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Climatic changes and cultural transformations in Farafra oasis, Egypt

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A long-term international investigation of the geoarchaeology and prehistory of Farafra oasis in the Egyptian Sahara is revealing how a series of abrupt short-term climatic changes during the past 12,000 years restructured patterns of human settlement and subsistence. Increasing aridity eventually prompted Neolithic desert dwellers to migrate to and settle in the Nile valley.

Famed for the natural beauty of its White Desert, Farafra oasis, once an inaccessible and mysterious place, has now become a favourite stop on the tourist itinerary. It was in the 1970s, while exploring the prehistory of Bahariya oasis,[1] that I ventured to the northern edge of the Farafra depression with Egyptian geologist El-Sayed Zghloul to examine a field of well developed calcite crystals at the pass of Naqb Abdulla. Some years later, in 1987, Barbara Barich (University of Rome La Sapienza) and I started a programme of investigations at Farafra that still continues to yield new information on the prehistory and Holocene geology of this part of the Egyptian Sahara.[2]

Figure 1 *The location of Farafra and other major oases of Egypt's Western Desert, part of the eastern Sahara.*

Like other oases in the of the vast desert west of the Nile, Farafra is situated in a depression where water is available from natural springs and artesian wells. In the past, prehistoric peoples not only benefited from the natural flow of groundwater, but also at times from surface water in ephemeral lakes fed by local seasonal streams and runoff during phases of wetter climate. Having already worked in Siwa and Bahariya oases north of Farafra (Fig. 1), I was confident when we began our investigations that we would find playa (ephemeral lake) deposits that bear witness to wetter episodes in the early and mid-Holocene (Fig. 2). But we did not know how the record of past rainfall in Farafra oasis might compare in amount and seasonality with that farther north. It was becoming clear that rainfall had increased from north to south, suggesting that its main source was related to the East African–Indian Ocean summer-monsoon belt, and we wished to find out whether geoarchaeological research in Farafra would confirm this hypothesis.

By then I had become particularly interested in the prehistory of Holocene populations in the Sahara, having realized early on that the virtual abandonment of the Egyptian Sahara coincided with the emergence of Neolithic communities on the banks of the Nile. I wondered if Farafra would shed more light on this probable link between the Egyptian Sahara and the Neolithic communities of the Nile valley. Together with my Egyptian assistants, geologists Abdel Moneim Mahmoud and M. Abdel-Rahman Hemdan, then postgraduate students at Ain Shams University and Cairo University respectively, I began a systematic exploration of the playa deposits of the Farafra depression. Barbara Barich was in charge of research on the cultural aspects of prehistoric settlements. Every year since then, a community of Italian and Egyptian academic nomads have set up camp at Farafra, and each year new discoveries help to resolve the geoarchaeological and archaeological puzzles of this intriguing oasis. They also provide new insights into the nature of climatic changes during the Holocene and the prehistoric transition in North Africa from hunting and gathering to herding and farming.

Origin of the Farafra depression

The current reputation of the White Desert as a major tourist attraction is attributable to the fairy-tale swarms of residual snow-white chalk pedestals there, produced by karstic processes of limestone solution. This exotic, almost surreal, landscape is unique to Farafra because the chalk of Cretaceous age, exposed in the northern part of the oasis, is very susceptible to erosion. The Farafra depression was once thought to have been formed by wind erosion because of the prevalence of wind-blown (aeolian) sand deposits. However, we now know that, like other depressions in Egypt's Western Desert, it was formed in stages as a result of a dynamic interplay between fluvial and karstic processes, with interludes of aeolian activity, under changing climatic conditions since the Miocene epoch.[3] During the late Quaternary (the late Pleistocene and Holocene periods), fluvial activity was limited to occasional seasonal flow, and karstic solution was also limited. Wind action was pronounced during the Last Glacial Maximum (*c.* 21,000 calendar years ago) and again

