600 (Gd-4587) to 7600 (Gd-6507) ^{14}C yrs bp (Fig. 3). The most stable, however, is a group of eight accelerator dates measured on seeds and tubers recovered from pits and huts.

The accelerator estimates range from ca. 8025 (OXA-3220) to 7900 (OXA-3221) radiocarbon years bp and are all placed within one standard deviation (Wendorf et al. 1992). Most likely the accelerator estimates date the occu-

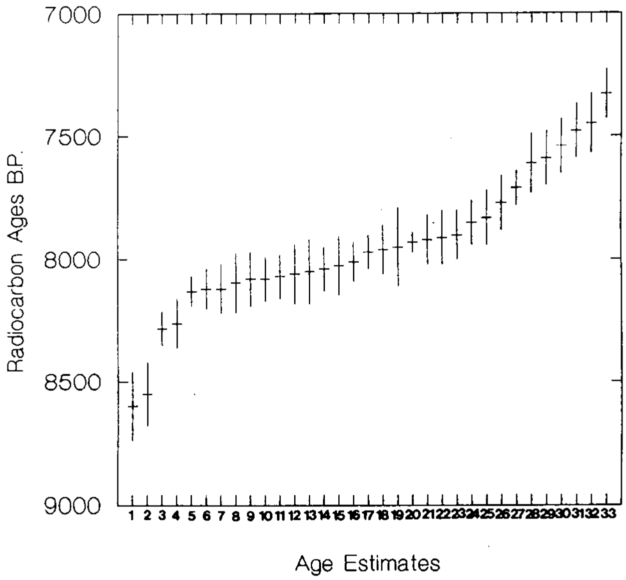

Fig. 3. Radiocarbon age estimates from Middle and Upper Levels. SMU ages according to Haas & Haynes (1980), OXA measurements after Wendorf at al. (1992), Gd ages measured by M. F. Pazdur & A. Pazdur (Silesian Technical University, Gliwice). Samples: 1 – Hut 3/90, Gd-4587; 2 – Hut 1/90, Gd-6254; 3 – Hut 1/91, Gd-5971; 4 – Pit 1/90, Gd-6260; 5 – Pit 3, SMU-255; 6 – Hut 132, SMU-219; 7 – Hut 117, SMU-199; 8 – Hut 1/90, OXA-3215; 9 – Hut 1/90, OXA 3214; 10 – Pit 1, SMU-252; 11 – Pit 2, SMU-253; 12 – Hut 2/90, OXA-3222; 13 – Hut 1/90, OXA-3218; 14 – Pit 2, SMU-249; 15 – Pit 1/90, OXA-3220; 16 – Hut 132, SMU-203; 17 – Pit 1, SMU-240; 18 – Hut 1/91, OXA-3216; 19 – Hut 3/90, OXA-3219; 20 – Hut 132, SMU-208; 21 – Hut 2/90, Gd-6258; 22 – Hut 2/90, Gd-6500; 23 – Hut 1/91, OXA-3221; 24 – Hut 1/91, Gd-6506; 25 – Hut 1/90, Gd-6498; 26 – Hut 1/90, Gd-6257; 27 – Hut 117, SMU-191; 28 – Hut 1/91, Gd-6507 (Upper Level); 29 – Hut 3/90, Gd-6503 (Upper Level?); 30 – Pit 3/90, Gd-6508 (Upper Level); 31 – Pit 2/90, Gd-6509 (Upper Level); 32 – Pit on sq. BB/10, Gd-4586 (Upper Level); 33 – Pit 1/91, Gd-6510 (Upper Level)

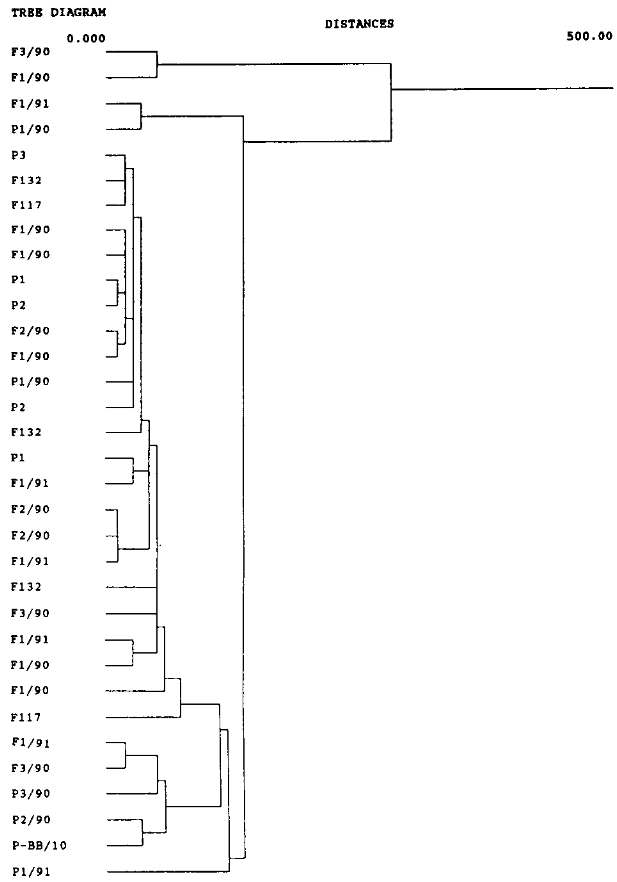

Fig. 4. Clustering of radiocarbon age estimates from Middle and Upper Levels, nearest neighbour method, Euclidean distance. Key: F – features (huts); P – pits. Note separate grouping of estimates from the Upper Level at the base

pation of the Middle Level. It is believed that the oldest estimates of the series result from the burning of fossil wood, while the youngest ones may show the contamination of later occupations.

Pits of the Upper Level cut through the water laid horizon of redeposited Middle Level and are sunk well into the dune. The pits are, in turn, overlain by a bed of homogeneous playa silts. There are five radiocarbon age estimates associated with pits and hearths of this level. Except for one, all of them are within one standard deviation and range from ca. 7600 (Gd-6503) to 7330 (Gd-6510) yrs bp (Fig. 4). The radiocarbon age estimates place the Upper Level in the early Middle Neolithic of the Western Desert of Egypt.

ARCHAEOLOGY OF THE MIDDLE LEVEL

Archaeology of the Middle Level was the most intricate and the best studied. The majority of the site had been initially exposed by the deflation (Fig. 5). There the destruction was the largest and the man-made features partially destroyed. In the areas covered by playa silts, that is, in the northwestern and southeastern corners of the excavated area, the huts and pits are well preserved.

The map of exposed huts, pits and wells indicate three to four rows of huts accompanied by bell shaped storage pits and water wells. The rows are seemingly placed in a slight arc probably reflecting the expanding, consecutive shore lines.

Archaeological work during the 1990–1992 field seasons was concentrated in the southeastern part of the site where four cuts and eight test trenches were opened. Here the Middle Level is covered by a relatively thin playa seal. It was this portion of the site that

