Mind the Gap!
Identifying Occupation Hiatus Macroscopically and Evaluating their Importance for Settlement Mound Research

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How can archaeologists identify something which is not there? The absence of occupation layers and architectural features does not notoriously mean that a settlement mound was not subjected to change. In contrary, ancient sites are and were constantly modified. The fixation on human-induced elements at settlement mounds and the routine processes of extraction and sample procedures have coloured many site's stratigraphies and subsequently their histories. The fact that it is very common to talk about the occupation history of a site, does not need further explanation. This biased view has influenced generations of scholars who consider settling and abandonment processes as the borders of an occupation period. In this paper the author sees them as the start and end of an occupational gap, probably one of the most neglected topics in settlement mound research. Purpose of the present paper is to draw attention to the potential of macroscopic analysis for identifying hiatus in the archaeological record.

KEY WORDS: Geoarchaeology, occupational gap, archaeological method, West Africa, Middle East

Introduction

Occupation hiatus at a settlement mound are still almost exclusively recorded by material culture. Scholars assume a continuing occupation if there is no change visible in ceramics: "there is no archaeological evidence for an occupational gap". The longer you look at this sentence, the more it clashes with modern archaeological standards. It is argued here and elsewhere that the main source of information to elucidate data that is needed for a complete and reliable interpretation of the occupation history, including non-anthropogenic agencies, should be the sediments of an archaeological site (*cf.* Bullard 1970; Hassan 1978; A. Rosen 1986; Petit 2009: 13-19). Geology, geography and geoarchaeology are nowadays highly valued disciplines in projects with an archaeological focus (Butzer 1982; Ellis & Waters 1991: 126; Deckers & Fuchs 2007). However, the call of Hassan some 40 years ago that those specialists should participate in excavations and should cooperate intensively with archaeologists is still ignored (Hassan 1978; *cf.* Bullard 1970).

The interest of macroscopic analysis of settlement mound stratification has recently greatly diminished to the incredible results of micromorphologic research (Goldberg 1983: 147-148; Bullock et al. 1985; Courty et al. 1989; Matthews & Postgate 1994; Matthews et al. 1997: 282; Shahack-Gross et al. 2005; Friesem et al. 2011: 1135). Archaeologists do recognise the value of collecting field data macroscopically, but are overwhelmed by the spectacular results that have arrived from microscopic sediment analysis. The result is that hardly anybody in the field feels responsible for a systematic and thorough description and study of profiles and excavated sediments (*e.g.* Gasche & Tunca 1983: 326). The meticulous recording of site formation and sedimentation processes with a microstratigraphic approach is without doubt the future (Matthews et al. 1996, 1997), but archaeologists remain responsible for most of the sediment analyses on-site: "The only difference between observations and interpretations in the field and in thin section is the greater visible resolution provided by microscopic analysis" (Matthews et al. 1997: 285). The aim of this paper is to draw attention to the potential of macroscopic sediment analysis in archaeology and to call for a change in perception of successive occupation levels.

State of Research

Since the work of Bullard (1970) and Davidson (1973), the term geoarchaeology is frequently found in archaeological literature. Its value for archaeological projects has been accepted, but this rarely includes the study of occupational gaps. And that is strange, while already Bullard (1970: 115-116) realised that stratified sediments in historical deposits must be studied including hiatus. He named three characteristics to recognise periods of abatements: 1) a stratified weathered zone in which there is gradational enrichment of clay mineral content vertically, 2) the occurrence of loess, and 3) sheet wash deposits or pounded sediments across broad areas of the site. According to Davidson (1973: 151; see also Sjöberg 1976; Canti & Huisman 2015, and references therein), particle size of the matrix and sudden site-wide changes are signs of cultural hiatus as are differences in phosphate concentration.

Final abandonment has been the topic of more studies, especially during the 1970s and 1980s. Abandonment has been identified as a key process in the formation of sites and the archaeological record (Ascher 1968; Schiffer 1972, 1976; Stevenson 1982; Cameron 1996: 3). Most researchers focus on the underlying causes for the ultimate abandonment of a certain site or region (Weiss et al. 1993; S. Rosen 2000), but there are a few who have discussed the processes itself (*e.g.* Zuckerman 2007), the effect (*e.g.* Baker 1975), the speed (*e.g.* Stevenson 1982), and ways of identification (*e.g.* Reid 1973). Folk (1975) describes a layer of windblown dust on top of the last occupation layer at the city of Stobi in former Yugoslavia. This indicates a dry period which was possible responsible for the abandonment of the settlement in the 7th century CE. Wind-blow material as a way to identify final abandonment is recognized in more studies (*e.g.* Friesem et al. 2011; see the situation at Oursi, this article). Also A. Rosen (1986) has discussed what happened to the settlement mound after the site was abandoned. Since the 1990s, the phenomenon of abandonment is largely neglected with only a few exceptions (*e.g.* Zuckerman 2007: 4).

The process of weathering and erosion has been studied from the 1960s (Yaalon 1963; see also A. Rosen 1986). Davidson (1973: 151) in his study of a settlement mound at Sitagroi in Greece has calculated that 50% of the original settlement had disappeared. Kirkby & Kirkby (1976) demonstrated for Oaxan mounds that sherd densities first increase within 50 to 100 years after site abandonment because of the breaking of large sherds, and then decrease because of burial by natural alluviation or later occupation deposits. They assessed that for settlement mound-heights of greater than five meters older periods are represented by less than 1% of the original sherd concentration. Also Baker (1978) investigated artefact density on surfaces and came to the conclusion that there was a disproportionate occurrence of large artefacts on the site's surface. More recently site degradation and erosion processes are studied by side-scans and multi-beam sonar, although not yet on settlement mounds (*e.g.* Cederlund 2004; Pascoe 2012).

Since micromorphology was introduced by Catt & Weir (1976) and Goldberg (1979), many studies have been conducted on the origin of sediments on settlement mounds (*e.g.* Namdar et al. 2011). This caused an increase in mud brick studies including the research of what happens after a mud brick structure is abandoned (Koulidou 1998; Goodman-Elgar 2008). Those studies rely heavily on ethno-archaeological data while extracting abandonment behaviour from archaeological material is thought to be extremely difficult (Cameron 2003; Friesem et al. 2011, 2014).

