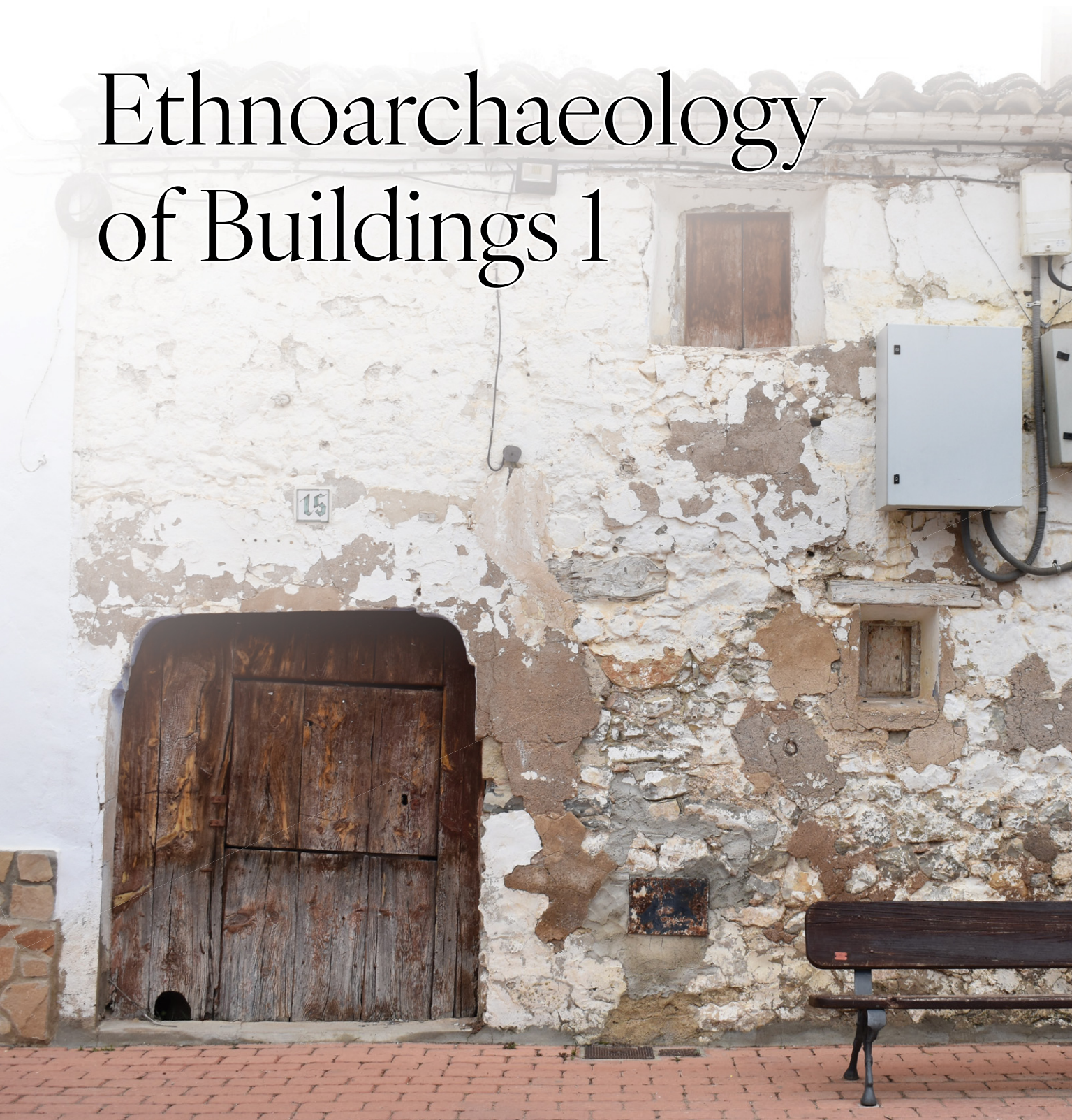


Ethnoarchaeology of Buildings 1



Edited by
María Pastor Quiles



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Ethnoarchaeology of buildings as a method for understanding and valuing earthen building cultures

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Ethnoarchaeology of buildings: Introductory notes on the global research landscape

María Pastor Quiles

Ethnoarchaeology ‘looks at contemporary societies with archaeological eyes and with archaeological questions in mind’ (Politis 2015: 69). Its focus is on living and contemporary societies and their material culture, especially the traditional and non-industrial aspects product of their daily lives, including buildings.

Ethnoarchaeology is a field of inquiry subjected to substantial theoretical development (e.g. Ascher 1962; Anderson 1969; David and Kramer 2001; Gallay *et al.* 1992; Gándara 1990; Gould 1978; Hodder 1982; Kramer 1979) and debate (see Chirikure 2016; Cunningham and MacEachern 2016; González-Ruibal 2016; Gosselain 2016; Roux 2007; Lyons and David 2019), and it also has its own history regarding the study of buildings.

In 1974, Roderick McIntosh published a paper in the journal *World Archaeology* emphasising the importance of addressing the processes of building and decay associated with contemporary mud walls to better analyse and interpret the archaeological record, based on the study of a modern dwelling in Begho, Ghana. Years later, in 1982, Carol Kramer’s book *Village Ethnoarchaeology. Rural Iran in Archaeological perspective* came to light. In 1985, Helga Seeden published, also in *World Archaeology*, ‘Aspects of Prehistory in the Present World: Observations Gathered in Syrian Villages from 1980 to 1985’. Other examples which also date back to the eighties and tackle Western Asian sites are the ethnoarchaeological works of Olivier Aurenche and collaborators (1983, 1984). At the same time, Anne-Marie and Pierre Pétrequin wrote an ethnoarchaeological study focused on Beninese buildings (1984), and in 1985, E. Kofi Agorsah published ‘Archaeological implications of traditional house construction among the Nchumuru of Northern Ghana’ in *Current Anthropology*.

Since these foundational works, others have followed, discussing contexts all around the globe up to the present day. In different territories of Africa, a continent central to this research tradition, studies have addressed organic and rarely preserved building components (Fleisher and LaViolette 1999), processes of degradation in earthen construction (Baloi 2001), uses of domestic space (Oluwole Ogundele 2005) and power, as well as gender relations connected to buildings (Lyons 2007, 2009), cooking installations and fuels (Portillo *et al.* 2016), the configuration of spaces for varied daily activities—from using the toilet to burying their dead and accommodating their animals (Calvo *et al.* 2017)—and specific earth construction techniques understood in depth (Pelmoine 2022). Some ethnoarchaeological studies that address architectural features arise from projects that were not primarily directed towards the study of buildings (e.g. Altamura *et al.* 2017; Anderson and Ahmed 2010), while others focus specifically on traditional architecture (Guddah 2019).

Research has been carried out as well, examining different architectural techniques and with different methodologies, in European lands (e.g. Brocato and Galluccio 2001; Peinetti 2016; Shaffer 2021) and on various islands, from the Mediterranean (Gkouma *et al.* 2022) to Iceland (Milek 2012). In Asia (Adams 2019; Talving-Loza 2019) and America (Hernández 2007; Moore 2017; Moore and Gasco 1990; Zeidler 1983), studies have also covered diverse categories of buildings and explored the contributions to

archaeology of studying recent and present-day construction features. These studies have addressed not only buildings—many of which are made with earth, a widespread natural resource commonly used for construction—, but also built installations designed for different activities and purposes.

Despite what these examples may convey, architecture and building activities have not been a primary focus of ethnoarchaeological research, as it has been noted before (e.g. González-Ruibal 2001). And there is still much to be pursued, documented and assessed in terms of its implications for archaeological practice concerning how the observation of recent and present-day built structures and associated spaces can contribute to generating knowledge of the human past.

To try to contribute to advancing in this direction is what motivated the initiative materialised in this book, the result of the International Seminar ‘Ethnoarchaeology of Buildings. How can it help the study of the past?’, held on November 20–21, 2023. This event arose from the interest of someone who works on the study of millennia-old earthen building remains and looks at contemporary building practices and their materiality, seeking help to better understand the archaeological ones, much older, less preserved and, sometimes, almost completely lost.

The present publication brings together studies by different specialists who have worked on this topic first-hand, and in very diverse geographical contexts, from North (Morocco, Egypt) and East Africa (Ethiopia) to Central America (Mexico), Amazonia (Ecuador, French Guiana), the Andes (Argentina) and territories across Europe (Germany, Spain) and Asia (Turkey, Turkmenistan).

These chapters show a diversity of approaches, strategies and methodologies in action (historical written sources, iconography, terminology, interviews, technical tests, microscopic analyses), demonstrating the different ways in which the ethnoarchaeological perspective on buildings contributes to shortening the distance between the past and the present, leading towards better and more complete archaeological interpretations. They offer in-depth reflections for the archaeological study of past communities regarding material culture and the historical development of building traits and patterns, as well as the intangible aspects that surround buildings. There is a focus on main architectural features, from roofs to walls, but also on combustion and storage installations, as well as activity areas and their dynamics. The importance and value of the community knowledge involved in building are highlighted, reflecting traditions and combining creativity with technical expertise. Throughout these pages, there are also important insights into built heritage conservation and sustainability, showing that even though the ethnoarchaeology of buildings looks into the here and now for a better understanding of past societies, it is equally and strongly connected to the present and the future.

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Ethnoarchaeology of domestic buildings in Egypt: A tool for the knowledge of the past and the present

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Abstract

The aim of this chapter is to highlight the importance of the cultural meanings and symbols associated with earth as a building material. Ethnoarchaeology has proven to be an essential tool for exploring this relationship and the ways in which it can be materialised in certain architectural choices. The contribution of this chapter is twofold. Firstly, it seeks to showcase the symbolism associated with earth across different cultures and expressed through traditions and language. Secondly, it presents a summary of the most important variables at play in architectural choices and features in earth and plant-based domestic constructions. These variables were extracted from an ethnoarchaeological study carried out in three areas of Egypt: Lower Egypt (Gharbeya and Kafr el-Sheikh provinces), Upper Egypt (Luxor and Qena) and the Dakhleh Oasis. By highlighting the cultural and social influences and the many dimensions of earthen architecture, this chapter aims to offer interpretative guidelines for archaeologists working with these structures.

Key words: Mud, mudbrick, houses, anthropology, surveying

1. Anthropological remarks regarding earth

When approaching the topic of domestic building with earth or plant-based materials, a pertinent question is what led, and still leads, people to build with mud or raw earth.

Practicality is an obvious factor, as earth, reeds and/or tree trunks can be materials locally sourced that do not necessarily require considerable transport or incur an extra cost, and that are often processed in situ. These are, of course, the same reasons that make natural materials sustainable and recommendable in the present and what explains their suitability as an alternative option to current polluting and costly building choices.

In addition to practical aspects, there are a series of cultural dimensions associated with earth which deserve further consideration. Such is their importance that a conceptual issue that can be reflected upon to begin with is whether it is the relevance of mud as a material that prompted a series of beliefs central to certain societies or if, conversely, the cultural importance of earth favoured, or at the very least encouraged, its use for construction and beyond.

There are certainly universal factors which, albeit potentially expressed in different ways, can help us interpret buildings and, by extension, buildings in the past. Ethnoarchaeology clearly provides the methods required for this kind of study, as it places the cultural dimensions of materials at the centre of the research.

2. Practicality of the use of earth and plant-based materials

The practical advantages of using earth as a construction material have been extensively highlighted. Its ability to help achieve a pleasant temperature, whether in hot or cold weather, is well known (provided that the material properties are mastered and the construction methods properly applied). In addition,

its immediate availability, as has already been mentioned, makes it highly convenient. Most importantly, earth provides flexibility of construction not only in the long but also in the medium and short term, adapting to the owners' needs and allowing cost-effective changes.

In agricultural societies, the land itself and the tasks associated with working it greatly condition daily activities. It is therefore fitting that earth provides the malleability needed to easily adapt living spaces to seasonal requirements.

However, these materials go beyond practical considerations to acquire deeper meanings profoundly embedded in societal beliefs.

3. Meanings associated with earth across cultures

The connection between the physicality of earth and the symbolic aspects of the land is apparent across world cultures.

This connection is clearly reflected in the language, with multiple expressions conveying this mental association. Speakers of some languages, such as Spanish, specifically refer to the land when expressing a longing for home (*'echo de menos mi tierra'* translates as 'I miss my land'). The English 'home turf' also builds on the idea of soil as an embodiment of a place, perhaps going further in evoking the exact qualities of the soil. Even within the same language, this attachment can be verbalised differently by various groups; in Ireland, for example, the expression 'the auld sod' is used to refer to the homeland (Correas-Amador 2022).

The importance of this connection is such that it has warranted its survival in language even in areas where the practices of building with earth and plant-based materials are long gone.

In fact, the careful analysis of ancient sources supports the long-standing importance of this association. In the case of ancient Egypt, this is exemplified by the *Tale of Sinuhe*, whose oldest copies date from 1900–1700 BC. Tales such as this one were copied time and again by scribes with a view to imparting a particular moral. This tale in particular recounts the story of a palace worker who is forced to leave Egypt after the pharaoh is assassinated. After a long period of time, he expresses his wish to the pharaoh to return to his home country. The story is told by Sinuhe after his death, and in it, he highlights the importance of dying in the homeland and of completing the complex set of rites which the ancient Egyptians believed were needed to successfully go on to the afterlife.

Sinuhe's reaction upon hearing that his request has been granted and that he is able to return to Egypt strongly demonstrates the depth of the link between the idea and the physical reality of the land (Parkinson 1997: 289):

It [the royal letter] was read to me and I prostrated myself / I touched the earth / and scattered it on my hair.

Sinuhe's first reaction prompted by joy is to touch the ground in gratitude. He further expresses his elation by throwing earth over his head. This scene thoroughly demonstrates that the land is the earth and that its proximity is a cause of rejoicing.

This idea is also strongly associated with the idea of community. Being an integral part of a society is a fundamental need expressed across cultures. Not without reason, Greek tragedies describe forced exile as the worst punishment that could be given to a citizen (Patsalidis 2011).

The importance of physically being in touch with the earth to maintain links with the community is also exemplified by the Luo people, a Nilotic ethnic group living in Kenya and Tanzania. Their women and children traditionally eat earth as a manner of showing compliance with their role in society and to maintain their place in the community (Wenzel Geisser 2000).

Ingesting as a means of acquiring the inherent properties of that which is ingested is an extensive practice in many historical cultures across the globe (Correas-Amador 2013a).

Skin contact can also be a means of acquiring these properties. The Luo people secure the connection of their group members with the community by rubbing native soil on those who are departing from their homeland. The importance of this link is also highlighted by the tradition of gifting bags of soil when visiting relatives who have moved away to, for example, pursue their studies (Wenzel Geisser 2000).

This strong symbolic dimension cannot be separated from materiality when looking at earthen domestic structures. With this outlook in mind, the following section presents an ethnoarchaeological study of mudbrick houses carried out in Egypt specifically.

4. Methodology and geographical span of data

The goal of the study described here was to apply contextual and material property information to a thorough understanding of modern mudbrick homes in each of the selected areas. The analysis of the effects of specific contextual and material relations on architectural elements, distribution and space use in modern homes was intended to yield this knowledge. A limited number of published and unpublished sources (Castel 1984; de Filippi 2006; Eigner 1984; Henein 1988; Hivernel 1996; Hug 1930; Lozach 1930; Schijns 2008; Simpson 2008; Hassan Fathy's personal collection (RBSCL-AUC)) as well as individual fieldwork were used to gather these data. Architectural surveys and observations, picture documentation and interviews with house builders and owners were conducted throughout individual fieldwork.

The previously described categories were used to separate the data that were gathered regarding architectural elements. The materials typically used and the variances discovered were reported for each feature. To aid in summarising and comparing the three areas—Lower Egypt, Upper Egypt and Dakhleh Oasis—this data analysis procedure was carried out for each of the three. Following a description of each of the areas, the data about internal and external features were presented comparatively.

The primary activities that were frequently observed in the sample and in the literature under review were identified; these included storage, areas for animals, cooking, sleeping, social interaction and other activities. The first three of these activities had particular archaeological significance. These categories allowed for the synthesis of data regarding the distribution and use of space. For each of the three geographic regions—Lower Egypt, Upper Egypt and Dakhleh Oasis—a description of these activity zones was produced. Following this, the similarities and differences between the three places for each type of activity were synthesised, with a particular emphasis on the rooms' location, access and roofing.

This was done to isolate any potential linkages between rooms that would be relevant to archaeology and to identify prospective places that may have supported a storey above. The information gathered from surveys and observations was supplemented by the interviews, which were processed in comparison with those conducted in other locations. The surveys were analysed through the creation of sections and plans (AutoCAD drawings).

The same process was used to analyse and interpret data from contemporary mudbrick homes before being applied to a number of archaeological house remains. The primary criterion for choosing

archaeological sites was the provision of a diverse sample, both geographically and chronologically (to enable the investigation of the environment as a contextual factor). This meant that locations were selected from the Old Kingdom (2686–2160 BC) to the Third Intermediate Period (1069–664 BC); a deliberate attempt was made to select locations with disparate natural circumstances (Nile Delta or valley). The specific sites involved can be found in Correas-Amador 2013b (volume II: 11).

Each archaeological site was subjected to the same techniques used for the modern sample, which involved analysing each group of dwellings in accordance with their surroundings and the materials discovered within them (see Correas-Amador 2013b: tables 4.1 to 4.29). To facilitate the comparison, features were condensed into tables. Subsequently, each feature was evaluated, consolidating data from every site and emphasising the parallels and divergences among them.

To enable a comparison of size and shape with respect to the estimated residential area, environmental considerations, social considerations, planned vs. organic settlements (community circumstances) and chronological considerations, the distribution of house space within each settlement was arranged in a series of tables. The net room and total areas of each property were determined in order to make the comparison easier. The house areas were then split into four groups: less than 50 m², 50–100 m², 100–200 m² and over 200 m².

The categories used for the modern sample—storage, animal keeping, cooking, sleeping, social contact and others—were used to analyse how space was used. All evidence of these behaviours discovered at each location was gathered and examined in light of the contemporary sample. An interpretative tool was created as a result of this analysis to show possible relationships between context, architectural aspects, materials and space, in order to provide a new array of interpretative options as well as to question some of the links that earlier interpretations took for granted.

The full interpretative tool is available in an offline interactive PDF format from the author. The following sections will focus only on the variables that were identified as being relevant and their characteristics.

5. Summary of variables identified in the study

5.1. Environmental variables

The following were listed as potential elements that could affect the different architectural features: climate, land availability, hydrography and flood, and settlement/site.

An examination of 20th-century modern mudbrick homes revealed a connection between the location of settlements and the recurrence of long or dense homes. This appeared to be the case in the archaeological sample that was examined as well, where a greater number of smaller buildings featured in mound locations (Correas-Amador 2013b: table 4.26). In general, the internal distribution of sites has been impacted by the movements and annual flood of the Nile, which have proven to be significant throughout history. To be more precise, the house's placement in relation to a river or a desert affects the type of soil, sediment or clay that was used to build it, which in turn affects the brick's colour and consistency. Last but not least, the effects of wind, sun and rain have always had an impact on houses throughout history; this is especially true with organic architecture. Finally, research on contemporary Egyptian mudbrick homes from the 20th century also suggested that the distribution of the homes was influenced by the availability of land. In actuality, the usable land area has been proposed as the cause of the enlarged dwellings in Amarna in the past (Fairman 1949: 42). However, the examination of the archaeological sample used in this study revealed that, while the settlement area may or may not be influenced by the specific land available on the site, it may have an impact on the distribution and design of homes.

5.2. Physical factors

Through an analysis of contemporary mudbrick homes, the following processes were found to alter the physical attributes of the home: collapse, recycling, lateral cycling, maintenance/repairs and secondary use. These variables were derived from two sources: an ethnographic study of processes within earthen buildings (see, for example, Van Beek and Van Beek 2008: 36) and the application of artefact processes (David and Kramer 2001: 93 based on Schiffer 1976: 27–41) to buildings.

Because mudbrick is an organic building material that is easily impacted by weather, frequent maintenance is necessary if permanent damage to the structure is to be avoided.

For this reason, it is quite likely that the processes described for modern dwellings also happened in ancient houses. Both short-term and long-term maintenance procedures can be performed. Examples of medium- to long-term maintenance include annual wall replastering and roof repairs; examples of short-term maintenance include sweeping and routine daily cleaning.



Figure 1. A mud column holds up a canopy and is repurposed as a container in certain times of the year (Kom el Byat, Lower Egypt).
Photograph by the author.

Certain components, like roofs, upper storeys and staircases, are susceptible to collapse in the medium term if regular maintenance is not performed, as noted in the examination of contemporary mudbrick homes.

Because mud is an organic building material, it may be recycled repeatedly into different features, such as storage containers, to meet changing needs—for example, seasonal ones (Figure 1). This process is known as recycling. In the course of maintenance, loose materials may also be absorbed into specific features through a technique known as passive recycling (McIntosh 1974 cited in David and Kramer 2001).

According to David and Kramer (2001: 93), ‘lateral cycling’ is one of the processes that some artefacts go through. This idea was used in this study to describe a process that takes place in mudbrick structures in which a feature remains functional but is utilised by a different person; repurposed lintels, for instance, are found in the archaeological sample.

A feature acquired a purpose other than that for which it was made through ‘secondary use’, which was also first described for objects by David and Kramer (2001: 93). An example of this process was seen in the modern sample, where stone fragments from neighbouring archaeological sites were frequently repurposed as lintels, steps, etc.

5.3. Cultural and social factors

These were described as follows: internal social variables, external changes, tradition, superstition/religious beliefs, local idiosyncrasy/produce, cultural meanings, class-specific cultural variables and ethnicity.

Social factors include both internal changes that take place within the home and exterior changes in how the community views the members of the household. Castel (1984) showed that internal family structure changes, such as children being born, moving out or including extended relatives, can directly affect the allocation of houses. For instance, a census conducted in the ancient city of Kahun revealed shifts in the composition of households over time, providing evidence for such shifts in internal family structure (Kemp 2006: 221).

Furthermore, how other community members view a household affects its status, which in turn affects architectural aspects; changes in this status are also likely to have an impact on variations in characteristics. Castel (1984: 133), for instance, records the adjustments made to the door location after the owner was named the village mayor.

Tradition is an essential component of vernacular architecture. During fieldwork interviews, this aspect—building competence passed down from generation to generation—was particularly mentioned. Furthermore, some architectural elements may also be a reflection of specific regional customs and businesses, representing idiosyncrasy/produce. For instance, the architecture of Naqada, Upper Egypt, was influenced by the city’s renowned pottery industry (Figure 2).

Certain architectural aspects can also be the result of other specific properties of a place, such as the existence of a certain type of rock; this was seen in the case of the ancient city of Elephantine, where red granite was widely available and used in unique wall protection plaques (von Pilgrim 1996: 77).

The existence and, in particular, the placement of specific home features can also be influenced by other cultural characteristics like superstition and religious convictions. This was exemplified in the modern sample by white plates that were placed over doorways to protect against bad luck. Similar to this,



Figure 2. The entrance to the city of Naqada (Upper Egypt), with walls made of its famous pots.
Photograph by the author.

Castel (1984: 133) described a case in which a door, which was believed to be affected by the evil eye, was moved after a small child died.

We are aware of the importance of religious beliefs in ancient Egyptian history and have particular instances of their use in a home setting, such as in Deir el-Medina (Weiss 2009). This suggests that we might be unaware of other superstitions or beliefs influencing architectural elements, mirroring the modern ones described.

All things considered, cultural meanings are best understood within the specific context in which they are formed. While some of these meanings may have been uncovered by combining the study of ancient Egyptian texts with iconography, much more research is necessary to fully understand the meanings that residential architecture expresses.

For instance, the study of the archaeological sample suggests that certain cultural factors may be restricted to particular socioeconomic classes.

Finally, as has been noted in both ancient and modern homes, ethnicity may influence the usage of specific motifs.

5.4. Community and personal factors

These were determined to be occupation, financial means, personal preference and food distribution/supply.

Community variables are basically the way the settlement was organised overall, including how food was distributed and supplied. This would have had an impact on the existence of certain features, most notably storage-related ones like bins, pottery and ground holes.

In archaeology, the importance of financial considerations has occasionally been exaggerated; thus, certain important disclaimers must be made. According to an examination of contemporary mudbrick homes, most households showed the same characteristics, with the only possible differences between the richest and poorest groups being the quality and level of elaboration of the features; no difference in the presence or lack of features was observed in the other categories. Furthermore, it is worth emphasising that research on contemporary materials has demonstrated that, ultimately, the details of certain architectural elements are a matter of personal choice, as was often repeated during the interviews ('I did it the way that suited me' (Figure 3)); this could have also been the case in ancient homes. This is obviously not very beneficial for archaeological synthesis, but it is a factor that needs to be taken into account, nonetheless. The expeditious implementation of distribution modifications,



Figure 3. A staircase made of a trunk, in a technique already recorded at the site of Amarna in the 16th century BC (Dendera, Upper Egypt). Photograph by the author.

even in state-planned settlements, serves as evidence of the significance of individual preference. For instance, the degree to which security-related measures are included also reflects personal preference.

Finally, the archaeological sample raises the possibility of a relationship between some aspects of the home and the occupant's job, although in specific circumstances, such as rural settings, it can be particularly challenging to differentiate between work and other regular household activities.

5.5. Space alterations

These were classified as gender, public/private sections, room distribution, access, room use/wear and function/use.

Numerous factors, including cultural and environmental ones, can affect how rooms are distributed, particularly insofar as distribution affects ventilation. As a result, adjustments can be a reaction to shifts in these parameters. This is also true for access alterations, which include either blocking or making openings and are a typical procedure in mudbrick homes (Figure 4).

Additionally, specific markers can be used to identify the kind of activities that take place in a room as well as the volume of traffic that passes through it. Among the most significant advances in spatial research is the contrast between function and use, which is evident in modern mudbrick buildings. It is crucial to remember that, even though a room may have been initially intended for a specific purpose, this purpose typically changes over time—not just over an extended length of time, but also at various times of the day and year. As a result, some rooms lose their ability to serve as bedrooms or for other typical purposes and are instead converted into storage or animal housing spaces (Figure 5).



Figure 4. A former window has been blocked to allow less sun in and control ventilation (Buto, Lower Egypt). Photograph by the author.



Figure 5. Former stables now used for occasional sleeping and storage in a nearly abandoned house (Kom el Byat, Lower Egypt). Photograph by the author.

Another significant aspect affecting the distribution of rooms is the differentiation based on gender or with respect to public and private areas. However, even though house interpretation frequently emphasises these elements, it is crucial to investigate the degree of their physical reflection. For instance, the analysis of the contemporary material revealed that the presence of non-household individuals had a significant impact on the locations where men and women performed specific tasks. Activities shifted when this presence vanished; however, this was only seen through activity analysis and had no tangible effect on the layout of the house. As was previously noted, the ethnoarchaeological study defined these activity areas.

Rather than analysing buildings by room, there was a focus on activities, aside from courtyards, which were specifically chosen because of the range of activities that take place there and due to their recurrence in earlier archaeological interpretations.

5.6. Individual house characteristics

These were determined to be the secondary role, orientation, surroundings and structure. It became evident that specific elements, like ovens, have specific locations and that the execution of certain tasks is significantly impacted by house orientation, which affects the areas that receive sunlight and the times of day that this happens (Figure 6). At least in some instances, this association was evident in the archaeological sample.

Thus, orientation may have an impact on light and ventilation, which may then have an impact on other aspects of the home, such as temperature. However, these circumstances can be altered by the



Figure 6. An oven shared by different families sheltered from the wind with the help of temporary structures (Surad, Lower Egypt). Photograph by the author.

presence of and changes to different kinds of openings, as was previously shown. The number of floors was another element that would have affected temperature and ventilation; however, it is challenging to determine this from the archaeological record.

Roof terraces were by far the most typical configuration for multi-storey homes in the modern sample. Such a setup could clarify some features in depictions of houses in art for which there is no surviving archaeological evidence. Finally, during the examination of the archaeological remains, it was hypothesised that, in addition to serving as a living space, residences may have had a secondary function related to the occupants' jobs. However, more investigation would be required to validate this regard.

5.7. Archaeological variables

When assessing the causes of the presence or absence of architectural elements, in addition to all other factors, deposit formation, inconclusive remains and the action of the elements should be taken into account. Given the organic character of mudbrick homes, which implies they are both easily altered and rapidly decayable, it is obvious that excavation can result in unique issues. For instance, the thick layers of deposits left behind by ongoing building maintenance may be misinterpreted as evidence of extended occupancy. It is also difficult to distinguish between a room's contents, its collapsed roof, and any structures above it (Figure 7).

Sometimes, remnants of various features can be difficult to identify; for instance, walls can be mistaken for roof and ceiling fragments, and vice versa; ceiling beams can also be misidentified as hardwood beams that are utilised as structural support in walls, such as those seen in modern homes, as rot typically severely damages their initial length and diameter. In certain situations, these erosion processes can even result in the complete disappearance of particular elements, like mudbricks. They can also change



Figure 7. A collapsed first floor has created a courtyard where now animals are kept (Kom el Naggar, Lower Egypt). Photograph by the author.

the size of these features. It was crucial to do routine maintenance, since this process happens over both the long and medium term.

6. Conclusion

The symbolic dimension of the land is an aspect that cannot be ignored when approaching the study of domestic earthen buildings, as these considerations are deeply embedded in the way that the building is conceived.

The practical aspects into which these mental and cultural conceptions translate can be extremely difficult to infer from the archaeological record. This is where ethnoarchaeology can greatly help in suggesting ways of rebuilding the functional and human aspects of the home environment and their bidirectional connections. A key tool for revealing the complexity of the daily experience, both literally and figuratively, is the abstraction of principles that can logically enlighten the sociocultural and environmental elements influencing the domestic sphere.

This chapter has sought to briefly summarise some ways in which a holistic approach based on all variables involved in building with earth, from sociocultural considerations to environmental and site-specific factors, can offer a much more realistic and vivid picture of the reasons behind earthen and plant-based architectural choices and their reflection in the archaeological record.

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Unearthing the past: A comprehensive exploration of earthen architecture and ethnoarchaeology in the Egyptian Delta

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Abstract

This article discusses the case study of Tell Timai, the ancient city of Thmuis, analysing it through various ethnoarchaeological perspectives to provide new data for investigating mudbrick manufacturing techniques and their impact on shaping and preserving social identities. Through ethnoarchaeology, we gain insights into the choices behind material selection and production processes in earthen construction, which reveal a blend of functional and socio-cultural influences. Preliminary findings suggest a complex relationship between raw material choices and manufacturing practices, highlighting the interplay between cultural norms and practical needs. While emphasising the complexity of ethnoarchaeological research, the study presents compelling evidence gained from ethnographic investigations into the study of building practices.

Key words: Mudbrick manufacturing, Craft specialisation, Skill transfer, Egyptian archaeology

1. Introduction

The exploration of mudbrick architecture, one of the most well-known forms of Egyptian architectural heritage, offers fresh insights into past social dynamics, cultural traditions and socio-economic factors impacting local communities (Correas-Amador 2013; Correas-Amador and Simpson 2017; Emery 2009, 2011; Fathy 1969, 1973; Nims 1950). In this study, we present findings from our community and ethnographic research project, conducted between 2013 and 2014 and re-initiated in 2023 at Tell Timai, a site located in the province of Daqahliyyah in the northeastern Nile Delta. We use this specific case study to offer broader reflections on the ethnographic and ethnoarchaeological knowledge gained in building archaeology from assessing vernacular practices, particularly by focusing on the mudbrick manufacturing process. Ethnoarchaeology provides a combination of interdisciplinary theoretical and methodological frameworks to investigate past craftsmanship, including manufacturing and construction practices. Primarily for this reason, ethnoarchaeology has been employed in archaeology since the 1970s to explore living communities and shed light on past behaviours and practices (Binford 1978; Iles and Childs 2014; Kramer 1985). More recently, archaeologists have been using a combination of ethnoarchaeology and geo-ethnoarchaeology to analyse the use of space (Friesem 2016; Lancelotti *et al.* 2017; Ogundele 2005; Portillo and Matthews 2020), the materiality of construction (Goodman-Elgar 2008), energetics (Debowska-Ludwin and Rosińska-Balik 2020; Trzciński *et al.* 2017) and settlement patterns (Kramer 1982; Lyons 2007; Reynolds 1981). The discipline's success in the 1980s and 1990s came not without its difficulties and controversies, including the inherent problem of its colonial history

and methodological drawbacks (Cunningham and MacEachern 2016; Gosselain 2016; Roux 2007). We can address the first problem—common to most archaeologically driven disciplines—by making the local community not the object of study but a participatory collaborator in the archaeological research, delegating control by empowering local stakeholders (Bonnie *et al.* 2023; Lorenzon and Miettunen 2020). The second problem is more complex and not as easy to solve in its entirety, but modern ethnoarchaeology, and especially geo-ethnoarchaeology, focuses on material culture analysis based on reference data. It differs from previous research by developing an understanding of the technical activities that pertain to the creation of materiality instead of their symbolism (Lyons and David 2019; Roux 2007).

During the course of two field seasons, in 2013 and 2014, as well as the summer of 2023, we collaborated with the local community residing in the modern village of Timai El-Amdid, in Egypt, to produce thousands of mudbricks to be used, after securing agreement from the Supreme Council of Antiquities, as part of the archaeological conservation project. This collaborative effort was part of our community engagement initiative, aimed at conserving the still-standing earthen architecture. The standing architecture presents multiple occupational phases (Hansen *et al.* 1967; Ochsenschlager 1967; Silverstein and Littman 2023), but it mainly dates to the Late Roman Period (Lorenzon *et al.* 2020). The site of Tell Timai has been significantly impacted by land salinisation resulting from the construction of the High Aswan Dam, which altered the water table beneath the site and eliminated the flood season (Abd-El Monsef *et al.* 2015; Darwish *et al.* 2017; Ibrahim 1982). The increase in water salinity, capillary moisture, aeolian erosion and human activities has endangered the numerous earthen structures still extant at the tell (Ibrahim and Ibrahim 2003). Initially, we meticulously documented all structures for preservation purposes. However, discussions with the labourers involved in our fieldwork and the local community provided invaluable insights into local geology and architectural traditions. What primarily began as a community collaborative project with a clear conservation goal became part of our ethnographic documentation of earthen architectural practices, which are progressively disappearing in the Egyptian Delta (Fathy 1969; Lorenzon and Zermani 2016). This gave us the opportunity to interview local craftsmen as well as the non-specialised workforce, and to observe and document local manufacturing and construction practices. The research further developed into an ethnoarchaeological analysis of Egyptian architectural practice at Tell Timai, providing new insights into ancient construction practices based on the availability of resources, economic factors and social customs (Lorenzon *et al.* 2013, 2020). This contribution discusses the data collected during our ethnoarchaeological project, when we recorded current practices in the Egyptian Delta through interviews, photographs, detailed documentation and video recordings.

In 2013, at the start of the ethnographic project, we asked the villagers for permission before photographing and recording and structured the interviews as informal interviews with open questions posed to the community members and builders taking part in the mudbrick manufacturing and conservation project. We observed the guidelines of the Finnish National Board on Research Integrity (<https://tenk.fi/en/ethical-review/ethical-review-human-sciences>), the European Association of Archaeologists' ethics and practice codes (https://www.e-a-a.org/EAA/EAA_New/About/Codes.aspx) and the World Archaeological Congress Code of Ethics (<https://worldarchaeologicalcongress.com/code-of-ethics/>). Most answers were recorded in the form of field diaries, but some parts of our discussions were also recorded on video with the permission of the participants. We also used video and photographs to record the specific actions undertaken during the mudbrick manufacturing process.

2. Mudbrick manufacturing in the Egyptian Delta

In Pharaonic times, ancient Egyptians collected topsoil to produce mudbricks from the alluvium after the flooding of the Nile. This soil matrix often had a suitable composition of clay, silt and sand, with some regional variability, for manufacturing durable sun-dried mudbricks (Lozach and Hug 1930;

Littman *et al.* 2014; Morgenstein and Redmount 1998). In the Delta, the alluvial deposits were often enriched by organic material, such as dung and the chaff left in the fields after the harvest (Gurcke 1987; Kemp 2000: 80). To create mudbricks capable of bearing the weight of large structures, sediments were mixed with additional human-induced tempering composed of organic or mineral degreasers, such as chaff or sand. Organic temper absorbed the stresses associated with shrinkage during the drying

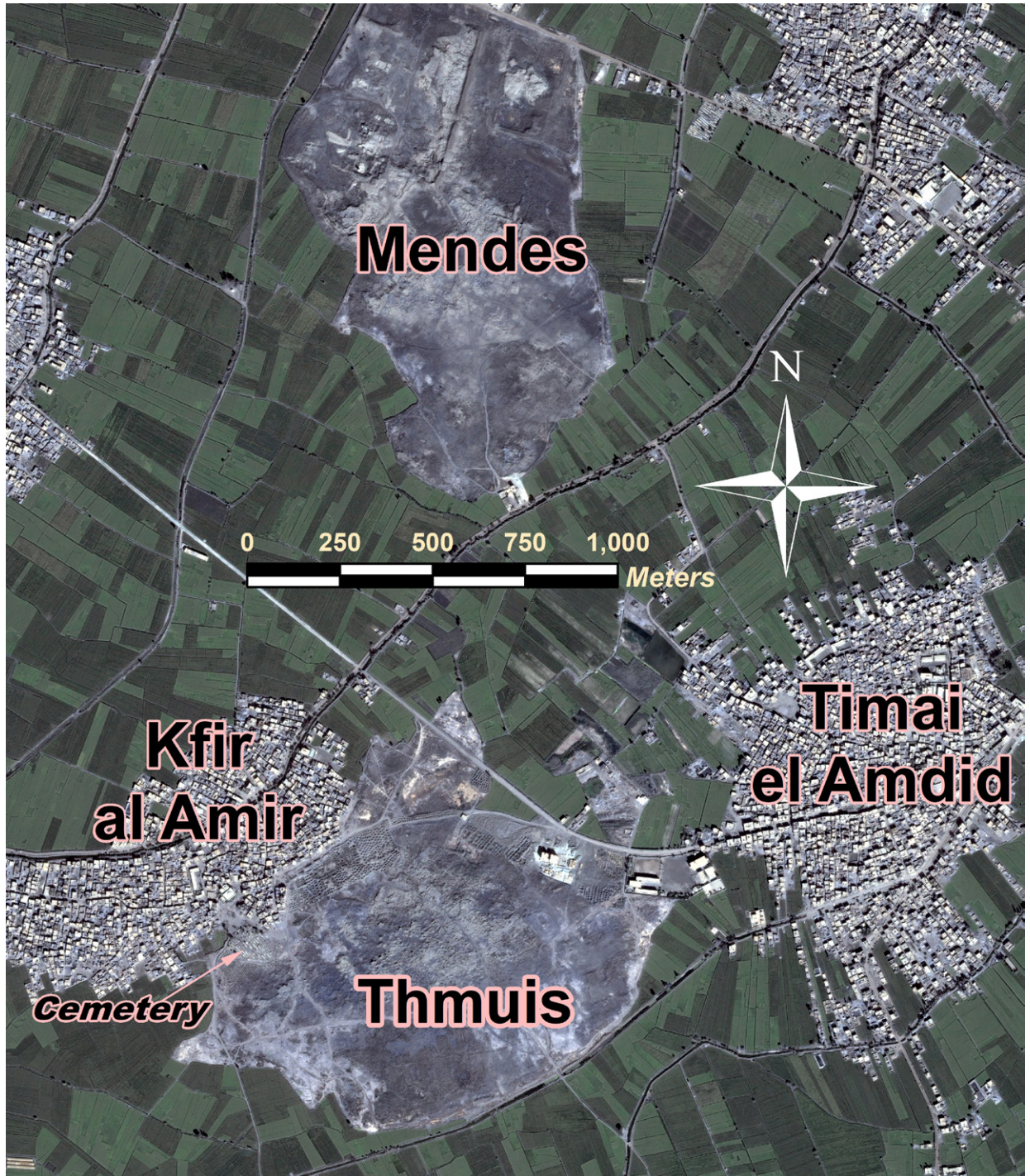


Figure 1. Satellite image (4 February 2013) of Mendes, Thmuis and the surrounding towns, and the location of Tell Timai (Google Earth, modified by J. Silverstein).

process, thereby preventing the formation of fissures and cracking. Chaff in mud plaster also helps with flexibility and tensile strength, allowing the material to stretch over the surface of the wall (Dawood *et al.* 2021; Littman *et al.* 2014).

Since the first half of the 20th century, mudbrick in the Delta has been progressively substituted by other building materials, such as fired bricks, and, after the second half of the century, by concrete (Correas-Amador 2013: 67–73; Correas-Amador and Simpson 2017; Mackenzie 1985: 10). Correas-Amador (2013: 81–82) has described the slightly different processes taking place in Lower and Upper Egypt, emphasising how in Lower Egypt the mould was used to cut into the mud mixture spread on the floor, which seems to have been part of the architectural tradition of Kafr el-Sheikh and Gharbeya (see Lozach 1930). In Upper Egypt, only one type of chaff was used, and the mud mixture was carried in baskets to the mudbrick maker at the moulding location (Correas-Amador 2013: 91; Henein 1988: 38–39). Of interest is the fact that researchers have observed a more specialised division of labour in Upper Egypt, in which specialists with a number of apprentices were in charge of mudbrick making (Correas-Amador 2013: 92; Hug 1930: 87). The mud mortar and mud plaster recipes are more homogeneous across Egypt, with mud mortar presenting less vegetal temper (Lower Egypt) and mud-plaster composition including more water and straw in both Lower and Upper Egypt (Correas-Amador 2013: 83, 95). The practices were, nonetheless, progressively disappearing due to the Westernisation of the countries and the regulation of building materials (MacKenzie 1985; Correas-Amador 2013: 67–73). However, in the villages of Timai El-Amdid and Kafr El-Amir Abd Allah, which flank the archaeological site of Tell Timai on the east and west, traditional mudbrick architecture is still visible, although the number of mudbrick houses is dwindling rapidly following a trend identified in other areas of Lower Egypt (Figure 1).

3. Archaeological research at Tell Timai

3.1. The site of Tell Timai

Tell Timai is the name of the archaeological site at the city of Thmuis, a Greek rendition of the Egyptian ‘Ta mawi’, meaning new land. It served as the southern extension of the city of Mendes, situated at the site of modern-day Tell el Rub’a, which has been inhabited since at least the 4th millennium BC (Redford 2010). The history of Mendes spans the Predynastic and Roman periods, with its peak prominence starting in the 7th century BC, when it emerged as one of the largest and most prosperous port cities in the Nile Delta (Blouin 2014: 72–76; Redford 2010). During the 29th Dynasty (399–380 BC), Mendes-Thmuis was, in fact, the capital of Egypt. In the 5th century BC, Thmuis was visited by the Greek traveller and historian Herodotus (*Histories* II, 166). During the Ptolemaic period, Thmuis replaced Mendes as the primary settlement in the Nile Delta, while the northern part continued its role as a religious centre dedicated to the Ram God Banebdjedt. By the 2nd century BC, Thmuis had evidently expanded in both size and significance as a Hellenised city (Silverstein and Littman 2023). Its importance continued to rise following the Roman conquest in 30 BC, eventually becoming the location of an episcopal see during the early Christian period. Although largely obscured by the passage of time, during the Roman era Thmuis was considered one of the most significant cities in Egypt (Ammianus Marcellinus, *Roman History* 22.16).

Today, Tell Timai has a perimeter of approximately 5.4 km and covers more than 90 ha, although at its height, during the Roman period, the city would have been somewhat larger. The well-preserved core of the city has streets and alleys defined by mudbrick buildings, some with walls still two or three storeys tall. Stone architectural fragments and traces of painted walls and plaster floors are visible. High points at the centre of the tell are approximately 12.5 m above mean sea level (amsl), with the outer edges sloping to approximately 1 m amsl. To the west, the modern village of Kafr El-Amir Abdallah Ibn al-Salam has encroached onto the mound, while to the northeast the village of Timai El-Amdid is even more rapidly encroaching onto the site (Figure 2). The western side of the tell contains a modern



Figure 2. Mudbrick houses in Kafr El-Amir, 2022 (J. Silverstein).

Islamic cemetery on top of a hill that likely once held a temple. On the western side of the cemetery hill, there is a nilometer with a destroyed stairway leading up the west slope of the hill (Silverstein *et al.* 2022). An antiquities inspector reported that near the Islamic cemetery, minor excavations by members of the Supreme Council of Antiquities had uncovered Graeco-Roman graves, and it is likely that a portion of the ancient necropolis on the west side of the tell has already succumbed to the growth of the neighbouring town, although such conclusions are preliminary. The presence of the nilometer provides information regarding the palaeocourse of the Nile, one branch of which apparently ran along the west side of the city (Darwish *et al.* 2017).

The tell has been despoiled since at least the 19th century (as reported by George Daressy in 1890) by *sebbakheen*, who used the mudbricks for fertiliser, as well as by townspeople, who have used the bricks and stones to build their homes (Bailey 1999; Holz *et al.* 1980). In the early 20th century, people systematically stripped the tell for mudbricks, which is most apparent in the northern portion of the tell, where almost uniform stripping has occurred to a stratum dating to the 1st century BC. In 2019, approximately 1 ha of this northern portion of the tell was transferred to the local government for the construction of a water purification plant. Construction on the tell is preceded by extensive test-pitting that generally uses 5 × 5 m units to recover valuable artefacts, leaving a checkerboard pattern of open units across large areas on the fringes of the tell. Eventually, the areas are bulldozed and levelled for development. Cleaning and recording such open units in the northern part of the site has provided some of the data underlying this analysis.

3.2. Mudbrick analysis at Tell Timai

The site of Tell Timai still preserves a significant amount of standing earthen architecture belonging to different historical periods. In considering mudbrick as cultural material, our work combines the analysis of the physical properties of material culture with a consideration of the meaning and use of those materials within their social context, as a means of understanding communities in the past. Geoarchaeological analysis of earthen building materials at Tell Timai highlighted a fixed ratio of fine and coarse fractions between buildings of the same period, pointing to similarities in composition, or recipes, for each building phase (Lorenzon *et al.* 2020). Knowledge is still lacking regarding specific raw source catchment areas at the site. In the past, soil was simply collected along the riverbanks, as mentioned by the people working with us, implying a tight link between selection choices and environmental availability for local communities.

In 2010–2013, we performed granulometric and geochemical analyses to gain a better understanding of the raw material sources. Geochemical analyses, specifically XRD, point towards the use of kaolinite, montmorillonite and illite clays, together with albite, plagioclase feldspar, augite, pyroxene and quartz, in the mudbrick compositions. The most consistent tempering identified in the historical mudbrick of Tell Timai is chaff, likely from cereal production, as identified through a field microscope (NEEWER® Portable 20X-800X 8LED 2.0M Pixel CMOS USB Digital Microscope with Base Stand). The microscopic analyses exposed the following features. First, the silt/sand component is mostly composed of quartz and igneous rock fragments. Second, numerous voids were identified in the microscopic analysis, appearing as smooth, round cavities or elongated fissures linked to the presence of organic matter remains (Figure 3).

At the same time, we conducted a thorough assessment of the overall physical state of the site, focusing on aspects such as spatial condition, structural integrity, building materials, finishes and modern environmental factors. This assessment led us to develop a conservation plan embedded in community archaeology and ethnoarchaeology, aimed at safeguarding the endangered architectural elements. Specifically, we focused on two distinct areas of the site: Unit Q14 and Unit L14. While evaluating the condition of the mudbrick structures in Units Q13, Q14 and L14, we paid specific attention to the southwest corner of Q14, designated as Street #1 (Main Street). Street #1 comprises a collection of structures, likely residential units, dating back to the Roman period (Lorenzon *et al.* 2020). Situated centrally within the tell, this area represents one of the best-preserved sections of Thmuis, showcasing urban architecture from the Graeco-Roman era. Three *insulae* flank the street, with additional street systems extending eastward. However, all buildings have been significantly affected by mudbrick decay, with walls showing severe deterioration and posing an imminent risk of collapse. Only a limited amount of excavation work has been conducted in this part of the tell, but preliminary results suggest that the structures served as local shops and residences during the Roman and Byzantine occupations.

The mudbrick deterioration is attributed to various factors, including erosion, animal activity, insect damage and natural wear. Additionally, extensive wasp nesting has further compromised structural integrity. The orientation of Street #1 is noted as northwest-southeast, impacting the buildings differently based on their exposure to sunlight, wind and moisture. An analysis of the earthen architectural structures in Unit L14 reveals the presence of a monumental public structure, likely part of a larger church complex dating back to the Late Roman period. Designated as Building #1, it is the sole remaining three-storey building on the tell, and it is experiencing rapid decay due to natural and animal erosion. The building's massive mudbrick construction, with walls up to 5 m thick, shows visible signs of deterioration, particularly along Walls #1 and #3. Despite its current state, Building #1 exhibits evidence of multiple floors, complex staircases, a round tower and various openings, suggesting a

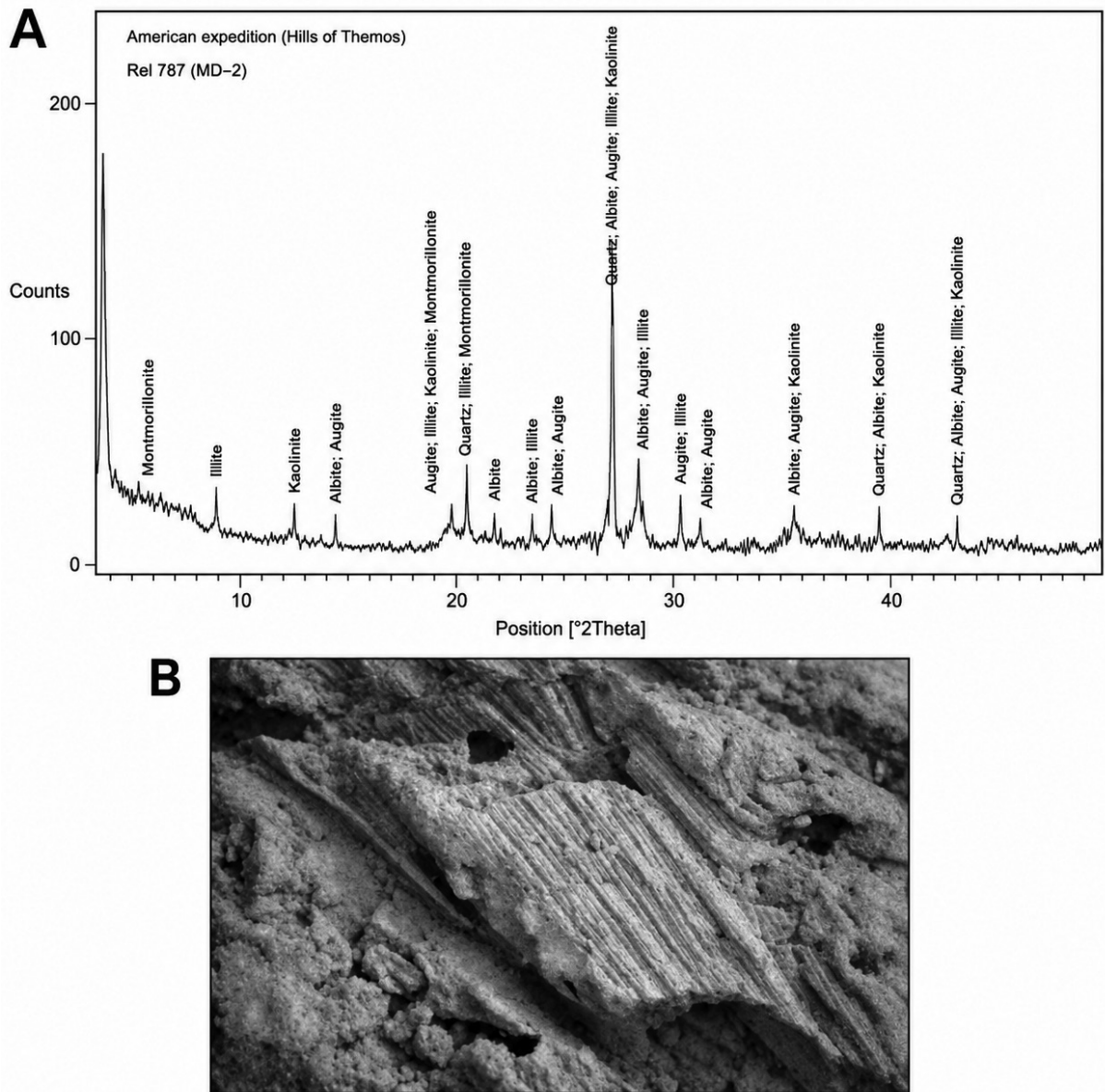


Figure 3. a) XRD analysis of a mudbrick from Tell Timai, performed by the late Dr Mohamed Ezzat Taha; b) microscopic image of a chaff impression from mudbrick samples from Street #1 (M. Lorenzon).

complex architectural design. Likewise, the condition of Building #1 varies based on its orientation, with exterior and interior walls facing similar exposure patterns (Lorenzon *et al.* 2013, 2020).

The primary objective of the intervention was to preserve the structures for future study and prevent further decay caused by environmental factors and animal activity. Several walls in both Q14 and L14 were identified as critically damaged, requiring immediate attention. In our outreach with the community of Timai El-Amdid and discussions with our local workmen, it became evident that most of the people were not only familiar with the basics of earthen architecture manufacture but also with the maintenance and conservation of mudbrick structures. One of the main obstacles to the manufacture of mudbrick is access to water that is not contaminated or saline. During the 2013–2014 seasons, water was brought in

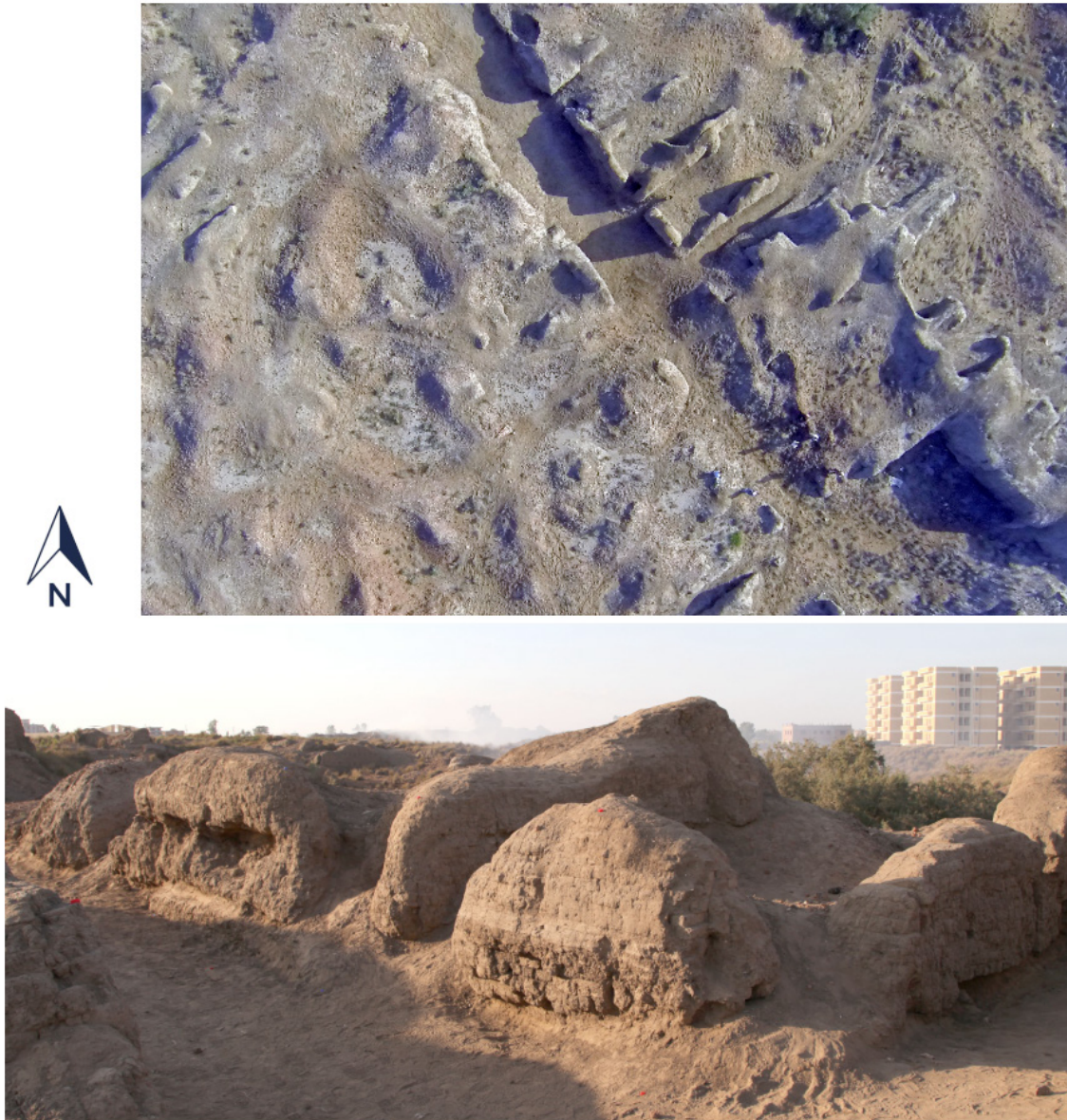


Figure 4. Aerial view of Street #1 (top) and close-up photo of the wall deterioration, view facing east (bottom) (M. Lorenzon).

by truck. In 2023, a Roman well was excavated. Once it was refilled with water, animals came to drink from it. The bricklayer tasted the water and confirmed that it was fresh and ideal for use. After that, the reconstituted Roman-period well became the primary water source for mudbrick manufacturing. Therefore, we designed a collaborative conservation plan that directly involved the community in the manufacturing of the mudbricks needed for consolidating the walls. All interventions were designed to be reversible to ensure that the integrity and authenticity of the walls were preserved. Conservation efforts included reconstructing damaged sections of the mudbrick walls, erecting retaining walls, injecting cracks with traditional mortar and plastering deteriorated areas with traditional mortar. The interventions aimed to halt deterioration while maintaining the authenticity of the original structures, but they also provided us with the opportunity to study, with the communities, the diverse steps involved beyond just the manufacturing and construction with mudbricks. Additionally, mudbricks still



Figure 5. Aerial view of Building #1 (top) and view facing north (bottom) (M. Lorenzon).

occur occasionally in outbuilding structures around Tell Timai, and we employed mudbricks made on site with a marble plaque to construct a new sign for the site as part of a heritage conservation project in collaboration with the local community.