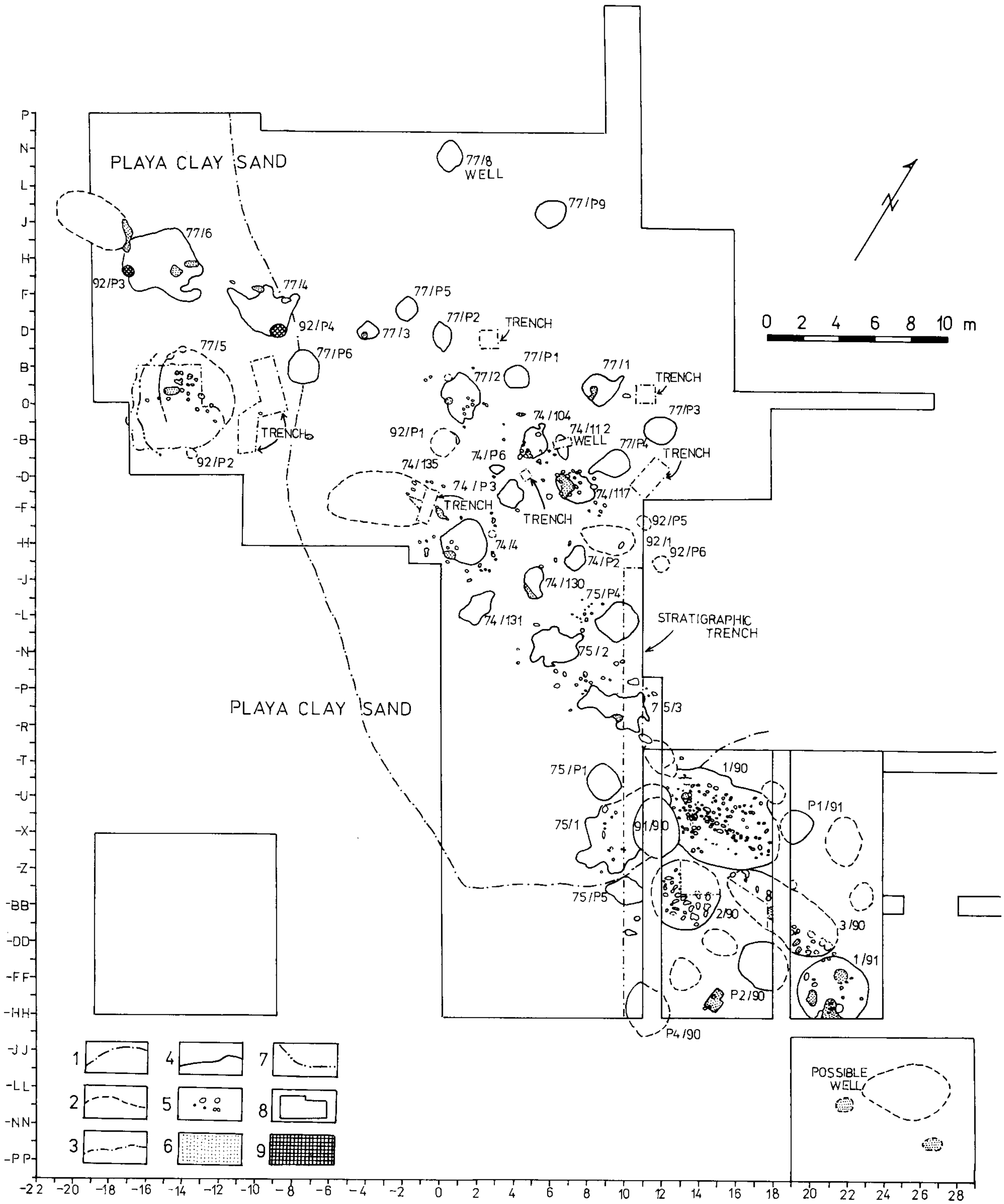

Fig. 5. Map of major cuts and trenches at site E-75-6. 1 – contact of playa silt and dune sand; 2 – unexcavated edges of huts and pits; 3 – additionally excavated areas within cuts; 4 – excavated edges of huts and pits; 5 – pot-hole/posthole; 6 – hearth/burned areas; 7 – edge of upper hut at Feature 77/5; 8 – cuts and trenches; 9 – excavated bell-shaped pit

was subjected to a systematic recovery program of floral macroremains.

Removal of the thin playa seal in the southeastern section of the site revealed four entire huts, a fragment of a hut excavated in previous seasons, ten bell shaped pits, a possible walk-in well and three hearths. The huts were almost entirely excavated while only a few pits were dug.

Very rich lithic assemblage of the Middle

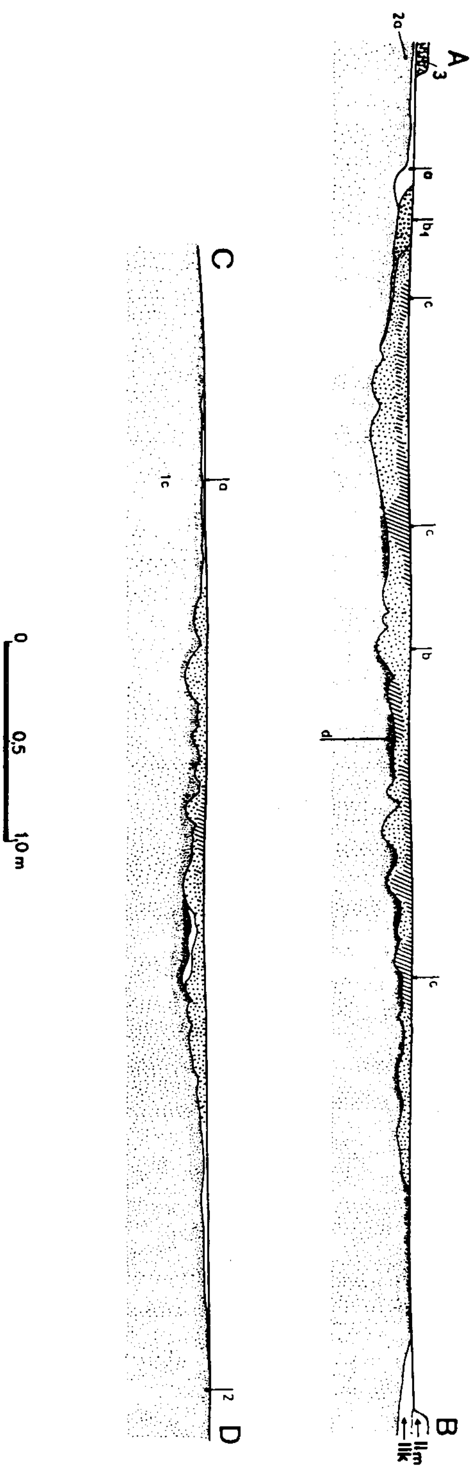

Fig. 6. Cross-section through hut 1/90 along lines A-B and C-D (Fig. 7). 1c – sand dune; 2 – stabilisation zone, truncated; 2a – stabilisation zone; IIk – Feature 1/75; IIm – spoil heap sand from Pit 1/90; 3 – deoxidized lacustrine silt; a – light gray cultural sand fill; b – gray cultural sand fill; b1 – dark grey cultural sand fill; c – reddish brown silt; d – red burned sand

Level belongs to the Nabta type of the early Neolithic (Banks 1984, p. 123). The rare pottery is well fired and decorated with a herring bone pattern. Shaped lower and upper grinding stones also occur. A rich fauna assemblage is composed mostly of hare and a small gazelle (Gautier 1980).

Huts

Two types of huts are present, elongated ones and round ones. In the cross-section, the huts appear as shallow basins (up to 30 cm in depth) cut into the underlying dune (Fig. 6). They are filled with ashy sand and cultural remains. Cooking hearths in the form of lenses of burned reddish brown silt, extremely rich in charcoal are deposited at various levels of the fill. Floors of the huts are dotted with shallow hemispherical pits (pot-holes) of various sizes that had served as nests for containers (Figs 7, 8). Small, deeper pits left by stakes and posts were located near the perimeters of the hut basins.

Detailed stratigraphy shows that some of the huts overlap and cut into each other. Also, several pot-holes and cooking hearths intersect each other indicating reuse of the hut.

Preserved details permit a fairly plausible reconstruction of the huts. It appears that they were roofed by sticking tamarix branches into the sand around the shallow basin (Figs 9, 10).

PREVIOUS STUDIES ON ANCIENT PLANT MATERIAL FROM NABTA PLAYA

The first studies on plant remains from site E-75-6 were carried out by El-Hadidi (1980). In the lower level, then described as the Terminal Palaeolithic and dated to about 9360–8580 bp, the following plants were found: pieces of *Salsola baryosma* (Schult.) Dandy, empty glumes of *Phragmites australis* (Cav.) Trin. ex Steud. (El-Hadidi 1980, Fig. A5.1d), and numerous fibrous grass roots. The Neolithic horizon, which is re-examined here, contained: “numerous fragments of *Tamarix* branchlets; fibrous roots of grass; reticulated vascular strands of a palm; numerous wood fragments of *Acacia ehrenbergiana*; bark and wood fragments of *Salsola baryosma* (Schult.) Dandy; a fragment of the pericarp of *Hyphaene thebaica* (L.) Mart. (dom palm); a fragment of a fruit of a *Medicago* sp. (an annual weed); and two well preserved grains of barley (Figure A5.2c, d)” (El-Hadidi 1980, p. 346–7).

From site E-75-8 at Nabta Playa, about 3 km west of site E-75-6, El-Hadidi (1980, p. 347–8) has also described “few spikelets of a

