The pharaonic state defined itself as the ‘Two Lands’, the union of the Nile valley between modern Cairo and Aswan (Upper Egypt) with the fertile Nile Delta (Lower Egypt). Beyond lay chaotic, dangerous lands to the west (Libya) and north-east (a succession of city states and greater powers in Syro-Palestine and beyond) and to the south, Nubia. Throughout much of the 3rd and 2nd millennia bc, Egypt occupied parts of Nubia (Smith 2003; Edwards 2004) where areas of broad, fertile floodplain are interspersed with Nile cataract regions framed by outcrops of granite where the bedrock is visible on the surface or in the river, making river navigation and large-scale agriculture rather difficult. These periods of pharaonic control are attested through the inscriptions, monuments, chapels and tombs left by individuals in the area between Aswan and Kurgus at the Fifth Nile Cataract, but also through a network of towns, fortifications and cult temples.

The New Kingdom (c. 1550–1070 bc) control of Nubia was characterized by the construction of Egyptian towns with temples and cemeteries, such as those at Sai, Kerma (Dokki Gel), Soleb, Sesebi and Tombos. These towns housed Egyptian administrators, priests and military men (Pl. 1). Amara West is one of these Egyptian towns, founded in the early 13th century bc, and partly excavated by the Egypt Exploration Society in the 1930s and 1940s (Spencer 1997; 2002). Further upstream, Gebel Barkal and Kurgus feature Egyptian inscriptions and monuments, but it is unclear whether a considerable Egyptian population was ever present.

The archaeology of Nubia was long subservient to the discipline of Egyptology. The modern perspective of the conquest, settlement history and culture of the region was effectively viewed through the prism of pharaonic ideology: depicting Kush as ‘wretched’, an outpost of the pharaonic state with local populations ‘Egyptianized’ (particularly local elites; Säve-Söderbergh 1991), while the riches of the desert gold mines were exploited and exotic goods traded from further south. Fieldwork in the last four decades has prompted a considerable reassessment, with the realization that Egyptian cultural impact outside certain key centres may have been minimal. Within the pharaonic settlements, a model of cultural entanglement (Smith 2003), rather than domination, is increasingly accepted. Furthermore, it is now evident that the loss of Egyptian control of the area in the 11th century bc did not lead to the abandonment of these settlements. Indeed, a number of cemeteries house burials spanning the era between Egyptian occupation and the rise of the next great Nubian polity (the 25th dynasty that would conquer and control all of Egypt) reflecting the persistence of indigenous funerary cultures.

The British Museum instigated a research project at Amara West in 2008, in both the town and its cemeteries. Fieldwork provides the opportunity to place the collection within the context of the latest archaeological research; all artefacts remain within Sudan, with a selection entering the collection of the Sudan National Museum. The human and animal remains, in addition to selected samples of organic and inorganic materials, are exported to the British Museum for further scientific analysis. Arguably the best
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regarding the Dead royal residence city of Tell el-Amarna (Kemp et al. 2012). The rather static, normalized view of houses suggested by much research on these sites (see Tietze 1987; Kotsikla 2007), is probably misleading. Amara West offers an opportunity to consider house(hold)s as dynamic entities, particularly the role of individual and household agency in shaping the lived environment, with adjustments to house layouts and interiors, often set within a palimpsest of earlier architecture (Spencer 2014). Around a century after the town of Amara West was founded, an extramural area of housing developed beyond the west wall, notable for the presence of several large villas, approaching 500m² in area (Pl. 5; Spencer 2009, 50–7).

Most houses cover a ground floor area of only 25–70m² (Pl. 4); light filtered through roofs of matting, wooden beams and clay, as well as through stairwells and doorways: no evidence for windows has been identified. Such an arrangement was ideal for retaining heat in the cold desert nights and ensuring it stayed cool during hot summer days. The inhabitants also lived in a dense environment filled with smoke from cooking and hearths, as well as human and animal waste and occupation debris that gradually engulfed the house entrances. The ‘low horizon of activity’ posited for modest houses at Tell el-Amarna, given the low benches and squat furniture (Kemp and Stevens 2010, 507), is probably an apt description of aspects of the lived experience at Amara West. The artefact assemblages are largely consistent with those found in contemporary Egypt: stone tools, fishing equipment, items of adornment in faience, carnelian, steatite and copper alloy, in addition to a small number of imported Canaanite and Mycenaean pottery containers. Some houses were provided with cult

preserved settlement of the 13th–11th century BC anywhere in the Nile valley, Amara West allows a detailed, high resolution and interdisciplinary investigation of the nature of cultural entanglement between Egypt and Nubia in the late 2nd millennium BC, through excavation of the town and its cemeteries within a framework of bioarchaeological and environmental analyses. The findings of such research naturally resonate with colonial contexts in other regions and periods.