4. Ethnoarchaeology at Tell Timai: Architecture as a process

In the summer of 2013, the initial collection of raw sources was carried out by one of the authors (ML) together with two workmen who also lived in the village. The local members of the team ranged from those with no experience in archaeology or mudbrick construction to people who had some expertise and experience in mudbrick manufacturing, having worked on their own homes using mudbricks and mud plaster. All the local team members demonstrated good knowledge of the local geology and the use of appropriate vegetal temper, as well as its availability in the area. This initial discovery underscores

the presence of a community of practice in the area, which shared common knowledge about the appropriate and available raw material resources. At the same time, we also analysed the ancient mudbrick composition to determine its geochemical and granulometric characterisation (Lorenzon *et al.* 2020).

Subsequently, we selected soil from local fields and from around the archaeological site to closely match the analysed composition, with the approval of the Ministry of Antiquities. We could not select topsoil since it is currently of poor quality for earthen architecture due to the presence of salts from fertilisers; thus, the selected soil was extracted from layers under the topsoil deposits. Straw procured post-harvest had been chopped and crushed and was utilised as a vegetal temper, a common practice in mudbrick and plaster production. Specifically, wheat chaff was integrated into the soil blend possessing the requisite clay, silt and sand content. The ratio of straw to mud was contingent upon the specific composition of the mud, evaluated subjectively by two workmen through visual and tactile assessments. Therefore, water and straw were incorporated into this soil mixture in varying proportions, but we used approximately half a pound of chaff for every cubic metre of mud mixture (Littman *et al.* 2014).

In the initial phase of mixing, two individuals from the nearby village who were familiar with the manufacturing process and who had helped construct small structures at a relative's house, although without formal training as mudbrick makers, assisted as semi-skilled labourers in this step of the *chaîne opératoire*. Specifically, they created a small artificial hill with the soil we had collected and placed chaff and water inside (Figure 6). Then, they began mixing it with spades and using their feet for 4–5 hours to create a doughnut-shaped mud mixture. The two workers continued adding soil and water for two days to achieve a mixture of the correct consistency. During this process, the doughnut-shaped mud mixture had a higher border to prevent water from running out and to preserve it in the middle, where soil was progressively mixed and combined. While mixing, any large inclusions, such as branches and rocks, which had been collected with the soil, were removed from the mixture. For our mudbrick manufacturing project, we sought the expertise of Mohammed al-Banna, an experienced craftsman from the nearby village of El-Rub'a, who has more than 37 years of experience since he first began his training in 1976, eventually becoming a master craftsman or master mudbrick maker. Mohammed visited the site twice during the proceedings to check the mixture and offer advice, such as the need to add more water and straw. His assessment was based on visual, tactile and olfactory perception. Additionally, a red pigment was introduced to distinguish the newly fabricated bricks from the original ancient ones and to aid in identifying the conservation intervention. The inclusion of straw as temper yielded several benefits. Primarily, it compensated for stresses incurred during the drying process, thus mitigating shrinkage and reinforcing structural integrity against possible fissures and cracks. The prepared mixture underwent a five-day kneading process, typically conducted barefoot by the two workers to facilitate the mixing of different elements. Following this step, the blend was allowed to rest for a day and a half before undergoing a final kneading session on the day of brick production. Transportation of the mixture to the brick-making site involved two workers carrying it on a wooden stretcher. To prevent adhesion to the ground, the workspace was wetted and lined with straw or sand the day before manufacturing (Figure 7).

At the brick-making station, the mudbrick maker kneaded the mud mixture by hand, folding it into itself three or four times and mixing it with a small quantity of sand to prevent it from sticking to the wooden table. Then, Mohammed poured the mixture into wooden double moulds, levelling it with a ruler before passing it on to the fourth member of the team, his apprentice, atop a wooden base, which facilitated the transportation of the mould filled with mud to the drying field (Figure 8). The apprentice, a youth in his late teens who had been training with him for just over a year, deposited the mould onto the floor; the double moulds were then swiftly lifted to prevent adhesion and to facilitate the manufacture of multiple bricks simultaneously. The mudbricks were deposited 2 cm apart in multiple



Figure 6. Raw materials collected in the circle (left) and mud mixing/kneading (right) (M. Lorenzon).

rows; if the edge was raised, the upper surface was smoothed with a wooden finishing trowel (Figure 9). We learned during the process that the tradition of mudbrick apprenticeship in Egypt used to demand multiple years of experience before one could be recognised as a master mudbrick maker, and it is the master mudbrick maker who has the authority to determine the accuracy of the initial mixing process. The mudbricks were left to dry for a week, being turned on-site after 3–4 days before being deemed suitable for use or stacking. After every moulding, the mould was washed in a basket containing water and sprinkled with chaff, making it ready for reuse. Remarkably, nearly 2000 bricks were produced within a short two-day timeframe.

One of the most impressive features of the manufacturing process was the accuracy and efficiency in the repetition of the same movements by Mohammed during the moulding process. These kinaesthetic movements, repeated over 1000 times, ensure that every mudbrick is the product of the same set of actions, which should be reflected in its final macroscopic and microscopic fabric. Mohammed was obviously highly skilled, while his assistant could be considered skilled/semi-skilled. Therefore, the entire manufacturing process was carried out by a set of people with diverse skill levels, ranging from unskilled and semi-skilled members of the team who collected the raw sources to semi-skilled members who mixed them, and finally a highly skilled member involved in the actual manufacturing.

Once the mudbricks were ready for use, a different team—composed of a local builder and local workmen who were assisting us—carried out the conservation and reconstruction of the wall, as well as the plastering. The separation of the two processes, manufacturing and construction, is a relevant element to consider when discussing ancient architecture. In this case, the team was made up of a skilled workforce that had been involved in numerous constructions and had a clear familiarity with the process.

5. Some considerations of labour organisation

In the Egyptian Delta, the process of mudbrick manufacturing is a blend of skill, tradition and practicality, often carried out by individuals whose expertise, or community of practice knowledge, may not be immediately apparent. Particularly in our case study, the process begins with unskilled or semi-skilled labourers gathering the essential raw materials: soil, water and organic matter, like cereal straw. These elements, seemingly basic, are meticulously prepared and mixed together, undergoing a transformative process that changes raw sources into material culture. The full *chaîne opératoire* of mudbrick



Figure 7. Transportation of the mud mixture (M. Lorenzon).

manufacturing, from raw material collection to mixing, moulding, drying and, ultimately, stacking, is well illustrated in the Rekhmire fresco, in which mudbricks are depicted being produced by prisoners during the New Kingdom (Figure 10). In our ethnographic study, the two workmen were community members from the nearby villages who participated in the excavation and had some previous experience working with mudbricks over the years and/or had done some mud plastering with neighbours and family members. However, neither of them would call themselves a mudbrick maker or an expert in the craft. Their previous personal experiences with mud plastering and mudbrick maintenance did provide them, though, with valuable insights and skills. This highlights the organic nature of skill transfer in traditional crafts, often passed down through generations or gained through hands-on experience in communal activities. On the other hand, the master mudbrick maker, Mohammed al-Banna, proudly defined himself as such. Mohammed was also keen on sharing his expertise in mudbrick recipes; thus, we observed no gatekeeping mechanism present in the Timai building community. His ability to discern the 'right' composition for the mudbricks through tactile and olfactory perception demonstrates the nuanced understanding that comes with years of practice. When asked what constitutes the right recipe, the answer was a durable mudbrick that would not crack and could be used for many years. His experience in manufacturing more than two thousand mudbricks consists of repetitive movements, arguably a form of kinaesthesia in which body and hand motions are repeated in identical patterns for each brick moulding. Each of his movements, repetitive yet precise, contributes to the creation of a form of material culture that is not just functional but embedded with social value and evidence of a high level of craftsmanship.

The difference between this process in Daqahliyyah and the *chaîne opératoire* implemented in Gharbeya can quite simply be ascribed to a regionalisation of the process based on the expertise of mudbrick makers in different Egyptian provinces. The tradition in the province of Daqahliyyah shares more



Figure 8. Moulding of the mudbricks (M. Lorenzon).



Figure 9. Mudbricks left to dry, with a wooden finishing trowel used to smooth the upper surface (Photo credit: Sarah Hitchens).



Figure 10. Fresco from the Theban tomb of Vizier Rekhmire: New Kingdom, c. 1450 BC
(Photo credit: flickr.com/manna4u, CC BY-NC-SA 2.0; modified by M. Lorenzon).

similarities with descriptions of mudbrick production in Upper Egypt (Correas-Amador 2013: 94–96). The mud underwent a mixing period consisting of multiple days, much more than the two days documented by Correas-Amador for Gharbeya, with a 24-hour rest period preceding the actual moulding of the mudbricks. Notably, the type, quantity and quality of vegetal temper vary significantly between regions, with choices often driven by opportunistic factors, such as availability and seasonality. Additionally, the similarities between the *chaîne opératoire* in Tell Timai and Upper Egypt also include the use of wheat broken down into small fragments and the transportation of the mud mixture via baskets to the location where the mudbrick maker was moulding the bricks (Correas-Amador 2013: 91; Henein 1988: 38). Likewise, the drying process, including the turning of the bricks as well as the length of each step, shares more similarities with our observations at Tell Timai. This variability in mudbrick recipes is driven by a range of factors, including local availability and seasonal fluctuations, highlighting the adaptive nature of traditional building practices.

In 2013, our ethnographic efforts focused more on conservation primarily aimed at stabilising endangered mudbrick structures to prevent them from collapsing. However, in 2014, our goal shifted towards conducting a comprehensive ethnoarchaeological and archaeometric study to identify the manufacturing process and possible craft specialisation (Lorenzon *et al.* 2020). Geochemical analysis was also employed to determine the use of expansive and non-expansive clays, which is an essential feature in selecting the best conservation strategy. On the other hand, the data collected during the ethnographic study allows us to gain deeper insights into ancient manufacturing techniques in the Egyptian Delta. The analysis of kinaesthetic movements has introduced a fresh and innovative approach to studying mudbrick production, and this method explores previously unexplored aspects of human involvement in the manufacturing process, stressing how each movement and action undertaken by the mudbrick maker leaves traces on the final material culture, the mudbrick.

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How was an Iron Age oven built, used and maintained? Contributions from ethnoarchaeological observations in Al Hoceima area (Rif, Morocco)

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Abstract

Our research focuses on Iron Age combustion structures in the Mediterranean coastal area of the Iberian Peninsula. Remains of these installations are quite abundant and provide information on hearths and ovens of the period. The characteristics of the hearths are quite well-known, whereas the ovens, whose domes are not usually preserved *in situ*, are more difficult to interpret; they also raise more questions about the nature of their uses and functions. To fill this gap, we have recently started ethnoarchaeological research on traditional ovens within the Al Hoceima National Park (Rif, Morocco), whose first results are presented here. Information has been collected on construction aspects (materials, techniques), formal characteristics (size, shape and parts of the ovens), functions and use. We have also considered social aspects regarding who possesses the knowledge of their construction and the private or collective nature of both the structures and their use. This approach provides some suggestive ideas for analysing Iron Age combustion structures in the western Mediterranean, similar in morphology to those studied here.

Key words: Non-portable structures, Combustion installations, Protohistory, Western Mediterranean, Earthen architecture

1. Introduction

This chapter aims to contribute to the knowledge of the ethnoarchaeology of buildings, and more specifically, the construction of culinary ovens. Our research focuses on protohistoric domestic combustion structures (hearths and ovens) along the eastern coast of the Iberian Peninsula (Figure 1a). It also aims to deepen our understanding of how Iron Age communities managed the natural environment for their subsistence and organised household spaces.

Ethnoarchaeology can be a powerful tool to better comprehend the archaeological remains of these structures, as demonstrated by previous projects on the topic. Of particular note are the studies on traditional ovens carried out in rural areas of Valencia (Albir 2010), as well as research conducted within

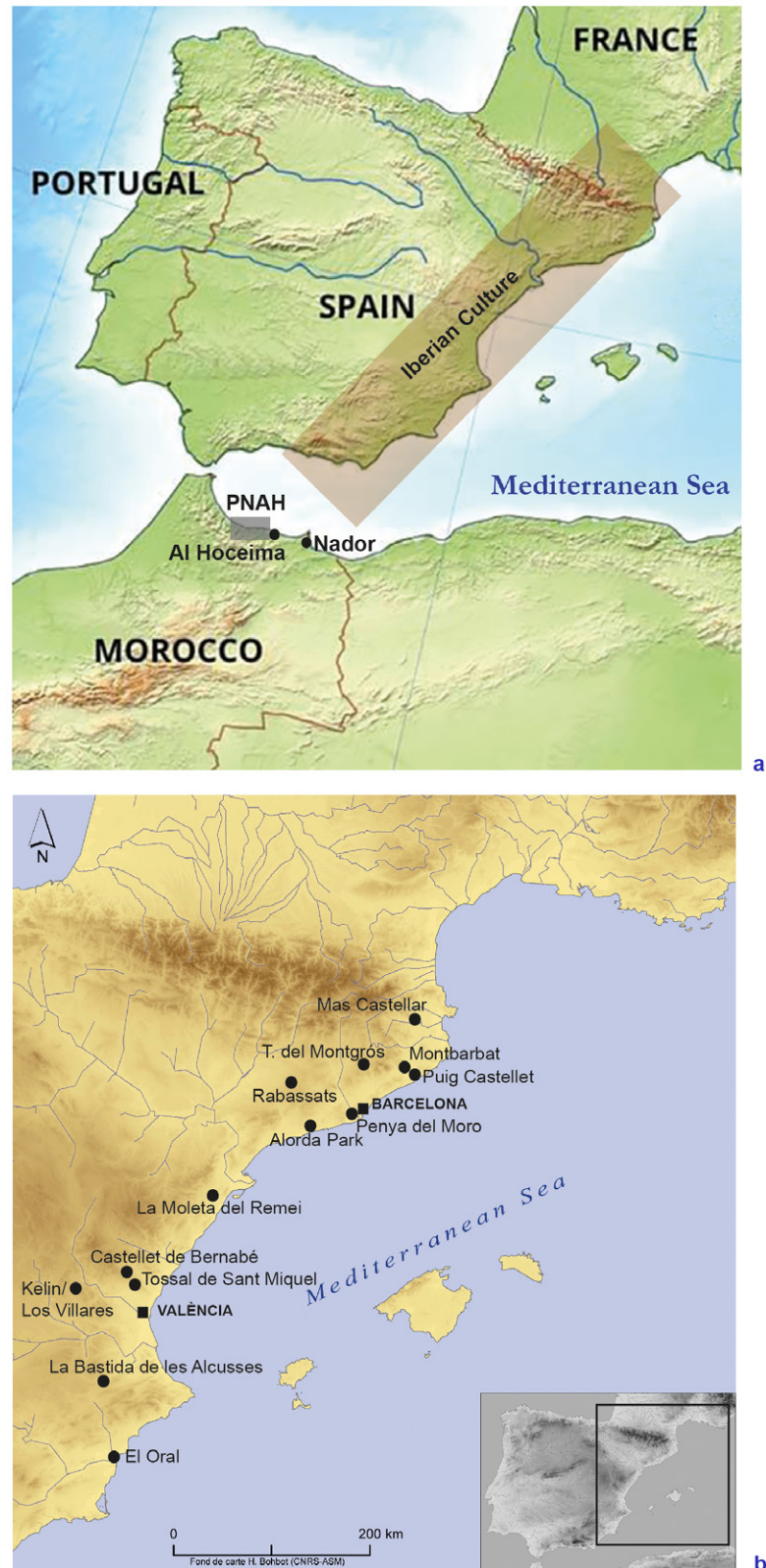


Figure 1. a) Map of the Iberian Peninsula and north of Africa showing the area of the Iberian Culture and the location of the Al Hoceima National Park (map background: freeworldmaps.net, modified). b) Map of the Mediterranean coast of the Iberian Peninsula, with the location of the sites mentioned in Figure 3 (map background: H. Bohbot, modified).

different projects in the Maghreb, both in Tunisia (Portillo *et al.* 2017) and Morocco (González *et al.* 2005; Zapata *et al.* 2003).

In the case of the Maghreb, traditional combustion structures are morphologically similar to those documented in the archaeological contexts under study. However, work carried out to date in this area has mainly focused on the study of fuels or the preparation of bread, and less on construction aspects. On the other hand, the study of traditional ovens in rural areas of the Iberian Peninsula can provide useful insights into use and management, as in the above-mentioned case (Albir 2010). We have thus also considered including here some pieces of information supplied by the family of the former baker of La Vilella Baixa (Priorat, Catalonia); however, these are large installations located in specific buildings, with different characteristics and sizes from Iron Age ovens.

To better comprehend the archaeological remains of these structures, we have chosen, among other strategies, to collect and study ethnographic data from different locations within the Al Hoceima National Park (PNAH), in the Rif area of northern Morocco (Figure 1a). There, the population still uses traditional ovens with similar characteristics to those documented at protohistoric sites. Unfortunately, we were unable to see traditional hearths in use. We are aware that the observations of these ovens cannot be directly extrapolated to the past, but they can point out which behaviours may have formed a certain material record (Hernando 1995). We consider it essential to analyse the materiality (structures and objects related) together with the human behaviours that generate it (González-Ruibal 2017: 272).

During the fieldwork, we were assisted by a local guide (Youssef Tachich) who accompanied us and acted as an interpreter with the women, builders and users of these installations, who very kindly agreed to show us their ovens and give us valuable information about them. In total, we have been able to document nine bread ovens, which should be considered as a sample to estimate the possibilities of this fieldwork. We have identified the different parts of the oven, taken measurements and asked about the different aspects of their construction and use. In the following lines, after the contextualisation of the protohistoric ovens documented archaeologically, we will present the most relevant data on the ethnological ovens.

2. Ovens and other fire installations in the Iron Age western Mediterranean: what we know and unanswered questions

Combustion structures are one of the most defining elements of domestic space and are usually abundant at habitat sites. They are mainly used for cooking, but also for heating, lighting or transforming raw materials. Their analysis can provide information on the fuels used, the management of natural resources, diet, craft activities or certain ritual practices. Their presence determines the circulation and use of space, as well as the organisation of daily activities, both individual and collective.

This research is part of a larger project¹ on combustion structures (hearths and ovens) from the Iron Age in the northwestern Mediterranean, more particularly in the eastern coastal area of the Iberian Peninsula, where the Iberian culture developed from c. 600 to c. 200 BC. Within this project, several actions are being conducted: one of them is the creation of a database² that collects information on fire installations and their main characteristics, such as size, location, construction techniques, morphology, function and dating; also, the systematic sampling of combustion structures for interdisciplinary analysis, to recover information on construction processes, fuels, use and maintenance of the structures

¹ TRANSCOMB Project (PID2019-104661GB-I00 and PID2022-137999NB-I00) funded by the Spanish Ministry of Science, Universities and Innovation.

² Belarte Franco, M.C.; Pastor Quiles, M.; Cuscó i Badia, O.; Camañes Villagrasa, P. 2023: "Protohistoric Combustion Structures from the Western Mediterranean", <https://doi.org/10.34810/data775>, CORA.Repositori de Dades de Recerca, V1.

(Belarte *et al.* 2023b, 2023c). The study of archaeological hearths and ovens is being combined with experimental archaeological work (Belarte *et al.* 2023a), to which we have more recently added ethnographic observation, as preliminarily presented in this chapter.

In the specific study area and period, settlement patterns show different types of sites ranging from less than 500 m² to more than 10 ha, fulfilling different functions, from farms to cities, reflecting the hierarchical organisation characteristic of archaic state societies (Sanmartí 2004: 20). Despite the differences in size and function, most Iberian settlements shared several common traits. They were of an agglomerated type, with houses arranged sharing party walls, sometimes grouped in blocks separated by streets or organised around a central area for collective use. Houses corresponded to different types; they were mostly compact buildings, some of them with internal courtyards, porticoes or corridors. As for construction materials and techniques, walls were mostly built of stone and earth, and roofs were usually made of a layer of earth on a bed of branches or reeds supported by wooden beams (Belarte 2023; Pastor *et al.* 2023).

2.1 Archaeological ovens

The most frequent domestic features inside houses were fire installations. These were mostly built with earth, combined with other materials such as stone and pottery. Most hearths had a flat earthen surface built in a shallow pit or directly on the floor, sometimes on a preparation of sherds, pebbles or both materials. Unlike hearths, which were at ground level, ovens were usually raised on a platform made of stones and plastered with earth. The main difference, however, is that the latter were covered by a dome, whereas hearths were open structures. The remains of the oven walls and domes are poorly preserved; only the lower part of them is sometimes visible (Figure 2).

In the above-mentioned database (see note 2), we have recorded 46 ovens from the Iberian period, dating mostly from the 4th and 3rd centuries BC, in the present-day Catalonia and Valencia areas. Sixteen of them have been interpreted as artisanal structures (related to lime production, metallurgy, etc.), while nine are of indeterminate use. The principal characteristics of the remaining 21, interpreted as domestic, are summarised in Figure 3. The sites' locations are shown in Figure 1b.

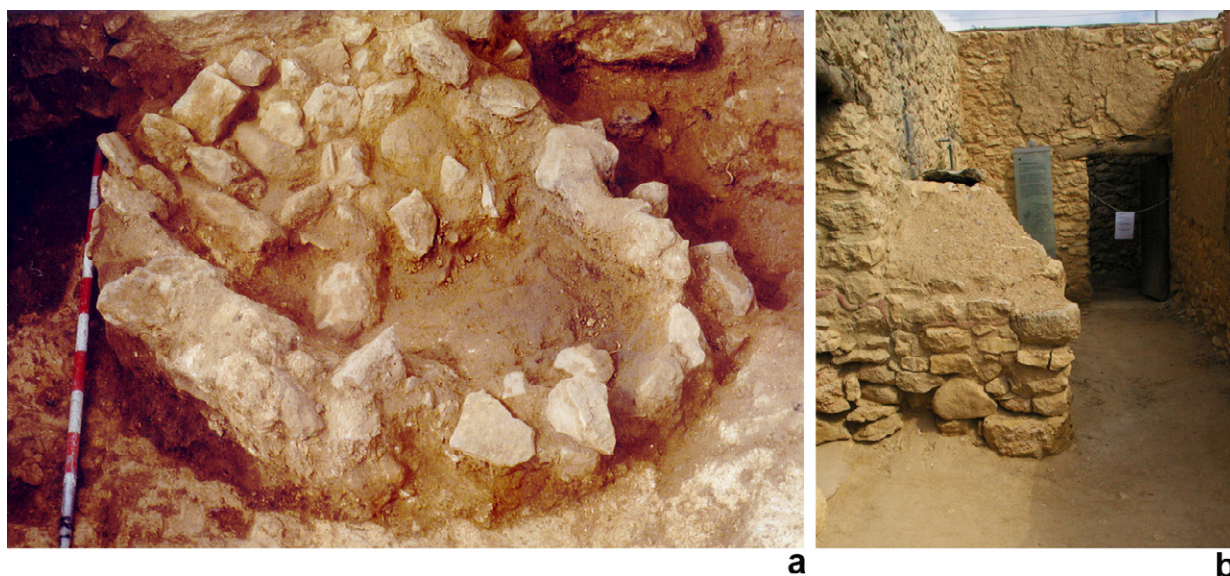


Figure 2. Two ovens at Alorda Park (Calafell, Tarragona). a) Remains of oven FR6024. b) Oven FR8393, with the dome reconstructed in situ.

Figure 3. Data on archaeological ovens from the Iberian period interpreted as domestic
(for references see <https://doi.org/10.34810/data775>).

Site	Oven name / location	Morphology	Length (cm)	Width (cm)	Diameter (cm)	Characteristics	Location	Chronology (cent. BC)
Mas Castellar (Pontós)	FR349 (Room 4)	square	--	--	--	semi-excavated	eccentric	5th-4th
Mas Castellar	FR49 (House 1)	circular	--	--	200	built on a podium	lateral	3rd
Mas Castellar	FR68 (House 2)	circular	--	--	200	built on a podium	corner	3rd
Montbarbat (Lloret de Mar)	Inside House IV, Room S6	rectangular	85	52	--	built on a podium	corner, covered	3rd
Puig Castellet (Lloret de Mar)	Inside E7 (vestibule)	circular	--	--	--	built on a podium	lateral, uncovered	3rd
Turó del Montgròs (El Brull)	UE 871 (Room B1)	undefined	--	--	--	built on a podium	corner, covered	3rd
Penya del Moro (Sant Just Desvern)	Inside S1	rectangular	100	80	--	built on a podium	uncovered	5th-4th
Alorda Park (Calafell)	FR10399 (House 101)	oval	35	18	--	semi-excavated	central, covered	5th-4th
Alorda Park	FR8393 (House 202)	square	90	60	--	built on a podium	lateral, uncovered	3rd
Alorda Park	FR6024 (House 210)	oval	140	100	--	built on a podium. Stone vault	corner, covered	3rd
Alorda Park	FR8609 (street 212)	semi-circular	--	--	--	built on a podium	lateral, uncovered	3rd
Rabassats (Nulles)	UE 1024 (Sector 2b)	semi-circular	--	--	108	built on a podium	lateral, uncovered	3rd
La Moleta del Re-meí (Alcanar)	Inside H14	rectangular	160	80	--	built on a podium	central, covered	5th-4th
Castellet de Bernabé (Llíria)	Inside Dep. 24 (Sector E)	square	140	120	--	built on a podium	corner, covered	3rd
Tossal de Sant Miquel (Llíria)	Inside Dep. 42b	semi-circular	--	--	70	semi-excavated	lateral, covered	3rd
Tossal de Sant Miquel	Inside Dep. 43	circular	--	--	200	built on a podium. Mud-bricks vault	corner, covered	3rd
Tossal de Sant Miquel	Inside Dep. 56	semi-circular	--	--	--	semi-excavated	corner, covered	3rd
Kelin/Los Villares (Caudete de las Fuentes)	H21 (Dept. 19)	semi-circular	--	--	--	built on a podium	lateral, covered	5th
Bastida de les Alcusses (Moixent)	Inside Room 155	semi-circular	--	--	--	built on a podium	lateral, uncovered	4th
El Oral (San Fulgencio)	Inside Sector VIII, A2	circular	--	--	200	built on a podium	corner	5th
El Oral	Inside Sector III, III-I	circular	--	--	230	built on a podium	corner, uncovered	5th

As for their location, hearths were usually inside houses, whilst ovens were mostly located outdoors, in open areas such as streets or plazas; they could also be situated in courtyards (Belarte *et al.* 2016).

The study of archaeological ovens presents specific challenges, such as reconstructing their complete original appearance and their construction and maintenance processes, especially those of the earthen domes. Other difficulties arise when interpreting the ovens' functions. It is generally accepted that their main use was baking bread, but they may have had other functions, mostly within the range of culinary activities.

Another question is whether they were for private or collective use. Their presence in open spaces suggests that, in addition to the need for ventilation, other factors may have conditioned their location, in particular, access by different people or families for their use.

We have several sources of information with which to reconstruct the protohistoric ovens of the Iberian Peninsula and their use (Figure 3). In addition to the remains preserved at sites from the period and study area, research on ovens in other ancient cultures can be helpful.

Phoenician and Punic archaeology provides the closest parallels from both a chronological and geographical point of view. According to Lorenza Campanella, who has studied these structures in depth in the ancient Mediterranean, truncated cone-shaped ovens, with a wide base and one or two openings, called *tannur* in the eastern Mediterranean, are the model to which most ancient culinary ovens correspond, including the Greeks, Etruscans and Romans (Campanella 2008).

In the study area, ovens of this type are already attested from the Early Iron Age. Among the best-preserved examples, we can mention those from Sant Jaume (Alcanar, Tarragona) (7th–6th centuries BC), which have been extensively studied in an interdisciplinary project (Saorin and Garcia i Rubert 2016), and Barranc de Gàfols (Ginestar, Tarragona) (early 6th century BC) (Sanmartí *et al.* 2000: 32–35). In both cases, the combustion surface is located on a stone construction, 40 cm above the floor level, from which the dome—which has not been preserved either—would have started. The oven at Barranc de Gàfols is located inside a house, in a corner; at Sant Jaume, however, several combustion structures of a similar kind have been attested outdoors. A Phoenician influence has been proposed for these structures (Saorin 2020).

In the western Phoenician and Punic areas, *tannur*-type ovens are well attested, both inside houses—such as in the 'Teatro Cómico' archaeological area (Gener *et al.* 2015: 28)—and in unroofed areas—e.g., at Sa Caleta (Ibiza) (Ramon 2007: 132). In the Iberian culture, ovens were mostly located in unroofed spaces, often attached to the façades of the houses; ovens inside buildings are also attested, e.g., at Tossal de Sant Miquel and Puig de la Nau (Oliver 2006: 122). Both in the Iberian and Phoenician cultures, outdoor ovens are proposed to be for communal use (Mata and Bonet 2015: 475; Ramon 2007).

Other unanswered questions regarding these protohistoric ovens relate to different aspects of their use, such as the maintenance needs of these often open-air structures, and the selection and storage of fuel. To explore these questions further, we have set our focus on the data that ethnoarchaeology can provide. We are aware, however, that the observations made cannot be directly extrapolated to the past.

3. The Riffian ovens: an ethnoarchaeological approach

3.1 *The Al Hoceima National Park*

This ethnographic study has been carried out within the Al Hoceima National Park (PNAH), located in the north of Morocco, along the Mediterranean coast, around 150 km east of the Strait of Gibraltar, near the town of Al Hoceima.

The Park is located in the heart of the central Rif, which is an extension of the Betic mountain range in southern Spain. As the *Atlas du Parc National d'Al Hoceima* (UICN 2012) highlights, it is a region of contrasts, with varied landscapes and exceptional physical and biological diversity. The dominant feature of this National Park is the presence of a stretch of rocky coastline, little exploited throughout history. The limestone massifs that make up this stretch of coastline plunge into the sea in the form of very high cliffs, creating an imposing natural landscape.

The land area of the PNAH covers 285 km² and is densely populated, with around 15,000 people spread over 36 *douars* (small groups of houses), according to the 2004 census. The PNAH area covers the territories of the five rural communes of Izmmourren, Ait Kamra, Rouadi, Snada and Bni Boufrah (UICN 2012).

3.2 *Riffian vernacular architecture*

Our research has been conducted in April 2024 in *douars* or rural clusters of houses within the communes of Bni Boufrah and Rouadi. On rarer occasions, we have visited isolated houses. In all cases, these are built of stone or stone and earth, with flat roofs made of earth mixed with straw. Earth is also employed for wall plaster as well as for wattle and daub walls.

Most houses correspond to the traditional Riffian dwelling previously described by several anthropologists. These buildings consist of a central courtyard with four or more rooms around it, although there are also one-room dwellings; they are mostly single-story houses, but some have two floors. Regarding the central courtyards (or areas adjacent to the one-room dwellings), Azul Ramírez mentions that, until a few years ago, domed earthen bread ovens were commonly built; however, they are gradually being replaced by gas appliances in which women prepare the bread (Ramírez 2023: 74).

During our research, we rarely visited the interior of the houses, but could verify that traditional ovens, although still present, are gradually being abandoned. We compiled information on nine ovens in the above-mentioned communes, although we were able to see only one of them while in use (Belarte *et al.* 2024).

3.3 *The ovens: materials and techniques*

Riffian houses usually possess one oven of the traditional type, called *ayanour* or *thayenour*, depending on the area. They are always located outdoors but do not have a specific or fixed location relative to the house (Figure 4). They can be attached to its façade or to a non-domestic building (e.g., a henhouse or a barn), although they can also be completely free-standing. In none of the cases we have visited were they inside the house or in the courtyard. Despite this outdoor location, they are rarely visible from the streets or other communal areas. Ovens are usually not covered by a roof, nor are there any walls to protect or delimit them. They may have a temporary, removable roof, or simply be covered with plastic or fabric while not in use.

The ovens we have been able to observe have some elements in common, which may vary according to the region or the preferences of the builders or users (Figures 4 and 5). They are usually placed on a kind of podium, with a height between 1 and 1.30 m, cubic or cylindrical, built of mud bricks or of stone and earth, locally called *el hammala*. This podium can be either solid or hollow; in the latter case, it is used as a henhouse or rabbit hutch (Figure 6b). Occasionally, there are side benches attached to the podium that can be used while cooking, and to reach, open and close the opening on the top. Recently, fired bricks have been introduced in the construction of both the podium and the oven dome, as they allow for a faster assembly. We will come back to this later.

The oven itself is built on the top of the podium. The combustion surface, circular and with a diameter between 1.10 and 1.50 m, is made of clay (Figure 6d) without straw. The oven dome is made of clayey earth mixed with straw and usually has two layers. The bond between the two layers is ensured by embedding fragments of pottery and stones in the first one, as we observed in an oven under construction whose dome still lacked the external earthen layer (Figure 6a). Sometimes, the dome is built with fired bricks, and then the final mud coat is applied. The external appearance of the structure in this case is identical to those built entirely of earth; the bricks are only visible from inside the oven (Figure 6c).

Two openings are normally left in the dome: one, at the front, measuring about 40 cm in width and 35 cm in height, and a second opening at the top, measuring between 15 and 20 cm in diameter. Both openings can be closed with removable lids: the frontal one is usually closed with a reused large metallic can lid, whilst the top opening can be covered with different materials: metal (Figure 7c) or ceramic, using a cloth between the lid and the opening (Figure 7b). Ceramic lids can be made of a reused pot or sherd, but sometimes they are made for this purpose.



Figure 4. Example of traditional Riffian oven. a) View from the street. b) Oven 3 in use.

Figure 5. Main characteristics of the nine ovens visited at the PNAH in 2024. Height was measured from the top of the podium to the top of the oven. The diameter was measured from the frontal opening to the back. For the location, the commune is indicated, not the specific douar, to maintain the owners' anonymity.

Oven no.	Commune	Morphology	Height (cm)	Maximum diameter (cm)	Characteristics and materials
1	Bni Boufrah	Oval	90	120	Built on a circular podium. Mud and straw
2	Bni Boufrah	Oval	80	110	Built on a circular podium. Mud and straw
3	Bni Boufrah	Oval	100	120	Built on a quadrangular podium, one side bench. Fired bricks, mud and straw
4	Bni Boufrah	Oval	96	140	Built on a quadrangular podium. Fired bricks, mud and straw
5	Bni Boufrah	Oval	98	140	Built on a quadrangular podium. Fired bricks, mud and straw
6	Rouadi	Oval (conic in the upper part)	92	150	Built on a quadrangular podium. Mud and straw.
7	Rouadi	Oval	80	150	Built on a circular podium. Mud and straw, lime.
8	Rouadi	Oval	95	150	Built on a circular podium. Mud and straw.
9	Rouadi	Oval	92	130	Built on a circular podium, two side benches. Mud and straw; ceramic and brick sherds.

Some specific features with specific functions can occasionally be added. These vary depending on the area or the preferences of the owners. One of them is a sort of ledge just before the front opening. It is used to store the charcoal and embers when the oven is in use (Figure 6e). Over the front opening, a small edge can be used to support the lid. Other ovens possess two side handles (Figure 7a) made from reused pottery sherds: these allow for tying a rope and fixing the plastics or fabric covering the oven temporarily.

3.4 Traditional vs. standardised construction

Traditional ovens are built by women and, as we will see, are mostly used by them. According to the information collected in Bni Boufrah, this is specialised work done by a reduced number of women.

As mentioned above, modern, industrial materials, such as fired bricks, have been introduced to reduce the time needed for the construction process and, consequently, the economic cost. Fired-brick vaults are built by men, whereas women are in charge of the lining. Also, they can help men throughout the construction process.

In any case, the construction of the podium on which the oven rests is the responsibility of the owners. Once this element is built, the specialised person builds the oven on top of it, whether it is made of raw, shaped earth or fired bricks.

Constructing earthen ovens takes longer than using bricks, and for different reasons. First, because no frame is used to build the dome, it cannot be built in a single step: it is made in sections, waiting for the mud to dry in each one before adding the next. Also, because it is necessary to wait for the structure to dry before the first use. The time needed for construction varies between one and eight days, depending on the dimensions of the structure and the builder's skill. It is necessary to wait at least one week before use. In the case of brick-built ovens, construction takes about three hours, plus the application of the

HOW WAS AN IRON AGE OVEN BUILT, USED AND MAINTAINED?



Figure 6. Details of the different parts of the ovens. a) Oven 9, whose dome still lacked the external earthen layer. b) The podium of Oven 3, which is hollow and is used as a rabbit hutch. c) Interior view of the dome of Oven 3, whose inside is built entirely of bricks. d) Interior view of the dome of Oven 7, whose inside is built entirely of earth. Its combustion surface is made of clay without straw. e) View of the ledge of Oven 3 while in use.



Figure 7. Examples of covering systems for the oven openings. a) View of Oven 7, which possesses two side handles and a ceramic (up) and a square metallic (down) removable lid. b) Ceramic lid of Oven 6 made by reusing a tajine. c) Metallic lid of Oven 3 with a rounded shape.

lining. The same person can thus build three ovens in one day. In any case, it is also necessary to fire the combustion surface, made of clay, before cooking inside the oven.

3.5 Maintenance of the structures

The observed ovens are, in all cases, covered with mud. This means that regular repair of the outer layer of the lining is necessary. There does not seem to be a predefined periodicity; instead, maintenance is carried out when necessary and according to use. A clear example was observed in a house at Jnanate (Bni Boufrah), where the family who owned the oven agreed to bake bread with us (Belarte *et al.* 2024). When everything was ready to start the combustion of the oven, it was observed that the lining had fallen off in some places, both on the vault of the oven and the shelf in front of the mouth, and even on the podium on which it was built. Repair was most needed at the vault, as it coincided with the attachment point of the metal lid. Earth material is abundant in the neighbouring buildings, so part of the lining already detached from the wall of the house was taken, mixed with water, and the repair was quickly done just before the combustion started. Afterwards, the fuel was lit without waiting for the newly repaired parts to dry.

In another of the study cases, the owners mentioned that maintenance tasks are carried out once a year, preferably in the summer, avoiding days of higher humidity.

3.6 Functions and uses

The morphological and constructive characteristics of the ovens are perfectly adapted to their main use, which, in all the cases studied, is the baking of bread.

The ovens consist of a single chamber in which fuel is placed, and the bread is baked in two separate phases. First, the chamber is filled with fuel, mainly composed of vegetal elements (branches of trees and shrubs, palm leaves and dried cacti) and occasionally cardboard. The fuel is set on fire and left until it turns to embers, which are then collected on the ledge protruding from the front opening (see Figure 6e) and covered so that the heat is retained and the embers can be reused. The inside of the chamber is then cleaned with a tool made of strips of cloth attached to a handle (a kind of mop, see Figure 7a), previously dampened in a pot of water. Once the oven has been cleaned of the remains of charcoal and ash, the bread is placed inside and the oven openings are closed. The bread bakes in a few minutes thanks to the heat maintained within the oven. Wooden shovels are used to insert and handle the bread in the oven. The entire process, as well as the preparation of the bread dough itself, is carried out by women. The oven has an average capacity of 13 loaves, each one with a diameter of approximately 20 cm.

Throughout the process, the benches attached to the sides of the oven are used as supports for various purposes: e.g., to place the bread and utensils or to stand on to close the upper opening of the oven as previously mentioned.

Ovens are not used nowadays for daily cooking due to the cost and effort involved in filling them with fuel and the time required for the entire process (about two and a half hours from when the fuel is introduced until the bread is baked). But once it has been lit to bake bread, the oven can serve other purposes, such as cooking or heating food. Among the different possible uses of these ovens, our informants mentioned drying fish, cooking tomatoes to make preserves, roasting barley to obtain semolina, preserving bread and storing dry bread. Drying clothes was also mentioned among their possible uses, which is not directly related to cooking.

Another secondary use of the oven is the repair of iron tools by peening after heating the tool. This was not mentioned by any of the families using the ovens, but we were able to observe it firsthand.

These structures are for private use. They belong to one family but can also be shared by different related families. Occasionally, people from other families can use them with permission. In such cases, each family contributes a portion of the fuel. Finally, in one instance, the owners of an oven in a coastal municipality mentioned baking cakes to sell to visitors during the summer.

4. Conclusions

This research has allowed us to obtain first-hand information on the construction processes and ways of using traditional Riffian ovens. From the point of view of construction techniques and materials (except for the incorporation of modern materials in some of the examples visited), they are similar to those documented in the Iron Age ovens. The observation of complete structures provides clues for reconstructing the missing parts of archaeological cases.

Some of the specificities of these structures are not archaeologically proven, but this does not necessarily mean that they did not exist. This is the case with the front and upper openings: although their existence

seems certain in the archaeological ovens, they are not documented (especially the upper one) due to the poor or non-existent preservation of the domes. Likewise, we have no evidence of the existence of a ledge protruding from the front opening (which, in the Riffian cases, has a practical purpose). Having been able to observe it in situ highlights the need to pay attention to signs of its possible existence in archaeological cases.

The visit and study of these ovens and the discussion with their owners have also provided rich information on social aspects that, although not extrapolable to the past, allow us to reflect on comparable behaviours. Among these, it is worth mentioning the information obtained on the cooked products, as well as the use of heat for other secondary functions and tasks. It is accepted that archaeological ovens were primarily intended for baking bread. But the heat was likely used for other purposes after the bread was baked. This seems to have been common in other traditional contexts, as the family of the baker in La Vilella Baixa (Priorat, Catalonia) told us: the inhabitants of the village used to bring some food to him so that he could cook it once he had finished baking the bread or cakes.

Other interesting aspects include the information recorded on the protection and maintenance of the structures, as well as the storage and consumption of fuel. Likewise, their use at the threshold between the private and the public, or the individual and the collective, provides interesting clues for the interpretation of Iron Age ovens. The time required to prepare and bake the bread, the capacity of these structures and the possibilities for secondary uses suggest a shared utilisation of the ovens, also in the past.

Taken together, all these elements reinforce the idea that the oven was a central feature in the life of traditional communities.

The research presented here is still ongoing, and we plan to continue it in the near future to obtain a much larger volume of data that will allow us to complete our conclusions and also raise new questions. Nevertheless, the results obtained in this first sampling are promising and show the interest of this line of study.

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Huts within History: The building of domestic space among indigenous groups in the borderlands of Western Ethiopia

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Abstract

The borderlands between Ethiopia and Sudan have been defined as a frontier mosaic. The expansion of various hierarchical polities over this region since the turn of the era led to increasing pressure on small-scale indigenous societies, which have ended up inhabiting a multi-ethnic borderland under the influence and domination of different states.

The historical constitution of this mosaic territorial pattern has involved different modes of interaction between these societies and with external polities over time. In this text, I argue that the current diversity in the design of the domestic spaces of the huts of the borderland indigenous populations is a key expression of this interaction. The internal architecture of these different domestic spaces responds not so much to a simple criterion of ethnic identity as to a form of political and cultural articulation of historical contact with external hegemonic political entities.

Key words: Materiality, Architecture, Resistance, Ethnic Mosaic, Frontier

1. Introduction

Anthropologist Wendy James (2007) has defined the Ethiopian-Sudanese borderlands as a ‘frontier mosaic’, borrowing a term from Brown and Fernández (1992) to explain the dynamics generated by the historical interaction in eastern Peru between the state figure and the tribal groups that have inhabited its margins. The models of ‘ethnic mosaic’ and ‘frontier society’ have been used to describe many of the interior frontiers in Africa, as they are well suited to the historical processes and mechanisms of ethnic interaction, domination and resistance between states and empires and their margins (Kopytoff 1987; Kusimba *et al.* 2005; Stahl 2004; Triulzi 1994).

Following James’s (2007) general argument, the ethnic mosaic formed by a variety of societies of different origins, and generally very warlike, inhabiting the peripheries and margins of state and empire is not the result of a random and chaotic interaction. Rather, it responds to a territorial pattern generated by the very presence of state or imperial borders. The intervention and territorial expansion of these political entities have profoundly affected the vernacular societies that inhabit the borderlands. The displacement of these populations is the most important consequence, as it leads to the reconfiguration of indigenous territories and often produces processes of ethnogenesis that respond both to the fragmentation of groups and to cultural contact and hybridisation between populations of diverse origins (Kopytoff 1987). States may respond in different ways, depending on their political nature and their interests in land and border populations, but these responses tend to be recurrent. This variety of historical events and scenarios is interwoven to shape the territorial model defined as a ‘frontier mosaic’, the fragments of which are organised into ordered and repeated patterns that ultimately respond to the external agency of states and their presence in peripheral territories or on the margins of their direct area of influence (James 2007: 280).

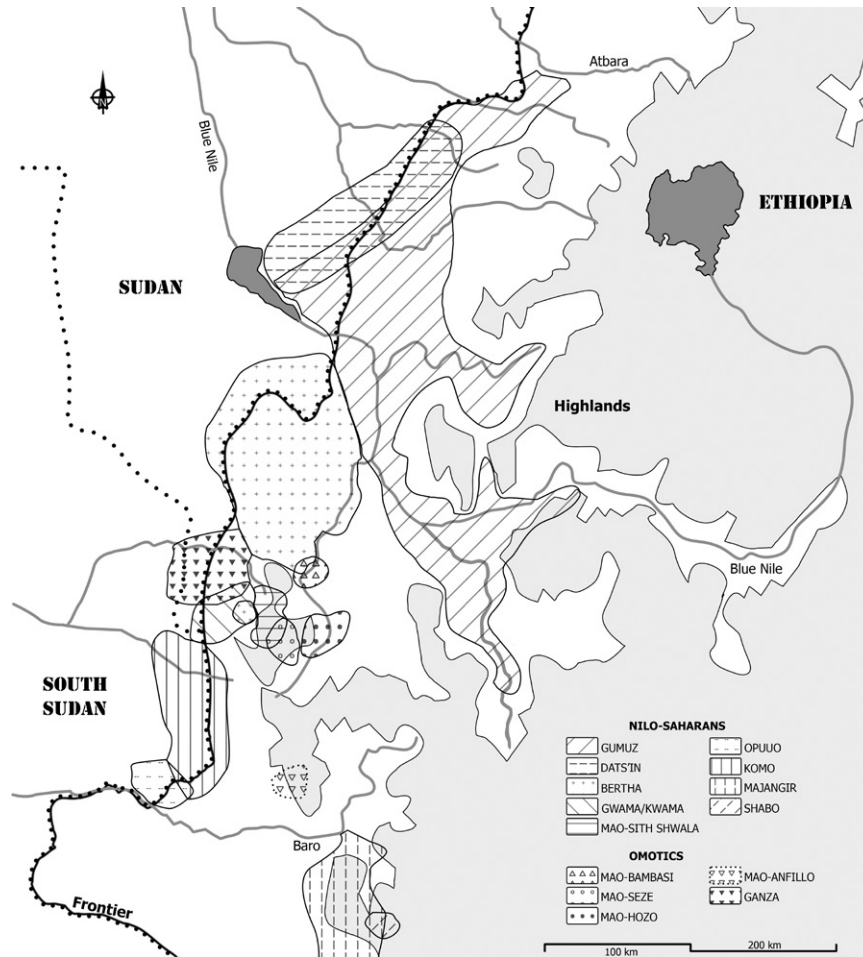


Figure 1. Current distribution of non-hierarchical societies on the Ethiopian-Sudanese frontier. Elaborated by the author.

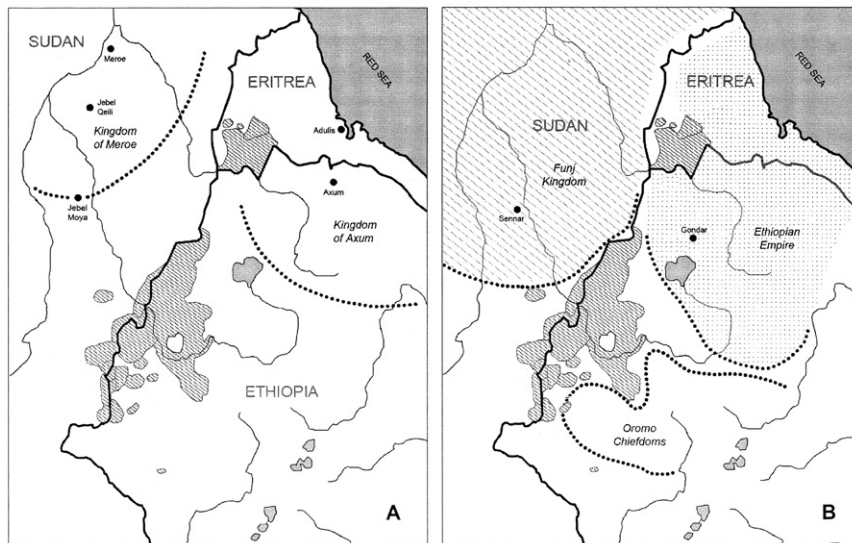


Figure 2. Historical evolution of state expansion from Ethiopia and Sudan over the border between the turn of the era (A) and 17th century AD (B). The dense grid indicates the current distribution of indigenous border groups.

According to González-Ruibal 2014: 55.

The existence of the great diversity of societies and ethnic groups that now populate the lands between the western edge of the Abyssinian highlands and the Sudanese Sahelian plains is a perfect response to the configuration of this type of territorial pattern generated by the influence of different hierarchical polities in the area throughout history (Figure 1). Contact with the state figure was most intense for the small-scale communities located on the peripheries and margins of the historic kingdoms of the Sudanese Nile and the Abyssinian highlands, which extended their influence into the territories north of the Blue Nile from the mid-1st millennium BC to the mid-2nd millennium AD (Connah 2016: 69–148; Tadesse Tamrat 1988a, 1988b). However, communities south of the Blue Nile did not come into contact with hierarchical social organisations until the 16th century AD (González-Ruibal 2024) and, more intensively, with the figure of the state from the 19th century AD, with the expansion of the border territory of the Oromo chiefdoms, the Ethiopian Empire and the Sudanese Islamic State (Negasso Gidada 2001; Triulzi 1981) (Figure 2).

But the presence since ancient times of various states and kingdoms around this region of the Horn of Africa, and their influence on the indigenous areas and populations beyond its boundaries, cannot alone explain the historical dynamics underlying this territorial pattern of frontier. In this context, neither the historical agency of these societies nor the motivation for their actions should be underestimated. The fragmentation and ethnic and linguistic diversity of the frontier zones between states and empires have given rise to other conceptualisations in order to explain a truly complex historical and territorial reality. In this sense, another term used to describe these border territories, made up of a complex aggregation of fragments formed by numerous ethnic groups and diverse languages, is the ‘shatter zone’. The concept has been coined by anthropologist James Scott (2009) to describe the highlands and mountains of Southeast Asia as a frontier area. In this geographical region, numerous communities have historically settled in an attempt to avoid control and assimilation by the states in the area. Scott’s work underlines the importance of the political agency of these societies. These territories made of pieces, in addition to being shaped by the influence of the commercial, predatory and expansionary policies of the surrounding state formations, have above all provided a refuge and a space of resistance for different societies, groups and individuals over time. This has allowed them to develop ways of life with varying degrees of autonomy from the dominating political entities.

In the case of Western Ethiopia, the historical evolution of the borderlands and the differential contact of small-scale societies with various hierarchical polities have led to the development of different strategies of political, social and material resistance among these communities (González-Ruibal 2014). North of the Blue Nile, with more time to adapt to the presence of state and predatory formations in their environment, the most widespread strategy has been that of open resistance and cultural empowerment of communities as a guarantee of their long-term survival. South of the Blue Nile, on the other hand, the implantation of state societies in the territory has taken place in modern times and has been much more rapid, so that resistance strategies have consisted mainly of flight or resilience after assimilation.

In this context, the built environment has played a key role in the historical adaptation of these indigenous societies in an adverse environment such as the frontier lands, articulating and mobilising their different material strategies of interaction and resistance (Falquina Aparicio 2018). The following paragraphs will be devoted to the way in which, through the different internal architectures of the domestic space, these different material responses to contact between societies have been articulated (for a similar approach to the evolution of vernacular wall-building systems in Senegal, see Pelmoine 2022). These architectures have acted as a nuclear device for the political and identity negotiation of historical contact between indigenous groups and hierarchical polities in the configuration of the frontier mosaic that is western Ethiopia.

2. A hegemonic hut for a border mosaic: the imposition of the cylindrical-conical model on vernacular architecture

The present-day indigenous populations of the western borderlands of Ethiopia are composed of a diverse group of small-scale societies speaking Nilo-Saharan and Mao languages. Probably descended from the hunter-gatherer groups of the west and southwest of present-day Ethiopian territory, from the turn of the 1st to the 2nd millennium AD they started to become slash-and-burn horticulturalists (Fernández Martínez 2003).

These groups are organised in patrilineal segmentary societies, whose political system is based on alliance through marriage by restricted exogamous exchange (Grottanelli 1948; James 1975, 1986). These are groups with a markedly communal character and a system based on moral economy, in clear contrast to hierarchical entities embedded in a market economy (cf. Graeber 2011). These groups, defined as ‘deep rural’, have historically shown strong resistance to subjugation by external powers, unlike peasant societies (Jedrej 2004, according to Fanthorpe 1998). One of the main features of their resistance strategies has been ‘conservative change’, developing devices of cultural appropriation and material bricolage that have enabled them to survive on the margins of states over centuries. The materialisation of these change-refractory responses of cultural hybridity becomes evident when analysing the internal architecture of domestic space, as it has acted as a device for the adaptation of ‘deep rural’ societies to the new human ecosystem generated by the presence of state frontiers.

The historical advancement of state political formations and the process of generating the frontier mosaic pattern in this territory have strongly influenced the architecture of the borderland populations, mainly due to the expansion and hegemony of the Ethiopian Empire. In this regard, one type of dwelling is now widespread among the groups inhabiting the western lands of Ethiopia, whether indigenous or not. This is the circular hut, 6–8 m in diameter, with a cylindrical wall made of wooden or bamboo poles and enclosed with bamboo interlacing or bundles of straw. The structure is topped with a bamboo-framed conical roof, covered with thatched bundles (Figure 3). Among small-scale societies with slash-and-burn agriculture this roofing is made with wild straw, while among farming populations originating from the high plateau the material used is cereal straw. The perimeter wall may also be plastered or covered with mud on the inside or on the outside, depending on the region and the ethnic groups living there. This basic architectural structure houses a multifunctional domestic space containing the main activity areas of the hut, such as sleeping quarters, kitchen, harvest storage and grinding area.

This building has different configurations inside and can be organised in an open-plan or compartmentalised space. The variability corresponds in the first place to the deployment of a model of internal organisation of the domestic space specific to each ethnic group. But it is also possible to observe differences within each of them or regional inter-ethnic convergences, which are due to the historical conditions of existence of each community and involve contact and coexistence with other ethnic groups in the same territory, whether they are non-stratified or hegemonic.

The cylindrical-conical hut is the typical dwelling among the main Semitic- and Cushitic-language ethnic groups (Amhara, Eritreans, Tigrins, Oromo or Sidama) (Grottanelli 1940: 138), and its presence among the frontier groups is considered an import from the sedentary societies of the high plateau. In fact, it is a widespread housing pattern throughout Ethiopia and has been assimilated by most of the ethnic groups inhabiting the peripheral areas of the great central Abyssinian plateau. The wide diffusion of this hut has been a substantial part of the historical construction of a pan-Ethiopian cultural tradition (Levine 1974: 59), which has acted as a unifying ideology within the Abyssinian state’s imperialist strategy of expansion and integration of peoples and territories over at least the last millennium (cf. Tadesse



Figure 3. Gumuz compound consisting of a group of cylindrical-walled, thatched-roof huts, Gelegu River valley (Qwara woreda, Amhara). Photograph by the author.

Tamrat 1988a, 1988b). On the other hand, at least since the last century, the cylindrical-walled, conical-roofed hut is also the most widespread model throughout the Nilotic Sudan (Grottanelli 1940: 138).

Today, a process of material renewal of this integrative ideology can be observed within the framework of the contemporary Ethiopian multicultural state and the logic of modernity. In the process of land occupation and resettlement of highland populations in the borderlands of western Ethiopia, the rectangular-plan dwelling with wooden post trusses, wattle-and-daub walls, compartmentalised into rooms and a gabled roof made of corrugated zinc sheeting, covering the main façade to form a portal or gallery, is beginning to spread from the urban to the rural environment. The gradual adoption of this type of building, which coexists with the cylindrical-conical hut, which is still the majority, responds to a modernising impulse of the rural environment based on the developmentalist policies of the Ethiopian federal state which, at the same time, acts as a marker of wealth and status between families in peasant societies and of these with respect to small-scale societies.

Today, however, it is still possible to observe a different type of hut, which is considered to be the oldest type in the entire border territory. This is the *capanna alveare* or beehive-shaped hut, first documented by the anthropologist Vinigi L. Grottanelli (1940: 138 ff.). In the 1940s, Grottanelli considered the hive-shaped hut to be in the process of extinction, but during our years of fieldwork, we have been able to see numerous examples of this type of structure (Figure 4). Its use is still considerably widespread among



Figure 4. Beehive-shaped hut in Mao-Sit Shwala village of Boshuma (Bambassi *woreda*, Benishangul-Gumuz). Photograph by the author.