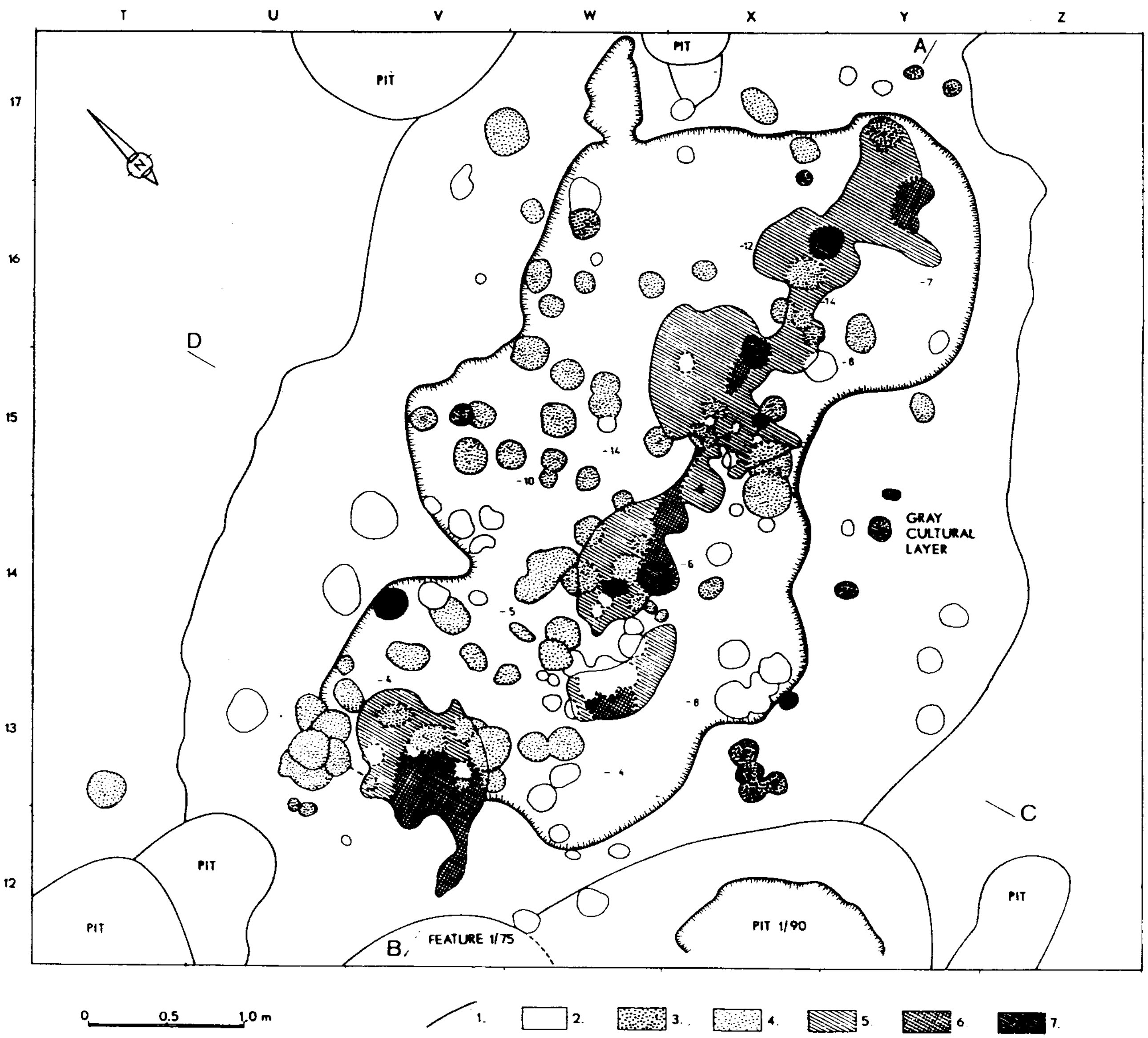

Fig. 7. Map of hut 1/90. 1 – edge of hut, 2 – unexcavated pot-holes, 3 – excavated postholes, 4 – excavated pot-holes with gray sand fill, 5 – hearths (burned, reddish brown silt with charcoal), 6 – red burned sand, 7 – excavated pot-holes with reddish brown fill (cooking pot-holes)

small-sized variety of barley" (El-Hadidi 1980, Fig. A5. 2a, b) in the lower level and larger and broader barley spikelets in the upper one. Other plants reported by him from this same site were: "extensive fibrous roots of a grass" (l.c., Fig. A5. 1b), *Calendula* sp. fruit (l.c., Fig. A5.1e), *Tribulus pentandrus* Forssk. mericarps (l.c., Fig. A5.1a) and a seed of a *Phoenix dactylifera* prototype (l.c., Fig. A5.3)

Both sites E-75-6 and E-75-8 were extensively sampled in 1990–92 with special attention paid to all plant remains other than charred wood, and particularly to those resembling barley and wheat. No seeds or fruits were found at E-75-8, while at E-75-6 they were very abundant. Barley and wheat were not found. We are convinced that these cereals were not present at the Nabta Playa sites (Wendorf et al. 1991).

Some other older plant determinations from these sites are also doubtful. The evidently uncharred specimen described by El-Hadidi (1980, p.346, Fig. A5.1d) as "empty glume of *Phragmites australis*" must be recent fruit of *Astragalus* and does not belong to the archaeological context. Dead *Astragalus* plants occur fairly abundantly on the playa not far from the site and their fruits, very numerous in the sand below every shrublet, can easily contaminate archaeological layers. No opinion can be expressed about the other specimens for which no information is given on their preservation state.

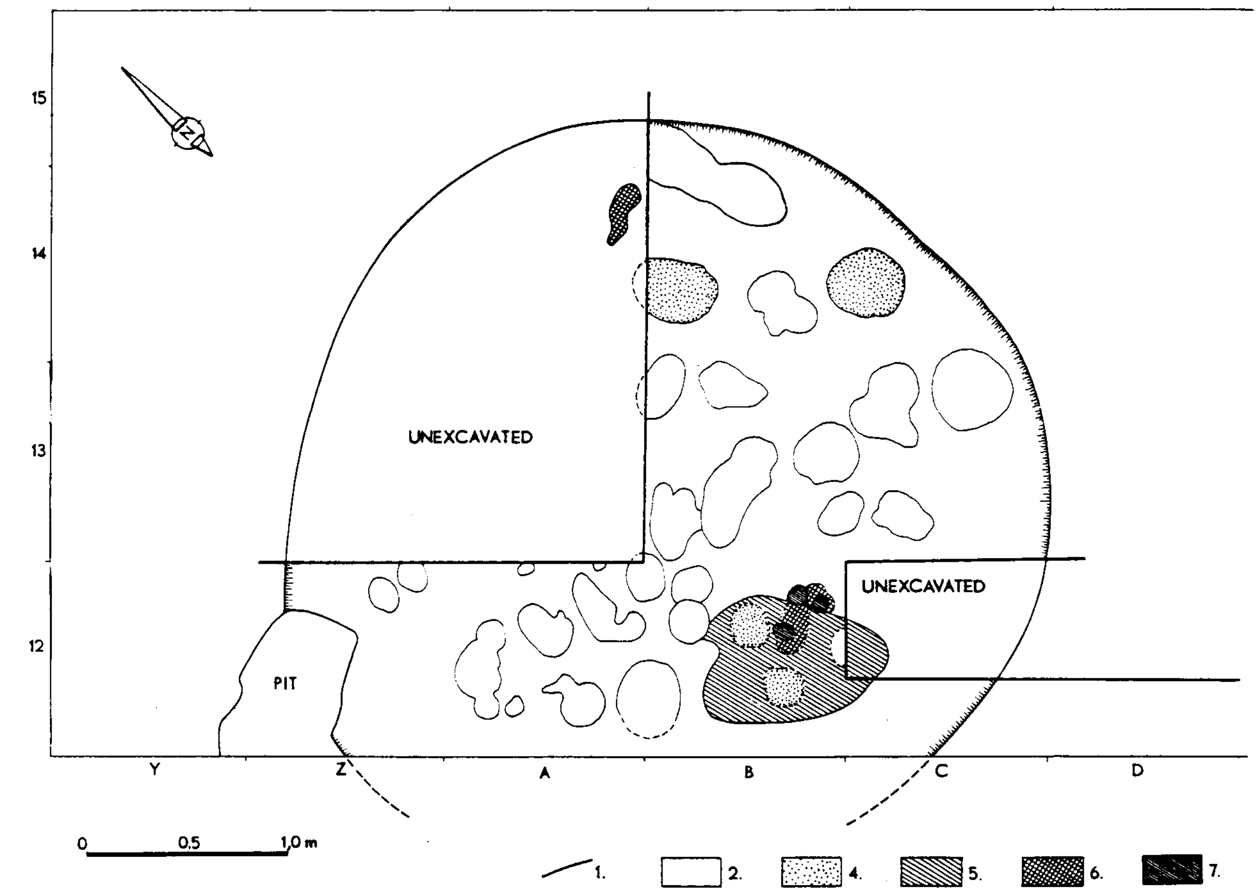

Fig. 8. Map of Hut 2/90. Key as in Fig. 7

NEW ARCHAEOBOTANICAL STUDIES

SAMPLING PLANT REMAINS IN THE FIELD

During the three excavation seasons in 1990, 1991 and 1992, ca. 460 sediment samples were collected for botanical examination from hearths, pot-holes, postholes and the fill of huts or pits. Samples were precisely located within archaeological context and their position was marked on the excavation plan. The following procedure of sample collection was adapted.

Hearths. Each hut contains one to five hearths. They appear as reddish brown ashy sand lenses, often overlying red, baked sand. The samples were collected from individual hearths.

Pot-holes. Floors of the huts, as well as the hearths show numerous small, hemispherical holes of various sizes, interpreted as supports for containers. They are shallow basins from ca. 7 to 30 cm in diameter and ca. 1–10 cm in depth. These small basins are filled with two kinds of ashy sediment. A light to dark grey sand with numerous charcoal flakes is similar to the fill of the house. The holes located farther from the hearths are slightly bigger, deeper and contain less charcoal flakes. Near to the hearths, the pot-holes often intersect each other.

Some of the pot-holes are filled with a different sediment, namely with a dark brown silty sand, rich in charcoal powder and flakes. They occur inside hearths and at their perimeter.

Samples were collected from individual pot-holes and the whole fill was brought to the field laboratory. Each pot-hole had its own number and was marked on the map. Stratigraphically younger pot-holes were sampled separately.

Postholes are relatively deep holes, ca. 8–15 cm in diameter and 10–22 cm in depth. Most of them occur at the margin of the huts. It is likely that they represent the remains of wooden sticks and posts sunk into the sand, and are considered to be elements of hut con-