Processes of Settling at Settlement Mounds

The process of settling contains at least two parameters that are important for understanding the archaeological record. The first is the determinants to settle. Why did individuals or groups settle at a certain site? The considerations are regularly dictated by the physical requirements of the area. People tend to establish their settlements in places that are close to drinking water, food resources, and in areas that are safe and secure (Trigger 1968: 60; Eriksen 1991: 116; Acheson 1995: 284). But settling can also be an emotional or religious motivated decision. The reasons why people settle can often be recognized in the field: returnees will renovate their former buildings, whereas newcomers will put more efforts in constructing a new village or a new building. This topic is discussed elsewhere in more depth (Petit 2009: 13). Associated with the determinants is the scale of settling

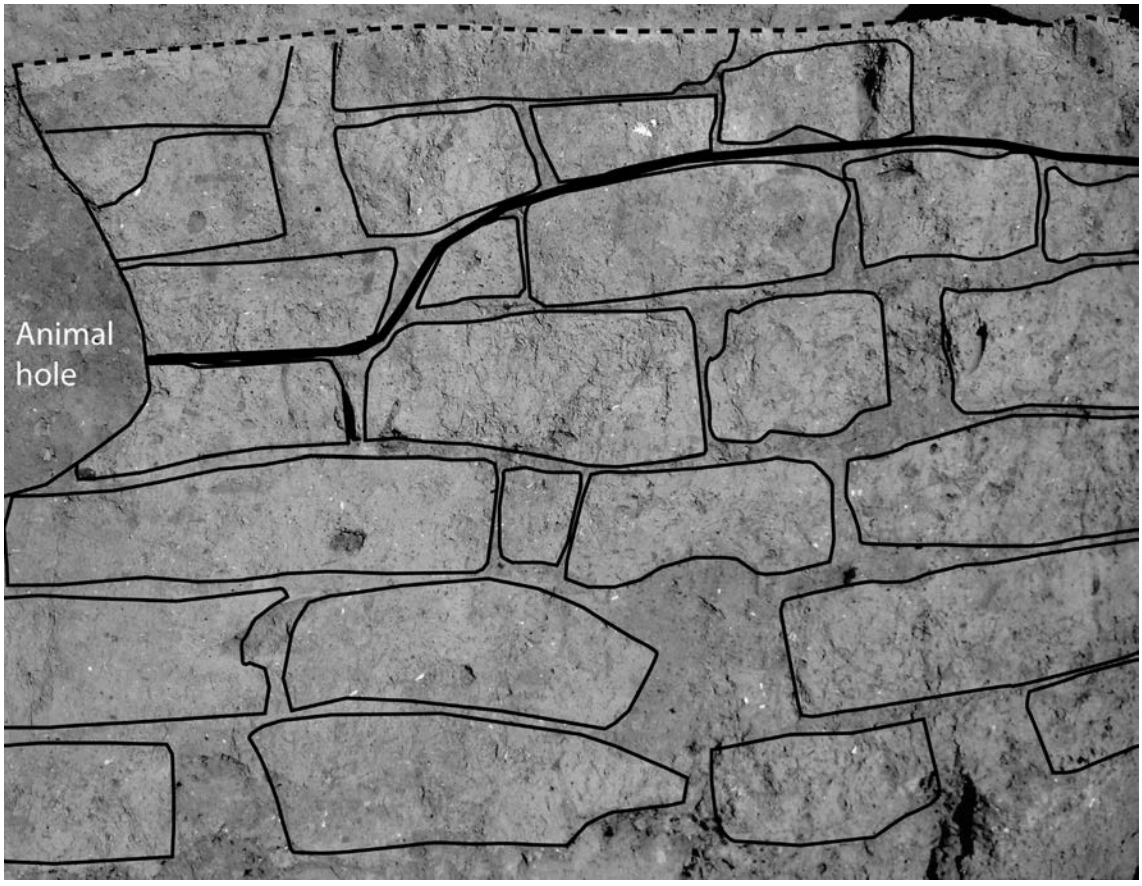

Fig. 1. A section drawing of a wall at Tell el-'Adliyyeh in Jordan, showing two building phases divided by a thick black line. The lower wall was restored after a period of abandonment with new mud bricks. Courtesy L. P. Petit.

strategies. Individual movements are difficult, maybe even impossible, to trace archaeologically, although they occur probably far more frequent as group activities.

How can archaeologists identify and recognise settling activities, which is seen in this paper as the end of an occupational gap? Certainly not the whole set of handlings is preserved in the archaeological record, but some evidence of individual or group settling can be recognized macroscopically. Clearing, digging, and modifying the underground before construction are such traces, and of course new architectural features. These process should get full attention of the fieldworker during settlement mound excavations, since the site consists of multiple occupation phases which have influenced each other enormously. It is certainly strange that settling processes at settlement mounds are not often documented.

Ancient inhabitants did often use older features when they arrived at a site; a horror scenario for any archaeologists, since rebuilding and restoring constructions are very difficult to identify. The restoration may include the raising of walls, the removal of debris, or the construction of a roof. Different types of clay, sizes of mud bricks, and building methods are indications of these restoration activities. They might point to a short occupational gap, since site formation processes during the hiatus had hardly affected the structures. Figure 1 shows an example of two building phases at the site of Tell el-'Adliyyeh in the Jordan Valley (Petit 2009: 65-101). The builders of the latest complex had not levelled the former, but simply restored the older walls with new mud bricks.

A more labour intensive activity for the settlers was the levelling of older ruins. The structures could be too deteriorated for restoration (which might point at a longer period of abandonment) or there was a well-defined plan for a new settlement outline. Large-scale levelling may be associated with group settling, rather than individual or familiar arrivals. In most cases, the newcomers used settlement mound deposit to level irregularities, after which they constructed their buildings often on top of stone or mud brick fundaments.

