The Emergence of Village Settlements During the Early Neolithic in the Western Desert of Egypt

Fred Wendorf and Romuald Schild

Abstract. *The early Holocene climate in the Egyptian Western Desert was very unstable, with frequent brief, but sharp periods of aridity when the area was abandoned. Summer rains provided the only water, and the last of these disappeared from the basins after a few months. Settlements dating between 9000-7000 cal BC (9800-8200 bp) were small and briefly occupied during or after the rains by small groups of cattle pastoralists. Around 7000-6100 cal BC (8050-7300bp), during the Holocene Climatic Optimum, the first true villages were established, most of which were sizable and supported by large, deep, water wells, intensive collecting of wild plants, hunting small animals, and herding cattle.*

Introduction: Climate and Archaeological Background

In this paper we propose that an early form of permanent, sedentary communities developed among the forager/cattle herders in the Western Desert of Egypt between 7000 and 6100 cal BC (8050-7300 bp). The evidence for this includes the pits dug beside each house for the storage of plant foods that had been intensively collected during the season of abundance, the large wells dug for water in each village, and most importantly, the careful placement of new houses directly over older house floors that had been temporarily abandoned because of seasonal floods. This placement of houses one above the other is also evidence for a strong concept of ownership, and a commitment to this particular place.

The Western Desert of Egypt is not a place where one would expect to find evidence for early villages and other complex cultural developments (Figs. 1 and 2). Today it is one of the driest places on earth, receiving less than 1 mm of precipitation per year, and is a seemingly lifeless desert. It lacks people and supports only a few desert adapted animals, such as lizards, gerbils, snakes, hares and small gazelle. There is almost no vegetation, and the few plants that are present occur in those rare places where ground water comes near the surface, or as patches of "accidental vegetation", a few bushes or clumps of dry grass that grow where water from the very rare rains happened to accumulate. In truth, the area would seem to have few redeeming qualities.

The Climate. Despite this forbidding appearance, there is a long history of human use of this desert, always coinciding with periods of increased rain. At several times in the past the Western Desert received as much as 500mm of precipitation per year at which times there were permanent lakes, large springs and at least seasonal streams (Wendorf et al. 1993). These wet intervals have an approximate correlation with the onset of interglacials and interstadials at higher latitudes. The most recent occurred during the last interglacial and is dated between 130,000 and 70,000 year ago by several radiometric techniques. During these warm wet periods the Sahelian zone moved northward into

Fig.1: View of Nabta Playa, looking east. Picture was taken from a large barcan dune that shelters the camp from prevailing north winds.

southern Egypt; the area was a thorn-bush savanna that supported large animals, such as extinct buffalo and camels, large giraffes, and several varieties of antelope and gazelle. Human presence is evidenced by numerous Middle Paleolithic sites associated with the lake and spring deposits of this period. Even earlier Middle Paleolithic, as well as Final and Late Acheulean, and perhaps Middle Acheulean artifacts are associated with possibly multiple wet periods that are prior to the Last Interglacial and are as yet poorly defined (Schild and Wendorf 1977; Wendorf et al. 1993).

After the Last Interglacial a long period of hyper-aridity followed when Egypt was at least as dry as today, and perhaps even drier. Much of the modern landscape of the Eastern Sahara was formed by the intense wind deflation that occurred at this time. This hyper-arid episode ended around 11,000 cal BC (12,000bp) (this and subsequent radiocarbon dates in this paper are calibrated measurements using the Calib 3.o.3c program of Stuiver and Reimer 1993) at which time the summer rains of tropical Africa expanded and began to move northward again. This increase in rainfall marks the onset of the early Holocene in the Eastern Sahara. Thick playa deposits below the oldest known Holocene occupations occur in several playa basins in southernmost Egypt, and indicate that there may have been an earlier wet interval, possibly followed by a cold-dry episode. There are no dates available for these older playa deposits, but this early wet phase may have been synchronous with the Allerod Oscillation, and the proposed following cold and dry period might be correlated with the Younger Dryas (Schild and Wendorf 2001b:46). There is, however, no evidence of human presence for at least the next two or three hundred years, until around 9000-8500 cal BC (9800-9500 bp).

Fig. 2: View of landscape near Bir Kiseiba. There were no dunes in the vicinity, thus the camp was placed in an exposed location.

The desert during the Holocene was not as wet as it was during the earlier humid interglacials. There have been several estimates of the amount of rain fall during the early Holocene; some of these are based on the identification of wood charcoal, and have yielded rainfall estimates between 50 and 100 mm (Barakat 1995); others, on the basis of associated fauna, have suggested that the rainfall was between 100 and 200 mm per year (Wendorf and Schild 1980, 236); and finally, estimates based on the character of the sediments yield an estimated rainfall of around 100 mm per year (Kropelin 1993). Regardless of the amount, the precipitation was limited and highly seasonal, and fell during the summer months, providing sufficient moisture to support a wide variety of Sahelian grasses, herbs, trees and bushes, and several kinds of small desert-adapted animals, mostly hares, small gazelle (who received their moisture from the vegetation), and a few small carnivores, such as foxes. Unpredictable throughout the early and middle Holocene, the climate was dominated by numerous droughts and five sharp periods of hyper-aridity, when humans abandoned the desert for periods ranging from 100 to 200 years.

Between 7000 and 6100 cal BC (8050 and 7300bp) the greatest precipitation during the Holocene occurred, probably well over 200 mm per year. This interval is known as the "Holocene Climatic Optimum" (Schild and Wendorf 2001a). While there were extensive seasonal lakes in the basins during this Climatic Optimum, the accumulation of silts in the basins was very limited, presumably because grasses and shrubs covered the uplands, and the runoff following the rains carried very little sediment. The first large villages in the Western Desert date to this period.

The Earliest Cattle. The Neolithic in the Eastern Sahara began around 9000-8400 cal BC (9800-9500 bp), and it ended around 3000 cal BC (4500 bp), when increasing aridity forced the abandonment of the desert, except for a few brief intrusions (Wendorf and Schild 2001). These early Holocene desert dwellers are identified as Neolithic because they had pottery and domestic cattle, but it seems likely that they were primarily foragers who kept as few cattle. It is interesting to note that while the people in the desert were herding domestic cattle, using well made and elaborately decorated pottery, and learning how to survive in the desert year-round (Wendorf et al. 2001), the people living in the adjacent Nile Valley at this time lacked pottery and had an economy that was focused on fishing in the summer, gathering wild plants and hunting ducks and geese in the fall, and occasionally killing wild cattle, hartebeest and gazelle.