Town and cemetery: complementary data sets on life and death

The town was founded in the reign of Seti I (c. 1306–1290 BC), upon an island in the Nile (Pls 2, 6), initially within a walled area of 108 x 108m (Pl. 3). Alongside a sandstone cult temple, the town was laid out with streets that mirrored the orientation of the town wall, comprising storage magazines and the residence of the ‘deputy of Kush’, the senior Egyptian administrator of the region. Over the ensuing five or six generations, the town developed into a more densely occupied, less formally arranged, settlement, with a much higher proportion of the walled area given over to housing (Spencer 2014). Nile valley settlement archaeology has focused on the royal foundations associated with important temples, funerary complexes, ‘workmen’s villages’, or the

Plate 1 Map of Egypt and Nubia, showing the location of Amara West (drawing by Claire Thorne)

Plate 2 Key map of Amara West, with location of town and cemeteries
simply reflecting a preference for, or the convenience of acquiring, local cookwares? Petrographic and chemical analyses reveal the same clay mix was being used for Nubian and Egyptian-style vessels (Spataro et al. forthcoming).

The cemetery provides clearer evidence for cultural entanglement and hybridity, but also for post-colonial occupation into the 9th or 8th centuries BC. Other than sherd scatters with material of 10th–8th century BC date, evidence from the town is restricted to the period of pharaonic control; surface deflation and a preference for niches, statues or small stelae with depictions of deities, reflecting the spiritual concerns of the inhabitants.

The evidence for foodways in the town and cemeteries is a particular focus of research. Most houses were provided with grinding emplacements, presumably used primarily for processing cereal, alongside cylindrical ceramic ovens and circular hearths. These hearths, which were used as sources of warmth as well as for cooking, are often set in front of the low bench (mastaba) in the smaller houses. In one case, two houses shared a space with grinding emplacements and ovens; the town is notable for the lack of communal spaces, at least any defined by architecture. Botanical remains – including seeds but also soluble silica taken up by plants (phytoliths) – are indicative of differential food provision within the town. A pilot study of archaeobotanical samples from an extramural villa and two small houses within the walled town (Ryan et al. 2012), data sets of contemporary date, revealed that emmer wheat comprised the source of nearly 90% of cereal chaff in the villa, compared to 53% in the smaller houses where barley fulfilled a more important part of the diet. Clover (for fodder?), flax, lentils, figs, colocynth and watermelon were also identified in the botanical record, with both dung and charcoal being used as fuel in the ovens and hearths. Faunal and fish remains have yet to be studied in detail, but appear to be consistent with the assemblages found in Egypt: cattle, caprines and pig dominate, with a very small amount of wild species.

But was this town in Nubia entirely Egyptian? One example of Nubian architecture has been identified in the town (Spencer 2010), which indicates that individuals or groups could deploy a local indigenous architectural style. It is the presence, however, of handmade basket-impressed Nubian cooking pots that is most significant. Initially forming only around 1% of the assemblages, in the later occupation phases (12th–11th centuries BC) this rises to around 10%; the increase in number of non-textual markers, such as incised images of animals, upon storage vessels seems concurrent. Does this reflect the presence of Nubian inhabitants, perhaps partly through intermarriage? Or is it
Regarding the Dead

whereas Cemetery C is located on an alluvial terrace above a wadi north-east of the town. Burial grounds associated with the settlement were first identified by the Egypt Exploration Society (EES) during their field work campaign in 1938–9 (Spencer 2002). In addition to large-scale excavations in the town, they also explored a small number of graves in the area of Cemetery D and elsewhere during the 1938–9 season. The discovery of three large chamber tombs used for the interment of several individuals which feature mudbrick pyramid superstructures – similar to tombs at other New Kingdom sites in Nubia and Egypt – led H.W. Fairman to identify the cemetery as the burial ground of the elite during the Egyptian occupation of Amara West (Spencer 2002, 3). Later material was interpreted as evidence for the reuse of the burials during the Napatan period (8th–6th centuries bc; Spencer 2002, 3). The survey and excavation work in Cemetery C was carried out during a survey of the Dal Cataract area by the Centre National du Recherche Scientifique (France) under A. Vila (1977) who assigned the excavated graves both to the New Kingdom and X-group (4th–5th centuries AD), a dating that now has to be revised.

continuing to occupy and modify existing buildings need to be taken into account. While the environmental setting, upon a fertile island, may have been a critical factor in leading to the foundation of Amara West, it is also likely to have been a major reason for the abandonment of the town. Investigations of the northern Nile channel, now dry, has revealed that this was no longer perennial by the late 2nd millennium bc, as indicated by Optically Stimulated Luminescence (OSL) dates (Spencer et al. 2012). Without water in this channel, all three barriers to considerable sand ingression would be removed (tamarisk trees, associated sand dunes and the water channel itself), resulting in the fertile island being transformed into the arid environment we see today. Alongside reflections of cultural affiliation, the excavation of the cemeteries at Amara West allows questions to be posed as regards to the effects of environmental stress on the town’s population.