Processes of Abandonment at Settlement Mounds

How can the archaeologist recognize abandonments? Let us first look at the underlying reasons. There are several explanations why people abandon an activity area, a building, a settlement or a region. The processes and strategies and thus the archaeological visibility differ between an unplanned retreat and an abandonment with anticipation of return (Stevenson 1982: 238-240). During an unexpected abandonment, particularly after a fierce conflagration, the inhabitants did not have much time to clear their properties: relatively rich floor inventories may be preserved (Cameron 2003; Zuckerman 2007: 3; Petit et al. 2011). If abandonment was anticipated during a longer time span, less signs of the original inventory are expected. The reason for the abandonment could be both internal and external, like demographic problems, economic poverty, environmental degradation, decreased water supply or political stress. If the distance was short and a return was anticipated, main architectural structures were left intact. On the other side, if there was no intention to return, house context and even heavy building materials were often removed. Sometimes intentional filling (*e.g.* Kempinski 1989: 182; Ben-Tor 2000: 248; Herzog 2002: 49-67) and burning (Wilshusen 1986) is distinguished, interpreted as a form of ritual abandonment. Each fieldworker should be aware, however, that scavengers could have destroyed the original abandonment situation. Scavenging is an underestimated problem that has major consequences for the interpretation of the abandonment process.

Site Formation Processes during Occupational Gaps

There are a number of ways to identify occupation hiatus macroscopically, apart from recognizing settling and abandonment processes. What happens if a house or a settlement is deserted? And a more relevant question for this study would be, what evidence of an ancient hiatus can still be found by archaeologists? Probably the most apparent site formation process during an occupational gap is the reduction of sediment supply. Natural processes and animal activities can still bring material to the site, but this can hardly cope with the sedimentation during a period of intensive occupation. More generally, we may say that the effects of natural agencies are more pronounced on settlement mounds during phases of structural abandonment (Butzer 1982: 90-91; Gé et al. 1993; Matthews et al. 1997: 288).

Erosion

Several scholars have investigated erosion behaviour on settlement mounds (*e.g.* Franken 1984: 16; A. Rosen 1986: 12). The removal of sediments is part of the natural geological process of denudation and occurs everywhere when precipitation falls on land (Strahler & Strahler 2006: 547). Plants or a dense pottery sherd cover that remains after lighter material has been washed away, protect abandoned settlement mounds during accelerated erosion. But this cover is highly sensitive and easily upset. Intense or frequent trampling by humans and livestock will cut this crust or will kill established plants, thus causing erosion of the bare surface. Also torrential rain can produce enormous destructive power, especially on steep slopes with older scored channels.

Erosion processes were certainly also abundant during habitation, but they could be controlled by the inhabitants. This means that the identification of erosion does not naturally suggest a period of abandonment. The rate and degree of erosional damage should be studied before one can speak of an occupational break. If material is weathered from a settlement mound, it will accumulate in the re-deposition area usually at the bottom of the site. Even though the archaeological finds in these layers are out of context and mixed, it may give a *terminus ante quem* for the period of erosion. During strong weathering activities, more material is deposited compared to times of little or no erosion. The same counts for the displacement of artefacts. The weight of displaced artefacts at the foot of the settlement mounds hints at the degree and level of erosion.

Fig. 2. The black, horizontal line marks an old settlement mound surface at Tell Damiyah in Jordan. Courtesy L. P. Petit.

Surface Crust and Soil Formation

A clear hallmark for a period of abatement is the presence of a compacted surface crust. Such a surface develops if a mound is subjected to long-term weathering, biogenic and geochemical processes (Butzer 1982: 90; Franken 1984: 16; A. Rosen 1986: 12; Matthews et al. 1997: 288). Erosion processes remove lighter material creating a cemented and clayey topsoil which contains small fragments of pottery, stones, and other material culture. The time that is needed to create such a crust is unknown. Levelling activities and other disturbances have removed signs of an older settlement mound surface (see, however, Fig. 2). Additionally, a surface crust is often erroneously classified as a beaten earth floor and associated with occupation rather than abandonment. The absence of associated architecture and signs of soil formation, such as burrows and root actions, are good arguments to assume it to be a natural-created surface.

Degradation of Architectural Features

Architectural structures transform constantly and an understanding of how and when they deteriorate will contribute much to the development of a refined site's history, especially when it concerns structures made of mud bricks (Friesem et al. 2011: 1136). Humidity, precipitation, soluble salts, and groundwater are disintegrating the mud brick walls continually, particularly if the walls are not maintained regularly (Torraca et al. 1972; McIntosh 1974; Carter & Pagliero 1966). It remains still extremely difficult to predict the time in between the abandonment and the final collapse of mud brick structures; ethnographic studies indicate a period of 20 years (McIntosh 1977: 187), 60 years (Friesem et al. 2011), and occasionally even 500 years (Del Bono 1999). Reasonable predictions are hampered by the limited number of studies conducted on structural decay in archaeological and ethnographic contexts (*cf.* McIntosh 1974: 158; Carter & Pagliero 1966; Gullini 1968/69; Hole et al. 1969; Friesem et al. 2011). And additionally, later disturbances, levelling activities, and weathering blur the stratigraphic situation and thus its identification (Friesem et al. 2011: 1135; 2014). It is argued here that the condition of architectural remains is, nevertheless, important for identifying occupational gaps. The archaeological fieldworker needs to investigate the remaining structural evidence thoroughly, especially its preservation (see Petit 2009: 18). Abraded wall stumps due to weathering hint at some time in between the abandonment and the deposition by sediments. If mud brick walls were reused or levelled by the succeeding occupants, the structure and debris also contain important information. Mud brick fragments in the matrix differ in size and shape. A fast destruction process causes large rectangular chunks, whereas a slow collapse reveals small rounded and abraded fragments. The latter is a sign for a longer hiatus during which the ruins slowly disintegrate. Be aware, however, that aggregates in street or courtyard deposits are often sub-rounded due to trampling (Matthews et al. 1997: 287).

Not all signs of wall degradation can be associated with occupation hiatus. Undercutting of mud brick walls, caused when rain drips from the roof or splashes while sweeping, appears as well during habitation periods (McIntosh 1974: 159, Figure 9). This additionally causes extra erosion of mud, the transportation of soluble salts within the walls, and the formation of preferential run-off channels (Carter & Pagliero 1966: 71). If the walls are not regularly re-plastered, this process will finally lead to collapse. Evidence of little or no repair, visible by extreme signs of undercutting, superficial flaking, and vertical cracks, might thus be reason to assume a period of little or no renovation activities – an occupation hiatus. Note that it is known from ethnographic studies that renovation activities may shift through the compound (McIntosh 1974: 165).