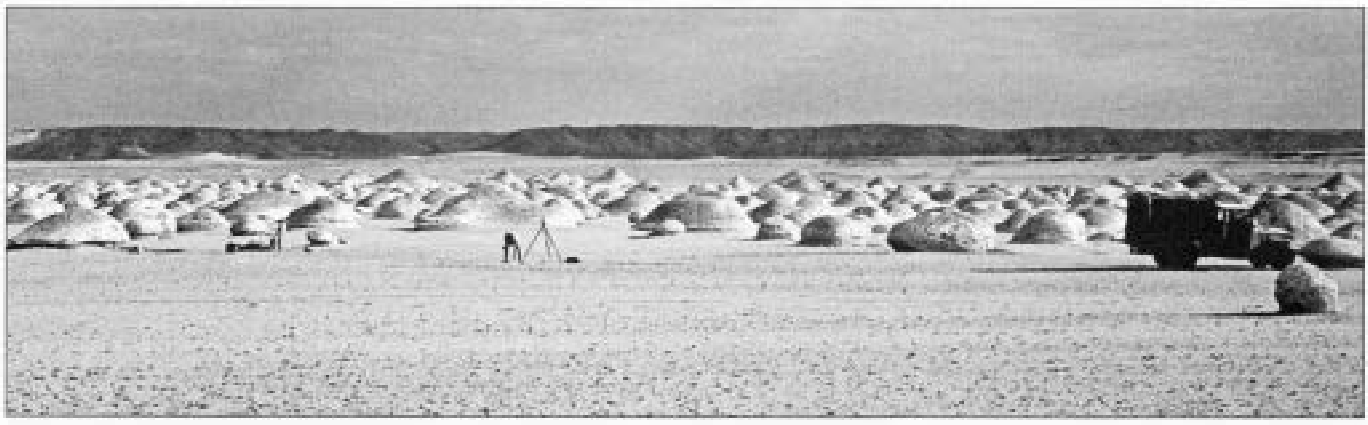

Figure 2 *Wetter conditions during the Holocene are indicated by the remains of ephemeral lakes (playas) that dot the depressions of the Western Desert. Bahr Playa (shown here) is one of the principal playas in the Farafra depression and has revealed evidence of human occupation. The rounded hillocks are erosional remnants of ancient lake beds.*

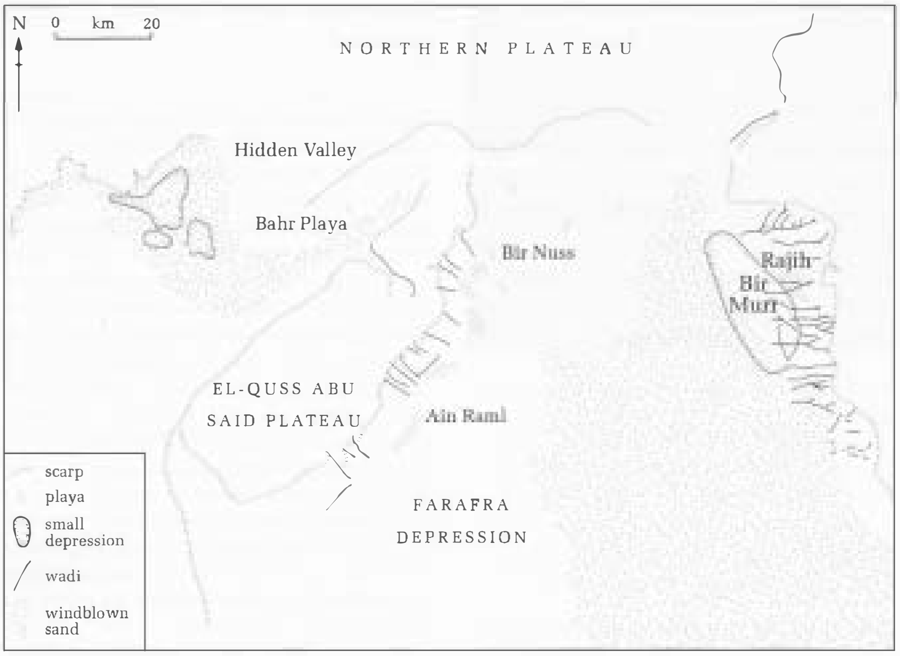

Figure 3 *The Farafra depression, showing places mentioned in the text, the surrounding desert plateaux, playas and other geomorphological features.*

throughout the past 7000 years. Wind-erosional features and aeolian sandsheets and dunes are no more than the final retouches on a more ancient landscape formed primarily as a result of water action.

