Development of the Memphite Floodplain

Landscape and Settlement Symbiosis in the Egyptian Capital Zone

Judith Bunbury, Ana Tavares, Benjamin Pennington, Pedro Gonçalves

1. Introduction

The city of Memphis (see figure 1), although its exact location was lost for many years, was famed in antiquity as the capital of Egypt with an active scribal school. The large ruin field of Mit Rahina is part of Egypt's "Capital Zone" that extends from Abu Rawash and Giza in the north 80 km southwards to Maidum and the entrance to the Faiyum. The whole of this stretch is studded with pyramids and contains the locations of many necropoleis and settlements. In this paper we consider the fortunes of Memphis as part of this capital zone and examine how a number of environment factors have affected the area and may have affected the city as its fortunes waxed and waned. We also discuss the evolution of the Memphite floodplain and the evolving architecture of the Egyptian delta.

2. Memphis

The foundation of ancient Memphis was traditionally associated with a large intervention in the landscape – nothing less than diverting the Nile.[1] The city's subsequent development, over the millennia, was inextricably linked to its dynamic landscape. The memory of Memphis as the ancient capital of Egypt was

1 Herodotus II, 99, Diodorus I, 505, see also Jeffreys, 1985, p. 53–55.

preserved although its location remained uncertain[2] until the French Expedition identified the capital with the ruins of Mit Rahina.[3] Despite its importance only sporadic excavation has taken place at Memphis. Many of its dispersed monuments were accidental discoveries and much of the site remains under cultivation, urban sprawl and private ownership. Our current understanding of the city's development and the ancient environment, particularly the movement of the river, is due mainly to the work of the Survey of Memphis (SoM).[4] From its inception the project combined geomorphology and archaeology. This approach was continued in the Mit Rahina Field School (MRFS)[5] which recorded and excavated the Middle Kingdom settlement at Kom el-Fakhry. The results of the MRFS will fill a gap in our understanding of ancient Memphis and Egypt's "Capital Zone".

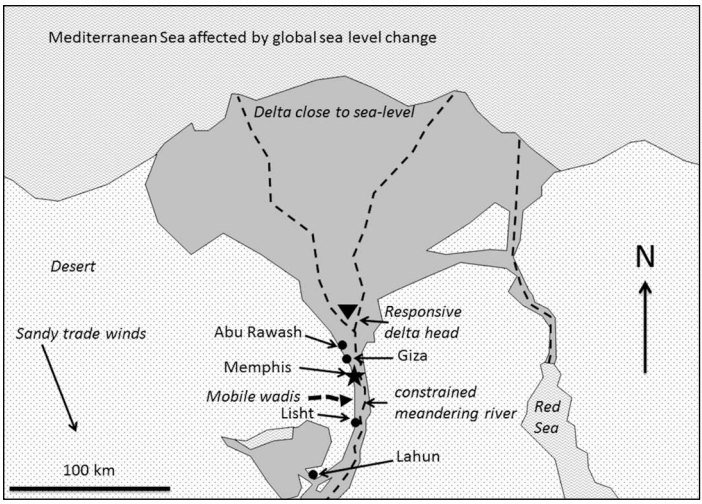

Figure 1. Location map of the "Capital Zone" showing the main locations including Lisht etc.

2 Memphis is aptly described by Jeffreys as "not a lost city, but a city temporarily misplaced", Tavares/Kamel, 2012, p. 5.

3 Jeffreys, 2010, p. 63–66, p. 191–192.

4 Jeffreys, 1985, Giddy, 2012.

5 The Mit Rahina Field-School 2011 (MRFS) was a joint project of Ancient Egypt Research Associates (AERA), the American Research Center in Egypt and the Egypt Exploration Society (EES). The project is under the auspices of the Ministry of Antiquities.

2.1 Location and Landscape: Holocene Climate Change as a Driver of Change

From a geographical perspective, Memphis is located at the point where the desert cliffs of the Nile Valley broaden out and the delta starts to form, an area often described as the delta head. This location, at a landscape tipping point, means there is a complex interplay of geomorphological processes, mostly arising from climate changes that act upon the site. These include:

1. Sea-level change swamping the deltaic coast and the Nile hinterland
2. Migration of the delta-head in response to sea-level changes
3. Lateral migration of the river around the site
4. Vertical aggradation of the floodplain
5. Incursions of desert and wadi sand into the Nile valley in response to changing rainfall and erosion
6. Aeolian sandflux into the valley and the river around Memphis.

Much is known about the approximate geometry of each of these processes and the timescales in which each was active (see figure 2). To calibrate these processes and the way in which they combine from this region is given by detailed archaeological studies at key localities within the ancient capital zone.

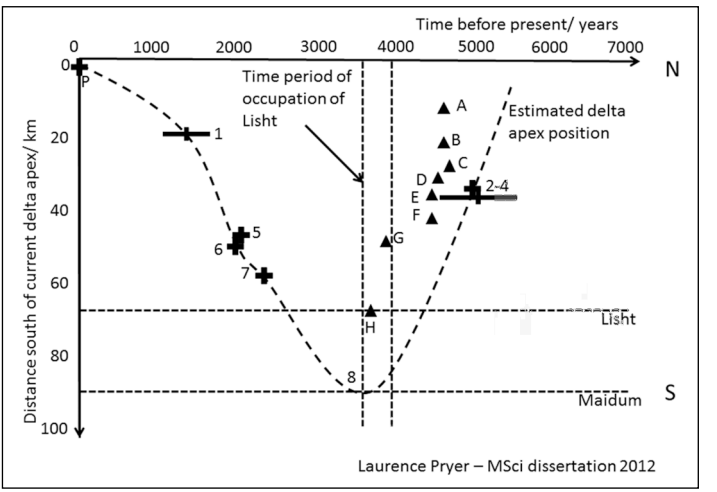

Figure 2. Delta head migration diagram after Pryer, 2012.

Combined studies of climate change proxies[6] suggest that the Holocene period has been characterised by a sharp rise in temperature from the last glacial maximum that peaked around 8,000 years ago during the wet phase in Egypt, designated the Saharan Neolithic. Following this peak there was a gradually oscillating decline in temperature until around 300 years ago when the post-industrial period caused temperatures to rise again. These global temperature changes generated two main effects on the Memphite area. The first was an increase in marshiness resulting from sea-level change in the Mediterranean coupled with the production of many river channels that formed an interconnecting distributary system.[7] The other effect of temperature change was humidification of the Saharan region as the equatorial belt widened and summer monsoon rains fell over a wider part of what is now the Sahara desert[8] with a subsequent decay of habitat as the rains retreated south. The equatorial monsoon in Ethiopia also affected the supply of water in the Blue Nile and hence the intensity and sediment content of the Nile flood.[9]

2.1.1 Sea-level change swamping the deltaic coast and the Nile hinterland

Global sea levels compiled from a number of sources[10] show a steep rise as ice-caps melted after the end of the last glacial maximum (see figure 3). This continued until around 6,000 years ago and was then followed by a period of very gentle rises in sea-level until present time. The coastal areas of deltas across the world were inundated,[11] as was the Egyptian Delta.[12] While marine incursion did not reach as far south as Memphis, at this time, fresh water in the Nile was retained in the valley making the area marshier and increasing the number of channels in the floodplain. Habitation seems to have been restricted to the Pleistocene sand "Gezirehs",[13] remaining from the previous high sand, and to the flanks of the Nile Valley[14] where the wadi mouths and low desert edge

6 Rohde, 2006.

7 Pennington et al., 2016.

8 Kropelin et al., 2008, Rodrigues et al., 2000, Stanley/Warne, 1993, Id., 1994, Id. 1998, Kuper/Kropelin, 2006.

9 Woodward et al., 2007.

10 e.g. Fairbanks, 1989.

