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Lisa Sabbahy Dr.

The American University in Cairo AUC, lsabbahy@aucegypt.edu

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# Did Akhenaten's Founding of Akhetaten Cause a Malaria Epidemic?

LISA SABBABY  
American University in Cairo

## Abstract

*This paper presents and discusses evidence for changes in the environment that would have taken place at the site of Amarna, ancient Akhetaten, during the rapid building and populating of the city in the reign of King Akhenaten. The evidence suggests that the effect of the founding of this city, with all the consequences of a changed environment on both sides of the river, could have been responsible for a malaria epidemic. This scenario is backed up by the high prevalence of signs of malaria in the skeletal material from Amarna, as well as in the short-lived history of the city, which was deserted after about fifteen years.*

## ملخص

يقدم ويناقش هذا المقال أدلة على تغييرات بيئية ربما قد حدثت بموقع العمارنة -أخت أتون قديماً- في أثناء العملية السريعة لبناء وتعمير هذه المدينة في عهد الملك أخناتون. تُشير الأدلة إلى أن أثر تأسيس هذه المدينة مع كل ما نتج عنه من عواقب تغيير البيئة على ضفتي النهر قد تسبب على الأرجح في تفشي وباء الملاريا. ويدعم هذا الرأي الانتشار الواسع لعلامات الإصابة بالملاريا في البقايا الأدمية القادمة من العمارنة، فضلاً عن التاريخ القصير لعمر المدينة التي صارت مهجورة بعد حوالي خمسة عشر عاماً من تاريخ تأسيسها.

In year 5 of his reign, Amenhotep IV, son of Amenhotep III, of the later Eighteenth Dynasty, changed his name to Akhenaten, closed the temple of Amun at Karnak, the repercussions of which are not really understood, and moved with his family and court officials to a virgin site in Middle Egypt, to build his new royal city for the Aten, called Akhetaten, "The Horizon of the Aten." The king set out his plans for the city in a decree, known as the "Early Proclamation" that was carved on two stelae, called M and X, cut into the rock on the northern and southern limits of the area that would become the city Akhetaten, now known by its modern name Amarna.<sup>1</sup>

The city of Akhetaten was located on the east bank of the Nile in an apparently empty and barren area, safely above the level of the Nile inundation. Across on the west side of the Nile was a large area of flood plain through which flowed the Bahr Yussef, the only tributary of the Nile in Egypt. In year 6, King Akhenaten set up eleven more stelae laying out the boundaries of his city on the east, and on the west side of the river stelae A, B, and F marked the edges of the fertile agricultural land that would feed the population of the city.<sup>2</sup> Because the Bahr Yussef bisected this two-hundred-kilometer-square area, it could be irrigated all year round, and thus could produce two crops of grain every year, rather than the traditional one crop that was dependent on the annual inundation.<sup>3</sup>

<sup>1</sup> William Murnane and Charles Van Siclen, *The Boundary Stelae of Akhenaten* (London-New York, 1993), 11; Barry Kemp, "The City of El-Amarna as a Source for the Study of Urban Society in Ancient Egypt," *World Archaeology* 9, no. 2 (1977), 124, fig. 1.

<sup>2</sup> Aidan Dodson, *Amarna Sunrise: Egypt from Golden Age to Age of Heresy* (Cairo, 2014), 11.

<sup>3</sup> Christian Tietze, "Amarna – The City and Surrounding Area," in F. Seyfried (ed.), *In the Light of Amarna: 100 Years of the Nefertiti Discovery* (Berlin, 2012), 58.

Agriculture enhances the breeding of mosquitos and therefore also the intensity of malaria for people nearby agricultural land. Irrigation attracts mosquitos because it facilitates water accumulation and “crop cover,” especially grain, provides mosquitoes with a favorable environment.<sup>4</sup> Studies show that there was “widespread endemic malaria in the Nile Valley”<sup>5</sup> throughout ancient Egyptian history, and specifically there was infection from *Plasmodium falciparum*, which causes the most “severe malaria.”<sup>6</sup> The year-round cultivation of the standard ancient Egyptian grains, emmer and barley, would have attracted mosquitoes and enhanced their ability to thrive.