The cemeteries of Amara West

The cemeteries of Amara West extend to the north-east and north-west of the settlement on the opposite side of the Nile channel (Pl. 2). Cemetery D is set on the low desert ridge, whereas Cemetery C is located on an alluvial terrace above a wadi north-east of the town. Burial grounds associated with the settlement were first identified by the Egypt Exploration Society (EES) during their field work campaign in 1938–9 (Spencer 2002). In addition to large-scale excavations in the town, they also explored a small number of graves in the area of Cemetery D and elsewhere during the 1938–9 season. The discovery of three large chamber tombs used for the interment of several individuals which feature mudbrick pyramid superstructures – similar to tombs at other New Kingdom sites in Nubia and Egypt – led H.W. Fairman to identify the cemetery as the burial ground of the elite during the Egyptian occupation of Amara West (Spencer 2002, 3). Later material was interpreted as evidence for the reuse of the burials during the Napatan period (8th–6th centuries bc; Spencer 2002, 3). The survey and excavation work in Cemetery C was carried out during a survey of the Dal Cataract area by the Centre National du Recherche Scientifique (France) under A. Vila (1977) who assigned the excavated graves both to the New Kingdom and X-group (4th–5th centuries AD), a dating that now has to be revised.
superstructures are preserved above the chamber tombs of Cemetery C; it is possible that any such superstructures may have been lost through surface deflation. While the chamber tombs in Cemetery C are similar in size (diameters of 2.4–3.0m across, height 0.7–0.9m), the number of interments found buried within the chambers is considerably higher than in cemetery D: 49 heavily disturbed and commingled individuals were recovered from grave G201.

While the chamber tombs continued to be constructed during the 10th and 9th centuries BC, a shift in funerary culture is discernible with some burials now placed in lateral side niches off a rectangular, east–west aligned shaft, usually ranging between 0.4–0.85m in depth. In contrast to the New Kingdom chamber tombs, these graves principally accommodated single or double burials, of both adults and children; only three examples held more than two individuals. During the New Kingdom these niche graves first appear in Lower Nubia (e.g. Qustul (Williams 1990), Wadi es-Sebua (Emery and Kirwan 1935)), then gradually spread further south, becoming common in Upper Nubian cemeteries during the 10th to 8th centuries, such as in Missiminia (Vila 1980) and Sanam (Griffith 1923; Lohwasser 2010). The niche grave remained in use throughout Nubia until the Post-Meroitic period (350–550 AD). The pottery

In Cemetery D, two new pyramid tombs (G301, G309, Pl. 7) dating to the New Kingdom period were uncovered, confirming Fairman’s initial dating (Binder et al. 2011). Radiocarbon dates obtained from bone bioapatite (mineral component of bone) of the two individuals buried in the western chamber of G301 (Meadows et al. 2012) are consistent with the dating suggested by the artefacts. The post-colonial burials comprise both the reuse of the New Kingdom tombs and the construction of new tombs; pottery suggests the cemetery was in use as late as the early 8th century BC. In 2012, fieldwork revealed evidence that the cemetery area was already used for burial much earlier during the Kerma ancien (2500–2050 BC) or Kerma moyen (2050–1750 BC) periods. Contemporary settlement evidence of these periods is so far only known from sites further north of the site (Vila 1977), while there is no indication of earlier settlement in the town of Amara West.

In Cemetery C, the earliest graves discovered date to the late New Kingdom (Binder 2011). These conform to the same chamber tomb type with underground burial chambers used for multiple burials (Pl. 8). Grave 244 features as many as five chambers and is the largest tomb discovered at Amara West so far. With the exception of this grave, which features a Nubian-style mound (tumulus) (Pl. 9), no superstructures are preserved above the chamber tombs of Cemetery C; it is possible that any such superstructures may have been lost through surface deflation. While the chamber tombs in Cemetery C are similar in size (diameters of 2.4–3.0m across, height 0.7–0.9m), the number of interments found buried within the chambers is considerably higher than in cemetery D: 49 heavily disturbed and commingled individuals were recovered from grave G201.

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Nubian burial customs, above Egyptian-style chamber tombs (e.g. G244 in Cemetery C, Pl. 9; G305, G314, both in Cemetery D). The use of funerary beds, and the placement of bodies in a flexed body position, further reflect the combination of Nubian and Egyptian funerary customs within the same grave.

Studying health and diet on ancient human remains

Studying health and living conditions of past human populations can be based on the occurrence of pathological changes in human remains. However, due to the unspecific nature of skeletal response to most disease processes, bioarchaeological research in this field has, in recent years, moved away from the diagnosis of specific pathological conditions to an analysis of more unspecific indicators of ‘physiological stress’ (e.g. Larsen 1997; Goodman and Martin 2002). This approach is based on the concept of the ‘systemic stress perspective’ (Goodman et al. 1984), a model in which health is perceived as the success or failure of populations to adapt to their biological and cultural environment. Skeletal changes resulting from failure do not necessarily correspond to a specific disease, but rather represent generalized responses to negative influences on the physiological system (see below).

suggests a dating of the Amara West niche graves to the 10th to 9th centuries BC, supported by a radiocarbon date of 1030–890 calibrated BC from bone bioapatite from one burial (Meadows et al. 2012). While evidence of superstructures is rarely found above these niche burials, several graves in the eastern central part of the cemetery feature low tumuli of alluvial silt, defined by loosely arranged schist stones. They further differ from the remainder of the niche burials in their significantly larger size, and location on a slightly elevated area overlooking the main burial ground; both aspects might reflect status differences.