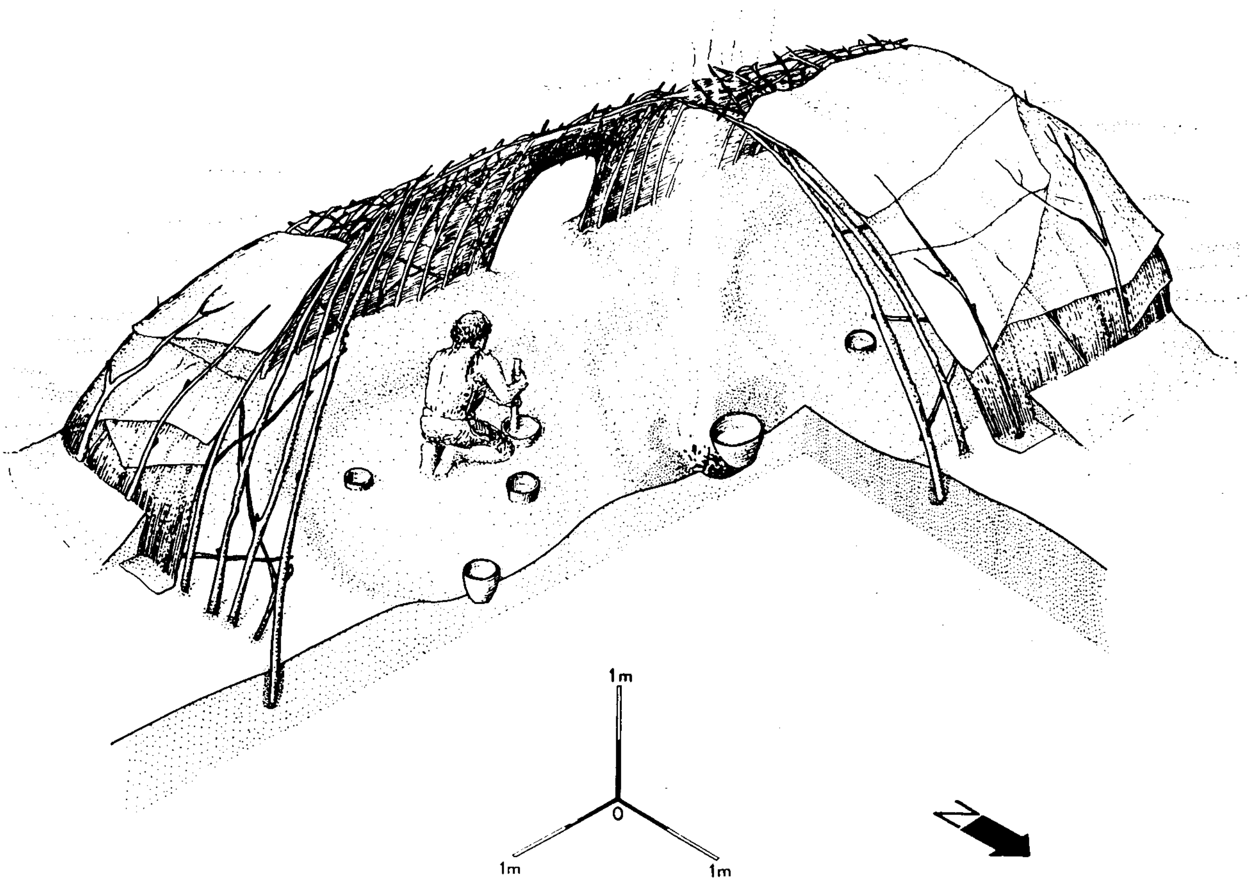

Fig. 9. Reconstruction of hut 1/90. Drawing by M. Puszkarski

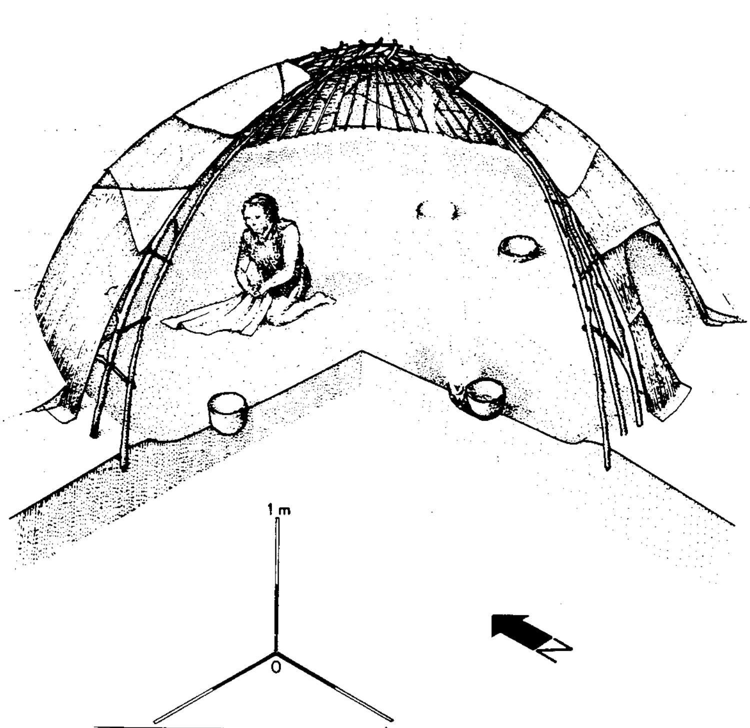

Fig. 10. Reconstruction of hut 2/90. Drawing by M. Puszkarski

structions. The postholes are filled with yellowish-grey sand, somtimes mixed with charcoal flakes or silt. The presence of silt indicates that the holes were filled with sediment after the decay of wood had occured.

Fill of the hut. The sampling of the fill of huts was not quite uniform. During earlier seasons samples were taken from individual square meters and either from the upper or lower part of the fill. In the 1992 season the square meters were gridded into 16 sub-squares of 25 x 25 cm and the samples were collected from individual sub-squares.

Fill of the pits. Only a few samples of the fill of the pits were collected. In every case they were stratigraphically discriminated, according to the filling phase, into the first and second phase.

In 1992, additional samples were collected in the western part of site E-75-6 that had been excavated during the 1974 and 1977 field seasons. For this aim, the part of the area excavated in earlier seasons was cleaned to the top of the unexcavated sand and, in a few cases, traces of previously unexcavated parts of the features were exposed. These were subjected to the sampling procedure described above.

In 1990, two types of samples were collected for the analysis of seeds and fruits: bulk soil samples untreated in the field and samples sifted in the field in coarse mesh sieves (4.5 mm and 2–3 mm mesh sieves) that are used in routine archaeological exploration. Both categories were examined in the field laboratory organized in a tent. The soil of bulk samples was dry sieved through either 1.0 or 0.5 mm mesh sieve and the fraction retained in the sieves was searched for plant remains with the aid of a 4 times magnifying lens. Occasionally, the fraction which went through the sieve was checked and it was found to contain a few small seeds. The examined volume of soil samples ranged between 350 and 2750 cm^3, in a few cases it was less than that. The samples sieved in the field contained mostly charcoal with a very small number of large *Ziziphus* fruits and tubers. During the next field seasons these samples were not examined with respect to their fruit content. In a few instances, individual large fruits recognized by the excavator in the field were sampled separately.

TAPHONOMIC PROCESSES

For the interpretation of plant remains in terms of paleoecology and paleoeconomy taphonomic processes, involved in the preservation of plant material are of great significance. All plant remains found at site E-75-6 are charred and are practically of the same radiocarbon age. They come from clearly defined archaeological contexts which include: 1. hearths, pot-holes, postholes, house fill and house fill top, all from the inside of huts; 2. the fill of pits outside the houses; 3. one hearth situated outside the houses. The majority, if not all of plants found in these various contexts must have been brought to the settlement by man. There could have been a few plants growing around the huts and pits within the settlement itself but their incorporation in charred assemblage by natural means must have been, quantitatively, insignificant. People were bringing plants mainly for two purposes, for food and fuel; other uses (medicinal, magic) probably played a subordinate role, at least quantitatively. Animals (wild) could also have contributed by bringing seeds or fruits on their fur or in droppings but animal dung was not found on this site. Thus, the ancient plant assemblage includes mostly plants selected by man, which means that it may not reflect properly the vegetation of the habitation time and area. Quantitative relations between plant species are certainly different and many plants of no use for man are missing.

Theoretically, charring of plant material could have occurred in two ways, either near the hearths (not in open fire) and pot-holes or in unintentional fires which would have destroyed houses and pits. Because there are no indications of a conflagration the latter possibility must be rejected. Seeds and fruits show damages caused by high temperature but they are always preserved as individual specimens, not lumped together. This may suggest that they had been spilled around the hearths and pot-holes during the preparation of food but they are not remnants of actual dishes ready for consumption. Plant fragments, charred near fires, were scattered over the whole house floor while the house was still inhabited and later, when it has been abandoned.

INTERPRETATION

The list of plant remains recovered from the site E-75-6 includes about 40 different morphological types of fruits and seeds. Only half of them are determined to taxonomic units of various ranks and a small number of specific identifications seriously bears upon the interpretation of the material. Particular limitations concern the possibility of paleoecological reconstructions while the estimation of the economic role of plants is less influenced. The exact knowledge of plant species used by people would also be important for better knowledge of ancient nutrition but some general statements are possible, such as, for instance, that sorghum was used, wild grasses from the millet group were collected, and that *Ziziphus* fruits were consumed.

Detailed results of archaeobotanical analysis will be presented elsewhere. Here only the question of plant exploitation and their distribution in the settlement will be addressed.

Exploitation of plants

No large accumulations of one type of plant seeds were found which would directly indicate their purposeful collection. The assumption about the use of plants is based on frequent and abundant occurrence of their diaspores in the subfossil assemblage, combined with the ethnographic information concerning individual species.

Grasses

The widest ethnographic analogies exist for collection of wild grasses which in modern times "have been harvested on every inhabited continent, sometimes on a grand scale" (Harlan 1989a, p. 69), and 8000 yrs ago could have been an important food too. At Nabta Playa these were sorghum, *Panicum* cf. *turgidum* and *Echinochloa* cf. *colona,* recovered in fairly large numbers and in many samples, and perhaps a few other grasses found in smaller quantity, e.g. *Digitaria* t. (not *D. exilis*), *Setaria* t., *Brachiaria* t. and *Urochloa* t. (Pl. 1, figs 2, 3, 5). Grains of these grasses were probably pounded, cooked and eaten as a kind of porridge; roasting of grain was also possible.