The Farafra depression (Fig. 3) extends over an area of 10,000 km^2. It is bounded on the north, east and west by escarpments of the surrounding desert plateaux at 270–300 m above sea level, with residual hills as high as 350 m. The depression itself is rimmed by a series of rock slopes (pediments) at the bases of the escarpments, and playas occur close to the edges of the depression and in karstic basins on top of the plateaux. Aeolian sand deposits extend along the eastern margin of the depression in the Rajih–Bir Murr area.

Playa deposits and palaeoclimate

The sequence of playa deposits in the Farafra depression begins with an initial episode of wadi (stream-channel) activity, associated with ponds and ephemeral lakes, which formed Bir Nuss Old Playa (Fig. 3). This was followed by an erosional episode, which was in turn followed by a phase of playa deposition dated to *c.* 11,000 cal. BP (9650 bp uncalibrated).[4] This playa phase, which is well represented at Ain Raml (Fig. 3), was fed by wadi wash (occasional streamflow), as is indicated by lenses of fluvial sand and gravel. Following another erosional episode, playa deposition resumed. Deposits from this latter phase are represented at Bahr Playa in Wadi El-Obeiyid (Fig. 3) and date from *c.* 9000 to 8000 cal. BP (8080–7320 bp). The lower part of these sediments was formed when wadi flow was active, as is indicated by cross-laminated deposits of fluvial sand and gravel.[5]

After *c.* 8000 cal. BP there was less fluvial activity, and most deposition was colluvial (i.e. the result of material being washed down slope), indicating that the climate was becoming progressively drier. White detrital deposits, dated to after *c.* 6800 cal. BP (6050 bp), show upward coarsening to granules and finally to large slabs of chalk overlying playa deposits, indicating severe mechanical weathering. Temperature variations coupled with the freezing of moisture trapped in fissures were sufficient to produce angular limestone blocks (Fig. 4). There is a shift from the yellowish hues of the main playa deposits to the white colour of the detrital deposits at the end of the phase, indicating that by then temperature and rainfall were too low to mobilize iron oxides. Also, there is no evidence for the formation of salt or gypsum, which suggests that the water table dropped rapidly following the termination of playa deposition.

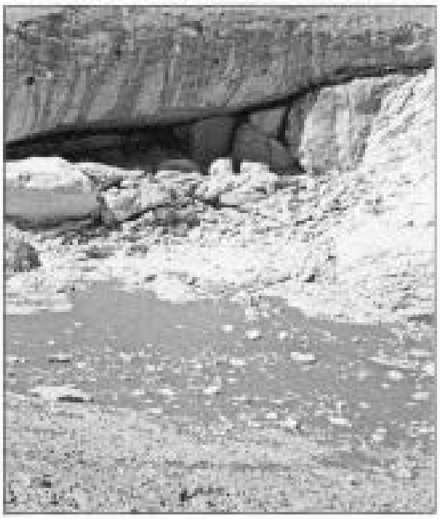

Figure 4 *Angular detrital deposits formed following the main phase of playa formation at Bahr Playa reveal that the shift to drier conditions by 6800 years ago was marked by extremely cold weather, sufficient to freeze moisture trapped in rock fissures.*

The youngest playa deposits in the sequence postdate the seventh millennium cal. BP. At Bir Nuss (Fig. 3) they were mainly fed by discharges from springs and they are overlain by a layer of tufa (spring-deposited calcium carbonate), marking a moist cool phase. Other younger playa deposits are found at Rajih in the eastern part of the depression (Fig. 3).

Palaeoclimate, subsistence and cultural change

The occupational history of Farafra oasis is closely linked to the changing climatic conditions and associated modifications of the desert landscape. Archaeological evidence suggests that hunter–gatherers who lived in transient encampments had inhabited the Farafra region since the early Holocene (eleventh millennium cal. BP). One of the main prehistoric settlements we have discovered – where excavations have revealed a complex depositional and occupational history – consists of a series of slab-lined circular huts at the edge of a playa on a pediment leading to the El-Quss Abu Said plateau above Bahr Playa, in the area we named Hidden Valley (Figs 3, 5). The huts were placed at the edge of an ephemeral pond, formed in a karstic depression. The stone slabs of the dwellings are now embedded in a stratified sequence of playa and colluvial deposits. Although radiocarbon age determinations from the site span a range from greater than 8000 to 7000 cal. BP (7300 to 6200 bp), the main occupation, which includes formal hearths, dates to 7650 cal. BP (6900 bp).[6] The hearths yielded evidence, in the form of charred plant remains, for the intensive utilization of wild sorghum and other wild grasses,[7] as well as bone fragments of domestic ovicaprids (sheep or goats).[8] Intercalated colluvial deposits above and below this occupation contain reworked older cultural material and provide anomalous (older) dates than might be expected from their stratigraphical position.[9] These colluvial deposits are particularly significant because they are evidence of short-term oscillations of severe storms alternating with episodes of relative stability. Also, the climatic oscillations between 8000 and 6800 cal. BP appear to have been associated with a change in seasonality, with incursions of winter rain into the Farafra depression (as indicated by the presence of Mediterranean poppy seeds found in a hearth deposit).[10]