11 Stanley/Warne, 1994.

12 Id., 1998.

13 Tristant, 2004.

14 Jeffreys/Tavares, 1994.

provided a refuge from the waters. After the marine incursion, new sediment started to rebuild the delta and the number of distributaries gradually fell and the network began to be more hierarchical dividing from a point in the capital zone area. Modelling of the landscape of the capital zone suggests that this distribution point, known as the "delta-head" migrated with time.[15]

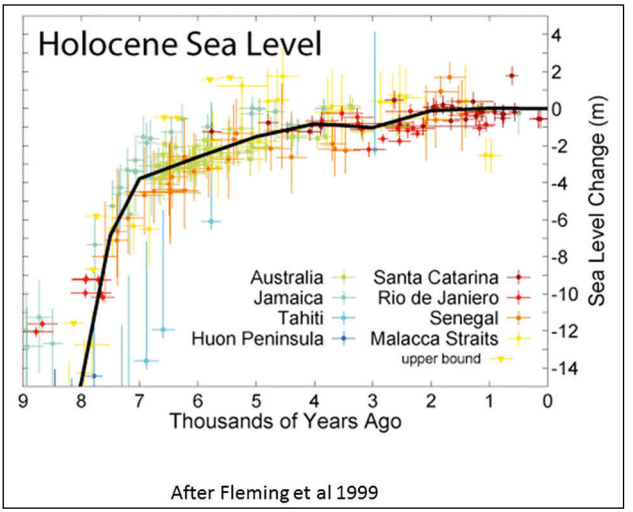

Figure 3. Holocene sea-level rise after the compilation of ROHDE, *2006.*

Intensive studies of the Rhine delta in the Netherlands, involving some 250,000 boreholes,[16] have shown that in an area of low gradient such as a river floodplain, a sea level increase of tens of metres can cause water to travel a hundred or more kilometres inland. The freshwater marshes that are created inland of the estuarine and coastal zone are a rich habitat and have a high nutrient availability. Thus at the same time that the Saharan region was interspersed with lakes and playa basins[17] there was also a rich habitat in the delta region. High levels of sediment accumulation in the area mean that much of this prehistoric inhabitation is

15 BUNBURY et al., in prep.

16 BERENDSEN, 2007, BERENDSEN/STOUTHAMER, 2001.

17 DRAKE, 2006, KUPER/KROPELIN, 2006.

cryptic but a few sites are known including Sais,[18] and several from the north-eastern delta that include Minshat Abu Omar.[19]

Our understanding of the protodynastic settlement is still in its infancy but it seems probable that settlement is reflected in the incidence of early cemeteries; interestingly these lie on both sides of the river (Saqqara, Giza, Helwan, Tura) whereas from the Old Kingdom (Third Dynasty) there is a marked preference for the western desert edge (pyramids and elite tombs).

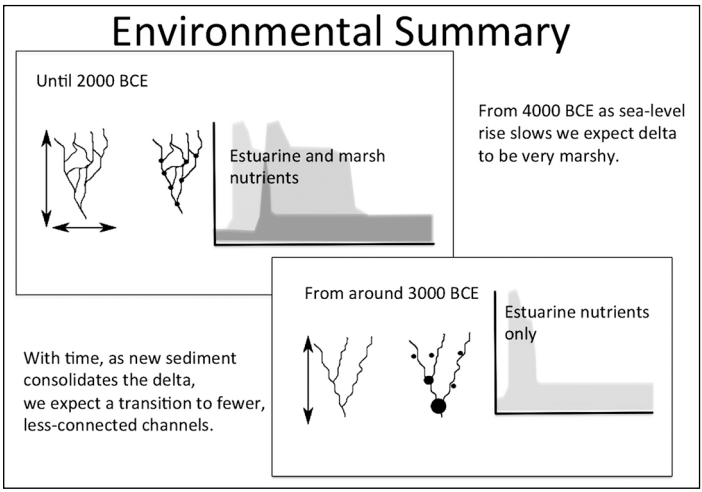

Figure 4. To show schematic river network and nutrient availability before (a) and after (b) c. 3000 B.C. from Pennington, et al., 2016.

In Egypt, the environment of diverse habitats with many interconnecting channels started to change around 4000–3000 B.C. with the marshes becoming marginalised towards the coast and a corresponding reduction in calories available. At the same time, the many anastomosing channels of the delta started to be replaced by more discrete meandering channels that divided from an upstream focus, the delta head. After this time there was a movement of settlements from the edges of the Nile Valley to the levees of the meandering Nile channel in the region of Memphis.[20] Borehole work by the Survey of

18 Wilson, 2006.

19 Rowland, 2012.

20 Jeffreys/Tavares, 1994.

Memphis[21] seems to suggest that there were two channels in the region of Memphis at this time, of which the western channel persisted until the Middle Kingdom.[22] However, constrained by the Nile Valley that narrowed to around 7 km (or less) at this point, the two channels were strategically close together and the "Capital Zone" starts to focus on Memphis.

2.1.2 Migration of the delta-head in response to sea-level changes

A distributary system is initiated as the base of a river channel reaches sea level when the channel divides into two smaller and shallower channels. These can continue to flow seawards until their bases reach sea-level and they, in turn, bifurcate. Thus the location of the delta head in the Nile is an inter-play between the amount of water in the river, which determines the size and depth of the channel, and sea-level. Factors causing migration of the delta-head inland include sea-level rise and increased water in the river, while factors that push the delta head sea-wards include aggradation of the floodplain and sea-level fall.

Observations of floodplain elevation suggest a rapid rise between the Old and the New Kingdom at Dahshur, which we expect to be reflected in a migration of the delta head seawards. Records of the location of the delta head from literature[23] can be combined with observations of Parcak[24] that the village of Lisht may have been located at the contemporary delta head, thus establishing a pattern of migration for this landscape feature during the development of Memphis (see figure 5). We seem to see two episodes during which the delta head was located at Memphis, broadly corresponding to the peaks of known activity in the area; the Old Kingdom necropolis of Saqqara and the New Kingdom expansion of Memphis.