Among grasses, the most interesting is sorghum, the oldest one hitherto known. Its taxonomic affiliation will not be discussed here because it is the matter of further studies (Dahlberg et al. 1995). Tentative morphological examination of ancient grains has shown their similarity to a race having relatively small and obovate, broad oval or oval elongated caryopses (Pl. 1, figs 6,7); similar caryopses were found in the races *verticilliflorum, virgatum* and *aethiopicum* but other possibilities were not checked. The few spikelet bases which are present in the material all show a smooth abscission scar, not a single specimen has a stalk typical of domesticated form (Pl. 1, figs 8,9). On this basis, combined with the whole botanical and archaeological context, it was supposed that sorghum from E-75-6 belonged to a wild race and it was described as *Sorghum bicolor* (L.) Moench. ssp. *arundinaceum* (Desv.) de Wet et Harlan (not to be confused with the race *arundinaceum* in the sense of Harlan 1976; Kubiak-Martens & Wasylikowa 1994, Wasylikowa & Kubiak-Martens 1995). However, the preliminary study of lipids by Evans (Wasylikowa et al. 1993) showed some resemblance to domesticated forms and extensive investigations on these grains have now been initiated by a group of specialists in various laboratories in an attempt to elucidate the status of this plant (Dahlberg et al. 1995). In this connection, the opinion expressed earlier by one of authors (Harlan 1989b), that the older Holocene in the Upper Egypt would have been a logical time and place to learn the arts of decrue agriculture is of interest because sorghum perhaps could have been cultivated that way.

No sorghum occurs today in the broad surroundings of Nabta Playa. Race *verticilliflorum* has its northernmost localities in central Sudan, at least 600 km to the south (Fig. 11). In some places (Sudan, Chad) it grows in great abundance (Harlan 1976, 1993). The occurrence of this race in the area of Nabta would require a great shift of its range to the north and a change in day length requirements. Such a change of its distribution, compared to the modern one, would agree with the other data which indicate the movement of savanna vegetation to the north in the older Holocene (Neumann 1989).

The presumption that sorghum from Nabta Playa could be the *verticilliflorum* race would have two consequences. Firstly, it would allow to include this finding in the line of possible

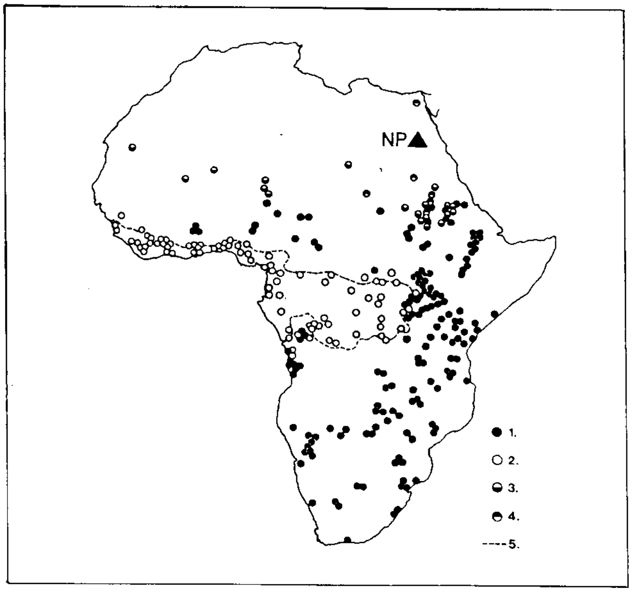

Fig. 11. Distribution of wild sorghum races in Africa. 1 – *verticilliflorum;* 2 – *arundinaceum*; 3 – *aethiopicum*; 4 – *virgatum*; 5 – forest limit; NP – Nabta Playa (after Harlan 1976).

progenitors of domesticated races and secondly, it would point to the existance of savanna, not far from site E-75-6, as the most likely habitat where this grass could have been gathered. Its modern habitats are described as follows: "In the area of greatest abundance, in Sudan for instance, or parts of Chad, you can drive for a hundred kilometers through tall-grass savanna, a marvellous formatiom extending as far as you can see, with spiny acacia dotted through it here and there, unploughed, uncultivated, not even grazed very much. This is clearly a primary habitat, and there is a lot of it left. The chief dominant of this grassland is the *verticilliflorum* race of sorghum, present in enormous quantities. It is a very productive plant which can grow 4 m high, with many panicles and lots of seed; if you want to get the seed you have to harvest it over a week or so, but it has enormous productivity in its native state" (Harlan 1993, p. 54).

However, if we take into consideration modern distribution the most probable race to occur at Nabta Playa is a *virgatum* race. This small grass grows along stream banks and irrigation canals in arid northeastern Africa and is mainly bound to the Nile floodplain (Harlan 1993, Wet de 1978). At Nabta Playa it would develop on damp sandy soils around the lake, in places moister than those suitable for the race *verticilliflorum*, and would there be available for harvesting. If this assumption is accepted, sorghum from Nabta Playa might have no relevance to domestication.

The third possibility would be the race *aethiopicum*. It is a desert grass which grows across the Sahel from Mauritania to Sudan (Wet de 1978) and in southern Sahara but does not occur in Egypt. According to observations in the Air Mountains in North Niger it occurs on clay floodplains, often in large populations. It is used for grazing animals and is collected for human food. It can give a high harvest, up to 250 kg/ha (Schulz & Adamou 1992, p.151). However, the wild status of this race is uncertain (Harlan 1993) and for this reason its presence at Nabta is doubtful. The race *arundinaceum* is excluded from our considerations because it is a west African taxon adapted to the tropical forest zone (Harlan 1993).

The wild millet *Panicum* cf. *turgidum* Forsk. is represented by numerous, well preserved naked grains without lemma and palea (Pl. 1, fig. 1). At present, the species occurs across the Sahara and northern Sahel and grows abundantly on sandy and stony soils. It makes typical communities of contracted vegetation along the wadi beds with *Acacia raddiana*. The species is extremely drought-resistant, it may live for years with no rain and dry plants may start to grow immediately after rainfall. Several habitat types of this species are described in the "Vegetation of Egypt" (Zahran & Willis 1992); a grassland community of *Panicum turgidum*, very common in the Egyptian deserts, makes good pasture and is subject to destruction due to overgrazing. The grass grows in tussocks on sandy soils and may be associated with trees and shrubs like *Cassia senna, Acacia ehrenbergiana, A. raddiana*. Some other plants found at the Nabta Playa site, like *Arnebia hispidissima* and *Schouwia thebaica*, can occur in this community.

Green *Panicum turgidum* plants are good fodder for all animals, dry ones will be eaten only by camels and donkeys. Stems are collected for fuel (Täckholm & Drar 1973, p. 435) and for making mats (Schulz & Adamou 1992). Grain is collected in the west and central Sahara as an important wild cereal (Harlan 1989b) to make porridge, ash from the plant is added to tobacco for chewing. The yield may be as much as 70 kg/ha (Schulz & Adamou 1992). Its significance for local people is manifested in the fact that it is protected under penalty from grazing before the grain is harvested (Harlan 1989b).

Echinochloa cf. *colona* (L.)Link., the most abundant grass type at the site E-75-6, like *Panicum* cf. *turgidum* is represented by naked grains (Pl. 1, fig. 4). It is an annual species occurring throughout the tropics and subtropics, a weedy species of muddy and swampy places (Clayton & Renvoize 1982). In Egypt it is a common weed in fields, gardens, cultivated ground, on channel banks, and in other moist places (Täckholm 1974, Cope & Hosni 1991). It may occur on slightly wet, saline soils in the Western Desert and as a weed in summer cultivations in the oases. It grows together with *Cyperus rotundus*, around the artificial lake below the Aswan Dam in the lower level of the terrace, subject to prolonged inundation, and in the middle level terrace of the rocky slopes subject to daily water fluctuations (Zahran & Willis 1992). It occurs on flooded, sandy substrate where it may form extensive stands (Schulz & Adamou 1992).

Täckholm and Drar (1973) write that the grains of *Echinochloa colona*, identified by Netolitzky, were found in the intestines of mummies from Nag' el Deir near Girga dated probably to 4000–3500 BC. Pure grain was preserved in great numbers and Täckholm suggested that the grass might have been cultivated as a cereal. Germer (1985) has pointed out that cultivation is highly unlikely and that the grass was probably collected in predynastic Egypt, just as it is done today by some tribes in the Sahara. The plant is counted in the group of "bougrou" grasses gathered on flooded swamps (Harlan 1989b).

Possible useful plants from other plant families

The presence of one type of seed from the Cruciferae family is very interesting because the seeds are both abundant and frequent. Tentatively they are identified as *Schouwia thebaica* Webb. (=*S. purpurea* (Forsk.) Schweinf.). Seeds with a conduplicate embryo, resemble *Brassica* seeds in shape and size, but testa, preserved only in small fragments, shows no reticulate pattern characteristic for *Brassica* (Pl. 2, fig.4).

Schouwia is an annual herb up to 1 m tall, which may have a shrubby appearance. According to Ozenda (1983) it grows commonly in the central Sahara as one of the dominant species of acheb flora and its leaves are edible. In northern Niger (Schulz & Adamou 1992) it forms extensive stands on inundated ground, in sandy-clayey soils; it is often grazed and is a good fodder for camels and cattle. Also Jafri (1977a) mentions that in Libya it is grazed by cattle. Gast (1968) describes the gatherings of people with their camels in the Hoggar Mountains in places where *Schouwia* covers large areas after summer rains. No informatiom has been found about the use of seeds of this plant for human consumption. The following means of exploitation could be suggested for Nabta Playa: 1. plants were gathered to obtain palatable leaves with seeds attached; what remained after use of the leaves was burned in the hearth; 2. animals grazed on *Schouwia* patches and seeds got to the house with animal droppings collected (?) for fuel; 3. seeds were collected for an unknown purpose.