Another of our main discoveries is a cavern in the cliff face that overlooks a high pediment above Wadi El-Obeiyid in Hidden Valley (Fig. 6). The entrance to the

Figure 5 *The foundations of one of the stone-lined circular huts at Bahr Playa in Hidden Valley that date to between 8000 and 7000 years ago.*

Figure 6 *The El Obeiyid cavern (arrow) is located in an escarpment cliff face above Hidden Valley at Farafra; Wadi El Obeiyid in the foreground. Dated deposits of wind-blown sand in the entrance to the cave demonstrate that intensification of aeolian activity began about 7850 years ago.*

Figure 7 *Rock engravings of an animal resembling a pregnant (?) oryx and a pattern of round depressions arranged in the "lion foot" motif, El Obeiyed cavern, Farafra.*

El-Obeiyid cavern was filled with wind-blown sand. Charcoal found at the base of the aeolian sequence (at 170 cm below the present surface) provided a date of *c.* 7850 cal. BP (7000 bp). This is a significant discovery because it pinpoints the onset of severe aridity when aeolian activity was re-intensified after the Last Glacial Maximum. A sample from the middle of the sequence at 110 cm below the surface provided a date of *c.* 5200 cal. BP (4460 bp). Pollen extracted from ancient sheep and goat droppings (coprolites) from the lower part of the aeolian stratigraphical unit (7850–5200 cal. BP) comes from plants typical of sandy plains and ridges that rise above the plains (cuestas).[11] We also made another significant discovery in the cavern: rock art. Near the entrance, in the front and middle galleries of the cave, one can discern engravings of a kind of mouflon, of an animal that resembles a pregnant (?) oryx, and of patterns of round depressions in what is described as a "lion foot" motif; also, in the rear gallery, there are many handprints on the wall and towards the ceiling (Figs 7, 8).[12]

Regional cultural implications

The earliest evidence of sheep or goats at Farafra dates to 7650–7350 cal. BP (6900–6500 bp), but there is no direct evidence of domestic cattle, which are present earlier farther south at Nabta Playa (Fig. 1).[13] There is also evidence at Nabta of intensive utilization of sorghum and other seeds and tubers at 8900–8700 cal. BP, pre-dating the sorghum found at Farafra by a millennium.[14] So far, only a few pot-sherds have been found at Farafra.

The advent of hyper-arid conditions at *c.* 8000 cal. BP, as indicated by the intensification of aeolian activity at Farafra, was associated with a highly unstable climatic regime that eventually, by 6800 cal BP, led to an actual reduction of rainfall. This pattern of climatic change at Farafra, which accords with evidence for a shift to arid conditions during this period all over North Africa,[15] stimulated many local population movements and cultural developments. It is also during this period that domestic sheep and goats were introduced into Egypt from Southwest Asia where they originated.[16] The evidence of goats and sheep at Farafra at *c.* 7650 cal. BP compares well with the other very early record of them in Africa (at *c.* 7850 cal. BP) in the Egyptian Red Sea Hills.[17]

It is probable that by 7300 cal. BP (6500 bp) intercultural contacts had intensified in the eastern Sahara as people ranged more widely across the landscape in response to greater climatic instability. This is suggested by similarities in the stone-tool assemblages found at Bashendi in the Dakhla oasis (Fig. 1) and Bahr Playa in Farafra.[18] It is likely that ovicaprids, which are better adapted to desert conditions than cattle are, would have been widely adopted at that time by eastern