Organic Material

Organic material, for example fragile siliceous remains or phytoliths, are frequently discovered in depressions and pits at settlement mounds. Plants grow rapidly at places where moisture is available and disturbances of human or animals are relatively minor. If these organic remains are found within building units, one may suggest that it was not inhabited at that particular moment (Schiffer 1987: 228). A correct functional assignment of the different excavated units is, however, necessary, while signs of plant grow can be expected on courtyards and in pits during occupation times as well.

Natural Deposition

The formation of clay layers during incipient soil development or sand layers may point at a relatively undisturbed phase, presumably associated with abandonment. Archaeologists should carefully search for water laid deposits and wind blow material, especially found in association with degraded mud bricks (A. Rosen 1986: 5; Friesem et al. 2011: 1144).

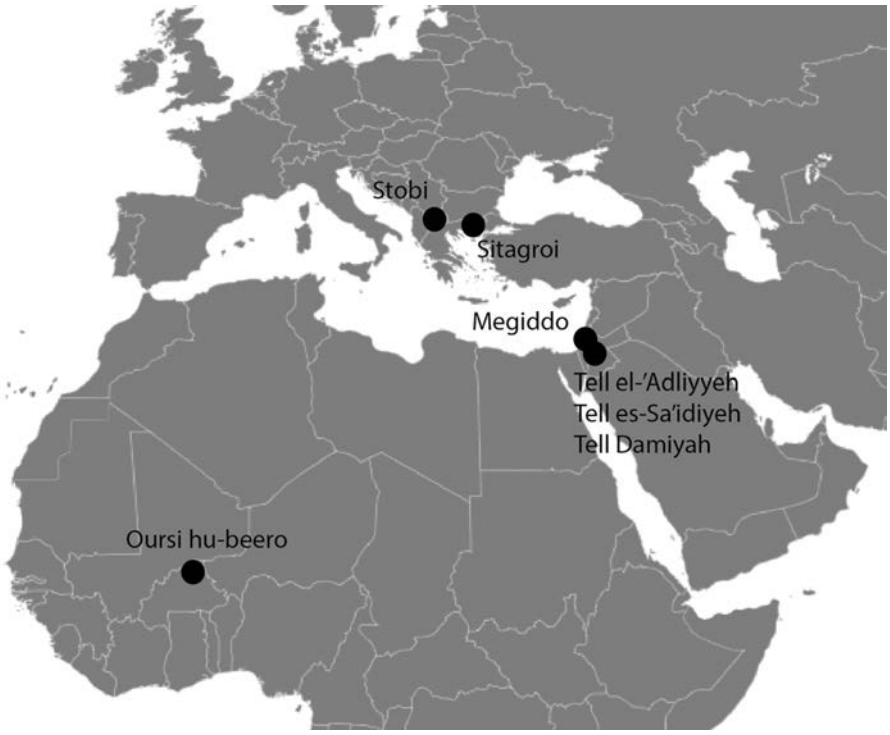

Fig. 3. Map of sites mentioned in the text.

Practical Examples

Oursi, Burkina Faso

Oursi (Fig. 3) is a small village situated in north-east Burkina Faso. The place is especially known for its picturesque location between the banks of a lake and an east-west running sand ridge. On the northern slopes of these dunes, a group of settlement mounds was found during survey work by the University of Frankfurt and the University of Ouagadougou in the 1990s. Excavations in 1997, 2000 and 2001 have revealed not only the well-preserved remains of a large pillared building (Petit et al. 2011, and references therein), but also a long occupation history from the Early Iron Age to the Middle Ages (von Czerniewicz 2004). For this study I will concentrate on a small profile south of the well-preserved remains of Oursi hu-beero (Figure 4; see also Petit & von Czerniewicz 2011).

Clearly visible are the red-burned debris layer and the architectural remains of Oursi hu-beero (Level 3). An earlier level with building remains was discovered directly underlying the burned remains and stating the existence of a long occupation history at Oursi. Interesting for this study is the yellow layer that covers the red burned remains of Level 3. It is a very well-sorted and clean layer of abraded sand without any sort of disturbance, material culture or soil development. Similar yellowish layers were seen in the large section excavated in 1997 (von Czerniewicz, pers. communication) and by geomorphological research (Albert 2011: 28). Albert has convincingly shown that it is sand from the dunes some 100 m southwest of the site transported by wind and erosion. Interesting for this study is the absence of any material in this layer, which is expected at times when people and cattle are using the settlement mounds for habitation. A fine laminated sand layer could only develop on top of the burned remains when there was a hiatus in occupation. After the total conflagration of Oursi hu-beero in the late 11th or early 12th century CE, the settlement mounds of Oursi were abandoned for a longer period of time.