Mao populations today—mainly Sit Shwala and Hozo. Generally, the Mao use this type of hut in addition to the perimeter wall and conical roof, and it has a very marked function as a ritual house (González-Ruibal 2013), although it is still possible to see dwellings built following this model. Its ground plan is also circular, but its elevation is flared and integrates wall and roof in a single body made by means of radial wooden poles. The upper end is pointed because the dome is built by joining the perimeter posts in the centre of the building. Of archaic appearance, Grottanelli considered this hut to be the model of vernacular housing that was widespread throughout the transition zone between the Abyssinian highlands and the Sudanese plains before the imposition of the cylindrical-walled, conical-roofed hut model. In fact, he documented this type of structure in two Gwama villages and it is still used today by other Nilo-Saharan groups, such as the Kunama and Nera of the Eritrean-Sudanese borderland and the Toposa group of Sudan, who live along the southern border of Ethiopia (Bødøgaard 1998; Grottanelli 1948: 298). Furthermore, Grottanelli (1940: 142) intuited that this type of hut must have been the traditional dwelling structure among the Nilotic populations of southern Sudan, since during the first half of the 20th century there was still evidence of its construction by the Shilluk, Dinka and Nuer.

The construction technique of the beehive-shaped hut is also reminiscent of that used today by several mobile agro-pastoralist societies in the Omo River region of southwestern Ethiopia. The Mursi dwelling—a Nilo-Saharan population of the Surmic branch—is a single-bodied hemispherical hut, whose dome is built with wooden poles forming meridian arches (Salazar *et al.* 2017: fig. 3). The Dorze dwelling—a group belonging to the Northern Omotic linguistic branch, distantly related to the Mao languages—also shows structural similarities with the beehive-shaped hut (radial structure by approximation of poles

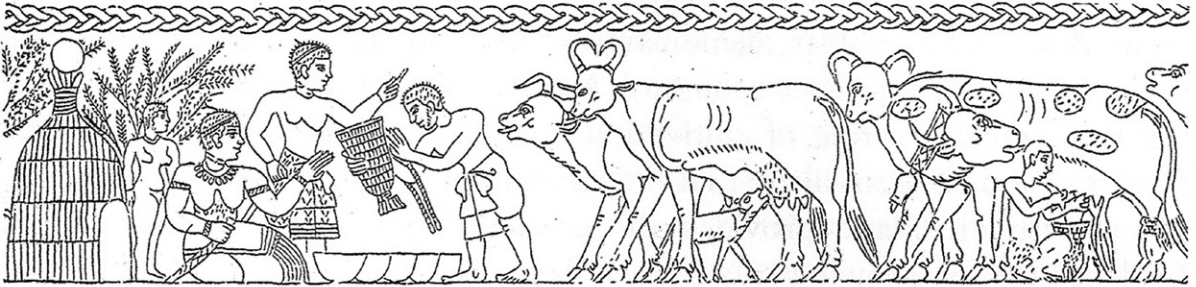


Figure 5. Detail of the scene showing a beehive-shaped hut on the left of the image (Connah 2016: fig. 4.9).

and bell-shaped), despite the technical differences and the constructive materials used in each case (cf. Olmstead 1972).

There are two documents that show the widespread use of this architectural model in Sudan and the Horn of Africa since ancient times. The first is mentioned by Grottanelli himself (1940: 143–144, after Conti Rossini 1928: 44 ff.) in his research on the historical distribution of the hive-shaped hut. This is a bas-relief sculpted on the west side of the portico of the temple of Ammon at Deir el Bahari, depicting the first expedition of the Egyptian Empire to the country of Punt (which the Italian anthropologist identified with the north-eastern sector of Ethiopia) during the 18th Dynasty (c. 1550–1295 BC). This work contains several depictions of huts belonging to the indigenous populations of that territory.

The second document is also a relief, in this case on a bronze bowl from the Meroitic period (c. 500 BC–AD 350) found in the necropolis of Karanòg in Egyptian Lower Nubia (Connah 2016: fig. 4.9, after Woolley and Randall-MacIver 1910: vol. 4, fig. 27). It depicts a scene in which a man offers fresh milk to a woman who is seated in front of a clearly beehive-shaped hut (Figure 5). The depiction is sufficiently accurate to see that the structure of the building is a single body made of plant material, with a pointed top formed by the union of the perimetric posts that make up the body of the hut. The scene may represent the pastoral communities that populated the eastern Sahara and the Butana in the Meroitic period, and which had a close relationship with the Nubian kingdoms from their origins. However, it seems more likely that the huts of these nomadic groups were similar to those still used today by the Beja, Afar or Somali pastoralist societies, which share a type of hut—or tent—of hemispherical or oval shape, whose dome is built with wooden poles forming parallel arches and covered with plant-fibre mats. Its detachable structure makes it a temporary and mobile dwelling perfectly suited to nomadic livestock farming. Grottanelli (1940: 138, 144) considered this model to be culturally different from the hive-shaped hut, which is built with a much more stable radial structure of poles.

In addition to the use of the Mao hive-shaped hut, the bulging and sloppy shape of the roofs of the present-day cylindrical-conical huts of Gwama and Gumuz, as opposed to the perfect conical shape of the roofs of the dwellings of the highland communities, would seem to be reminiscent of the presence of the hive-shaped hut among these groups in the past. In this regard, a brief description of the Gumuz hut from the 18th century AD is preserved, which had a structure apparently similar to this type of hut:

The Shanqellas [Gumuz], during the fair half of the year, live under the shade of tree, the lost branches of which they cut near the stem on the upper part and then bend, break them down planting the ends of the branches in the earth (James Bruce, quoted in Pankhurst 1977: 27).

However, despite the cultural specificities that support the differentiation between dwellings with a parallel-arched structure and those built with meridian arches, both hut models are still built on a single-bodied structure where the building is not divided into wall and roof. This basic structure seems in all cases to be related to lifestyles based on mobility, whether pastoral nomadic or mobile horticultural. Meanwhile, the hut that differentiates the cylindrical wall from the conical roof seems to relate to peasant or agro-pastoral societies, in contact with or immersed in a hierarchical socio-political system.

In short, a plausible hypothesis, in the absence of strong archaeological evidence, is that if the circular hut model separating roof and wall is originally typical of highland peasant societies, the non-hierarchical frontier societies would progressively abandon the use of the single-bodied radial structure huts to adopt the cylindrical-conical model from the moment when the contact and colonisation of the western frontier by the state societies of the Ethiopian highlands became more intense, their mobility was reduced, slash-and-burn agriculture became the main subsistence activity as opposed to foraging activities, and their settlements became more stable—although without losing the constructive dynamism that characterises them today.

3. Vernacular huts tell the history of the frontier. Architectural variability for a common spatial pattern

In the realm of domestic space, it has been proposed that small-scale societies in Western Ethiopia share a common spatial pattern that is embodied in a type of domestic space that acts as a body, ordering the social actions and practices of humans and things according to a system of agency based on the physiological principles of the human body (Falquina Aparicio 2017).

Alongside this spatial pattern that mobilises the material agencies of the house as if it were a human body, common to all ‘deep rural’ groups in western Ethiopia, we have also found a variety of structural and constructional elements present in the interiors of the huts on which the diversity of regional and ethnic patterns rests. In all cases, it is possible to make a historical and political reading of the presence of these architectural elements. In a typical hut with a circular floor plan and a conical thatched roof, open-plan centres, central posts and platforms, concentric structures of posts, concentric interior walls or party walls respond to a more political than cultural logic, constituting the basic material expression around which contact between different ethnic groups and societies is articulated throughout history.

To make this point, I will give two examples. The first deals with the huts of the Gumuz communities north of the Blue Nile, while the second describes a type of hut found in several groups south of the great river. This division is based on historical criteria. As we saw earlier, until the 16th century AD the borderlands had remained around the course of the Blue Nile, while the southern lands were outside the sphere of influence of the northern kingdoms. From that time onwards, the process of expansion of different state polities and predatory chiefdoms into these territories began, culminating in the early 20th century AD with the establishment of the present-day border between Sudan and Ethiopia (Gwynn 1901).

3.1. *The Gumuz and empowerment in the ancient Christian frontier of the Blue Nile*

Today, the ‘concentric hut’ is the vernacular dwelling model among the Gumuz of the Metekel Area (Benishangul-Gumuz Regional State), which constitutes the current core territory of this group. It is a building with a cylindrical-conical structure, whose roof is supported from the inside by a central pole around which a circle of secondary posts is distributed (Figure 6). These elements, together with the perimeter wall, compose a concentric figure in plan that defines the internal organisation of the space and the domestic artefacts. The presence of the posts gives the interior of the hut a truly monumental appearance.



Figure 6. Gumuz hut under construction, showing the concentric structure of posts supporting the roof from the inside. Photograph by Xurxo Ayán Vila.

The internal organisation of the domestic space is adapted to the concentric structure of the hut. The sparse furnishings and most of the objects are located in the perimeter space, usually attached to or hanging from the wall. The central area, delimited by the intermediate circle of posts, remains diaphanous and only the cooking fires are located here. In the centre is the main post of the dwelling, known as the *michina*. In this space, taking advantage of the structure of concentric posts and the central pole, a raised rectangular wooden platform is built, which is used as a storage space for the cereal harvest (Figure 7).

The central space is the main sacred area of the house, as the central pole is home to *mus'a mets'a*, the protective spirit of the hut and its inhabitants. *Musa* is the Arabic name for Moses, who has a pre-eminent role in Sudanese Islam and Ethiopian Orthodox Christianity, as well as among the highland minority groups who have had historical and current contact with the Gumuz (Quirin 1998). Ironically, this figure has been assimilated by the Gumuz as part of their strategy of resistance against the state. As a group that has been invaded and enslaved by various states since ancient times, one of the foundations of this strategy is the reworking of their myths of origin through the assimilation of external influences as a form of empowerment in the face of the subjugation of the dominating societies around them (González-Ruibal 2014: 107–112).

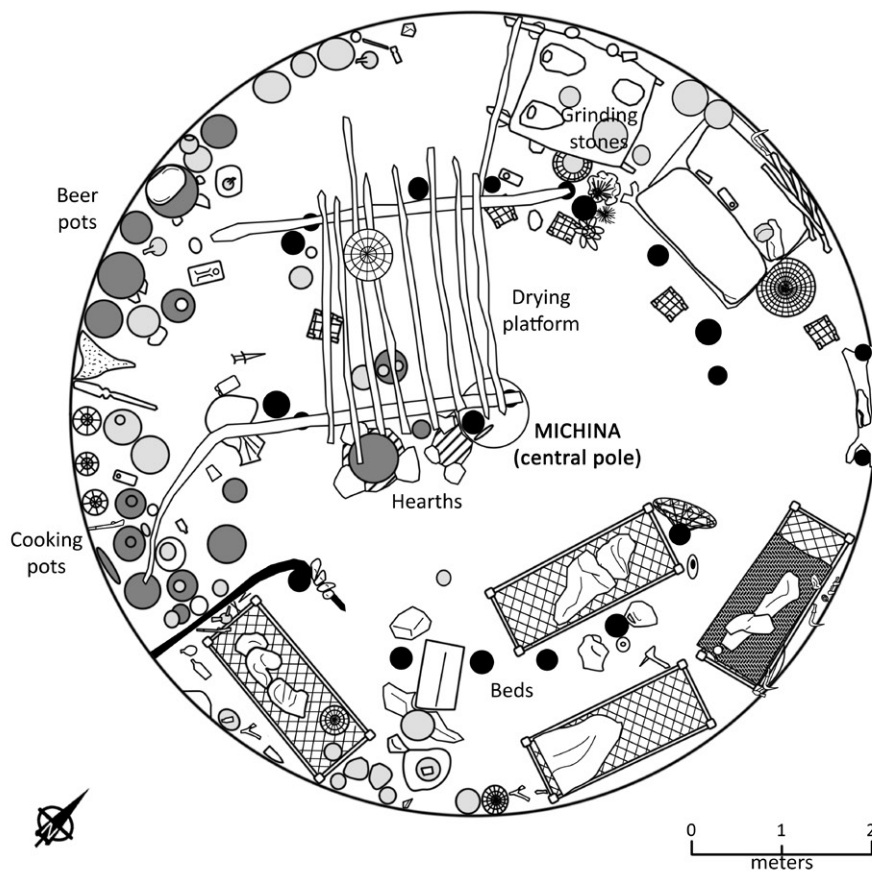


Figure 7. Above: central pole with pedestal of clay, from which hang various valuables and ritual objects (*Mandura woreda*). Below: floor plan of a hut in the village of Bawla-Dibatsa (*Dangur woreda*). Photograph by Alfredo González-Ruibal, plan by the author.

This is a *phagic* strategy among the Gumuz, a practice whereby a society incorporates elements foreign to its cultural tradition in order to reinforce its own identity (cf. Bauman, 1995; Lévi-Strauss 2001 [1955]). In this sense, the figure of the liberating prophet and protector of slaves fits perfectly into the Gumuz history and worldview, which have assimilated him to the multiple protective spirits they possess: some examples are *mus'a mets'a* (the spirit of the house), *mus'a dēma* (spirit of water and rain), *mus'a dib'a* (spirit of the granary) or the multiple protective spirits of each clan.

The most relevant fact about the adaptation of the figure of Moses to the body of traditional religious beliefs is that the idea has been assimilated by means of a material element foreign to the vernacular architecture of the border groups. The central pole of the hut is irrelevant among the Nilo-Saharan and Mao groups. However, it is a building element of great symbolic and ritual importance among the Metekel Gumuz, as well as among the major highland groups. In Ethiopia, domestic architecture, and specifically the central pole, has acted as one of the main vehicles for the hegemonic construction of a pan-Ethiopian cultural identity (Levine 1974: 59). Among all the highland groups that have come into contact with the Gumuz throughout history, whether ancient or recent, the central pole is an element imbued with relevant social and religious properties, so it is quite likely that the Gumuz adopted it as an external element of power for their protection.

As I said, for the Gumuz it is the place where the protective spirit of *mus'a mets'a* dwells. In this sense, it acts as an apotropaic element against illness, misfortune and all kinds of evils. As among their Boro neighbours—for whom the central pole (*ira*) is a ritual and religious element of crucial importance, as they pray to their god *ik'o* through it—among the Gumuz the main rituals take place around the central pole. There they pray to *mus'a mets'a* for protection for children, health and good harvests. Rituals for the healing of sick children also take place around this element. Like the Boro, the Gumuz make offerings to the protective spirit of the house, the most significant of which are made during the ritual of the inauguration of the house and the first fruits of the harvest. In the inaugural ceremony, after the feast in which the neighbours who have collaborated in the construction of the house are invited to eat porridge and drink beer, a rooster is sacrificed and its blood is smeared on the pole and spread on the floor of the hut. To make the offering of the first-harvested fruits, these are hung on the central pole and *mus'a* is prayed to. The floor of the hut is then sprinkled with traditional beer, porridge or schnapps. In addition, it is common to see all kinds of objects hanging from the pole as part of the daily rituals of blessing and protecting the family: money, medicines or students' textbooks.

The monumentalisation of the central interior space of the hut seems to be related, therefore, to an increase in the religious and ritual emphasis of this area, in contrast to the rest of the border populations. However, its symbolic character is due to a process of cultural bricolage in which traditions of diverse origins are amalgamated among the highland societies. In fact, the name Gumuz for the central pole, *michina*, seems to derive by homophony from the name it receives from another neighbouring population, the Agäw, with whom they have shared territory since at least the first half of the 2nd millennium AD (Taddesse Tamrat 1988b). For the Agäw, the *mosisini*, or central pole, has a function similar to that given by Boro and Gumuz. The Agäw designation for this post would in turn derive from the word *meseso*, the name by which the Amhara call the central post of their dwellings from the highlands.

For the Amhara this area is a space where the most rewarding and intense social experiences take place (Levine 1974: 59), a function that probably derives from the religious architecture. Orthodox Christian churches organise the space according to a concentric logic. The centre is a sacred space enclosed by a cylindrical wall to which only the religious hierarchy has access and in which is kept the *tabot* or ark of the covenant, the most important sacred object for the Orthodox church, the basis of the power of the Ethiopian Solomonid monarchy.

The sacred character of the central area of the Gumuz hut gives specific qualities to the elements and the activities that take place there, which seem to have a special link with the protective power of *mus'a mets'a* and the central pole. In this sense, it is no coincidence that the hearths and the platform for drying and smoking the harvested grain are located there. The arrangement of these elements and activities in the central area would point to an emphasis on the sacred protection of the substances and processes for the nourishment of the family and the community, which has a bearing on the exacerbated involvement of the Gumuz culture with fertility, survival and the continuity of society (González-Ruibal 2014: 135).

Therefore, the concentric division of the areas of activity inside the Gumuz hut implies a segmentation of space in which the central area is the most religious and ritual place, while the perimeter space is related to daily domestic activities and has a more profane character.

3.2. *The Gumuz and Mao subordinate societies of the modern frontier*

The Kamashi region, immediately south of the Blue Nile, is also an area that is mainly inhabited by Gumuz people. In all the villages we were able to visit, the hut pattern used is the concentric type described above. However, in the districts closer to the Oromo region of Wollega, the concentric huts usually also have an inner party wall made of bamboo, with a central access connecting the front and back parts of the domestic space. Although the activity areas and related objects are usually located in the same way as in the rest of the Gumuz territory, the subdivision of the interior space and the arrangement of the beds tend to compose a domestic space similar to the interior of the Oromo huts, in which the front part starts to become a kind of living room for the men (with some furniture, such as long benches) and the back part tends to agglomerate the rest of the activity areas (kitchen and sleeping areas), mainly female areas, which were previously distributed over the entire surface of the hut.

In the areas where contact between Gumuz and Oromo has been more intense historically, the former have abandoned the concentric model and developed a different hut model, which can be called 'pauperised'. The latter has smaller dimensions, a quadrangular floor plan with rounded corners, an interior party wall and a neglected appearance. However, the activity areas tend to be organised in the familiar Gumuz manner, adapting to the new floor plan design (Figure 8).

The Gumuz who live with the Oromo show a marginalised way of life. As a consequence of the interaction between Gumuz and Oromo and the introduction of a monetary and market economy in the region, the Gumuz here see themselves as poor, perhaps as part of their resistance strategy by circumventing the introduction of the monetary economy in marriage exchanges and avoiding marriage with the Oromo through the system of 'bride wealth' (James 1986: 130–132).

The 'pauperised' hut model of the Gumuz of the Kamashi highlands seems to act as the spatial materialisation of this socio-political and economic context of cohabitation and subalternisation of a non-hierarchical community. Although the organisation of domestic space is distributed in the same way as in the previous case, the loss of the circular floor plan and the existence of the dividing wall tell us of a new socio-spatial logic that seems to respond to the principles of the divided society. In general, the segmentation of domestic space has been conceptualised as a feature of greater socio-economic complexity (Kent 1990). In this case, it seems that the inner diametral wall could represent the social division within the framework of a hierarchical relationship in socio-economic, but also political and cultural terms, between the Gumuz and the Oromo of Kamashi and Wollega. The most striking feature of this new formal structure is that the kitchen area is greatly reduced in space and out of sight by being placed behind a wall. The integrating role of women and their relation to the maintenance of the family and the community is constrained and relegated, which in a way makes the community

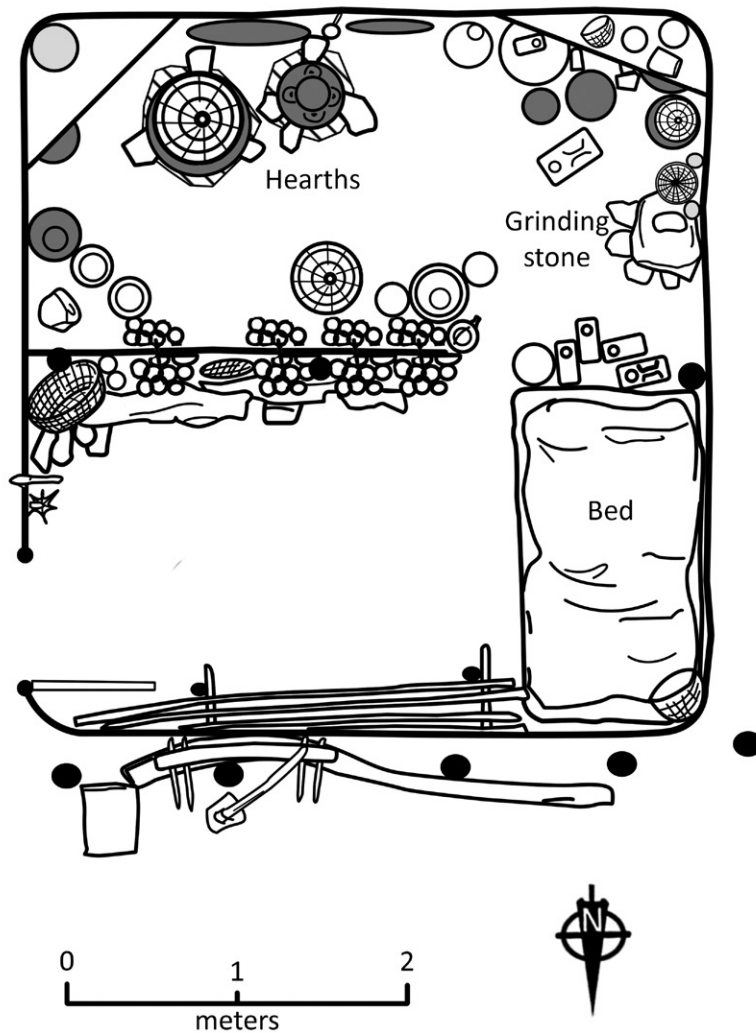


Figure 8. Plan of a Gumuz hut in Dimtu village, Kamashi Zone highlands.
Plan by the author.

of equals as a whole invisible in the domestic sphere, in its spatial and architectural expression. In this sense, the 'pauperised' hut constitutes the Gumuz as a subaltern subject within the framework of political, cultural, social and economic relations with the hegemonic and predatory hierarchical Oromo society. This point is reinforced by the fact that this same type of hut appears among the 'deep rural' populations south of the Blue Nile who live alongside the Oromo.

The Gwama, Kwama and Mao communities south of the Blue Nile, in continuous contact with the Oromo populations since the 17th century, have responded in a similar way to the Gumuz populations of Kamashi. Most of the huts of these groups are cylindrical-walled, conical-roofed buildings, with a party wall diametrically dividing the interior of the domestic space (Figure 9). The party wall seems to be again, in this case, an import from the highland Oromo communities. Among the groups with more intense contact with the Oromo, this wall is sometimes referred to as *Shangalla*. *Shangalla* (or *shanqilla*) is one of the pejorative designations given by the Ethiopian highlanders to the savage lowland communities

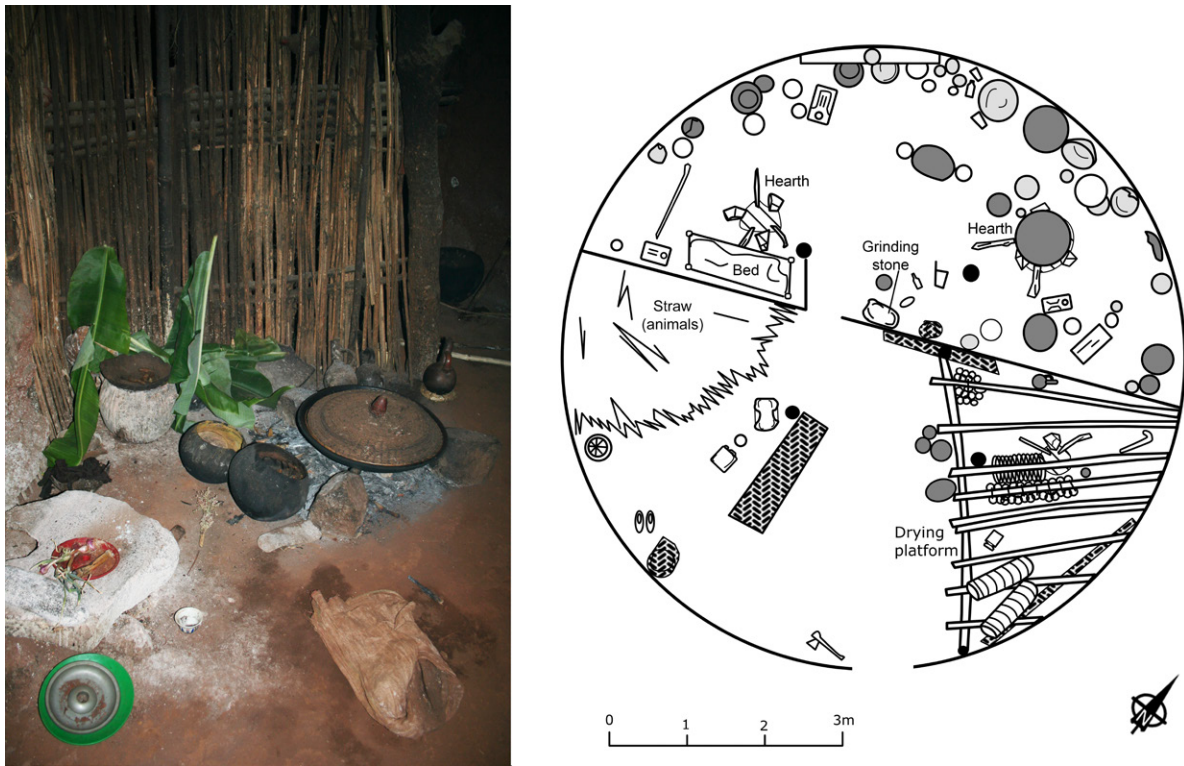


Figure 9. Detail of the kitchen area behind a party wall at Ishgogo-Gedashola (left) and floor plan of a hut at Boshuma (right), both villages of the Mao-Sit Shwala group in the Mao-Komo special *woreda* (Benishangul-Gumuz). Photograph by Alfredo González-Ruibal, plan by the author.

of the western borderland who have historically been subjected to slave raids (Pankhurst 1977). In this sense, if the inner party wall is an Oromo import, its use by Mao, Gwama and Kwama populations could be acting as a mnemonic marker of the time of enslavement by predatory Oromo chiefdoms.

In short, given the extensive Oromo presence in the frontier territories south of the Blue Nile, the diametrical inner wall seems to be acting between Gwama, Kwama and Mao populations as a material marker of the process of conversion of these groups into subaltern communities, in a context of hegemonic domination by the Oromo, as was precisely happening among the Gumuz of the Kamashi highlands. The Oromo are a hierarchical society with socio-economic differences, which historically assimilated all the peoples they came into contact with, in the process of expansion towards the western borderlands. Many of the groups adopted the new Oromo identity without any problems, because they were ethnically, socially and economically very similar, and became part of the Oromo society. In contrast, the Nilo-Saharan and Mao communities living alongside them have not been able to be easily adopted, as racial and cultural differences, as well as the assimilation resistance strategies developed by these societies, have been a major obstacle. The Oromo have chosen, in this case, to marginalise and make them invisible. The attitude of political resistance in this case is evidenced through the expression of cultural otherness in the face of attempts at phagocytisation by Oromo society, even if it implies a certain acceptance of the subaltern and marginalised position (González-Ruibal 2014: 241–265).

4. Discussion

We cannot speak of a traditional type of hut for frontier groups, since its constitution is historical in each case, as I have tried to show in this text. The circular design of the hut plan characteristic of these

groups imposes a series of spatial restrictions within the domestic interior. As a geometric figure, a circle has two main spatial dimensions: one with respect to the centre and the other with respect to the diameter. The centre, understood as a focus and always in relation to the hearth of the dwelling, has political and cultural connotations that relate the formal structure of the huts to the idea of a higher power that gives a contextual and historically situated form to the community: among the Gumuz communities inhabiting areas where there has been greater historical contact with the Abyssinian states, the hut centre expresses and articulates that political and cultural relationship through the presence of the central pole, just as the Bertha hut centre, another border group, has articulated its historical relationship with the Sudanese kingdoms of the Nile.

The diametric dimension, on the other hand, supports the division into binary categories within society and exists in all border groups in the way areas of activity are organised. The organisation of the domestic space into a front half and a back half orders social relations within the family and defines the positions of each person in society (Falquina Aparicio 2017). However, when a physical division of the front and back spaces of the huts appears, materialised in a diametrical wall, it always does so in areas where there is an important presence and political hegemony of the Oromo society. Contact with this group is therefore not expressed materially through the centre of the hut, but through the diametral division. The idea of power in Oromo society does not refer to a superior or divinised power, as it does in the Ethiopian monarchy and Christian state, but rather to a power based on class division and social hierarchy. The most striking aspect of the diametrical wall is not the binary division of the interior space of the dwelling, something that already exists in the common spatial pattern among indigenous border communities, but the spatial constriction and invisibilisation of the rear. This fact has important political implications for the expression of the non-hierarchical community characteristic of frontier groups, because women and ancestors, both closely related to the back of the house, are the two key social entities through which the reproduction and continuity over time of the family and the community are constituted and sustained. The diametrical wall, therefore, seems to work on the reduction of community power among indigenous societies and their inclusion in a hierarchical socio-political system that places them in a subordinate position.

To conclude, however, I would like to insist on the idea that the adoption of culturally foreign structural elements within the domestic space of indigenous frontier societies of western Ethiopia does not necessarily imply a passive assimilation of the principles of inequality and power that these same elements represent in the more complex societies from which they originate. As I have tried to explain, the concentric Gumuz model is part of a strategy of resistance and politico-cultural empowerment in the face of coexistence with and submission to the statised societies from the Ethiopian highlands. For its part, the Gumuz, Gwama, Kwama and Mao diametrical wall hut model partly implies the acceptance of a subaltern position vis-à-vis Oromo hegemony. But it does not imply cultural assimilation, since the diametrical division of domestic space already exists and is common to all groups in the cultural context of border societies, although it is not physically or architecturally expressed. In this case, the strategy of resistance front to Oromo society consists in the acceptance of the subaltern position and marginality, which is a failure of the very strategy of population absorption (i.e. the process of 'Oromoisation') deployed by this group in the face of historical and contemporary contact with other societies, throughout their process of expansion into the border territories of western Ethiopia.

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Building traditions through time in the Mazatec Highlands (Mexico). Strategies for heritage valuation and traditional knowledge recovery

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Abstract

Building practices of the Mazatec Highlands involved the use of a wide variety of local materials. Initially, earthen constructions were elaborated using the technique of wattle-and-daub and later, using adobe. In the 1960s, some houses had a layer of finer clay mixed with lime whitewash, which over time has been replaced by cement as paved roads were built (between the 1950s and 1960s) and industrialised materials entered the region. This particular situation constitutes both the loss of ancestral knowledge and a health problem, since cement is incompatible with earth and, when it is used as a plaster in adobe houses, it eventually cracks and contributes to the reproduction of harmful insects such as *Triatoma dimidiata*, responsible for the Chagas disease. Thus, as part of a strategy of conservation, recovery of knowledge and valuation of this heritage, we have organised workshops to resignify the Mazatec house and relearn how to make earthen plasters. Thereby, the interest of this text is to share this experience with researchers from other regions in a similar situation, in order to contribute to the conservation and valuation of the heritage of earthen building traditions.

Key words: Oaxaca, adobe, earthen plasters, Chagas disease, traditional building techniques

1. The case of Mazatlán Villa de Flores municipality in the Mazatec Highlands (Sierra Mazateca)

Mazatlan Villa de Flores is a municipality located in the highlands of the Sierra Mazateca and part of the Cañada region of Oaxaca, Mexico, a highly marginalised zone (Figure 1) with a population of 12,722 inhabitants. Spanish (the official language of Mexico) and Mazatec (part of the indigenous heritage) are the most widely spoken languages in that region, where 30% of the population is still monolingual and a low percentage have lost their mother tongue, a process that has unfortunately accelerated in the last decades.

2. Mazatec traditional building systems in the 20th century

Historical and ethnographical accounts prove that there was a wider variety of local building materials, as well as traditional house designs and building techniques, at the end of the 19th and early 20th centuries.

Regarding the traditional construction of contemporary indigenous populations in the state of Oaxaca, existing analyses are scarce and, with few exceptions, most of them are architectural studies (see, for example, De Leo 2015; Torres Zárate 2012, 2013; Zafra and Gastellum 2012). An example is the *Catálogo de Arquitectura Vernácula de Oaxaca* (De Leo 2015), in which the importance of geographical, climatic and cultural contexts, which influence the variability of housing types, is emphasised. The author focuses



Figure 1. Location of Mazatlán Villa de Flores, Oaxaca, Mexico. In yellow, the approximate location of communities within the municipality where fieldwork was carried out between 2022 and 2024 (originally taken from Google Earth).

on the architecture of rural areas above 1400 m and emphasises, like other authors, the importance of enhancing the value of this heritage, citing the few works that exist for the region (*cfr.* De Leo 2015), among which the Mazatec Highlands are absent.

A recent publication is the book entitled *La Vivienda tradicional de la Mixteca poblana; las últimas casas de techo de oreja de San Jerónimo Xayacatlán, Puebla* (Rodríguez Cano *et al.* 2021), whose particularity is that the study of Mixtec housing is approached from an ethnohistorical, ethnographic and architectural perspective.

On the other hand, there are very few photographic records of vernacular architecture from the late 19th or early 20th centuries. In the Archivo Fotográfico México Indígena, located in the digital repository of the Instituto de Investigaciones Sociales (National Institute of Social Research) of the Universidad Nacional Autónoma de México (National Autonomous University of Mexico), one can find, for example, a series of six photographs of vernacular houses in the Sierra Mazateca. Some are of anonymous authorship and others were taken by Jorge Martínez Ríos (1930–1973)¹ between the 1960s and 1970s, as well as by Raúl Estrada Discua². Most of these images are of stick and palm-roofed houses, as well as adobe (mudbrick) and palm-roofed houses in the Huautla de Jiménez area³. Only one of them (a stick and palm-roofed house) is from Mazatlán⁴.

¹ Former researcher at the Instituto de Investigaciones Sociales of the National University of Mexico (Universidad Nacional Autónoma de México).

² This artist, a Honduran national who emigrated to Mexico in 1928, was the official photographer of the UNAM between 1936 and 1972, leaving a photographic archive of 7979 images (see <https://revistas.inah.gob.mx/index.php/alquimia/article/view/3623/3507>).

³ <http://ru.iis.sociales.unam.mx/jspui/handle/IIS/1893> (adobe house and palm roof with ears), <http://ru.iis.sociales.unam.mx/jspui/handle/IIS/1895> (adobe and palm roof with ears), <http://ru.iis.sociales.unam.mx/jspui/handle/IIS/1954> (adobe and palm roof), <http://ru.iis.sociales.unam.mx/jspui/handle/IIS/1968> (unspecified material and palm roof), <http://ru.iis.sociales.unam.mx/jspui/handle/IIS/2140> (corral with palm roof).

⁴ <http://ru.iis.sociales.unam.mx/jspui/handle/IIS/1887> (construction of poles and palm roof).

Similarly, at the Instituto Nacional de Antropología e Historia (National Institute of Anthropology and History), in the Ethnic Collection - National Photographic Library⁵, there is a photograph of a Mazatec family from Ayutla (taken between 1910 and 1920) in front of wooden houses with palm roofs. All these images show us a wide tradition of vernacular architecture that includes adobe, wood, reed and thatched roofs of various designs; some with vents on the ridge, known as ‘ears’ in Huautla de Jiménez, and others with only two waters.

This photographic record allows us to know that there was great constructive variability. Regarding this subject, for the case of Huautla de Jiménez—a town near Mazatlán Villa de Flores—George M. Cowan (sponsored by the Summer Institute of Linguistics) elaborated a description of the types of Mazatec houses between 1943 and 1946 (Cowan 1946), a work of great value as it is possibly the only one of its kind in the region. The variety of materials recorded by this author invites us to reflect on the dynamism of the construction tradition in the indigenous world.

3. Variability and dynamism in the constructive tradition of the Mazatec Highlands

To speak of tradition is to speak of dynamism, variability, innovation and cultural exchange, as Lindsay Asquith and Marcel Vellinga point out; a tradition ‘can be seen as a creative process through which people, as active agents, interpret past knowledge and experience to face the challenges and demands of the present’ (Asquith and Vellinga 2006: 7).

When we refer to the traditional building systems of the Sierra Mazateca, we can affirm that they have been part of one or several pre-Hispanic building traditions. In this respect, ‘traditional’ refers to a set of dynamic knowledge, just as any tradition has been since its origins throughout the world.

Over time, builders went through a long learning process in which new materials were incorporated and previous designs were modified, according to the demands and challenges of each period. However, despite the numerous changes that traditional construction has undergone since pre-Hispanic times in general, it is possible to speak of a continuity and, therefore, of several traditions whose techniques have been perfected and adapted to the climatic and cultural conditions of each region and time period.

Thus, the dynamism that characterises every tradition allows us to understand the logic of change regarding the materials, design and meaning of the elements that have characterised the Mazatec Highlands households over time. However, when changes are very abrupt and the main local materials that characterise traditional construction are replaced by industrialised materials, we can say that this heritage has begun to be lost and is in danger of disappearing. This is the case of the Mazatec Highlands in general and of Mazatlán Villa de Flores in particular; its traditional building heritage is in danger. Therefore, in this context, as part of a strategy to value this heritage and for knowledge recovery, two workshops have been implemented, as described in the corresponding section.

The materials of the houses and the size of their components vary from one community to another and from one period to another, according to the social and cultural changes in which their builders are immersed. Some elements recorded by Cowan and others derived from ethnographic work allow us to exemplify this situation.

Cowan conducted three field seasons between 1943 and 1946, mainly in Huautla de Jiménez (a settlement located about 30 km from Mazatlán) and, to a lesser extent, in other Mazatec towns. According to this author:

⁵ http://mediateca.inah.gob.mx/islandora_74/islandora/object/fotografia%3A361815 (wood and palm roof without ears).



Figure 2. Contemporary thatched-roof house in the Sierra Mazateca (Photographs from the Project AZ 14/BE/23 Gerda Henkel Foundation).

First, the Mazatec house has a thatched roof with a long, hairy, protruding ear at each end of the roof gable. The Mazatec call them *šòño nt'ia* (*šòño* 'su-ear', *nt'ia* 'house'). These ears characterize a thatched roof as distinctively Mazatec [...]. Every Mazatec building, of whatever kind, whether it is a chicken house, a barn, a shelter for a dog [...], a stable for the horse, a roadside shelter for travellers, the kitchen, the living quarters, the storehouse, or the town hall building, if it has a thatched roof, will have these two ears. A roof without ears, to a Mazatec, is an eyesore, as is a dog without ears (Cowan 1946: 375–376).

This type of roof 'with ears' was also registered in the Mixteca Poblana in 1942 by Eunice V. Pike (Cowan 1946: 376) and in 1974 by Klaus Jäcklein, as a distinctive component of 'the Popoloca house' (Rodríguez Cano *et al.* 2021: 75). Therefore, as Rodríguez Cano *et al.* indicate, it is a characteristic that has also been present in the regions known as Mixtecas Poblana and Oaxaca. Therefore, we can affirm that, rather than a 'distinctive element of the Mazatec or Popoloca house', it is a characteristic shared by the original Popoloca peoples of southern Puebla, the Mixtecs of northern Oaxaca and the Mazatecs.

Unfortunately, during the fieldwork, only two thatched roofs could be attested, and only one of them seems to have had an ear for ventilation, replaced today by a sheet of cardboard (Figures 2 and 3).

According to oral tradition in the Mazatec Highlands, cement, galvanised sheeting and asbestos sheeting (along with other industrialised materials) were introduced to the region with the construction of the dirt road, which is now being paved, and dates back to the mid-1960s, making it easier to transport goods in motorised vehicles:

In the 1960s, Incháustegui described in the Sierra Mazateca region horseshoe trails made of uneven stones to avoid muddy areas; people and mules walked along these paths where it was very difficult to walk on and the mules sometimes fell through the overhang. Another circumstance that increased the difficulty was banditry (Incháustegui in Ramírez Rodríguez 2006: 54).

This rugged geography was a factor that contributed to the preservation of the traditional construction heritage because initially, the introduction of industrialised building materials was too costly due to the fact that they had to be transported 'by mule' (Fieldwork, F.T.A.U. Ramírez Rodríguez, 2023–2024).



Figure 3. Galvanised sheet metal roof ruined by strong winds in Mazatlán Villa de Flores, Oaxaca (Photograph of the Project AZ 14/BE/23 Gerda Henkel Foundation).

Housing Type	Mazatec name (variant of Huautla de Jiménez)
Any construction with a palm roof with ears	<i>n'tiaškà</i>
Adobe house	<i>n'tiaš'i'ntè</i> (<i>š'i'ntè</i> "adobe")
Stone house	<i>n'tialàhàò</i> , or <i>n'tiašhàò</i> (<i>làhàò</i> "stone", <i>šhàò</i> "masonry")
Plank house	<i>n'tiayátèe</i> (<i>yátèe</i> "plank")
Thick plank house	<i>n'tiayátèethaj'</i> (<i>-thaj'</i> "thick".
Thin plank house (saw-cut, wood shingles or long shingles, hand-hewn with machete)	<i>n'tiayátèechoè</i> (<i>-choè</i> "thin")
Corn storage house	<i>n'tiayáchàì</i> (<i>yáchàì</i> 'a "corn stalk")
reed house (reed and mud)	<i>n'tiašì 'ntèyá' mà</i> (<i>šì 'ntè</i> "adobe", <i>-yá-</i> "wood", <i>mà</i> "hidden")
Building without walls (one house underneath)	<i>n'tiatiš 'ànkíyáa</i> (<i>tiš 'à</i> "open", <i>-nki-</i> "down", <i>yáa</i> "wood")

Figure 4. Names of house types in Huautla de Jiménez (taken from Cowan 1946).

Once the roads for motorised vehicles were opened, a process of change began in the design of housing, not only because of the introduction of new materials but also because of the increase in migration to urban areas, a situation that brought with it a greater economic spillover for some families, as well as cultural changes. In this context, having a concrete or galvanised sheet house was a matter of prestige and synonymous with economic success; Mazatec Highlands houses began to lose their vital essence and, metaphorically, we could say that they became 'deaf' when they lost their 'hairy ears' of palm.

The people of Mazatlán say that the grass, palm or sugarcane roofs were initially replaced by tiles because they burned easily, and there were many accidents when someone left a candle lit, a firework fell during a holiday or a stranger did the evil deed of throwing a match. Later, galvanised sheet metal took the place of clay tiles, which became more expensive and difficult to transport or produce. In addition, 'mice, snakes and other vermin can live on the roofs and get into the houses' (L. Mota in personal communication with F.T.A.U. Ramírez Rodríguez, 2023).

However, although there are no reports of whirlwinds throughout the year, sometimes strong winds affect the houses roofed with sheets, which are easily torn off (Figure 3), while the palm roofs are designed in such a way that they resist these bad weather conditions. On the other hand, there are those who consider it more practical to use steel beams instead of wood, since the latter is more complex to maintain. Nevertheless, according to tradition, wood that is cut during the ‘tender moon’ (*sa* ‘moon’ *chindie* ‘tender’) will not be very durable since it will be infested by moths; one must wait until the moon is full and becomes a ‘*luna maciza*’ or ‘*luna gruesa*’ in Spanish, or *kamahcha* ‘old’, that is ‘strong or solid’, *sa* ‘moon’ in Mazatec language⁶ (T. Zaragoza in personal communication, 2023).

Still, Mazatecos recognise the virtue of natural fibre roofs, which keep the space cool compared to industrialised materials, including concrete slabs. Although fortunately, urban fashions have not penetrated deep into the Sierra Mazateca, when one enters the paths that lead to the communities farthest from the municipal capital, the main road and the highways, one can still see a few houses made of wattle-and-daub and with thatch roofs. Likewise, adobe, produced using moulds, continues to be a very popular building material, appreciated for its durability and thermal properties. Between February and mid-May, people usually prepare the adobe they will use for new constructions. Although it seems that the variability in vernacular architecture was much wider in the past, now it seems that only adobe and wattle-and-daub structures are available; except for some fences, reed wall constructions are practically a memory.



Figure 5. Example of several adobe measures in the municipality of Mazatlán Villa de Flores.

⁶ It is noteworthy that in other regions there are other references, since it is considered that it is during the new moon when the wood must be cut to be durable. This discrepancy is present in several communities since the ‘agreement’ has been lost regarding the days when the ‘moon’ is considered to be solid’. There are those who believe that it is during the seven days from the crescent to the full moon, while others insist that it is the four days before and after the full moon, that is, nine days.

Cowan recorded different types of houses and compiled the Mazatec names of each from Huautla de Jiménez, as shown below:

At present, the two main types of earthen traditional building techniques (adobe and wattle-and-daub), as well as the few remaining thatched roof techniques in the region, constitute a heritage in danger. This is mainly due to: 1) a rupture in the transmission of traditional knowledge from one generation to another, generated in part by the migration of young people to urban areas and the United States; 2) the loss of mutual aid systems such as the '*faena*' and the '*mano vuelta*', which nowadays are gradually being replaced by salaried labour; 3) the ignorance of government authorities that encourage the use of cement and industrialised materials instead of earth, and 4) the false notion, promoted by these authorities, of seeing the traditional earthen houses and thatched roofs as synonymous with poverty.

4. Change in building materials and room designs

Nowadays, the dimensions of the rectangular adobe rooms with stone foundations are 3.5 to 4 m wide and 7 to 10 m long. Only a few households have a second floor (though most have a wooden loft for storage over half the house's length). Rooms are built at different periods of time since they are erected according to the growth of the family and the needs of the household group. There is neither a standard size nor a precise rule regarding orientation, but the selection of the space for a new rectangular room is linked to the topographic characteristics of the space and the way rooms are connected to each other.

The height of the rooms is variable, with inclined roofs, high areas (average 3.5 m) towards the valley and low areas towards the slope (average 3.1 m), to keep the interior cool, with an average of between 14 and 23 courses of adobe on a 0.5 m stone foundation—though depending on the availability of materials and topography, it may be higher or at ground level.

According to interviews conducted during the fieldwork, some 60 or 70 years ago (in the mid-1950s), most houses were made of wattle-and-daub with thatch roofs (*niya shkahi* or *niya liji*); in Mazatlán, only the houses of wealthy people were made of adobe (C. Rosas G., fieldwork, February 2023). During the 1970s, adobe houses, as well as clay tile roofs, cardboard roofing sheets and, to a lesser extent, metal roofing sheets, began to proliferate as the decline of the *carrizo* (*Phragmites*), corn stalks and wood as building materials took place. Also, the builders interviewed indicated that several years ago, adobe bricks tended to be larger, but because they were very heavy, their size has decreased over the years. At present, each builder tends to have a mould with the size of his preference.

The major changes of the 20th century in the Mazateca region occurred in the 1950s with the construction of the Miguel Alemán dam in the Lower Mazateca and, in the upper Mazateca (Mazatec Highlands), with the emergence of the first dirt roads for automobiles that led to the massive introduction of industrialised materials, such as cement, which became a symbol of modernity and economic success.

Likewise, migration to urban areas increased during this period, initially to Tehuacán and gradually to Puebla City, Mexico City and the United States. This process brought changes at an ideological level regarding construction. In the 1960s, in neighbouring Huautla, adobe houses with clay roof tiles were 'rich people's houses' or used for communal buildings (churches, schools, government offices) (Inchaústegui 1967: 21–22). According to Flannery and Marcus (2005), also in the 1960s, some wattle-and-daub houses were given a layer of finer clay mixed with lime whitewash (Flannery and Marcus 2005: 31). However, according to interviews conducted during fieldwork, in Mazatlán, earthen plasters began to be replaced by cement in the 1960s. Unfortunately, these cement plasters favour the reproduction of some insects harmful to humans, such as the *Triatoma dimidiata*, responsible for Chagas disease. This insect finds the appropriate conditions for its reproduction in the cracks produced by mixing these two

materials. For this reason, we chose to focus on the topic of earth plasters during the workshops, as explained in the corresponding section.

5. The *Niya Nama*, wattle-and-daub house of Mesoamerican tradition

During the pre-Hispanic period in Oaxaca, archaeological excavations show that the first Mesoamerican earthen houses (Formative period, 1500–200 BC) were built using wattle-and-daub with fieldstone foundations (Flannery and Marcus 2005). According to Flannery and Marcus (2005), ‘in the 1960s a number of hamlets and small villages in Oaxaca still featured wattle-and-daub houses, either as residences or outbuilding’ with thatch roofs (Flannery and Marcus 2005: 31). Pine was the preferred wood when available because its resin repels termites, and the roof frames were made with strong canes of *carrizo* (*Phragmites*). Instead of nails, rope was used to secure the canes and timbers—during the Formative period, agave or yuca fibre was the source for these ropes (Flannery and Marcus, 2005: 31).

The roofs were:

laid out to extend well beyond the walls of the house, and [...] steeply peaked to shed rain. Reed mats would next be stitched over the frame, forming a continuous surface over which the thatch would be laid. The thatch itself would consist of thick layers of a monocot like *Phalaris* sp. (reed canary grass). This material might have to be renewed after a few rainy seasons (Flannery and Marcus 2005: 31).

The walls of the wattle-and-daub houses were composed of:

bundles of reeds or canes lashed together with rope. These are tied to the weight-bearing posts, usually on the outside. Over the wattle goes a layer of daub, or clay, often the same kind used for pottery. On the houses of some families [...] this daub is the final coat, and may develop a crazed surface as it dries (Flannery and Marcus 2005: 31).

As previously mentioned, some houses of:

more well-to-do families, get a layer of even finer clay mixed with lime whitewash. This layer may be burnished, producing a smooth, uncrazed surface that sheds rain and looks more attractive. Care may be taken to make sure that the corners of these better-made houses are nicely squared, rather than rounded (Flannery and Marcus 2005: 31).

6. The pre-Hispanic adobe houses

In Oaxaca, adobe appears in the Middle Formative period, in the San José phase (1150–850 BC)—possibly the oldest evidence of adobe in Oaxaca. These earliest adobes were oval to circular in plan and plano-convex in cross-sections. Archaeological evidence shows that ‘the lower halves of broken jars were used as moulds for these “bun-shaped adobes”’ (Flannery and Marcus 2005: 38).

These plano-convex adobes were used for centuries in public buildings, without many changes in construction techniques between the San José and Guadalupe phases. During that period, the outer walls were of dry-laid stone masonry, ‘with the interior fill strengthened by retaining walls of planoconvex adobes’ (Marcus and Flannery 1996 in Flannery and Marcus 2005: 40). It was later, during the Rosario phase (750–500 BC), that the first rectangular adobes appeared, as well as the first adobe houses. Although it is not known what the moulds for their elaboration were like—or if moulds were used at all.

Furthermore, there were constant changes in measures. The elder people in Mazatlán Villa de Flores, Oaxaca, recall that the adobe bricks used to be larger; the first blocks measured around 40 cm long by 40 cm wide, with a thickness of between 12 and 15 cm. Consequently, the houses had walls half a metre wide. But as ‘those blocks were very heavy’, over time their size was reduced to more manageable measures of between 40 and 35 cm long by between 30 and 28 cm wide and 10 or 12 cm thick, although each builder has his own *yara shindie* (English: wooden adobe mould) with similar but not identical measurements (Figure 11). In addition, ‘before, the *nanga* (measuring with the arm) was used as a measure and not the metre’ (C. Rosas G., personal communication 2023).

According to interviews with elderly people, adobe was introduced for the construction of the wealthiest families in the 1950s and 1960s and, as they remember, the oldest houses were made of wattle-and-daub. Therefore, although we are not certain whether the current adobe in the municipality of interest is of Mesoamerican origin or of Spanish influence, it is certain that this contemporary indigenous tradition is the result of combining ancient local knowledge of earthen building systems with constant experimentation carried out over several generations by traditional builders.

7. The impacts of the introduction of industrialised materials

As in all societies, external influences are inevitable; sometimes these influences have a positive impact and generate improvements in the quality of construction, but on other occasions, they turn out to be negative and cause deficiencies to the detriment of technologies that had functioned adequately for millennia.

In comparison with the wattle-and-daub building tradition, the adobe system is the one that has been best preserved. A large majority of the population considered adobe to be more durable than cement, but mixing it with industrialised materials, in particular with cement, has not been favourable for this tradition. Although there is evidence of the existence of earth plasters since pre-Hispanic times and, at least, until the 1960s (Flannery and Marcus 2005: 40), nowadays clay layers have been replaced by cement. This generates several problems. Firstly, although cement plasters apparently give a more modern look to the houses, the problem is that cement and earth are materials that do not match and never completely bond, creating a gap between the wall and the plaster that allows the proliferation of insects harmful to humans, such as a type of bugs locally called as the ‘*chinche besucona*’ (*Triatoma dimidiata*), responsible for the transmission of Chagas disease—as already mentioned—a widespread

General changes in the building traditions of Mazatlán, Villa de Flores	
Before 1950	Wattle-and-daub and few adobe rooms with large adobes and thatched roofs. adobe measurements in the range of 50 cm long by 40 cm wide and 10 cm thick
Mid-1960s and during 1970s	Adobe rooms with clay tile roofs, cardboard roofing sheets and, to a lesser extent, metal roofing sheets adobe measurements in the range of 38 to 40 cm long by 22 to 29 cm wide and 10 to 11 cm thick
1990s to present	Adobe rooms plastered with cement and metal roofing sheets adobe measurements in the range of 38 to 40 cm long by 25 to 29 cm wide and 10 to 11 cm thick

Figure 6. General changes in the building traditions of Mazatlán Villa de Flores.



Figure 7. Example of adobe rooms with a small external kitchen.



Figure 8. Cement plaster detached from the wall, creating a crack.



Figure 9. Local government advertisements showing how to recognise the *Triatoma dimidiata*.

disease in the region. Secondly, cement is a material that does not allow moisture to escape from the walls, which eventually weakens their internal structure (Figure 7).

8. Workshops as a strategy of heritage valorisation and knowledge recovery

Two workshops were held in 2022 and 2024 in the municipality of Mazatlán Villa de Flores. Considering the importance of preserving building traditions and recovery of knowledge, as well as the need to avoid cracks in the walls for health and hygiene reasons, the workshops were focused on: 1) how to repair cracks in adobe houses and 2) how to prepare and apply earthen plasters to adobe walls.



Figure 10. Experiments with earth collected from the municipality of Mazatlán Villa de Flores.



Figure 11. Workshops in Mazatlán Villa de Flores, Oaxaca.



Figure 12. Workshops in Mazatlán Villa de Flores, Oaxaca.

Due to the fact that the local population did not remember how to apply earthen plasters, we first carried out a series of experiments with earth collected from the place where the workshops were to be held, at the Architecture Laboratory of the Escuela Nacional de Conservación, Restauración y Museografía of the Instituto Nacional de Antropología e Historia (National School of Conservation, Restoration and Museography of the National Institute of Anthropology and History) of Mexico (Figure 10).

In particular, the second workshop was more than successful. The adult participants, who already knew how to make adobe and wattle-and-daub houses, began to experiment with different types of earth and materials until the earthen plaster was entirely to their satisfaction. Children and women learned how to prepare the materials and repair cracks in the walls, as well as how to apply the plaster. Models of traditional adobe houses were also made, providing different materials for the children and adults, making the workshop fun and educational for everyone (Figures 11 and 12).

9. Conclusions

As previously stated, the traditional construction heritage of the Sierra Mazateca in general refers us to both the pre-Hispanic and modern worlds. Today, this heritage is in danger, and it is necessary to develop strategies for its conservation and valorisation. In this regard, we believe that the organisation of workshops focused, on the one hand, on the recovery of knowledge and, on the other hand, on the re-signification of the traditional earthen Mazatec house—which, due to ignorance, has been seen as synonymous with poverty by state and municipal governments—plays a fundamental role in the conservation of a heritage that is also harmonious with the environment, unlike industrialised materials, whose production contributes to environmental deterioration and climate change.

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Ethnoarchaeological study of pre-Hispanic and current granaries and the constructive forms of agricultural storage (*cuexcomates*) from the archaeological site of Xochitecatl-Cacaxtla, Tlaxcala, Mexico

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Abstract

In the 1970s, three archaeological granaries or barns, locally called *cuexcomates*, were found in the residential-administrative area known as the Great Basement of the Cacaxtla archaeological site. Another was found in 2011, associated with residential units from the Epiclassic period (650–950). This discovery was made through the research project titled ‘Man and His Resources in the Puebla-Tlaxcala Valley’. The presence of *cuexcomates* in different hierarchical and social contexts suggests they held a unique importance, whether as elements of state or community use, but linked in their production to the peasant sector. This text accounts for the ethnoarchaeological study that has been carried out regarding the productive activities of the inhabitants of the Xochitecatl-Cacaxtla archaeological site, a pre-Hispanic settlement located in the state of Tlaxcala, Mexico. The project titled ‘Trades of Pre-Hispanic Mexico: An Ethnoarchaeological Study’ has allowed the identification of the productive processes necessary for the creation of the *cuexcomates* which, both now and in their pre-Hispanic stage, served to store corn grains, the main crop in the diet of the ancient and current inhabitants of Mexico. Their contemporary production implies that ancestral and millennial knowledge is still maintained and should not be lost.

Key words: Mesoamerica, Epiclassic period, Productive activities, Specialisation, Pre-Hispanic Agriculture

1. Theoretical framework

The research being conducted in relation to the society that settled and formed the Xochitecatl-Cacaxtla archaeological site in Mesoamerica (our case study) is based on the postulates of the theoretical position known as Ameroiberian Social Archaeology (ASA).

The theoretical position of ASA is based on historical materialism, primarily formed from the ideas of Marx, Engels and Lenin (Bate 1998), and whose representative archaeologists in Latin America included Sanoja, Maggiolo, Montané, Lumbreras, Vargas, Bate, Gándara, Fournier and Sarmiento, among others. ASA posits that the explanation of historically concrete societies is based on the tri-categorical relationship of Social-Economic Formation–Mode of Life–Culture.

We will define these aspects further in relation to the pre-Hispanic society we are studying.