Wild cattle were an important prey in the Nile Valley at least as early as the end of the Last Interglacial and remained important throughout the most recent Middle and Late Paelolithic in the Valley. Domestic cattle were not known in the Valley until around 5200-4400 cal BC (6300-5500 bp), about 3500 years after they were present in the Western Desert. As a partial explanation for this anomaly, it has been suggested that there may have been an independent center of cattle domestication in the desert areas of northeast Africa, possibly in the Western Desert or nearby (Gautier 2001). We doubt wether it was in the Western Desert; more likely it occurred in the Sahelian area of central Sudan where permanent surface water was available. Nevertheless, the distribution of the earliest known cattle in the driest part of the Sahara, their need to drink water at least every other day in an area where there was no permanent water, and the genetic study of modern African, Near Eastern, and European cattle all provide strong supporting evidence for the suggestion of a separate and early center of cattle domestication somewhere in northeast Africa ((Wendorf and Schild 1994; Bradley et al. 1996; MacHugh et al. 1997; Hanotte et al. 2002).

It has been suggested that cattle may have facilitated human use of the Sahara by providing a mobile, dependable, and renewable source of food in the form of milk and blood (Close and Wendorf 1992). The use of cattle as a renewable resource rather than for meat is seen as a possible explanation for the paucity of cattle remains in most of the Saharan sites. Such use in a desert, where other foods were so limited, may have initiated the modern East African pattern of cattle pastoralism in which cattle are important as a symbol of prestige, are primarily used for milk and blood, and are rarely killed for meat.

The Earliest Pottery. In the Nile Valley around Khartoum, and in the upper Atbara, locally made rocker-stamped pottery, similar to that in the Egyptian Western Desert, was known as early as 8150 cal BC (9300 bp) (Khabir 1987; Haaland 1987:49), but the knowledge of pottery somehow did not spread farther north along the Nile, because it is absent in the Nile Valley of Sudanese and Egyptian Nubia, the area adjacent to the Western Desert, until 4800-4400 cal BC (5900-5500 bp), and in the Fayum and the far northern Valley until 5000 cal BC (6300 bp) (Wendorf and Schild 1976: 211-226).

It is likely that pottery, as in the case of domestic cattle, is a local African development (Close 1995:26). Well-made pottery decorated with rocker stamped designs over

the entire exterior, and dating around 8100 cal BC and slightly earlier has been reported from several localities in the central Sahara/ Sahelian region, including Adrar Bous, Tagalagal, and Tamaya Mellet in northern Niger (Roset 1987: 222; Delibrias et al. 1974:44), at Launey in the Hogar Mountains of southern Algeria (Maitre 1974: 101), and Ti-n-Torha East in eastern Libya (Barich 1987:105). These sites are clustered in the southern Saharan /Sahelian zone of the central Sahara, and it seems likely that in that area, or probably farther south in the Sahel, is where the first pottery in Africa may have been invented. This Saharan/Sahelian area in the southern Sahara was unoccupied during the Late Pleistocene long interval of hyperaridity, and it is thought that recent migrants from the south were the first occupants of these early ceramic sites. One might speculate that these early migrants followed the northward movement of the monsoon rains and that pottery might have an even greater antiquity in what is now the southern Sahelian zone (Close 1995:26). There is, however, no archaeological evidence to support this hypothesis.

The Neolithic Background

The earliest Holocene intrusions into Eastern Sahara probably occurred during the summer months and early fall, and came either from farther south, following the monsoon rains, or from the Nile Valley where sites with similar lithic tool assemblages occur, but with no evidence of domestic cattle or pottery (Schild et al. 1968). In the desert these rains produced seasonal lakes in the larger basins, but, due to high evaporation, the water probably was present only for a few months after the rains. There was no permanent surface water anywhere in the

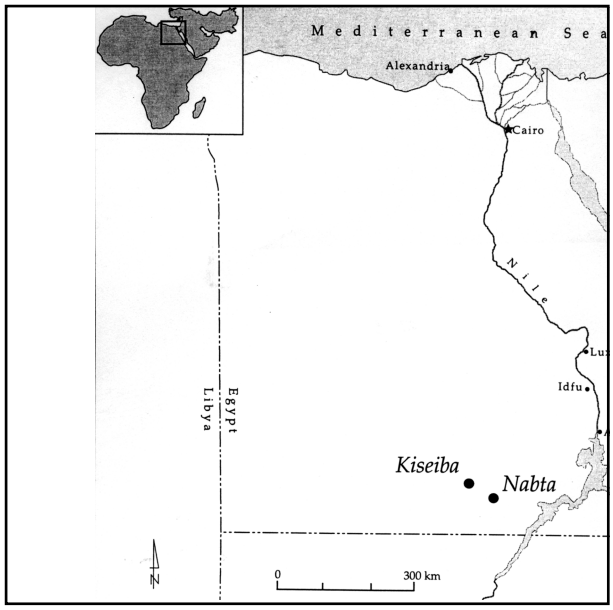

Fig. 3: Map of Northeast Africa showing location of Nabta and Bir Kiseiba (redrawn from Nelson 2002, Figure 1)

Western Desert south of modern Kharga and Dakhla, and extending for at least two hundred km into northern Sudan (Fig.3). By the time of the earliest human presence, however, the rains were sufficient to support a variety of grasses and a few trees and bushes on the desert plains, along the drainages, and around the basins.

Beginning around 9000 cal BC, small groups of people began to come into the desert, bringing with them a few domestic cattle (Gautier 1980, 1984: Wendorf et al. 1984). In addition, they either made or brought with them a few pots (Ciose and Wendorf 2001). The archaeological evidence suggests that these groups were forager/pastoralists with small herds of cattle. Besides milk and blood from the cattle, both of which must have been important food resources, they hunted gazelle and hare. It was not a rich fauna, and the animals present were limited to desert-adapted species that could obtain the moisture they needed from

vegetation (Gautier 1980, 1984, 1987, 2001). These forager/pastoralists did some collecting of wild plant foods, but how much is unknown due to poor preservation. These small groups must have been highly mobile, often moving from place to place to provide grazing for their cattle, and the duration of their stay in the Egyptian Sahara must have been limited to no more than three or four months, beginning with the summer rains and ending before the deepest parts of the basins were dry. There is no evidence that they dug water wells, and because cattle need to drink at least every other day, it is assumed that before the ponds were dry these cattle herders must have moved to permanent water, either to the Nile Valley 100 to 200 km to the east and south east, or to their presumed, but unknown home villages near permanent water in what is now central Sudan.

Pottery occurs in almost all of these localities, but it is rare, limited to only a few shreds in each site. The pottery is made with unrefined playa clay, and is decorated over the entire exterior with closely packed rocker-stamped design made with either a comb or stylus (Nelson 2001a). The vessel forms are limited to deep bowls, and all of them are tempered with crushed granite, similar to that occurring in local outcrops. The function of this pottery is unknown, there is almost no evidence that the pots were used for cooking, and they may have had a ritual purpose.