21 Jeffreys, 1985.

22 Bunbury/Jeffreys, 2011.

23 Bunbury et al., in prep.

24 Parcak, 2011.

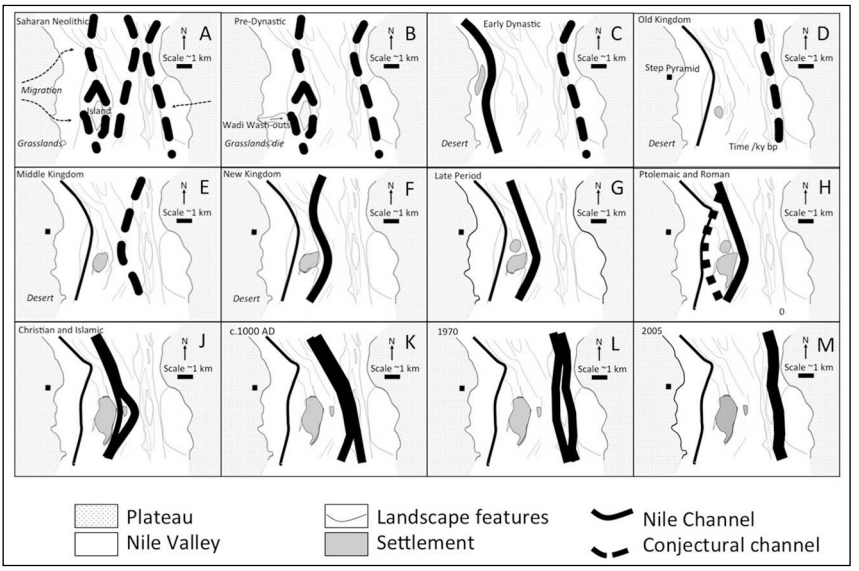

Figure 5. Time series to show the likely history of Nile migration across the Memphite Floodplain as inferred from boreholes of the Survey of Memphis.

2.1.3 Lateral migration of the river around the site

Lateral migration of the meandering Nile within the river floodplain was described by Butzer,[25] observed at Memphis[26] and studied further at Karnak[27] and in the Giza area.[28] Lateral migration of river bends, outwards and downwards across the floodplain, has a mean rate in Egypt of around 2 km/millennium, though lateral rates may reach up to 9 km/millennium in some areas and are frequently characterised by island production and capture.[29] The Survey of Memphis has bored around 150 cores amounting to some 2 km of sediment in a variety of locations across the mounds and in the surrounding floodplain. Facies analysis of these cores has suggested that in the Memphis area there has been broadly eastwards migration of the Nile across the floodplain during the past 6,000 years.

25 Butzer, 1976.

26 Jeffreys, 1985.

27 Bunbury et al., 2008.

28 Bunbury/Lutley, 2008.

29 Hillier et al., 2006.

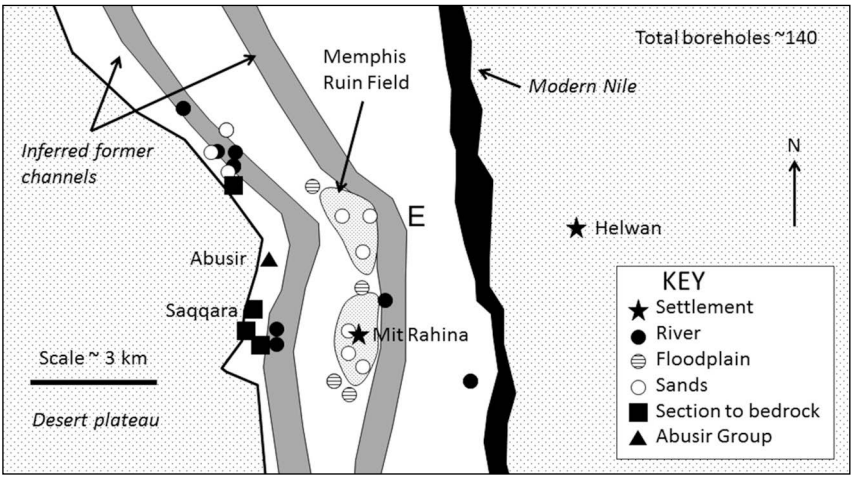

Figure 6. Summary map of the Survey of Memphis boreholes into the Memphite Floodplai showing erstwhile river positions (grey) and the current Nile location (black).

2.1.4 Vertical aggradation of the floodplain

The earliest work at Memphis, by Hekekyan in the 1850s,[30] was focussed on determining the rate of flood-plain silt accumulation in order to calculate the time since the recorded biblical flood. During his excavations Hekekyan made comprehensive notes and detailed observations of the sediments and monuments he encountered, making him the first geoarchaeologist of Egypt. Hekekyan was unable to determine the time since the flood but observations of sediment accumulation rates[31] give values around 1 m/millennium. This is a mean rate so there are areas such as river levees and settlement mounds where rates exceed this as well as areas like distal parts of the river plain where the sedimentation rate is lower. Comparison of the typical rate of vertical aggradation of the floodplain with the typical rates for lateral migration of the river channel, suggest that the latter is more rapid than the former (cf 1 m/millennium rise vs 2 km/millennium migration). None the less, results from the late Old Kingdom at Dahshur[32] suggest that floodplain rise was faster than that since the New Kingdom, which may be a product of an asymptotic approach to the base level of the river and a

30 Jeffreys, 2010.

31 e.g. Borchard, 1907 and reviewed in Bunbury et al., 2008.

32 Alexanian et al., 2012.

large influx of sandy sediment to the Nile Valley during the Late Old Kingdom and Middle Kingdom.

2.1.5 Incursions of wadi sand into the Nile valley in response to rainfall and erosion

Studies of borehole cores drilled as part of the Cairo waste-water programme (AMBRIC) were examined by El-Senussi and Jones[33] and later Brandon.[34] The results revealed that the Pleistocene Nile canyon was filled by coarse sandy sediments that flowed out of the wadi mouths, that impinge upon the Nile Valley as rain fell directly in the Saharan region. Early settlements at Omari and Helwan were focussed on these paleo-fans. As the Holocene began and dark Nile silt accumulated above the sands the toes of the paleo-fans began to be covered. The presence of a water tank at Giza and of structures in the wadi at Dahshur[35] indicates that the wadis were stable during the early part of the Old Kingdom. However, around the end of the Fourth Dynasty the wadis seem to become unstable and as El-Senussi and Jones[36] and Dufton and Brandon noted,[37] successive tongues of sediment flowed out of the wadi mouths into the Nile valley. At around this time, settlement moved away from the wadi mouths and the terraces that flank the Nile Valley into the floodplain and occupied the levees of the Nile channel in somewhat extended "ribbon" developments.[38]

Studies of erosion rates in dry deserts[39] show that there is little erosion at high rates of rainfall since the rain sustains plentiful vegetation that stabilises the soil. When there is no rainfall, erosion is also low. However, at intermediate rainfall, around 200 mm/year erosion increases dramatically since the rain does not sustain sufficient vegetation to stabilise the sediment. We therefore infer that these sand tongues intruded into the Nile silts of the valley at the time when the climate was in transition between the wet early Holocene conditions and the drier conditions that were reached around 2000 B.C. The loss of vegetation from all but the refugia of the Saharan region focussed populations into the oases and the Nile Valley, as was shown by Kuper and Kropelin in their study of carbon

33 El-Senussi/Jones, 1997.

34 Branton, 2008.

35 Bebermeier, 2011, Alexanian et al., 2012, Ramisch, 2012.

36 El-Senussi/Jones, 1997.

37 Duffton/Branton, 2009.

38 Jeffrey/Tavares, 1994.

39 Goudie/Wilkinson, 1977, p. 88.

dates across the Saharan region.[40] As trade winds became established across the area,[41] sand dunes that had previously been locked in place by vegetation were released and started to move across the landscape, moving generally towards the south-east.