This theoretical position is chosen because:

1. It offers an alternative to eclectic stances or idealistic subjective viewpoints found in post-modern archaeology.
2. It transcends the cultural-historical thinking that is still deeply rooted in Mexican archaeology.

3. It distances itself from basic positions of analogical interpretation based on 'common sense' and from reasoning that 'explains' the social past based on the inherently good or bad nature of human beings.
4. It does not accept 'voluntarist or decision-making' stances, in which human societies, 'being very complex and whose actions are volatile, have no regularities'.
5. It has the cognitive goal of explaining the transformations humanity has undergone throughout its history (Lazcano 2015).
6. It stipulates that ethnoarchaeology is a useful tool for generating hypotheses for archaeological theory.

Based on the theoretical characteristics indicated, the ongoing studies aim to identify the productive activities (modes of work) directly related to the way of life (WL) of the Xochitecatl-Cacaxtla society of the Epiclassic period (650–950). In this text, and in particular, the discussion focuses on grain storage facilities, known as barns, granaries or *cuexcomates*. To this end, the study is supported by two research projects.

2. Research projects: 'Man and His Resources in the Puebla-Tlaxcala Valley' and 'Trades of Pre-Hispanic Mexico: An Ethnoarchaeological Study'

The research work of the projects 'Man and His Resources in the Puebla-Tlaxcala Valley' and 'Trades of Pre-Hispanic Mexico: An Ethnoarchaeological Study' aims to report on the work methods that were carried out alongside agricultural activities in pre-Hispanic times. Therefore, anthropological, archaeological and ethnographic analogical reasoning studies (ethnoarchaeology) are conducted.

The study is based on the archaeological work carried out at the Xochitecatl-Cacaxtla site in the state of Tlaxcala, Mexico, and on the findings and identifications made in the residential units dating to the Epiclassic period (650–950). It is in these residential units where productive activities were carried out, such as tanning, lapidary work, the production of granaries/barns for storage, bone and obsidian work, adobe production or jadeite work, among others.

We study only a sector of the entire society: a field of agro-artisanal and/or peasant economy, both in the pre-Hispanic stage and in the present.

The comparison of the proposals regarding the way of life and work methods carried out by the agro-artisanal groups is primarily done with the evidence obtained from the housing units of Xochitecatl-Cacaxtla, because they are:

1. The main space for daily use and protection for the agro-crafts.
2. Where the daily lives of their inhabitants were expressed, and cultural values were transmitted through a variety of productive, daily and ritual activities.
3. The primary unit of production and consumption in society.
4. The means through which products were stored, acquired and distributed.
5. Their purpose was to survive and reproduce, and the work that their inhabitants did determined their permanence in society.
6. It was in these units where productive activities were carried out and organised, allowing the social and biological reproduction (Flores 2006: 40; Lazcano 2011: 10–12).

Therefore, we firstly want to identify the following aspects:

- To recognise the use of resources and understand their areas of production, distribution and storage-consumption.

- To understand not only the diversity of productive activities but also to establish their hierarchical sequence and identify the levels of specialisation that the work methods under study had.
- To suggest various aspects of social organisation and the division of labour and, above all, to stipulate the productive process and, thereby, to identify the work methods (production-consumption process) through the ethnoarchaeological study.

And secondly, we want to verify the necessary work for the particular case of the construction of traditional granaries (*cuexcomates*).

We seek to confirm another productive activity carried out by the agro-crafts groups of Xochitecatl-Cacaxtla during the Epiclassic period (650–950). This involves approaching their activities and work in their daily lives. In this way, we incorporate information from an ethnoarchaeological perspective.

3. Ethnoarchaeology

Ethnoarchaeology is a heuristic: a procedure to facilitate knowledge production and to generate hypotheses; it is an aid in archaeological research. To achieve effectiveness, the proposed hypotheses must be contrasted (Gándara 1990: 47).

It is important to recognise that ethnographic analogical reasoning is constitutive of archaeological theory, and it is necessary for archaeological inference (*Principio Cortina*). However, ethnoarchaeology is not an end in itself; it is a means to address and answer questions within archaeological theory (Lazcano 2023), referring to the formation and transformation of archaeological contexts and, in our case study, to infer productive and social aspects.

Ethnoarchaeology should establish a cause-and-effect relationship, and the use of analogy is perfectly legitimate since its projection does not necessarily involve the historically specific structural elements that govern, for example, Historical Materialism (Gándara 1990: 79), which is our fundamental substantive theory.

It is necessary to relate current studies to archaeological contexts. Otherwise, they will only be interesting contributions to ethnography, rather than to archaeological research. If this is not fulfilled, it is a return to historical particularism, leading to purely ethnographic descriptions (Gándara 1990). Without a connection between the past and the present, these studies will only be irrelevant monographic-descriptive or ethnographic studies disguised as ethnoarchaeology, even if they bear that name, such as ‘The Basketry of the Bongo Bongo’, ‘The Ethnoarchaeology of Bongo Bongo Harvesting’, or ‘Comparative Study between Mapanda Basketry and Bongo Bongo Ethnoarchaeology’ (Gándara 1990: 79). They will not be studies about past societies or the processes of socio-historical dynamics (Gándara 1990: 80).

It is necessary to emphasise that ethnoarchaeology is neither a subdiscipline nor a new science.

Following Skibo (in Fournier 2007: 78), we assume the elements that characterise ethnoarchaeology:

1. It is carried out by archaeologists as they are the only ones trained to record the types of data required to solve archaeological problems and understand archaeological contexts.
2. Data can be gathered from any contemporary group, but primarily, in the case of studying Mesoamerican societies, from indigenous groups inheriting pre-Hispanic traditions.
3. The research should focus on solving archaeological questions, including the processes involved in the formation of the archaeological record.

Ethnoarchaeological information is directly derived from work conducted in various communities in the central region of the country, such as Chalcatzingo and Jaltetenco in the state of Morelos, and Amaxac de Guerrero and Tlacotalpan in the state of Tlaxcala. For now, these are the only populations that have been visited and which still have *cuexcomates* in the courtyards of their houses. It is worth noting that in the state of Puebla, Mexico, there are also several populations still using *cuexcomates*.

4. Socioeconomic formation of the society at the Xochitecatl-Cacaxtla archaeological site (650–950)

The monumental settlement of Xochitecatl-Cacaxtla is located in the north of the Puebla-Tlaxcala Valley, in the southern part of the present-day state of Tlaxcala. The summit of an extinct volcano and the surrounding hills were chosen as the site for its construction, a central location at the confluence of the Zahuapan and Atoyac rivers. To the north, there was an extensive lacustrine area, now vanished, formerly known as ‘El Rosario’ (Figure 1). The city of Xochitecatl-Cacaxtla has two occupational phases. The first, called the Zahuapan phase (with a precedent known as pre-Zahuapan), marks the period during which an initial class-based social stage was consolidated (800 BC–AD 200). During this time, society had administrative institutions and state control, in which class division was primarily established by the presence of agro-artisans and the elite, who appropriated the labour or goods produced by the peasants. During this period, a way of life was established in which the primary sector sustaining the entire economy and social aspects was the peasantry engaged in rain-fed agriculture.

The second occupation, known as the Atoyac phase (650–950), is characterised by an intensive lacustrine agricultural way of life. In this phase, the peasantry, who similarly supported the entire economic and cultural structure of the Xochitecatl-Cacaxtla society, engaged in food production using the agricultural system known as *chinampa* (raised-field agriculture in a highly productive lacustrine area). In parallel, they also practised hunting, gathering and other productive activities.

During this occupation in Xochitecatl, two monumental buildings, the Pirámide de las Flores and El Basamento de los Volcanes, were present. Various ceremonies were held there, and the ideological realms that justified the economic order of the existing social classes were reproduced. In Cacaxtla, the spaces of the Great Platform were modified, expanded, and redesigned, and in the nearby hills, only 700–900 m to the east, the residential units of different social levels were located in what is identified as the Nativitas area. To the north, the entire *chinampa* agricultural zone was located in what was the El Rosario lagoon, now dried up (Figure 2).

The peasant-artisan class was dedicated to producing the majority of primary goods within their homes or residential units. Their daily life included agricultural work on the *chinampas*, the manufacture of various goods for their own needs and, occasionally, goods exclusively for the elites (Serra and Lazcano 2011, 2016).

In summary, we note that the socio-economic formation of the inhabitants of the city of Xochitecatl-Cacaxtla during the Epiclassic period (650–950) was initially class-based (Bate and Gándara 1986) and later secondary (Lazcano 2011). This period was defined by the existence of two main social classes: those who performed manual labour, known as agro-artisans, and the sector of the population that performed intellectual work, or the elite, who were the ruling class.

As mentioned, the way of life was intensive lacustrine agriculture, where peasant labour involved *chinampa* agriculture, hunting-gathering and fishing. Additionally, within the *chinampa* area, there were groups that managed agricultural production and established the surplus labour requirements to meet the needs of the elite.

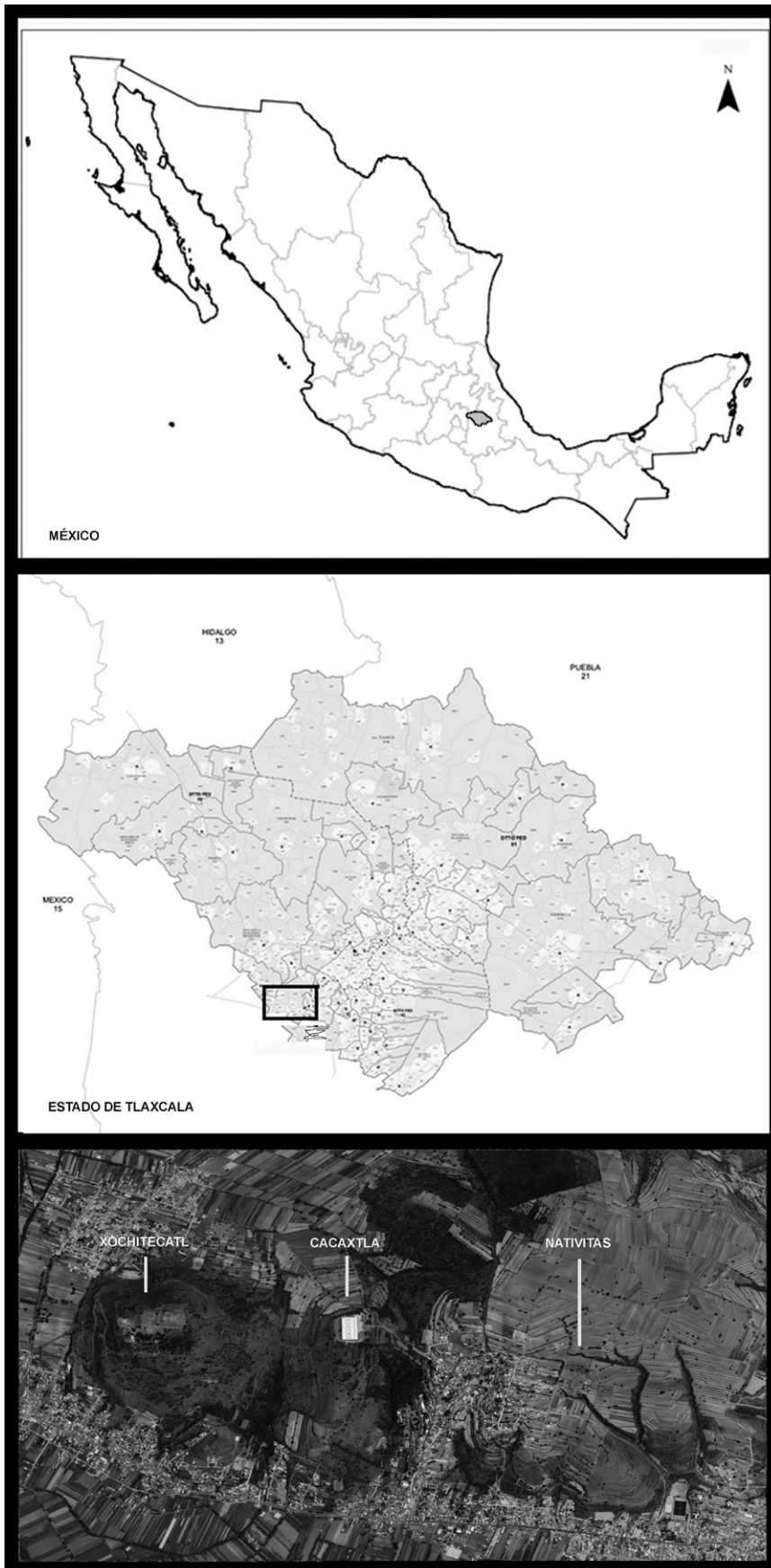


Figure 1. Location of the monumental archaeological sites of Xochitecatl-Cacaxtla and the area where the housing units are located in Nativitas, Tlaxcala, Mexico.



Figure 2. In the foreground, Xochitecatl; in the background, Cacaxtla (with a roof), and in the distance, the Matlacueye volcano. Photograph: Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

Based on these aspects, we seek to answer the following questions: besides *chinampa* agriculture, did the peasants of the Epiclassic period also engage in other productive activities (types of work)? Among these activities, did they construct barns or *cuexcomates*, or was this a specialised productive activity? How were the *cuexcomates* constructed?

Thus, the objective of our study, from a general perspective, is the secondary initial class-based Mesoamerican societies and, from a specific perspective, the sectors of the population that performed manual labour, specifically the peasant or agro-artisan social class.

5. Archaeological contexts

Studies conducted at the Xochitecatl-Cacaxtla site, specifically in the residential units, have provided relevant information about the constructional aspects of the houses and the spaces that comprised them. A notable discovery was made in the northeast area, consisting of a set of three rooms and a courtyard with a stela and altar at its centre, defined as a Portico. Associated with these structures, in the outer area near the stairs of a second construction phase, the remains and base of a granary (*cuexcomate*) for storing corn were found (Figure 3).

The discovery of this structure adds to those found in the Great Basement of Cacaxtla, where the elite group lived. The Great Basement has seven construction stages that were interconnected. In the patios and stairways of this enormous complex, the mural paintings stand out, with representations alluding to symbolic aspects and the discourse of the subjugation of external groups (Maya). On the northeast

side, between the third and fourth construction stages, three *cuexcomates* were found in good condition. The work carried out allowed us to stipulate that the elite area had state warehouses that guaranteed the supply of corn grain to the ruling class and probably for the redistribution of the product during times of food crisis (Figure 4).

The *cuexcomate* found in association with the houses and the Portico area dates to the Epiclassic period (650–950) and was in a poor state of preservation. It was directly associated with the skull of a young male (19–22 years old). The *cuexcomate* had a circumference of no more than 2 m, and only the base, 40 cm high, and poorly preserved remains of a small portion of the body that formed its shape were found. It is evident that it was made of a mixture of mud (earth with water) and a significant amount of plant material, probably *zacate* (grass, *Cynodon dactylon*) that grows locally.

Undoubtedly, this finding, combined with the *cuexcomates* found at the Great Platform of Cacaxtla, indicates that this type of granary was an integral part of the residential areas of the privileged sectors of the population.

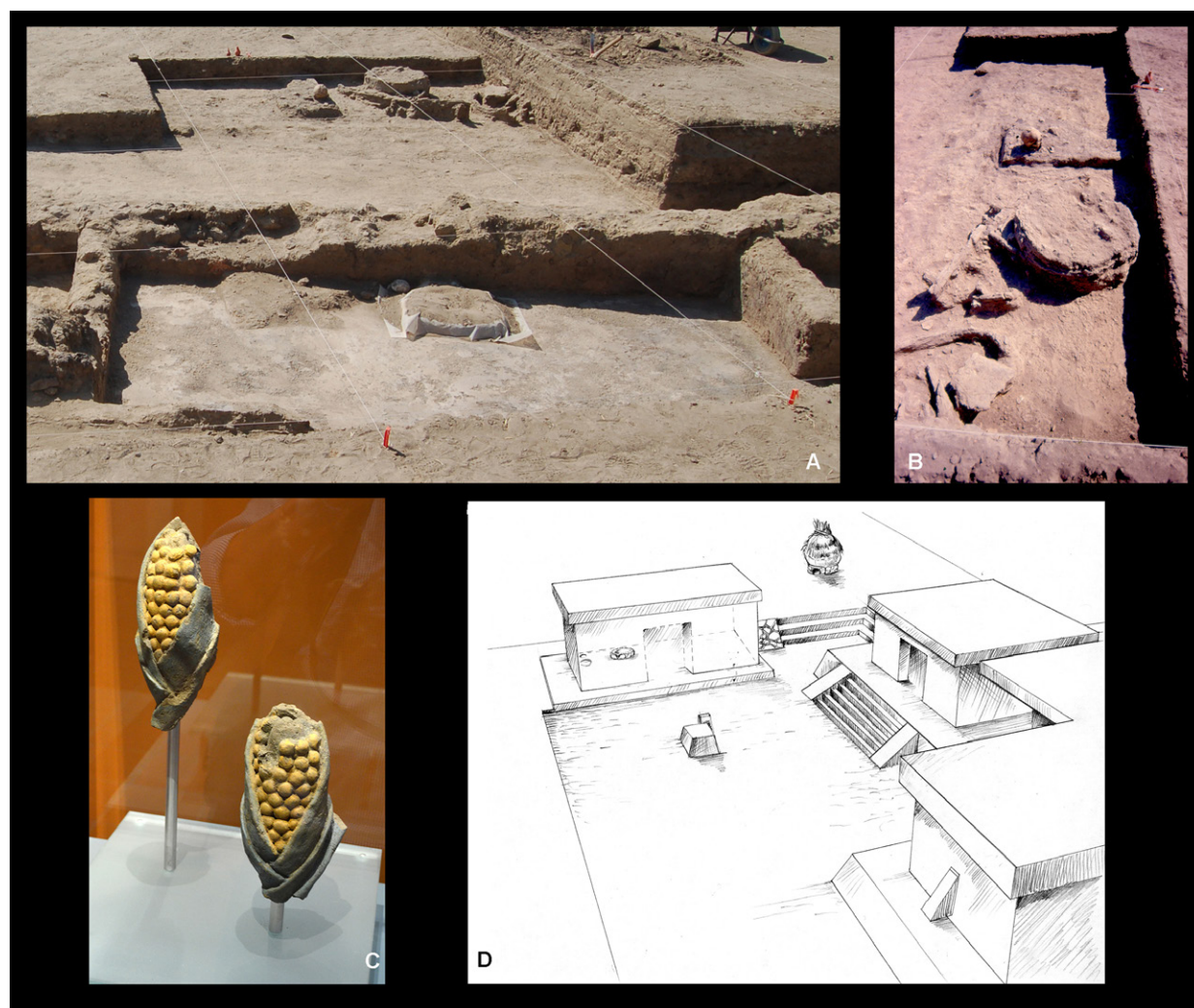


Figure 3. A) *Cuexcomate* located east of a room in the Portico. B) *Cuexcomate* associated with a skull. C) Corn cobs made of clay (Museum of the Cacaxtla Site). D) Recreation of the *cuexcomate*'s location in relation to the rooms that form the Portico. Photograph: Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.



Figure 4. A) The Great Basement of Cacaxtla. On its far right side, under the plastic cover, is the place where three state *cuexcomates* were found. Photograph: Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage. B and C) Photographs of the discovery of the state *cuexcomates* located in the third construction stage of the Great Basement. Photographs: Wall of the Cacaxtla archaeological zone, detail; 77_20140827-134500:887743; c. 1998; Documentary photographs; Cacaxtla, Tlaxcala, Mexico; 650; 950; Mediteca Collection: Photographs; Acervo Mexico Project Collection-Fototeca Nacional, Fototeca Nacional INAH and Wall of the Cacaxtla archaeological zone, detail; 77_20140827-134500:887728; c. 1998-03-06; Photos documentary; Cacaxtla, Tlaxcala, Mexico; 1986-03-06; Mediteca Collection: Photographs; Acervo: Mexico Project Collection-Fototeca Nacional, Fototeca Nacional INAH. D). Current view of the state *cuexcomate* that is restored in the Great Basement of Cacaxtla. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

6. The production process of traditional granaries or barns (*cuexcomates*) in the style of Cacaxtla, Tlaxcala

Accounting for the manufacture of *cuexcomates* necessarily involves specifying the production process. The production process refers to the integrated organisation of work processes that a society undertakes to produce the goods it needs. It is primarily divided into: a) means of production (tools, techniques, functionality), b) the concrete work process (involving the means of production and the workforce, which is inferred as a necessary condition for the process), c) products (which are assigned a use-value)—use-value refers to the utility that an object or a good possesses (Marx 1976: 43–44)—and finally d) forms of consumption, which depend on the mass of products (Bate 1982: 64; Montané 1980: 52).

The proposal regarding the production process of *cuexcomates* in the pre-Hispanic society of Xochitecatl-Cacaxtla is recognised, stipulated and proposed according to ethnoarchaeological studies conducted within the framework of the project called ‘Crafts of Prehispanic Mexico: Study of Applied Ethnoarchaeology’ (Lazcano 2017). Therefore, a heuristic approach is used to perform an ethnographic

analogical reasoning and establish a general comparative theoretical stance (Fournier and Freeman 1991).

The ethnoarchaeological study was conducted in four indigenous and mestizo communities in Mexico, allowing for the proposal of the minimum necessary characteristics of a traditional granary or barn (*cuexcomate*) production work mode. Some aspects of this particular production process must be observed empirically, while others must be inferred.

With the incorporation of ethnoarchaeological insights, we reiterate our acceptance of Gándara's proposal (1990: 47): studies in present-day societies from which information is generated without being contrasted with the archaeological context maintain a particularistic historical stance, leading to the multiplication of studies unconnected to the past; therefore, there are not ethnoarchaeological studies, but rather only descriptive ethnography. In this way, and with the aim of having greater clarity regarding the production process, we indicate that the *cuexcomate* found in the Portico of Xochitecatl-Cacaxtla and those of the Great Platform are referred to as the Cacaxtla type.

6.1. Means of production. Work objects and tools

The object of work is the raw material obtained primarily from nature itself. In other cases, they are previously elaborated products with use-value that will be modified (reused). For the production of *cuexcomates*, the main objects of work are: *quiote* (agave stalk), clay, water, *ixtle* (fibre from agave leaves), *tepetates* (clayey soil), lime, wood (posts, logs, branches) and *zacate*, all of which are present in areas near the Xochitecatl-Cacaxtla archaeological site. Only lime (CaO) is proposed to have been brought from Puebla and Morelos, or from the north-central region of the country (Guanajuato-Querétaro-Hidalgo).

Work tools refer to the artefacts used to create tools or other objects. These are previously crafted instruments necessary for obtaining raw materials and for the production of the objects themselves. Work tools vary depending on the productive phases of the specific work process.

For obtaining raw materials, we have the following work tools (Table 1).

The instruments considered here are mostly perishable and were not found in archaeological peasant households. Only the basalt and andesite tools were preserved, several of which are multifunctional. It is important to note that the areas where raw materials were obtained were communal property or at least spaces where the interests of the ruling class were secondary. Nevertheless, they had to ensure the peasant class had access to these tools, since many of them were beneficial to their constructive implementation.

Currently, the manufacture of a *cuexcomate* takes approximately seven hours, depending on the desired size and volume. Around four people participate, and ethnoarchaeological work indicates that all those who make them are also involved in agricultural work.

6.2. Concrete work process and productive phases

This refers to the implementation and application of living labour force for the transformation of nature (the object of work) and, thus, for the manufacture of work tools, artefacts or structures and constructions to which use-value is given. In the concrete work process, previously obtained knowledge is applied alongside manufacturing technique or techniques, which vary depending on the product or artefact to be produced and the prior knowledge of the person conducting the productive activity. The productive phases, as part of the concrete work process, involve the application of living labour force

Table 1. Current and pre-Hispanic work tools used for the production of *cuexcomates*

Activity and object of work	Work tools	
	Current instruments	Pre-Hispanic instruments
Zacate cutting	Machete, sickles and long branch in the shape of 'L'	Axe and sickle with obsidian blade inlaid handle
Clay collection	Picks and shovels	Wooden hoes and wooden shovel
Water collection	Buckets and pots	Pots
Extraction of <i>tepetate</i> (clayey soil)	Picks, shovels and chisels	Andesite and basalt chisels, planting stick (<i>coa</i>)
Obtaining and collecting posts, poles and wood	Machetes and axes	Basalt axes
Obtaining and producing <i>ixtle</i> (fibre from agave leaves)	Metal, shredders, machetes and knives	Basalt or rhyolite shredder and axes
Measurement and calculation of vertical and horizontal angles with a wooden square	Wooden square and plumb bobs	Plumb bobs made with igneous rock of basalt or rhyolite with <i>ixtle</i> or animal skin rope tie
Transportation of work objects: wood, water, <i>tepetates</i> , clay, <i>zacate</i> , etc.	Wheelbarrows, donkeys and motorized vehicles, according to the distance where the <i>cuexcomate</i> will be manufactured	Baskets with carrying straps (<i>mecapal</i>), tied with <i>mecapal</i> and wooden base

that must follow a manufacturing sequence; that is, the implementation of a technique specific to the product to be elaborated.

For the concrete work process in the elaboration of pre-Hispanic *cuexcomates*, we stipulate the following sequence of productive phases based on what has been recorded in current communities.

6.2.1. Productive Phase 1. The extraction and obtaining of the object of work (raw material)

Different modalities of extraction and collection are applied. In some cases, this refers to obtaining raw materials through simple collection, such as obtaining water and collecting wood. For obtaining wood for posts, poles, crosspieces, etc., the technique of direct striking with an axe on trees and branches is also applied, provided they meet the length and diameter needed to build the framework required for manufacturing the upper part and roof of the *cuexcomate*.

In other cases, it refers to the application of the labour force with tools, such as those used for extraction in *tepetate* deposits. In this case, it is proposed that a tool similar to a planting stick (*coa*) was used as a lever, alongside an axe for cutting and a long chisel for opening spaces between the required *tepetates*. The extraction technique is performed by striking the indentations observed on the surface of the *tepetates* with these tools. The goal is to strike the exposed *tepetate* from various angles so that it breaks, fractures or cracks. The width and depth of this fracture are achieved by striking with a chisel or axe, followed by levering to detach the *tepetate*. Once freed (around 20–30 of approximately 40 to 50 cm in diameter), they are transported to the area where the *cuexcomate* will be definitively constructed (courtyards of housing units or associated areas).

For obtaining *zacate*, primarily a machete or a sickle is used. During the cutting manoeuvre, the farmer is assisted by a notable tool which, although lacking a particular name, can be identified as a 'puller'.

This tool is obtained by cutting or collecting a tree branch that has a long, straight section at one end and a smaller section at a closed angle at the other, which helps to pull or separate the plant material to be cut from its base. The work is done by using the 'puller' with the left hand, inserting it among the *zacate*. The material 'pulled or snared' will then be cut from its base. The worker cuts and progresses, taking breaks for rest, but it is only at the end of the necessary *zacate* cutting that all the plant material is collected. This cutting action is called 'weeding' or land clearing. In pre-Hispanic times, a sickle was used for *zacate* and/or hay collection. The *zacate* has a length ranging from 0.80 to 1.40 m.

Other work tools that are used are already produced; we refer to the *ixtle* (ropes) and lime, which are used as products with use-value. It is important to note that the production of *cuexcomates* does not generate waste or residues, either in obtaining the work tools or in their final construction. The entire final product (*cuexcomate*) is perishable, which is why its discovery was notable.



Figure 5. Scaffold constructed around a *cuexcomate*. Photograph located at the municipal agency of the town of Chalcatzingo, Morelos. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

6.2.2. Productive Phase 2. The construction of the wooden structure that will be placed next to the *cuexcomate* (scaffold)

The construction of this structure is to achieve sufficient height to provide a base and, with it, build the middle and upper parts of the *cuexcomate*. It is also for placing the roof, which has variations or different types. The construction of this structure (scaffold) can also vary depending on the diameter, circumference and height specified. Some *cuexcomates* that are not very large and have a height of only 3 m do not require a scaffold, since a ladder is used. For the pre-Hispanic stage, we consider the use of a ladder made of a thick pole of a single piece or one made with equally thick poles and perpendicular branches with lashings made of *ixtle*, which can reach a height of at least 3.5 m (Figure 5).

6.2.3. Productive Phase 3. *Cuexcomate* construction. Base

Once the location for building the *cuexcomate* is designated, typically in the courtyards of residential units, all the necessary raw materials previously obtained are transported. This phase involves constructing the base that will support the entire body and roof of the *cuexcomate*. The base is essential for the granary. As mentioned, the size of the base is determined by the circumference and height of the *cuexcomate*. In current houses in Tlaxcala, which are typically made up of nuclear families (grandparents, parents, children), the bases are not very large, with a circumference ranging from 0.7 to 1.2 m in diameter. Typically, the base is constructed using *tepetates*, but some may be made with rounded stones or igneous rocks that require cement for adhesion.

The construction begins by marking a circle on the ground. A shallow pit is dug, and *tepetates* are placed and cemented with mud previously prepared by mixing water and earth or clay. This cementing process does not involve organic material; *tepetates* are simply joined together, ensuring the most similar parts fit together. The vertical alignment of the base is established using a wooden square, followed by the use of a plumb bob.

Once a height of between 0.7 to 1 m is reached, the goal is to make the entire upper surface completely smooth and flat. The base does not have any grooves or holes that traverse it horizontally, unlike some other cases or what has been observed in the archaeological site of Xochitecatl-Cacaxtla. The diameter of the base can range from 0.8 to 1.4 m.

6.2.4. Production Phase 4. *Cuexcomate* construction. Body

There is no predefined design for the construction of the *cuexcomate* body. It is all based on the living experience of the agro-artisan or farmer. To manufacture the body, bundles of *zacate* mixed thoroughly with abundant mud are continuously prepared beforehand. This mixture of *zacate* and mud is then horizontally placed along the edge of the previously built *tepetate* base.

The entire body of the *cuexcomate* is constructed in this manner, with bundles of *zacate* and mud placed one after another until the necessary height is reached. It is important to note that a few centimetres above the start of the body construction, between the bundles being placed, a hole of 15 to 25 cm in diameter is made that penetrates through the entire thickness of the body. This hole serves to collect, once the *cuexcomate* is filled with maize grains, through pressure and gravity, a notably unique knowledge.

The *cuexcomate* will have a larger circumference in its central part and then close to the diameter it initially had at the base. Once the body is completed, it is finished on the outside with several layers of mud. For pre-Hispanic *cuexcomates*, both the exterior and interior were finished with lime, giving them greater durability. Nowadays, only in the state of Tlaxcala, Mexico, have some *cuexcomates* been found with these lime finishes.



Figure 6. Preparation of *zacate* ties for the construction of a *cuexcomate* body. Photograph located at the municipal agency of the town of Chalcatzingo, Morelos. Photograph archive Crafts Project of Pre-Hispanic Mexico. Ethnoarchaeological Study Phase 2.

When they have lost this lime finish, efforts are made to repair them in some way. In some current cases, flexible sheets are placed all over the body. In other cases, a layer of cement is applied, as it is believed to provide greater durability and less wear. Those that are not repaired and are subsequently abandoned clearly show traces of the vegetal material and mud with which they were built, a characteristic feature by which the pre-Hispanic *cuexcomate* was identified and found in association with the Epiclassic residences (Figure 6).

6.2.5. Production Phase 5. Construction of the *cuexcomate*. Protective cover against animals

Once the entire body, also referred to as *olla*, is finished, its construction continues with a layer of *zacate* around its upper perimeter, preventing various animals from climbing, entering and feeding on the maize grains. This layer covers the entire upper circumference and is built with bundles of *zacate* that are tied with *ixtle* on one end. The other end is coated or mixed with a large amount of mud. They are placed vertically, joining the mud-covered side to the ‘mouth’ of the *cuexcomate* so that it adheres, and the dry part with the tie is allowed to hang over the external area of the body. This manoeuvre is repeated until the entire upper circumference of the *cuexcomate* is covered. This protective layer can



Figure 7. Layer of dry *zacate* that prevents animals from climbing and entering the *cuexcomate*. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

also extend halfway down the *cuexcomate* using the same technique. Traditionally, three layers of this vertical *zacate* layer are applied, ensuring its effectiveness (Figure 7).

6.2.6. Production Phase 6. *Cuexcomate* construction. Roof

After completing the base and body, the next task is to create the roof that will cover the opening or upper part of the *cuexcomate*. There are various types; the most common ones are simple, very different from what is seen in the community of Chalcatzingo, in the state of Morelos, Mexico. Some reported roofs from past centuries show coverings made of agave leaves, while others have gabled roofs, conical roofs made of *zacate* or a single-sloped roof covered with *zacate* or tiles (Figure 8).

The roof is a structure made of previously cut and collected logs, woods and branches. The intention is to create a lattice-like framework that can support, in current cases, tiles that will cover the structure. This type of roof is very simple and is placed on top of the *cuexcomate*'s mouth. It is placed on a base consisting of three or four blocks of *tepetate* or adobe that are vertically placed on the edge of the mouth, one on top of the other, with a distance of at least 1 m between them. The aim is to cover the maximum area of the mouth's perimeter. Another two layers, or just one, are placed on the part of the mouth that will be the rear area, i.e., on the opposite side of where the maize will come out at the bottom of the *cuexcomate*. The idea is to keep them all at the same distance. They are placed by slightly flattening the edge of the *cuexcomate* and adhering them with mud. The roof is inclined to allow enough space between the mouth and its final placement to insert the maize grains. At the other end, its height is almost level, and it is placed, as mentioned, on two or just one *tepetate* or adobe. In other cases, directly on the mouth.

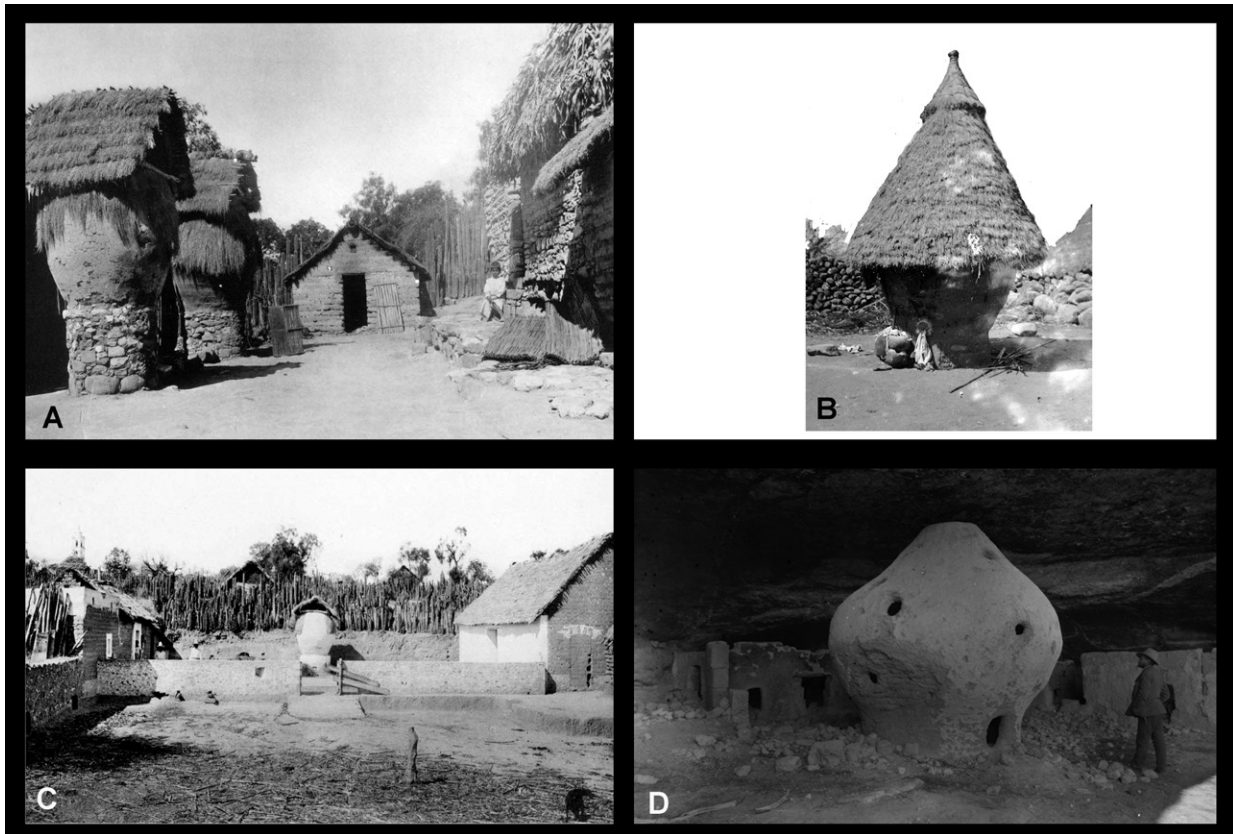


Figure 8. A) Tlaxcalans: San Juan Totolac; Frederick Starr. 1899. Chicago. Indians of Southern Mexico: An Ethnographic Album. Plate XLVI. B) *Cuexcomate* with conical roof. Instituto Nacional de los Pueblos Indígenas INPI; Nacho López Photographic Library; Carl Lumholtz Photographic Gallery: A 19th Century Explorer; Author: Carl Lumholtz. C) Panotla, Tlaxcala; Frederick Starr. 1899. Chicago. Indians of Southern Mexico: An Ethnographic Album. Plate XLV. D) Lumholtz looking at a *cuexcomate*. Casas Grandes, Chihuahua, Mexico. Instituto Nacional de los Pueblos Indígenas INPI; Nacho López Photographic Library; Carl Lumholtz Photographic Gallery: A 19th Century Explorer; Author: Carl Lumholtz.



Figure 9. Three views of the roofing that covers some current *cuexcomates* in the state of Tlaxcala, Mexico. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

In the case of archaeological *cuexcomates*, those located in the Great Platform of Cacaxtla did not have a roof but a well-crafted clay lid. The use of a lid is unique, as are its dimensions, which do not exceed 2.5 m in diameter and a height of no more than 2 m. It is estimated that they could contain 9.8175 m³ of maize. Currently, in the archaeological zone of Cacaxtla, it is still possible to observe one of the three *cuexcomates* found; unfortunately, a recent intervention almost completely covers it (Figure 9).

7. Product with use-value

The final product currently manufactured is known as a granary, barn, *zincal* or silo, and was recognised in the pre-Hispanic era as a *cuexcomate* (Figures 10a and 10b). This product with use-value was and still is used to store corn grains in the states of Tlaxcala, Puebla and Morelos, Mexico. Corn is harvested mainly in the central Mexican plateau from September to November, and during this period, the *cuexcomates* are filled. The grain can be stored there for more than a year. Shelling the corn cobs is the preceding task. The grain is poured into the *cuexcomate* using buckets; in all recorded cases, a ladder is used to reach the mouth or entrance of the *cuexcomate*. A *cuexcomate* can last up to 60 years if maintained. Its production takes approximately 3 to 7 hours, depending on the size of the 'pot' and the type of roof installed. Currently, in Chalcatzingo, Morelos, Mexico, crafts are made that imitate the shape and characteristics of the *cuexcomates*.

8. Forms of consumption

The estimation of forms of consumption is directly related to the distribution and quantity of products distributed among the members of society who participate directly or indirectly in production. From this, we have the following forms of consumption: subsistence-surplus, individual-collective, productive-unproductive and superstructural-infrastructure (Bate 1977: 44).



Figure 10. A) Product with use-value: *cuexcomate* associated with adobe houses, Tlacotalpan, state of Tlaxcala. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage. B) Miniature *cuexcomate*. Handicraft produced in Chalcatzingo, state of Morelos. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

Cuexcomates are products consumed collectively within families for subsistence. They are unproductive, meaning that with this structure, no artefact or other product is produced. They are a form of infrastructural consumption, meaning they were produced and consumed within a food production-based economy.

9. Final considerations

The *cuexcomate* is a storage structure that primarily integrates into the food production-consumption relationship, serving as the designated place for storing corn grains, a necessary precursor stage for food production. During the Epiclassic period (650–950), corn was used to produce *tortillas*, *tamales*, *atoles* and other foods.

As noted, the Epiclassic period had an intensive lacustrine agricultural way of life, with the primary activity being the production of various edible plants. Corn was the main crop, with up to three annual harvests thanks to the *chinampa* system. Therefore, the *cuexcomate* was a product with use-value that was permanently required.

Today, it is still used, but it is disappearing because few people know how to build it, and former farmers are now entering new economic fields, mainly in services. The knowledge of its manufacture is communal, but those who develop it are farmers with the specific skills needed. This aspect is believed to have been the case in the pre-Hispanic period as well, meaning that, as members of the agro-artisanal class, the work of producing *cuexcomates* was communal. Four or five people would participate and receive support from those requiring the structure with food and possibly the necessary raw materials.

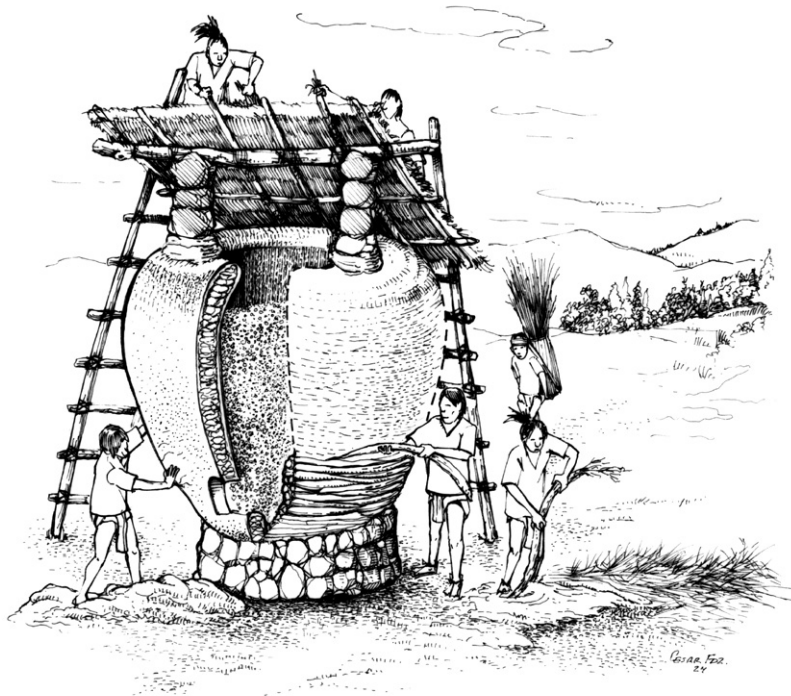


Figure 11. Recreation of *cuexcomate* construction in the pre-Hispanic era. Ancestral and millenary knowledge. Photograph Project Crafts of Pre-Hispanic Mexico. Ethnoarchaeological Study Final Stage.

While construction knowledge is required, it was not a specialised activity nor of interest to the ruling class. The peasant labour force, which was exploited, participated in multiple projects, including the production of state granaries or *cuexcomates*.

The knowledge of their production is directly related to pre-Hispanic communal labour, and for this reason, it is considered ancient knowledge that should be recognised, protected and encouraged. This ancestral knowledge is still practised in central Mexico, directly connected to the most cherished food of both Mesoamerican and contemporary cultures: corn (Figure 11).

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Evidence, characterisation and the use of orchid mucilage as an adhesive and binder in archaeological and earthen built heritage

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Abstract

Orchid mucilage, known as *tzauhtli* in Nahuatl, has been used as a binding agent and adhesive in Mesoamerican art and construction due to its valuable properties. This study focuses on the identification, cultivation and application of orchid mucilage in the conservation of cultural heritage. The Laboratory of Traditional and Sustainable Technologies for Conservation (Tectrad) at the National School of Conservation, Restoration and Museography (ENCRyM-INAH) cultivates mucilage-producing orchids to develop natural alternatives for restoration. The research aims to promote the care and cultivation of these orchids, which are at risk of extinction, and to preserve the traditional use of mucilage as a cultural legacy. A greenhouse was constructed using the wattle and daub technique, incorporating natural materials such as orchid and cactus mucilage, straw and reeds. The text also explores the use of heteropolysaccharides from endemic Mexican plants to enhance the properties of protective coatings for immovable cultural heritage. The results demonstrate the potential of orchid mucilage as a sustainable and eco-friendly material for restoration and conservation practices.

Key words: Orchid mucilage, *Tzautli*, Mesoamerican art, Cultural heritage conservation, Sustainable restoration materials

1. Introduction

Tzauhtli is a Nahuatl term that refers to the mucilage obtained from the storage organs of certain orchids. Its use as a binding agent and adhesive was common in Mesoamerica due to its properties, which led to its appreciation as a natural resource, a legacy of traditional Mesoamerican technologies, and, therefore, as biocultural heritage. This mucilage was found in featherwork and also as a pigment binder in pre-colonial murals and monoliths, such as the Feathered Serpent in Teotihuacan and the murals of Bonampak (García-Alonso 2019). Since ancient times, the significance of *tzauhtli* is further evidenced by its role in various artistic activities, as recorded in the codices and artistic productions that are still preserved, such as the *Codex Borgia* and the *Florentine Codex*.

In the *Historia General de las Cosas de Nueva España*, Fray Bernardino de Sahagún uses the word *tzacutli* to refer to a glue, in general, but also to a colour binder made from the orchid identified as *Epidendrum pastoris* L.H. (Garibay 2006: 928). Sahagún (2006) mentions that, like most other vendors in the Basin, glue merchants were not above adulterating their product by selling it coarsely ground and mixed with ground beans and pulverised corn stalks and kernels. This not only suggests a higher value for *tzauhtli* than for maize and beans but also indicates that it may have been necessary to add other materials to use it as an adhesive. It also indicates that when orchid mucilage was used for mixing and applying colours as a binder, it was not mixed with beans or maize.



Figure 1. Process of the elaboration of a feather mosaic.
Florentine Codex. Volume II. folio. 65v. XVI century.

obtained from what the chroniclers considered roots; in reality, these referred anatomically to the pseudobulbs or corms of orchids (Cullina 2004; García-Alonso 2019). The cited chroniclers mention several species of orchids, possibly terrestrial. The orchids that have been investigated during our work are epiphytes and terrestrial, and although some are considered in the above-mentioned bibliography, not all are directly referenced. For example, among the orchids cited in the *Codex De la Cruz-Badiano* (Leibellus de Medicinalibus indorum herbis, 1991), a Mesoamerican medicinal herbarium with colour illustrations, there is only one reference to vanilla.

The technology of using orchid mucilage dates back to pre-Hispanic times, but the knowledge of its extraction and technique was adapted and modified after the Conquest. Techniques and materials

Sahagún met with several indigenous elders who informed him by commenting on and using images and codices. The Franciscan understood the indigenous way of communicating through oral tradition, expressing it in the form of anthropological research (León-Portilla 1999). Perhaps for this reason, he does not provide detailed botanical descriptions of a scientific nature, and it has not been possible to determine in what type of works these colours mixed with *tzauhtli* were employed. It is possible that they were used in the elaboration of murals, codices and even to paint ceramics (González 1996).

The protomedic Francisco Hernández was sent by Philip II to New Spain for seven years to study and record the medicinal resources of the region. In 1615, he wrote *De la naturaleza de las plantas y animales de la Nueva España* (*Rerum medicarum Novae Hispaniae Thesaurus, seu Plantarum, Animalium, Mineralium Mexicanorum Historia cum notis Joannis Terentii Lineæi*), also known as *Quatro libros de la naturaleza, y virtudes de las plantas, y animales* (a work published between 1942 and 1946). Among his botanical descriptions, Hernández refers to *Tzacutli* as a plant from which a 'gluten' is prepared. In Hernández's description (1942–1946), *tzauhtli* is referred to as a paint binder, and he mentions it when describing painting techniques, stating that to produce it, 'the root is cut into small pieces, taken out in the sun and ground, and with the powder this famous gluten is prepared' (Hernández 1942–1946: 377).

When interpreting ancient texts, the historical context in which the authors used the words must be considered. The terms *engrudo* and *gluten* are used as synonyms for the mucilage



Figure 2. Tzacutli. *History of the Plants of New Spain*. XVII Century. *Epidendrum pastoris* (La Llave y Lexarza 1825).

changed, either because some were difficult to obtain or because others were substituted by European technological contributions, such as rabbit and beef bone glues. Historical documentation and communication with orchid biologists confirm the use of *tzauhtli* in the elaboration of feather art specimens and as a paint binder, as well as in the creation of corn cane paste sculptures, musical instruments and amaranth sweets. Against this background, it is possible to clarify the importance of the use of orchid mucilage in the Mexican territory throughout time, as well as all its potential applications in restoration and research as a study material, and thus to promote the care and cultivation of this biocultural heritage inherited by our native cultures.

Currently, it is believed that orchid mucilage could be a suitable option as a consolidating agent, an adhesive for the restoration of organic materials and as an additive for earthen coatings, but access to the raw material is increasingly difficult. Since 2011, as part of an interest in the study of natural materials and traditional technologies used in the elaboration and conservation of cultural heritage, studies aimed at recognising the qualities of *tzauhtli* as an adhesive for restoration have been resumed, aiming to promote the care and cultivation of the mucilage-producing orchids (García-Alonso 2019, 2022).

The utilitarian use of orchids in the present time has been restricted to local uses or to a particular ethnic group, which has preserved it in some of its productions, such as the elaboration of corn cane paste Christs in Michoacán and musical instruments in Oaxaca (García 1981; Emeterio-Lara et al. 2016). The technique, tools and materials used have changed, so there is no record of a recipe. For decades, some artisans and specialists from different disciplines have been concerned with rescuing and preserving this natural material. The *tzauhtli*-producing orchids, it is a fact, have ceased to be used; what is not permissible is to lose the knowledge of their use and importance as biocultural heritage; otherwise, we will not be able to prevent it from being lost forever.

It is easy to understand why the identification of the products derived from orchids has been a challenge for specialists in different areas due to the difficulty of identifying the material, partly because of the necessity to access living material. However, through historical documentation, a scientific approach and collaboration with archaeologists, biologists and orchid experts, it has been possible to appreciate its significance and offer a solution.

The Laboratory of Traditional and Sustainable Technologies for Conservation (Tectrad) at the National School of Conservation, Restoration and Museography (ENCRyM-INAH) is dedicated to the preservation



Figure 3. Building the orchid house with the wattle and daub technique.

of ancestral construction practices with natural materials, which are creative, technically advanced and provide cultural identity to the region. We cultivate orchids that produce mucilage to create adhesives and natural alternatives for conservation. These endemic plants constitute a living collection with both cultural and biological importance.

2. Problem and solutions

The identification and acquisition of orchid species represent an important point for the successful use of mucilage as a restoration material. Through contact with biologists, archaeologists and artisans who continue to use mucilage, it was understood that orchids as living material are at risk, with some species in danger of extinction, and that the use that has been given to them since ancient times is part of our cultural legacy and deserves to be preserved.

We decided to build the orchid house with the technique of wattle and daub because it is one of the most forgotten techniques in modern construction that allows the creation of components that can be used both in restoration and structural reinforcement due to their lightness, flexibility and reversibility. Noteworthy is the technique's versatility in adapting to various materials and its capacity for staged construction, facilitating a gradual implementation without compromising structural stability. The planning and precise definition of a specific architectural project to shelter living specimens were



Figure 4. Tests with orchid mucilage used as a glue for paper and as an aggregate for earthen coatings in different proportions.

essential, as was the careful distribution of reeds and bamboo to maintain the stability of the structure. The proportions of earth, straw and lime varied according to the stage of construction.

The orchid species cultivated in the greenhouse include *Prosthechea citrina*, *Prosthechea ghiesbreghtiana*, *Prosthechea vitellina*, *Encyclia adenocaula*, *Bletia campanulata*, *Laelia autumnalis*, *Laelia speciosa*, *Cranichis tubularis* and *Euchile karwinskii*. These species were selected based on their mucilage-producing capabilities and their historical use in Mesoamerican art and construction. We included other orchids that, if not directly referenced, could have been used due to their properties, such as *Cyrtopodium macrobulbon* and *Catacetus laminatum*. By growing these orchids in a controlled environment, we can ensure a sustainable supply of mucilage for research and conservation purposes while also protecting the species from extinction.

One of our lines of research focuses on the use of heteropolysaccharides extracted from endemic plants of Mexico as an alternative to transform the properties of protective coatings made of earth and lime for application on the surfaces of archaeological and immovable cultural heritage. Articles by Guerrero Baca *et al.* (2022), García-Alonso and Ruvalcaba (2020), Guerrero Baca *et al.* (2019) and Vissac *et al.* (2017) have shown that mucilages and other plant biopolymers can improve the physical and mechanical



Figure 5. The orchid house with both epiphytes and terrestrial orchids.

properties of different materials, such as earth mortars and coatings applied for conservation and restoration purposes.

To assess the effectiveness of orchid mucilage in enhancing the properties of protective coatings, we conducted a series of experiments. The mucilage was extracted from the pseudobulbs of the cultivated orchids and added to earth and lime mixtures in varying proportions. The resulting coatings were tested for adhesion, moisture resistance, reversibility, permeability and durability using standard laboratory methods. The results were compared to coatings prepared without the addition of mucilage to determine the extent of improvement in their properties.

3. Results

The use of nopal mucilage as a stabilising agent has shown relevant results in modifying the properties of materials such as lime and various types of soil (Ruiz 2014; Vissac *et al.* 2016). However, despite these advances, there was a research gap in terms of comparing the effects of different plant heteropolysaccharides, such as orchid mucilage, on improving the characteristics of different soils and developing a procedure for the application of these materials that allows for obtaining concrete results on the transformation of their properties. This includes the improvement of adhesion, moisture protection, reversibility, permeability, durability and preparation. By recognising the versatility and

beneficial properties of natural aggregates, a precedent is set for their potential application in a variety of contexts within the fields of conservation, research and restoration of cultural heritage.

The experiments conducted with orchid mucilage as an additive in earth and lime coatings demonstrated significant improvements. The addition of mucilage increased the adhesion of the coatings to the substrate, reducing the risk of delamination and flaking. Moisture resistance was also enhanced, with the mucilage-containing coatings showing reduced water absorption and increased resistance to weathering. The coatings remain reversible, allowing for easy removal, if necessary, while maintaining good permeability to prevent the buildup of moisture behind the coating. Overall durability was improved, with the mucilage-containing coatings showing greater resistance to cracking, powdering and other forms of deterioration over time.

The alternative of using orchid mucilage as a restoration material is a way to promote the recognition and recovery of traditional pre-Hispanic Mexican technologies. In addition, it is a 100% natural product that does not affect or contaminate the environment and accounts for the ecological importance of the producing species, which justifies the need to introduce this type of material to the field of restoration and conservation. It is considered that orchid domestication can be a sustainable practice in terms of the production of organic materials for restoration with a direct impact on the preservation of biocultural heritage.

Mucilages, with their ability to improve cohesion, erosion resistance and water retention, present an option in the transformation and utilisation of materials used in earthen construction. For this reason, we used aggregates from the same plants that we preserve and cultivate in the completion of the orchid house's final stages. It is a remarkable achievement that the same orchids that we so passionately preserve were the ones that gave us part of the materials that we needed to make this possible.

This greenhouse is the result of our collective efforts to safeguard, research and use Mexican endemic orchids at all levels. This construction technique is a sustainable way of building durable and resistant structures. The use of natural and local materials, such as orchid and cactus mucilage, straw and reeds, and the use of traditional construction techniques, such as reed framing and continuous consolidation, are ecological and sustainable practices that can be used in the construction of durable and resistant structures. This approach not only offers a sustainable alternative for the treatment of cultural heritage but also promotes the preservation of traditional practices and biocultural heritage.

4. Conclusion and future directions

The importance of this project lies in the intrinsic value of renewable construction systems rooted in natural materials and their potential for technological advancement. It also underscores the significance of participatory teaching in cultivating a deeper understanding of these sustainable practices.

Future research directions could include further investigating the long-term performance of orchid mucilage in restoration work, both in laboratory studies and in real-world applications. It would also be valuable to explore other endemic plant species with similar mucilage-producing properties and assess their potential for use in conservation and restoration. Collaborations with indigenous communities who have traditional knowledge of these plants and their uses could lead to the identification of new sources of sustainable restoration materials.

Another area for future research is the development of standardised protocols for the extraction, preparation and application of orchid mucilage in conservation work. This would help to ensure consistency and reproducibility in the use of this material and facilitate its wider adoption by conservation professionals.

The use of orchid mucilage as a sustainable restoration material represents a promising approach to the conservation of cultural heritage that combines traditional knowledge with scientific research. By promoting the cultivation and use of these endemic species, we can contribute to the preservation of both the built environment and the biocultural heritage of Mexico. The orchid house project demonstrates the potential for sustainable construction practices that prioritise the use of local, renewable materials and the transfer of knowledge through participatory teaching. As we continue to explore the possibilities of *tzauhtli* and other natural materials in conservation, we can work towards a more sustainable and culturally sensitive approach to the preservation of our shared heritage.

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‘Te voy a hacer una casa en el aire’.¹ Ethnoarchaeology of indigenous houses in Amazonia

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Abstract

Two Amazonian ethnoarchaeological studies are presented to illustrate the confrontation and back-and-forth between archaeology and ethnography. The first case study is based on open-area excavations of an artificial earth mound in the Upano Valley, Ecuadorian Amazon. This dig produced a well-preserved domestic level, permitting a spatial analysis of activities between 800–1200 CE. This domestic structure was studied on the basis of contemporaneous houses of Aents Chicham groups who live today in the region. This parallel has highlighted the close similarity between the archaeological habitat and that of today, while also explaining the relationship between the two peoples. The second case study was conducted on the French Guiana coast. The abrupt abandonment of a small Palikur indigenous village provided a rare opportunity to organise an ethnoarchaeological study to verify the validity of large-scale excavations. The interpretations provided by the archaeological analysis of the settlement were submitted to the testimony of the former chief. Many inferences then appeared biased or false, while some aspects had completely escaped the researcher. These two fieldworks show the importance and finesse of the indigenous contribution to the archaeological assessment of a site in Amazonia.