As with the settlement, funerary customs in both cemeteries attest to the strong influence of Egyptian culture, both during the New Kingdom and its aftermath (Binder 2014). The tombs dating to the New Kingdom are almost exclusively of Egyptian style, both in terms of architecture and treatment of the deceased: burial in an extended body position, the use of wooden coffins and the array of artefacts placed in these tombs (Pl. 10). This trend continues well into the post-New Kingdom period with pharaonic funerary customs remaining prevalent, but there are indications for a revival of indigenous Nubian burial customs. This cultural mixture is particularly well exemplified by the construction of tumulus superstructures, one of the hallmark features of Nubian burial customs, above Egyptian-style chamber tombs (e.g. G244 in Cemetery C, Pl. 9; G305, G314, both in Cemetery D). The use of funerary beds, and the placement of bodies in a flexed body position, further reflect the combination of Nubian and Egyptian funerary customs within the same grave.

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However, the study of health and disease in the past through human remains demands consideration of methodological and theoretical issues, which can limit any possible conclusions. One major problem is linked to the nature of skeletal samples: these only represent a sample of the entire population, limited by a number of intrinsic (e.g. mobility, mortality rates) and extrinsic (e.g. preservation, excavation strategies) factors which are impossible to control. Therefore, frequency results gained from cemetery studies are not necessarily representative of the entire population (Waldron 2007, 27ff). Other problems are related to the limited potential of bone to respond to pathological stimulus or insult: usually, only chronic diseases affect the skeleton. Consequently, those individuals that do show skeletal signs of disease are the ones that survived long enough to develop bone responses, which presupposes a reasonably good immune system; those with a weak immune system may have died straightaway (Wood et al. 1992).

Other underlying factors, such as individual susceptibility to disease, will always remain unknown (Wood et al. 1992; Wright and Yoder 2003).

With regards to ‘stress markers’, the systemic stress perspective has been the subject of criticism for only focusing on the biological side, while failing to acknowledge the influence of psychological factors on health and wellbeing (Bush 1991). Nevertheless, by analysing human remains within their archaeological, environmental, cultural and socio-economic context, it is possible to make inferences about health and living conditions of past human populations (Roberts and Cox 2003).

Reconstructing health and living conditions at Amara West

The time period between 1300 and 800 BC is marked by major political and environmental change: the loss of Egyptian colonial control over Nubia in the 11th century BC and a significant climatic deterioration affecting the Middle Nile valley in the later 2nd and early 1st millennium BC (Macklin and Woodward 2001). The end of Egyptian colonial rule may have had a significant impact on the socio-economic infrastructure of the colonial settlements in Nubia due to a disruption of imports. In addition, recent palaeoenvironmental research is revealing evidence for deteriorating environmental conditions that affected the entire middle Nile valley region, including the drying up of the northern channel at Amara West (Spencer et al. 2012). This would have limited the amount of land suitable for agriculture and been a major factor in the abandonment of the town. The health status of the people living at Amara West is being used to address questions about general living conditions and to test whether these individuals were subject to significant changes brought about by the political, cultural and environmental transformations that affected Upper Nubia around 1000 BC.

To date, 246 individuals have been excavated from the Amara West cemeteries (Table 1), comprising both complete individuals as well as a large number of individuals recovered from commingled contexts. Commingled human remains are problematic as disarticulated and mixed bones are difficult, often impossible, to reassociate as individual skeletons. Matching of elements can be based on morphological and metric criteria as well as DNA studies, and the success rate usually depends upon bone preservation, the number of commingled individuals and presence of differentiating features (Ubelaker 2008). At Amara West, most of the commingled contexts are small enough to allow for the relatively secure establishment of a minimum number of individuals and partial reconstruction of individuals. However, smaller skeletal elements such as hands, feet, ribs or vertebrae are often difficult to assign to an individual, limiting some of the palaeopathological interpretations. Therefore, only 152 individual skeletons (25 New Kingdom, 127 post-New Kingdom) have so far been included in the detailed bioarchaeological analysis. The assemblage of human remains also comprises a small number of soft tissue fragments including brain, muscle and skin, in addition to a few samples of hair.

Age and sex were established based on protocols outlined by Buikstra and Ubelaker (1994) and the recommendations of the British Association for Biological Anthropology and Bioarchaeology (BABA; Brickley and McKinley 2004). Sex determination was carried out through visual inspection of morphological features on the skull and pelvis. Estimation of age-at-death of adult individuals was based on final epiphyseal fusion, degenerative changes on the auricular surface and pubic symphysis. The selection of ‘stress indicators’ included in this study is based on suggestions outlined by Goodman and Martin (2002), which are now commonly employed in bioarchaeological studies that seek to address questions of health in past human populations (e.g. Steckel and Rose 2002; Buzon 2006). Stature, though determined genetically, is also considered to be a valuable indicator of living conditions during childhood as the amount as to which one’s genetic potential can be fulfilled is largely dependent on nutritional and health status during childhood (Goodman and Martin 2002). Due to problems with available stature estimation methods, mean adult femur lengths were used as a proxy (Brothwell and Zakrzewski 2004).