2.1.6 Aeolian sandflux into the valley and the river around Memphis.

Studies of the First Intermediate Period and the associated climate crisis have highlighted the influx of sand to the Nile Valley that occurred around this time.[42] However, from the results of Moeller[43] and other studies further south[44] it is clear that the north of Egypt was desiccated far earlier than the south of Egypt or the Sudan.[45] Neither can the transition be considered as instantaneous, with Kröpelin et al.[46] seeing a lag of some 2000 years between the death of the tropical vegetation in the area of Lake Chad and the ultimate establishment of trade winds across North Africa.

Large accumulations of wind-blown sand along the base of the escarpment at Saqqara seem to post-date the Early Dynastic occupation of the site but a much clearer picture of the amount and timing of sand arriving has been determined by Alexanian and colleagues in their excavations at Dahshur.[47] Here sand flux into the wadi below the valley temple of the bent pyramid began in the late Fourth Dynasty and peaked during the late Old Kingdom. Since the end of the Old Kingdom, sand has continued to accumulate but at a lesser rate. Sand accumulation along the base of the escarpment may have encouraged the early occupants of Memphis to move into the Nile Valley but there seems little evidence of aeolian sand deposited directly onto the site of Memphis from the borehole evidence and micro-morphological observations of Qin.[48] Qin's results suggest that sand deposited around Memphis at this time had been transported by river before its arrival at the site but there are traces of a former history as aeolian sand was still visible on the grain surfaces indicating that the Nile was

40 Kuper/Kropelin, 2006.

41 Kropelin et al., 2008.

42 Hassan, 2005.

43 Möeller, 2005.

44 Bunbury, 2010.

45 Woodward et al., 2001, Rodrigues et al., 2000.

46 Kropelin et al., 2008.

47 Bebermeier, 2011, Alexanian et al., 2012, Alexanian, et al., in press a and in press b., Ramisch, 2012.

48 Qin, 2009.

transporting sand that had recently been blown into the Nile valley. Additional islands and bars are likely to have formed in the river beds as the extra sand was flushed towards the sea.

While all five of these landscape factors affected the landscape of the capital zone a study of the archaeological material is required to discern which are the most important in the evolution of the city of Memphis.

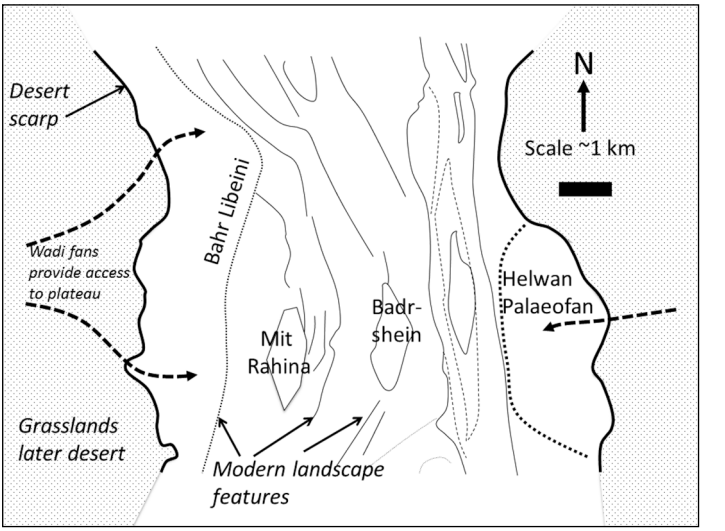

Figure 7. Diagram to show the effects of landscape processes at Memphis.

2.2 Dynamics of settlement at Memphis

A complex picture of the city of Memphis emerged from the work of the Survey of Memphis (SoM). The team provided a broad overview of the dynamics of settlement across the millennia,[49] as well as in-depth stratigraphic information on parts of the city.[50]

49 Jeffreys, 1985, Id., 2010.

50 Aston/Jeffreys, 2007, Jeffreys, 2006, Giddy, 2012.

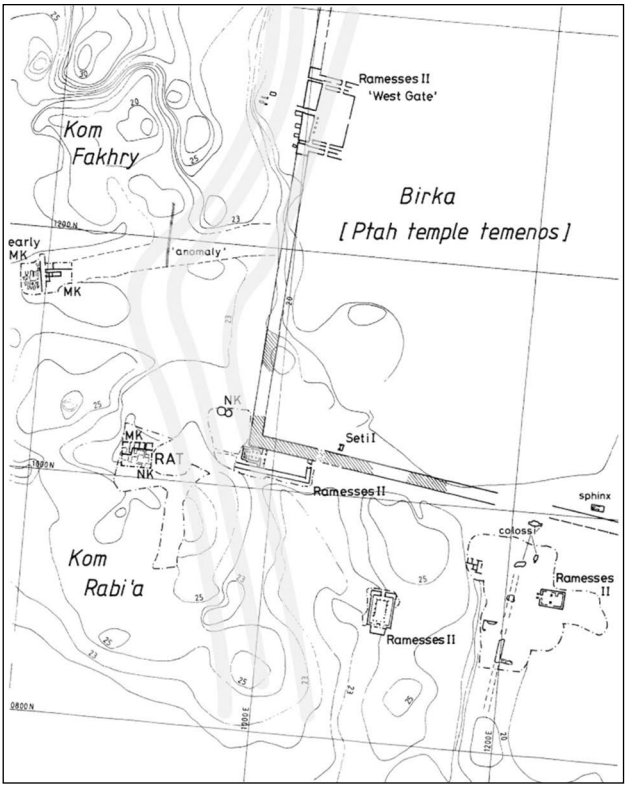

Figure 8. Map of the excavations and monuments in the Kom el-Fakhry and Kom Rabia area. After Giddy 2012, plate 1.

The most striking results concerned the movement of the Nile eastwards (see 2.1) above), and terracing of the settlement at Kom el-Fakhry and Kom Rabia.[51] The resulting topography preserved Middle Kingdom stratigraphy at a higher elevation than the New Kingdom remains to the east. For example the threshold of the West Gate of the Ramesside Ptah Temple is at elevation 18 m a.s.l., while the First Intermediate Period cemetery at Kom el-Fakhry just 100 m to the west is at elevation at 21 m a.s.l.. This 3 m difference in elevation between the two sites indicates an ancient slope with a gradient of 1: 30 or 1: 40. Jeffreys suggests an even greater gradient, up to 1: 10, in ancient times.[52] This slope suggests that the

51 Jeffreys, 2010, p. 193–194, Id., 2008.

52 Jeffreys, 2006, p. 1.

early town was on, or to the west of, Kom el-Fakhry.[53] It also created a window of opportunity to investigate early stratigraphy which elsewhere at Memphis is inaccessible as it lies under the water table.

The SoM excavations at Kom Rabia (site code RAT)[54] revealed a long sequence of occupation from the Third Intermediate Period[55] to the late Middle Kingdom.[56] Earlier occupation is attested but remains unexcavated as it lies below the water table. The Third intermediate Period levels consisted of a series of walls, an associated floor, a stone threshold, a pavement and a kiln. Earlier Ramesside architecture was still visible and possibly in use during the Third Intermediate Period.[57] The team also recorded two distinct phases of urbanism: an upper horizon of New Kingdom streets, houses, and a thick enclosure wall, representing part of an extra-mural priestly quarter,[58] and a late Middle Kingdom lower horizon of small rooms [houses?], streets and silos. The latter corresponded to an artisans' quarter, probably close to the Middle Kingdom waterfront, which was identified at the north-east corner of the excavation site.[59] The two urban layouts showed quite distinct alignments; the First Intermediate Period/late Middle Kingdom structures follow a north-south alignment, also found at Kom el-Fakhry, while the New Kingdom quarter respects the Ramesside Ptah temple enclosure aligned west-north-west to east-south-east.[60]

3. Mit Rahina and Kom el-Fakhry

As elsewhere at Memphis much of the ancient topography of Kom el-Fakhry is obscured by urban development or cultivated fields. Kom el-Fakhry lies immediately south of the modern village core of Mit Rahina.[61] The mound originally extended south into Kom Rabia but both mounds are now separated

53 Aston/Jeffreys, 2007, p. 1, Jeffreys, 1985, p. 6–10, p. 28–30, Kemp, 1976, p. 25–27, pl. I, Id., 1977, p. 192–195, fig. 7.