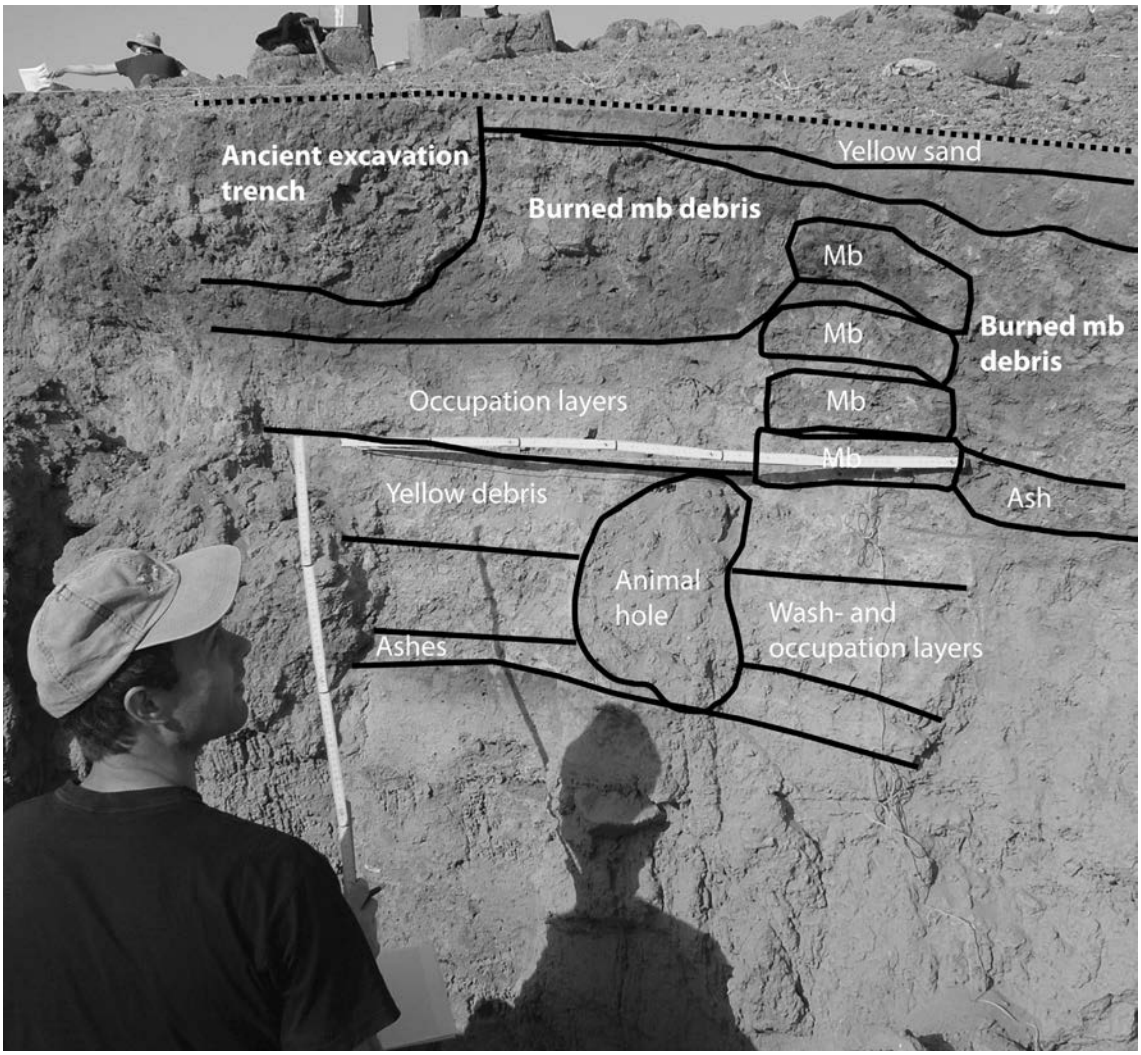

Fig. 4. Drawing of a profile at Oursi hu-beero showing wind blow material at the top. Courtesy L. P. Petit.

Tell es-Sa'idiyeh, Jordan

This prominent settlement mound is situated in the central Jordan Valley (Fig. 3). The site was first excavated by James Pritchard in the 1960s (Pritchard 1985). He was overwhelmed by its strategic location and the abundance of surface pottery from the Bronze and Iron Ages. Renewed excavations were carried out by Jonathan Tubb from the British Museum between 1985 and 1996 (Tubb et al. 1996, and references therein). Tell es-Sa'idiyeh shows twelve occupation phases dated from the Bronze Age to the Roman Period with only one short occupational gap in the 10th century BCE. This following paragraph will briefly re-interpret the transitions from stratum VII (*ca.* 825-790 BCE) to Stratum V (*ca.* 750-730 BCE).

Stratum VII reveals nine houses built upon the destruction debris of Stratum VIII. A system of streets, a drain, and a segment of the city wall were excavated. The buildings were abandoned without any sign of destruction or fire and covered with a 10 cm thick reddish silt layer (Pritchard 1985: 4, Fig. 181). Silt layers are clear indicators of little or no use. Also according to Pritchard (1985: 11), Stratum VII was abandoned which fits well with the revealed stratification. The next stratum VI (*ca.* 790-750 BCE) consists of the remains of six houses, a north-south street, and two east-west streets that meet in at right angles. Some erosion was detected by the excavators, who must be honoured for their detailed analysis of the sediments and stratigraphy (*e.g.* Pritchard 1985: 11). Buildings numbers 31 and 41 suffered natural processes, most likely after their abandonment. Except for a local destruction of room numbers 37-39, the rest of the city seems deserted at the end of Stratum VI. In Stratum V,

the houses were built upon fill that had accumulated over the floors and stubs of the walls of the previous city (Pritchard 1985: 14). The buildings are larger and more uniform in plan. A city wall had enclosed the buildings that reveal a different orientation as Stratum VI. A sudden destruction ended this occupation after which some erosion took place (*e.g.* house number 15).

The stratigraphic description differs remarkably from the occupation scheme presented by the excavators. Even though the on-site evidence points to numerous gaps, Pritchard wrote in the conclusions "… it appears that the occupation was continuous, without any major breaks, from Stratum VII through Stratum IV" (Pritchard 1985: 79). This supposedly long and continuous occupation history at Tell es-Sa'idiyeh has influenced many reconstructions. Recent excavations at sites in the direct environment of Tell es-Sa'idiyeh have stated the presence of multiple occupational gaps during the Iron Age (Kooij 2001; Petit 2009) and it is very likely that Tell es-Sa'idiyeh did see the same discontinuous occupation history.

Megiddo, Israel

The large site of Megiddo (Fig. 3), located on the southern foothills of the Jezreel Valley in modern Israel, is setting the agenda when it comes to Bronze and Iron Age reconstructions in the Southern Levant (*e.g.* Finkelstein et al. 2000, 2006, 2013). Innovative research strategies and hundreds of high-precision radiocarbon dates have produced a supposedly secure and extremely detailed occupation history. This article will focus on Stratum IVA and III, dated to *ca.* 900-650 BCE.

Stratum IVA consists of a large and solid fortification wall, some north-south oriented public buildings and several domestic units. Archaeologists have discovered signs of rebuilding and reuse pointing to a longer period of habitation. In the 8th century BCE, the city of stratum IVA was partly destroyed and abandoned for several decades before the city of Stratum III was constructed (Peersman 2000: 526; Finkelstein et al. 2006: 857). Well, that is one suggestion. According to others, the site was destroyed by the Assyrian army in 733/732 BCE and immediately afterwards rebuilt as the Neo-Assyrian provincial capital (Reich 1992: 216-218; Niemann 2006: 821). These two ideas differ in many ways, but especially in the presence or absence of an occupation hiatus.