Inferring the presence and frequency of infectious diseases in past human populations on the basis of human remains is compromised by the slow and unspecific nature of skeletal response (Ortner 2011); the deposition of newly formed bone on the long bones is often used as a proxy (Larsen 1997, 82ff; Goodman and Martin 2002). These changes can be caused by a wide range of infections (both direct and in association with a specific systemic disease), but also by trauma, circulatory disorders and muscle activity (Larsen 1997, 82ff) which has led to some criticism over the past years (Weston 2008). New bone formation in the maxillary sinuses and on the visceral surface of the ribs is

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<th></th>
<th>Complete individuals</th>
<th>Commingled individuals</th>
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<tbody>
<tr>
<td></td>
<td>adult</td>
<td>sub-adult</td>
</tr>
<tr>
<td>New Kingdom</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>Post-New Kingdom</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>82</td>
<td>66</td>
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Table 1 Assemblage of human remains excavated between 2009 and 2013 at Amara West
New Kingdom samples at Amara West (blue=New Kingdom, grey=post-New Kingdom) indicative of non-specific infections of the upper and lower respiratory tract (Roberts et al. 1994; Roberts 2007) and was also included in this study. While infection of the maxillary sinuses is mainly caused by two different factors: poor air quality (both indoors and outdoors) which leads to an irritation and subsequent inflammation of the upper respiratory tract (Roberts 2007) or dental disease, chronic infections in the lungs are usually linked to diseases such as pneumonia, tuberculosis, brucellosis or fungal diseases. Pathological changes in the orbital roof (cribra orbitalia), were also assessed. Furthermore, the study included a systematic analysis of skeletal trauma, osteoarthritis as well as dental pathologies (caries, ante-mortem tooth loss (AMTL), dental calculus, periapical lesions and dental wear).

Within the framework of this study, further insights into dietary habits and possible diachronic changes occurring therein were sought through a biomolecular study of stable carbon and nitrogen isotopes. However, repeated attempts to extract collagen from samples of bones and teeth at Amara West have failed to provide suitable amounts of collagen. The poor survival rates of bone collagen in arid regions is a well-recognized problem (Grupe 1995) which, in combination with the high amount of natural salt in the burial environment, may have prompted collagen deterioration at Amara West.

Preliminary results and discussion

**Demographic parameters**

Comparing the age-at-death distribution of the adult individuals between the New Kingdom and the post-New Kingdom samples (Pl. 11), the proportion of older adults is significantly larger in the earlier sample. While in theory this could indicate better living conditions and therefore a higher life expectancy during the early phase of occupation of Amara West, the size of the New Kingdom sample is currently too small to allow such conclusions. In the larger post-New Kingdom sample, 46.6% of the adult deaths occurred in the young adult range (21–35 years), potentially suggesting a high degree of environmental pressure during the later phases of occupation, a notion that is further supported by other markers of stress analysed in this assemblage (see below).

**Childhood health**

Another striking difference regarding patterns of mortality between the two groups is the apparent absence of infants from the New Kingdom sample. Infant mortality is generally considered a strong indicator of living conditions as neonates and infants are particularly susceptible to infectious diseases such as pneumonia, diarrhoea, malaria and malnutrition (WHO 2012). However, Egyptian and Nubian archaeological skeletal assemblages are known to be problematic in this regard as infants were also buried within the settlements (Zillhardt 2009) or in separate areas of the cemeteries (Brunton and Engelbach 1927; Murail et al. 2004). Consequently, the relatively low infant mortality rate during the New Kingdom period at Amara West is not likely to be a representative indicator of the living conditions. Above the age of five years, the risk of dying from diseases usually decreases considerably (Margeson and Knüsel 2002). The considerable number of older infants and juveniles during the post-New Kingdom period therefore suggests considerable environmental pressure, probably due to infectious diseases, affecting the population living at Amara West.

Further clues towards detecting potential causes of childhood mortality at Amara West were observed in some child remains in the post-New Kingdom sample. Of the individuals below 5 years, 92% display porosities in the orbital roof which are possibly indicative of dietary deficiencies such as anaemic conditions due to malaria, chronic diseases, dietary deficiencies (Walker et al. 2009) or scurvy (Ortner and Ericksen 1997). New bone formation on the endocranial side of the skull, generally caused by an inflammatory reaction of the meningeal vessels due to an infection or scurvy (Lewis 2004), was also observed in six (50%) of the infants with a preserved skull. All of those affected by endocranial changes also displayed signs of cribra orbitalia.