54 The current project uses the site codes attributed by Jeffreys, see Jeffreys, 1985, fig 7–8.

55 Aston/Jeffreys, 2007.

56 Giddy, 2012.

57 Aston/Jeffreys, 2007, p. 6–8, fig. 4–9.

58 Jeffreys, 2006.

59 Giddy, 2012, p. 4–7.

60 For a discussion of building alignments over time see Jeffreys, 1985, p. 65, fig. 15.

61 For sites and monuments in the southwest of the Ptah Temple see Ibid.

by the modern Saqqara-Bedrashein road.[62] Kom el-Fakhry was designated as "Tel el Moukalid" by Hekekyan during his pioneering geoarchaeological work in 1852–1854.[63] The mound is bounded on the east and west by lower ground: the Birka ("pool") on the east, corresponding to the New Kingdom Ptah temple enclosure;[64] and a cultivated plain "Hôd bahr al-qantara"[65] on the west, now almost entirely built up. Here remains of a limestone pavement, possibly an extension of the "Serapeum Way" into the Hellenistic town, were recorded.[66]

The Kom el-Fakhry mound has been reduced substantially since antiquity, in height and volume, due to digging for mudbrick and saltpeter. The ground rises from an elevation of 18 m a.s.l. (saltpeter pits) to 30 m a.s.l. under the Mit Rahina village. The accidental finds and principal excavations, up to 1981, around Mit Rahina are discussed in detail by Jeffreys,[67] and an overview of Middle Kingdom Memphis is provided by Giddy.[68] The cemetery at Kom el-Fahkry (site code FAC) was discovered accidentally during extension of the Saqqara-Bedrashein road and subsequently excavated, in 1954, by Abd el-Tawwabal-Hitta.[69] The adjacent settlement, dated to the Middle Kingdom, was excavated by Ashery in 1981,[70] while to the east, a Cairo University team under the direction of Gaballa Ali Gaballa[71] excavated large granary silos and an industrial area dated to the New Kingdom. The settlement and cemetery at Kom el-Fakhry represent the oldest *in situ* remains excavated to date at Memphis. Old Kingdom sherds were reported just south of Mit Rahina village.[72] Here the SoM recorded mudbrick walls and noted at least 12 m of intact settlement stratigraphy beneath the modern occupation.[73] This may well be the earliest accessible stratigraphy in Memphis, and merits further investigation.

62 Ibid., p. 28

63 Jeffreys, 2010, Id., 1985, p. 28–31, fig 7.

64 Extensively investigated see Id, 1985, p. 33–38.

65 Ibid., fig 4.

66 Ibid., p.47.

67 Ibid., p. 28–31, fig. 7.

68 Giddy, 2012, p. 4–7.

69 Al-Hitta, 1955, Dimick, 1959, p. 83, n. 18.

70 Smith et al., 1983, p. 35, Jeffreys 1985, p. 29, p. 68, fig. 20.

71 Gaballa, 1991.

72 Kemp, 1977, p. 194.

73 Jeffreys, 1985, p. 29–30, fig 21, 25.

3.1 Cemeteries in the Settlement

Two cemeteries have been excavated within the Memphite settlement. At Kom el-Fakhry tombs date to the First Intermediate Period/early Middle Kingdom (site code FAC), while those at Kom Rabia date to the Third Intermediate Period (site code RAC). A tantalising reference to burials was made by Burton: "The mounds appear to have been used as a Necropolis at some time, perhaps some later period ... And mummies and cases have been found in them particularly during the great rains that fell in 1824 when they were laid bare."[74] Jeffreys notes that this is unlikely to refer to either Kom el-Fakhry or Kom Rabia's cemeteries.[75]

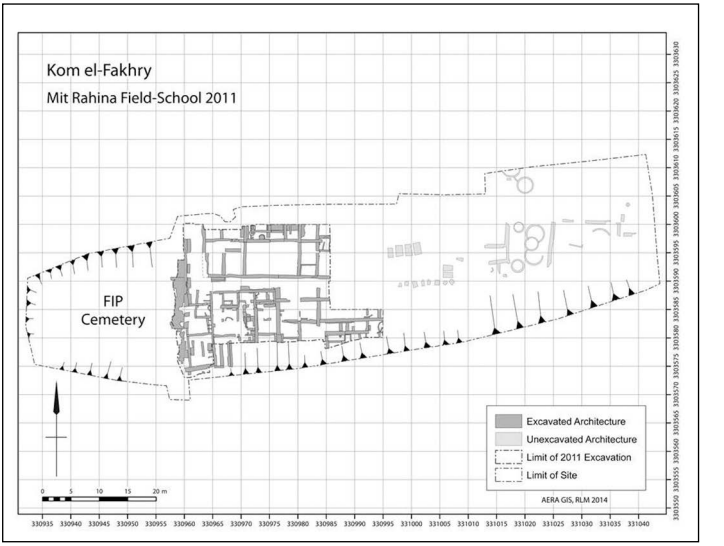

Figure 9. Settlement and cemetery at Kom el-Fakhry. (Prepared by Rebekah Mracle).

At Kom el-Fakhry tombs consisted of rectangular mudbrick chambers, aligned north south and topped by brick vaulting. The chambers were lined with large limestone slabs, which also formed a flat roof.[76] Some of the chambers were decorated. A square pit, also stone-lined, below the floor, served to deposit

74 Burton, Manuscripts British Museum, British Library MS 25618.84A.

75 Jeffreys, 2010, p. 73–74.

76 Id., 1985, p.29, p. 68, fig 19, Lilyquist, 1974, Willems, 1996.

funerary offerings or canopics. The tombs were built adjacent to each other with no apparent streets or access between groups, unlike tombs of the same period at Ehnasya el-Medinah which formed east-west streets.[77] The First Intermediate Period cemetery at Ehnasya also developed within the town. The area of cemetery exposed at Kom el-Fakhry shows a series of up to three tombs north to south, and at least six tombs adjacent to each other east to west. The finished faces of mudbrick walls indicate horizontal development, although eventually the tombs formed a single massive superstructure. There is also some vertical stratigraphy with earlier tombs emerging at a lower level but these may also be double chambered tombs. At Ehnasya individual funerary stela were set up, facing east, outside each tomb group. The Kom el-Fakhry tombs also seem to have had a communal frontage, on the east, where two false door stelae and 15 offering tables were excavated by Al-Hitta.[78] Here small mudbrick walls formed a chapel which held the funerary stelae of Impy-ankh, priestess of Hathor, and a man named Impy. Both stelae are currently in the Memphis open-air museum.