Recent work in area H at Megiddo hints what really happened in between Stratum IVA and III. Level H-3, which is equated with Stratum IVA, is a single occupation phase consisting of small domestic structures "which produced large quantities of restorable pottery" (Joffe et al. 2000: 143; see also Singer-Avitz 2014: 123). A destruction at some of its buildings has preserved much of its inventory. The limited occupation accumulation seen during the excavation (Joffe et al. 2000) and in the profile (Petit 2006: Fig. 9.3) suggests that Level H-3 did not last very long. The next phase, Level H-2, seems to be restricted to the northern edge of the settlement mound. It contains the remains of a large rectangular building, a bread oven, and a beaten earth floor (Joffe et al. 2000: 151-152). Immediate on top of the sparse remains of Level H-2, buildings of Level H-1 were found, associated with the Assyrian city of Stratum III.

The discovery of an intermediate phase, even though local, points to some time in between Level H-3 (Stratum IVA) and Level H-1 (Stratum III). The fact that Level H-2 was not detected in other areas at Megiddo, suggests that it was a very local occupation. If the Assyrians had annexed, partly destroyed and rebuilt Megiddo in 732/722 BCE, you would not have find any occupation remains in between the two strata. The presence of Level H-2 thus changed the site-history even though it was local and patchy. But there is more evidence for an occupational gap between Stratum IVA and III. Cline (2006: 120) mentioned that in area L he discovered some activities in between Stratum IVA and Stratum III. However, he explained it as "an early effort to collect stones for the construction of the Assyrian city".

Closing Words

The macroscopic identification of occupation hiatus is crucial for understanding human ecosystems, occupation periods and site chronologies. This article is certainly not intended to create more chaos in the already complicated settlement histories. It is apparent that a gap-assignment remains often hypothetical, even with a set

of tools as defined above. The author is, however, convinced that, whatever the scale, a thorough study of the stratification may help to refine chronologies and histories throughout the world, more than thousand ^{14}C dates or unending numbers of pottery studies. The article "Mind the Gap" is dedicated to Peter Breunig whose interest in occupational gaps is visible through his inspiring and innovative theory about the Dark Millennium in West Africa (Neumann et al. 2000; Breunig & Neumann 2002). He pointed out to me that absence of evidence is as important as the many intriguing discoveries in the field. All archaeological theories and interpretations are based on human activities at a certain site or in a certain region. Is it not high time for archaeologists to focus more on what is missing in the archaeological record than what is present?

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References

Acheson, S. R. 1995. In the Wake of the Iron People: A Case for Changing Settlement Strategies among the Kunghit Haida. *Journal of the Royal Anthropological Institute* 1, 273-300.

Ascher, R. 1968. Time's Arrow and the Archaeology of a Contemporary Community. In: Chang, K. C. (ed.), *Settlement Archaeology.* National Press Books, Palo Alto, pp. 43-52.

Albert, K.-D. 2011. Geomorphodynamic Events at Oursi. In: Petit, L. P., von Czerniewicz, M. & Pelzer, C. (eds), *Oursi hu-beero. A Medieval House Complex in Burkina Faso, West Africa.* Sidestone, Leiden, pp. 23-29.

Baker, C. M. 1975. Site Abandonment and the Archaeological Record: An Empirical Case for Anticipated Return. *Arkansas Academy of Science Proceedings* 29, 10-11.

Baker, C. M. 1978. The Size-Effect: An Explanation in Variability in Surface Artefact Assemblage Content. *American Antiquity* 43 (2), 288-293.

Ben-Tor, A. 2000. Notes and News: Tel Hazor, 2000. *Israel Exploration Journal* 50, 243-249.

Breunig, P. & Neumann, K. 2002. Continuity or Discontinuity? The 1st Millennium BC-Crisis in West African Prehistory. In: Lenssen-Erz, T. et al. (eds), *Tides of the Desert. Contributions to the Archaeology and Environmental History of Africa in Honour of Rudolph Kuper*. Africa Praehistorica 14, Heinrich-Barth-Institut, Köln, pp. 491-505.

Bullard, R. G. 1970. Geological Studies in Field Archaeology. *Biblical Archaeologist* 33, 98-132.

Bullock, P., Fedoroff, N., Jongerius, A., Stoops, G. & Tursina, T. 1985. *Handbook for Soil Thin Section Description.* Waine Research Publications, Wolverhamton.

Butzer, K. W. 1982. *Archaeology as Human Ecology: Method and Theory for a Contextual Approach.* Cambridge University Press, Cambridge.

Cameron, C. M. 1996. Abandonment and Archaeological Interpretation. In: Cameron, C. M. & Tomka, S. A. (eds), *The Abandonment of Settlements and Regions. Ethnoarchaeological and Archaeological Approaches.* Cambridge University Press, Cambridge, pp. 3-10.

Cameron, C. M. 2003. A Consideration of Abandonment from Beyond Middle America. In: Inomata, T. & Webb, R. B. (eds), *The Archaeology of Settlement Abandonment in Middle America.* University of Utah Press, Salt Lake City, pp. 203-210.

Canti, M. & Huisman, D. J. 2015. Scientific Advances in Geoarchaeology during the last Twenty Years. *Journal of Archaeological Science* 56, 96-108.

Carter, T. H. & Pagliero, R. 1966. Notes on mud-brick preservation. *Sumer* 22, 65-76.

Catt, J. A. & Weir, A. H. 1976. The Study of Archaeologically Important Sediments by Petrographic Techniques. In: Davidson, D. A. & Shackley, M. L. (eds), *Geoarchaeology: Earth Science and the Past.* Duckworth, London, pp. 65-91.

Cederlund, C. O. (ed.) 2004. *Final Report of the MOSS Project.* National Board of Antiquities, Helsinki.

Cline, E. H. 2006. Area L (The 1998-2000 Seasons). In: Finkelstein, I., Ussishkin, D. & Halpern, B. (eds), *Megiddo IV. The 1998-2002 Seasons.* Monograph Series 24. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv, pp. 104-123.

Courty, M. A., Goldberg, P. & Macphail, R. I. 1989. *Soils and Micromorphology in Archaeology.* Cambridge University Press, Cambridge.