The possibility of scurvy deserves further comment as a chronic lack of vitamin C results in the weakening of the connective tissue in the walls of blood vessels, leaving them prone to rupture and consequent haemorrhaging (Ortner and Ericksen 1997). Six of the post-New Kingdom sub-adult individuals display new bone formation in different locations on the skull – such as the inner and outer table of the skull vault, the orbits, sphenoids and maxilla – are generally accepted as markers for scurvy in children (Ortner and Ericksen 1997). Six of the post-New Kingdom sub-adult individuals display new bone formation in the orbits, on the maxilla and on the exterior and interior surface of the skull vault which, particularly if occurring in combination, may indicate scurvy. While it is tempting to associate these findings with deteriorating agricultural potential due to increasingly arid conditions, this remains difficult to determine in the absence of intact settlement layers and associated palaeoenvironmental data of the post-New Kingdom.
Mean femur lengths

Further indications for significant environmental stress affecting infants and children at Amara West are provided by mean adult femur lengths (male: 44.6cm, female: 41.6cm), although these were only available for the post-New Kingdom sample. In comparison to other Nubian sites ([Pl. 12]), the Amara West individuals rank at the very low end of the scale, particularly the female individuals. These findings provide additional evidence for the presence of environmental challenges, such as infectious diseases, or high levels of nutritional deficiencies affecting children during the period of growth and development.

Infectious diseases

Periosteal new bone formation (NBF) was detected in six New Kingdom and 23 post-New Kingdom individuals. Further differential diagnostic features associating the changes with a specific disease were entirely absent in the sample, thus we can only note the unspecific signs of negative environmental influences.

Pathological changes in both the ribs and maxillary sinuses regions ([Pl. 13]) are also very common findings both in the New Kingdom and in the post-New Kingdom samples ([Table 2]).

Taking the archaeological and environmental data into account, poor air quality and the presence of infectious diseases seem to be reasonable assumptions. Ovens and hearths within small roofed spaces, combined with considerable amounts of dust, dirt and windblown sand brought through doorways, stairwells and windows by strong northerly winds, increasing in later occupation phases due to climatic deterioration, would have created a living environment conducive to contracting respiratory diseases.

In addition, infections such as tuberculosis, brucellosis or fungal infections have to be considered (Roberts et al. 1994); these have been tentatively identified in the palaeopathological record of the Nile valley (Ortner 2003, 254). Given the close proximity of humans and livestock, and their likely presence within the settlement itself, it seems plausible to assume that these diseases affected people living at Amara West as well. Both infectious diseases are known to cause unambiguous skeletal changes in some cases (Ortner 2003). Detection of pathogen DNA in the skeletal material could help identify the possible source of such infections, but it is doubtful whether DNA is preserved in the Amara West material given the poor bone preservation, the environmental conditions and unlikely survival of collagen.

Cribra orbitalia

Changes in the orbital cavity were observed in many adult individuals, although they seem to have been more prevalent during the New Kingdom ([Table 2]). Previously assumed to result from anaemic conditions caused by dietary deficiencies or chronic infections (Stuart-Macadam 1992), recent research indicates that lesions of similar appearance can be caused by chronic eye infections, infections of the maxillary sinuses and periosteal new bone formation.

Table 2 Frequencies of major disease categories observed (n = affected, N = total number of individuals with skeletal element preserved, NBF = new bone formation)

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<th>New Kingdom</th>
<th>post-New Kingdom</th>
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<tr>
<td></td>
<td>n/N %</td>
<td>n/N %</td>
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<tr>
<td>NBF Tibia</td>
<td>6/13 42.9%</td>
<td>23/61 37.7%</td>
</tr>
<tr>
<td>NBF Ribs</td>
<td>11/18 61.1%</td>
<td>29/59 42.0%</td>
</tr>
<tr>
<td>Sinusitis</td>
<td>10/13 76.9%</td>
<td>23/35 65.7%</td>
</tr>
<tr>
<td>Orbital lesions</td>
<td>10/14 71.4%</td>
<td>29/50 58.0%</td>
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Plate 12 Mean adult femur lengths from Amara West in comparison with other Nubian sites (comparative data taken from Buzon 2006) (blue = male; red = female)

Plate 13 New bone formation (arrows) at the inner side of the ribs of Sk301-4 (New Kingdom)
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sanitation, inadequate access to water and closeness to animals (Wright et al. 2008).