During the 2011 season we were able to clarify the stratigraphic relationship between the town and the cemetery, both at the north and south limits of the site. The central area of the site was previously excavated quite deeply, and therefore the stratigraphic information was removed. The earliest structures at the south are the southern and eastern boundary walls of cemetery. A series of rooms were built in the first half of the Twelfth Dynasty against the cemetery frontage. By the mid Twelfth Dynasty the earlier spaces were decommissioned, and overlaid with a sequence of make-up layers, floors, a bin and a hearth. Most of this building phase was removed by previous excavations, and survives only in small patches.

A second cemetery has been excavated within the Memphite settlement, at Kom Rabia.[79] Cist burials dated to the Twenty-First Dynasty were cut into the south enclosure wall of the Ptah temple. A group of stone roofed tombs, belonging to High Priests of Ptah, was built outside the south-west corner of the temple enclosure. Jeffreys points out that the deterioration of the temple enclosure wall may have freed land for funerary use.[80]

It is probable that the presence of these tombs within the settlement may correspond to a period of reduced urbanism when a lessening of urban pressure

77 Perez-Die, 2004.

78 Al-Hitta, 1955, Lilyquist, 1974, Daoud, 2005.

79 Anthes, 1959, see also Jeffreys, 1985, p. 22, p. 70–71, fig. 26–28. For tombs of the Twenty-second Dynasty see Anthes, 1959, p. 3–4, n. 1 and Jeffreys, 1985, p. 22.

80 Jeffreys, 1985, p. 70–71.

allowed for funerary structures to be built within the settlement. During the First Intermediate Period/Middle Kingdom there is a marked decline in the use of Saqqara as a burial ground. The Middle Kingdom is characterized by the development of important provincial cemeteries throughout Egypt. This, as well as the presumed move of the Twelfth Dynasty capital away from Memphis to Itiy-Tawy, contributed to the decline of Saqqara as a national cemetery in this period.[81] At Saqqara a few tombs dated to the First Intermediate Period/Middle Kingdom were built close to the pyramids of Teti, Unas and Merykare.[82] While to the south (South Saqqara to Mazghuna) necropoleis developed around the pyramids of the Twelfth and Thirteenth Dynasties.[83]

As Memphis contracted, at the end of the Old Kingdom, areas of high ground were freed for use as burial ground. River movement and the resulting change in landscape also played a part in this process. As part of the MRFS six auger corings were carried out in 2011 at Kom el-Fakhry. These filled a gap in the extensive Memphite geomorphological sample. Most of the augers reached depths of 11 m below the surface, about 10 m a.s.l., showing considerable depth of occupation as well as deposits indicative of river activity. An uneven sand of fluvial origin, recorded between 9 to 13 m a.s.l. may represent an island, or a bank of a palaeo-river channel, on which the cemetery and settlement were founded.[84] Finally, tomb owners in both the Kom el-Fakhry and the Kom Rabia cemeteries had a connection with the cult of Ptah and therefore proximity to the Ptah temple may have been desirable and/or permissible. It is possible that burials in the central Memphite area were reserved for the priesthood of the nearby temple.

3.2 Kom el-Fakhry Settlement

Part of the Kom el-Fakhry settlement was excavated by Ashery for the Antiquities Organisation in 1981.[85] The SoM reported two broad phases of architecture dated to the Middle Kingdom. Large rooms, some with fine limestone thresholds, were organised either side of an east-west street leading

81 Callender, 2000, Seidlmayer, 2000, Knoblauch 2008.

82 Daoud, 2005,

83 Lehner, 1997, p. 168–187. For further evidence of Twelth Dynasty Memphite monuments see Sourouzian, 1988, p. 229–254.

84 Gonçalves, 2012.

85 Jeffreys 1985, p. 29, p. 68, fig. 20.

to a courtyard with a basin installation.[86] The SoM team also noted that the eastern frontage of the cemetery, and its offering basins and chapels, became inaccessible as the settlement developed.[87] In 2011 the MRFS team recorded the architecture exposed by the previous missions, and excavated part the exposed settlement to gain an understanding of its character and date. The settlement sequence recorded runs from the first half of the Twelfth to the late Thirteenth Dynasty.[88]

The road works in 1954[89] and the excavations of 1981 left the site with a concave north-south profile. Thus later structures were exposed along the northern and southern limits of the excavation but have been removed in the central area of the site. These two areas are connected stratigraphically only through their relationship to earlier structures. The excavation reports of the MRFS 2011 are currently being prepared for publication and will refine the detail of the phases identified by the Survey of Memphis.[90]

Finally, New Kingdom remains are attested in the northern section by a series of walls and ash deposits. Kemp noted, on the north side of the Kom el-Fakhry cemetery, deposits sloping down markedly to the north, representing the destruction of both the cemetery and the settlement.[91] On the southern edge of the cemetery walls dated to the Late Period (Sixth century B.C.) were recorded just 0.5 m under the modern ground level.[92] Beneath these walls Eighteenth Dynasty sherds were noted, leading Jeffreys to conclude that the area had been levelled down in the first millennium B.C.[93]

4. Discussion

Memphis, at a geographically strategic point in Egypt, was subject to a range of landscape processes through time. In the early Holocene, the site was a marshy area at the head of the Egyptian delta. Recently swamped, as sea level rose, the rest of the delta was also marshy and had begun to recover when sea-level rises

86 Jefffreys, 1985, p. 29, p. 68, fig. 20 and Giddy, 2012, p. 4.

87 Giddy, 2012, p. 4.

88 Tavares/Kamel, 2012.

89 Jefffreys, 1985, p. 29.

90 Abd el-Aziz et al., 2011.

91 Kemp, 1977.

92 Jefffreys, 1985, p. 28–29.

93 Jefffreys, 1985, p. 29.

slowed around 6,000 years ago. The delta at this time is expected to consist of sand gezireh (or islands) surrounded by marshes, the source of abundant cattle and the opportunity for hunting and fishing. The Nile, fed by the equatorial monsoon and augmented by tributaries in Egypt and Sudan, was high and rich in sediment which, supplied to the floodplain, caused it to rise gradually with the many channels of the Nile focussing into a few channels with distinct levees suitable for habitation.

In the Early Dynastic and Early Old Kingdom settlement moved from the edges of the valley onto the Nile levees, where the earliest deposits at Memphis dating to the Old Kingdom are recovered. Declining rainfall during this period also attenuated the vegetation in the wadis that impinge upon the Nile Valley and the wadis became unstable, washing out into the Nile Valley on a number of occasions, making them less desirable for habitation and muting their topography. The stabilisation of the Nile channels was accompanied by a restructuring of the distributary system into a hierarchical network. The rising of the floodplain reducing marshiness coincides with the Old Kingdom and the earliest known sherds found by the SoM at Mit Rahina and in boreholes by the MRFS. Current excavations have not yet reached these early levels whose geography therefore remains speculative.

As aeolian sand flowed into the Nile valley at the end of the Old Kingdom, we expect rapid floodplain rise and other records from Dahshur[94] suggest that this was indeed the case. The effect at Memphis seems to have been to reduce the size of the settlement (by sediment on-lap) and by the First Intermediate Period at Kom el-Fakhry the settlement had been replaced by use of the site as a cemetery. Eastward Nile migration may also mean that mounds/islands further to the east were favoured for settlement and that the western mound was therefore given over to the dead. The slope of the land to the east coupled with the north-south elongation of the settlement are suggestive of a river levee and borehole analysis of the SoM archive suggests that a channel lay close by to the east.