There was at least one major break in this sequence of seasonal occupations. A period of hyper-aridity that probably began around 7600-7500 cal BC, and may have lasted 100 years or so, resulted in the abandonment of the desert. When the rains returned the groups who came with them were closely similar to those in the area already, but there were a few changes in some of the stone tools, and the addition of the first houses. The houses or huts consisted of shallow, oval structures, probably with wood frames and brush or hide walls, and vertical slab lining around their bases. In one instance there were three huts forming a community (Schild and Wendorf 1977: 113-147). Without wells, however, the settlement must have been brief. This lifestyle of brief visits by small groups of foragers with their cattle survived in the Western Desert until around 7300 cal BC (8400 bp) when yet another interval of hyper-aridity again forced the abandonment of the area.

The First Settled Villages

Successful foragers living in areas with strong seasonality and seasonal variation in the available food know that they must either control the food resources over a large area so that various kinds of food can be obtained somewhere throughout the year; or if the foragers are constrained to a small area by unfriendly neighbors or landscape, then they must have a food economy in which the seasonally abundant food can be stored for use when there is little or no other food available (Binford 1990; Wendorf and Schild 2002).

The ca. 800-year interval of the Holocene climatic Maximum coincides with the appearance of a new entity of forager/cattle pastoralists in the basins of Southwestern Egypt. These new groups were concentrated in a roughly rectangular area that begins on the east at Nabta Playa (some 100 km west of Abu Simbel and the Nile), and extends west another 100 km to Bir Kiseiba. The Southern boundary of the area is about 25 km north of the Egypt/Sudan border, and the

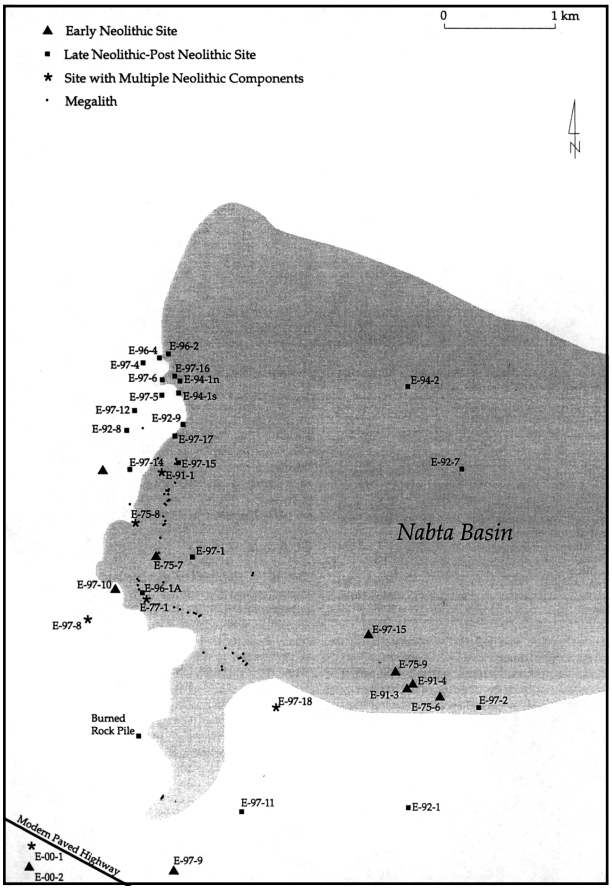

Fig. 4: Map of the Nabta area showing extent of the playa deposits and the locations of studied sites.

boundary on the north is the foot of the steep Eocene Scarp, about 75 km north of Nabta. Within this area there are numerous large playa basins, the most prominent of which is Nabta Playa (Fig-4). Almost all of the many basins in this area contain sites of various sizes, sometimes very large, and all associated with the new migrants. We identify these as El Nabta/Al Jerar Early Neolithic (Figs. 5 and 6).

When the desert was reoccupied after the drought that ended about 7000 cal BC (8050 bp), it was by a new group, one who came prepared to live in the desert year around. They brought with them knowledge of how to find subsurface water, the social controls needed to dig large water wells, and equally importantly, how to collect and store the food they would need if they intended to stay in the desert when other food resources were exhausted. The only obvious connection with the earlier cattle herders, who had been in the area seasonally for several hundred years earlier, is in the pottery. At least at the beginning the ceramic of the two periods are closely similar in paste and temper, and have the same designs made with a comb or stylus (Figs. 7, 8 and 9).

The source of these new groups is unknown. It is unlikely that they came from the Egyptian Nile Valley, because the few sites with the Nabta complex of lithic tools and pottery known along the Nile are very small and include tools that date to the final part of this interval (Shiner 1968). It seems more likely that these new groups came from farther south in Sudan, following the rains northward.

Whatever their source, the new groups built permanent settlements, many of them quite large, in the lower parts of almost every basin in the Nabta-Kiseiba area. They introduced a life style previously unknown in the Egyptian Western Desert. Unlike the previous inhabitants, who were present in the area only briefly after the summer rains, these new groups came prepared to live in the desert year-around. They dug large, deep, walk-in wells (Fig.10,11, and 12), and built villages consisting of 20 or more oval to round brush or skin-covered huts with shallow, saucer-shaped floors and central hearths (Krolik and Schild 2001 [Figs.13, 14 and 15]); outside each hut they dug several large, deep, storage pits, often "bell-shaped," that were presumably used to store seeds and other plant foods to be consumed during the

winter and spring months, when other resources were very limited (Figs. 16).

We refer to these as sedentary, even though they were abandoned briefly each year with the onset of the summer rains (Fig.17). They were sedentary and permanent because they were reoccupied when the basins had dried sufficiently, and the new houses were almost always erected directly over the previous house floor. Excavation of some houses disclosed several hearths placed one above the other, with peripheral wall posts also located in the same approximate positions (Nelson 2001b: 212, 228; Wasylikowa et al.1995: 138). Evidently part of the wooden structure was left in place to mark the location of the house so it could be rebuilt on that same spot, implying a strong sense of ownership, and a commitment to this particular place. It is for these reasons that we identify these settlements as sedentary and permanent.