Key words: Ecuador, French Guiana, Archaeology, Indigenous settlement, Wooden house

The ethnoarchaeology of construction has a long tradition in Europe and Africa. Conversely, few researchers have dealt with the subject in South America, and even fewer in Amazonia. While the permanence and resilience of indigenous peoples in the world’s largest rainforest offer exceptional opportunities for observing lifestyles in tropical environments, ethnoarchaeology remains relatively uncommon. A few researchers have focused on stonework (for instance, Laming-Emperaire *et al.* 1978) or ceramics (DeBoer and Lathrap 1979; Rostain 1992; Rostain *et al.* 2014; Rostain 2016). Habitat has occasionally been the subject of study (Politis 2007; Roe and Siegel 1982; Schmidt 2010, 2014; Siegel 1991; Siegel and Roe 1986; Silva 2012, 2014; Zeidler 1983). However, this work is still limited to very specific regions, thus, we still have a lot to learn about Amazonian dwellings.

Despite the scarcity of such studies, some lessons can be drawn from approaches that cross-reference ethnographic and archaeological data using controlled methods. Two excavations undertaken at opposite ends of the Amazon (Figure 1) have produced original and innovative data on indigenous habitats. One was carried out in the upper Ecuadorian Amazon, at the foot of the Andes, where Aents Chicham peoples still live (linguistic affiliation = Jivaroan) (Rostain 2016). The other was conducted on the Amazonian coast, in French Guiana, in an area now occupied by the Palikur (linguistic affiliation = Aruak) (Rostain 2017).

1. When the past looks toward the present: the Upano Valley, Ecuador

I used ethnoarchaeology to identify the organisation of a domestic floor during the horizontal excavation of a pre-Columbian proto-Aents Chicham house at the Sangay site, Ecuador (Rostain 2003,

¹ “I’m going to make you a house in the air”. Song by Rafael Escalona, performed by Carlos Vives.

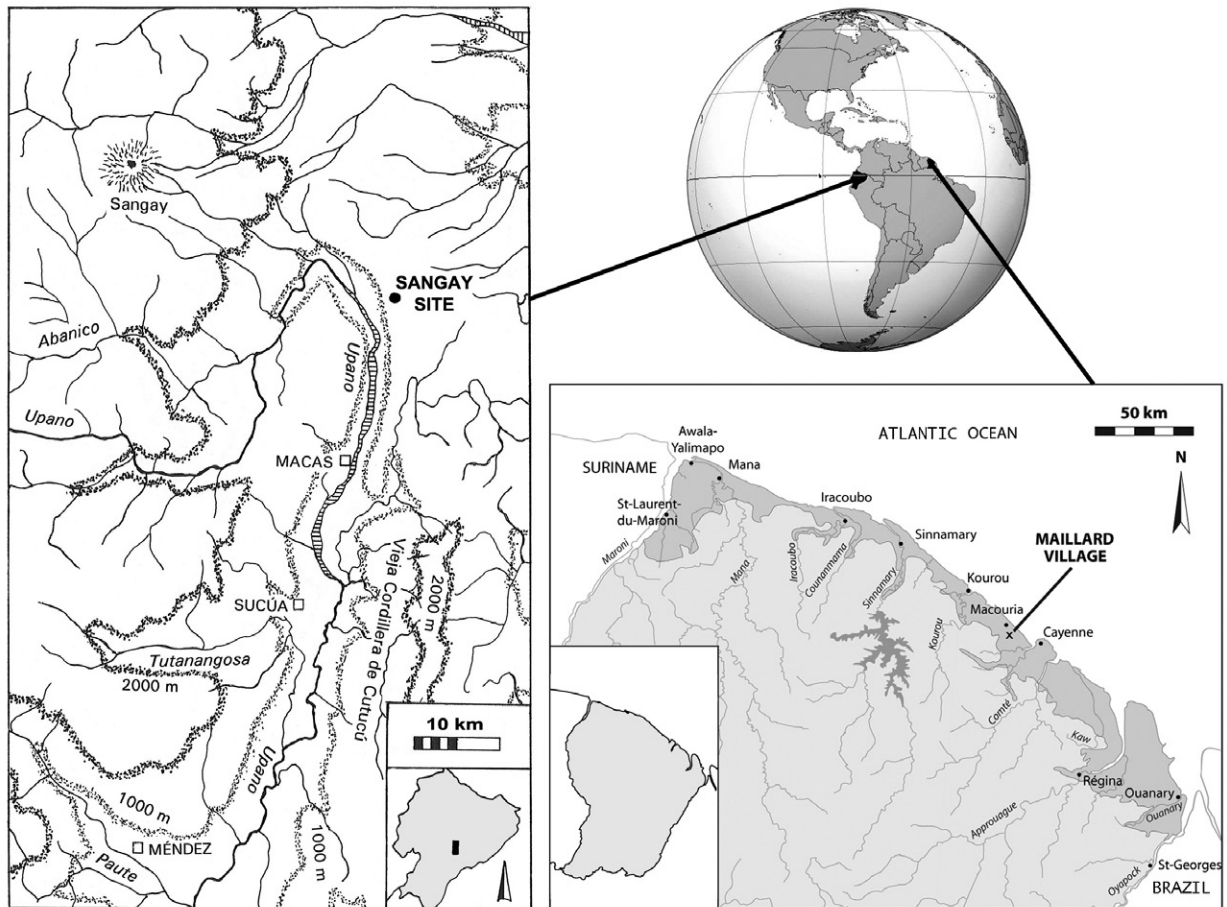


Figure 1. Location of the two case studies. The Sangay site in the Upano Valley to the west, in the Amazonian foothills of the Ecuadorian Andes. The Maillard Village on the French Guiana coastal plain to the east (drawings by S. Rostain).

2006, 2011). Brenda Bowser (2004) and John Patton (Bowser and Patton 2004) analysed the gendered division of activities and spaces in contemporaneous Achuar (an Aents Chicham group) and Kichwa houses in Ecuador.

Stretching along the eastern slope of the Andes, south of the Equator and enclosed by two mountain ranges—the Andes to the west and the Cutucú to the east—the Upano Valley constitutes a specific region in which two ecosystems meet. The landscape is typical of the high Amazon rainforest, but there are few Andean mountain features.

When I arrived in Ecuador in 1995 to organise an archaeological project at the Sangay site in cooperation with local archaeologists, I soon realised that the unusual scale of the settlement and the large number of mounds required the application of an adapted excavation method (Rostain 2003). I opted for large-area stripping, a methodology known as ‘horizontal excavation’. Part of the top of the platform was scraped, representing 90 m². My team and I used shovels to clear each layer of occupation over a wide area, leaving the remains and traces in place for later detailed study. By way of comparison, until then, stratigraphic surveys had only been carried out over one square meter, providing limited information. Large-scale stripping of Upano platforms enabled the systematic study of all traces from the same period. The results obtained enabled us to identify mound construction methods, habitat soils

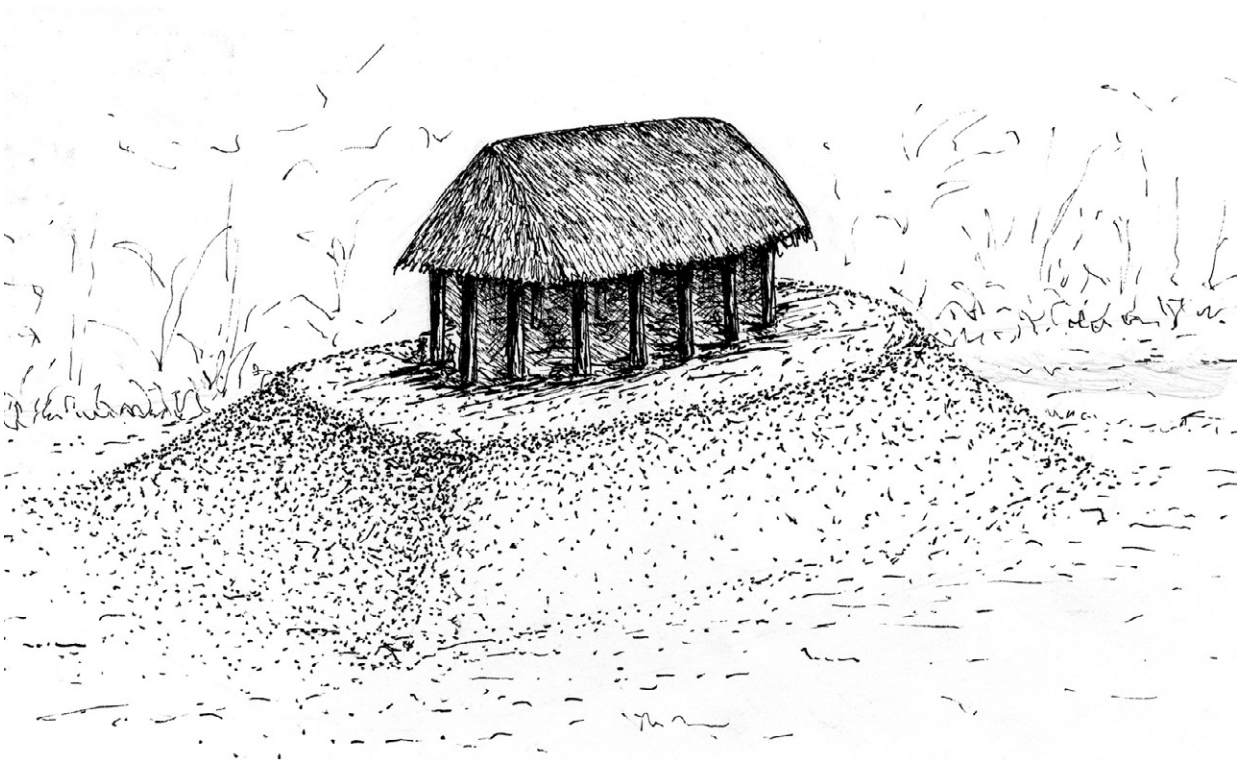


Figure 2. Large-scale archaeological excavation on the top of an artificial earthen platform in the Sangay site and an artistic restitution of the original house (photograph and drawing by S. Rostain).



Figure 3. Domestic archaeological level of the Huapula culture (800–1200 CE) at the top of an artificial platform at the Sangay site (photographs by S. Rostain).

and material culture, cultivated and consumed plants, as well as to define the different peoples who succeeded one another, with over fifty dates obtained and a complex cultural history. After the first horizontal excavation campaigns, a clearer picture of the ancient occupation emerged.

I was thus able to establish that the previous occupation of the valley produced an original urban layout on a scale unprecedented in South America, consisting of large rectangular mounds and platforms, low square plazas, streets and straight dug-out roads over ten metres wide linking the mound complexes, integrating drained fields, cultivated terraces and *camellones* (ridged fields) into an urban network (Rostain *et al.* 2024). Farming communities developed a civilisation (Kilamope and Upano cultures) which, starting almost 3000 years ago, flourished for over a millennium until around 600 CE; after which occupation of the valley was interrupted for 200 years, only to resume between 800 and 1200 CE with the Huapula culture.

Stripping the top of a platform uncovered a very well-preserved Huapula habitat dating back to 800–1200 CE (Figure 2). The most common features were 49 postholes. They appear as dark spots on a lighter soil, with straight walls and convex bottoms. Although a precise house plan could not be reconstructed, its general shape was visible, settled on a maximal area of 80 m² and covering almost the entire useful flat surface of the mound, which reached c. 130 m² (Rostain 2003). This size is comparable to the majority of modern Aents Chicham houses (Rostain 2006).

The kitchen was located at the centre of an area of c. 15 m², which represents one-sixth of the total surface of the house (Figure 3). It consisted of two groups of central hearths, supporting stones, two grinding stones with their grinders (*manos*), stone tools, pottery vessels and food remains. Four large jars, with the smallest one partially buried, were grouped just north of the central hearths. Two bowls were found close to these vessels. Pottery sherds from the same container were not scattered over more than c. 10 m², which is a very low rate of dispersal for an archaeological site in Amazonia. Another characteristic of the pottery is that the base of each vessel was covered in soot, including the white-on-red painted jars and lids. There was a thick layer of soot on the big jars and a thinner one on the bowls and the decorated small jar. This implies that all the vessels were used for cooking on the hearth. This area was dedicated to the storage of food, especially *chicha*, a thick and nourishing maize beer.

The seven simple hearths discovered had a diameter between 25 and 45 cm. They were combustion structures installed at ground level, with no adjustments or excavations. The hearths consisted of a layer of irregular red clay. Some experiments carried out at the site showed that the yellow clay soil reddened with fire. After one or two years, the hearths in which these experiments were carried out presented a similar aspect to those found during the excavation. In the centre, three of them formed a large, single combustion area. They were, in fact, connected by an area of compact, hard, reddish soil containing numerous wood charcoal fragments and calcined grains, which was interpreted as the result of the dispersion of the hearths. Similar phenomena occur today in indigenous houses, particularly those of the Aents Chicham:

... in the immediate vicinity of the hearths [...] abundant quantities of material residues were compacted into the trampled ash accumulations, which connected the individual hearths. This phenomenon was due, of course, to the high frequency of use in daily food preparation, where food debris is constantly incorporated into the trampled deposits of soft ash around the hearths (Zeidler 1983: 181).

Two other hearths, located to the north, formed another area. Both were arranged symmetrically, about 4 m from the central group; the first to the east and the second to the west. As is seen today, there were several hearths in the Huapula house. The two central groups had a culinary function. A

grinding stone covered one of the hearths, indicating that the utensil had been displaced and that the spatial organisation of the kitchen was sometimes changed. The two peripheral hearths were probably intended for lighting and as a source of heat—given that the site is at an altitude of 1000 m.

Seven large uncarved stones were found near the central hearths. They probably served as supports to keep the ceramic vessels with convex bases on the fire. In the Amazon, three stones or three logs are usually placed around the fire in a triangular arrangement to hold up a cooking pot. The other remaining stones were likely used as tools. In the centre of the mound, a small slab was found with a finely polished surface that had been used as a sharpener and a rectangular hand to make needles or points, which also served as a polisher. Two millstones, located parallel to each other less than a metre apart, facing each other, and with their opposite evacuation ends, occupied the centre of the kitchen (Figure 3). Consequently, when they were used, the women would have been facing each other. Grinding was thus done near the heat of the fires. The two circular grinders were not far away. The other three uncovered rectangular grinders were too wide to serve on those grinding stones. They could have been used on other supports that have not been preserved, such as wooden bases.

During the excavation, many burnt seeds were collected from the kitchen area in the centre of the house. A total of 87 burnt seeds, 21 intact seeds and 43 fragments have been identified at the level of the genus, while the 23 remaining specimens are unidentified species (Gómez de la Peña 1998; Leonard 1997). *Zea mays* is the most commonly found species. Crushed grains of maize were found stuck inside a jar, suggesting that *chicha* beer was probably prepared in it. The other plants—*guaba* (*Inga edulis*), cherry (*Prunus*), blackberry (*Rubus*) and *granadilla* (*Passiflora*)—are edible or can be used as medicine. This sample is interesting because it was the first time that such a large variety of useful plants had been found in a primary archaeological context in Amazonia. Archaeobotanical analyses led to the identification of 18 morphospecies representing five families (*Mimosaceae*, *Passifloraceae*, *Phytolaccaceae*, *Poaceae* and *Rosaceae*) and various mushroom types. For that reason, the numerous burnt seeds collected from the central platform are very interesting because of their diversity and their presence within a culinary area. Whether cultivated or wild, these plants were gathered and brought back to the settlement by the former inhabitants. While most of them were eaten, some may also have had pharmacopoeial uses.

Sweet and bitter manioc (*Manihot* sp.) produce few discernible remains in the archaeological record; thus, it is possible that this plant was also cultivated and consumed in association with maize, which was the main staple. Maize can be cooked in various ways, but it seems that the Huapula people preferred to consume it as *chicha*. After separation from the cob, women ground grains on grinding stones. The obtained flour was mixed with water, with the flavour potentially varied through the addition of different fruits. The fermentation agent was made with saliva by the mastication of the flour, which was left to settle for at least one night or cooked on a hearth. It has been proven that *chicha* was prepared in the large globular jars found in the kitchen. Food remains adhered to the inner wall of one of the jars exhibited typical micro-striations found on the surface of maize grains. So, it is obvious that maize constituted a part of the food that was prepared in this vessel. The thick soot layer on the base of the pottery shows that food was cooked in it. Today, many indigenous societies consume *chicha*, which can even replace lunch because of its high nutritional value. It is prepared in big brewing vessels similar to those from the Huapula house. The drink is offered in gourds or pottery bowls, and very high quantities are produced and consumed during communal parties.

Historical chronicles provide some indications of plant use by indigenous societies in the Ecuadorian Amazonia (Renard-Casevitz *et al.* 1986; Rumazo González 1982). For instance, in 1542, during the construction of a boat on the banks of the Coca River, Gonzalo Pizarro traded for 'maize, yucca and *guabas*' in the surrounding indigenous villages (Carvajal [1542] 1992). Today, the *guaba* fruit is still highly appreciated and often consumed. However, it is never more than a simple supplement to the diet. The

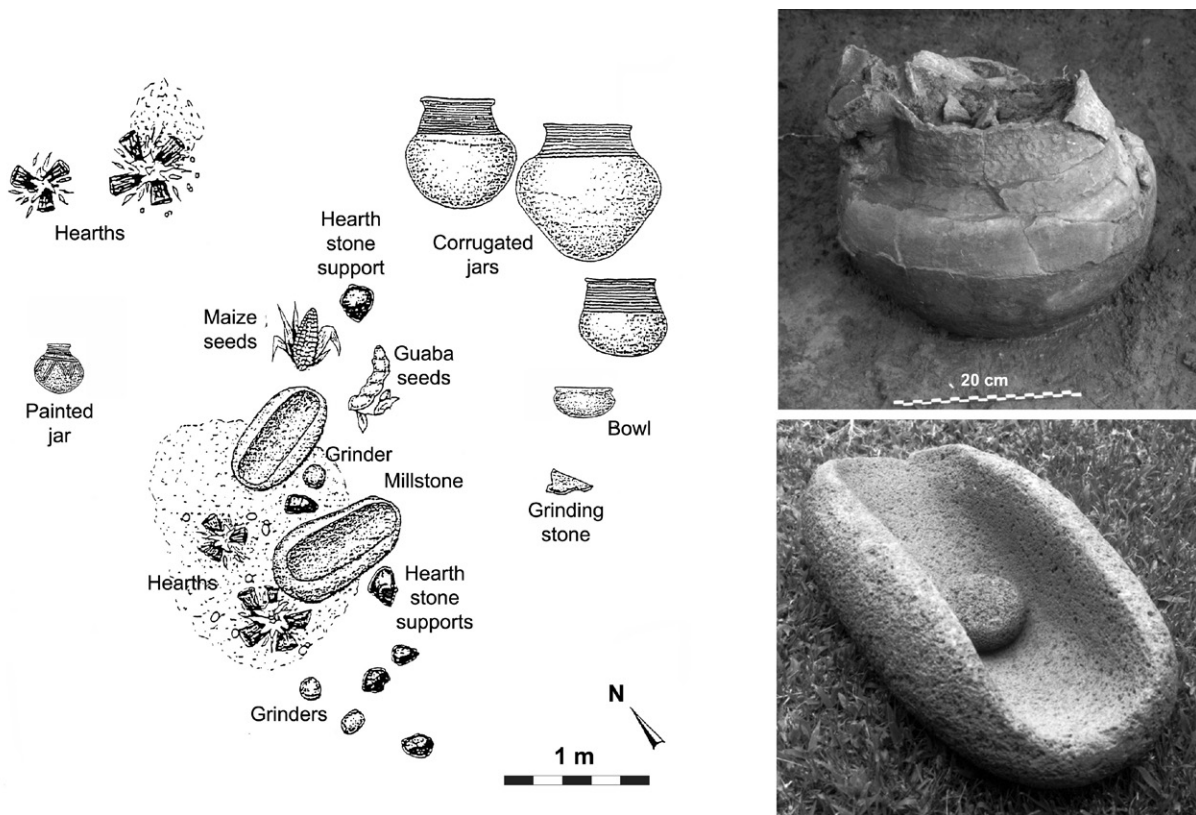


Figure 4. Left: interpreted domestic archaeological level of the Huapula culture at the top of an artificial platform at the Sangay site. Right: corrugated pottery jar and a millstone and its grinder found in the Huapula kitchen (photographs and drawing by S. Rostain).

pulp is eaten fresh or prepared, and the big seeds can be roasted. *Guaba* sap is sometimes used as a dye. The bark, buds and leaves of the plant have a medicinal use to reduce rheumatic inflammation, treat liver complaints, facilitate digestion, cure mouth dermatoses and soothe ant sting pain. The Witoto grate the root and mix it with water to encourage the birth of a boy.

Other plants used as food found in the Huapula house include blackberries (*Rubus*), cherries (*Prunus*) and *granadillas* (*Passiflora*). Most fruits of the Rosaceae family are eaten in Amazonia, but the *Passiflora* fruit is also valued. For instance, in 1691, Pedro Ordóñez de Cevallos tried to establish peace with the Quijos and reported on the *granadilla*: 'it is absolutely the best fruit in the world and eating it a smell of musk comes to the nose and a better taste than our pomegranates' (cited by Estrella 1998: 175). These plants also served for pharmacopoeia. Cherry is used in a variety of ways: as an anti-inflammatory, antiseptic, astringent, purgative, diuretic, laxative and tonic. *Phytolacca* cures skin affections, disinfects and heals wounds and eliminates dandruff. Similarly, *polyporus* mushroom remains found in the house can cure dermatosis. Because cherry wood is rot-resistant, it is used to build houses and to manufacture tools.

Finally, two pottery spindle whorls have been found at the western end of the house, not far from one non-culinary hearth. They are evidence of the cultivation and use of cotton (*Gossypium barbadense*), which is still amply used by Amazonian peoples to manufacture clothes, hammocks and ornaments.

The ethnoarchaeological study of contemporary Aents Chicham houses aids to interpret pre-the Columbian features found during the house excavation at the Sangay site. Due to the good preservation

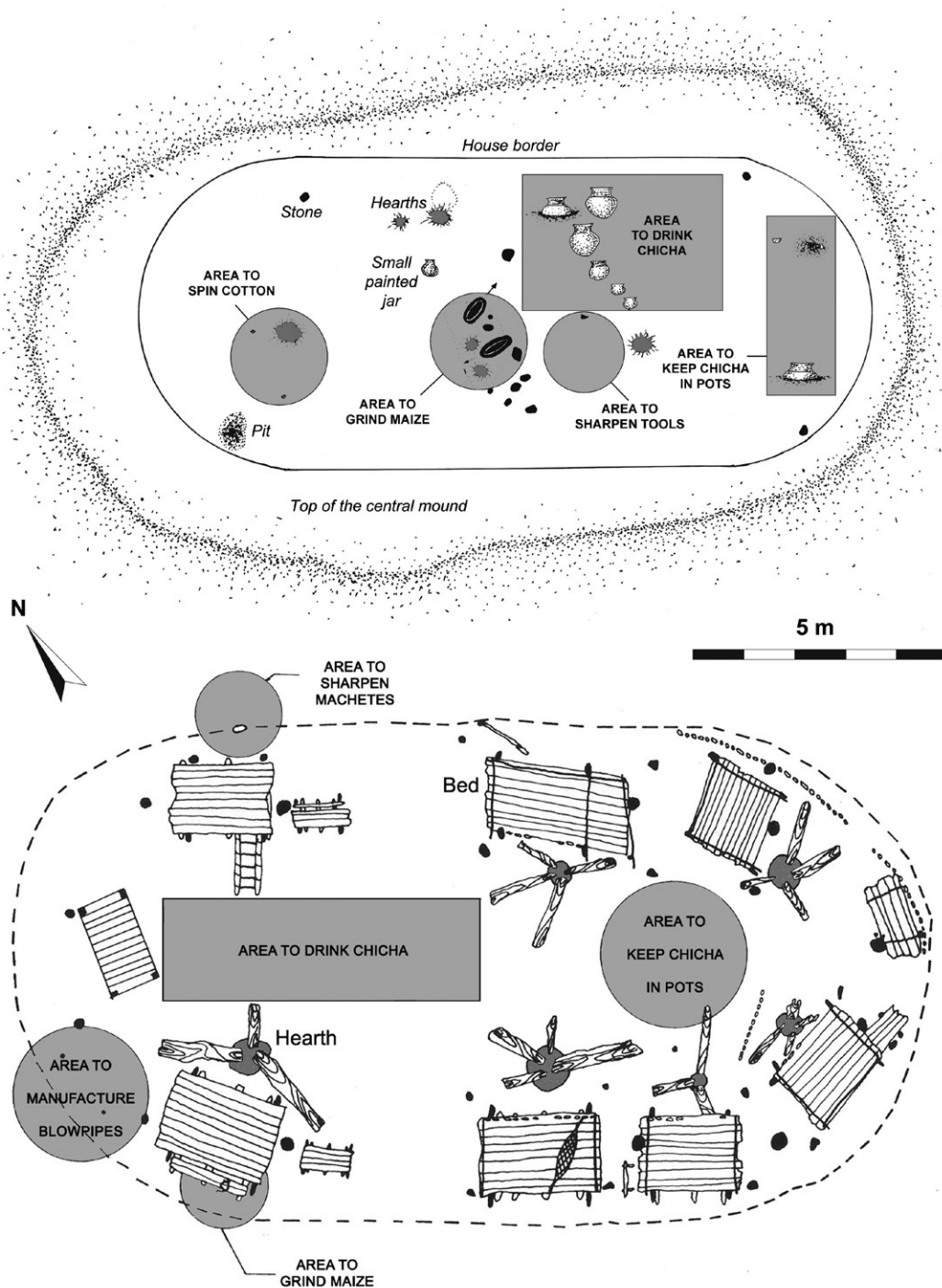


Figure 5. Comparison between the archaeological Huapula domestic floor and the distribution of modern Achuar domestic activities (drawings by S. Rostain and in J. Zeidler 1983).

of the archaeological context, it has been possible to reconstruct the floor plan and the distribution of ancient activities. It was interesting to compare these data with the modern situation. Most of the studies of residential areas are oriented more towards the general pattern of a village than to the specific inner distribution of a single house (Cauiby Novaes et al. 1983). However, an overview of Amazonian habitat

shows a great variety of house types throughout the region, from very simple shelters to the larger *maloca* (Carsten and Hugh-Jones 1995; Hugh-Jones 1985). The catalogue of various indigenous residential patterns shows that the pre-Columbian Huapula house is similar to modern Achuar and Shuar houses. For that reason, Shuar houses in the Upano Valley were observed during the archaeological programme. A previous study conducted by Zeidler (1983) in an Achuar house in the Pastaza Valley, in the Morona-Santiago province adjacent to the Upano Valley, was also particularly useful. Many similarities can be observed between the Huapula and Aents Chicham houses.

The Achuar habitation pattern is characterised by isolated houses, which constitute the basic unit. Occasionally, two or three houses can be grouped together. The floor plan of the house is elliptical (Figure 5). It has no exterior walls, except during conflict situations when it is protected by a high palisade. The roof is made of woven palm leaves. Generally, it measures 13–15 m long, 8–10 m wide and 5–7 m high (Bianchi 1982). It can be exceptionally large, as exemplified by a house inhabited by 20 persons and measuring 23 by 12 m (Descola 1986: 141). Uxorilocal households tend to reside in single houses inhabited by 5 to 20 persons: that is, the head of the family, his wife or wives and children (Descola 1986; Zeidler 1983).

Achuar and Shuar houses are organised according to a sexual dichotomy (Harner 1972). While couples sleep together at night on wooden beds spread throughout the house, the inner space is divided into two exclusive areas during the day. One sector, representing more or less half of the house, is reserved for women (*ekent*), while the other one is for men (*tankamash*). The kitchen and vessel are located in the female area, where the wife has complete authority. In the male space, benches are situated to receive visitors, drink *chicha*, eat and manufacture tools. Each adult has a designated place to perform activities, and each woman has a personal area with her own hearth and commodities (Zeidler 1983).

Hearths are important features for the occupants: women use them for cooking and preparing pharmacopoeia, whilst men need hearths to process medical and hallucinogenic plants and to make poison for hunting darts. Some labour and activities are only performed in specific places. For instance, maize is ground in a single area. *Chicha* is stored away from hearths and consumed in the central space. Each woman stores one or more pottery jars (*muits*) filled with *chicha*, and some bowls to offer it. Consequently, each woman is identified by her large, visible brewing vessels in the centre of the house, which are symptomatic of her status level in the family and the society. 'Prestigious women who hold large gatherings in their houses make a lot of beer, and the number of beer jars in a woman's house is a statistical indicator of her status' (Bowser 2004: 22). The space dedicated to drinking *chicha* is used by both genders. Two typically male activities are conducted on the periphery of the house: the sharpening of machetes and the manufacture of blowpipes. Beds are platforms (*peak*) distributed along the wall of the house with a personal hearth at the foot of each.

The reconstruction of activity areas in the Huapula house reveals strong characteristics and an organisation comparable to those of Aents Chicham dwellings (Figure 5). Located at the top of an elevation, it has a surface of approximately 80 m². The central kitchen was comprised of hearths with stone supports, grinding stones and associated *manos* (grinders), large pottery jars and bowls. Only one family inhabited this house, but the presence of two sets for grinding suggests that two women lived there. Such a characteristic corresponds to a polygamous structure of the society. Various cultivated and wild plants were used: maize was the main staple, consumed as *chicha*. *Guaba*, cherry, blackberry and *granadillas* were eaten. Some of these plants could also have served as pharmacopoeia, especially the species *Inga*, *Prunus* and *Phytolacca*. Women spun cotton thread in the western part of the house.

Maize grinding and cooking were done in the centre of the house. The presence of two grinding stones (*metates*) and their two associated hand tools (*manos*) near the central hearths, as well as the two spindle

whorls, suggests that two women lived in the house. Today, each Aents Chicham wife owns her personal tools: 'the female "tool kit" is duplicated in each activity area and consistently located around immobile features, as the central hearth, the bed, etc.' (Zeidler 1983: 172). In this case, the presence of double tools most likely indicates a mother and daughter living in the same household. Large brewing jars and associated pottery bowls were placed in the eastern part of the kitchen. Women collected *chicha* in bowls from this storage area to serve men and visitors. In modern Achuar houses, such big jars are also grouped in the central area of the female sector. Moreover, the shape, paste, size and corrugated decoration of the Huapula and modern Aents Chicham jars are similar. The persistence of a shape and a specific decoration for more than one millennium in the Morona-Santiago Province in Ecuador is remarkable. However, this situation has also been encountered in other parts of the Ecuadorian Amazonia (Guffroy 2006). As is the case today, different activities were conducted in specific areas: the sharpening of cutting tools, the polishing of wooden pieces and the spinning of cotton thread with pottery spindle whorls. Many archaeological data point to the existence of a common spatial pattern between the Huapula and the Aents Chicham house. The preeminent feature is the division of the inner area into two gendered spaces and the existence of areas dedicated to specific tasks.

Many aspects of the Huapula house can be compared to contemporary Achuar houses. The elevated location of the house is an important aspect for these communities. In Amazonia, drying out the residential space is a major priority. Generally, gullies are dug around the house to drain water and avoid muddy ground. For this reason, high spots are often preferred for building a house. The Huapula people settled on the top of the artificial mounds built by their predecessors of the Upano culture. Features of a Huapula house have been found at the top of a central platform at the Sangay site. Modern Achuar of the Pastaza Basin also choose high locations at the edge of a stream to build their houses, generally oriented parallel to the river (Descola 1986: 154). In the case of the Sangay site, it was necessary to reduce the steep slope down to the small Huapula River. Inhabitants had to cut into the cliff to reduce the inclination and to shape a softer pathway down to the water. In a similar way, the Achuar secure the river access from their houses by creating a plank pathway (Descola 1986: 139).

Large-scale excavations at the Sangay site offered a general view of a pre-Columbian domestic area. Connections have been established between remains and features of the same anthropic soil, dated between 800 and 1200 CE. This surface represented the last occupation of the place and the traces are very well-preserved. The excavation revealed the building technique, the mound function and the chronology of occupation. Moreover, it was possible to recognise the plan of one house and to interpret the ancient activities that took place in it. The spatial organisation of one Huapula family unit could thus be understood.

The location, size, features and remains of the Huapula house are closely comparable to those of the modern Aents Chicham settlements, located in the same Upano Valley and the nearby Pastaza Basin. Moreover, the ceramic vessels show stylistic similarities with the Aents Chicham pottery. The activities carried out in the dwellings are the same in both cases. The definition of precise inner spaces for men and women with particular use, sociability and rights seems to be a priority in both the Huapula and the Aents Chicham houses. Besides this gender division, areas with specific functions are delimited by the arrangement of furniture and features. The 'domestic spaces are public places, too, that the boundary between public, political life and private, domestic life is often indistinguishable, that intimate, social, and public interactions occur in almost every home, and that women's and men's domestic and political lives are distinct yet inseparably intertwined' (Bowser and Patton 2004: 179).

The many similarities between the pre-Columbian and contemporary houses suggest that the Huapula society could represent the first appearance of the Aents Chicham culture in the Upano Valley. This would push back the arrival of the Aents Chicham in the region by more than 500 years.

2. When the present looks toward the past: the French Guiana coast

Another ethnoarchaeological approach was tested twenty-five years ago in French Guiana (Rostain 2017). In this case, it began with the mapping and excavation of a recently deserted indigenous village, followed by a confrontation with the memory of the former chief. This demonstrated the weakness of inference models often applied to the tropics, derived from experiences in temperate countries.

Some Amerindian families had settled in a small village near the French Guiana coastal road, a few kilometres west of Cayenne. In October 1990, I visited the village and was very surprised to find it empty, completely abandoned, apparently very recently (Figure 6). After searching for the former occupants, I met them 3.1 km to the west in the new village of Kamuyene, to which they had recently migrated. I found there the opportunity to set up an ethnoarchaeological study in this settlement, a setting that provided interesting potential for an experiment in archaeological methodology.

First, I conducted a study using classical archaeological field methods, including recording of topography and excavations. Then, I imagined how an archaeologist might interpret such data, acting as if he/she knew nothing about this village or its inhabitants. The work was conducted with the intention of determining the characteristics of the material culture of the former occupants. Despite centuries of colonisation, hybridisation, transculturation and integration, each modern Amerindian village of the Guianas still presents ethnic specificities and particular traits that differ from other settlements. They constitute a set of clues that can generally help to identify the origin of the inhabitants.

The settlement stretched over 38 m from north to south and 50 m from west to east, with an additional house located 22 m east of the eastern border. More than 100 planimetric measurements were taken using a transit (a horizontal alidade) with magnetic orientation at a scale of 1/200. Altitude measurements confirmed that the village was located on the highest point of the flood-prone savannah, so it remained dry even during the rainy season. The first step was to locate posts and postholes. In this way, it was possible to reconstruct the map of each individual house and of the latrines. Then, garbage dumps were located and measured. The map of internal pathways was drawn. Planted trees were located and their species identity determined. Two wooden benches, which constituted the largest artefacts, were located. Finally, houses were numbered for the study. A complete map of the settlement was drawn, showing postholes, house plans, latrines, pathways, middens and discard areas, the well, notable artefacts, planted trees and the central plaza (Figure 7).

During the topographical work, the remains of seven houses were spotted: only traces remained of the first house (# 6); three were almost completely destroyed (# 1, 2 and 7); two were partially ruined (# 3 and 4) and the last one was well-preserved, almost habitable (# 5). Diameter of posts ranged from 7.5 to 9 cm and up to 14–15 cm for the main posts. All houses had been built on low stilts. For houses 6 and 7, only postholes, sometimes including part of the post, were still visible. The floor beams of houses 1 and 2 were preserved. In house 3, the posts, beams supporting the floor, horizontal beams, and some palm leaves of the roof were intact.

Inhabitants of the settlement used only two latrines, located apart from the houses on the northern and western peripheries of the settlement (Figure 8). Four garbage dumps were found near houses 1, 3, 4 and 5, as well as two dispersed discard areas near house 4 and in the centre of the village (Figure 8). Garbage covered surfaces ranging between 3 to 5 m in diameter and were about 20 cm thick. A precise inventory of each midden was made. The great majority of the refuse was of European and industrial origin. Artefacts were broken and made of material that would not long resist destruction. Metal artefacts dominated the sample: cans, soda bottles, sprays, drums, pieces of gas lamps, aluminium-foil food packaging, etc. Glass containers were numerous: bottles, flasks, pots and baby bottles. A great quantity

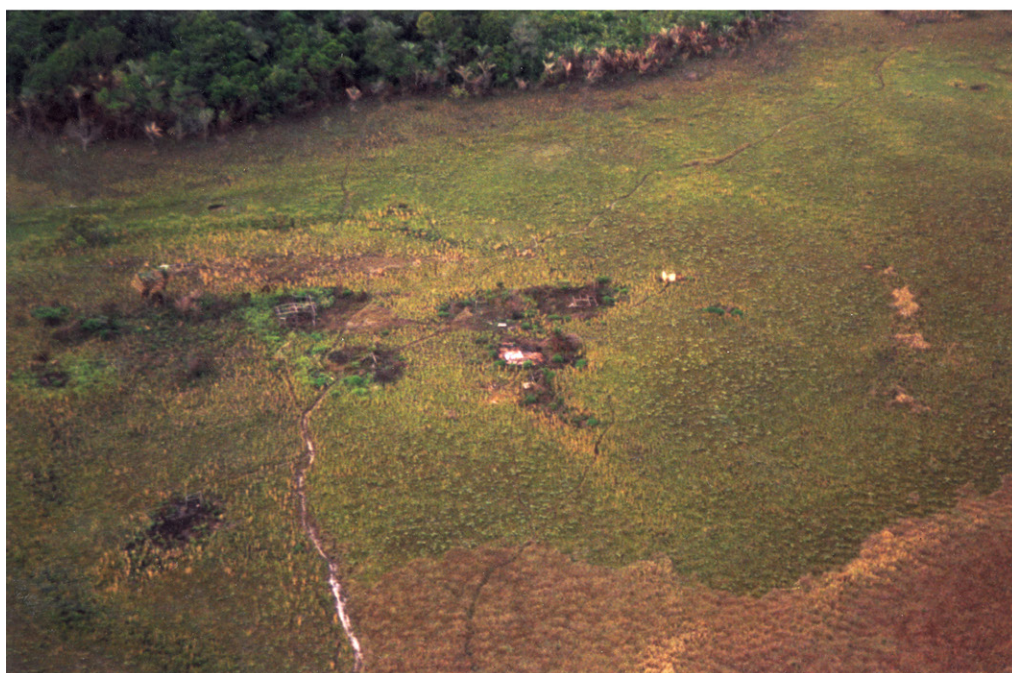


Figure 6. Aerial view of the abandoned Savane Maillard village (photographs by S. Rostain).

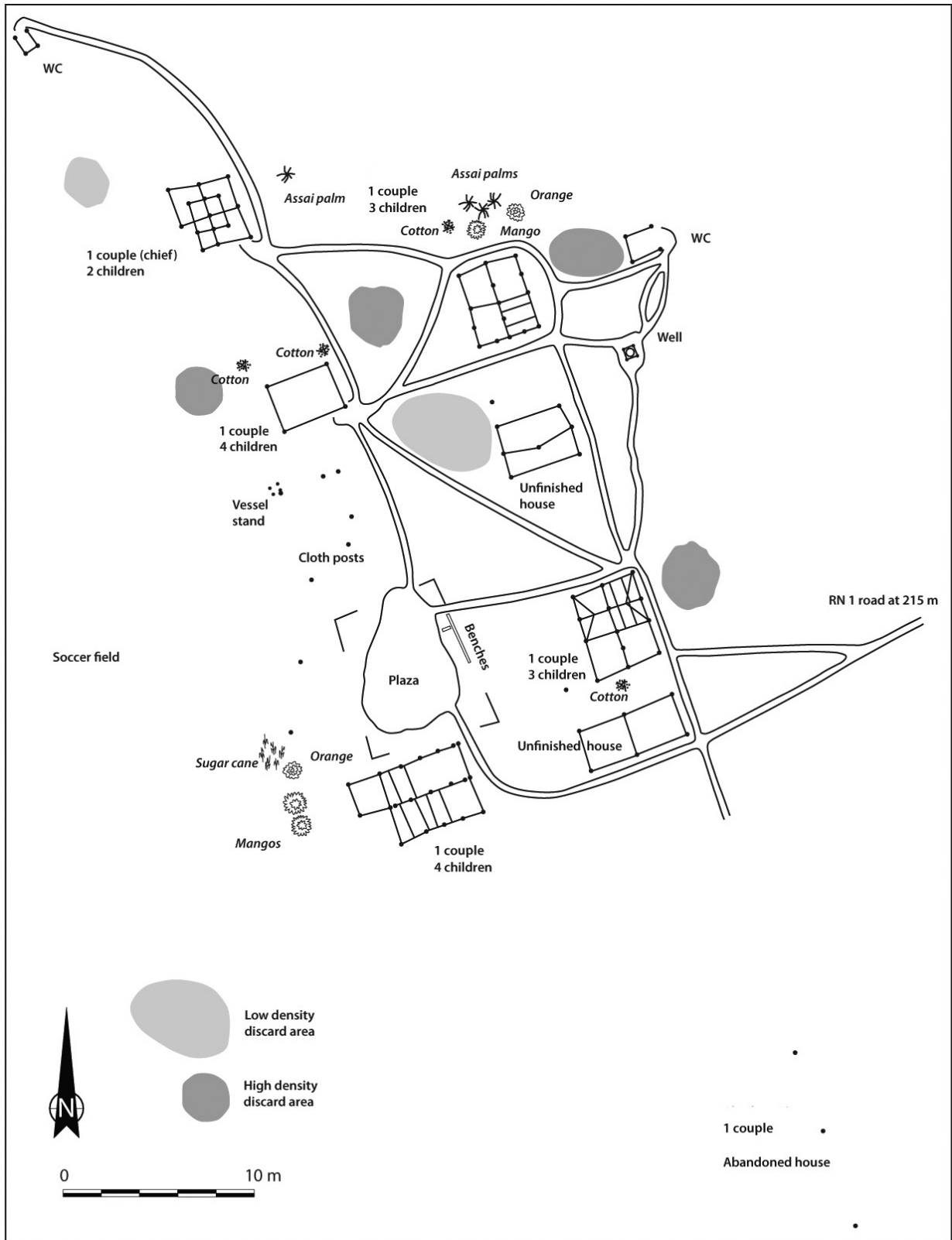


Figure 7. Map of the Savane Maillard features (drawing by S. Rostain).



Figure 8. Domestic garbage and toilets in Savane Maillard (photographs by S. Rostain).



Figure 9. Individual and collective wooden zoomorphic benches found in the Savane Maillard village plaza. The elongated one is painted and represents an anaconda (photograph by S. Rostain).

of spent electrical batteries was found. European earthenware and plastic bottles or containers were rarer. Several cardboard food packages were intact because the weather was still dry—the study was conducted at the end of the dry season. Various usable metallic containers were found in the garbage associated with house 5: one cooking pot, one saucepan and one pie pan. The house 5 garbage dump was the only one in the village that contained rum and wine bottles. The absence of similar remains in other middens suggests that the village inhabitants did not drink alcohol, except for those in house 5.

The only culinary remains were eggshells and some piles of broken nuts or shells of snails (*Pomacea*, *Ampullaria crassa* and *Neritidae*). Various useful trees and other plants grew near the houses, including açai palm (*Euterpe oleracea*), cotton (*Gossypium barbadense*), orange (*Citrus sinensis*), mango (*Mangifera indica*), mombin (*Spondias mombin*) and sugar cane (*Saccharum officinarum*).

One gourd bowl had the rim decorated with incisions painted in black. One lid of a metal can had been perforated with a nail to make a rasp, presumably used to grate coconut (*Cocos nucifera*) or sweet manioc (*Manihot esculenta*). This was the only secondary tool we found, made from a European object and used for a function different from its original one. Finally, the red bark found in a cooking pot attests to an Amerindian activity, probably the manufacture of a dye for basketry or calabashes.

As in any archaeological research, the data collected during the fieldwork were classified and analysed before evaluating how an archaeologist could interpret them, obviously using bibliographical references and known data on modern populations to make comparisons. This study resulted in a broad set of interpretations and a description of the village and its former inhabitants.

The location of the Maillard village—on the top of a sandy ridge, not far from the national road and near forest patches—was considered to reflect a careful choice made by the former inhabitants. The spot was high and thus free of flooding, and was located near natural resources.

The mapping of posts and postholes led to the recognition of seven houses in different conditions of preservation. They were all built on stilts with the same technique. Such houses, resting on short stilts, are perfectly adapted to the flood-prone savannahs of the Guiana coast. Simple observation of the architectural style of the houses shows that they were neither Western nor Creole (the Black community predominant on the French Guiana coast), but clearly Amerindian. The organisation of the village, with a small number of houses, external latrines, a well, pathways and a central plaza, was typical of many modern indigenous villages of the Guianas. The largest house was located just in front of the central plaza, so it was logical to infer that the village chief lived in this relatively prestigious building, as is the case in other Amerindian settlements. Using the characteristics of the habitation features, the house sizes and the indigenous birth rates in French Guiana, an average of three to four members could be proposed for each family—the large quantity of baby bottles in almost all garbage suggesting the presence of children in each house. On the basis of these estimations, it could be hypothesised that seven families resided in the settlement, amounting to between 21 and 28 persons.

All the characteristics seen in the village indicated a sudden departure. Ceremonial benches were left in the ceremonial plaza, numerous useful artefacts were still in house 5 and the dye had not been taken. The broken collective bench was interpreted as having been produced by a ceremonial destruction and a social deposition of the bench symbolised by the cut tail. The abandonment was estimated to be very recent, between several weeks and a few months.

Few truly Amerindian artefacts were found, notably two wooden benches. An individual bench carved from a wooden trunk in the rough shape of a bird was found in the ceremonial plaza. This small bench was placed against a collective bench, which lay on the border of the central plaza. The latter bench was made from a beam 370 cm long and 10 cm wide, square in cross-section (Figure 9). One end of the bench was sculpted in the shape of a stylised snake head. The beam was not perfectly straight; the snake's tail was slightly raised. The two sides were decorated with geometric motifs, basically diamond-shaped, painted in red, blue and white. The general impression of the decoration evoked a snakeskin. Before being abandoned, this bench was mutilated: the last 13 cm of the tail had been sawn off. The cut fragment was still present near the bench at the site.

Only two Amerindian pottery artefacts were found. The first one was a red-painted pitcher. The section was oval and the neck, located on one side, was inclined. The container was used with a wide handle, which was found broken. The second artefact was a small sherd painted with red and white motifs and with one small perforation (0.7 cm in diameter)

The two Amerindian pottery artefacts can easily be attributed to a specific ethnic group. The first one was a red-painted pitcher with a broken handle, made only by Kali'na, who call it *watalakan*. The *watalakan* is a Kali'na globular pottery pitcher whose shape is inspired by the European water jug (*gargoulette* in French) that is specifically made to keep water cool by sweating thanks to its porous walls. The Kali'na make many of these containers, which they call by the Karib name *watalakan*, created by associating the Dutch words 'water' and 'kan' (jug).

The second artefact, a perforated painted sherd, was probably part of a flowerpot. In view of its technological and decorative characteristics, there is no doubt that these two ceramics were Kali'na. Such data would indicate the presence of a member of this group in the village or trade relations with the Kali'na.



Figure 10. House ruins in Savane Maillard (photographs by S. Rostain).

The Maillard settlement was located in traditional Kali'na territory. The French Guiana coast is divided into two Amerindian territories, with Cayenne Island as a boundary. The Palikur are located in the Lower Oyapock and in the neighbouring Brazilian state of Amapá, and the Kali'na are settled in some villages west of the city of Kourou. From all the collected data, it was possible to infer the presence of one or two ethnic groups in the village. The ceramic sherds and pottery bottle found were typically Kali'na, so it was reasonable to think that representatives of this group lived in this village. However, the two wooden benches were not Kali'na, but clearly Palikur (as was the half-calabash bowl), so it could be inferred that this group also was represented here. This duality of style in the settlement could be interpreted as reflecting the presence of residents from these two ethnic groups in the Maillard village, but it was difficult to determine which was dominant.

Then, I returned to the village with the chief, who gave me his testimony and his own interpretation of the remains. I compared the first results with this new evidence and re-evaluated the whole interpretation.

The first revelation was the identification of the former inhabitants, who were Palikur (who call themselves *Paykweneh*); none of the residents were Kali'na. The historical Palikur nucleus was located along the Urucaú River, in the Uaçá Basin, in the northern part of the Brazilian state of Amapá (Nimuendaju 2008). The chief said that he was the first Palikur to settle in the Maillard village in 1986. He was born in Saint-Georges, on the French bank of the Oyapock River, and migrated when very young with his parents to Ukumene on the Urucaú River. When he came of age, he returned to Saint-Georges, where he stayed for two years before flying to Cayenne to work and to seek good health and happiness. In 1986, he decided to build his house near Macouria. That same year, his brothers and other Palikur joined him there.

In making the list of inhabitants, he omitted two houses, so I asked him who lived in these houses (6 and 7). He answered that no houses had been there. I insisted, showing him the postholes, at which point he said that people had begun to build two houses that were never finished, and thus never inhabited before work on them was abandoned. This state of affairs was not obvious based on the present evidence and features. A clue to this fact could have been the absence of a garbage dump associated with these houses, but a dispersed midden was located just in front of house 7 and could have served for that household. No discard area was associated with house 6, but it is common in Amerindian villages to sweep out the garbage against the neighbour's house, so that a dump near one house could have come from another house. Conversely, he told me that there was a house east of the settlement that I had not seen. The inhabitants of house 8 had left long before the others.

In the majority of Amazonian villages, the chief's house is the largest and is often located in front of the central plaza, so it was logical to infer that the large house 2 (Figure 10 bottom), just east of the ceremonial plaza, was the chief's house. In fact, his house was the small one further away, at the end of the western pathway of the settlement. Thus, the inference of the social significance of the central location of the chief's house was invalidated. He said he did not want to live in front of the plaza because of the noise and, for that reason, his house was distant from the centre of the village. His brother lived in house 2.

Moreover, the study of the distribution of postholes and posts seemed easy, and one could think that it was relatively evident to reconstruct the plan of the buildings. However, such features are sometimes traps that lead to mistakes. I saw two houses that were never finished nor inhabited, and I missed another one that was on the periphery of the village. Finally, the chief confirmed that the owner of house 4 was a handyman, but not a professional.

The presence of Kali'na pottery in Maillard village could be explained by the absence of ceramic manufacture in the village. No women manufactured pottery in the settlement; this craft industry had almost completely disappeared among the Palikur by the 1980s (Rostain 1992). The closest Amerindian potters were Kali'na, so the Palikur had to trade with them to obtain Amerindian ceramics. This ethnographic evidence is very interesting for archaeologists, because similar phenomena surely occurred in the past. For example, until recently in the Upper Xingu, only one group made pottery, which was then traded to other neighbouring communities, which were affiliated with four different linguistic families.

I did not see the remains of the football field, which were hidden by grass just at the southern edge of the village. I also did not find the posthole of the ceremonial pole that had been removed from the central plaza. Thus, I failed to detect two essential parts of Palikur community life concerning sport and ceremonies. Because I was not sufficiently aware of these particular activities, I did not pay attention to the discreet—yet present—traces of these domains of village life.

After one year, including the rainy season, I came back to the village, but for the most part, it had disappeared. House posts had been taken by Amerindians or had naturally degraded. Vegetation had regrown, hiding pathways and garbage. Only the centre of the ceremonial plaza was still visible and not yet colonised by secondary vegetation.

Various visits were made during the years afterwards to follow the natural degradation of the site and the disappearance of features and traces. Twenty years after the first fieldwork, in May 2009, I made another visit to the site with the ethnobotanist Marie Fleury to evaluate the amount of remains, useful plants and the post-abandonment changes in the settlement. No evidence of the old settlement was visible. Even the planted trees had disappeared, destroyed by the annual savannah fires. This absence of visible remains, only twenty years after abandonment, indicates that coastal savannah villages generally leave few traces of human occupation.

It is easy to imagine what features could be found if excavations were to be conducted today: postholes, the well, latrine pits, evacuation canals and drip lines indicating the rain streaming from the houses. The majority of the artefacts, mainly European, were made of perishable raw materials and would have been destroyed. It could be expected that an excavation would reveal glass and earthenware containers and Amerindian pottery vessels.

The objective of the Maillard village project was to test the viability of interpretations used by archaeologists in the tropics, which are currently based largely on a framework developed in the temperate regions of the Northern Hemisphere. More than viability, this experiment revealed the fallibility of the inferential process, showing that archaeological data are misunderstood in many cases. The experimental study of Maillard village has provided clues to evaluating the relevance of the intuitive analytical approach. The inferential process used for the archaeological interpretation led to crucial errors of interpretation. The confrontation of the results and their interpretation with the ethnographic interview led to a profound re-evaluation of many conclusions. Although some archaeological interpretations were confirmed by this cross-referencing, others were completely rejected. This experiment teaches us to be cautious when interpreting archaeological facts, even when their meanings seem obvious at first glance. There are so many biases that they can radically distort results.

3. Archaeological trowel and indigenous parole

Ethnoarchaeology can take many forms. It can be conceived as an ethnographic view of archaeological facts or, conversely, as the acquisition of ethnographic data through archaeological methodologies. The



Figure 11. Top: Shuar house in the Upano Valley (photographs by S. Rostain). Bottom: Wayana and Saramaka people building a house in the Upper Maroni (photograph by P. Frenay).

two Amazonian case studies presented here illustrate this confrontation and back-and-forth between the two disciplines. When it avoids unconvincing direct comparativism, the combination of archaeology and ethnography provides useful tools for the researcher (Figure 11). In Amazonia, this alliance is particularly desirable and takes on a strong dimension if it also takes into account indigenous discourse and knowledge.

Large-scale excavations at the Huapula site in Ecuador offered insights into a prehistoric settlement location. Connections have been established between the remains and features found in the same anthroposol, dated between 800 and 1200 CE. This particular archaeological surface represents the last occupation of the site, and its traces are very well preserved. The excavation revealed the techniques of house building, the mound function and the chronology of the occupation. Moreover, it was possible to recognise the plan of one particular house and to interpret the ancient activities that took place in it. The spatial organisation of one Huapula family unit could thus be understood. The location, size, features and remains of the Huapula house are closely comparable to those of modern Aents Chicham settlements located in the same Upano Valley and the nearby Pastaza Basin. Moreover, the ceramic vessels show stylistic similarities with Aents Chicham pottery. The activities carried out in the vicinity are similar in both cases. The definition of the precise inner spaces for men and women, with particular use, sociability and rights, seems to be a priority in the Huapula houses as well as in those of the Aents Chicham.

The Maillard village study in French Guiana shows, conversely, that ethnographic data were not devoid of error, because the situation was described through the distorted filter of the subjectivity of the witness and the limits of the accuracy of his memory. In the Maillard village, the indigenous chief gave evasive or inexact answers concerning the reasons for the abandonment of the settlement and the 'deconsecration' of the collective anaconda bench. The interviewer must keep in mind that the interviewees are influenced by cultural rules and interdictions.

The archaeological mapping and the excavation of the Savane Maillard site in French Guiana revealed profound methodological and interpretative flaws. The social organisation and occupation of the settlement were misidentified (the voluntary choice of the settlement location, unfinished houses and the attribution of a house to the chief), and an incorrect ethnic identification was made (Palikur/Kali'na). An activity area was erroneously identified (raised fields were not contemporaneous with the site's occupation). Important features were missed (a separate external house, the posthole of the ceremonial pole, the football field). These are not insignificant errors, but essential misunderstandings that invalidate a great part of the conclusions proposed by the archaeological work. Most of these errors resulted from the inferential process applied to the chain of successive interpretations. The logical conclusions provided by the archaeological study must be severely reassessed in the light of the ethnographic revelations. The weaknesses of the intuitive analytical approach suggest that it should be critically examined before it is used for the interpretation of archaeological data.

Let people not show too much confidence in their judgments, like one who, in a field, estimates the wheat before it is ripe (Dante, *The Divine Comedy*, 1303–1321).

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Multiscale details. Technological choices and gestures in the construction of earthen roofs in the high Andean area

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Abstract

Earthen building technologies present relevant research traditions, which allow for an approach to their current significance as well as to their historical meanings. There have been certain tendencies towards the analysis of the general and shared characteristics of techniques. This has led to the neglect of the small-scale technological choices that shape subjectivities within the process of construction. These choices involve the selection of raw materials, and particularly the technical gestures and the associated corporealities.

This paper proposes an approach to the subjectivities of these technical gestures that imprint characteristics onto materialities, based on the procedures associated with roof construction in the high Andean area, particularly in the north of Argentina. Roofs have the particularity of displaying a remarkable diversity of procedures with different materials. This paper emerges from the fieldwork carried out in recent years with an ethnographic approach, involving collaborative work in construction.

Key words: Andean area, Building cultures, Technology, Chaîne opératoire, Making

1. Introduction

The materialisation of earthen roofs in the Andean area has historically been an action that has tended to be repeated over time as part of the processes of maintenance and renovation of buildings (Gose 1991; Sendón 2004; Tomasi 2013). Both in domestic and collective architectures, such as churches, these instances involve the use of a very diverse set of materials, practices and knowledge (Rotondaro 1984; Tomasi 2012). Work on roofs, unlike what usually happens with other sections of buildings, involves extensive instances of collective work. These collective instances are, in turn, inseparable from a dense rituality linked to the entity of architecture in society (Arnold 1998; Sendón 2004).