During the mid-Twelfth Dynasty, the earlier cemetery was decommissioned and the settlement expanded into this area. Although by this period, texts and models of delta development suggest that the palace and the delta head were now further south, possibly at Itiy-Tawi (currently thought to be in the Lisht area),[95] Memphis re-emerged as a regional centre. The active national cemetery was no

94 Bebermeier, 2011, Alexanian et al., 2012, Alexanian, et al., in press a and in press b., Ramisch, 2012.

95 Parcak, BBC1 research project – Egypt's Lost Cities.

longer at Saqqara but the regional centre at Memphis seems to have retained some eminence[96] and grew to be a significant administrative centre by the mid Thirteenth Dynasty at Kom el-Fakhry. During this period the Nile continued to migrate eastwards and new land forming to the east no doubt accommodated some of the expansion of the city.

Delta-head migration northwards again from Lisht to Memphis was completed by the beginning of the New Kingdom and the burgeoning of activity around the Ptah temple, a little to the north-east of Kom el-Fakhry seems to have stimulated a revival, albeit one that was mostly removed during a period of first millennium B.C. levelling. It is likely that the sediment supply required to drive the delta head north also contributed to the consolidation of the delta reducing the area of marsh and increasing the agricultural potential. The construction of the Ptah Temple enclosure wall in the low ground of the Birka suggest that the Birka may have formed from an in-filled channel or bay that was by that time consolidated and dry.

By Roman times, the main waterfront (Hekekyan's Nilometer and Jeffreys' nymphaeum) was now around a kilometre away to the east of Kom el-Fakhry.[97] The river has continued to migrate eastwards since that time to its location near Helwan today. Some of the levelling of Kom el-Fakhry reported from the first millennium B.C. may be related to construction of new developments closer to the waterfront in the east or to the construction of the monumental mound of Kom Tuman for the palace of Apries to the north.

As the delta head continued to migrate northwards, Memphis was supplanted by Babylon and later Cairo. Eventually the ruin mounds were abandoned with the exception of Mit Rahina and satellite villages (Shimbab, Aziziya, etc).

5. Conclusion

The results of the borehole surveys of the Survey of Memphis when combined with observations of the processes of landscape change in Egypt and archaeological excavations suggest a time series of landscapes that have formed part of a dialogue between the city of Memphis and the landscape in which it is set. The pinning of archaeological excavation data to models of landscape change helps to provide a time-scale for the geological processes and a context for the development of the city.

96 Sourouzian, 1988.

97 Jeffreys, 2010.

Bibliography

Abd el-Aziz, Ashraf. et al., Mit-Rahina (Memphis) Field School (MRFS) 2011. Data Structure Report (DSR) for the excavations at Kom el-Fakhry. Report on file Ancient Egypt Research Associates Archive, Boston 2011.

Adbel Hamid, Hussam. Survey study of animal bones from Miet-Rahena, in: Travaux du Centre d'Archéologie Méditerranéenne de L'Académie Polonaise des Sciences, Warsaw 1990.

Alexanian, Nicole et al., The Pyramid Complexes and the Ancient Landscape of Dahshur/Egypt, in: Landscape Archaeology. Proceedings of the International Conference Held in Berlin, 6th – 8th June 201, ed. by Wiebke Bebermeier et al., eTopoi, Journal for Ancient Studies, Special Volume 3 (2012), p. 131–133. http://journal.topoi.org/index.php/etopoi/article/viewFile/97/126, 28.04.2015.

Idem., The Discovery of the Lower Causeway of the Bent Pyramid and the reconstruction of the Ancient Landscape at Daschur (Egypt), in: International Colloquium on Landscape Archaeology. Egypt and the Mediterranean World, Cairo, 19th–21st September 2010, Bibliothèque d'études (in press a).

Idem., The Necropolis of Dahshur, (2002-2010) Excavation Report German Archaeological Institute/Free University of Berlin, Annales du Service des Antiquités de l'Égypte (in press b).

Al-hitta, Mohamed, Les grandes découvertes archéologiques de 1954, in: Revue du Caire 33, 175 (1955), p. 50-51.

Anthes, Rudolf, Mit Rahineh 1955, Philadelphia 1959.

Aston, David/Jeffreys, David. The Survey of Memphis III. The Third Intermediate Period Levels, London 2007.

Bebermeier, Wiebke et al., Analysis of Past and Present Landscapes Surrounding the Necropolis of Daschur in: Die Erde 142, 3 (2011), p. 41-68.

Berensden, Henk, History of geological mapping of the Holocene Rhine-Meuse delta, the Netherlands, in: Netherlands Journal of Geosciences, 86, 3 (2007), p. 165-177.

Berendsen, Henk/Stouthamer, Esther, Paleogeographic Development of the Rhine-Meuse Delta, The Netherlands, Assen 2001.

Borchardt, Ludwig, Das Grabdenkmal des Königs Ne-user-re'. Ausgrabungen der Deutschen Orient-Gesellschaft in Abusir, 1902-1908; Band 1, Leipzig 1907.

Branton, Thomas , The Development of the Memphite Floodplain from borehole data, Cambridge University Unpublished MSci dissertation 2008.

Bunbury, Judith, The Development of the River Nile and the Egyptian Civilization. A Water Historical Perspective with Focus on the First Intermediate Period, in: A History of Water, Series II, vol 2. Rivers and Society. From Early Civilizations to Modern Times, ed. by Terje Tvedt et al., London 2010, p 52-71.

Bunbury, Judith et al., Stratigraphic landscape analysis. Charting the Holocene movements of the Nile at Karnak through ancient Egyptian time, in: Geoarchaeology 23, 3 (2008), p. 351-373.

Bunbury, Judith/Jeffreys, David, Real and Literary Landscapes in Ancient Egypt, in: Cambridge Archaeological Journal 21 (2011), p. 65-76.

Bunbury, Judith/Lutley, Katherine, The Nile on the move, in: Egyptian Archaeology 32 (2008), p. 3-5.

Butzer, Karl, Early hydraulic civilization in Egypt: A study in cultural ecology, Chicago and London *1976.*

Callender, Gayer, The Middle Kingdom Renaissance (c. 2055-1650 BC), in The Oxford History of Ancient Egypt, ed. Ian Shaw, Oxford 2000, p. 544.

Daoud, Khaled, Corpus of inscriptions of the Herakleopolitan period from the Memphite necropolis. Translation, commentary, and analyses, Oxford 2005.

Dimick, John, Descriptive text for the Survey Map of Memphis, in: MitRahineh 1955, ed. by Rudolf Anthes Philadelphia 1959, p. 81-83.

Diodorus Siculus (Loeb trans. H Oldfather) Cambridge M.A. 1968, Vol I.

Drake, Nick/Bristow, Charlie, Shorelines in the Sahara. Geomorphological evidence for an enhanced monsoon from palaeolake Megachad, in: Holocene 16 (2006), p. 901-911.

Dufton, David/Branton, Tom, Climate Change in Early Egypt, in: Egyptian Archaeology 36 (2009), p. 2-3.

el-Sanussi Ashraf/Jones, Michael, A site of the Maadi Culture near the Giza pyramids, in: Mitteilungen des deutschen archäologischen Instituts, Abt. Kairo 53 (1997), p. 241–53.