On the other side of the river, the building of the city spread north to south about four miles along the east bank of the river from the North Riverside Palace to the Sun Temple of Nefertiti.<sup>7</sup> The king lived in the North Riverside Palace, and royal females were in the North Palace slightly south of it. The bulk of the city’s population was in the two main suburbs of the north and the south, where there was a mixture of elite villas with clusters of small houses around or near them. In the southeast, in a more barren area, were two workmen’s villages, now referred to as the Workmen’s Village and the Stone Village. The population of the city has been estimated to have ranged from 20,000 to 50,000 people.<sup>8</sup>

Buildings for the living in ancient Egypt were constructed of mud brick, and Akhetaten was no exception. The palaces, all the administrative buildings, and all houses were mud brick covered with mud plaster, and that included floors and ceilings of both houses and palaces. The temples were built of rectangular blocks of limestone known as *talatat*, although the pylons of the largest two temples were mud brick, and all enclosure walls would have been mud brick, as well as other large structures, such as the massive pillars of the bridge from the King’s House to the Great Palace.<sup>9</sup>

Mud brick at Akhetaten was of two basic types: alluvial or marl, and the typical inclusions, especially with marl mud brick, was gravel.<sup>10</sup> The best ancient Egyptian evidence of brick making is a scene in the Eighteenth Dynasty tomb of the vizier Rekhmire at Thebes.<sup>11</sup> There, men are shown filling pottery vessels with water from a square pool with trees,<sup>12</sup> and then mixing and working together the soil, water, and inclusions, forming the rectangular shape of the bricks with a mold, and then laying them out in the sun to dry.

The important point about bricking-making for this discussion is twofold. First, because there had to be water by any brick-making area, a pit was dug that was then filled with water from a well or brought from the Nile. Such pits, often referred to as borrow pits, are still dug for mud brick making in villages today. One could assume with the building of the city, particularly the private houses, there would have been bricks made at different sites throughout the city, each of which would have had a pit for water. “Various pits found beneath the floors and walls of houses at Amarna might have been dug for brick-making materials,” so bricks seem to have been made at the building site where they were used.<sup>13</sup> Brick evidence from the Workmen’s Village shows that the bricks used to build the substantial enclosure wall around the village were made from materials used in the construction of the main city, while the village houses themselves were built with bricks made from material from a huge pit dug right by the village.<sup>14</sup>

The second point is that houses of traditional materials, such as mud brick, attract mosquitoes because the cracks and spaces in mud bricks and mud plaster offer mosquitos not only ways into the house, but the cracks and

<sup>4</sup> Kwadwo Asenso-Okyere, Felix Asante, Jifar Tarekegn, et al., *The Linkages between Agriculture and Malaria*, International Food Policy Research Institute (2009), 16, 21.

<sup>5</sup> Nicole Smith-Guzmán, “Cribra orbitalia in the Ancient Nile Valley and Its Connection to Malaria,” *International Journal of Paleopathology* 10 (2015), 1.

<sup>6</sup> Andreas Nerlich, Bettina Schraut, Sabine Dittrich, et al., “Plasmodium falciparum in Ancient Egypt,” *Emerging Infectious Diseases* 14/8 (2008), 1317–18.

<sup>7</sup> Barry Kemp, *The City of Akhenaten and Nefertiti: Amarna and Its People* (Cairo, 2012), 46, fig. 2.1.

<sup>8</sup> Kemp, *City of Akhenaten and Nefertiti*, 272.

<sup>9</sup> Kemp, *City of Akhenaten and Nefertiti*, 132, fig. 4.7.

<sup>10</sup> Charles French, “A Sediment Analysis of Mud Brick and Natural Features at el-Amarna,” in B. Kemp (ed.), *Amarna Reports I* (London, 1984), 191.

<sup>11</sup> Norman De Garis Davies, *The Tomb of Rekh-Mi-Rē at Thebes* (New York, 1943), pl. 58.

<sup>12</sup> Undoubtedly showing an idealized pond for the afterlife, and not just a pit, Davies, *The Tomb of Rekh-Mi-Rē*, 54.

<sup>13</sup> Kemp, *City of Akhenaten and Nefertiti*, 70.