Descriptions of the techniques employed for earthen roofing in the region, mostly ethnographic, show a remarkable diversity of ways of making, with different combinations of fibres and mud (Arnold 1998; Gose 1991; Rotondaro 1984; Delfino 2001, Sendón 2004; Tomasi 2013; Yuste and Giribas 2015). However, despite the importance of roofing techniques, in general, they have not been the subject of systematic research in architectural terms, which has tended to focus more on the procedures used for walls, such as adobe, *quincha*¹ or rammed earth.

Roofs present, in turn, some methodological challenges for their characterisation in historic architecture. Given their functionality, they are more affected by wind and water erosion, to such an extent that in many cases they are no longer recognisable. On the other hand, in relation to these same erosion processes, the materiality of roofs is often replaced periodically, which implies an updating

¹ *Quincha* is a type of wattle-and-daub technique based on the use of canes. Although it is mostly used for walls, there are cases of *quincha* roofs, particularly vaults.

of the methods in the framework of renewed conditions of existence. Finally, various institutional actors, particularly the state, have forced the eradication of earthen roofs, encouraging the use of other technologies. This set of factors has favoured the invisibility of the technological universe of mud and plant-fibre roofs.

At the same time, a second type of invisibilisation takes place. The characterisation of building techniques in general, and those oriented towards earthen roofs in particular, tends to focus on the broad features of the procedures and their underlying logics, favouring an understanding of the general mechanisms. While this scale of analysis is relevant, so is the identification of the many technological choices that people make and that define specific ways of doing. The effectiveness of a building resolution, as the capacity to respond to the objectives for which it is used, is mediated by choices at different scales (Lemonnier 1992). Many of the gestures involved are imperceptible from an external view and emerge from the conditions of execution of the procedures and the expertise of the builders. The details in many cases are associated with the selection of raw materials, their processing and arrangement, but also with the set of technical gestures of the builders in the flow of action. Within this framework of multiple choices, a wide universe of variations emerges, arising from subjectivities and operating on different scales, between the regional, the local, the domestic and the personal, forming a weft in which multiple trajectories intersect.

This paper seeks to approach this subject by observing the techniques used for the materialisation of roofs in a portion of the Andean area in what is now northern Argentina. Specifically, two procedures that have been used historically in the region, and which still have a certain presence today, will be observed: *torta de barro* (literally, mud cake) and *guayado* (Figure 2a and b). The first technique is based on continuous layers of mud and the second on bundles of straw soaked in mud. In addition to the general characteristics of these techniques, the aim is to describe a multiplicity of details that mark the making in different localities and even by different builders. This will enable recognition of how the variations arise from the multiple choices made throughout the process, which ultimately define the characteristics of the techniques in their dynamic condition. Rather than developing an operational chain of these procedures (*sensu* Lemonnier 1992), the aim will be to look at a series of actions, in the sense of people's actions in their correspondence with materials.

This article arises from fieldwork carried out in recent years in and with different communities both in the highlands of the province of Jujuy in northern Argentina and in certain localities in northern Chile and southern Bolivia. This fieldwork has involved participant observation of the procedures, from an ethnographic perspective, and the documentation of current and historical constructions, but particularly the physical involvement in construction tasks together with groups of builders in an active learning process. Based on these experiences, rather than focusing on the logics of the techniques in each of these communities, the aim will be to create a kind of patchwork or collage that will allow the recognition of a totality emerging from the superimpositions and variations of the choices and gestures.

2. The scalarity of choices

Any building practice involves multiple simultaneous and sequential decisions that operate in different technical and social domains. In particular, the materialisation of roofs confronts builders with a remarkable number of choices in a process that involves many materials and procedures. These choices, on the other hand, involve different scopes in social terms. As multiple papers have illustrated, the assembly of a roof can involve up to a dozen people in a house and up to more than a hundred if it is a collective architecture, such as a church. All these people, with different levels of expertise, must act in a coordinated manner, with varying margins for decision-making. The construction of roofs offers the

possibility of investigating the notion of technological choices from a scalar dimension, contemplating the different domains that operate from the social and the technical.

In recent decades, anthropological interest has shifted towards understanding the phenomenon of making, the set of techniques and procedures that allow objects to exist, in the traditions of the anthropology of techniques in the French context or material culture studies in the British tradition. As Lemonnier proposed, every object 'is always a product of its fabrication or use, through gestures, skills, and knowledge which may vary from one culture to another' (2012). Both things and techniques 'are embedded in and conditioned by social relations and cultural practice' (Dietler and Herbich 1998: 235).

Techniques are social facts whose effectiveness, in the terms of Mauss (1935), does not rest solely on practical reasons, although these should not be underestimated. Indeed, in many analyses, techniques are presented as a way to understand other dimensions of the social, something that has also happened with architecture as an object of study (Vellinga and Tomasi 2024). This implies a loss of awareness of the motivations that guide the technological choices of craftspeople. After all, builders make their choices to ensure that the roof protects, first and foremost, people from the impact of environmental agents such as rain. The problem of technological choices within the framework of a matrix of criteria that guide action lies in the preference for one or another solution that ensures this objective. The different scopes of the choices and the actors involved are established in the social, temporal and making multiscalarity.

In Lemonnier's terms, technological choices 'emphasize the sorting of possibilities on which the development of a technical system is *de facto* based, although usually in an unconscious and unintentional way, and they refer both to the process of selection and to its results' (2012). Thus, choices involve a set of decisions regarding the production process, as well as the type of results or objectives that are defined. These objectives can be understood in the sense of levels of relevance, which are not absolute and may even be interchangeable. Regarding roofs, it could be relevant to consider those of a practical nature, such as ensuring water and thermal insulation, but also those that have to do with a certain language, texture, finish or expression. The latter can often take precedence over the former, although not always overriding them, based on the social representations of the builders who shape the choices (Lemonnier 1992). The objectives or expected outcomes are not always aligned and may contradict each other, forcing a position to be taken during making.

All technological activity 'is the result of practical possibilities being reviewed and selected through cultural criteria' (Sillar and Tite 2000: 9). This cultural criterion leads to the observation that the choices in each procedure are deeply linked to the choices of procedures in other technical domains. In this way, the choices in a certain technique, for example, for the preparation of mud for a roof, are related to similar ones concerning, for example, the production of adobe, at least in terms of knowledge of the materials. Even preferences to act in a certain way may be linked to a completely different domain. Not coincidentally, references to material textures, in many circumstances, often appeal to analogies with the field of food preparation.

Technological activities are modelled in multi-scalar terms, in such a way that they operate with possibilities and restrictions emerging from the conditions of existence on a community and domestic scale, as Dietler and Herbich (1998) observed, but also on the individual scale in which the subjectivities of craftspeople are expressed. In the same way, regional, national or global dynamics act to limit or favour certain choices by enabling or restricting access to materials through changes in the availability of markets or the prohibition of the use of certain raw materials due to conservation policies.

Dietler and Herbich (1998) have proposed that techniques are formed in the *habitus*, taking up Bourdieu's concept. In this way, the set of dispositions of the *habitus* shapes action, orienting the practice of

craftspeople and builders, and thus their choices, without this implying absolute determination. Choices operate within a more or less broad universe of options available in the framework of the conditions in which the actions take place. At this point, a collective scale operates but also the subjectivity emerging from the individual trajectories of the actors who provide the conditions for extending or restricting these available options. The training of a builder in a different social and cultural context may imply the incorporation of a new set of dispositions in the updating of the habitus. In any case, the scope of habitus allows for a focus on the multiple individual and collective variations in making.

Technological processes, and thus choices, unfold in steps within a sequence, in what Leroi-Gourhan (1964) defined as an operational chain (*chaîne opératoire*). That is, a series of actions, including gestures, ordered in a certain way to achieve the desired outcome, characterised by both rigour and flexibility (Leroi-Gourhan 1964). Technological choices become co-dependent in the formation of the operational chain, such that decisions tend to condition and modify the margins of subsequent ones. However, as Ingold has observed, rather than a sequence of discrete operations, making can be defined as ‘an unbroken, contrapuntal coupling of a gestural dance with the modulation of the material’ (2013: 26). In these terms, an understanding of the fluidity of technological processes is favoured, rather than their compartmentalisation into clearly definable steps. More importantly, technological choices do not operate on the materials, but with them, and so the operational chains do not involve a logical process that is imposed but one that emerges from a dialogue with those materials. In other words, the materials impose their conditions on the making, in what could be considered a kind of agency.

Technical gestures are related to know-how and certain skills, embodied and modelled in an apprenticeship based on making that combines observation, repetition but also improvisation that can be understood in the light of subjective preferences. Technical gestures, in Lemonnier’s terms, involve ‘matter being acted’ (2012). This is the body acting and being acted with the materials, in the sense of a correspondence (Ingold 2013) that takes distance from the manipulation of a resource. In the acted body, in that gesture, lies an intelligence that operates in the rhythm of the movements.

Manual constructive actions, in fact, involve a constant repetition of movements that follow a rhythm, a physical displacement ordered in time lapses, in an almost choreographic sense, that favours the achievement of certain results in an appropriate time. However, this choreography does not arise from an automated repetition of an a priori designed scheme. The idea of automation, and even the lack of full consciousness in the gesture, is recurrently present in the literature (e.g. Lemonnier 2012), in relation to the repetitive nature of the action. However, observation and performance in building tasks show that it is a vigilant and attentive repetition, which enables improvisation when conditions change. If a bundle of straw does not have the right amount of mud, or the expected consistency, the builder will revise the way it is laid or discard the material, acting consciously in response to changed conditions.

3. The multiplicity of roofs in building cultures

Earth and fibre roofs in the Andean area have been the object of study in recent years from two well-differentiated fields. On the one hand, the more technical approaches, from architecture, which have focused on the characterisation of procedures and the operability of these resolutions, the application in the field of conservation of historic architectures or the analysis of the transformation processes (Rotondaro 1984; Tomasi 2013, 2017; Yuste and Giribas 2015) and the development of technological innovations to increase the durability of roofs (Latina *et al.* 2017; Rotondaro and Rabey 1988). On the other hand, anthropological approaches focus on the high significance of actions on roofs in renovation processes, in which dense social ties are actualised, both in houses and in larger buildings (Arnold 1998; Gose 1991; Sendón 2004). In a sense, disciplinary cut-offs have led to a fractured understanding of

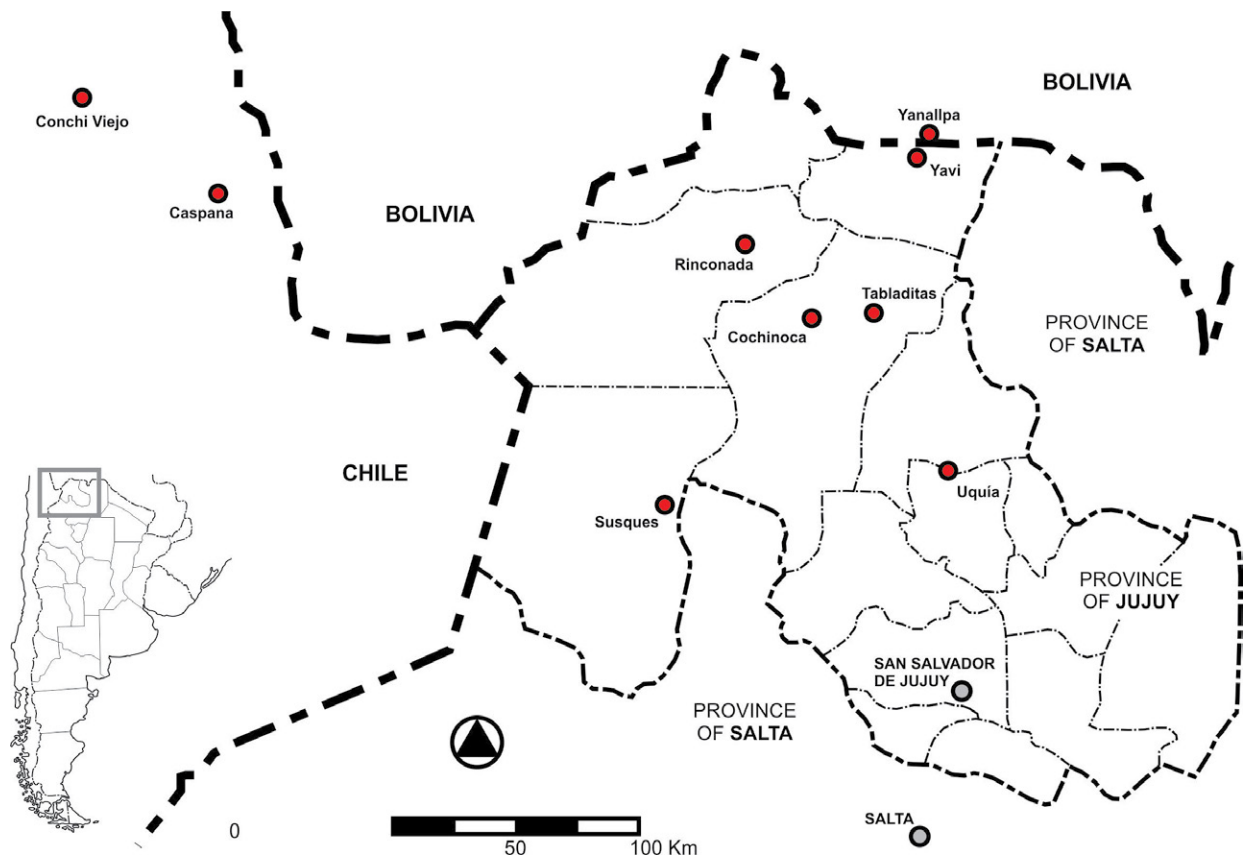


Figure 1. Places and communities where activities related to the production of earthen roofs took place.

building as a social phenomenon. In the terms discussed above, in the making of roofs, builders act on all these dimensions simultaneously.

This simultaneity of reasons underpinning technological choices is evident in the practice of roofing, which was studied and physically acted upon in dozens of actions in nine different communities, such as Susques, Cochino, Rinconada, Tabladitas, Yavi and Uquia in northern Argentina, Caspana and Conchi Viejo in northern Chile, and Yanallpa in southern Bolivia (Figure 1). These academic and building actions revolved around two procedures, namely the *torta de barro* (Figure 2a) and the *guayado* (Figure 2b), considering both new roofs in some cases and the renovation of materials in others. These projects were carried out in research contexts, as in the case of Susques, or as part of conservation actions, as in Yavi, Uquia or Conchi Viejo. Although the proposed approach did not consist in a long-term long-term ethnography of apprenticeship, in the terms developed by Marchand (2009), it did involve training in the handling of materials throughout the process.

These roofing techniques cannot be seen in isolation. On the contrary, they are part of building cultures defined by the use of earth. The notion of building cultures, which has been widely used in the French context (Simonet and Potié 1992), allows for a comprehensive approach to building techniques associated with the interrelationships between procedures in each society. This does not imply a space of making with hard edges and static in time but enables the understanding of interactions and dialogues on different scales, within the dynamics of making in time (Tomasi *et al.* 2020).



Figure 2. Views of the *torta de barro* roof at the Casa del Marqués in Yavi (a) and the *guayado* at the Church of Susques (b).

Focusing on earthen building cultures does not make invisible the use of other technologies in complex articulations, as occurs with reinforced concrete on adobe walls or the use of plastic materials in the case of roofs. The different communities in which research has been carried out share features of a building culture, which does not imply that the procedures are exactly the same. On the contrary, they present a remarkable diversity within what could be considered a family spirit. Precisely, much of this variability is associated with the set of technological choices that, in many cases, fall within the field of subjective decisions of the builders or preferences on a community scale within the framework of their possibilities and restrictions.

Both the *tortado* and *guayado* techniques are recurrent in the region, although their use has decreased significantly in recent decades, and they have been massively replaced by metal roofing, particularly in urban areas (Tomasi *et al.* 2020). This replacement, in any case, has not been absolute, but the resolutions coexist, even in the same house. The *torta de barro* tends to be more characteristic of the high-altitude valleys, such as the Quebrada de Humahuaca, where Uquía is located, while the *guayado* is present in the communities of the highlands, such as Susques, Yavi or Cochinoca. Strictly speaking, the name *guayado* refers to the procedure carried out in the communities in the present-day north of Argentina and surrounding areas, while in the cases in Chile, such as Caspana and Conchi Viejo, it refers to the *repaje* (rethatching) of the roofs.

In both cases, they consist of procedures that seek to generate redundant layers of mud and fibres, although combined in different ways, which are placed on straw, branches or wood frames that are supported on the roof structure. *Torta de barro* refers to continuous layers of mud in a plastic state, usually two: a base layer of about 5 to 8 cm and a top layer of 2 to 3 cm of wear and tear. The mud is usually stabilised with vegetal fibres cut in lengths of about 5 cm, but may also incorporate manure, animal fat, lime or ash. These variations are part of the builders' choices based on their appraisals, local preferences or the availability of resources. In the case of *guayado*, or *repaje*, on the other hand, the covering is achieved through the arrangement of overlapping horizontal strips, made up of bunches of straw partially soaked in mud in a viscous state. In this case, the expression of the roof is that of straw, which is laid with particular care, not only to facilitate water runoff, but also to make the house look pretty.



Figure 3. Structure made of *queñoa* wood with rods on top in Tabladitas (a) and its combination with other species in Yanallpa (b).

Both techniques, with proper execution, provide adequate water and thermal insulation for a period that depends on the type of procedure and environmental conditions. After this time, the roofing material must be partially or completely replaced. This is a significant point since the execution of an earthen roof is not an activity that is performed sporadically but is somehow part of the daily life of families and communities, which favours the learning processes of the builders. This need for periodic maintenance has been one of the motivations, although not the only one, that has favoured the replacement of these techniques. In the case of the *torta de barro*, moreover, it generated several searches for innovations, mostly from the disciplinary field, aimed at increasing its durability (Rotondaro and Rabey 1988). This has included the incorporation of layers of cement and lime mortar, the use of plastic film on the base to ensure insulation or the use of liquid membranes, among other solutions. Beyond the technical considerations that could be made about these incorporations, it is interesting to observe their massive use as part of the new dynamics of building cultures in their interaction with different technologies.

4. Details, choices and gestures

Technological choices operate, and are observable, at different scales, simultaneously and sequentially. These choices range from the definition of the overall morphology of a roof and the relationships between the elements to the way in which a bundle of straw is laid or the trowel is moved over the mud in the smoothing process. Even in the micro-choice of the placement of that bundle, associated with a subjective technical gesture, the eye, in the same act, is directed to the whole of the roof, seeking to control the continuity between the hundreds of bundles. These are different scales of action in the constructive practices that builders are engaged in. For this reason, it is proposed that technological choices are multi-scalar and cannot be completely isolated.

In recent years, the concept of scale has gained relevance, transcending geography, as a way of interpreting the multiple dimensions of social phenomena. Its definition, however, is not univocal. Scale has been approached with different scopes and instrumental bodies (Barada 2016). On the one hand, scale can refer to the resolution of observation, in the sense of the geographical scale in cartography (Marston *et al.* 2009). That is, the level of detail depending on the greater or lesser proximity with which the phenomenon under analysis is viewed. On the other hand, scale is understood in operational terms, establishing processes from the micro to the global (Marston *et al.* 2009). This refers to what Herod (2003) defines as an idealistic approach to scale as a mental device for ordering and classifying



Figure 4. Assembling a structure with *cardón* boards (a) and processing the wood (b), both in Susques.

phenomena, as opposed to a materialist approach. In this operational understanding, processes interact and influence others on a different scale. Finally, the materialist approach refers instead to thinking of scale as a social construct, as an outcome of processes rather than a way of observing them (Marston 2000). In different ways, it will be noted that these approaches to the notion of scale are not mutually exclusive but are articulated for the purposes of observing the technological choices that mobilise the production of roofs.

These technological choices must be understood as scales of social scope, between the individual and the collective. As mentioned, the production of a roof involves the coordinated work of a significant number of people, which varies according to the building's dimensions. Unlike other construction practices that can eventually be carried out by a single person, this is not the case for roofs. That is due to the large number of tasks that are carried out at the same time and the fact that the roofing, whether with *torta de barro* or *guayado*, should be completed in one day or in a maximum of two to avoid discontinuities. Thus, the making of roofs is one of the tasks in which kinship or neighbourhood collaboration networks have historically been activated (Alberti and Mayer 1974).

In this context, roofing requires a collective coordination of multiple actors in what could be considered a collective technical gesture, in which the choreographic rhythm referred to by Ingold (2013) operates. Those who prepare the materials, transport or apply them on the roof must sustain this rhythm to achieve a continuous process in which the flow of the action is sustained. This implies the coordination of individual gestures, in the sense of the action of the body, in that collective gesture. In the case of a small house, one or two people will be needed to prepare the mud or soak the straw, two others transporting the material and at least one more, normally the most expert, on the roof placing the material. In larger constructions, these roles can be multiplied up to tenfold, which gives a good idea of the kind of coordination needed for long working days. When many people perform the same task simultaneously, the margins of subjectivity of the technical gesture are reduced in favour of the production of materials with equivalent conditions.

This is the type of flow that will be described in the following points, based on the actions. It is not a description of stages within an operational chain but rather the differential tasks that occur, in many cases, simultaneously within this flow in which people and materials interact. Nor is it an exhaustive description in the sense of a building manual. The aim is to show different instances in which gestures are inserted into multi-scalar choices.

4.1. Assembling

The assembly of structures made of wood or other materials involves different elements within the framework of a certain general morphology, which is usually single or gabled, or even conical roofs of circular kitchens. This morphological choice regarding the conformation of the roof at its general scale is constituted as a project in the sense of an open field of action, rather than as a definitive resolution based on the criteria of a plan in disciplinary terms (cf. Ingold 2013). The specific conditions, the choices associated with the elements to be assembled are established in the building process itself in an articulation with the available materials. This implies that the roof structures have a significant degree of innovation and creative experimentation within multiple possible responses.

In the study area, the two available timber species are *cardón* (*Trichocereus atacamensis*), a columnar cactus, and *queñoa* (*Polylepis tomentella*), a shrub species, which present very different conditions for making (Barbarich and Tomasi 2020). While *cardón* allows the production of boards, albeit with the constraint of the lengths available, *queñoa* permits very limited processing. Its use requires an understanding of the curvatures of the branches to model the shape of the roof. This is the case, for example, in the sacristy of the Church of Tabladitas, one of the worked cases, where a larger diameter piece was used as the main beam and smaller ones for the rafters, all tied with leather strips (Figure 3a). The structure of the nave, on the other hand, was made with *cardón* A-frame trusses, which shows the margins for the choice of resolutions in the same building.

Such choices, in any case, are not limited to what is available, but may involve significant efforts to expand the universe of what is possible and to obtain the kind of resources that are desired or considered most appropriate. The *cardón* boards in the Tabladitas nave, for example, were moved from Susques² southwards. The exchange or purchase of building resources has been a historical constant³, as well as a current one under new modalities. Veliz (2023) has observed how in Nazareno, in the Cordillera Oriental of Salta, families obtain timber as part of journeys to manage their livestock in the *Monte* area. The current access to wood from large production centres, with species such as pine or eucalyptus, implies new possible choices for builders, with impacts on all scales, in relation to the opportunity to use longer pieces.

In the case of *cardón*, the boards are regularised, in the direction of the vein, with the use of the adze (Figure 4b), seeking to obtain relatively flat surfaces. Depending on their dimensions, the resulting boards will be used to form reticular pieces, such as the *par y nudillo* A-frame trusses (Figure 4a). The connection between the pieces has historically been made with leather from the back of llamas, although nowadays cow leather is also widely used. The production of the leather strings, called *tientos*, and the binding of the wooden pieces require an accurate control of the technical gesture according to the strength of the strings, seeking to adjust the boards without weakening the leather. The same is true for the formwork that is arranged on the wooden structures, binding straw, branches or forming meshes.

4.2. Weaving

These formworks are a distinctive feature of earthen roofs in the region. The conditions of the roof coverings, whether made of mud or fibres, make it necessary to form a homogeneous surface to support the material, at least during the drying process (Tomasi 2013). These formworks are not removed but form the expression of the roof towards the interior of the enclosures, so that the choices and the precision of the gestures are marked by an aesthetic component: the ceilings must look pretty. The

² The Church of Nuestra Señora de Belén, in Susques, has an integral structure made of *cardón* boards.

³ In the case of the Church of Uquía, built in the 17th century, white tipa wood (*Tipuana tipu*) was used for the roof structure, a species from the lowlands that had to be transported to the Quebrada de Humahuaca in large pieces.



Figure 5. Weaving with straw in Conchi Viejo (a) and with tola branches in Rinconada, tied with leather strings (b).



Figure 6. The weaving process of the *cortadera* in a historic house in Yavi (a), and the weaving process of the *tientos* mesh that supports the layer of straw in the Church of Tabladitas (b).

universe of possible resolutions is remarkably wide with a great diversity of possible materials involving wooden boards, canes, branches of bushes or straw, each with different arrangements. Within this diversity, at regional and local level, a shared trait is the tendency to form textile fabrics through the weaving of the elements. The shaping and interlacing of the fibres are not imposed upon the materials but rather operates in correspondence with their flexibility.

Integral wooden boards are characteristic of certain emblematic buildings, such as the Church of Susques or the Church of Caspana in Chile, as they require the use of many *cardón* boards, which are scarce. Instead, these boards are usually used individually as battens (*alfajías*) tied with leather strings (*tientos*) to the beams, upon which the straw is deployed. The straw can be bound to create mats, as seen in Conchi Viejo, also in Chile, where successive bundles are tied together with leather strips (Figure 5a).

The complex knots require a precise tightening gesture that is repeated successively with rhythmic movements of the hands at the joints. Similar bindings are made with canes, for example, in Yavi, or with bush branches, as in the case of Rinconada (Figure 5b). The use of *tola* branches (mainly *Parastrephia*,

Baccharis and *Fabiana*) (Lambaré *et al.* 2024), a characteristic shrub in the altiplano areas, requires cleaning down to the stem of the plant, leaving a portion of the leaves that will help the cover. The canes can be arranged continuously and parallel, although they also occur, for example in Yavi, placed diagonally within an open grid that supports a layer of straw.

Two significant resolutions have been observed and worked on in Yavi and Tabladitas. In the former, a weave of *cortadera* (*Cortaderia speciosa*) is placed on a weft of canes, with a remarkably complex interweaving at the end, which is called *simba*, literally braid, which forms the expression of this layer at the edge of the eaves. The weaving of the fibres involves the work of two or more people coordinating their hands in a collective technical gesture, for the interweaving of the bundles (Figure 6a). In Tabladitas, on the other hand, there is a mesh created by weaving stitches across a single piece of leather that runs longitudinally and transversally across the roof, at the limit tension of the material (Figure 6b). In this resolution, two fields of knowledge outside the field of construction intersect. On the one hand, herd management and the processing of animal materials such as leather and, on the other, knowledge of llama or sheep wool textile production. Building cultures extend their networks to the integrity of social practices.

4.3. Mashing [*Majar*]

The technological choices, with detailed bodily gestures, are not limited to the moment of the concrete execution of the techniques but involve extensive processing of the materials that are often projected far back in time. This is valid for what has been observed in the previous points, with the notable example of the production of the leather *tientos*, but especially for the preparation of the vegetal fibres and the soils. As far as the fibres are concerned, *guayado* requires the preparation of immense quantities of bundles, involving their cleaning and separation. For the *torta de barro*, the straw must be cut into lengths of no more than 5 cm, with the repeated blow of the machete on a piece of wood, accumulating material that will then be spread on the soil for the preparation of the mud.

In *guayado*, in fact, the straw fibres are the central component, which are then embedded in the mud. For the roofing of a church, in the case of Caspana for example, up to 10 tons of straw must be processed to form around 10,000 bundles. This means that it is a task that cannot be carried out in parallel with thatching, as this would compromise the flow of work. Straw *majado*, *chanchado* in some communities in northern Chile, must be projected back at least a week with the simultaneous action of dozens of people.



Figure 7. The work of *majado* in Cochinoa (a) and the storage of the bundles in Susques (b).

The term *majar*, like *chancar*, has its meaning in the culinary and agricultural fields, and refers to crushing and mashing a product or separating the grain from the plant. Both meanings are present in the *majado* of straw. In the process of *guayado*, this action aims to separate the fibres at the root (Figure 7a), remove the shortest fibres and arrange them in a uniform bundle that can be held in the hand by touching the tips of the opposite fingers (Figure 7b). The removal of the short fibres is strategic as they would generate a weak roof coverage. The technical gesture on a micro scale of hitting the straw conditions the macro-scale of the continuity of the roof. Indeed, a large part of the effectiveness of the covering rests on the correct execution of the *majado*.

The *majado* is based on the execution of a series of repetitive clean strikes of a bunch of raw straw against a relatively sharp stone placed on the ground (Figure 7a). The bundle is taken by the tip of the fibres, taking advantage of its elasticity, and is beaten rhythmically, breaking the root and freeing the fibres that are not gripped by the hand. The bundle must then be smoothed, aligning the fibres, with a gentle and continuous movement of the wrapping hand. Once the bundle has been crushed, it is placed with the remaining bundles, individualised, by crossing it in the form of a herringbone (Figure 7b). All these actions condition the subsequent development of both the transfer to the mud pit, the process of soaking it and then placing it on the roof. In a task that can involve many days, the margins of subjective choice regarding the procedure are limited. All the bundles must have similar characteristics.

4.4. Whipping

The soil also has its own preparation process, prior to the execution of the techniques, with differential characteristics in each one. While the mud for the *torta de barro* must be in a plastic state, like that required for adobe, in the case of *guayado* a viscous, almost liquid consistency is required. The types of soils used are also different, almost antagonistic. The granulometry of the soil and its hydric state favour different gestures with the tools in relation to the forms of application. Gestures shape the materials as much as they are shaped by them. The granulometry of the soil for *guayado* is extremely fine, with very high percentages of clay, above 20%, which favours adherence to the fibres, which in turn will limit shrinkage (Tomasi 2017).

Soils for *guayado* are usually known as *greda* or *lame* and have a remarkable similarity in their granulometry throughout the region (Tomasi 2017). In the case of *torta de barro*, on the other hand, the soils offer wider ranges, with a more balanced granulometry, which may, in certain places, admit the presence of gravel.



Figure 8. Preparation of the mud for the *torta de barro*, with the addition of water, in Uquía (a) and the pit with viscous material for the *guayado* of a house in Susques (b).

This amplitude also provides scope for choice with variations and disputes between builders in the same locality. In any case, builders know the particularities of their soils and the possibilities they have to act on their properties by regulating their behaviour with the use of mineral, vegetal or animal stabilisers, such as sand, fibres, grease and manure.

The preparation of the mud for the *torta de barro* is made on the ground, mixing the components dry, as it is done for the preparation of a paste, including the initial addition of straw and the remaining stabilisers. The work is carried out with a certain temporality, observing the different moments for the addition of water. In the first instance, this involves forming channels in the dough and allowing the soil to gently absorb the water (Figure 8a); in the second, the mixing is based on a movement with the shovel that favours the complete rotation of the soil and the homogenisation of its components. The third is the mixing and final adjustment before it is lifted onto the roof.

In the case of *guayado*, due to its consistency, the preparation is carried out in a pit about 2 m in diameter, usually in the patio of the house, which is filled in after the rethatching is finished. The soil and the water are added proportionally and the people inside the pit, moving a hoe and with the movement of their legs, try to break up the clay stones (Figure 8b). The movements of the body are wide and oscillating, moving as much material as possible in each action. The whipping must be done constantly to avoid precipitation of the soil particles, which would lead to a more liquid consistency in the upper part and a more plastic one in the lower.

The gestures are not limited to preparation. Checking the state of the material also has its gestures in relation to the verification by touch of the texture and consistency of the material, constantly adjusting the necessary variables. The analogies with cooking are not casual and in fact the different points of the mud are associated with certain culinary preparations. In any case, the right texture does not depend exclusively on people, but the material has its own processes that are beyond absolute control. This is why it is said that the mud must sleep or must rest. This refers to the preparation time, no less than 24 hours or even more, in which the soil does its own work in relation to the activation of the clays.

4.5. *Embedding*

When embedded with the mud, the bundles of straw are called *guayas*, in relation to the name of the technique, and thus a change in their conditions of existence takes place. Each bundle must be placed in the mud pit before it can be used, a task that cannot be done beforehand. The nearly 10,000 bunches that a church roof may require have to be embedded in a process that has a continuous rhythm that must be managed in relation to the activity on the roof. Different scales operate there: that of the technical gesture of those working with the mud, those transporting the material with their own collective gestures and those placing the *guayas* uniformly on the roof. The interrelation of these scales must take place through a continuous flow of material marked by speed, but also by the quality of each of the *guayas*.

The bundle of straw should be opened like a fan, holding one of the ends, and with the palm of the hand pressed against the mud, trying to get the material to penetrate between all the fibres (Figure 9a). The straw, to become *guaya*, must be covered in a third or half of its length, depending on local preferences and the interpretation of the conditions imposed by the fibres. In the process of embedding the straw, three mutually regulating forces are at work (Ingold 2013): the flexibility of the straw, the strength of the builder's hand and the resistance of the mud. In the balance of the three lies the proper preparation of the *guayas*. If the fibres break or the mud does not soak them, the *guaya* cannot be used or will create a weak point in the roof. This action is repeated hundreds of times during a day, in gestures that are by



Figure 9. Opening of the straw to be dipped in the mud (a), and the arrangement of the *guayas* before being lifted onto the roof (b).

no means inattentive, and in this sense are not completely automatic. They require vigilant repetition of the sinking of the fibres and the consistency of the mud, which varies as the day progresses.

The *guayas* then enter a transport chain that can involve between two and ten people, from the pit to the roof's edge. The flow must be continuous and agile and, at the same time, precise so as not to damage the material or lose the mud. Each change of hands has its own gesture, as happens with the buckets in the *torta de barro*, to deliver the *guayas* with the correct hand and with a balance that favours the continuity of the movement, giving fluidity while also easing the load. A choreography operates here between the people involved, who must coordinate all their movements.

4.6. Applying

The rhythm of the material flow is set by the *guayador* or *torteador*, the person in charge of the final disposition of the *guayas* or mud on the roof. Their indications mark the speed of delivery, but also the corrections in their characteristics. In a regional context in which building knowledge is widely spread among the population, the person or persons on the roof are those who are collectively recognised as experts. They master the gestures necessary to place the material as well as those needed to conduct the whole process.

In certain situations, when a large area has to be roofed, the experts are often on the ground, observing from a distance the process of execution and the uniformity of the roof. Here, two very marked scales are expressed: those associated with the detail of the placement of each *guaya* or bucket of mud, and that of the integrity of the roof. The builders themselves on the roof act on both scales, looking at the material they are placing at that moment and looking up to observe the continuity of the whole. The existence of irregularities or discontinuities can create points of weakness where the roof could deteriorate or where water could accumulate during rainfall.

The task of receiving and placing hundreds of *guayas* or buckets of mud over the course of a day requires a fluid action that does not allow for the possibility of stopping to check every part. The movement must be continuous and precise, with the greatest possible economy of movement. In the case of the *torta de barro*, the buckets are emptied in a certain area to then begin to distribute it evenly over the entire surface, taking care to connect it with the sectors that have already been worked. The distribution has its moments, and each moment has its own gesture. In the first instance, the movement is coarser, not



Figure 10. The technical gestures for the smoothing of the mud in the *torta de barro* process of the Church of Uquía.



Figure 11. Succession of movements for the placement of the *guayas* on the roof.

very careful, while then the smoothing begins (Figure 10). The trowel is positioned slightly inclined, firmly, to prevent the mud from overpowering and imposing its own finish. Gestures vary among the builders, with various, often serious, objections to each other's way of doing. When many builders are working on the roof, for example, in a church, the gestures must be in harmony and become collective to obtain a common finish.

The work on the roof in the case of *guayado* requires a multiplicity of chained gestures that define micro details that condition the integrity of the roof, many of which are dependent on the subjective judgement of the builder. The vigilant attitude within the framework of repetition allows constant adjustments to be made, responding to the changing conditions of the material, the roof or the time of day. This allows to dispute the idea of the unconscious character of action in repetitive tasks. There is a mechanical, but attentive action at each step. The first of these steps is the laying of the *cijne*, or the *copa* as it is called in some communities in Chile: a dense layer of the loose straw resulting from the process of *majado*. The *cijne* seeks to unify the height of the roof, compensating for the unevenness of the supporting structure. When the builder receives the *guaya* must open it with both hands to form a longitudinal body, but with a certain thickness, and then press it firmly in the corresponding place, next

to the previous one (Figure 11). With the tips of the fingers, they press down on the surface to promote adhesion, eliminating the air in between and allowing the mud to penetrate. With a delicate movement, the edge of the bordering straw is lifted, and the newly laid straw is placed underneath, overlapping the pieces. The fibres must complete the entire surface, in a continuous resolution. The effectiveness of the entire roof is defined in each *guaya*, in each gesture in its placement.

Once a sector has been completed, the roof is beaten with a piece of wood to unify it and give it greater density. In some places, as in Susques or Rinconada, buckets of liquid mud are thrown on the roof to fill in the gaps. In these cases, for a while the roof will have the expression of mud, until the rains begin to wash it away, exposing the thatch. The techniques are not only completed by human action, but other agents, such as rain, impose their gestures on the processes. The strikes with the wood, in addition to unifying, seek to align thousands of fibres of straw, favouring runoff while simultaneously brushing the roof to ensure it is neat and thus looks pretty. The aesthetic expressiveness of the roof is part of the motivation, and the same is true of the mud in the *torta*. The effectiveness of the technique, in the sense of Mauss (1935), includes water and thermal insulation, as well as the beauty of the finish and the social cohesion that is built throughout the process.

5. Conclusions

The complexity of the production processes of the earthen roofs, from the assembly of the wooden structures to the placement of the material on the roof, provides a very interesting field for exploring the set of technological choices that operate simultaneously or sequentially within the flows of making. As illustrated in the text, these technological choices deserve to be observed from a multi-scalar approach, as a way to recognise the scope of the decisions together with their margins of manoeuvre. The multi-scalar approach implies observing the interactions that operate between the different scales, so that a micro-decision, as the *majado* of the straw, has implications for the whole operation of a *guayado*. In other words, the effectiveness of a technological action resides in a set of technical gestures that are not always sufficiently observed when analysing building practices.

When these technical gestures involve a repetitive action, the idea of automation or a certain unconscious character is repeatedly mentioned. Observation of building practices and their performance in fact shows that in repetitive action lies a vigilant attitude, which enables a reaction to changing conditions in the materials or the context. Indeed, no specific meditation is observed for each action that is repeated, which does not deny the conscious control that operates in making. Making, on the other hand, lies in the interactions with the materials, a correspondence, rather than in the imposition of unilateral decisions. This is observable both in the integral design of the roof structure, subject to the emerging characteristics of the woods and in the conditions posed by the soils or fibres, modelling the gestures that in turn shape them.

The diverse technological choices emerge from the intersections between individual and collective preferences, within the framework of the recognition of the technical capabilities of a given builder. On the one hand, inclinations to act in certain ways, even if they do not imply a determination, emerge from the collectively orchestrated dispositions within the framework of a building culture. On the other hand, certain details of gestuality may enter the realm of a builder's individual subjectivity, while simultaneously having to be synchronised on a collective scale to obtain equivalent results within a certain margin. The *majado* of the straw is an example of this, with dozens of people cleaning the fibres and forming bundles that cannot depend on personal preferences. The collective gestures, with their rhythms, find a very clear expression in the chain of work for the transfer of the materials from their place of preparation to the roof. There, the art lies in the dedication to a choreography of building that arises from the dialogue between the bodies and the materials.

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Solid earth building in central Germany: projecting vernacular building techniques onto prehistoric finds and tracing their origins

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Abstract

The purpose of this case study is to sketch a brief outline of the development of solid earth building in Central Germany back to prehistory. The region to be studied is characterised by vast loess plains, fertile black soils and low precipitation—in short, perfect conditions for building with earth. The almost unknown and poorly investigated earthen architectural heritage of this area offers numerous points of reference for the reconstruction of prehistoric structures. The latter are usually not preserved at all, with the exception of dug-in features, such as postholes or bedding trenches. As the timber has decomposed and the earthen parts have simply flown off, the raised walls are missing. But in some fortunate cases, parts of the earthen walls have been preserved by hardening during fire. These fragments can be compared with the rich vernacular cob architecture, dating back to the Middle Ages. The earliest evidence for load-bearing earthen walls can now be dated to the first millennium BC. The fired fragments do not show any traces of organic temper, nor any imprints of frameworks of moulds. The early earthen walls consisted of earth (loess) only.

Key words: Evolution of earth building techniques, Settlement archaeology, Earthen architectural remains, Late Bronze/Iron Age

1. The vernacular earthen architecture in central Germany

There are several parts of Germany famous for their earthen architectural heritage within the framework of half-timbered buildings. Central Germany, comprising the modern states of Saxony, Saxony-Anhalt and Thuringia, is one of them. The town of Quedlinburg, a UNESCO World Heritage Site, hosts some of the oldest timber-frame constructions, dating back to 1300 AD (e.g., ‘Hölle 11’, see Heinrich and Schmidt 2010). But the region along the north to south-eastern edge of the Harz Mountains is also home to one of Europe’s most remarkable ensembles of historic solid earth buildings (Mileto *et al.* 2011). Benefiting from low annual precipitation due to the rain shadow of the Harz Mountains, thousands of earthen houses dating back to at least the Late Middle Ages are spread over rural as well as urban areas (Figure 1).

Although this inventory is a unique feature, apart from a few small-scale studies (e.g., Kristin and Klamm 2019; Lieberenz 2021; Noky 2016), solid earth buildings have not been the focus of research to date. Thanks to the ‘GOLEHM initiative’, an interdisciplinary alliance established in 2020 to research the innovative transformation towards modern, modular and automated construction based on traditional earth techniques¹, these buildings are being successively recorded, documented and made available to the public via a digital atlas (see GOLEHM Atlas). Of course, solid-earth buildings are often hard to spot because the earthen wall core is hidden under a thick layer of conventional plaster. However, the

¹ The GOLEHM initiative is funded by the German Federal Ministry of Research, Technology and Space (BMFTR) within the framework of the program ‘WIR! - Wandel durch Innovation in der Region’ from 2020.

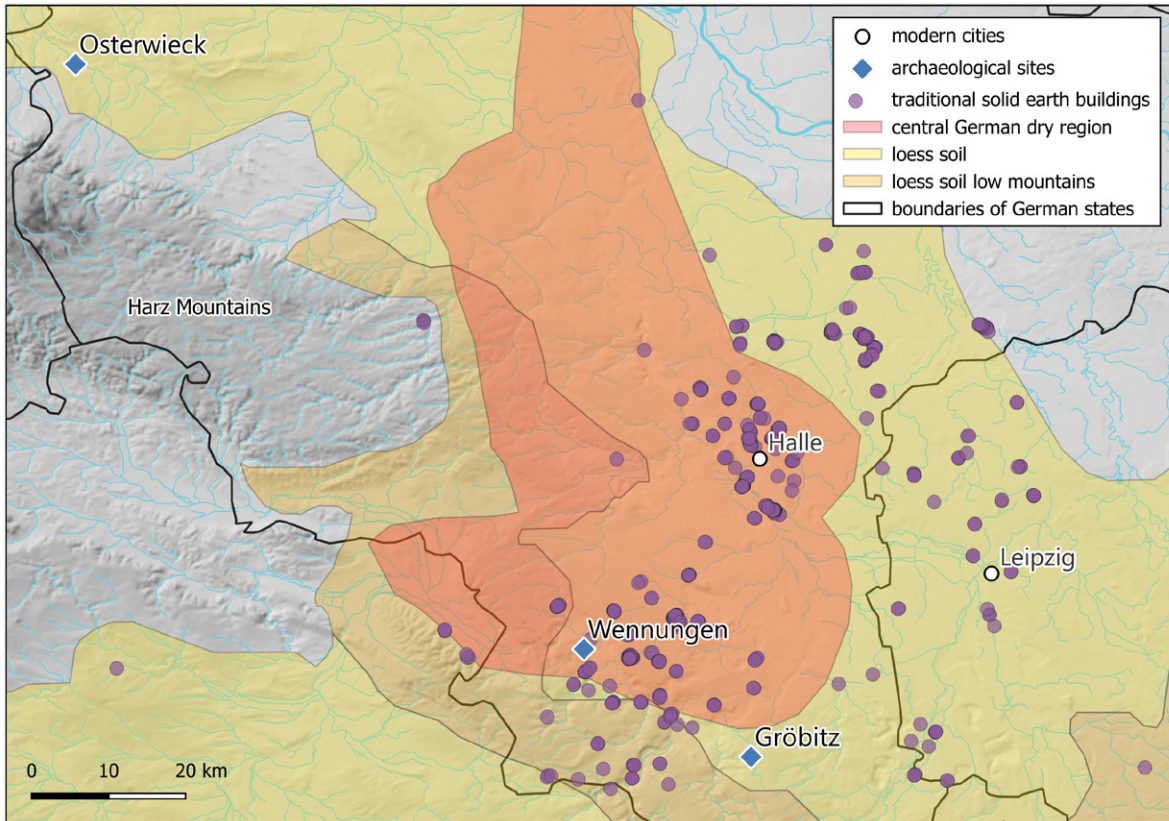


Figure 1. The map shows the central German dry region (red) and the loess areas (yellow) east of the Harz Mountains. To date, around 700 traditional massive earth buildings have been mapped during the GOLEHM survey (violet dots; see GOLEHM Atlas). There is also some prehistoric evidence of monolithic earth constructions in this area (blue rhombi). Map base: DGM 200, © GeoBasis-DE / BKG (2021); rivers: EU-Hydro River Network Database 2006-2012, Europe, <https://doi.org/10.2909/393359a7-7ebd-4a52-80ac-1a18d5f3db9c>; boundaries of German states: © GeoBasis-DE / BKG (2022); traditional solid earth buildings: GOLEHM Atlas; Central German Dry region after Fabig 2007: 19.

extreme thickness of the walls (up to 1 m) or their conical shape towards the roof top, for example, can be good clues to identify monolithic earth constructions.

Most of the buildings still standing date from the second half of the 18th century to the 1950s (Figure 2). In several ‘earth building waves’, which became clearly visible from the 19th century with the start of coal mining and industrialisation, small, often uniform buildings were erected to house workers and their families. Additionally, large barns were built to provide more storage space for the crops and machinery of the growing agricultural production. After both World Wars, due to the post-war shortages of resources and energy, earth building was propagated by the state (Fissabre and Wilson 2012; Körner 1994: 44–48). The production of several tens of thousands of rammed earth buildings alone has been recorded in the soviet occupation zone (the later German Democratic Republic). From the mid-1950s, earth building was finally replaced by concrete construction, and the DIN standards were abolished by 1971. Since 2013, the Dachverband Lehm e.V. has been pushing for new DIN standards (Ziegert *et al.* 2016). The recently enacted DIN standard is for load-bearing earth block masonry (DIN 18940, from 2023). This makes it, once again, the first standard for solid earthen walls in Germany. Both rammed earth and cob techniques are difficult to standardise, as much of the craft skills as well as the know-how of earth building have been lost over the last 70 years.



Figure 2. Lettewitz, Saalekreis district, Saxony-Anhalt, a typical late baroque manor house (c. second half of the 18th century). A load-bearing cob wall rises above a stone base (porphyry) to form two full storeys. As gables are difficult to construct using the cob technique, other earthen building techniques or materials (in this case, stone masonry) were generally used. (© GOLEHM, LDA Saxony-Anhalt, F. Knoll).

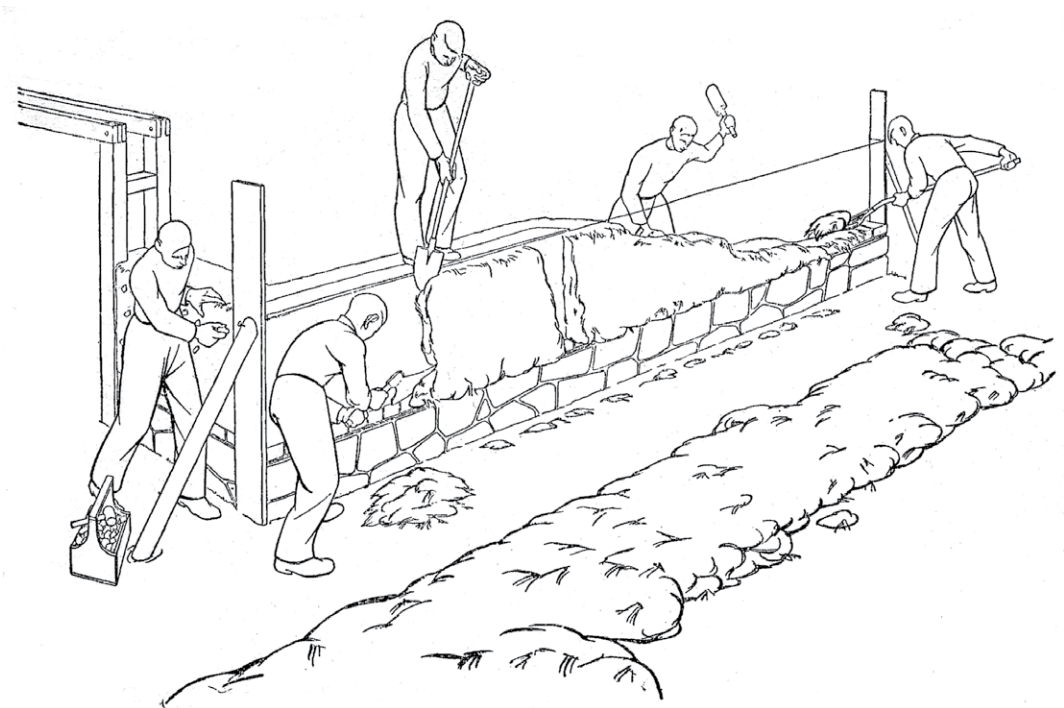


Figure 3. Instructions for the production of cob walls from a manual printed in 1947. The mixture of wet (rye) straw and earth is applied with a fork and compacted by beating with a wooden club. When the first row (up to 80 cm high) is built and has slightly dried, the wall surface can be cut off with a spade-like tool (Henselmann 1947: 34 Fig. 16).



Figure 4. Abtsbessingen, formerly Kyffhäuser district, now translocated to the open-air museum at Hohenfelden, Thuringia. This traditional, newly renovated dwelling with a cob-basement and half-timbered upper floor has been dendro-dated to 1550 AD and it is one of the oldest solid earth buildings still standing (© GOLEHM, LDA Saxony-Anhalt, N. Henkel).

However, this regulation does not apply to the main traditional solid or massive earth building technique represented in Central Germany, which is the pitchforked cob (Knoll *et al.* 2019: 18; Knoll and Klamm 2015: 41–49). In this technique, the wet mixture of 40-cm-long rye straw and earth (mainly loess) is packed with a pitchfork. After drying, the surface is cut off straight with a spade-like tool (Figure 3). This is the simplest way of making a load-bearing earthen wall, as no formwork or pre-drying is required. Consequently, most earthen buildings in this region were constructed using this technique, especially in rural, agricultural areas where the required straw was available in abundance (Ziegert 2003).

Rammed earth construction is a very recent construction technique in Central Germany, although buildings in the Roman provinces are the oldest evidence of this technique in Central Europe. The multi-storey dwellings at Xanten (*Colonia Ulpia Traiana*), for example, have been reconstructed and give a good idea of the Roman-influenced architecture north of the Alps in the first centuries AD (Kienzle and Ziegert 2008). But the regions next to the river Elbe were never part of the Roman Empire. Rammed earth first became popular at the end of the 18th century AD, when François Cointeraux presented his works on rural house building in Paris. His *École d'Architecture Rurale* was cited all over Europe (Cellauro and Richaud 2016) and was soon published in Leipzig in 1803 (Cointeraux 1803; Stieme-Kirst and Knoll 2022: 7–8). Compared to the cob technique, rammed earth requires much more effort to produce, as it

Table 1. Overview of the fired fragments of prehistoric massive earth walls from settlement sites (c.f. map Figure 1) in Saxony-Anhalt. They all date to the first millennium BC (based on radiocarbon dating and the stylistic classification of the ceramic finds) and were recovered from pit features containing debris and domestic waste. The respective number of fragments, their weight and structure are provided.

site	district	type of site	type of feature	dating	radiocarbon date (animal bones)	cal. Sigma 2	number of fragments	weight (g)	layer sequence of the wall construction		
									wall core	level out plaster	plaster coating
Gröbitz	Burgenland	settlement	pit (extraction of soil?)	Late Bronze Age	2821 ± 26 (MAMS 56889)	cal BC 1048-906	136	3,904	pure loess	none	(brighter) surface with calcareous sinter (no extra layer!)
Wenungen	Burgenland	settlement	pit (storage)	Early Iron Age	2492 ± 31 (MAMS 104237)	cal BC 731-545	5441	47,189	pure loess	none	bright clay + organic temper
Osterwieck	Harz	settlement	pit (storage)	Late Iron Age	2155 ± 21 (MAMS 56888)	cal BC 351-61	102	14,437	pure sandy loess	none	compressed (brighter) surface (no extra layer !)

uses wooden formworks and muscle power for compaction, which is not necessary for cob construction. It can therefore be assumed that these walls were originally built as a kind of status symbol. At the very least, the first buildings are associated with large, prestigious manor houses and barns in rural areas.

This also applies to earth block masonry (or adobe), where the blocks must be moulded, then dried and finally laid with mortar. In areas of the Middle East, North Africa and the Mediterranean, where adobe masonry originated, higher temperatures mean that drying times are shorter than in Central Europe or Germany. Although David Gilly strongly promoted earthen building techniques in his book and began to propagate them in Prussia in the late 18th century (Gilly 1790), only a few small buildings were constructed using adobe masonry. Mud bricks were used as cheap fillings for half-timbered constructions, as Goethe did when he completed the construction of his theatre in Bad Lauchstädt in 1802 in just three months (see Goethe-Theater 2020). However, the oldest mudbrick found in excavations belongs to the fortification of the Heuneburg in the south-west of Germany, a Hallstatt ‘princely seat’ dating to the 5th century BC. This construction remains unique and may have been influenced by Mediterranean models (Krause and Fernández-Götz 2012). Archaeological evidence for this technique in Central Germany is lacking for all periods.

The oldest dated solid earth building still standing is in Kappellendorf, Thuringia. Its basement was erected using the cob technique, followed by a half-timbered upper floor. A wooden beam from the ceiling yielded a dendrochronological date of 1422 AD (Nitz 2021). Further dated evidence from the Thuringian Basin includes the cob-bottomed farmhouse from Abtsbessingen (Figure 4), now located in the open-air museum at Hohenfelden, with dendrochronological dates from the mid-16th century (Lieberenz 2021: 71). It was at this time, in 1560, that a Saxon edict was issued restricting timber construction due to a shortage of building materials and stipulating that earth should be used as a building material in the absence of stone (Körner 1994: 40–42).

2. Archaeological record

Going further back in time means searching for archaeological finds and contexts of former massive earth constructions. Unfortunately, the conditions of preservation in Central Germany, as in the rest of Central Europe, are generally poor for the identification of earthen dwellings. Earthen walls or structures, once abandoned and deprived of a protective roof, simply erode and can only be detected as a layer in archaeological contexts. However, thousands of years of ploughing have eroded the ancient

surface, causing the loss of floors and the debris of former upstanding walls. As a result, these layers of earthen building material are only preserved in exceptional cases, such as in forested areas with no agricultural use, or in urban core areas where further settlement processes have buried them (e.g., the city of Weißenfels, medieval profile, see Knoll and Klamm 2015: 85). Consequently, the most common way of determining the ground plan of a house is through the excavation of dug-in features, such as postholes or bedding trenches.

In fact, the first archaeological evidence of massive earthen building is the deserted village of Hohenrode, next to the Harz Mountains, excavated by Paul Grimm in the 1930s. Beneath the forest floor, he recovered several dwellings and small buildings for storage and backing, consisting of a slightly oval stone base covered with a thick layer of former earthen walls. Grimm immediately associated these finds with the cob dwellings and barns he had seen in the nearby village of Grillenberg. These features can be dated to the 12th to 14th centuries AD (Grimm 1939: 12–36). Similar observations have been made in other excavations, particularly in the region of Weimar, Thuringia, possibly dating as far back as the 9th century AD (Güntzel 1986: 13–19; Nitz 2021a).

All this research was carried out decades ago. At least three small fragments of massive burnt earth and a hearth slab from Hohenrode were characterised by thin section. Local loess loam was clearly identified as the raw material based on the mineral composition and the presence of organic temper (Otto 1939: 49–50). Unfortunately, none of the unburnt earthen building layers has been pedologically studied, and no samples of the possible earthen walls have survived. A comprehensive analysis and characterisation of the techniques and materials used is therefore not possible. It is not known whether these massive walls already contained large quantities of straw, as was usual in the traditional construction of cob buildings, documented from the late Middle Ages (15th century; see above). This has led to the assumption that massive earthen buildings in Central Germany did not appear until the 10th century at the earliest, and that only wooden post constructions had been used previously (for a summary, see Feiglstorfer *et al.* 2023: 34–35).

It is true that comparable in situ evidence for earlier periods is currently lacking for Central Germany. But there is other archaeological evidence for massive earthen structures. All of these were found ex situ. The oldest fragments that could be identified as parts of solid earthen walls were found at three settlement sites in southern Saxony-Anhalt (see Figure 1 and Table 1), dating from the Late Bronze Age to the Iron Age (1st millennium BC). They represent the earliest evidence for this earthen building technique in this part of Europe.

In all three cases, the fragments have survived in a stable shape due to previous heating or burning (more than 450° C) and because they were deposited in deep pits shortly after the building collapsed. Whether the burning of the earthen building fragments was caused by a house fire or by continuous exposure to heat, for example in the vicinity of a stove, is not possible to determine. They constitute, so to speak, discarded building rubble.