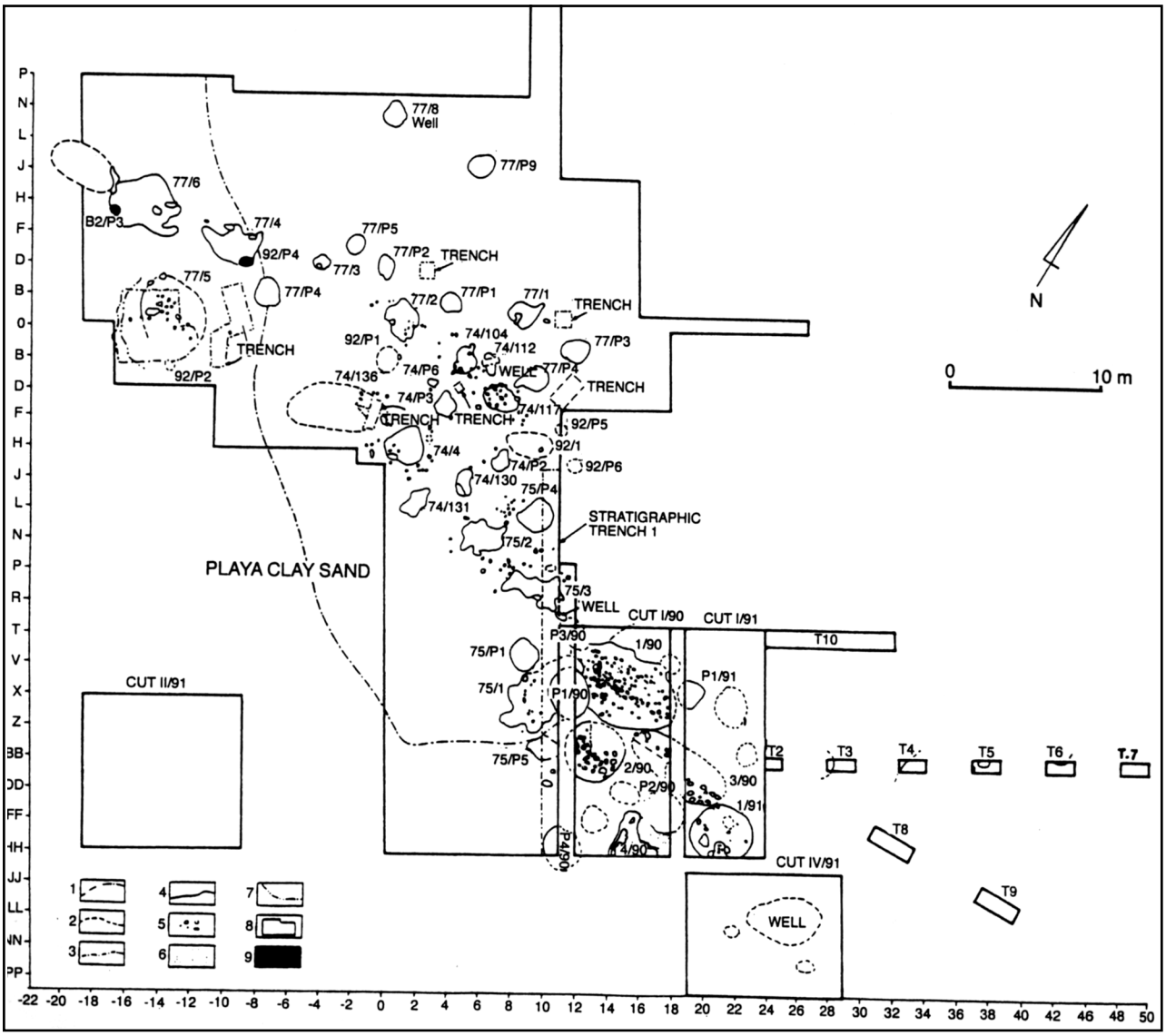

Fig. 5: Map of Site E-75-6, Nabta/ Al Jerar entity (from Krolik and Schild, 2001, Fig. 7.3).

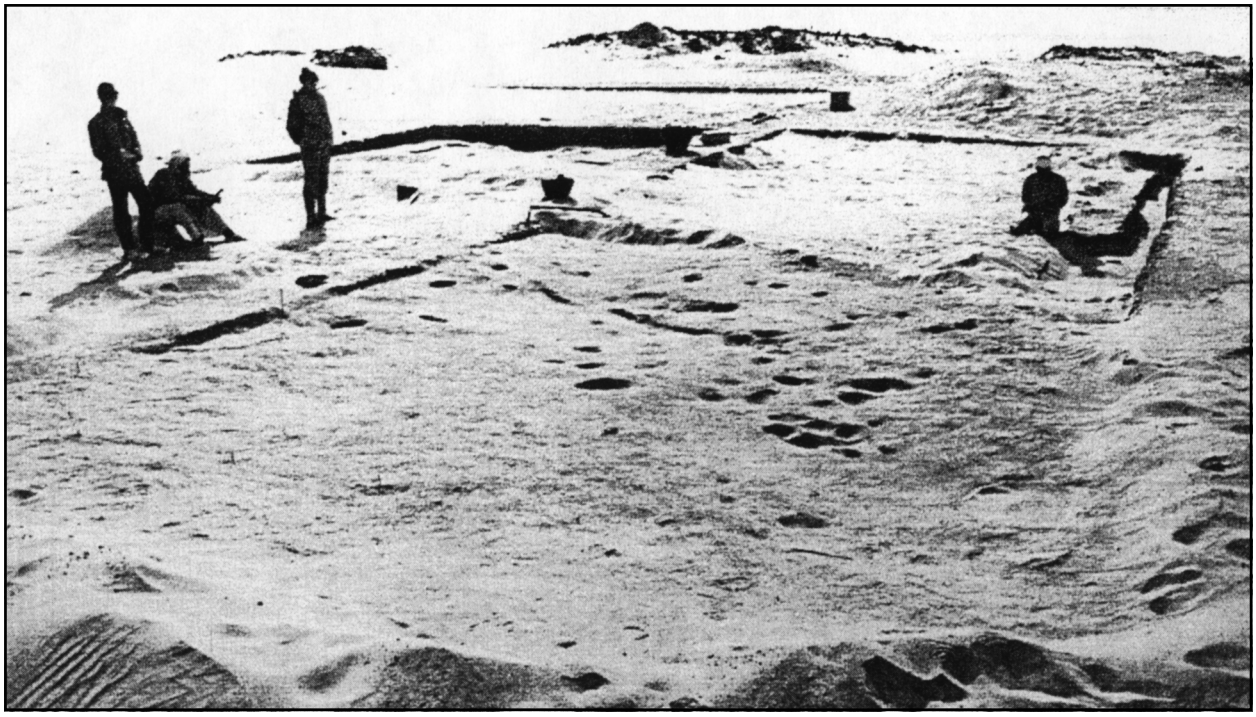

Fig. 6: View across excavated area of Site E-75-6. Note the numerous saucer-shaped pits. Most of these contained ash and charred plant remains (from Krolik and Schild 2001, Fig. 7.7).

We know that these new groups intensively harvested seeds, tubers, legumes and fruits, because one of their sites yielded over 20,000 identified charred plant remains, representing 128 different species, including eight kinds of trees and shrubs, and a wide variety of edible seeds, legumes and fruits (Wasylikowa et al. 2001a: 2001b). The most frequent edible plant was wild sorghum, followed by two kinds of wild millet. The intensive collecting of plants most probably occurred during the fall and early winter when most of the plants matured. The surplus was then placed in the storage pits for later consumption, probably during the winter and spring months when other foods were in short supply.