<sup>14</sup> Kemp, *Amarna Reports I*, 4–5.

crannies offer them a micro-environment in which to live. Mud brick houses usually have a grass or reed roof as well, which also attracts mosquitoes and makes it easy for them to get into the house.<sup>15</sup> Particularly at the Workmen's Village, matting, loose grass, and reeds have been found with roof fragments, and these plant materials seem to have been used to fill the gaps between the poles and beams in the roofs.<sup>16</sup> The Workmen's Village also had animal pens on the its east side, and keeping animals is "associated with greater exposure to mosquitos."<sup>17</sup>

It has been estimated that there must have been about three thousand houses at Akhetaten, ranging from small tri-partite houses to large villas, all built of mud brick.<sup>18</sup> Adding to that all the other administrative and royal buildings made of mud brick, the construction and the repair and upkeep of Akhetaten's buildings, along with the large fields of irrigated land just across the river, this newly established city provided an excellent environment for mosquitos to live and breed.

Borrow pits were not the only standing bodies of water that would have allowed mosquitos to thrive. For a barren desert area, the city of Akhetaten had numerous wells, pools, and water gardens, as well as irrigated plots for trees and other plants. The royal palaces and every elite villa had their own well, and wells were also dug in public places for occupants of smaller houses to use. In fact, King Akhenaten's city "is the location of the earliest wells in the Nile Valley."<sup>19</sup> Only a few of these wells have been excavated; in particular, there is a large well in excavation square Q48.4, Area 23, on the east side of the main city, in the beginning of the wadi leading to the Workmen's Village.<sup>20</sup> The Workmen's Village did not have a well, but water was brought from well Q48.4 to a "zir area" near the village, a plot of land with large vessels that would be filled with water, and set into stones to keep them upright.<sup>21</sup> The Workmen's Village was too far into the desert to dig a well, and any water reached would have been brackish because of the "naturally high salt content of the desert."<sup>22</sup>

The Q48.4 well was formed of two parts. First, a staircase or ramp led down to a square platform, and then a shaft cut in the platform dropped down to water level that varied with the height of the Nile.<sup>23</sup> A *shadouf* on the platform was used to bring water up to that level, and then the water could be poured into vessels and carried up the stairs or ramp. This type of large well with *shadouf* is depicted in the midst of an orchard in the rock cut tomb of the High Priest Meryra at Amarna.<sup>24</sup> Smaller wells, found with houses or in public areas, had a spiral staircase that descended down far enough that pottery vessels could be filled with water and carried back up.<sup>25</sup> In the North Suburb, there seems to have been at least two public wells that were associated with a well-house for a guard that was reached by a long, straight, flight of steps.<sup>26</sup>

The palaces and many of the villas at Akhetaten also had pools, although the largest pool, probably better referred to as a lake, was the one found at the Maru-Aten, the sun temple, or Sunshade of Ra, belonging to Akhenaten's daughter Meretaten, south of the city. There was also a second, but very much smaller enclosure on its south side.<sup>27</sup> The lake of the Maru-aten was almost four hundred feet long, two hundred feet wide and

<sup>15</sup> London School of Hygiene and Tropical Medicine, *Malaria Centre Report* (London, 2014–2016), 48.

<sup>16</sup> Barry Kemp, "Report on the 1985 Excavations, Work inside the Walled Village," in B. Kemp (ed.), *Amarna Reports 3* (London, 1986), 24; Barry Kemp, "Work inside the Walled Village (1): south-west corner," in B. Kemp (ed.), *Amarna Reports 4* (London, 1987), 7, fig. 1.4.

<sup>17</sup> Hassan Bassiouny, "Bioenvironmental and meteorological factors related to the persistence of malaria in Fayoum Governorate: a retrospective study," *Eastern Mediterranean Health Journal* 7, no. 6 (2001), 904.

<sup>18</sup> Kemp, *City of Akhenaten and Nefertiti*, 272.

<sup>19</sup> Henning Franzmeier, "Wells and Cisterns in Pharaonic Egypt: The Development of a Technology as a Process of Adaption to Environmental Situations and Consumers' Demands," in K. Griffin (ed.), *Current Research in Egyptology 2007* (Oxford, 2008), 41.

<sup>20</sup> Pamela Rose, "The pottery survey," in B. Kemp (ed.), *Amarna Reports 4*, 124–25 and fig. 9.6.

<sup>21</sup> Kemp, *City of Akhenaten and Nefertiti*, 194.

<sup>22</sup> Kemp, *City of Akhenaten and Nefertiti*, 55.