Davidson, D. A. 1973. Particle Size and Phosphate Analysis: Evidence for the Evolution of a Tell. *Archaeometry* 15, 143-152.

Deckers, K. & Fuchs, M. 2007. Introduction. *Geoarchaeology* 22 (6), 557-558.

Del Bono, E. M. 1999. *Characterization and Analysis of the Caliche Walls of the Great House, Casa Grande Ruins National Monument, Coolidge, Arizona*. Master Thesis, University of Pennsylvania, Philadelphia.

Ellis, G. L. & Waters, M. R. 1991. Cultural and Landscape Influences on Tucson Basin Hohokam Settlement. *American Anthropologist* 93, 125-137.

Eriksen, B. V. 1991. *Change and Continuity in a Prehistoric Hunter-Gatherer Society. A Study of Cultural Adaptation in Late Glacial – Early Postglacial Southeastern Germany.* Archaeologica Venatoria 12. Aarhus University Press, Aarhus.

Finkelstein, I., Ussishkin, D. & Halpern, B. (eds) 2000. *Megiddo III. The 1992-1996 Seasons.* Monograph Series 18. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv.

Finkelstein, I., Ussishkin, D. & Halpern, B. (eds) 2006. *Megiddo IV. The 1998-2002 Seasons.* Monograph Series 24. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv.

Finkelstein, I., Ussishkin, D. & Cline, E. H. (eds) 2013. *Megiddo V. The 2004-2008 Seasons.* Monograph Series 18. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv.

Folk, R. L. 1975. Geologic Urban Hindplanning: An example from a Hellenistic-Byzantine city, Stobi, Yugoslavian Macedonia. *Environmental Geology* 1, 5-22.

Franken, H. J. 1984. *De Puinhopen van het Verleden. Onderzoek naar het Wonen in de Oudheid met Behulp van Stratigrafische Analyse van Ruïneheuvels.* Palaestina Antiqua 4. J. H. Kok, Kampen.

Friesem, D., Boaretto, E., Eliyahu-Behar, A. & Shahack-Gross, R. 2011. Degradation of Mud Brick Houses in and Arid Environment: A Geoarchaeological Model. *Journal of Archaeological Science* 38, 1135-1147.

Friesem, D. E., Karkanas, P., Tsartsidou, G. & Shahack-Gross, R. 2014. Sedimentary Processes involved in Mud Brick Degradation in Temperate Environments: A Micromorphological Approach in an Ethnoarchaeological Context in Northern Greece. *Journal of Archaeological Science* 41, 556-567.

Gasche, H. & Tunca, Ö. 1983. Guide to Archaeostratigraphic Classification and Terminology: Definitions and Principles. *Journal of Field Archaeology* 10, 325-335.

Gé, M. A., Matthews, W. & Wattez, J. 1993. Sedimentary Formation Processes of Occupation Surfaces. In: Petraglian, M. D. & Goldberg, P. (eds), *Formation Processes in Archaeological Context*. Monographs in World Archaeology 17. Prehistory Press, Madison, pp. 149-163.

Goldberg, P. 1979. Micromorphology of Pech de l'Aze II Sediments. *Journal of Archaeological Science* 6, 17-47.

Goldberg, P. 1983. Applications of Micromophology in Archaeology. In: P. Bullock & Murphy, C. P. (eds), *Soil Micromophology*. A. B. Academic Publishers, Berkhamsted, pp. 139-150.

Goodman-Elgar, M. 2008. The Devolution of Mudbrick: Ethnoarchaeology of Abandoned Earthen Dwellings in the Bolivian Andes. *Journal of Archaeological Science* 35, 3057-3071.

Gullini, G. 1968/69. Contributions to the study of the preservation of mud-brick structures. *Mesopotamia* 3/4, 443-473.

Hassan, F. A. 1978. Sediments in Archaeology: Methods and Implications for Palaeoenvironmental and Cultural Analysis. *Journal of Field Archaeology* 5, 197-213.

Herzog, Z. 2002. The Fortress Mound at Tel Arad. An Interim Report. *Tel Aviv* 29 (1), 3-109.

Hole, F., Flannery, K. V. & Neely, J. A. 1969. Prehistory and Human Ecology of the Deh Luran Plain. *Memoirs of the Museum of Anthropology, University of Michigan*, 1, 23-28, 73.

Joffe, A. H., Cline, E. H. & Lipschitz, O. 2000. Area H. In: Finkelstein, I., Ussishkin, D. & Halpern, B. (eds), *Megiddo III. The 1992-1996 Seasons*. Monograph Series 18. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv, pp. 140-160.

Kempinski, A. 1989. *Megiddo: A City State and Royal Centre in North Israel.* C. H. Beck, München.

Kooij, G. van der 2001. The Vicissitudes of Life at Dayr 'Alla during the First Millenium BC, Seen in a Wider Context. *Studies in the History and Archaeology of Jordan* VII, 295-303.

Koulidou, S. 1998. *Depositional Patterns in Abandoned Modern Mud-Brick Structures.* M. Sc. Thesis, University of Sheffield.

Matthews, W. & Postgate, J. N. 1994. The imprint of living in an Early Mesopotamian City: questions and answers. In: Luff, R. & Rowley-Conwy, P. (eds), *Whither Environmental Archaeology*. Oxbow Monograph 38. Oxford, Oxbow, pp. 171-212.

Matthews, W., French, C., Lawrence, T. & Cutler, D. 1996. Multiple surfaces: the micromorphology. In: Hodder, I. (ed.), *On the Surface: Catalhoyuk 1993-95.* The MacDonacld Institute for Research and British Institute of Archaeology of Ankara, Cambridge, pp. 301-342.

Matthews, W., French, C. A. I., Lawrence, T., Cutler, D. F. & Jones, M. K. 1997. Microstratigraphic traces of site formation processes and human activities. *World Archaeology* 29 (2), 281-308.

McIntosh, R. J. 1974. Archaeology and Mud Wall Decay in a West African Village. *World Archaeology* 6 (2), 154-171.

McIntosh, R. J. 1977. The Excavation of Mud Structures: An Experiment from West Africa. *World Archaeology* 9 (2), 185-199.