Bornkamm and Kehl (1990) have described two associations from Egypt in which *Schouwia thebaica* occurs. One is the association *Zygophyllum coccineum-Schouwia thebaica* counted into precipitation dependent, permanent contracted vegetation. It is the main vegetation type of a large area of the Western Desert, especially around the Qattara depression. They have recorded *Schouwia* in subassociations growing in runnels, affluents and on the margins of depressions. *Schouwia*, together with *Zygophyllum coccineum* and *Capparis leucophylla* was most abundant in the deepest part of the depression, where water stays the longest (Bornkamm & Kehl 1990, p. 175), but it was frequent also on elevated margins of the depression; sometimes *Acacia* was growing there (Bornkamm & Kehl 1990, p. 179, Fig. 10). *Schouwia* was also present in the association *Zygophyllum coccineum-Salsola baryosma* described from the area of the Kharga and Dakhla oases. This association belongs to the precipitation dependent, accidental contracted vegetation and is "the most important vegetation type outside the oases in the south of our investigation area" (Bornkamm & Kehl 1990, p.194).

Zahran and Willis (1992, p. 235) have observed *Schouwia* in the stands of ephemeral vegetation in the Eastern Desert between Idfu and Kom Ombo (north of Assuan). Sometimes it occurred in large numbers and in association with *Arnebia hispidissima* (Zahran &

Willis 1992, p. 235). They describe the *Schouwia thebaica* community as one of the two main ephemeral communities in this area. Its characteristic features are the richness of the flora (ca. 43 species) and fairly high plant cover (20–50%) in spring, which diminishes to less than 5% in summer and most plants later disappearing (Zahran & Willis 1992, p. 243). It may occur in the *Acacia ehrenbergiana* community together with *Panicum turgidum*. In the desert along Red Sea coast it may dominate in patches of ephemeral vegetation and is also known to invade cultivated land in the oases as a weed (Zahran & Willis 1992, p. 340).

Edible fruit trees and shrubs are represented by fruit-stones of *Ziziphus* sp. and seeds of *Capparis* sp. (Pl. 2, figs 1, 2, 5) neither determined to the species level.

Fragments of *Ziziphus* fruit-stones are frequent at Nabta Playa but not abundant. In this case the number of "specimens" is misleading compared to other taxa; each stone fragment was counted as 1 specimen because the estimation of the number of complete stones from small fragments seemed too arbitrary. Only very few complete or almost complete fruit stones were found.

Two *Ziziphus* species could be taken into consideration, *Z. spina-christi* (L.) Willd. and *Z. mauritiana* Lam. *Z. spina-christi* is common in Egypt, it grows i.a. in the Nile Valley, in all deserts and oases. It has both a wild and a cultivated variety; fruits are edible (Täckholm 1974). According to the "Flora of Libya" (Jafri 1977b) it is "native of Sudan, Ethiopia etc.", introduced and cultivated elsewhere. Ozenda (1983) mentions this species only as cultivated in various oases of central Sahara. It occurs in central and northern Sudan (Andrews 1952). According to the "Vegetation of Egypt", which mentions only *Z. spina-christi* (Zahran & Willis 1992), the species grows in the tree layer in the desert ecosystem of the Kharga and Dakhla oases along with *Acacia nilotica, Balanites aegyptiaca* and *Hyphaene thebaica,* on sand accumulations and small mounds near cultivated land and villages. It occurs in the wadis of the Western and Eastern Deserts. In the Nubian Desert it grows in the *Acacia raddiana* community together with, among others, *Balanites aegyptiaca* and *Capparis decidua. Ziziphus spina-christi* has also been observed at Bir Takhlis in south Egypt (Bornkamm & Kehl 1990). *Z. mauritiana* appears in the southern part of central and west Sahara (Ozenda 1983) as well as in the east, in central and southern Sudan. Flora of Sudan includes three more species (Andrews 1952). On the basis of modern geographical distribution, *Z. spina-christi* seems to be the most likely species to have occurred at Nabta Playa. Archaeobotanical finds from other sites are usually included in this species.

The use of its fleshy fruits must have been common where the plant occurred in nature. According to ethnographic information in northern Niger, fruits are eaten fresh or dried, they may also be pounded to flour and they have medicinal properties as well (Schulz & Adamou 1992). Zaghawa people eat fresh fruits of the two *Ziziphus* species, *Z. spina-christi* and *Z. mauritiana* (Tubiana & Tubiana 1977). Both are consumed as fresh fruits, particularly by children and shepherds, but also by adults when they sit and chat. They eat the soft part and collect stones to extract the seed from inside. Seeds are pounded in a mortar to obtain flour. The flour is mixed with millet flour and consumed as porridge or boiled in water or milk; it is also used for making cakes. *Z. spina-christi* has smaller but sweeter fruits than the other species (see also Barakat 1995).

Ziziphus is preserved almost exclusively in the form of crushed stones. This might indicate the purposeful crushing of fruit-stones in order to get seeds and use them for cooking. However, before such a suggestion can be taken as a more or less convincing one, the effect of charring on the preservation of these stones should be tested.

Six species of *Capparis* (or 3 species with subspecies) appear in Egypt today (Täckholm 1974), only *C. aegyptia* Lam. (= *C. spinosa* L. var. *aegyptia* (Lam.)Boiss.) being common on rocky ground and steep cliffs. *C. decidua* (Forssk.) Edgew. is rare and grows in the Nile valley and in oases. Another rare species is *C. cartilaginea* Decne (= *C. galeata* Fres.) occurring on rocky ground in the north-east and south-east of Egypt. *C. aegyptia* can also grow on dry salt marshes in the oases and in the wadis (Zahran & Willis 1992, pp. 91, 34). It is described by these authors from a desert ecosystem of the Kharga and Dakhla oases as a component of the shrub layer in the community dominated by *Tamarix nilotica* (Zahran & Willis 1992, p.100). The species often occurs in shrub communities together with different *Acacia* species. One isolated specimen of *Capparis decidua* was observed by Bornkamm (1986) between Bir Kurayim and Bir Naklai, not far west from Nabta Playa.

According to Täckholm (1974), only *C. decidua* and *C. cartilaginea* have edible fruits, after their bitter skin is removed. She does not give this information for *C. aegyptia* but Germer (1985) repeats the statement of Plinius that this species should have edible fruits. However, should this information not refer to flowers rather than to fruits because buds of *C. spinosa* are used as a condiment? Ten species occur in Sudan and the information about fruits being edible is only given for *C. decidua, C. micrantha* A. Rich. and *C. erythrocarpos* Isert. but not *C. spinosa. C. decidua* is listed among the fruits consumed by the Zaghawa (Tubiana & Tubiana 1977), the fruits are eaten only by herdsman and children and are not harvested and brought home by women. Gast (1968) mentions the use of leaves and flowers of *C. spinosa* in the Hoggar as a medicine. Its use is also known in northern Niger (Schulz & Adamou 1992).

It is not possible to decide which species has been growing at Nabta Playa. Ancient seeds cannot be identified precisely and modern distribution does not give an unequivocal indication. Wood of *C. decidua* has been identified from Nabta Playa (Barakat 1995) and perhaps seeds also belong to this species.

Other useful plants represented by seeds or fruits at the E-75-6 site may include unknown species of the families Cyperaceae, Leguminosae and Cucurbitaceae. A common type described as NP-21 (Pl. 2, fig. 6) may be the seed of a species from the sedge family. Another representative of this family is *Schoenoplectus* t., less common than the former type, recovered in the form of fruits (they cannot belong to the same species as the type NP-21). Many *Schoenoplectus* and *Scirpus* species have edible fruits (Hillman et al. 1989); they could have been collected from the moist area of Nabta Playa. The purposes for which plants from the two other families could have been used cannot be suggested. Small seeds of Leguminosae (Pl. 2, fig. 7) are often found in archaeological sites in the Near East. Ethnographic information on their possible uses was recently assembled by Butler (1995). The genus of Cucurbitaceae is not identified (Pl. 2, fig. 3), but it is not *Citrullus*, known from the other sites.

Very frequent appearance of *Arnebia* cf. *hispidissima* suggests that the plant was gathered but no information was found about its useful properties. Perhaps dry plants, abundantly occurring in the area, were collected for fuel.

Additional information about the use of food plants comes from the study of parenchymatous tissues by Hather (1995).

Botanical characteristics of archaeological features

It is supposed that various ways of plant exploitation could be recorded by the distribution of plant remains within the settlement. All archaeological objects (huts, hearths and so on) contained more or less the same plant taxa and, with one exception, were not characterized by individual plant types. Small differences were, however, noticed in the combinations of taxa and their quantitative representations. A few gross features of this pattern, which can be seen with the "naked eye", will be outlined below. It is hoped that numerical analysis applied to the entire material will enable, in the future, more sound conclusions but until now this method was applied only to hut F1/90 (Mitka & Wasylikowa 1995).

The present discussion concerns only four houses (1/90, 2/90, 3/90, 1/91) and one pit (P2/90) from the southeast end of the settlement (Fig. 5), which were sampled for plant remains in the most detailed and uniform way. The general characterization is based on total numbers of seeds and fruits, their densities, and total numbers of taxa in each kind of archaeological object. The density of remains was calculated as the number of specimens per 1000 cm^3. The answers to two questions were sought: 1. Did the individual huts differ in plant content and 2. Did the distribution of seeds and fruits differentiate among hearths, pot-holes, postholes, house fill and house fill top.