<sup>23</sup> Barry Kemp, "Report on the 1987 Excavations, A Large Well beside Building Q48.4," in B. Kemp (ed.), *Amarna Reports 5* (London, 1989), 1–14.

<sup>24</sup> Alex Wilkinson, *The Garden in Ancient Egypt* (London, 1998), 160, fig. 84; Kemp, "A Large Well beside Building Q48.4," 13; Cathie Spieser, "Eau et lumière dans les monuments amarniens – Le disque solaire, le miroir et l'oeuf solaire," *CENiM* 20 (2018), 130–32; Kemp, *City of Akhenaten and Nefertiti*, 51, figs 2.4 and 2.5.

<sup>25</sup> Franzmeier, "Wells and Cisterns in Pharaonic Egypt," 42, fig. 5.

<sup>26</sup> Henri Frankfort and John Pendlebury, *The City of Akhenaten, Part II* (London, 1933), 61, and pl. 9.

<sup>27</sup> Thomas Peet and Charles Woolley, *The City of Akhenaten, Part I* (London, 1923), pl. 29

three feet deep, and surrounded by a garden of trees and flowers.<sup>28</sup> In the northeast corner of the Maru-Aten's enclosure were also eleven T-shaped offering pools twenty feet long, more than ten feet wide, and 3 feet deep.<sup>29</sup> There is no evidence of a channel to bring water in from the Nile for the lake or garden of the Maru-Aten and its smaller southern enclosure, so "deep and large wells within the enclosures" were the sources of water.<sup>30</sup>

The need for water in everyday life does not seem to have been the only reason for such an emphasis on wells, ponds, and water gardens. Water, and animals and plants in and near water, were also depicted on the painted mud plaster of the walls and floors of royal palaces and the sun temples in the south of the city. This type of decoration may have been purposely used to reflect fertility and abundance, as well as to represent the Aten's creation of every aspect of the living world, as put forth in the Great Hymn to the Aten.<sup>31</sup> Kemp's idea that Akhenaten might have issued a decree requiring the digging of wells because of this symbolic purpose would make sense in this light.<sup>32</sup>

Since the mid-2000s excavation of two non-elite cemeteries at Amarna that seem to have been the "main public burial grounds,"<sup>33</sup> have produced extensive evidence of death and disease, which possibly substantiates some kind of epidemic at the city. Excavation at the South Tombs Cemetery for six seasons shows that it probably contains burials for 6,000 individuals, of whom 417 were excavated and their skeletons studied for indications of malaria; 50% showed signs of recent malarial infection.<sup>34</sup>

The North Tombs Cemetery began to be excavated in 2015. It contains an estimated 4,000–5,000 burials.<sup>35</sup> Of the 150 individuals who had been studied by 2017, 85.7% have bone lesions "that have been previously identified as indicators of malarial infection."<sup>36</sup> The latest report from the 2017–2018 seasons suggests 92% have these bone lesions.<sup>37</sup> The report on these findings suggests the individuals buried in this cemetery belonged to a workforce "subject to working/living conditions that saw their immune responses compromised."<sup>38</sup> In both cemeteries, but particularly in the North Tombs Cemetery, as well as malarial infection, skeletal remains produced evidence of stunting, nutritional insufficiencies, and a high rate of bone fractures and trauma. Granted, all the publications on these human remains so far are preliminary, but they all point to a very high malaria rate among the non-elite population of Akhetaten.

It is not a surprise that with intensive agriculture, the making of mud brick, living in mud brick houses, as well as all the pits and pools of water, that the human remains found at Amarna reflect the existence of extensive malarial infection. In fact, it appears that Egypt, in general, suffered from malaria in ancient times.<sup>39</sup> But, could the extent of the suffering from malaria at Akhetaten have been intensified by the fact that the city was probably built in no more than seven years, beginning in year 5 and completed by the *durbar* in year 12?<sup>40</sup> During that time,

<sup>28</sup> Wilkinson, *Garden in Ancient Egypt*, 148–49.

<sup>29</sup> Wilkinson, *Garden in Ancient Egypt*, 151. For a detailed plan, see Fran Weatherhead, *Amarna Palace Paintings* (London, 2007), 276–78, and figs. 139a–139b.

<sup>30</sup> Kemp, *City of Akhenaten and Nefertiti*, 54.