Figure 8 *Handprints on a wall in the rear chamber of the El Obyeiyid cavern, which is one of only three in Egypt to reveal prehistoric rock art.*

Saharan communities. No evidence of domestic cattle has been found at Farafra, but there is evidence of them at Dakhla in phase B of the Bashendi assemblages, which dates from 7300 to 6300 cal. BP. This may represent the northernmost occurrence of domestic cattle in the Egyptian Sahara at this time, probably because the catchment areas of ephemeral lakes at Dakhla were larger than those at Farafra.[19] Dakhla, which was at the junction of the expanding Mediterranean climatic regime and the retreating monsoonal front, probably benefited from both winter and summer rains. Desert conditions at Farafra, even with occasional rain showers in winter, were not suitable for herding cattle. Instead, sheep and goats were incorporated into a subsistence regime that emphasized the hunting of gazelle and other desert game animals as soon as they became available seasonally. However, there is no evidence that the adoption of domestic sheep and goats from Southwest Asia was accompanied by the introduction of domesticated wheat or barley, which also originated in Southwest Asia. Moreover, there is no evidence that wild cereal grasses indigenous to northern Africa, such as sorghum, were ever domesticated locally.[20]

Desertification during the eighth millennium BP and thereafter would have encouraged some inhabitants of Farafra and Dakhla, as well as those farther south at Nabta, to expand their search for pastures. Some may also have ventured into the Nile valley, perhaps initially for shorter visits and eventually to take up long-term residency. In the Nile valley, the earliest food-producing communities date to *c.* 6800 cal. BP at Merimde Beni Salama, in the western Nile delta, and perhaps as early as 6400 cal. BP at Badari in Middle Egypt (Fig. 1). These sites contain stone artefacts analogous to those from the eastern Sahara dating from 7600 to 7300 cal. BP.[21] Spells of severe hyper-aridity beginning about 8000 cal. BP could thus have encouraged some desert dwellers to settle on the banks of the Nile. However, the desert was not totally depopulated. The occupation at Rajih in Farafra and the late occupations at Dakhla suggest that the prehistoric inhabitants of the oases struggled on until *c.* 5200 cal. BP, when desert conditions were already firmly established across North Africa.[22]

Conclusion

Our joint programme of geoarchaeological investigations and systematic archaeological survey and excavation in Farafra has already yielded vital information concerning both the changing Holocene climate and the prehistoric peoples of the eastern Sahara. Detailed microstratigraphical and sedimentological studies, coupled with other palaeoenvironmental analyses and many radiocarbon age determinations, are revealing how critical for human survival short-term climatic events were in the fickle desert environment. Our research in the Farafra depression has confirmed the supposition that rain was linked to northerly advances of the monsoonal front during the warm intervals of the Holocene, but the possibility that incursions of winter rain from the Mediterranean occurred during the transitions from warm to cool climate requires a refinement of the current model of climatic change in North Africa during the Holocene.

Notes

1. F. A. Hassan, "Archaeological explorations at Baharia Oasis and the West Delta, Egypt", *Current Anthropology* **20**, 806, 1979.
2. The term Holocene (literally "wholly recent") refers to the postglacial epoch of geological time, from about 11,500 calendar (*c.* 10,000 radiocarbon) years ago; together with the preceding two million years of the Pleistocene epoch it comprises the Quaternary era.
3. B. E. Barich & F. A. Hassan, "The Farafra Oasis archaeological project (Western Desert, Egypt)", *Origini* **13**, 117–85, 1984–87. The Miocene epoch of geological time encompasses the period from approximately 24 to 5 million years ago.
4. The relationship between calendar and radiocarbon years varies as one goes back in time. The difference between them is determined by reference to calibration curves that are obtained by radiocarbon dating samples of known calendric age. For more information about calibrated and uncalibrated radiocarbon dates, see p.2 of *AI 1997/98*.
5. See F. A. Hassan, B. E. Barich, M. Mahmoud, M. A. Hemdan, "Holocene playa deposits of Farafra Oasis, Egypt, and their

palaeoclimatic and geoarchaeological significance", *Geoarchaeology* **16**, 29–49, 2001.