The comparison of huts is based on totals of seeds/fruits, their densities and totals of taxa for each hut (Tab. 1). The highest total number of specimens was recovered from house 1/90, the lowest total from house 1/91 and pit P2/90. If these numbers are calculated in relation to the volume of examined sediment it appears

Table 1. Nabta Playa, E-75-6. Summary data for four houses and one pit. Sample volume in cm^3

Object type	Sample volume	Number of specimens	Density	Number of taxa	Number of samples
Hut 1/90	131.17	11139	84.92	24	144
Hut 2/90	25.04	2835	113.22	22	23
Hut 3/90	37.11	2242	60.41	21	30
Hut 1/91	42.63	253	5.93	13	45
Pit 2/90	6.53	228	34.92	18	5
Total	242.48	16697	68.86	28	247

that hut 2/90 was the most rich in plant remains and 1/91 the poorest. Assuming that post-depositional destruction of charred plant remains was the same in all features, we may suppose that higher density indicates longer (or more frequent) habitation or more intensive use of plants in a particular house. The low density of plant remnants in hut 1/91 may also reflect a special character of this house (see below).

To compare the other types of archaeological contexts between themselves, number of specimens, density and number of taxa found in all samples from hearths, pot-holes, postholes, house fill and house fill top from all huts were summed up (Tab. 2). The greatest volume of soil was examined from the house fill samples which contained the highest number of taxa but the highest total density of fruits and seeds was found in the hearths. This was also true for individual huts except for hut 1/91 in which pot holes were richest in plant remains.

Table 2. Nabta Playa, E-75-6. Summary data for hearths, pot-holes, house fill, house fill top and postholes in all houses. Sample volume in cm^3

Object type	Sample volume	Number of specimens	Density	Number of taxa	Number of samples
Hearths	65.71	9099	138.47	23	70
Pot-holes	37.16	1412	38.00	19	50
House fill	103.77	3083	29.71	27	95
House fill top	29.04	3012	103.72	21	23
Postholes	6.8	91	13.38	12	9
Total	242.48	16697	68.86	28	247

The huts were also compared with respect to the occurrence of taxa represented in at least one of the houses by 10 or more specimens. The comparison was based on the abundance, frequency and density of seeds/fruits of each taxon. Abundance means total number of specimens in a house. Frequency is a percentage number of samples in which a taxon occurs, calculated in relation to the total number of samples from the house. Density is the number of specimens calculated in relation to the volume of samples that contain a given taxon (Tabs 3, 4).

The clearest difference separates house 1/91 from the three others. The main difference is the greater significance of sorghum in 1/91; it occurs there more frequently than in the other huts, namely in 78% of the samples, it attains the highest number of specimens (189) and the highest density (5.0). The relation of sorghum to the other taxa in this house is also different, it attains a much higher frequency than any other taxon, none of which appears as more than 16% of the samples (Tab. 3).

This striking predominance of sorghum over all the other plants, including grasses from the millet group, suggests that sorghum was the main plant food prepared, consumed or stored in that house. Other plants were a small admixture, accidental or intentional. For the time being no well founded explanation can be offered. A special character of this house could be one reason, but this would have to be confirmed by other archaeological data. The other reasons might be either that people inhabited this house in a year, or in a season of the year, when only sorghum was available in sufficient quantity, or that they harvested pure sorghum stands. This indicates also that sorghum was considered a special food, distinguished from grasses of the millet tribe.

It is interesting to note that in hut 1/91 sorghum was present in all contexts, i.e. in the hearths (80 grains), pot-holes (75 grains), house fill (33 grains) and house fill top (1 grain), but its highest density was achieved in pot-holes – 13.3 specimens/1000 cm^3 (2.7 in hearths and 5.7 in house fill). If we are right in assuming that sorghum was the main food plant in this house, its concentration in pot-holes is an additional confirmation of the character of these small hollows as places where containers with food were placed, as it has earlier been suggested (Wendorf et al. 1991).

The special character of hut 1/91 is additionally stressed by the lowest total density of specimens (Tab. 2) and different relations between densities achieved in samples from various contexts compared to the other huts. In

Table 3. Abundance (A) and frequency (B) of common taxa in four huts from the site E-75-6 at Nabta Playa (s-s – small-seeded, oth – others, *Cyp/Fuir/Scir* – *Cyperus/Fuirena/Scirpus holoschoenus* type)

	Hut 1/90		Hut 2/90		Hut 3/90		Hut 1/91	
	A	B	A	B	A	B	A	B
Sorghum	130	42.4	28	56.5	18	26.7	189	78.4
Paniceae	1967	80.5	698	95.6	116	60	19	13.5
Leguminosae s-s	989	74.3	208	91.3	214	76.7	2	5.4
Leguminosae oth.	132	27.1	23	30.4	19	20	1	2.7
Cucurbitaceae	21	10.4	8	21.7	4	13.3	0	0
Capparis sp.	206	34.7	15	17.4	35	33.3	1	5.4
Ziziphus sp.	320	35.4	75	65.2	154	76.7	4	10.8
Schouwia	4092	64.6	999	95.6	1313	86.7	7	10.8
Boraginaceae	400	57.6	46	60.9	32	33.3	9	5.4
Cyp/Fuir/Scir	41	8.3	24	8.7	3	6.7	0	0
Schoenoplectus	2	1.4	34	26.1	6	13.3	0	0
NP-21	1202	55.55	250	43.48	19	26.67	2	5.4
NP-18	989	63.19	260	86.95	196	73.33	8	13.51
NP-9	239	34.7	65	60.9	44	46.7	0	0
NP-19	68	28.5	24	56.5	4	6.7	6	16.2
NP-23	28	12.5	7	21.7	0	0	1	2.7
NP-24	266	38.9	37	52.2	54	23.3	4	8.1
NP-28	24	4.9	26	30.4	7	0.3	0	0
Total specimens	11139		2835		2242		253	
Total samples		144		23		30		37

Table 4. Frequency (B) and density (C) of common taxa in four huts from the site E-75-6 at Nabta Playa (abbreviations as in Table 3)

	Hut 1/90		Hut 2/90		Hut 3/90		Hut 1/91	
	C	B	C	B	C	B	C	B
Sorghum	1.97	42.4	2.24	56.5	1.61	26.7	5.02	78.4
Paniceae	17.21	80.5	29.91	95.6	5.1	60	1.92	13.5
Leguminosae s-s	9.26	74.3	8.67	91.3	7.27	76.7	0.69	5.4
Leguminosae oth	2.72	27.1	3.09	30.4	1.91	20	1	2.7
Cucurbitaceae	1.47	10.4	1.93	21.7	0.8	13.3	0	0
Capparis sp.	3.7	34.7	3.85	17.4	2.63	33.3	0.71	5.4
Ziziphus sp.	6.01	35.4	4.05	65.2	5.37	76.7	2.13	10.8
Schouwia	43.72	64.6	40.89	95.6	40.3	86.7	1.2	10.8
Boraginaceae	4.8	57.6	3.24	60.9	2.19	33.3	1.88	5.4
Cyp/Fuir/Scir	2.3	8.3	14.1	8.7	0.58	6.7	0	0
Schoenoplectus	0.8	1.4	5.7	26.1	1.26	13.3	0	0
NP-21	14.85	55.55	23.11	43.48	1.73	26.67	2	5.4
NP-18	10.2	63.19	11.69	86.95	7.36	73.33	1.48	13.51
NP-9	4.18	34.7	3.91	60.9	2.4	46.7	0	0
NP-19	1.09	28.5	1.8	56.5	1.32	6.7	0.66	16.2
NP-23	1.29	12.5	1	21.7	0	0	0.4	2.7
NP-24	3.78	38.9	2.76	52.2	0	23.3	0.76	8.1
NP-28	2.31	4.9	3.29	30.4	2.46	0.3	0	0
Total samples		144		23		30		37
Total density	84.9		113.22		60.4		5.9	

this house hearths have the smallest and potholes the greatest number of specimens per sediment volume.

The other three houses are also not identical in plant composition. Hut 3/90 is distinguished by the smallest significance of sorghum, expressed in the lowest frequency, as well as in the lowest total number of specimens and the lowest density (Tabs. 3, 4). The same is true about grasses from the Paniceae tribe, though they are more frequent and abundant than sorghum. Boraginaceae and NP-21 type (Cyperaceae seeds?) are less frequent than in the two other houses, while *Ziziphus* attains its highest frequency. Higher frequency is not always connected with greater density; for instance seeds of the type NP-21 are more frequent and attain higher density in 1/90 and 2/90 than in 3/90, while the density of Boraginaceae and *Ziziphus* is more or less the same in all three houses in spite of differences in frequencies. Without additional treatment of data with numerical analyses it is difficult to evaluate the significance of these differences in plant composition, unless the situation is so clear as in the case of house 1/91.

If we look at the ratio of Paniceae to sorghum grain numbers we can see that it was the lowest in hut 1/91 (0.1) and increased in 3/90 (6.4), in 1/90 (15.1) and 2/90 (24.9). These relations may indicate that the role of various grasses was different in the diet of people living in different houses. In 1/91 pure sorghum was most important, in the other houses sorghum contributed to the food in various proportions; relatively more sorghum was used in 3/90, less in 1/90 and still less in 2/90. These variations in millet to sorghum proportions do not reflect time progressive changes, because house 2/90 is a little younger than 3/90. Whether these variations are intentional or not is not possible to say, but they may reflect a better or worse yield of individual grasses in different years or seasonal variations of crops. We also cannot say if sorghum was mixed with other grasses or consumed separately but the second possibility seems more probable in view of the separate use of sorghum in house 1/91.

CONCLUSIONS

The placements of huts and storage pits near the centre of the playa lake clearly indicate the seasonal character of the settlements. Water wells suggest that the ground water was available at the depth of ca 1.5–2.0 m. Intersection of huts and small features within the huts strongly suggests repetitive use of the location and shelters.

Obviously, multiple occupations of the Middle, and probably Upper Levels are associated with dry (winter) season harvesting of sorghum, tubers and other seeds. The groups were composed of several individuals. Compartments in long huts, differing, as in hut 1/90, in plant contents (Mitka & Wasylikowa 1995), may indicate that nuclear family units and multi family groups were camping around the shores of the Nabta Playa Lake.