Two of the pits can be classified as settlement pits: Wennungen (see Knoll 2018: 32–36) and Osterwieck (Figure 5; for the publication of the excavation, see Hermann in prep.). Originally, these silo-like pits were used for grain storage. Once the stored goods were removed, the pits had to be filled quickly to minimise the risk of injury to the people living nearby (Biederer 2022: 67–117). Waste was used for this purpose—primarily household rubbish—but also building rubble when the house site had to be cleared for a new building. The pit feature found at Gröbitz deviates from this pattern. There, the fragments were recovered from a large area that had been dug out directly into the natural loess. This amorphous feature is probably the result of the extraction of raw material for earthen building purposes. This type

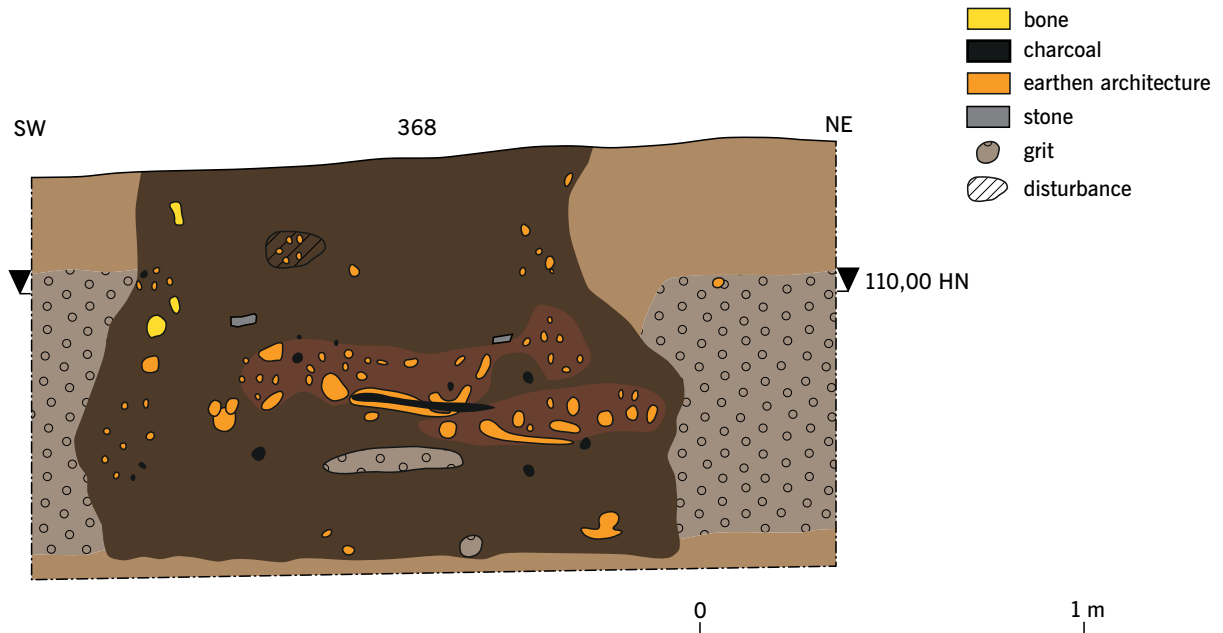


Figure 5. Osterwieck, Harz district. Profile section through settlement pit feature 368. The fired fragments of the massive wall(s) are clustered in the centre of the pit infill. The remains of charcoal nearby indicate a fire event (or incident) (© LDA Saxony-Anhalt, J. Filipp, Bad Bibra).

of small-scale open-cast mining has been documented next to settlements since the Neolithic (Klamm and Kürbis 2007: 485–490; Knoll and Klamm 2020: 12–13).

The Wennungen find contained 47 kg of fired rubble from a massive wall; other earthen architectural remains from a painted wattle-and-daub wall, an oven and other massive structures contributed more than 230 kg. This amount is exceptional and can be compared to the debris from a buried house (Knoll 2018: 57–60; Tab. 2; Tab. 11). Naturally, these few remains of the solid wall close to the surface represent only a small fraction of the entire wall. But this picture provides an approximation of the volume of hardened debris that can be expected after a house fire. When firing a newly mud-covered cob wall for experimental purposes, it was found that even after several hours of direct exposure, only the outermost 5 to 8 cm of the plaster and wall core had hardened (Knoll 2018: 252–257).

All fragments show plain and bright surfaces with no traces of direct fire exposure, unlike what would be expected on hearth plates (Figure 6). The Wennungen wall is covered with a plaster consisting of bright clay and organic temper (chaff) about 1 cm thick. Osterwieck also appears to have a separate layer of plaster, or at least a white paint on the surface, as does Gröbitz. However, the section does not show a layer (Figure 7); therefore, a separate coating can be excluded. But it is noticeable that the uniform matrix becomes significantly lighter towards the surface. After a test with 10% hydrochloric acid, it can be ruled out that the lime from the loess has accumulated on the surface. Measurements with LIBS (laser-induced breakdown spectroscopy) confirm this: the composition of the darker core does not differ in its elemental composition from the lighter surface. However, the reason for this light colouration has not yet been clarified.

There is another similarity between the three different massive earth finds: the matrix is uniformly compact and shows no voids that would indicate former organic components, both in the sawn fracture (Figure 7) and in the thin section of one of the Wennungen fragments (Figure 8). Hairline cracks are

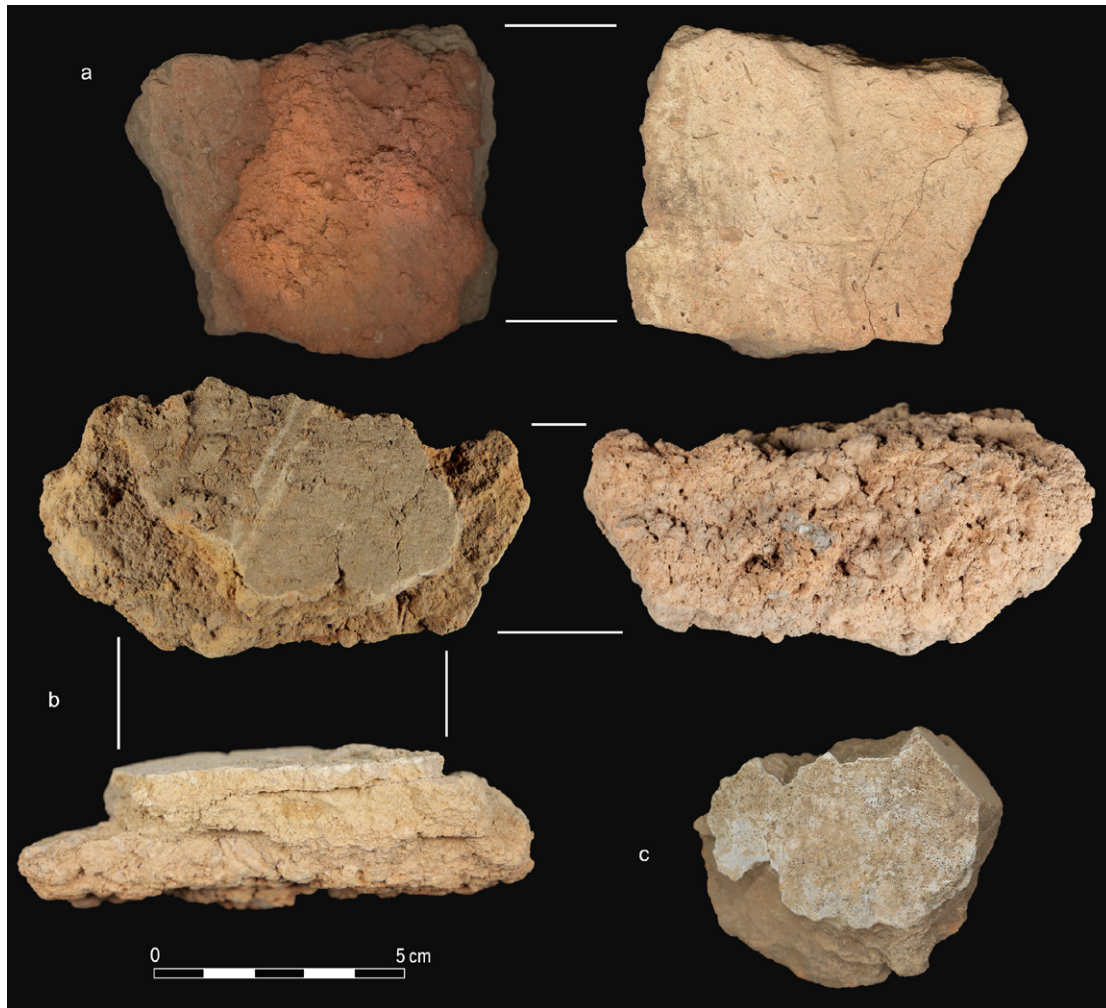


Figure 6. Characteristic fragments of fire-hardened massive earthen walls from: a) Wennungen: reddish wall core (crumbly appearance), covered by a bright, organic-temper plaster (right); b) Osterwieck: massive wall core (backsight right and sideview down) with a shiny surface (no coating); and c) Gröbitz: massive wall core with a bright surface that is not a paint
(© LDA Saxony-Anhalt, F. Knoll & J. Filipp, Bad Bibra).

visible in the thin section. These are probably because the substrate used was only mixed with very little water and was not significantly compacted. XRF (X-ray fluorescence) and XRD (X-Ray diffraction) analyses revealed pure loess for the inorganic elements and minerals in the Wennungen fragment. Indeed, an experimental setup provided a good approximation of the origin of the prehistoric finds: moist loess mixed with a small amount of water was formed into small test blocks. After air drying, the blocks were fired in a ceramic kiln at different temperatures. Once cooled, the blocks were broken open. The block fired at 800° C produced the best consistency, with a slightly crumbly appearance (Figure 9).

In summary, all three massive earthen walls identified in settlement contexts of the first millennium BC were built by mixing only loess and water.



Figure 7. Section of a fragment from Gröbitz. No separate layers, such as a white finish or paint, are visible under the microscope. In fact, the matrix becomes lighter towards the surface, but it is still the same pure sandy loess (© LDA Saxony-Anhalt, C.-H. Wunderlich).

3. Where is the ‘missing link’?

This raises the question of when straw, characteristic of the traditional cob houses in the region, was first added. Crops, and therefore straw, have been available since the Early Neolithic (from 5600 BC). There would have been plenty of straw, as the topsoil above the loess is and has been the most fertile black earth. However, to date, we do not have any archaeological evidence for solid earth construction until the Late Bronze. All the recovered ground plans belong to timber-post constructions, and all the fragments of fire-hardened earthen architecture belong to non-solid structures, mainly wattle and daub fillings.

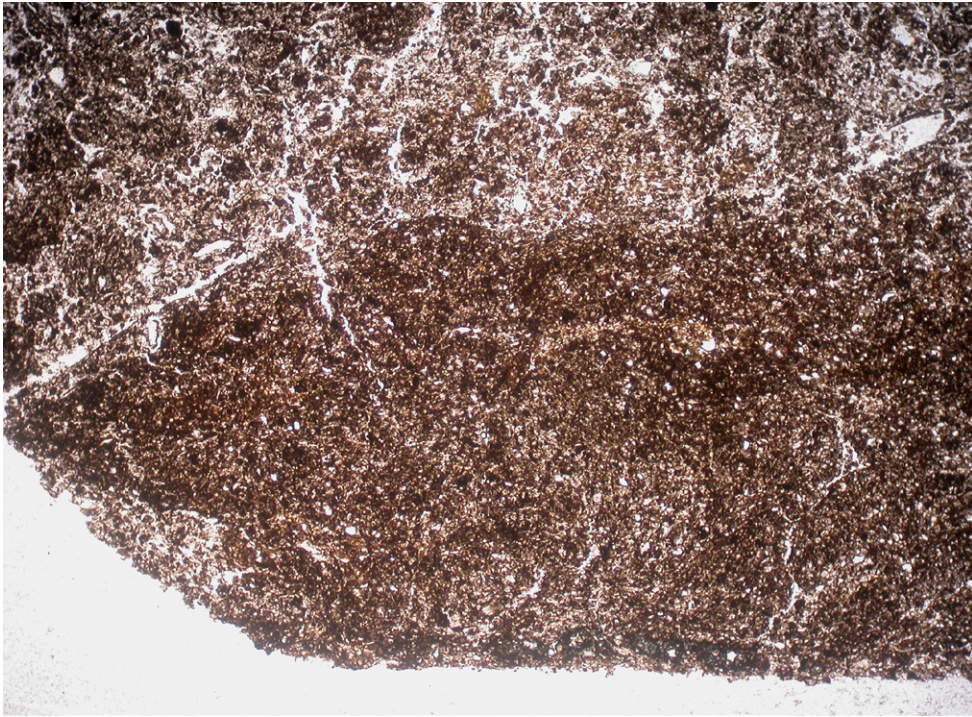


Figure 8. Thin section of the lower part of a massive wall core fragment from Wennungen (D. Gómez Gras, Universitat Autònoma de Barcelona). There are no voids indicating former organic components, but there are some cracks suggesting that the loess was not intensively compacted (Knoll 2018: 232 Fig. 237).

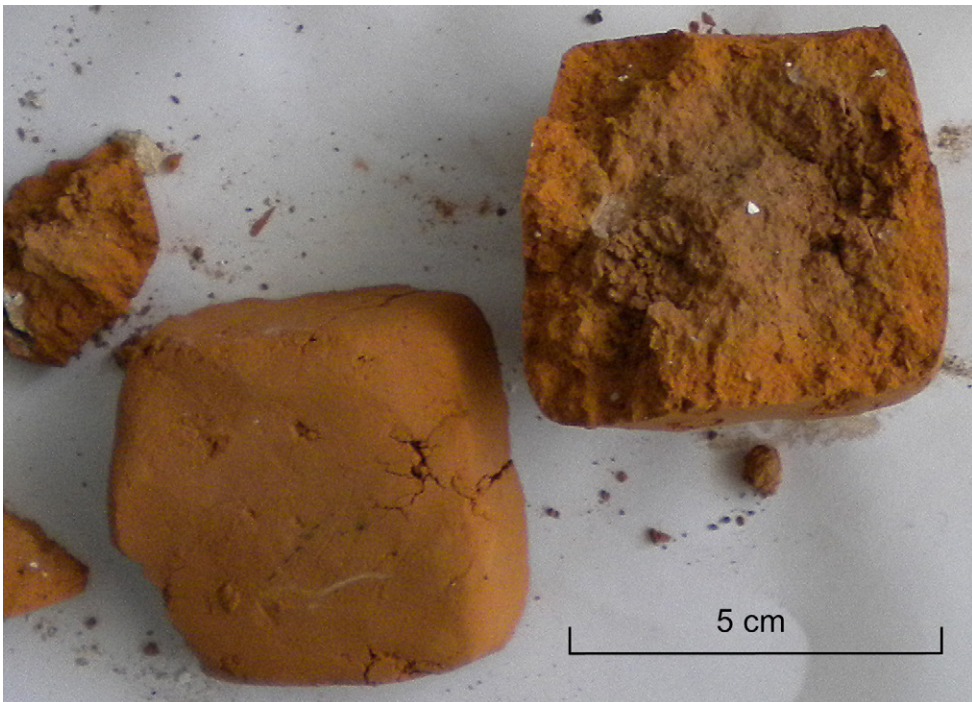


Figure 9. Experimental approach: loess from the Wennungen site had been mixed with a small amount of water. After air-drying and one hour in the ceramic kiln at 800° C, the small cube was broken open, revealing a crumbly structure very similar to that of the fragments of the prehistoric fire-hardened massive earth walls (Knoll 2018: 58 Fig. 39).

What we can state for the Late Bronze Age in this region is a significant increase in the use of wood, due to the increased demand for metal smelting and processing and salt refining. At the same time, settlement remains are present throughout the area. However, there are relatively few house foundations in the form of postholes. At this stage of research, it seems plausible to locate the origin of the first solid earthen buildings right here, albeit without the use of straw.

By at least the 12th century AD, straw was part of the massive walls at Hohenrode. This technical innovation had several advantages: assuming agriculture was flourishing, straw would have been available in large quantities, perhaps exceeding what was needed to feed cattle. Using straw meant less digging for loess and, of course, wet mud weighs much less when about half of it is replaced by straw. Perhaps this change took place relatively late. A pollen profile from Lake Süßer See, located in the eastern Harz foreland, shows the designated *Cerealia-Poaceae* pollen zone from around 800 AD onwards, the beginning of the Early Middle Ages (Hellmund *et al.* 2011: 120–121). Sweet grasses predominate, with almost no arboreal pollen visible. This means that there was a lack of construction timber.

This hypothesis will hopefully be confirmed by future excavations and research in the (deserted) villages of this period.

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Ethnoarchaeological insights into Cantabrian architecture: raw materials, construction techniques and architectural traditions

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Abstract

Traditional architecture in the Cantabrian region is abundant and diverse, reflecting both regional identity and an ingenious adaptation to a challenging natural environment. Although increasingly lost or altered due to the introduction of modern, supposedly more efficient materials, remnants of these structures continue to offer valuable insights into the utilisation of raw materials and construction traditions specific to these areas, where the humid climate and dense woodlands play a fundamental role. This paper adopts an ethnoarchaeological perspective to investigate the cultural and material aspects of this vanishing architectural heritage. Focusing on thatched roofs, carpentry, dry-stone walls and the multifaceted use of earth as a construction material, our analysis emphasises the critical influence of raw materials on architectural design. Additionally, we delve into the techniques employed by local craftsmen and their deep-rooted knowledge of available resources, as well as review the necessary maintenance practices required to preserve these structures. Our primary objective is to gain a deeper understanding of the diverse operational processes involved in using these raw materials for construction. This insight will enhance our interpretation of the architectural remains discovered at archaeological sites across the Cantabrian region.

Key words: Traditional architecture, regional identities, environmental adaptations, Cantabrian Façade, ethnoarchaeology

1. Introduction

Until the mid-20th century, significant examples of traditional architecture were still preserved in both coastal and inland areas of the Cantabrian Façade. However, over the past seventy years, this architectural heritage has experienced a pronounced decline and transformation—across the Iberian Peninsula in general, but in these mountainous regions in particular—largely due to the profound shift from a pre-industrial to an industrial economy. This transition has led to the introduction of factory-made materials that are easier to obtain, install and maintain—such as plastic, tile, cement or fibre cement siding—along with the democratisation of motor vehicles, which facilitates access to high mountains and pastures, as well as the profound rural exodus to cities. The loss of functionality of dry-stone constructions, with thatched roofs or earthen walls, has led to their transformation or abandonment, eventually resulting in their collapse and disappearance.

Despite this significant and traumatic process of decline and transformation, remnants of these structures persist, offering invaluable insight into the complexities of the traditional building techniques and the cultural and historical significance of this architectural heritage. Through the lens of ethnoarchaeology, this study aims to expand our understanding of the *chaînes opératoires* associated with various traditional raw materials: stone, wood, rye straw and broom. Our aim is to elucidate how these materials are selected and integrated into construction processes, the labour-intensive tasks involved in both construction and maintenance, and their adaptation to the region's prevailing climatic challenges. Furthermore, we explore sociocultural aspects such as the involvement of different community members in building

and maintenance, decision-making processes, knowledge transmission mechanisms and the tapestry of rituals and customs intertwined with construction practices.

For this purpose, this research focuses on thatched buildings located in the western sector of the Cantabrian Mountains—a prominent range in northern Spain stretching from the western Pyrenees to the Galician Massif. Known for their rugged terrain, these mountains form a natural barrier between the coastal plains and the Northern Plateau. This range is characterised by steep cliffs, deep valleys and a diverse ecosystem. Here, prevailing oceanic winds strike the mountains, resulting in significant precipitation along the northern slope. Consequently, this isolated area is known for its lush vegetation and high humidity, earning it the nickname of ‘green’ or ‘humid Iberia’. In upland areas, winters are harsh, with minimum temperatures falling as low as -20°C . The landscape is dominated by deciduous forests, interspersed with a diverse array of tall shrubs (Sundseth 2005).

At present, the record of traditional construction methods in this region is somewhat limited; however, it is extensive enough to enrich our comprehension of the building techniques used in the past. Throughout this sector of the western Cantabrian Mountains, numerous structures employ dry-stone masonry. These encompass a wide array of typologies, including dwellings, barns, stables, huts, shelters, mills and various ancillary structures (Alonso 2013; Cantero Fernández 2016; García Martínez 2010; Menéndez Martínez 2008; Paredes and García Martínez 2006; Ruano Posada 2020). Among these

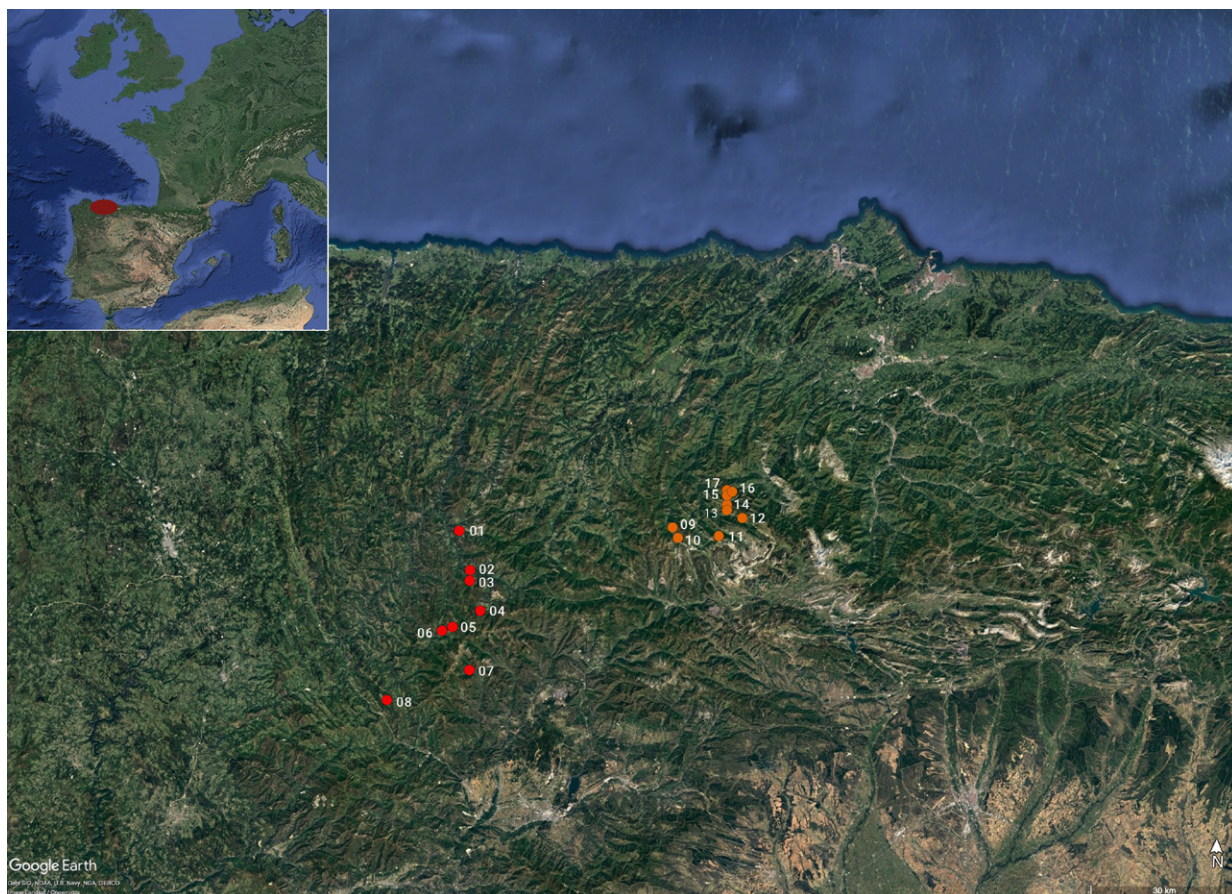


Figure 1. Location of examples of the different types of structures mentioned in the text: Structures with rye thatch (red): 01) Ibias, 02) Arandoxo, 03) Pelliceira, 04) Balouta, 05) Piornedo, 06) Vilarello, 07) Campo d'Agua and 08) O Cebreiro; and structures with broom thatch (yellow): 09) Brañaviecha, 10) La Pornacal, 11) Sousas, 12) Morteras de Saliencia, 13) La Corra, 14) Rebellón, 15) Murias Longas, 16) Tuiza and 17) Tromeu.

auxiliary constructions are facilities designed for tasks such as milk-cooling and circular enclosures for gathering wild products and dung, as well as structures intended to safeguard beehives (Naves *et al.* 2009). Additionally, in response to the imperative need to protect local resources, a diverse array of traps for wild animals can also be found (Torrente 1999). It is noteworthy, however, that dry stone



Figure 2. Broom thatching: a) Braña del Rebellón and b) Braña de Tuiza (Teverga, Asturias).

is frequently complemented by other construction materials, notably wood and earth (Ruano Posada 2021). Furthermore, vegetation—particularly varieties suitable for thatching—plays a significant role in these architectural assemblages. This study focuses specifically on this traditional thatched architecture.

2. Thatched roofs in the Cantabrian mountains

In the north-west of the Iberian Peninsula, across both sides of the western Cantabrian Mountain range and in the Sierra de los Ancares, we can find different types of plant materials used for roofing. These include broom (*Cytisus scoparius*), floriferous greenweed (*Genista florida* subsp. *polygaliphylla*), rye straw (*Secale cereale*), turf sods and oak wood (*Quercus petraea*), although the most common examples nowadays are structures thatched with broom and rye straw (Figure 1). In all cases, we are dealing with a ‘smoke architecture’—known in Galicia and Portugal as ‘smokehouses’ (*casas de fume*). This name is given to those constructions or houses that lack a chimney to evacuate combustion gases from the hearth (Bonet Correa 2007: 15).

2.1. Broom thatching

Today, the best-preserved examples of vegetal-roofed structures in this area are found in the Principality of Asturias, thanks to a significant effort by the administration. These are structures thatched with broom, primarily located in the municipalities of Somiedo, Teverga, Quirós, Proaza and Miranda, although in the latter three they have now almost completely disappeared (Paredes and García Martínez 2006: 82). These are mountain territories bordering the province of León, where cattle farming has underpinned the rural economy. Currently, we only find this type of roof in auxiliary livestock structures and to a lesser extent in *hórreos* (elevated granaries), although until the mid-20th century, thatch was used in all types of architecture, from houses to mills and even churches. Small circular constructions with broom roofs were also very common on the southern slopes of the Cantabrian Mountains, although we hardly find examples today, aside from some huts restored by certain villages and cultural associations.

The use of broom or floriferous greenweed instead of rye straw—more common in other territories within our study area (see below)—is determined by orographic conditions and the pronounced livestock character of these communities, among whom agriculture has historically played a secondary or even non-existent role (Cátedra Tomás 1989; Martínez García 1988). Therefore, the amount of cultivated cereal does not yield enough straw to build and maintain these roofs. Instead, broom and other shrubs are gathered from the immediate vicinity of the constructions, consistent with other mountainous areas with a livestock tradition across Europe. While in towns and villages, broom has been progressively replaced by tiles, this has not occurred with auxiliary structures for livestock. Their persistence is mainly related to their excellent adaptation to environmental conditions and their technical possibilities. Broom, like straw, is a highly effective thermal insulator which also allows the existence of high roofs with a steep pitch; this prevents snow accumulation and ensures water run-off, minimising its deterioration. At the same time, this height creates a wide space beneath the roof to be used as a hayloft, something that would not be possible with tile roofs (Figure 2) without building a second floor. They are also cost-effective structures, since the material needed for construction is collected from the surrounding land, and maintenance can be carried out by the owners, obviating the need to hire professionals.

2.1.1. Typology of structures with broom thatches

Nowadays, the typology of broom-thatched structures is not very extensive; however, we can still differentiate structures with different uses. In Asturias and in Babia, León, in the highest pastures, we find huts without haylofts, whose function is to provide shelter for the younger cattle and the shepherd when tending the animals. They are structures with a circular plan and a conical thatched roof, with



Figure 3. Small huts thatched with broom (*chozos*): a) diagram of a *chozo de horma* (Graña and López Álvarez 2007: 146), b) *chozo de horma* in Brañaviecha (Somiedo, Asturias), c) *chozo* of La Fonfría (León, photograph by José Ramón Lueje, 1936, courtesy of Museo del Pueblo de Asturias), d) interior view of the broom thatch (Museo del Pueblo de Asturias), e) *chozo de pie* (Museo del Pueblo de Asturias) and f) *chozo de pie* from Burín (Valdeburón, León; photograph by José Ramón Lueje, 1946; courtesy of Museo del Pueblo de Asturias).

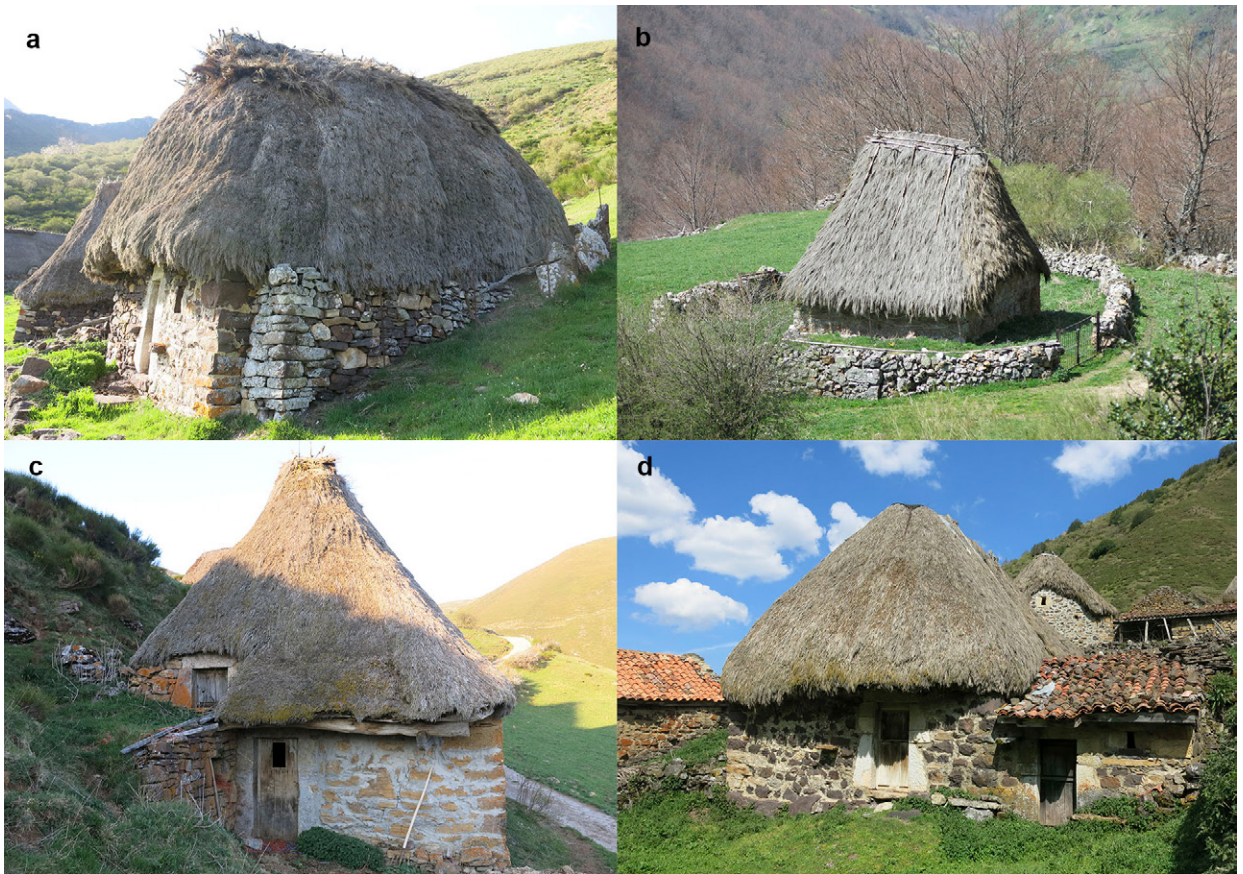


Figure 4. Types of cabins (Somiedo, Asturias): a) Braña de Murias Llongas, b) Las Morteras de Saliencia, c) Braña de Sousas and d) Braña de La Pornacal.

walls usually made of very roughly worked dry masonry (*chozo de horma*) (Figures 3a–b). They do not have foundations and have an outer diameter of between 5 and 6 m, with walls that usually do not exceed 1.5 m in height and a width of between 0.4 and 0.6 m. Their conical roof is made with a wooden framework, usually of beech, which rests directly on the walls or on horizontal beams. The framework is formed by multiple rafters, between 15 and 20, converging at the apex, which is reinforced by metal straps. Several broom stems or hazel branches are interwoven across this wooden framework, onto which the broom bundles are directly placed (Figure 3d). The top is finished with turf sods, although in other cases, we have found one or two stones holding the roof and preventing water from seeping through the ridge, the most vulnerable area of the structure (Figure 3c). A variation is the so-called *chozo de pie* (Figure 3e–f), characterised by the absence of a stone wall. Instead, the rafters are driven directly into the ground in a circular arrangement and later secured with several large stones. Although more vulnerable to fire, they usually provide better shelter, as they are warmer than the masonry variation (Alonso 2013: 206; Rodríguez Pascual 2001).

In lower pastures or on the valley bottoms, we find a second variant. In these meadows, grass is mown, harvested and stored in haylofts, and livestock are stabled overnight. Therefore, a structure with a rectangular layout and two floors is erected, with the lower floor used as a stable and the upper one as a hayloft (Menéndez Martínez 2008: 128). They have ample dimensions, ranging from 6 to 10 m in length by 5 to 6 m in width. These cabins have two openings: the entrance door to the stable on the lower floor and a small door giving access to the hayloft (Navarro Pallarés 1985: 240). They are usually built

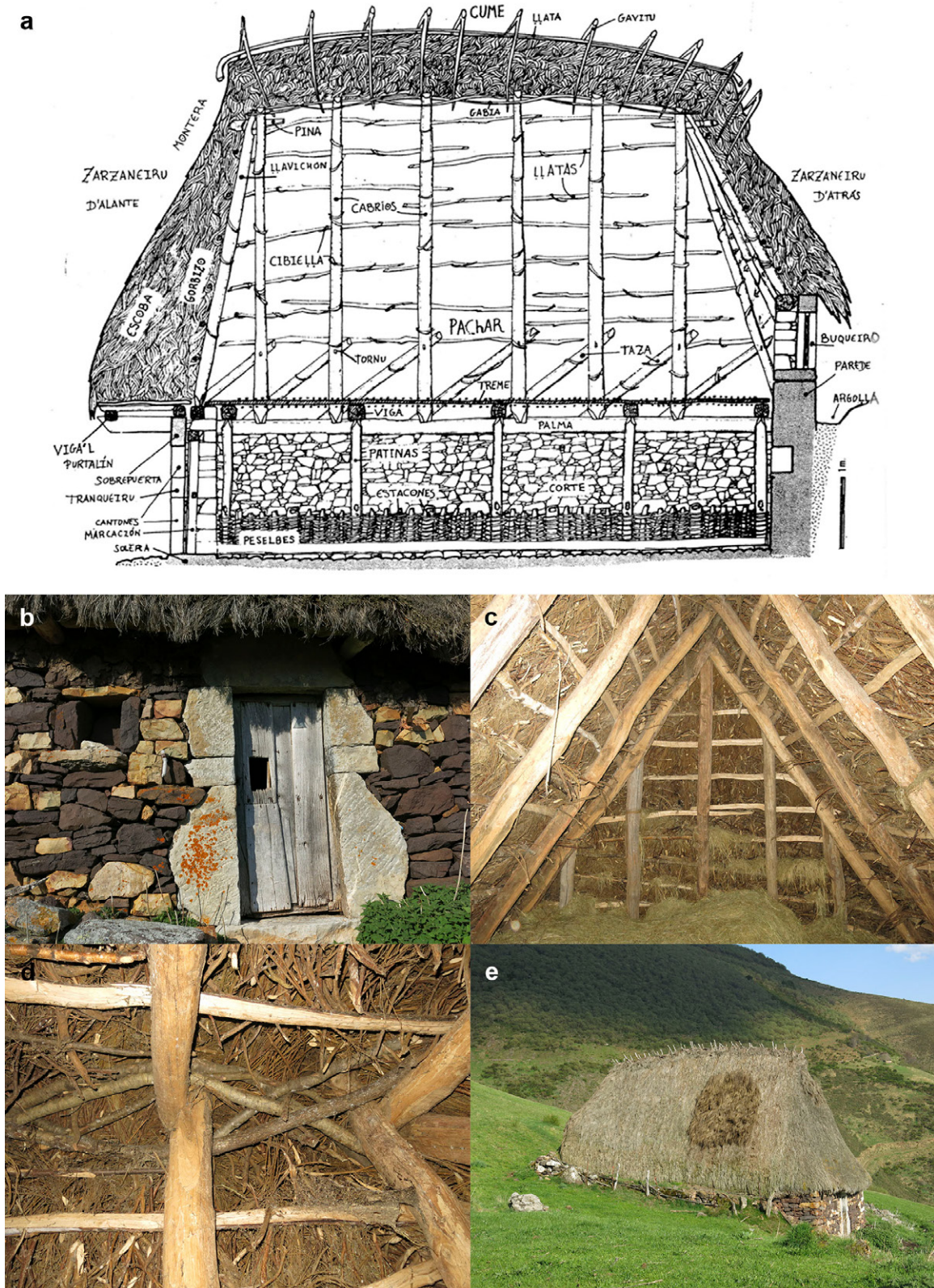


Figure 5. Elements of a broom-thatched structure: a) diagram of a thatched structure (Graña and López Álvarez 2007: 124), b) dry-stone wall of a structure from Murias Llongas (Somiedo, Asturias), c-d) wooden framework of a structure from La Corra (Somiedo, Asturias) and e) repaired thatch of a structure from Murias Llongas (Somiedo, Asturias).

on sloping terrain, following the direction of the slope so that the entrance to the upper floor is level with the ground at the back of the structure. The researcher Carmen-Oliva Menéndez classified these structures based on various criteria, such as plan layout, location, the arrangement of openings, the construction system of walls and roofs, and the fastening of the broom (Figure 4) (Menéndez Martínez 2008: 133–143).

Finally, the main building in the villages was the dwelling, where the entire family group lived together with their belongings and domestic animals; these thus belong to the group known as byre-dwellings. Despite the evolution of various dwelling types over the centuries, shaped by the economic capacity of each family and technical innovations, the traditional house has consistently relied on the same natural resources, resulting in similar architectural characteristics (García Martínez 1988: 224–230). They were all constructions of modest dimensions, with limited or no privacy, where animals and humans lived under the same roof and, initially, within the same space. Throughout the 19th century, housing evolved towards a progressive separation of family spaces from those intended for livestock, while other attached structures, such as barns and granaries, were built to store crops. The interior of the dwellings also underwent numerous modifications, with the introduction of new types of kitchens with chimneys, the opening of windows, the appearance of bathrooms and an increase in the number of rooms, with a corresponding gain in privacy (Paredes and García Martínez 2006).

2.1.2. Building materials and construction techniques

Regarding their construction, the most common technique for building the walls of these structures is dry-stone masonry (Figure 5b), although mud or manure was sometimes used for plastering or to set larger structures. Generally, the stones are irregular and barely worked, with only the most prominent protrusions removed. This apparent technical simplicity requires significant prior work in selecting stones according to their characteristics for each area of the construction, as well as the skill to fit them together without mortar. For greater stability, small slabs are used, obtained from the remains of larger stones, and placed to fill gaps and consolidate the next course (Navarro Pallarés 1985: 451). Typically, these walls have two faces, and the interstitial cavity is filled with rubble and debris, the latter helping to balance the structural thrusts. The primary material used is usually local stone, such as ferruginous sandstone and limestone, although limestone tuff, slate and quartzite are also found (Menéndez Martínez 2008: 130). Generally, simpler structures, such as huts and enclosures, lack buried foundations and are built directly on bedrock or prepared ground. Conversely, larger structures, such as cabins and houses, require foundations to transmit loads to the ground and ensure stability; a trench-footing system is used for this purpose. If the ground is thick and the bedrock or rocky stratum is not reached, foundations are laid on beams using unseasoned beech or alder (Navarro Pallarés 1985).

Over these walls, a wooden framework is placed (Figure 5c). Different types of wood are used, depending on their function and the location of the structure. In villages and lowland pastures, the most common wood is oak (*Quercus robur*), cut in June and dried before being used in construction. The logs are hewn, as it is preferred to use the heartwood; the outer part, the sapwood, is more susceptible to attack by wood-boring insects. Conversely, in highland villages and pastures, beech wood (*Fagus sylvatica*) is more abundant. Chestnut (*Castanea sativa*) is also common for the framing. Additionally, thinner logs and branches of hazel (*Corylus avellana*) and rowan (*Sorbus aucuparia*) are used for making partitions, floors and some elements of the roofs (Figure 5d). In these cases, the wood is harvested near the structures and used green, when it is still flexible. Only an axe, a drill, a chisel and a mallet are used to work the wood. The wooden framework may be constructed by a carpenter for larger structures, although it is generally built by the owners themselves, neighbours or family members. To manufacture the rafters, the log is roughly hewn, with only the ends shaped to facilitate fitting. However, the wood for the horizontal logs is properly worked on all four sides to create true beams (Menéndez Martínez 2008: 172–173).



Figure 6. Social implications of broom thatching. 1) Different ways to secure a broom thatch: a) planks and logs (*zancas* and *xugos*) in La Pornacal (Somiedo, Asturias), b) logs and sticks (*llatas* and *gabitos*) in Murias Llongas (Somiedo, Asturias), c) dry logs (*tuerus*) in Tuiza (Teverga, Asturias) and d) turf (*tapines*) in Sousas (Somiedo, Asturias); 2) Collaborative structure rebuilding: *chozo* in Peñalavera (Acevedo, León, courtesy of Ángel Cimadevilla).

High-pitched roofs are constructed with a slope of about 50 degrees, which can reach 65 degrees once thatched. Circular structures have a simpler frame, consisting of several rafters placed close together and supported directly on the wall or on a log sill. Conversely, larger square or rectangular structures feature hipped roofs with two main pitches (*naves*) and two smaller ones (*zarzaneiros*) (Figure 5a). The *naves* are formed by 6 m long pairs of rafters, placed between 0.5 and 1 m, while the *zarzaneiros* are raised with rafters of different sizes, with the central one being the longest. In this sense, it is interesting to highlight that to achieve these rounded shapes, some pieces are selected for their natural curvature, or trees are deliberately bent while still growing, before harvesting, to achieve the needed shape for construction (Graña García and López Álvarez 2007: 120–130). Different types of joints have been documented, but they generally employ mortise and tenon joinery, with one end fitted with a tenon inserted into another, the mortise, and secured with a wooden dowel. The dowels are usually made of white willow (*Salix alba*) (Navarro Pallarés 1985: 258). In other cases, we find that the crosses are half-lapped or joined with forks, counteracting the loads of the pairs.

On top of this frame, the bundles of plant material are laid (Figure 5e). For the roofing, common broom (*Cytisus scoparius*) is used due to its high resistance. These are shrubs about 2 m tall, very abundant in the landscape, and whose stems have small grooves that, according to thatchers, facilitate the drainage of rainwater. In case of scarcity, other plants of the genus *Genista* are used, with a preference for the Moorish broom (*Genista obtusiramea*) variety as it has denser branches. The use of this plant is often criticised in the area, as it is not as resistant as common broom and deteriorates more quickly. However, this species is used to create a first layer, mixed with soil and roots (Menéndez Martínez 2008: 143).

The cutting of these bushes follows a very specific process guided by the lunar calendar. According to some owners, it should be harvested during the waning moon, as this can make the thatch last up to twelve years, while if harvested at other times, the plant may rot, break or fail to withstand the elements. The cutting should be done between August and October (Graña García and López Álvarez 2007: 125; Menéndez Martínez 2008: 146), when the broom is no longer in flower and therefore has less sap, which allows for better preservation. The cutting must be done by hand with a sickle, choosing the thickest bushes. The stems should be cut at an angle (pointed), as this facilitates the thatching process. For new roofs, the thatching begins by placing the Moorish broom layer on the rafters, which is secured with rope made of twisted broom, and then the broom is stuck. Ideally, a team of at least six people is needed on the roof, with another four assisting from the ground by handing up the bundles, while for annual repairs, two or three people are enough. The only tools used in thatching are ladders and a glove to protect the hand. It is advisable to carry out this process in dry and warm weather, typically in early autumn, though rain is needed shortly afterwards to allow the roof to settle.

The most fragile part of the thatch is the horizontal top; therefore, it usually has a greater thickness, between 50 cm, that can reach 1 m at the ridge. Here, the broom should be better secured to prevent deterioration from wind or rain. When looking at the ways people secure the thatch, it is worth noting that in each valley, within a few kilometres, the technique used to protect this upper part is different (Menéndez Martínez 2008; Ruano and Berrocal-Rangel 2019). In the Pigüena Valley (Somiedo), the broom is fastened with planks which anchor the thin logs placed at the ridge (Figure 6a). The connection between the pieces is made with mortice-and-tenon joints, secured with wooden pegs. In contrast, in the neighbouring territory of Saliencia Valley, a system with sticks is used (Figure 6b). Here, the thin logs placed at the ridge are secured with forked sticks of 1.5 m long, anchoring the broom to the wooden frame underneath. Another very common system in a near territory is the use of bark or halved logs, generally of beech, placed on the ridge and secured by the weight of large rocks or other heavy elements (Figure 6c). Lastly, roofs in other areas are also protected with turf sods, pieces that can be up to 50 cm thick, although they are usually soil planks (Figure 6d). These differences within just a few kilometres



Figure 7. Rye straw thatching: a) *palloza* in Piornedo (Lugo) and b) *palloza* in O Cebreiro (Lugo).

are not driven by practical or economic considerations, but by social and cultural ones, serving as true symbols of the traditional know-how of the social groups of each valley.

2.1.3. *Building as a communal practice: reciprocity, rituals and gender roles*

To conclude this section, we aim to explore several aspects regarding the historical social dynamics of construction. The erection of a new structure required not only the labour of the homeowner's family but also that of relatives and neighbours within the same village or parish (Figure 6e). This collaborative effort was widespread in the past, epitomising a form of reciprocity in which individuals supported each other in various day-to-day tasks, fostering a sense of communal interdependence (*sensu* Sahlins 1972). Neighbourly assistance was often perceived as obligatory, fostering relationships that bolstered community cohesion (Paredes and García Martínez 2006: 63). Primarily, this assistance involved the transport of raw materials and the procurement of various types of wood and plants essential for construction. In instances where a building demanded more specialised techniques, individuals with expertise from neighbouring villages would travel to the site, often in exchange for lodging and sustenance for the duration of their work. Although these workers typically did not receive daily wages, the homeowner's family was responsible for covering their travel expenses. Moreover, the construction followed distinct rituals. Prior to laying the first stone, a communal meal was shared, a practice that varied in lavishness based on the social standing of the household. This tradition was often repeated in the evening upon completing the day's tasks, and again once the thatching was finished (Ruano Posada 2020).

Construction tasks were heavily gendered, with men predominantly possessing the expertise and tools required for working with materials such as stone, wood and thatch. Nonetheless, all family members participated in construction activities, with their roles determined by gender norms, age and capabilities. Women typically undertook responsibilities such as transporting smaller raw materials, crafting ropes and managing provisioning duties, while children contributed according to their abilities, gradually acquiring skills as part of their informal education (Cantero Fernández 2016: 19; Ruano Posada 2020).

2.2. *Rye straw thatching*

On the other hand, structures with circular or oval plans covered with cereal straw, known as *pallozas*, were traditionally the most characteristic architectures of the northwest Iberian Peninsula until the mid-20th century (Figure 7). The distribution of these thatched roofs encompasses the foothills of the western Cantabrian Mountains, extending westward to Lugo and Ourense; spreading northward through the Asturian councils of Cangas de Narcea, Degaña, Ibias, San Martín de Oscos, Villanueva de Oscos and Santa Eulalia de Oscos, and southward through the valleys of Ancares, Fornela and El Bierzo. However, as we have seen in the case of broom thatches, this range has been considerably reduced; today, they are found only in certain remote and isolated mountain areas, where customs and traditions have survived until the second half of the last century. This type of thatched roof is typically associated with an Atlantic climate and terrain strongly conditioned by topography. However, they historically existed in areas with more continental climates and in gentler relief, although in these cases the circular floor plan gave way to square, rectangular or more complex shapes (i.e., Alonso 2013; Feduchi 1974; Fréal 1977; Lanier and Herman 1997).

When discussing *pallozas*, we typically refer to circular or oval byre-houses where humans and animals coexist under the same roof. However, in these regions, straw has also been used to cover other structures, such as elevated granaries. The distinctive feature of these dwellings lies in the survival of the circular plan. As widely discussed, various environmental, economic and cultural factors have influenced the design and construction techniques employed in this type of architecture (*sensu* Rapoport 1969).

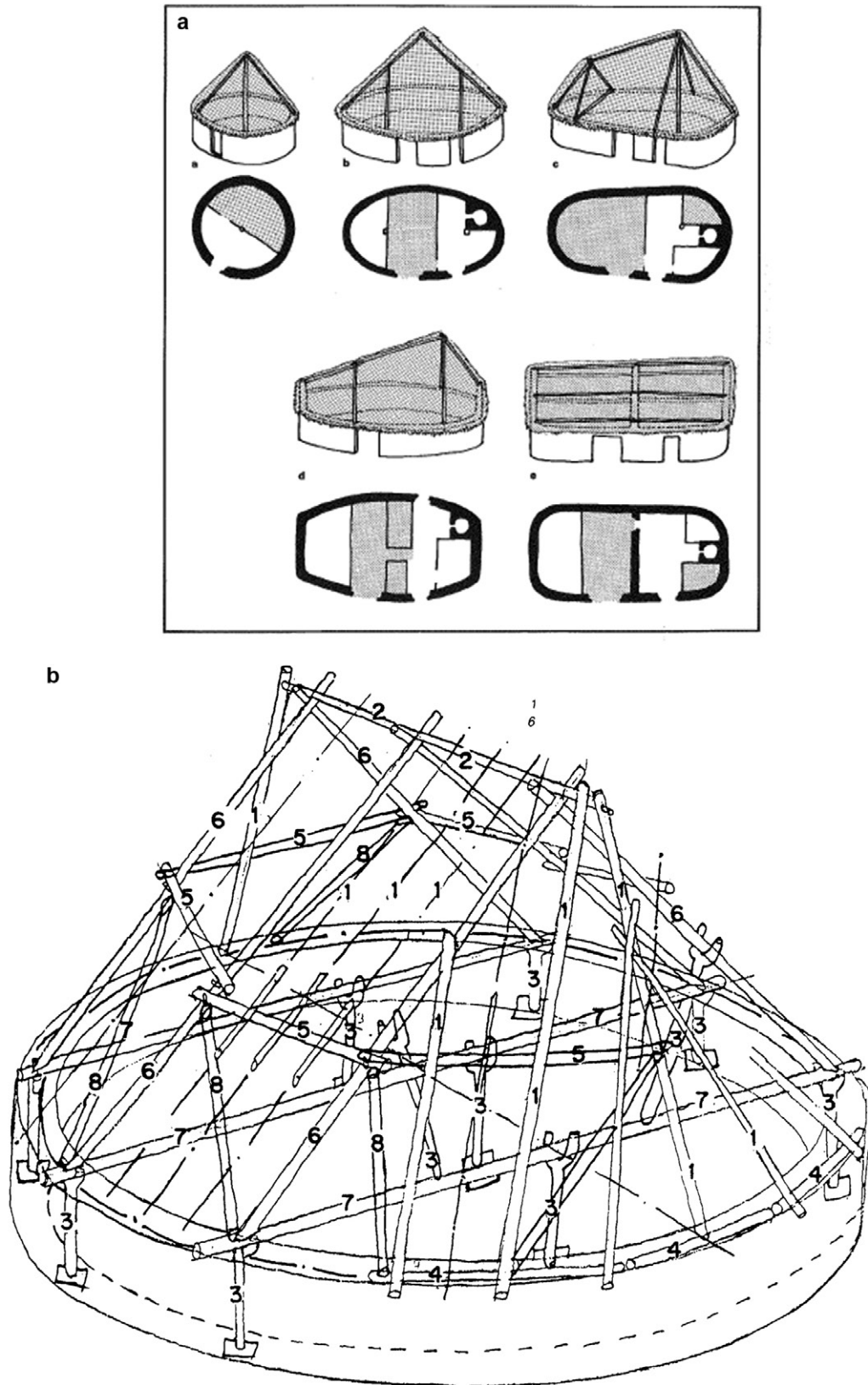


Figure 8. a) Typology of *pallozas* (Llano 1981–1983: 195) and b) diagram of the roof framework of a *palloza* (González Fernández *et al.* 1987: 43).

Once again, the area has been primarily dedicated to livestock farming, particularly cattle and sheep husbandry. Nonetheless, agriculture also plays a significant role here, adapted to the high mountain terrain with subsistence crops such as rye, which is the cereal used for thatching, thus significantly reducing economic expenses. Another crucial factor influencing the circular design of these structures is their seamless integration with the natural environment. Situated in mountainous regions with harsh climates—characterised by low winter temperatures, frequent fogs, snow and strong winds—their circular or rounded shape minimises wind resistance. Partially embedded in the slope, along with their conical thatched roof, they effectively regulate temperature by evenly distributing heat from the fire and animals, maintaining a constant internal temperature (Gimson 1983: 71; González Fernández *et al.* 1987: 46). In this sense, studies have indicated that *pallozas* are 35% more efficient than modern dwellings constructed in the same villages (Molina Huelva and Fernández Ans 2013). Moreover, these territories historically experienced isolation during winter months due to heavy snowfall, necessitating that animals and families cohabited under the same roof to avoid the need to venture outside for daily tasks.

2.2.1. *Characteristics and typology of structures with rye thatches*

The *palloza* is a structure typically erected on sloping terrain, where humans and animals live under the same roof in two separate spaces. The roof, which can reach heights of up to 6 or 7 m, lacks a chimney, making it another example of ‘smoke architecture’ (Bonet Correa 2007). It also has no windows, and light enters solely through doors or small openings in the roof and walls, resulting in a characteristically dark and smoky interior. This absence of windows, coupled with the architectural characteristics of the structure, helps maintain a cool interior in the summer and facilitates heating during the winter. The floor plan is divided into two main areas: the lower part, dedicated to the byre and barn, and the upper half, comprising the living quarters.

The more archaic circular structures lacked a separate byre, meaning animals and humans shared the same space. Over time, these spaces became distinctly demarcated by the introduction of interior partitions. The stable occupies a larger area with a large two-leaf door that allows entry for livestock and carts. It sometimes has a subdivision separating cattle from sheep. The stable is always at a lower level to facilitate the removal of manure. On the contrary, the living area is at least 1 m higher than the stable, separated by a wooden partition, made either of planks or a framework of branches, that includes an opening. The entrance door to the living quarters leads to a hallway opening onto the kitchen. The hallway also provides access to the stable through an interior opening, to the oven, and to smaller compartments within the living space, separated by wooden partitions. These smaller compartments are small spaces approximately 1 by 2 m, used for storing farming tools, firewood and small animals such as pigs, goats, sheep or chickens. Above the living quarters and the stable is the hayloft, which is used for storing winter fodder and also serves as a sleeping area.

The typology of the *palloza* is highly varied, ranging from circular floor plans to elliptical or sub-rectangular ones, including some with completely irregular layouts. It is likely that the more modern form is the sub-rectangular plan, resulting from a desire for larger dimensions or influenced by other regions where rectangular plans predominate. In his study on *pallozas*, Mark Gimson indicates that round plans were more common in high mountain areas, where winter weather is harsher, while oblong or rectangular plans are found on lower slopes (Gimson 1983: 72). The shape of the plan is also likely closely related to the terrain’s circumstances. Thanks to the work of scholars such as Ángel del Castillo or Gimson, up to five different types can be identified (Figure 8a), though in practice further variations exist due to the development and blending of models. The supposed unilinear evolution from the circular plan, seemingly simpler, to the sub-rectangular or barrel-shaped plan has been defended by several authors. However, many question this assertion, noting that the timber framework of the roof



Figure 9. Thatching a *palloza*: a) wooden leggets from Piornedo (Lugo); b) partially collapsed *palloza* in Campo d'Agua (León), with the thatch held in place by straw ropes; c) thatch secured with straw ropes in Campo d'Agua (León); d) straw cord used to lift the thatch in Campo d'Agua (León), and e) stone slabs used to lift the thatch in O Cebreiro (Lugo).

can be more complex in oval structures than in sub-rectangular ones (Castillo López 1913; Gimson 1983: 56; Llano 2006: 117).

2.2.2. Building materials and construction techniques

Regarding the construction of these dwellings, the walls are also built using the dry-stone technique. Granite is more commonly used in the León area (Figure 7a), while slate predominates in the eastern Ancares and the Asturian territories (Figure 7b) (Gimson 1983: 67). As is common, each village utilises the rock available in its immediate surroundings, thereby limiting transportation costs, typically managed using ox-carts. Larger and thicker stone blocks are only used for thresholds, generally sourced from other areas. In this regard, the circular plan offers a clear advantage, as the absence of corners reduces the cost of sourcing raw materials. To construct a *palloza*, the sloped terrain is first levelled into two terraces. The lower one is designated for the animals, while the upper, smaller terrace is reserved for the family. Once each area is levelled, a small strip foundation is created, typically protruding between 10 and 15 cm from the rest of the wall. In cases where bedrock is not found and the soil is softer, a fill of rubble and stones is laid, upon which the footing is constructed. At the same level, post-holes are dug, in which various flat stones are placed to serve as bases for posts and forks. In self-supporting structures, the wooden framework is erected first, followed by the dry-stone masonry enclosure. In other cases, the process is reversed: the masonry wall is built first, and then the wooden framework is installed.