Fairbanks, Richard, A 17,000 year glacio-eustatic sea level record. Influence of glacial melting rates on the Younger Dryas event and deep ocean circulation, in: Nature 342 (1989), p. 637-642.

Gaballa, Ali, Latest excavations in Memphis: progress report, in: Fragments of a shattered visage: the proceedings of an international symposium on Ramesses the Great, ed. by Bleiberg, Edward/Freed, Rita, Memphis 1991, p. 25–27.

Giddy, Lisa, The Survey of Memphis VI. Kom Rabia. The late Middle Kingdom Settlement (Levels VI-VIII), London 2012.

Gonçalves, Pedro, Preliminary Report on Auger work. Mit Rahina Field-school 2011. Specialist Report February 2012. Report on file, Ancient Egypt Research Associates, Boston 2012.

Goudie, Andrew/Wilkinson, John, The Warm Desert Environment, Cambridge 1977, p. 88.

Hassan, Fekri, A River Runs Through Egypt, in: Geotimes April (2005), http://www.geotimes.org/apr05/feature_NileFloods.html, 28.04.2015.

Hillier, John et al., Monuments on a migrating Nile, in: Journal of Archaeological Science 34 (2006), p. 1011-1015.

Herodotus, Historia, Book II, Leiden 1988.

Jeffreys, David, The Survey of Memphis I. The archaeological report, London 1985.

Id., Archaeological implications of the moving Nile, in Egyptian Archaeology 32 (2008), p. 6-7.

Id. The Survey of Memphis V. KomRabia. The New Kingdom Settlement (Levels II-V), London 2006.

Id., The survey of Memphis VII. The Hekekyan Papers and other sources for the Survey of Memphis, London 2010.

Jeffreys, David/Tavares, Ana, The Historic Landscape of Early Dynastic Memphis, in: Mittelteilungen des Deutschen Archäologischen Instituts, Abt. Kairo 50 (1994), p. 143-173.

Jeffreys, David/Bunbury, Judith, Fieldwork, 2004-05. Memphis 2004, in: Journal of Egyptian Archaeology 91 (2005), p. 8-12.

Kemp, Barry, A note on stratigraphy at Memphis, in: Journal of the American Research Center in Egypt 13 (1976), p. 25-28.

Id., The early development of towns in Egypt, in: Antiquity 51 (1977), p. 185-200.

Knoblauch, Cristian, The Memphite area in the late First Intermediate Period and the Middle Kingdom, in: Ancient Memphis: 'Enduring is the Perfection'. Proceedings of the international conference held at Macquarie University, Sydney on August 14-15, ed. by Evans, Linda, Sydney 2008, p. 267-278.

Kropelin, Stefan et al., Climate-Driven Ecosystem Succession in the Sahara. The Past 6000 Years, in: Science 320 (2008), p. 765-768.

Kuper, Rudolph/Kropelin, Stefan, Climate-Controlled Holocene Occupation in the Sahara: Motor of Africa's Evolution, in: Science 313 (2006), p. 803-807.

Lehner, Mark, The complete pyramids, London 1997.

Lilyquist, Christine, Early Middle Kingdom Tombs at Mitrahina, in: Journal of the American Research Center in Egypt 11 (1974), p. 27-30.

Moeller, Nadine, The First Intermediate Period. A Time of Famine and Climate Change?, in: Agypten und Levante 15 (2005), p. 153-167.

Parcak, Sarah, Egypt's Lost Cities, 2011, http://www.bbc.co.uk/programmes/b011pwms, 30.04.2011.

Pennington, B.T. / Bunbury, J.M. / Hovius, N., Emergence of Civilisation, Changes in Fluvio-Deltaic Styles and Nutrient Redistribution Forced by Holocene Sea-Level Rise, in: Geoarchaeology 31(3) (2016), p. 194-210.

Perez-Die, Maria, The ancient necropolis at Ehnasya el-Medina, in: Egyptian Archaeology 24 (2004), p. 21-24.

Pryer, Laurence, The Landscape of the Egyptian Middle Kingdom Capital Itj-Tawy, Unpublished MSci. dissertation, Department of Earth Sciences, University of Cambridge, Cambridge 2012.

Qin, Ying, Landscape change in the Saqqara/Memphis area of Egypt from 3000 BC to the present. Unpublished MSci.dissertation, Earth Sciences, University of Cambridge, Cambridge 2009.

Ramisch, Arne et al., Fractals in topography. Application to geoarchaeological studies in the surroundings of the necropolis of Dahshur, Egypt, in: Quaternary International 266 (2012), p. 34-46.

Rodrigues, Donald et al., Seasonality in the early Holocene Climate of Northwest Sudan: interpretation of Etheriaelliptica shell isotopic data, in: Global and Planetary Change 26 (2000), p. 181-187.

Rohde, Robert, Holocene Temperature Variations, in: Global Warming Art (2006), http://commons.wikimedia.org/wiki/File: Holocene_Temperature_Variations.png, 28.04.2015.

Rowland, Joanne, Minshat Abu Omar, in: The Encyclopedia of Ancient History, 2012, http://onlinelibrary.wiley.com/doi/10.1002/9781444338386.wbeah15282/pdf, 28.04.2015.

Seidlmayer, Stephan, The First Intermediate Period (c. 2160-2055 BC), in: The Oxford History of Ancient Egypt, ed. by Ian Shaw, Oxford 2000, p. 544.

Smith, Harry et al., The Survey of Memphis 1981, in: Journal of Egyptian Archaeology 69 (1983), p. 30–42.

Sourouzian, Hourig, Standing royal colossi of the Middle Kingdom reused by Ramesses II, in: Mitteilungen des deutschen archäologischen Instituts, Abt. Kairo 44 (1988), p. 229-254.

Stanley, Daniel/Warne, Andrew, Recent Geological Evolution and Human Impact, in: Science 260 (1993), p. 628-634.

Idem., Worldwide Initiation of Holocene Marine Deltas by Deceleration of Sea-Level Rise, in: Science 265 (1994), p. 228-231.

Idem., Nile Delta in its Destructive Phase, in: Journal of Coastal Research 14 (1998), p. 794-825.

Tavares, Ana/Kamel, Mohsen, Memphis. A City Unseen, in: AERAGRAM: Newsletter of Ancient Egypt Research Associates 13, 1 (2012), p. 2-7.

Tristant, Yann. L'Habitat Pre-Dynastique de la Vallee du Nil: Vivre sur le rives du Nil aux V et IV Millenaires, Oxford 2004.

Willems, Harco, A note on the date of the early Middle Kingdom cemetery at Ihnâsiya al-Medîna, in: Göttinger Miszellen 150 (1996), p. 99–109.

Wilson, Penelope, Survey of Sais (Sa El-Hagar) 1997-2002, London 2006.

Woodward, Jamie, et al., The Holocene fluvial sedimentary record and alluvial geoarchaeology in the Nile Valley of Northern Sudan, in: River Basin Sediment Systems. Archives of Environmental Change, ed. by Darrel Maddy et al., Rotterdam 2001, p. 327-356.

Idem., The Nile Evolution, Quarternary River Environments and Material Fluxes, in: Large Rivers, Geomorphology and Management, ed. by Avijit Gupta, Chichester 2007, p. 261-291.