Trauma

One of the most notable findings in the Amara West population so far is the high frequency of fractures (Pl. 15). While 37.9% (11/29) of the New Kingdom individuals had suffered at least one healed fracture, 39.8% (43/108) of the post-New Kingdom individuals were affected. High trauma frequencies have commonly been reported in Nubian samples (Kilgore et al. 1997; Judd 2004), but the distribution of traumatic lesions in the Amara West sample is notable for the high levels of trauma in the axial skeleton. Both groups show a particularly high frequency of trauma to the spine, comprising both of oblique fractures of the transverse and spinous processes (structures of the posterior part of a vertebra), as well as compression fractures of the vertebral bodies (Pl. 16). If they are not related to other underlying pathologies such as osteoporosis or cancer (neither was apparent in the individuals with fractures of the spine), fractures to the spine usually result from high-energy trauma caused by falls, crashes or direct blows to the spine (Resnick 2002). Similar mechanisms are also the cause of other rather uncommon types of complex fracture observed in the Amara West samples, such as multiple fractures to the pelvis and the scapula. Since there is no explicit evidence that inhabitants were involved in high levels of interpersonal violence, attributing the observed lesions to accidental injuries seems reasonable. The trauma profile appears to be consistent with patterns observed in farming communities, where the main

Plate 14 Circular depression in the roof of the right eye socket (Sk314-12, post-New Kingdom)

frontal sinuses or scurvy (Wapler et al. 2004). Differentiation between such causes would require further, invasive, histological analyses. Two more distinctive cases of orbital infection were detected in the post-New Kingdom data set, which featured circular depressions in the roof of the eye cavity, surrounded by healed new bone formation (Pl. 14).

Such lesions are consistent with a diagnosis of trachoma (Webb 1990), a bacterial eye infection which principally affects children, though symptoms can persist into adulthood resulting in blindness. Its presence also provides clues towards hygiene within the settlement, as the transmission of trachoma is linked to factors such as poor

Plate 15 Frequencies of fractures in the New Kingdom and post-New Kingdom samples from Amara West

Plate 16 Compression fractures of the three lower thoracic vertebrae (Sk216-1, post-New Kingdom)
causes of injuries are falls and blunt trauma related to the handling of large animals (Gerberich et al. 2001). While the topography at Amara itself does not represent an overly risky environment, additional hazards accounting for the high frequency of accidental injuries may be sought in the multi-storied houses where some activities would have been located on roofs made of wooden beams, plant material and mudbrick which may have occasionally collapsed. Other possibilities include activities related to agricultural activities such as palm harvesting or the handling of large animals.

Comparably high values of axial skeleton trauma were also observed in the New Kingdom workmen’s cemetery at Amarna, Egypt (Kemp et al. 2012) where they were interpreted as a testimony to the populations’ involvement in the construction of Akhenaten’s new city. Fractures to the long bones (Pl. 17) are generally less common, with no fractures to the long bones of the lower extremity yet identified, in contrast to other Nubian samples (Kilgore et al. 1997; Judd 2004; Buzon and Richman 2007). Fractures of the upper limb are again usually associated with falls.

Despite the severity of some observed fractures, many are well healed. Nonetheless, several of the spinal fractures are rather severe in nature and it is very likely that such injuries would have been accompanied by further complications and health impairment, due to soft tissue trauma. Thus, the high degree of healed fractures may indicate some form of medical treatment or care being provided within the community.

Osteoarthritis

Osteoarthritis, a disease of the synovial joints, was also assessed. Primary osteoarthritis is one of the most common diseases reported in human remains (Waldron 2009, 26ff). It results from general degeneration of the joints over a lifetime and can be enhanced by factors such as excessive movement. As such, the frequency of osteoarthritis can provide indications of general workload levels in a population. The condition is manifested through osteophyte formation on the joint margins, in combination with pitting and eburnation on the joint surfaces, with either of the latter having to be present (Rogers and Waldron 1995).

At Amara West, osteoarthritis of the spine and extra-spinal joints was encountered in many adults during both time periods (Pl. 18). The high frequencies during the post-New Kingdom period are particularly notable, given the generally much younger age-at-death at this time.

Osteoarthritis in the spine was equally common with 94.4% of the New Kingdom and 82.8% of the post-New Kingdom sample displaying signs of joint disease in the intervertebral joint, alongside intervertebral disc disease resulting from degeneration of the spinal discs. These results suggest that people living at Amara West were involved in physically strenuous activities in day-to-day life, as might be expected in a largely agricultural society. Drawing reliable conclusions about any diachronic trends requires a larger New Kingdom assemblage.

Dental pathologies

The assessment of dental pathologies (Table 3) reveals poor levels of dental health throughout the period of occupation. The higher values in the New Kingdom sample is likely to be the result of higher ages-at-death in this group (see above). The most striking characteristic of dental health in both samples is the exceedingly high amount of ante-mortem tooth loss (AMTL) (Pl. 19), a phenomenon common at other sites in Nubia (Buzon and Bombak 2010). It is most likely related to a diet high in abrasive materials such as grit or sand, which is also reflected in the high degree of dental wear observed at Amara West. These findings also have to be taken into account when interpreting the occurrence of other pathologies such as caries or abscess formation, as their development and frequency is often facilitated or removed by dental abrasion.