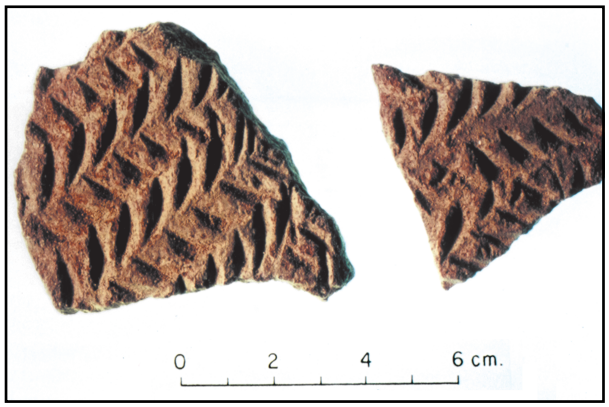

Fig. 7: Pottery sherds from Site E-75-6, El Nabta entity.

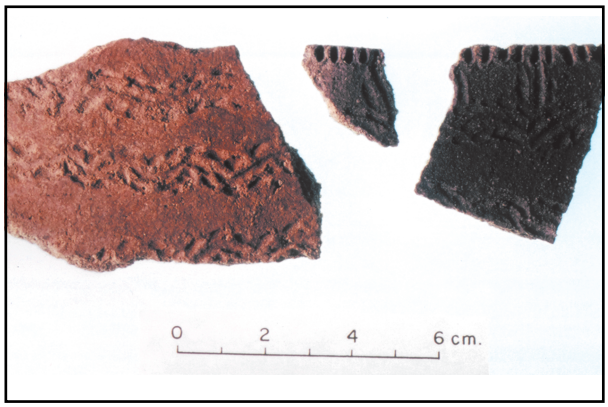

Fig. 8: Dotted Wavy Line Sherds from Site E-91-1, El Nabta entity.

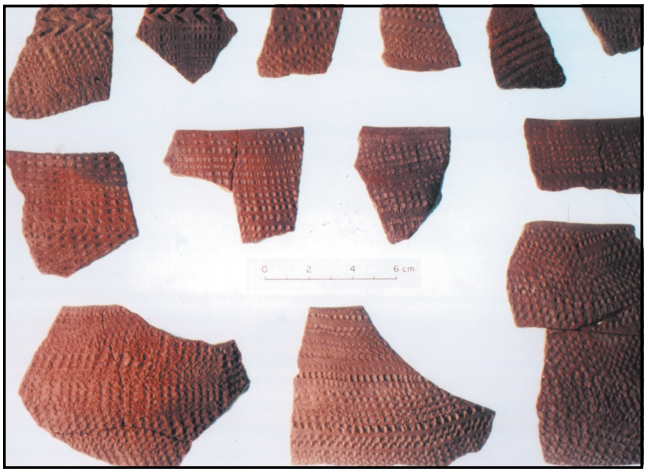

Fig. 9: Rocker-Stamped pottery from Al Jerar entity.

The largest village during the Nabta/Al Jerar period is over a kilometer long, and follows the contemporary western beach line of Nabta Playa. This huge site is exposed on the surface only on the north and south ends, the rest being deeply buried under massive silts that average 2 m in thickness. Test pits dug at intervals between these two exposed ends disclosed Nabta/Al Jerar pottery and other cultural material in and on dune sand everywhere below the silts. The width of this huge occupation area has not been determined, but at Site E-91-1, the designation given to the exposed northern end of this very large settlement, there are houses and storage pits in an area 300 m wide. Based on the number of houses in the two exposed sections, the total occupied area at this locality alone must have included 200 houses or more, and many of these, but not necessarily all, may have been occupied at the same time.

The rains began to decline in intensity around 6000-6100 cal BC (7300 bp), and shortly afterward, the area was abandoned and the early experiment at sedentary living ended, terminated by an abrupt and increasingly arid climate. The summer rains were no longer adequate to support a dense vegetation cover over the uplands surrounding the basins, and soon the runoff from the reduced summer rains began to carry a heavy load of

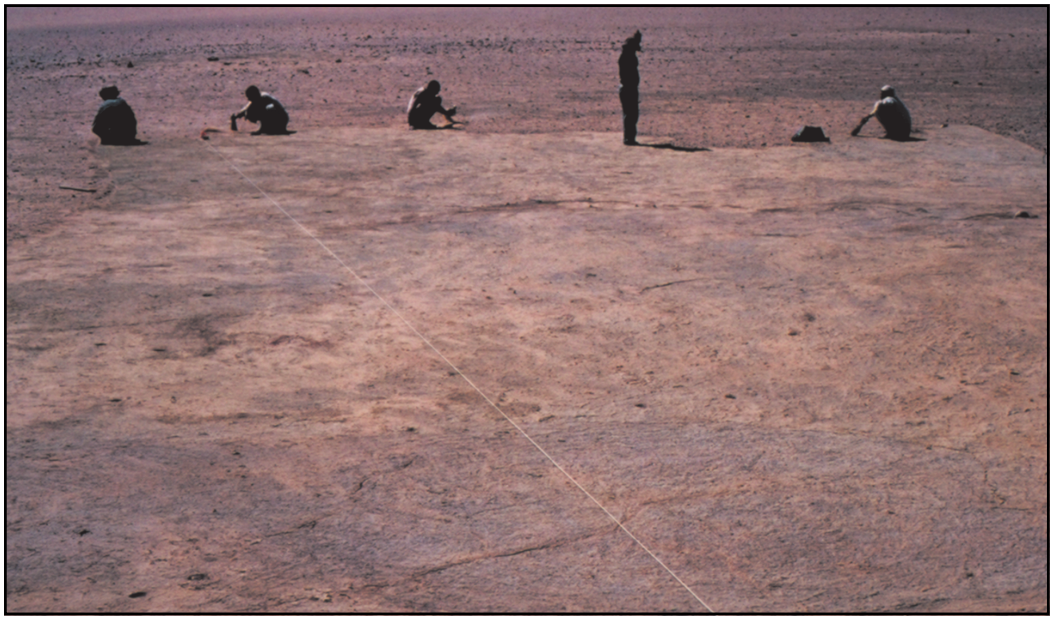

Fig. 10: Well outline before excavation, Site E-80-1, El Adam Playa, near Bir Kiseiba. This view shows large, circular stains on the surface. Each of these stains is a large, deep well.

Fig. 11: Close up view of large circular stain that marks the location of a large well before excavation. Site E-80-1

sediment that rapidly covered the lower parts of the basins in the Nabta/Kiseiba area with a thick deposit of playa silts (Schild and Wendorf 2001a). Before that, the loss of the plants on the uplands must have been a major blow to the cattle herders, a blow that forced them to abandon the area, presumably moving south in search of better grazing and permanent water. Then, as the drought continued to deepen into a sharp interval of hyper-aridity, the thick, but still soft body of recently deposited silts was rapidly removed by erosion from much of the now abandoned basin, leaving remnants of silt along the western margin of the deflated hollow.