6. Detailed microstratigraphical examination revealed that dwellings were frequently inundated by rising water in the pond and that houses were destroyed by violent episodes of surface runoff that reworked charcoal from old settlements, resulting in anomalous radiocarbon age determinations. However, several age determinations on charcoal from *in situ* hearths have established the age of one of the main occupations at *c.* 7650 years ago.
7. H. Barakat & A. G. Fahmy, "Wild grasses as 'Neolithic' food resources in the eastern Sahara", in *The exploitation of plant resources in ancient Africa*, M. van der Veen (ed.), 33–53 (London: Kluwer Academic/Plenum, 1999).
8. Identified by A. Gautier of the University of Gent, Belgium.
9. B. E. Barich & F. A. Hassan, "A stratified sequence from Wadi el-Obeiyd, Farafra: new data on subsistence and chronology of the Egyptian Western Desert", in *Recent research into the Stone Age of northeastern Africa*, L. Krzyzaniak, K. Kroeper, M. Kobusiewicz (eds), 11–20 (Poznan: Poznan Archaeological Museum, 2000).
10. Personal communication from A. Fahmy of Helwan University, Cairo, Egypt.
11. Identified by E. Schulz of the University of Würzburg, Germany.
12. B. E. Barich, F. A. Hassan, A. Stoppiello, "Farafra oasis between the Sahara and the Nile", in *Interregional contacts in the later prehistory of northeastern Africa*, L. Krzyzaniak, K. Kroeper, M. Kobusiewicz (eds), 71–79. (Poznan: Poznan Archaeological Museum, 1996).
13. F. Wendorf, A. E. Close, R. Schild, "Early domestic cattle in the Eastern Sahara", *Palaeoecology of Africa* **18**, 441–8, 1987.
14. F. Wendorf, R. Schild, K. Wasylikowa, J. Dahlberg, J. Evans, E. Biehl, "The use of plants during the early Holocene in the Egyptian Sahara: early Neolithic food economies", in *Before food production in North Africa*, S. di Lernia & G. Manzi (eds), 71–8 (Forli: ABACO, 1998).
15. F. A. Hassan: "Abrupt Holocene climatic events in Africa", in *Aspects of African archaeology*, G. Pwiti & R. Soper (eds), 83–9 (Harare: University of Zimbabwe Publications, 1996); "Holocene Palaeoclimates of Africa", *African Archaeological Review* **14**, 213–30, 1997.
16. See p. 86 in Hassan (1996: *n.* 15 above).
17. P. Vermeersch, J. van Peer, J. Moeyersons, W. van Neer, "Sodmein Cave site, Red Sea Mountains (Egypt)", *Sahara* **6**, 31–40, 1996.
18. M. M. McDonald: "Relations between Dakhleh Oasis and the Nile Valley in the Mid-Holocene: a discussion", in *Interregional contacts in the later prehistory of northeastern Africa*, L. Krzyzaniak, K. Kroeper, M. Kobusiewicz (eds), 94–9 (Poznan: Poznan Archaeological Museum, 1996); "Adaptive variability in the eastern Sahara during the early Holocene", in *Before food production in North Africa*, S. di Lernia & G. Manzi (eds), 127–36 (Forli: ABACO, 1998).
19. I. A. Brooks, "Early Holocene basinal sediments of the Dakhleh Oasis region, south central Egypt", *Quaternary Research* **32**, 139–52, 1989.
20. H. N. Barakat, "Regional pathways to agriculture in northeast Africa", in *Droughts, food and culture: ecological change and food security in Africa's later prehistory*, F. A. Hassan (ed.), 111–22 (New York: Kluwer Academic/Plenum, 2002).
21. F. A. Hassan, "Desert environment and origins of agriculture in Egypt", *Norwegian Archaeological Review* **19**, 63–76, 1986; Barich, Hassan, Stoppiello (1996: *n.* 12 above); McDonald (1996: *n.* 18 above); R. Kuper, "Between the oases and the Nile–Djara: Rholfs' Cave in the Western Desert", in *Interregional contacts in the later prehistory of northeastern Africa*, L. Krzyzaniak, K. Kroeper, M. Kobusiewicz (eds), 81–91 (Poznan: Poznan Archaeological Museum, 1996).
22. F. A. Hassan, "Conclusion: ecological changes and food security in the later prehistory of North Africa: looking forward", in *Droughts, food and culture: ecological change and food security in Africa's later prehistory*, F. A. Hassan (ed.), 321–33 (New York: Kluwer Academic/Plenum, 2002).