Table 3 Dental pathologies in samples from Amara West (NK = New Kingdom; AMTL = ante-mortem tooth loss)

<table>
<thead>
<tr>
<th></th>
<th>NK</th>
<th>post-NK</th>
<th>NK</th>
<th>post-NK</th>
</tr>
</thead>
<tbody>
<tr>
<td>teeth affected</td>
<td>Caries</td>
<td>2.8%</td>
<td>9.7%</td>
<td>60.0%</td>
</tr>
<tr>
<td></td>
<td>AMTL</td>
<td>31.7%</td>
<td>31.3%</td>
<td>78.9%</td>
</tr>
<tr>
<td></td>
<td>Abscess</td>
<td>57.9%</td>
<td>46.9%</td>
<td></td>
</tr>
</tbody>
</table>
and consecutive ante-mortem tooth loss (AMTL; Hillson 2008). Thus, the relatively low amount of carious teeth, especially in the New Kingdom sample, is not necessarily representative. The presence of caries does attest to the availability of foods high in fermentable carbohydrates, including fruits such as dates or figs, identified in the palaeobotanical material (Ryan et al. 2012).

The frequent occurrence of abscesses, some of them rather severe, is also related to the high degree of dental abrasion and AMTL at Amara West. If teeth are cracked or the pulp cavity becomes exposed through micro trauma or excessive dental wear, the entry of bacteria is facilitated, usually leading to the formation of a dental abscess.

**Preliminary conclusions**

Due to the small size of the New Kingdom sample, it is not yet feasible to undertake a diachronic study to ascertain if, and to what degree, the proposed cultural, political and perhaps most importantly environmental changes would have affected the health and living conditions of people living at Amara West. Some tendencies can be noted in the assemblages analysed to date. The frequencies of all markers used here are generally very high in both phases, with stress markers more common in the earlier samples, with the exception of mean age-at-death. This is higher in the earlier sample and might argue for deteriorating living conditions during the post-New Kingdom period. The detailed assessment of selected pathological changes does indicate a fairly high degree of environmental pressures affecting the inhabitants of Amara West throughout the entire time period of use of the site. In addition to more unspecific stress markers, the pathological spectrum also comprises diseases such as cancer (Binder et al. 2014) and atherosclerosis (Binder and Roberts 2014). However, confirming any diachronic trends will require further investigation and a larger sample size.

**Mobility**

Further research carried out on human remains from Amara West addresses the question of human migration related to the Egyptianization of Nubia from a biomolecular perspective. Up until recently, it has been assumed that the Egyptian colonization of Nubia was brought about by large-scale migration of Egyptians resulting in a widespread Egyptianization visible in the material culture. However, this approach has become increasingly challenged in recent years (Edwards 2004, 107). Bioarchaeological data informing these research questions can be gained through stable strontium and oxygen isotope values from bone and teeth, which provide a lasting record of a person’s geographic origin. Analysis of these biomolecules from archaeological remains has successfully been applied to track human migrations in the past. With regards to the Egyptianization of Nubia, analysis of individuals from the New Kingdom cemetery at Tombos tentatively identified a small number of Egyptian immigrants alongside a predominantly indigenous Nubian population (Buzon et al. 2007). Similar analyses have been carried out on tooth samples from Amara West by M. Buzon at Purdue University (Buzon and Simonetti 2013). However, the individuals from Amara West included in the study are largely of post-New Kingdom date, therefore further analyses are needed. Again, a larger New Kingdom data set would be essential to explore such research questions. Furthermore, Amara West may have been inhabited by individuals relocated from other Egyptian sites in Nubia and people indigenous to the region, which would not result in a distinctive strontium isotope signature.

**Conclusion: life and death in colonial Kush**

The detailed assessment of the ancient lived experience of Amara West through the skeletal remains of its inhabitants, as well as the traces they left behind in life and for burial (from architectural through artefactual and geochemical residues) is still at a preliminary stage. However, the site is already providing a detailed impression of how individual/household agency was the primary factor in dictating the form of the domestic physical environment. The built environment further represents one of the major factors governing the spectrum of diseases affecting people living therein. The bioarchaeological research in the cemeteries further expands our understanding of the urban sphere, from the high number of individuals with healed fractures, suggesting care within the houses, to potentially high levels of indoor pollution causing chronic respiratory diseases, but also an increasing number of Nubian cultural markers from c. 1200 BC onwards. The individuals who chose tumuli, funerary beds or flexed burials – how they were to be represented in eternal life – do not seem to have lived in houses (or used objects) much different from those in contemporary Egypt.

Without the integration of town and cemetery data, the degree of cultural entanglement would be more difficult to gauge. In the near complete absence of texts relating to individuals who lived at Amara West, the study of the human remains and the bioarchaeological data enables the proposal of a more nuanced, heterogeneous vision of life in a colonial town, one in which ‘Egyptianization’ may represent one extreme of a nuanced spectrum, which also included a degree of ‘Nubianization’ within a previously pharaonic
town and its cemeteries. This research project therefore provides a case study of how the combined study of architectural, artefactual, environmental and bioarchaeological data from new fieldwork at archaeological sites can vastly improve our knowledge about life in the past gained.

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**Notes**

1 KIA-46312 301-3 bioapatite 2944±26 1260–1050 cal bc, p=95; KIA-46313 301-4 bioapatite 2908±24 1210–1015 cal bc, p=95.
2 KIA-46314 237 bioapatite 2807±26 1010–890 cal bc.

**Bibliography**