The End of the Grand Experiment

The numerous Nabta/Al Jerar settlements, some of them very large, in the basins of the southern Western Desert were a "Grand Experiment," and for almost 800 years it was a highly successful experiment. Their occupants built large, permanent villages, that

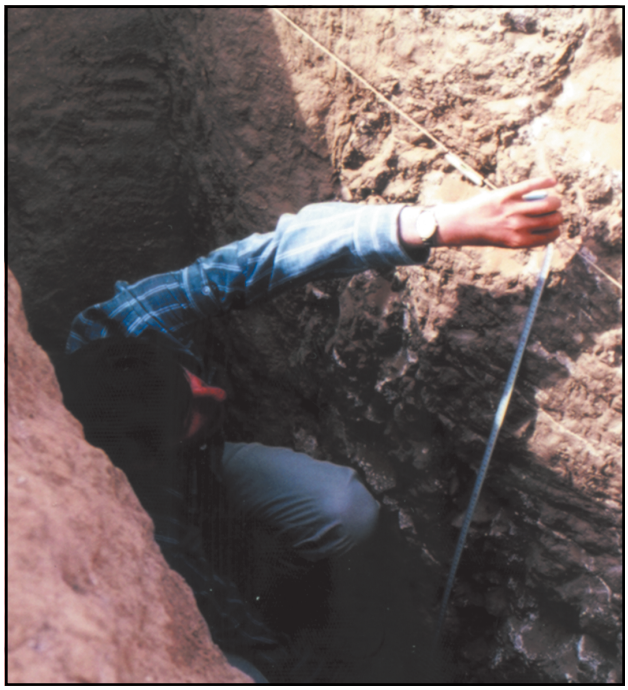

Fig. 12: Partial excavation of well in Figure 11.

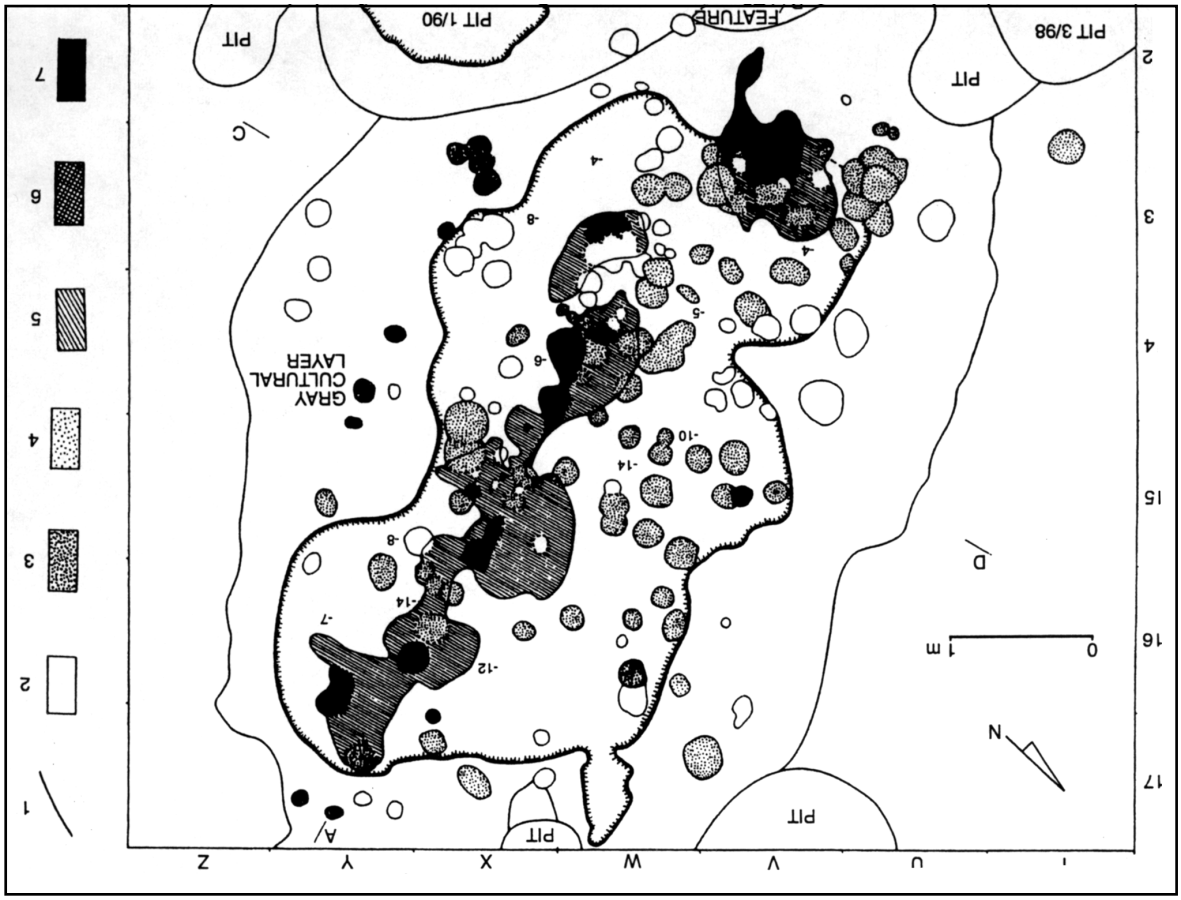

Fig. 13: Detail map of elongated house with several hearth and pit features, site E-75-6. Nabta/Al Jerar entity.

Fig. 14: Excavation of hut floor, note numerous saucer-shaped pits and hearths.

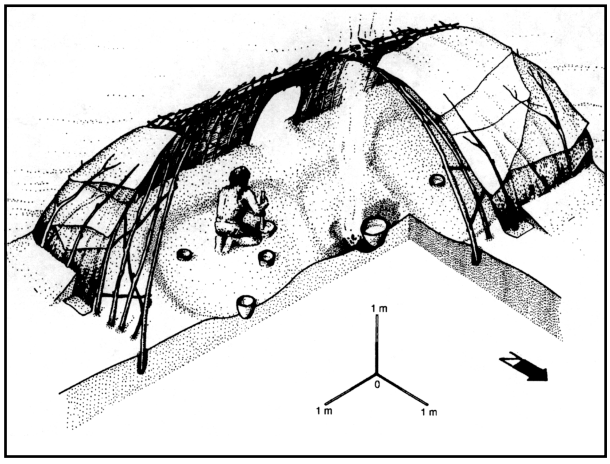

Fig. 15: Reconstruction of hut 1/90 at E-75-6. Note numerous hearths and heating pits (from Krolik and Schild 2001, Figure 7.8).