<sup>31</sup> Weatherhead, *Amarna Palace Paintings*, 28–29; Kate Spence, "Royal Power in New Kingdom Egypt: The Palaces and Gardens of Amarna," in J. Ganzert and I. Nielsen (eds.), *Herrschaftsverhältnisse und Herrschaftslegitimation: Bau- und Gartenkulturs historisch Quellengattung hinsichtlich Manifestation und Legitimation von Herrschaft* (Hamburg, 2014), 26; Patrick Sallard, *Palatial Paintings and Programs: The Symbolic World of the Egyptian Palace in the New Kingdom (c. 1550–1069 BCE)*, PhD dissertation (Institute of Fine Arts, New York University, 2015), 208. For the Great Hymn see William Murnane, "The Great Hymn to the Aten," *Texts from the Amarna Period in Egypt* (Atlanta, 1995), 113–15.

<sup>32</sup> Kemp, "Report on the 1987 Excavations," 14.

<sup>33</sup> Anna Stevens, "Death and the City: The Cemeteries of Amarna in Their Urban Context," *Cambridge Archaeological Journal* 28.1 (2017), 103.

<sup>34</sup> Nicole Smith-Guzmán, Jerome Rose and Kathleen Kuckens, "Beyond the Differential Diagnosis: New Approaches to the Bioarchaeology of the Hittite Plague," in M. Zuckerman and D. Martin (eds.), *New Directions in Biocultural Anthropology* (Hoboken, 2016), 309–10.

<sup>35</sup> Stevens, "Death and the City," 111–12.

<sup>36</sup> Anna Stevens and Gretchen Dabbs, "Tell el-Amarna, Spring 2017," *JEA* 103.2 (2017), 146.

<sup>37</sup> Anna Stevens, Gretchen Dabbs, Corina Rogge, et. al., "Tell el-Amarna, Autumn 2017 and Spring 2018," *JEA* 104.2 (2018), 133.

<sup>38</sup> Stevens and Dabbs, "Tell el-Amarna, spring 2017," 148.

<sup>39</sup> Nicole Smith-Guzmán, "Cribra orbitalia in the Ancient Nile Valley and Its Connection to Malaria," *International Journal of Paleopathology* 10 (2015), 11; Andreas Nerlich, Bettina Schraut, Sabine Dittrich, et al., "Plasmodium falciparum in Ancient Egypt," *Emerging Infectious Diseases* 14.8 (2008), 1317–18.

<sup>40</sup> Dodson, *Amarna Sunset*, 10, 13. It has been suggested that the foreign emissaries coming to Akhetaten for the *durbar* brought plague

all the mud brick buildings had been completed, the agricultural fields established, and the entire population of the city brought in from other parts of Egypt. The building of Akhetaten was not the normal slow growth of a settlement from a small village to a city; it was a relatively swift transformation of the environment of that area of Middle Egypt.

A study of land reclamation and settlement in the Fayum from 800 BCE to Roman times, a much more extended time than the settlement and cultivation at Amarna, has shown high frequencies of malaria brought about by the intensified irrigation, cultivation, and human crowding.<sup>41</sup> The situation in the Fayum was exacerbated by co-infection with tuberculosis, which has not been found at Amarna, although the human remains from the non-elite cemeteries show extensive trauma from hard labor, as well as nutritional deficiencies, that must have made the burden of malaria more deadly.

Within three to four years after Akhenaten's death, the few members remaining of the royal family and their entourage left the city. The rest of the population chose to move away as well, abandoning a place where so many of their family, friends, and neighbors had been buried. Only the southernmost part of the site has evidence that people remained on into the late Ramesside Period.<sup>42</sup> The reason for the desertion of the city of Akhetaten has never really been satisfactorily addressed; maybe it was simply an unhealthy place to live.

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with them, and this might have caused the apparent deaths of several royal females. See Donald Redford, *Akhenaten: The Heretic King* (Princeton, 1984), 186–87, and Dodson, *Amarna Sunset*, 17–18.

<sup>41</sup> Albert Lalremruata, Markus Bell, Raffaella Bianucci, et. al., “Molecular Identification of Falciparum Malaria and Human Tuberculosis Co-infection in Mummies from the Fayum Depression (Lower Egypt), *PLoS ONE* 8/4 (April 2013), e60307, 4–5.

<sup>42</sup> Kemp, *City of Akhenaten and Nefertiti*, 301.