Plant food included wild cereals, sorghum, several grasses of the millet tribe, fruits of *Ziziphus* and *Capparis*, seeds of unknown plants from the sedge family (*Schoenoplectus* and *Scirpus*-types), tubers and other underground parts of a few plant species (Hather 1995), and perhaps leaves of *Schouwia thebaica*. We do not know for what purpose the small seeds of various Leguminosae were used (Butler 1995). The use of *Arnebia* cf. *hispidissima* is also difficult to explain, one suggestion is that the plant was collected for fuel; the same might also concern *Schouwia* plants. Coming back to the same habitation places, year after year, people were returning to conditions which were similar but not identical.

The distinct difference of hut 1/91 from the three others, expressed in the greater significance of sorghum and the subordinate role of other plants, suggests that sorghum was the main plant food prepared or stored in this house. The other huts were more similar to each other. The same plants were used, though in slightly varying proportions, perhaps as a result of their different participation in the vegetation developing in different years.

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PLATES

Plate 1

Charred grass remains from Nabta Playa, site E-75-6; caryopses from dorsal side showing embryo.
Scale equals 1 mm

1. *Panicum* cf. *turgidum*
2. *Setaria* type
3. *Urochloa* type
4. *Echinochloa* cf. *colona*
5. *Digitaria* type

6–9. *Sorghum bicolor* ssp. *arundinaceum*, 6, 7 – two grains, 8, 9 – two spikelets

Phot. A. Pachoński

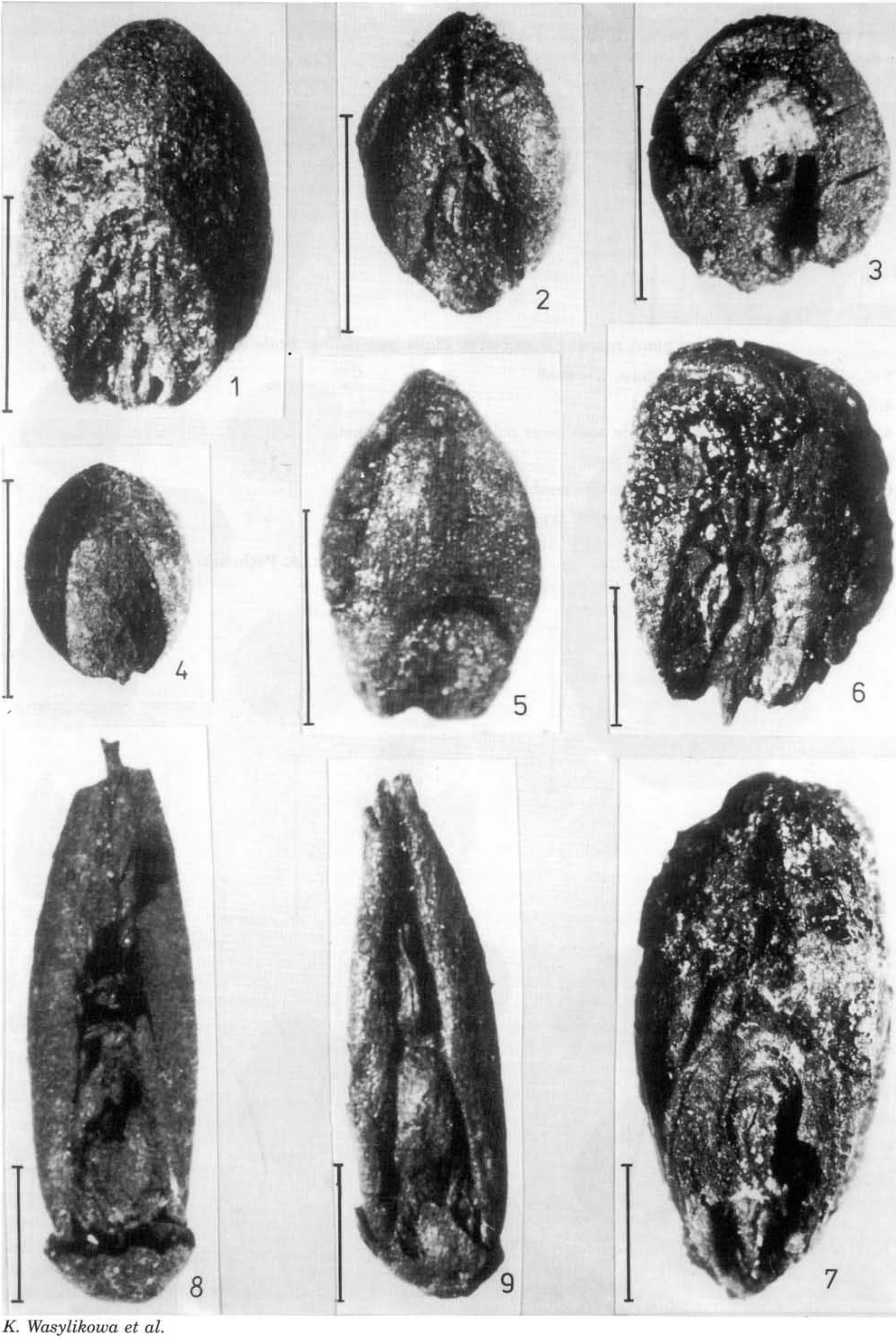
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Plate 2

Charred plant remains from Nabta Playa, site E-75-6. Scale equals 1 mm

1–2. *Ziziphus* sp., 1 – fruit-stone, 2 – seed

3. Cucurbitaceae indet., seed

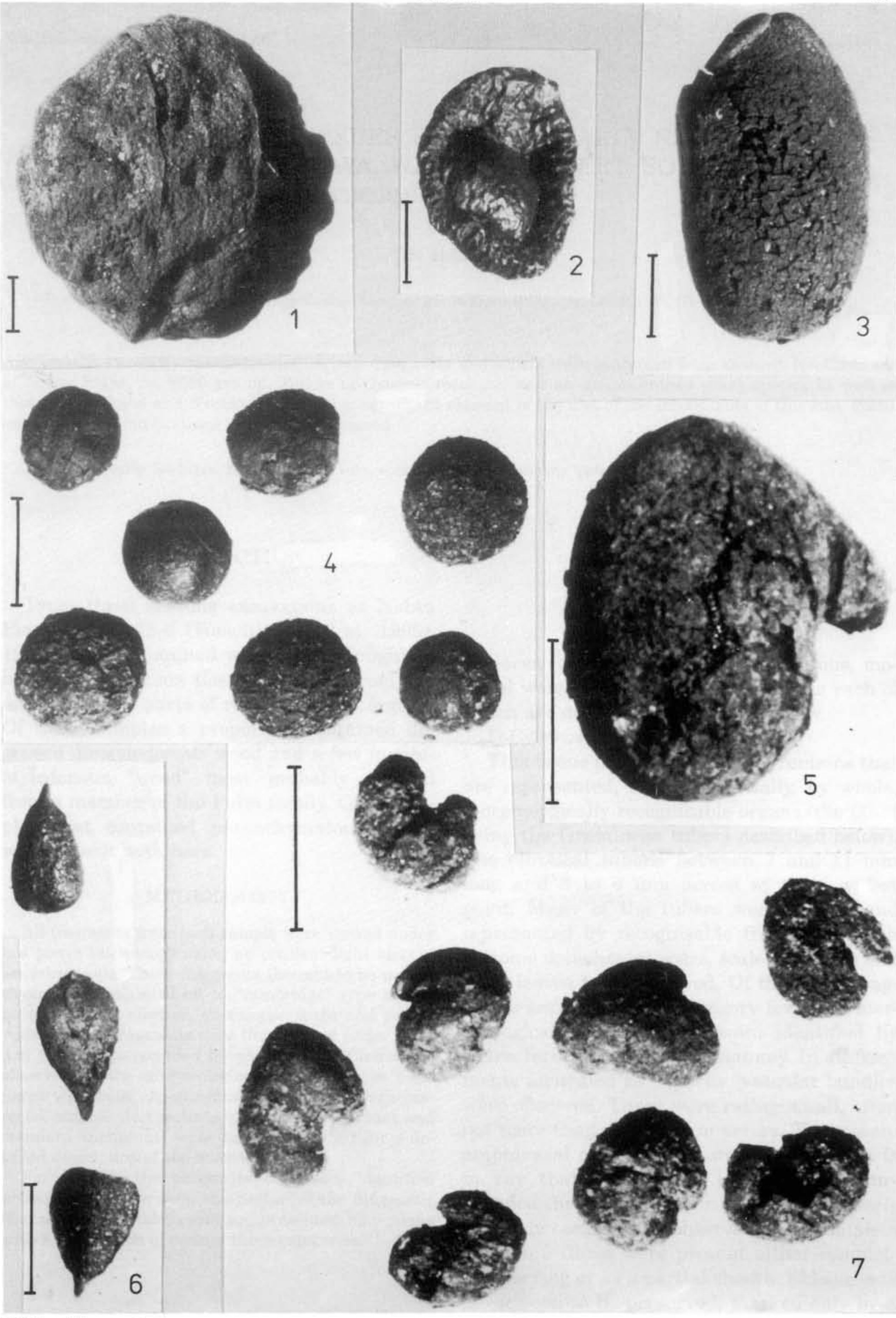
4. cf. *Schouwia thebaica*, seeds with no or only fragments of testa

5. *Capparis* sp., seed with no testa

6. Type NP-21, possibly Cyperaceae seeds

7. Leguminosae indet., small-seeded type, seeds with no testa

Phot. A. Pachoński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