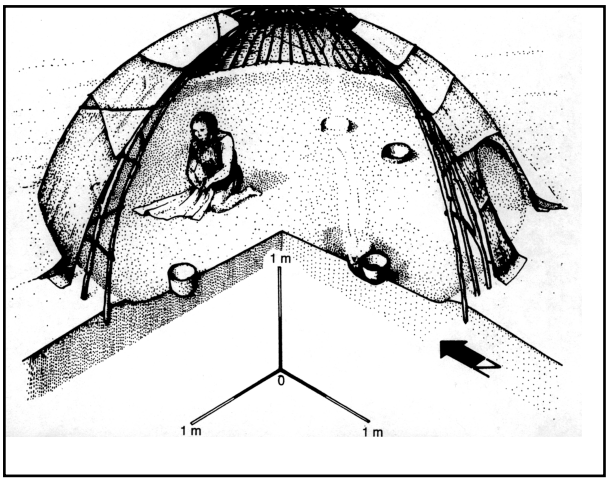

Fig. 16: Reconstruction of hut 2/90 (from Krolik and Schild, Figure 7-10).

had to be seasonally abandoned with the summer rains, not unlike some of the towns along the Mississippi River in the United States that were flooded every summer, until dams were built to control the river. But the success of the Nabta/Al Jerar experiment was dependant on the increased rainfall of the Holocene Climate Optimum, which clearly did not last forever. We do not know exactly when the Nabta/Al Jerar villages were abandoned, but 7300 bp (6100 cal BC) is the most recent radiocarbon date from any El Nabta/Al Jerar locality. Abandonment must have occurred very shortly after that date. Where they went is not known; however, there are several small sites near Wadi Halfa that may represent some of the survivors (Shiner 1968). The unknown length of the hyper-arid period with perhaps no rainfall at all, the damage to the grazing areas, and the lower water tables prevented an immediate return to the area.

When a few people finally did return, the communities are small and rare. They had a few new stone tools, and the pottery resem-

Fig. 17: Abandoned modern pastoralist hut near Jebel Medub, north central Sudan.

bled that used earlier, but it was not as well made and the decorations were carelessly executed. What must have been the most important new addition was domestic sheep/goat (in addition to the cattle). The sheep/goats are present in the earliest occupations of this interval, and were almost certainly introduced from Southwest Asia, and most likely by way of the Nile Valley.

This new group probably occupied the area in the fall and winter, because numerous grinding stones and many large, deep storage pits indicate that they probably intensively gathered plant goods, although due to poor preservation none have been recovered. They also dug large, deep, water wells, and they surely had houses, but none have been found. The general impression is that of a not very successful adaptation to the area. The environment was perhaps too hostile; there were summer rains, but they were much reduced from those earlier in the Holocene, and there were no huge playa lakes, only small temporary pools behind dunes on the floors of the basins. They managed to survive for a period of around 400 years, but another period of hyperaridity that began around 5700 cal BC (6700 bp), finally drove them from the area, and they never returned. New groups with a very different Neolithic cultural tradition more closely allied to contemporary developments in the Nile Valley, occupied the area around 5400 cal BC (6500 bp).

Prtof. Fred Wendorf : Department of Anthropology Southern Methodist University Dallas, TX 75275 USA. E-mail: fwendorf@mail.smu.edu

Dr. Romuald Schild: Institute of Archaeology and Ethnology Polish Academy of Sciences A1. Solidarnosci 10500-140 Warsaw, Poland. E-mail: rschild@archeolog.iaepan.edu.pl

ملخص: كان المناخ الهولسيني الأول في الصحراء الغربية المصرية متقلباً جداً؛ تتخلله باستمرار فترات قصيرة، لكنها حادة، من الجفاف، ما أدى إلى هجران المنطقة. كانت أمطار الصيف هي المصدر الوحيد للماء، وكان آخرها قد اختفى من المحاجر بعد عدة أشهر. أما المستعمرات التي تعود إلى الفترة الموزونة الواقعة بين ٩٠٠٠–٧٠٠٠ قبل الميلاد، فقد كانت صغيرة وتسكنها لفترة وجيزة مجموعات من رعاة الماشية. وفي حوالي الفترة الموزونة الواقعة بين ٧٠٠٠–٦١٠٠ قبل الميلاد، إبان المناخ الهولسيني المناسب، تكوَّنت القرى الحقيقية، فكان أغلبها ذا حجم كبير ويعتمد وجودها على: آبار كبيرة وعميقة، ونبات بري يجمع بكثرة، وصيد الحيوانات الصغيرة، ورعي الماشية.

References

Barakat. H. N. 1995. Contribution Archaeobotanique a l'Histoire de la Vegetation dans le Sahara Oriental et dans le Soudan Central. Doctoral thesis. University d'Aix-Marseille III. (unpublished).

Barich, B.E. 1987. "The Wadi Ti-n-Torah Facies". In: B. E. Barich (ed), **Archaeology and Environment in the Libyan Sahara: The Excavations in the Tadrart Acacus, 1978-1983**, pp. 97-112. British Archaeological Reports, International Series 368. Oxford.

Binford, L. 1990. Mobility, Housing, and Environment: A Comparative Study, **Journal of Anthropological Research** 46: 119-152.

Bradley, D.G., D.E. MacHugh, P. Cunningham, and R.T. Loftus 1996. Mitochondrial Diversity and the Origin of African and European Cattle. **Proceedings of the National Academy of Sciences USA** 93: 5131-5135.

Close, A.E. 1995. Few and Far Between. Early Ceramics in North Africa. In: W. K. Barnett and J. W. Hoopes (eds), **The Emergence of Pottery. Technology and Innovation in Ancient Societies**, pp.23-37.

Close, A. E. and F. Wendorf 1992. The beginnings of Food-Production in the Eastern Sahara. In: A.B. Gebauer and T.D. Price (eds), **Transitions to Agriculture in Prehistory**, pp 63-72. Prehistory Press, Madison, WI.

..... 2001. Site E-77-7 Revisited: The Early Neolithic of El Adam Type at El Gebel El Beid Playa. In: F. Wendorf, R. Schild, and Associates (eds), **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa**, pp.57-70. Kluwer Academic/Plenum Publishers. New York.

Delibras, G., M.T. Guillier, and J. Labeyrie 1974. Gif Natural Radiocarbon Measurements VIII. **Radiocarbon** 16: 15-94.

Gautier, A. 1980. Appendix 4: Contributions to the Archaeozoology of Egypt. In: F. Wendorf and R. Schild (eds), **Prehistory of the Eastern Sahara**, New York: Academic Press. Pp. 317-344.

..... 1984. Archaeozoology of the Bir Kiseiba Region, Eastern Sahara. In: **Cattle keepers of the Eastern Sahara: The Neolithic of Bir Kiseiba, assembled by** F. Wendorf and R. Schild, edited by A. E. Close. Dallas: Department of Anthropology, Institute for the Study of Earth and Man, Southern Methodist University. Pp. 49-72.

..... 1987. Prehistoric Man and Cattle in North Africa: A Dearth of Data and a Surfeit of Models. In: A. Close (ed), **Prehistory of Arid North Africa, Essays in Honor of Fred Wendorf,** Dallas: Southern Methodist University Press. Pp. 163-187.

..... 2001. The Early to Late Neolithic Archeofaunas from Nabta and Bir Kiseiba. In: **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa**, by F. Wendorf, R. Schild, and Associates. New York: Kluwer Academic/Plenum Publishers. Pp. 609-635.