Namdar, D., Zukerman, A., Maeir, A. M., Katz, J. C., Cabanes, D., Trueman, C., Shahack-Gross, R. & S. Weiner, S. 2011. The 9th century BCE destruction layer at Tell es-Safi/Gath, Israel: integrating macro- and microarchaeology. *Journal of Archaeological Science* 38 (12), 3471-3482.

Neumann, K., Breunig, P. & Kahlheber, S. 2000. Early Food Production in the Sahel of Burkina Faso. *Bericht des Sonderforschungsbereichs* 268, Band 14, 327-334.

Niemann, H. M. 2006. Core Israel in the Highlands and its Periphery: Megiddo, the Jezreel Valley and the Galilee in the 11th to 8th Centuries BCE. In: Finkelstein, I., Ussishkin, D. & Halpern, B. (eds), *Megiddo IV. The 1998-2002 Seasons.* Monograph Series 24. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv, pp. 821-842.

Pascoe, D. 2012. Samuel Pepy's navy preserved in situ? *Conservation and Management of Archaeological Sites* 14, 182-192.

Peersman, J. 2000. Assyrian Magiddu: The Town Planning of Stratum III. In: Finkelstein, I., Ussishkin, D. & Halpern, B. (eds), *Megiddo III. The 1992-1996 Seasons*. Monograph Series 18. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv, pp. 524-534.

Petit, L. P. 2006. The 1998 Season (Level H-4). In: Finkelstein, I., Ussishkin, D. & Halpern, B. (eds), *Megiddo IV. The 1998-2002 Seasons*. Monograph Series 24. Tel Aviv University, Sonia and Marco Nadler Institute of Archaeology, Tel Aviv, pp. 130-136.

Petit, L. P. 2009. *Settlement Dynamics in the Middle Jordan Valley during Iron Age II*. BAR International Series 2033. Archaeopress, Oxford.

Petit, L. P. & von Czerniewicz, M. 2011. Stratigraphical Setting. In: Petit, L. P., von Czerniewicz, M. & Pelzer, C. (eds), *Oursi hubeero. A Medieval House Complex in Burkina Faso, West Africa*. Sidestone, Leiden, pp. 35-41.

Petit, L. P., von Czerniewicz, M. & Pelzer, C. (eds) 2011. *Oursi hu-beero. A Medieval House Complex in Burkina Faso, West Africa*. Sidestone, Leiden.

Pritchard, J. B. 1985. *Tell es-Sa'idiyeh: Excavations on the Tell 1964-1966*. Pennsylvania University Monograph 60. University Museum, Philadelphia.

Reich, R. 1992. Palaces and Residences in the Iron Age. In: Kempinski, A. & Reich, R. (eds), *The Architecture of Ancient Israel*. Jerusalem, pp. 202-222.

Reid, J. J. 1973. *Growth and Response to Stress at Grasshopper Pueblo, Arizona.* University Microfilms, Ann Arbor.

Rosen, A. M. 1986. *Cities of Clay. The Geoarchaeology of Tells*. Prehistoric Archaeology and Ecology Series, The University of Chicago Press, Chicago and London.

Rosen, S. A. 2000. The Decline of Desert Agriculture: A View from the Classical Period Negev. In: Baker, G. & Gilbertson, D. (eds), *The Archaeology of Drylands. Living at the Margin*. Routledge, London, pp. 45-62.

Schiffer, M. B. 1972. Archaeological Context and Systemic Context. *American Antiquity* 37, 156-165.

Schiffer, M. B. 1976. *Behavioral Archaeology.* Academic Press, New York.

Schiffer, M. B. 1987. *Formation Processes of the Archaeological Record.* University of New Mexico Press, Albuquerque.

Shahack-Gross, R., Albert, R.-M., Gilboa, A., Nagar-Hilman, O., Sharon, I. & Weiner, S. 2005. Geoarchaeology in an Urban Context: The uses of space in a Phoenician monumental building at Tel Dor (Israel). *Journal of Archaeological Science* 32 (9), 1417-1431.

Singer-Avitz, L. 2014. The Pottery of Megiddo Stratum III-II and a Proposed Subdivision of the Iron IIC Period in Northern Israel. *Bulletin of the American Schools of Oriental Research* 372, 123-145.

Sjöberg, A. 1976. Phosphate Analysis of Anthropic Soils. *Journal of Field Archaeology* 3 (4), 447-454.

Stevenson, M. G. 1982. Toward an Understanding of Site Abandonment Behavior: Evidence from Historic Mining Camps in Southwest Yukon. *Journal of Anthropological Archaeology* 1, 237-265.

Strahler, A. H. & Strahler, A. 2006. *Introducing Physical Geography*. John Wiley and Sons Ltd, New York.

Torraca, G., Chiari, G. & Gullini, G. 1972. Report on Mudbrick Preservation. *Mesopotamia* 7, 259-286.

Trigger, B. G. 1968. The Determinants of Settlement Patterns. In: Chang, K. C. (ed.), *Settlement Archaeology*. National Press Book, Palo Alto, pp. 53-78.

Tubb, J., Dorrell, P. & Cobbing, F. 1996. Interim Report on the Eight (1995) Season of Excavations at Tell es-Sa'idiyeh. *Palestine Exploration Quarterly* 125, 51-74.

von Czerniewicz, M. 2004. *Studien zur Chronologie der Eisenzeit in der Sahel von Burkina Faso/Westafrika*. PhD Dissertation, Frankfurt University.

Weiss, H., Courty, M.-A., Wetterstrom, W., Gouichard, F., Senior, L., Meadow, R. & Curnow, A. 1993. The Genesis and Collapse of Third Millennium North Mesopotamian Civilization. *Science* 261, 994-1004.

Wilshusen, R. H. 1986. The Relationship between Abandonment Mode and Ritual Use of Pueblo I Anasazi Protokivas. *Journal of Field Archaeology* 13, 245-254.

Yaalon, D. H. 1963. On the Origin and Accumulation of Salts in Groundwater and in Soils in Israel. *Bulletin of the Research Council of Israel* 11G, 105-131.

Zuckerman, S. 2007. Anatomy of a Destruction: Crisis Architecture, Termination Rituals and the Fall of Canaanite Hazor. *Journal of Mediterranean Archaeology* 20 (1), 3-32.