Haaland, R. 1987. Problems in the Mesolithic and Neolithic Culture-History in the Central Nile Valley, Sudan. In: T. Hagg (ed), **Nubian Culture: Past and Present**, pp. 47-74. Kungl. Vitterhets Historie och Antikvitets Akademien, Konfernser 17. Almqvist and Wiksell, Stockholm.

Hanotte, O., D. G. Bradely, J. W. Ochieng, Y. Verjee, E. W. Hill, and J. E. O. Rege 2002. "African Pastoralism: Genetic Imprints of Origins and Migrations", **Science** 206; 336-339.

Khabir, A.M. 1987. "New Radiocarbon Dates for Sarurab 2 and the age of the Early Khartoum Tradition", **Current Anthropology** 28: 377-380.

Krolik, H. and R. Schild 2001. Site E-75-6: An El Nabta and Jerar Village. In: F. Wendorf, R. Schild, and Associates (eds), **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa,** New York: Kluwer Academic/Plenum Publishers. Pp. 111-146.

Kropelin, S. 1993. The Gilf Kebir and Lower Wadi Howar: Contrasting Early and Mid-Holocene Environments in the Eastern Sahara. In: L. Krzyzaniak, M. Kobusiewicz and J. Alexander (eds), **Environmental Change and Human Culture in the Nile Basin and Northern Africa until the Second Millennium B,C., Vol. 4, Studies in African Archeology**, Pp. 249-258. Posnan Archaeological Museum, Posnan.

MacHugh, D. E., M. D. Shriver, R.T. Loftus, P. Cunningham, and D. G. Bradley 1997. "Microsatellite DNA Variation and the Evolution, Domestication and Phylogeography of Taurine and Zebu Cattle (Bos Taurus and Bos indicus)". **Genetics** 146:1071-1086.

Maitre, J.P. 1974. "Nouvelles perspective sur la prehistoire recente de 1' Ahaggar", **Libyca** 22: 93-143

Nelson, K. 2001a. "The Pottery of Nabta Playa: A Summary", In: F. Wendorf, R. Schild, and Associates (eds),

Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa, New York: Kluwer Academic/Plenum Publishers. Pp. 534-543.

..... 2001b. Area 2. **In Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa,** edited by F. Wendorf, R. Schild, and Associates. New York: Kluwer Academic/Plenum Publishers. Pp. 211-229.

..... 2002. **Holocene Settlement of the Egyptian Sahara, Volume 2, The pottery of Nabta Playa**, edited by K. Nelson and Associates. New York: Kluwer Academic/Plenum Publishers.

Rosert, J. P. 1987. Paleoclimatic and Cultural Conditions of Neolithic Development in the Early Holocene of Northern Niger (Air and Tenere). In **Prehistory of Arid North Africa: Essays in Honor of Fred Wendorf,** edited by A. E. Close, pp.211-234. Southern Methodist University Press, Dallas, Texas.

Schild, R. and F. Wendorf 1977. **The Prehistory of Dakhla Oasis and Adjacent Desert.** Polish Academy of Sciences. Warsaw: Ossolineum.

..... 2001a. Geoarchaeology of the Holocene Climatic Optimum at Nabta Playa, Southwestern Desert, Egypt. **Geoarchaeology: An International Journal** 16:9-28.

..... 2001 b. Geomorphology, Lithostratigraphy, Geochronology and Taphonomy of Sites. In **Holocene Settlement of the Egyptian Sahara, Volume 1. The Archaeology of Nabta Playa**, by F. Wendorf, R. Schild, and Associates. New York: Kluwer Academic/Plenum Publishers. Pp. 11-50.

Schild, R., M. Chemielewska and H. Wieckowska 1968. The Arkinian and Shamarkian Industries. In: **The Prehistory of Nubia**, Volume II. Edited by F. Wendorf. Dallas: Fort Burgwin Research Center and Southern Methodist University Press. Pp.651-767.

Shiner J. L. 1968. The Khartoum Variant Industry. In: **The Prehistory of Nubia**, Volume II, edited by F. Wendorf. Dallas: Fort Burgwin Research Center and Southern Methodist University Press Pp. 768-790

Struiver, M. and P.J. Reimer 1993. Extended ^{14}C Data Base and Revised CALIB 3.0 ^{14}C Age Calibration Program. **Radiocarbon** 35:215-230

Wasylikowa, K., R. Schild, F. Wendorf, H. Krlik, L. Kubiak-Martens and J.R. Harlan, 1995. Archaeobotany of the early Neolithic Site E-75-6 at Nabta Playa, Western Desert, South Egypt. **Acta Palaeobotanica** 35 (1)/ 1995, pp: 133-155

Wasylikowa, K., H. N. Barakat, L. Boulos, A. Butler, J. A. Dahlberg, J. Harther and J. Mitka 2001a.Site E-75-6: Vegetation and Subsistence of the Early Neolithic at Nabta Playa, Egypt, Reconstructed from Charred Plant Remains. In **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa**, by F. Wendorf, R. Schild, and Associates. New York: Kluwer Academic/Plenum Publishers. pp. 544-591

..... 2001 b. Other Botanical Studies, Part IV: Nabta Playa Sites E-75-8, E-91-1,E-97-2, E-94-1, E-94-2, and El Gebal El Beid Playa Site E-77-7: Seeds and Fruits. In **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa,** by F. Wendorf, R. Schild, and Associates. New York: Kluwer Academic/ Plenum Publishers. Pp. 605-606.

Wendorf, F. and R. Schild 1976. **Prehistory of the Nile Valley** (with sections by Bahay Issawi). New York: Academic Press.

..... 1980. **Prehistory of the Eastern Sahara**. New York: Academic Press

..... 1994. Are the Early Holocene Cattle in the Eastern Sahara Domestic or Wild? **Evolutionary Anthropology** 3:118-128.

..... 2001. Conclusions. In **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa**, by F. Wendorf, R. Schild, and Associates. New York: Kluwer Academic/Plenum Publishers. Pp. 648-675.

..... 2002. The Role of storage in the Neolithic of the Egyptian Sahara. In **Tides in the Desert - Gezeiten der Wuste. Contributions to the Archaeology and Environmental History of Africa in Honour of Rudolph Kuper**. Koln: Keinrich-Barth-Institut fur Archaologie und Geschichte Afrikas, Universitat zu Koln. Pp. 41-49.

Wendorf, F. and R. Schild (Assemblers) and A.E. Close (Editor) 1984. **Cattle-Keepers of the Eastern Sahara: The Neolithic of Bir Kiseiba**. Dallas: Department of Anthropology, Institute for the Study of Earth and Man, Southern Methodist University.

Wendorf, F., R. Schild, A.E. Close and Associates 1993. **Egypt During the Last Interglacial, The Middle Paleolithic of Bir Tarfawi and Bir Sahara East**. Plenum Press. New York.

Wendorf, F., R. Schild and Associates 2001. **Holocene Settlement of the Egyptian Sahara, Volume 1, The Archaeology of Nabta Playa**. New York: Kluwer Academic/Plenum Publishers.