Sometimes, a type of mortar can be added between the stones, made from the sand resulting from the stonework. Bundles of straw were also often inserted between the stones to seal gaps and prevent draughts. The walls are constructed with two faces, placing the larger stones on the outside and filling the core with smaller ones. In some cases, the walls are topped with overhanging slabs, which prevent moisture from penetrating the wall. To avoid water infiltration, slabs are also placed at the base of the wall. There are no downspouts, but a small perimeter trench is dug at the base of the wall to collect run-off from the roof and prevent it from pooling. Generally, the lower part of the wall is taller, between 1 and 2 m, while the upper part reaches much lower heights, between 0.50 and 1 m. If the *palloza* is on flat ground, the walls typically reach heights of 2 m around the entire perimeter (Llano 2006: 121; Menéndez Martínez 2008: 272).

The wooden framework is the most crucial component of the structure. As noted, in some constructions, the wall merely serves as an enclosure, with the roof structure resting on thick wooden pillars made of oak or chestnut. However, in non-self-supporting structures, the load-bearing walls support the weight of the roof, carrying the main beams, the ridge beam and other secondary, smaller rafters. For larger elements, such as upright pillars, beams or main rafters, thick oak or chestnut logs are used (Llano 2006: 123). As seen before, it was common to manipulate the wood in various ways to produce the necessary curved or forked pieces for the roof structure. The rafters, being thinner, could be made from yew, birch, holly, ash or oak. The wood required for these elements is prepared a year in advance, as it must be cut around October when the sap flow is minimal to reduce moisture levels, enhance dimensional stability and strength, and prevent insect infestation. In contrast, the thinner rafters and the battens are cut and fitted while green, since they are easier to handle and bend to achieve the desired shape.

Depending on the type of floor plan (circular or oval), its size and the type of wall, with or without gables, different solutions for the roof structure are documented (Figure 8). In circular *pallozas* with simple conical roofs, one or two main upright posts are placed, on which two large, inclined beams, the main rafters, are seated, carrying the entire weight of the roof as the secondary rafters rest on them (González Fernández *et al.* 1987: 40). These roofs are constructed on the same plane, despite the slope of the terrain and the varying height of the wall. In larger *pallozas*, different solutions were employed to span the width of the structure. For instance, we see cases where one end of the ridge beam is supported by the



Figure 10. Methods for securing a rye straw thatch. *Teitado a paleta*: a) straw cord fixed with ropes and stakes (Balouta, León) and b) interwoven branches tied at the top (O Cebreiro, Lugo). *Teitado a baguna*: c) interwoven branches tied across the entire thatch (Genestoso, Asturias, photograph by Fitz Krüger, 1927, courtesy of Museo del Pueblo de Asturias) and d) mesh of interwoven branches and straw ropes secured with rocks (O Cebreiro, Lugo, photograph by Manuel Chamoso Lamas, courtesy of Real Academia Gallega de Bellas Artes).

gable, while the other rests on a forked post aided by another smaller inclined beam. In other instances, the post is replaced by one or several pairs of rafters with forked ends, on which the tie beams, which cross horizontally across the *palloza*, are supported (Alonso 2013: 68–69). These structures generally align with the internal partitions of the structure. It is very common to find mixed systems, where both posts and forked beams are used, especially in larger *pallozas* (Figure 8b). Additionally, variations of this simple model occur where part of the wall is raised in what would eventually be configured as a gable. In these cases, other solutions were executed with non-conical roofs, with a horizontal ridge supported by both the mains upright and the gable (Alonso 2013; Menéndez Martínez 2008).

The rye necessary to cover these structures was cultivated in the vicinity of the villages and has been the foundation for the sustenance of these human groups for centuries. This cereal adapts well to poor soils and cold regions, as siliceous soils favour a more resilient plant, while in more fertile soils, the straw produced is less flexible and more fragile, making it less suitable for roofing. It is common to hear that it is better to sow the cereal in places where there is more snow, as this results in longer and stronger straw. Rye was traditionally sown in the fall, with the harvest taking place between June and July. Like the broom, the cutting process must be done by hand with a sickle and close to the ground to

obtain long and intact straw for thatching. To ensure the stems are not broken, the grain is not threshed but rather beaten. After separating the straw from the grain, the most suitable stems are chosen and tied into bundles. The straw is also cut into smaller lengths for secondary uses in roofing, such as straw ropes. To make these, eight or ten long straws, moistened with water, are interwoven and twisted to create a rope up to 1.5 m in length. These cords are used to secure the rafters and battens, and also to tie the straw (Figure 9c).

The straw is laid in courses of 0.5 m in width, starting from the bottom of the frame—which may have been previously prepared with a layer of heather or broom—and ascending vertically to the ridge, although it is occasionally laid in horizontal rows (González Fernández *et al.* 1987: 41). Each bundle of straw is tied to the battens every 30 cm at two points, with the spike facing inward and the cut, the thicker part, facing outward. Thus, when the straw is dressed to level it, the thatch becomes tighter. The bundles are between 40 and 50 cm thick—the maximum that the rope can tie (Figure 9b)—and should cover at least one third of the previous ones. The overall thickness of the roof should not be less than 30 cm, reaching half a meter at the ridge. The straw should protrude about 50 cm from the stone wall to divert rainwater or snow away from the masonry (Menéndez Martínez 2008: 227). To raise the roof and achieve effective eaves, thick straw cords are tied to close the gaps between the thatch and the wall (Figure 9d). In other cases, stone slabs serve as support for the straw eaves (Figure 9e).

There are two documented techniques for placing and securing the straw to the frame. The most common method, which persists to this day, is known as *teitado a paleta*. For this, a wooden legget about 80 cm long and 10 cm wide is used (Figure 9a). With this tool, the thatcher taps down the straw along the cut area, levelling the roof and creating a surface with a uniform pitch. The leggets have a series of notches that prevent the straw from slipping on the wooden surface. Once levelled, the roof is combed and any excess material is trimmed with a knife or blade. After completing the entirety of the thatch, any remaining gaps are plugged with small bundles of straw.

With this system, different methods are used to finish the roof. In conical roofs, a tightly bound sheaf of straw is used, nailed at the apex. On the same vertex, a metal object, such as old pots or wheel clamps, is placed to prevent water infiltration. In *pallozas* with a horizontal ridge, a twisted straw and rope element is placed around the entire perimeter of the ridge, held in place by small stakes driven into the ridge. New bundles of straw, sometimes mixed with soil, are placed on the horizontal plane created, secured with boards and large slabs (Figure 10a). We can also find fastenings made with hazel rods intertwined around the conical roof or following the horizontal ridge (Figure 10b). Roofs thatched using this system can last between twenty and thirty years, though the most damaged parts need repair every four or five years, with new straw placed in those areas most affected. This is said to be the most durable system, but also the most labour-intensive and expensive, as renewing an old roof often requires removing large sections of the previous thatch and replacing it with new material, a process that must be done by a specialist to ensure waterproofing (Menéndez Martínez 2008: 192).

However, in the past, other simpler systems for placing the straw were also used. Thanks to old photographs and descriptions, we know that in some territories, the wooden legget was not used, and the straw was not packed (Krüger 1949). Instead, it was only secured with straw ropes and interwoven branches of heather or hazel (Figure 10c), running from the ridge to the eaves, sometimes forming a mesh secured with stones to protect the thatch from the wind (Figure 10d). The apex of the roof presents a thicker layer, reinforced with several drive-in stakes. The post could sometimes pierce through the roof, but it was always covered with a tightly bound bundle of straw. This system is simpler and requires less work; the owners themselves were responsible for thatching or repairing the roofs with straw from their own harvest. However, it is less effective; the straw is prone to slipping, and maintenance is more demanding in terms of both labour and raw material. While one person could handle these maintenance

tasks, it was common for the work to be carried out by at least two people, a task in which women also participated. In contrast, the more complex technique of thatching with the legget led to the emergence of a specific profession, and crews of male thatchers used to travel in late summer between the various villages of the region to build or repair thatches (Fernández Riestra and Marcos Fernández 2011: 24).

2.2.3. Neighbourhood reciprocity: the ritual of collaborative dwelling construction

In the past, whether the construction of a dwelling was entirely undertaken by the family and neighbours or if the expertise of master thatchers was enlisted, the process was characterised by ritualised collaboration. An example of this can be seen in the tradition of carting, where processions of carts carried stone, wood or straw. This communal effort involved family members and neighbours engaging in the task with minimal conversation, fostering an atmosphere of reverence. Everyone participated in the construction without payment, adhering once more to this system of neighbourhood reciprocity; in the evening, once the task was completed, everyone was invited to a festive dinner. Therefore, all the residents of a village gathered to assist each other in building houses, sharing both designs and practical expertise (Gimson 1983: 68–69).

3. Discussion and final remarks

The ethnoarchaeology of construction emerges as a crucial discipline for unravelling the enigmatic features surrounding past construction processes, providing a dynamic perspective that goes beyond mere structural assembly. By delving into the knowledge of the materials used and the intricate *chaîne opératoires* required to build these thatched constructions, we enhance our ability to make insightful inferences about how archaeological structures were built and used in the past. It also helps us to appreciate construction not as an isolated event but as a continuum intertwined with annual socioeconomic and cultural activities, since the construction and maintenance of a structure necessitate ongoing efforts throughout the year, involving numerous social, economic and cultural dimensions within human communities: vast knowledge of the environment, the surrounding landscape and the raw materials it provides, as well as neighbourly reciprocity, community ties and resistance to change.

Moreover, this approach invites reflection on broader issues, such as the possibility that differences in architectural practice contribute to the construction of a group's collective identity. It opens a space for debate on knowledge transmission over time and between communities, highlighting how construction is not only a physical act but also a means for transferring traditions and skills; this, in turn, implies the reflection and reproduction of sociocultural values and norms. The observation of entrenched knowledge, where techniques are passed down through generations and between groups even when the original reasoning is not fully understood, raises questions about social structure and individual agency, and the perpetuation of traditional practices despite evolving circumstances.

A final reflection underscores the paramount importance of documenting traditions that are on the brink of disappearance. This involves not only understanding variations and concepts related to raw materials and techniques, but also capturing the rich linguistic heritage associated with construction. As these architectural landscapes undergo dramatic transformations, there is a pressing need to safeguard the intricate knowledge embedded in the linguistic nuances of construction practices. Through the documentation of these aspects, we preserve not only the tangible structures but also the intangible wealth of wisdom encapsulated in the language of construction, ensuring that future generations can appreciate and learn from the diverse and vanishing traditions that have shaped our architectural heritage.

In conclusion, an ethnoarchaeological approach to construction offers a multifaceted perspective on past human endeavours, highlighting the intricate interplay between material culture, social dynamics

and cultural heritage. By examining these complexities, we can enrich our understanding of the diverse and vanishing traditions that have shaped our architectural heritage. This deeper insight assists in reconstructing the structures documented in archaeological sites and provides a clear understanding of the socioeconomic processes of the people who designed, used, modified and ultimately destroyed them.

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Dynamic processes of abandonment: The ethnoarchaeology of buildings in Armutalan, Northwestern Anatolia

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Abstract

Ethnoarchaeology is an interdisciplinary approach that bridges archaeology and ethnology, aiming to gain insights into past human behaviour, technologies, and social structures by systematically observing and analysing the material culture and practices of modern or historical societies. In the context of archaeological excavations, the investigation of buildings and their decay is of essential importance: the condition of structural remains and the location, quality and quantity of find material they contain reveal patterns that contribute to the reconstruction of past ways of life. Furthermore, they allow inferences regarding the social, political, economic and environmental factors that led to abandonment, as well as the modalities of the abandonment process itself.

Abandoned settlements, despite their outward appearance of desertion, are anything but static. They are dynamic entities where cultural and non-cultural formation processes continuously shape the archaeological record; over time, a myriad of reduction and accumulation processes take place, each leaving behind a distinct imprint for archaeologists to unravel the settlement's past.

Key words: Settlement archaeology, Cultural and non-cultural formation processes, Abandonment and post-abandonment behaviour, Archaeological record

1. Introduction: the role of abandonment processes in the formation and transformation of the archaeological record

To permanently become part of the archaeological record, an installation must be abandoned by its users. Whether it is an entire city, a village, a single structure or even just a spatially limited activity zone, the way it is abandoned significantly influences the appearance of the later remains.

1.1. *Active use inventories*

Of paramount importance in reconstructing prehistoric living conditions are those infrequent yet pivotal instances where a structure undergoes abrupt destruction during its active use, precipitated by external factors such as seismic events, volcanic activity, conflict, etc. (Schiffer 1987: 231–255), or internal causes like conflagrations (Kramer 1982: 94–95; Newell 1987: 142, 149; Schlanger and Wilshusen 1993: 91–92). Following such catastrophic events, substantial quantities of collapsed building materials and the assemblage of objects contained within a given spatial unit at the time of collapse are deposited,

frozen in a moment of upheaval. In the chaotic aftermath of a disaster, occupants often lack the temporal luxury to salvage their belongings; only items possessing significant personal or economic value are hastily retrieved, leaving behind a repository of everyday items *in situ*. Subsequent salvage operations may further deplete the assemblage, but if access to the buried inventory is impeded by thick debris or other circumstances, anthropogenic influences remain minimal (Schiffer 1987: 99–120).

Assemblages formed in the wake of catastrophic events display notable coherence in terms of content, with a high level of completeness, particularly for fragile artefact categories (Lightfoot 1993: 169; Schiffer 1985: 21; 1987: 25–261; Wood and Johnson 1978: 315–370). Moreover, the original systemic and functional context of the associated objects is often partially preserved, as evidenced by their location of discovery or their spatial relationships within the assemblage (Schiffer 1976: 149–152, 178–185). While it is common for objects used in the same activity to be found together, there is often a close spatial relationship between immobile installations and their associated items. Additionally, active room inventories typically exhibit a significant prevalence of artefacts with a low discard rate; these items are distinguished by their exceptional durability and their elevated material, functional or symbolic value (Murray 1980: 492; Schiffer 1976: 45–46, 58; Schiffer and Miller 1999: 24–25, 78, 109; Stevenson 1991: 273–276, 278).

Determining and evaluating a find assemblage resulting from sudden events hinges on the observation that the surface of the activity area is devoid of significant waste materials. Throughout the building's period of use, frequently visited areas are routinely cleared of all debris generated during everyday activities through regular sweeping. The accumulation processes during the active use phase of residential, storage or production facilities primarily stem from activities related to building maintenance or the upkeep of the household or community residing within. Nearly all objects undergo a limited lifespan or usage cycle following their production, typically concluding with disposal due to wear and tear or breakage (Schiffer 1975: 839–841; 1976: 27–52; 1983: 678–696; 1987: 25–262. *Cf.* Lightfoot 1993: 170–108).

The timeframe for an object to be classified as waste and transferred into the archaeological context varies depending on the artefact category; it primarily relies on the material's durability, specifically its resistance to mechanical stress, along with the object's intensity and frequency of use. The waste produced in household activity areas under typical everyday conditions mainly consists of organic residues from food preparation, small inorganic elements like ceramic shards and various types of industrial waste (*cf.* Carr 1991: 230–232; Hayden and Cannon 1983: 126; Wilson 1994: 47–51). In their entirety and systematic arrangement, however, such find assemblages, initially formed as primary waste, have a relatively short lifespan, with only a small number of objects ultimately categorised as such (Hayden and Cannon 1983: 119–120, 126; Murray 1980: 492, 494).

In many instances, a notable portion of household waste—primarily smaller items—is deposited in the 'sweepings area' of a building during cleaning activities, forming secondary deposits. These deposits may be situated directly within or just outside the entrance area of a structure. Objects stored in highly frequented parts of the building for extended periods may exhibit visible signs of wear and tear due to foot traffic (Schiffer 1976: 30–31, 67–71, 129–139; 1983: 684–686. *Cf.* Kent 1984: 169–171; Rosen 1986: 92–114; Metcalfe and Heath 1990: 794). Larger objects that might impede workflow in the area or those classified as hazardous due to their physical characteristics, such as bone fragments or sharp-edged ceramic and stone fragments, can be disposed of along traffic routes surrounding the structure or in unused settlement areas (Hayden and Cannon 1983: 119–126; Joyce and Johannessen 1993: 139; LaMotta and Schiffer 1999: 21); unmixed kitchen waste is often repurposed as animal feed or fertilizer, while oven and stove ash is typically deposited in passive areas—locations that are not constantly or intensively used—such as the edges of courtyards or along traffic routes (*cf.* Bartram *et al.* 1991: 97, 106–107, 127,

136). In any case, it is of crucial importance that the quantitative and qualitative ratio between primary and secondary waste inside—and possibly also outside—buildings shifts increasingly in favour of the latter as the duration and intensity of use increases (Schiffer 1972: 162); objects discovered on the surface of an archaeological site are therefore only rarely able to reflect the precise location and nature of the activities carried out there, akin to a ‘fossil record’, due to their spatial displacement from their original point of creation or actual use (Binford 1962: 219; 1964: 425; 1967: 1–3. Cf. Deal and Hagstrum 1995: 119–120; Kosso 1991: 622–624; LaMotta and Schiffer 1999: 19; Raab and Goodyear 1984: 258–263; Schiffer 1972: 156; 1985: 19–24; Tschauner 1996: 8–9).

In multi-phase settlements, the presence of an active-use inventory can also be inferred from larger quantities of collapsed building material or fire debris. Consequently, the matrix directly overlaying such a complex stratigraphically can serve as a supplementary criterion for identification. While a clear concentration of individual finds is expected directly on the surface of the room floor, it is not an absolute prerequisite for determining an active-use inventory: objects positioned on wall shelves, elevated furnishing elements or suspended on walls, as well as items located on the upper floor or roof of a house at the time of collapse, may descend onto sections of the roof and walls that had collapsed inward, landing directly on the floor during a sudden tilting of building components (Schiffer 1987: 33). Consequently, these objects can be found deposited separately from one another in the stratigraphy, despite originally belonging to the same contemporary furnishings.

1.2. *Abandonment inventories*

The second type of end-of-use of a building is abandonment; this requires a conscious decision by the occupants and may also extend over a longer period of time (Blum 2003: 216; LaMotta and Schiffer 1999: 22–24; Nelson 2000: 52–61; Schiffer 1985: 25). Once a household decides to vacate the buildings and facilities they have been using in the foreseeable future, the standard of room hygiene is usually reduced to the essentials (Deal 1985: 264–268; LaMotta and Schiffer 1999: 22–24; Schiffer 1976: 33–34; 1985: 25; Stevenson 1982: 241–261; 1985: 64; 1991: 279, 282–283). Following the decision-making process, there is a notable increase in primary and secondary waste deposited within the interior of the space. The accumulating refuse is no longer routinely removed as before but is either left in place at its source or shifted only during sporadic cleaning efforts to less frequented areas within the room. Consequently, in such situations, a greater quantity of waste than usual or waste in relatively uncommon locations within the respective rooms is to be expected (Schiffer 1987: 97–98). A systematic accumulation of this ‘abandonment refuse’ typically occurs in the areas of room corners, around and beneath immobile furnishings and anywhere it does not significantly obstruct daily activities (Seymour and Schiffer 1987: 553). The qualitative and quantitative structure of intra-room deposition zones is, aside from the physical characteristics of the discarded objects themselves, contingent upon the duration of the abandonment phase as well as the specific use of the respective room cells and their distance to the nearest waste disposal site (Schiffer 1985: 25).

In the case of a planned abandonment of a building, typically all those items whose material, functional or ideological value exceeds the transportation costs involved are taken away (Cameron 1992: 179–181; 1993: 3–5; Schiffer 1987: 90; Shott 1989: 288–289; 1996: 260–269, 274; Tomka and Stevenson 1993: 193); the likelihood that an intact and/or recyclable item remains within a building—i.e., is not formally disposed of—primarily depends on its future utility value, the cost of replacement and the transportability determined based by weight and specific volume, or the loading capacity of available means of transportation. Abandoned houses and residential complexes are therefore sometimes visited multiple times by their owners to transport objects left behind at the location.

In accordance with these selection mechanisms, abandonment inventories typically do not include numerous semi-finished products or many new items (Deal 1985: 270; Schiffer 1985: 31; Stevenson 1982: 241), but mainly consist of objects that either exhibit typical waste-specific characteristics, such as heavy wear, contamination, repair needs, etc., or are considered unsuitable for further use due to their characteristic physical and functional properties. In reconstructing the vessels and other utensils found within an abandonment inventory, one should not expect to find many, if any, complete or still functional objects. However, it is also not primarily expected to encounter individual broken pieces; instead, a relatively high proportion of large fragments and sherds can be anticipated, which can be pieced together to form incomplete vessel parts. If a return is not planned, discarded items are typically left carelessly and disorganised on the surfaces of abandoned rooms, gradually decaying over time. A significant portion of the elements comprising an abandonment inventory is expected to be primarily located on the floor (Schiffer 1985: 24). Reflecting their origin, content and structure, abandonment inventories thus represent an intermediate stage between active inventory and waste. The remaining items in an abandoned house constitute a markedly reduced portion of its former systematic room furnishings and occasionally offer insights into the activities once conducted within the house. Archaeological assemblages predominantly composed of bulky, broken or randomly distributed artefacts are therefore by no means representative (*cf.* Dibble *et al.* 1997: 642–647; Diehl 1998: 617–618, 620–622; Stevenson 1982: 241–246, 255–260). Even the spatial distribution of individual objects within a building can, at least in undisturbed conditions, to some extent still reflect the systemic context of their former use, as little effort is typically made to organize or deposit items in a specific location during abandonment (Metcalf and Heath 1990: 781–794; Schiffer 1976: 150, 184–185; 1985: 18, 23. *Cf.* Lightfoot 1993: 166).

The life cycle of abandoned buildings, however, rarely concludes with the departure of the occupants; post-depositional processes, whether anthropogenic or natural, can disturb or alter existing deposits. In accessible sites, the scavenging of reusable parts is common, involving the removal of both movable objects and, if applicable, building components for reuse elsewhere (Lightfoot 1993: 174; Newell 1987: 142, 149; Schiffer 1987: 114). This extraction typically diminishes the artefact inventory of abandoned structures uniformly, irrespective of the original contents. It is not unusual for parts of buildings or entire structures to serve as dumping grounds after their primary use, especially if they are within areas no longer utilised by their original owners and lack spatial boundaries (Deal 1985: 271; Hayden and Cannon 1983: 131–140; Newell 1987: 149; Rosen 1986: 92–93; Seymour and Schiffer 1987: 554). The introduction of new items often significantly alters the existing artefact inventory within the premises, both quantitatively and qualitatively, and may not be easily discerned from older deposits based solely on formal or structural criteria. If clear differentiation based on stratigraphy cannot be achieved, distinction is often only possible when the newly added pieces exhibit characteristics that indicate they have been relocated; for example, particularly small-sized ceramic fragments heavily abraded along their outer fracture zones may be considered tertiary, i.e., post-depositional, relocated waste (Nielsen 1991: 493–494, 501; Scarborough 1989: 415).

1.3. Passive use inventories

Passive inventories—a special form of abandonment inventories—are formed when buildings are temporarily vacated by their occupants. This typically occurs due to periodic interruptions in use, common in households reliant on a subsistence economy tied to agriculture and livestock farming, which necessitate temporary or seasonal absences. Left behind are items either of no use at another location or unsuitable for transportation due to their size or weight (Gould 1980: 71–72; Schiffer 1985: 26), yet intended for reuse upon the occupants' return, thus forming what can be considered 'de facto refuse' (Schiffer 1972: 160. *Cf.* Gould 1980: 71–72; LaMotta and Schiffer 1999: Tab. 2.1). These inventories represent only a fraction of the original furnishings, tailored to specific activities and seasonal

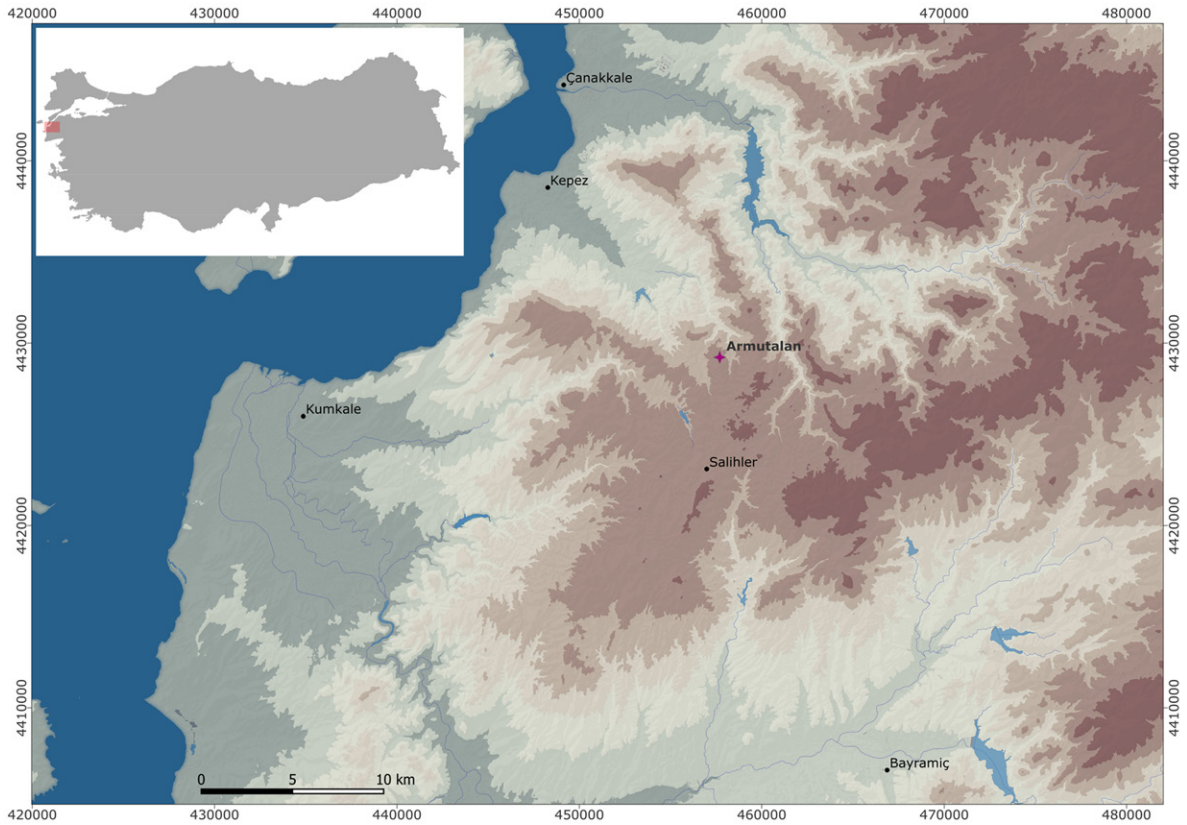


Figure 1. Map of the western part of the central Troad.

conditions. Despite containing a relatively high proportion of usable items—such as intact vessels, tools, equipment, etc.—they offer only a partial representation of the household’s contents. Assemblages left behind as *de facto* refuse do not constitute static entities. Instead, they undergo significant variation due to the cyclical use of the buildings; new items may be added upon return and subsequently retained within the building after use, or there may be a reduction in inventory through disposal (Blum 2003: 228–229; Brooks and Yellen 1987: 81; Cameron 1993: 3–4; Graham 1993: 33, 39; Joyce and Johannessen 1993: 139, 149, 151; Lightfoot 1993: 166; Stevenson 1982: 241–246, 252–255; Tomka 1993: 11, 21; Tomka and Stevenson 1993: 192–193. *Cf.* Kent 1993: 67; Schlanger and Wilshusen 1993: 90).

In rare instances, items intended for continued use are left in their primary areas, allowing these spaces to be identified as kitchens, bedrooms, living rooms, storage spaces or workshops (Schiffer 1985: 22). However, more commonly, movable goods are consolidated in select parts of the building during the occupants’ absence, thereby safeguarding them from weather and unauthorised access. This results in clear concentrations of objects in certain areas, contrasting with other parts of the building left empty and unused. Consequently, the functional and spatial arrangement of objects in a passive inventory differs significantly from their arrangement during active use (*cf.* Pfälzner 2001: 47–49; 2015: 37).

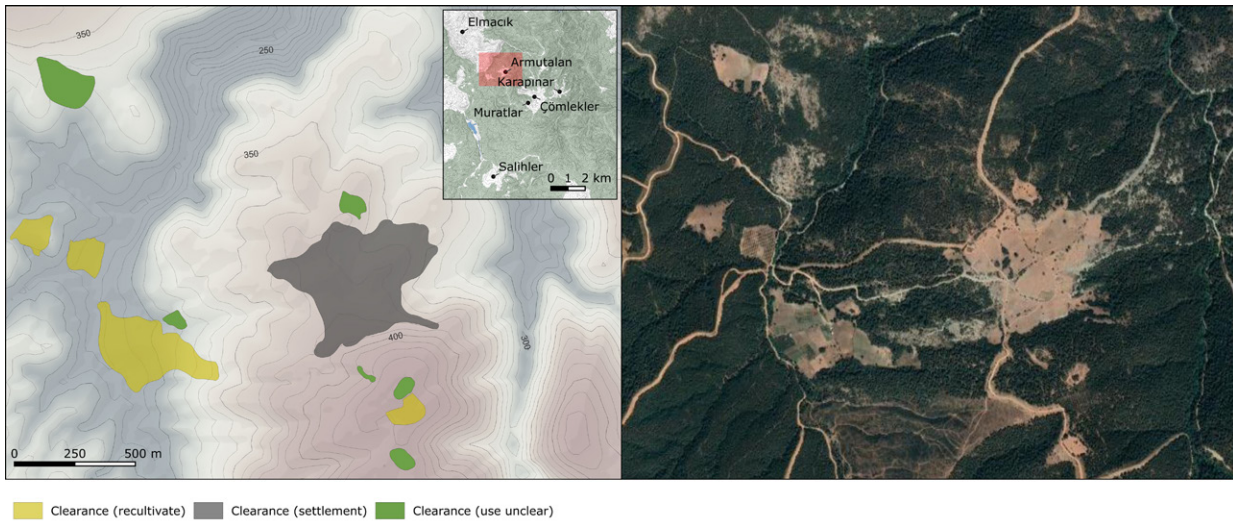


Figure 2. Location of Armutalan and its spatial relationship to the cleared areas in the surrounding region (Google Earth).

2. Exploring Armutalan: geography and architecture of a rural settlement

2.1 Geographical and historical insights

As an example of a village intentionally abandoned by its residents, with the process of abandonment extending over a long period of time, the settlement of Armutalan will be discussed below. Investigations conducted in 2006, 2016 and 2017 primarily focused on documenting the collapse and decay of buildings and installations, as well as spatially and quantitatively recording movable objects such as furniture and household items. As part of the research, additional information was gathered from interviews with Murat Kadir. Born in 1958, he relocated with his parents and older brother from Armutalan to nearby Çömlekler during his childhood. He is married, has three adult children and works as a farmer.

Armutalan is situated at an altitude of *c.* 375 meters above sea level, at 40° 00' 44" north latitude and 26° 30' 14" east longitude, within the municipality of Karapınar, in the district and province of Çanakkale, Republic of Turkey/Türkiye (Figure 1). Continuously inhabited since the Palaeolithic era (Bulut *et al.* 2022), today the broader region surrounding the village is marked by a striking contrast between highly utilised agricultural lands near the coast and expansive, densely wooded mountain and hill areas further inland (*cf.* Höhfeld 2014: 957–967). The settlement is located in the northern part of the Salihler Plateau, a predominantly Pliocene rock formation that constitutes a significant portion of the hilly and mountainous terrain of the central and northwestern Troad. In a manner typical of settlements in such a location, Armutalan was established in an extensive clearing (Höhfeld 1990: 341. *Cf.* Blum 2003: 11); the gently sloping terrain, which descends slightly to the northwest, is bordered to the north and east by seasonally water-bearing streams that cut deep into the mica schist bedrock (Figure 2).

The current climatic conditions can be characterised as typically Mediterranean-semiarid (Höhfeld 1995: 23). Winters are relatively mild and moist, while summers are hot and dry. The precipitation maxima generally occur from November to January, while the summer months of June, July and August are largely rainless, as are sometimes May and September (total precipitation amount: approximately 1000 to 2000 mm per year). Due to sudden cold air intrusions from the north, frost and moderate snowfall can generally be expected between November and April, but snow rarely stays on the ground for extended periods and seldom forms a continuous cover (Erol 1983: Abb. 4–5, 8; Höhfeld 1995, 23, Abb. 2; Hütteroth



Figure 3. View of Armutalan from a southeastern direction (15 August 2016).

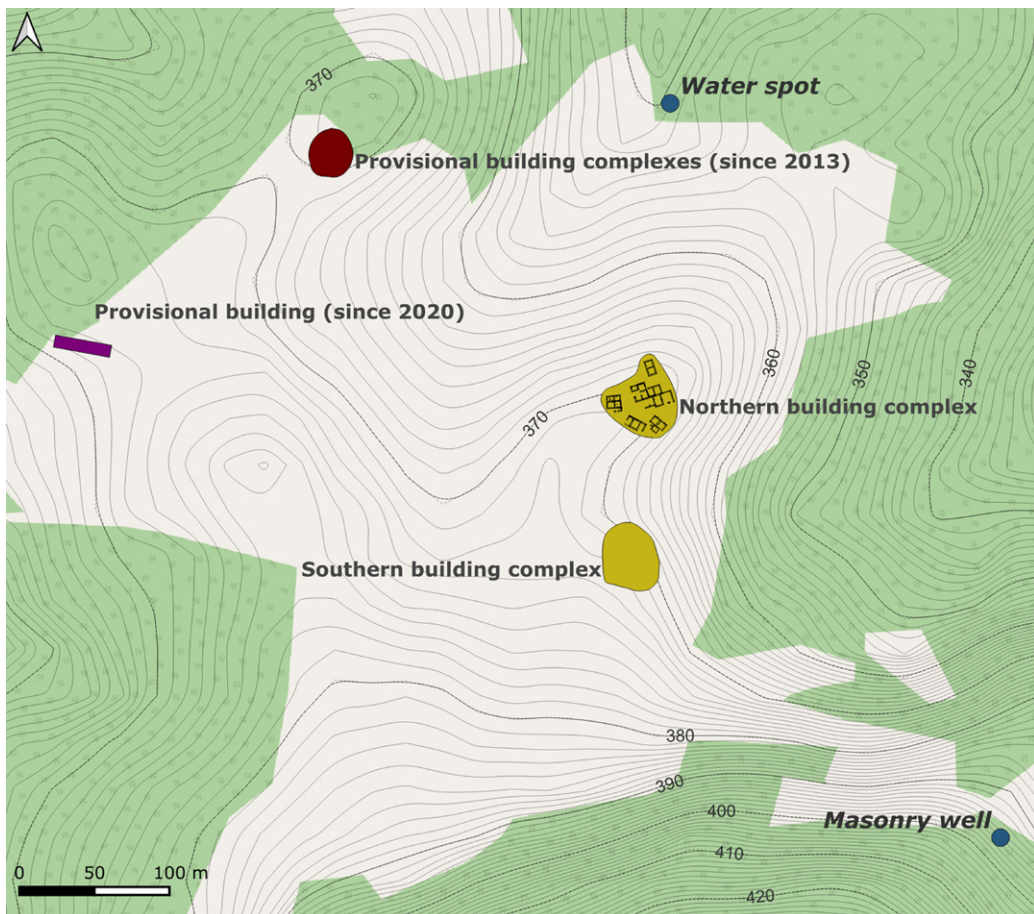


Figure 4. Armutalan: location of the various functional units within the cleared area.



Figure 5. Southern and northern parts of the village separated by a terrain cut (11 August 2017).

1982: 108, Abb. 38; Hüttheroth and Höhfeld 2002: 84–85). The vegetation in the immediate vicinity of Armutalan primarily reflects the local climatic conditions. Additionally, it is influenced by geological and petrological factors, soil quality, surface morphology and varying degrees of human impact. Aside from extensive dry and scrub forests, the natural vegetation predominantly comprises evergreen Mediterranean maquis (cf. Blum 2003: 15–16).

The founding date of the village is completely unknown. In the earliest known administrative records for the region, the Ottoman land revenue and tax registers from 1530, Armutalan is not included—or if it is, it appears under a different, unknown name, as name changes are not uncommon for settlements in the rural areas of the Troad. Unfortunately, the same applies to the cartographic documentation of the landscape. However, it is possible that it was recorded as ‘Başalan’ in the topographical map by the Great Britain War Office from 1941 (1:200,000 TURKEY, Sheet D2, Edremit).

According to Murat Kadir, livestock farming has consistently served as the economic cornerstone of Armutalan, with sheep and goats constituting the primary livestock (cf. Aslan 2011: 50). The acquisition of a few cows, which were costly, was solely for meeting the household’s milk needs, while chickens were kept to avoid purchasing eggs. Due to natural environmental conditions, agricultural activities were largely minimised, with extensive field and garden farming effectively meeting the community’s daily demand for fruits and vegetables.

In response to inadequate infrastructure measures (Höhfeld 2014: 955–956), Armutalan began experiencing gradual depopulation from the early 1980s, contributing to a broader trend of rural depopulation (Höhfeld 2014: 953–955). Smaller hamlets and farms situated away from main thoroughfares were excluded from regional expansions in electricity and water networks, resulting in a sustained decline compared to neighbouring settlements. Some residents migrated to Çanakkale, the district capital 17 km away, and its suburb Kepez (13 km), attracted by opportunities in newly established artisanal enterprises offering stable employment. However, many relocated to slightly larger villages nearby, such as Karapınar (3.5 km) or, like the Kadir family, to Çömlekler (2.3 km), maintaining an agrarian lifestyle. Proximity to their new homes offered logistical advantages, allowing for gradual relocation and retention of infrastructure for livestock, fields and gardens. This facilitated ongoing agricultural activities with minimal logistical effort.

2.2. The settlement: structure, architecture and function

In its current form, the settlement reflects various cultural traditions as well as past and present socio-economic conditions of the Çanakkale region; it served as a human habitat where activities and



Figure 6. View of building 1A from a southwest direction (18 August 2016).

architectural elements influenced each other on a daily basis. Consequently, its buildings and structures have required continuous adjustments to meet the evolving needs of its inhabitants over time.

The rural village is situated in the southeast of an extensive clearing and was established in the layout of a group settlement (Figures 3–4). The developed area is divided into two sections, a northern and a southern one, separated by a narrow terrain cut (Figure 5)¹. Although the latter may appear today as a larger, cohesive unit, it only formed over time through the connection of initially separate buildings and structures: older rooms were demolished and new ones were created. At the time of recording, several sections of the complex had largely collapsed, while others, for temporary continued use, were either maintained or repurposed according to their new functions. Consequently, significant parts of the ensemble are still in use today, primarily as storage for agricultural equipment and housing for animals during the summer months. Approximately 70 meters to the north lies a cluster of five buildings loosely arranged around a central open space. By 2006, the buildings and their accompanying elements were already in a state of significant decay. Seasonal use can be excluded for these structures; however, it is evident that various intact rooms are being used ad hoc by shepherds as overnight accommodation (*cf.* Schiffer 1985: 29).

Architecturally, the buildings primarily evolved through additive methods, with additional rooms integrated into a core structure with floor plans ranging from square and rectangular to slightly

¹ The documentation work conducted in 2006, 2016, and 2017 was limited to the northern part of the settlement, as several rooms in the southern part of the village were locked or barricaded, and access to them was not attempted without the owner's consent.



Figure 7. Building 1B viewed from the west (18 August 2016).



Figure 8. (a) Northwestern façade of the residential areas of building 1B (18 August 2016); (b) view of the residential areas of building 1B from the east (18 August 2016); (c) collapsed storage and utility rooms of building 1B, viewed from the south (18 August 2016); (d) collapsed condition of building 1E on 19 August 2016, viewed from the southwest.



Figure 9. (a) Building 1C on 19 August 2016, viewed from the west; (b) building 1C, viewed from the south (3 August 2017); (c) view of building 1D from the north-northwest on 18 August 2016; (d) masonry foundation of a freestanding dome oven (18 August 2016).

trapezoidal shapes. Moreover, buildings were internally structured by installing partition walls to delineate functional areas. The spatial distribution of activities such as cooking, living, sleeping, craft production, animal husbandry, storage and provisioning has resulted in various architectural solutions. In simpler cases, especially for barns and storage rooms for large equipment, buildings might have started with only a single room; a design rarely encountered today, however, due to later modifications. More commonly, buildings feature two or more rooms, often accompanied by additional spaces like storerooms and pantries adjacent to kitchens, and chambers used for living and sleeping.

As is common in the rural areas of the Çanakkale region, the construction of residential and agricultural buildings in Armutalan relied almost exclusively on traditional building materials such as stone, wood and clay (*cf.* Aslan 2011: 105–130; Blum 2003: 52–180). These materials could be sourced from the surrounding landscape at any time and in practically unlimited quantities. Modern building materials, such as cement or concrete, played only a minor role in comparison. The primary building material dominating today's village architecture is locally sourced mica schist, which was mostly used in the form of lightly hewn rubble and field stones. Clay, used for laying the masonry, plastering and roofing, could be easily procured near the village, as was wood. The dense coniferous forests of the plateau allowed for generous harvesting of timber; it was only since the late 1970s that logging required special permission from the forestry office. The primary construction wood was black pine, with oak being rarely used.



Figure 10. Foundation plans of building 1B with functional designation of the rooms.

Regardless of the type, height or thickness of the walls, shallow strip foundations were used for constructing single-story buildings. The foundations typically varied in width from 50 to 80 cm and consisted of a single layer of large, mostly unworked rubble stones tightly packed to prevent moisture penetration, with gaps filled using smaller stones and clay mortar. The rubble masonry used for the walls was relatively basic in terms of material selection and construction. Walls generally followed an irregular block pattern with minimal alternation between header and stretcher stones. The main qualitative differences between residential and utility buildings were evident in certain construction aspects. For instance, larger, more evenly worked stones were often used for building corners compared to the rest of the masonry. The stone walls of the living quarters, storage facilities for perishable goods and some stables were—as far as can be judged from the often only fragmentary condition of the wall plasters—coated on the inside with a thin layer of white lime mortar in a separate step. This coating, due to periodic renewals, can now be multi-layered and several centimetres thick in some places.

Originally, all buildings had flat clay roofs. However, those still in use were mostly upgraded to ‘modern’ materials like tiles or Eternit, reducing the need for ongoing maintenance. Roof structures typically consisted of parallel beams spaced 25 to 60 cm apart, reinforced by a central transverse beam. Beam spans averaged 3 to 6 m, with roofs sloped at approximately 3–5 degrees. Eaves extended 25 to 60 cm, tailored to local precipitation patterns to effectively manage water runoff.

In utility buildings, ceilings often featured horizontally laid timber panels, sometimes double-layered and perpendicular to the beams. These were insulated with a dense layer up to 4 cm thick made of twigs and thin branches. In residential areas, ceilings typically comprised precisely joined board panels directly supported by the main structure. Ceilings were generally left unpainted but occasionally had lime coatings applied directly to the wood without priming.

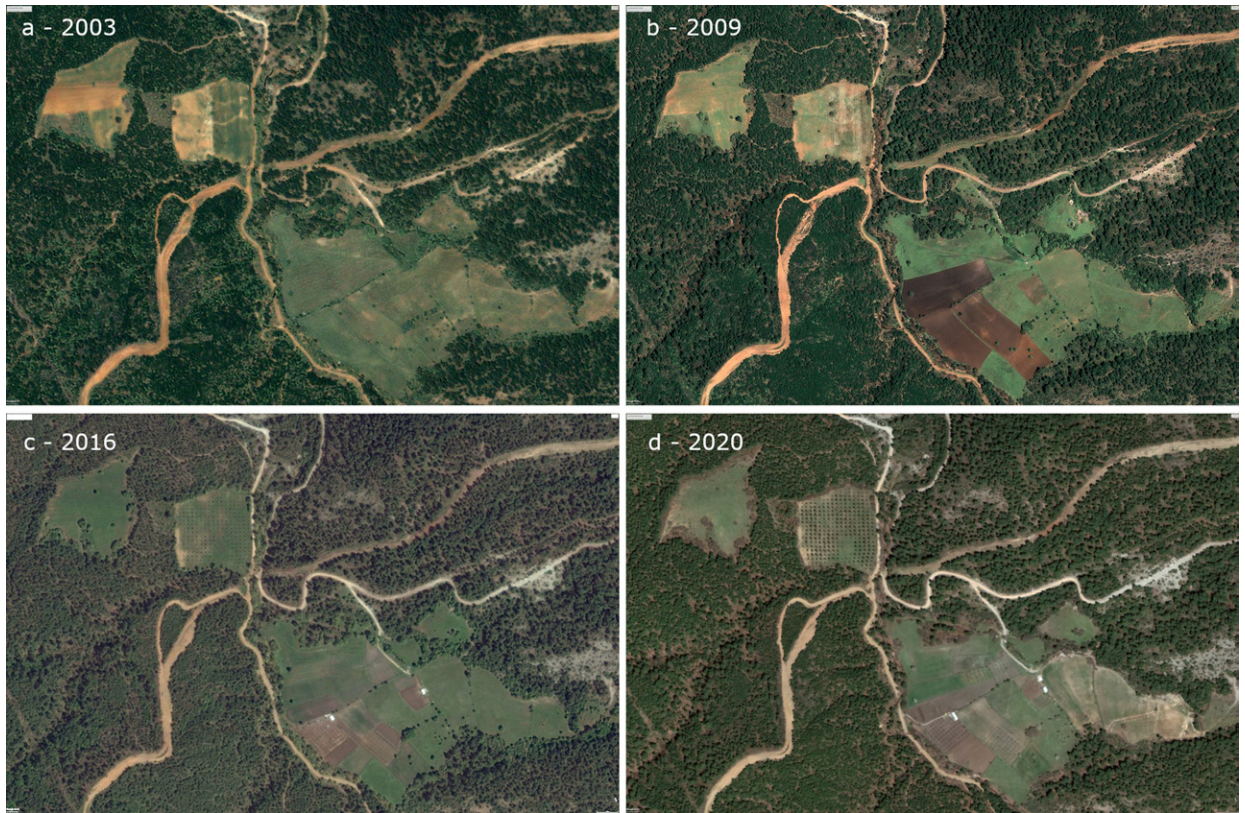


Figure 11. Development and changes in the cleared areas around Armutalan, observed over the years (Google Earth).

Building 1A is situated in the southern part of the northern building cluster and is oriented north-northwest to south-southeast. With exterior dimensions of 10.5×9 m, it comprises three rooms and a small area separated by a narrow wall in the west (Figure 6). Judging by distinctive construction seams visible in the masonry, the room in the northeast appears to be the oldest section of the building; it measures 5×4.5 m internally and features an open fireplace in the eastern wall. The adjoining room to the southeast is similarly spacious and includes a flat masonry bench along its northern wall. The most recently developed area is probably a room in the southwest, which does not have permanent installations.

Up until the year 2000, buildings 1B and 1E were under the ownership of Hüseyin Kadir, who is the uncle of Murat Kadir. Following this, the entire family relocated to Kepez, situated 13 km away. The main building, oriented from west-northwest to east-southeast and measuring 10.7×6.2 m, has undergone several additions over time. The newly added rooms were primarily built for agricultural purposes and were gradually incorporated to accommodate evolving needs (Figures 7–8c). The exact chronological order of their construction is now unclear. Only one room, measuring 4.5×4.5 m inside, is equipped with an open fireplace; all others lack fixed installations. Included in the property was building 1E, situated approximately 12 m to the northwest (Figure 8d). This building measures 10×6.3 m and includes two rooms, each accessible through doors on the southwest-facing façade.

Building 1C is oriented northwest to southeast and was last used by İsmail Tuna, his son Murat and Murat's family. In response to the need for additional living space due to the birth of a grandchild, older parts of the house were demolished and replaced with new construction (Figures 9a–b). Today,



Figure 12. Village fountain on (a) 15 August 2015 and (b) on 24 August 2016.

the building measures 10.7×9.5 m and consists of five rooms. Among the oldest areas is a slightly trapezoidal room measuring $4/4.5 \times 4.5$ m in the southwest, which features a relatively large, elaborately constructed open fireplace. All other rooms are of more recent construction and slightly smaller at 4×3.5 m internally. The ceiling height is uniformly 1.6 m, and there are no additional installations within the building.

Building 1D, measuring a total of 13×6.4 m and oriented west-northwest to east-southeast, marks the southwestern boundary of the building cluster (Figure 9c). By 2006, it had already suffered significant destruction. The middle room, measuring 5.5×5 m, is the largest, with the two flanking rooms added later; building 1D lacks any installations such as stoves, ovens or benches.

The northern building complex of Armutalan is complemented by a 1.5×1.5 -metre oven located between buildings 1C and 1B. It features a masonry base and a dome constructed of clay and tile fragments, which has since collapsed (Figure 9d). Additionally, there are two granaries located just under 20 m northwest of building 1C. Their sill beams rest on large stone blocks, forming a square base of 2.5×2.5 m. Several vertical corner posts, all 1.6 m high, are clad with planks all around and support a correspondingly high gabled roof covered with corrugated metal. The south-facing façade features a door in the middle for access (see below).

While rooms with open fireplaces can reasonably be identified as combinations of kitchens, living areas and winter sleeping quarters (cf. Blum 2003: 169), the functions of the remaining areas of the houses are not immediately evident. Based on their spatial arrangement, some can confidently be identified as stables, storage rooms and utility areas; however, architectural evidence alone does not provide certainty for this. Particularly helpful in this regard were the interviews with Murat Kadir, who could reconstruct the functions from memory for buildings 1B and E: the complex included a kitchen used as living and sleeping quarters in winter, a pantry, two areas for storing agricultural tools and a dedicated space for the carriage. Additionally, there were two goat stables and four cowsheds, accommodating up to three animals each, where they were housed, fed, milked and cared for (Figure 10).

2.3. The ethnoarchaeology of buildings and their inventory: implications of seasonal and occasional use

One of the primary objectives of the ethnoarchaeological investigations in Armutalan was to document the structural changes in buildings and installations resulting from decay or reconstruction during phases of permanent and non-permanent abandonment. Another aim was to document the dynamic processes associated with the phenomenon of total desertion in comparison to temporary abandonment,



Figure 13. Granary on (a) 8 August 2006 and (b) 19 August 2016.

utilising the movable inventories of the structures both interior and exterior. This documentation aimed to capture the variability of these processes and highlight their active and evolving nature.

This multifaceted process extends beyond existing buildings and their inventory to encompass the entire cultural landscape in the immediate vicinity of Armutalan, including the presumed clearing islands associated with the area. A comprehensive view spanning at least two decades of historical development within these individual clearing islands, likely part of Armutalan's former catchment area, is facilitated by Google Earth satellite images from various years.

In Armutalan itself and on the clearing islands within a 1.5 km radius, aerial images from May 2003 reveal minimal human activity such as new construction or maintenance on existing buildings (e.g., re-roofing). Agricultural use is sporadically visible, notably on the clearing island in the northwest (Figure 11a). The northern building complex in Armutalan was largely abandoned starting in 2000 (see above), aligning well with the reduced land use visible in satellite images.

Within approximately 1 km southwest of the main clearing, satellite images indicate a shift in land use on the clearing islands. This change is clearly influenced by developments in Armutalan and its surroundings. To ensure comparability in vegetation status, images from the same season are consistently used. Particularly revealing are the spring months of April or May in the years 2003, 2009, 2016 and 2020 (Figure 11a–c). Agricultural activity on the clearing island southwest of Armutalan is evident by 2009, accompanied by temporary structures in the northeast near the road (Figure 11b). These non-



Figure 14. (a) Condition of building 1C on 8 August 2006 and (b) on 19 August 2016; (c) southern building complex of Armutalan from a northwestern perspective on 8 August 2006 and (d) on 26 August 2016.



Figure 15. Storage room in the southern part of the settlement with and without furniture, on (a) 8 August 2006 and (b) 26 August 2016.



Figure 16. Various utensils and tools left inside the rooms of the southern building complex (15 August 2016).

permanent structures appear to relocate within the clearing island over time, while agricultural activity continues (Figure 11c–d).

Around 2012, a shift in agricultural use is noticeable, affecting other clearing islands similarly. By 2016, systematic reforestation efforts began, indicating a transition from subsistence farming and livestock practices to forestry and orchard cultivation. Forestry authorities have been systematically reforesting clearing islands across the Salihler Plateau (Höhfeld 2009, 71–72, 75), suggesting a reclamation of fallow arable or grazing land rather than a change in agricultural strategy. Extensive reforestation has already occurred in some areas, such as the northwestern and southern clearing islands near Armutalan, resulting in little discernible difference in vegetation height and density compared to the surrounding



Figure 17. 11 August 2017, two wooden mortars (left) that were moved to their later position after 2006.

forest over nearly ten years. This process is partially visible in the 2020 aerial images of the large clearing islands southwest of Armutalan (Figure 11d). Advanced vegetation development suggests these once-open clearing islands will likely become fully forested in the coming years. However, the clearing island of Armutalan itself shows no signs of this secondary use or reforestation. Instead, there has been an increase in land use intensity with the construction of buildings in 2012 and 2020. Since 2003, there has been a noticeable resurgence of human activity overall, though Armutalan itself has not seen permanent resettlement.

Due to the specific nature of abandonment, the formation of the archaeological record in Armutalan does not follow a ‘classic’ pattern in which the settlement is abandoned, left to interact solely with nature, and gradually decays. Instead, the process was interrupted at numerous points (such as through maintenance activities) or even reversed (for instance, through additions and new constructions), resulting in a juxtaposition of (1) completely decayed or removed, (2) partially decayed or removed, (3) partially restored, (4) fully restored and (5) newly constructed buildings. The interval between abandonment and reclamation could span several years or merely a few days. Additionally, a space that was re-used at some point could, upon subsequent abandonment, once more re-enter the archaeological record, and so forth.

In this context, only a select few will be listed here to illustrate the diversity of changes over a specific period. Among the newly established elements, two somewhat provisional building complexes stand out, erected in c. 2012 and c. 2019 at the northwest edge of the clearing (*cf.* Figure 4). Constructed from wooden planks, metal frames and plastic tarps, these structures serve for seasonal livestock husbandry but also include areas designated for cooking and sleeping for the herders. Also new to the site is a



Figure 18. Former kitchen/living area in the southern part of the settlement on (a) 26 August 2016 and (b) 3 August 2017; (c–d) ad hoc sleeping quarters in the northern room of building 1C (15 August 2016).



Figure 19. Various objects that were introduced into the abandoned rooms at a later date (18–26 August 2016).

concrete well located approximately 250 m southeast of the southern settlement area; in 2016, this replaced an old masonry well, likely dating back to the Ottoman era, which was completely removed with heavy equipment due to its dysfunctionality caused by a lowered groundwater level (Figure 12).

Regarding installations that nearly disappeared between 2006 and 2016, notable examples are the two granaries mentioned above. In 2006, one of the structures was still completely intact, while the other was already showing signs of decay. However, by 2016, only the foundation stones and wooden sills of the former remained; the latter structure, on the other hand, had completely vanished—and certainly not without anthropogenic influence—except for a few sill stones scattered randomly in a shallow depression (Figure 13). Overall, it is remarkable how rapidly decay can progress, even in substantial structures, with little or no human intervention.

For instance, in the summer of 2006, only a few parts of the west-facing façade of building 1C were damaged, the roof was largely intact, and parts of the wooden cladding of the entrance area on the south side were still present (Figure 14a). However, just ten years later, by August 2016, almost the entire southern section of the house had collapsed, the roof had completely caved into the rooms below, and the wooden cladding had entirely disappeared (Figure 14b). The same applies to buildings 1B and 1E: by 2006, only six years after their abandonment, the buildings had largely deteriorated into a state of ruins (*cf.* Figures 7–8). While the northern cluster of the settlement saw no significant changes indicative of continued use between 2006 and 2017 and remained in a state of structural decay, various rooms in the southern section of the village underwent extensive repairs, renovations, adjustments and expansions directly linked to seasonal activities. Despite some rooms being completely destroyed, the southwestern sections of the building complex received new roofing and stabilised walls (Figures 14c–d) to convert them into storage for larger equipment, tools, fertiliser and operating materials. Additionally, provisional rooms made of wood and metal sheets were erected in front of the southern and eastern façades, serving either as storage or as stables for cows and goats.

A critical aspect contributing to these findings is the reuse of building materials, many of which were sourced from the collapsed northern parts of the complex or recycled from elsewhere, thereby reintegrating them into the systemic context. However, once these areas reach the end of their usage cycle and are abandoned, this effect is reversed.

Regarding movable objects such as furniture, appliances, tools, clothing, etc., the differences are particularly noticeable when comparing inventories from 2006 and 2016. Nevertheless, significant changes are also noteworthy for the short period between 2016 and 2017. The residents of Armutalan did not leave hastily and were not forced to abandon usable items on site. Due to the short distance to their new homes, they always had the option to return and collect items initially left behind, with several years potentially passing between departure and retrieval. Additionally, due to seasonal reuse of abandoned structures, objects that originally served various activities in daily life were concentrated in one location—either to protect them from unauthorised access or simply for practical reasons—resulting in seemingly unrelated collections of items. During this process, these objects could enter areas of the house with which they had no functional connection whatsoever.

In addition to items disposed of as primary and secondary refuse in or near the buildings during the village's active use, numerous usable objects remain present. These include, among other things: (1) items left behind at their last point of use or storage for reasons such as size, weight, potential future utility, etc., thus becoming *de facto* refuse as they have not yet been collected; (2) objects removed from their original context and deposited elsewhere for later use; (3) items newly introduced to Armutalan as part of seasonal or occasional use and left there; and (4) primary and secondary waste generated from the seasonal utilisation of the clearing island and settlement. However, it is important to note that these

categories represent snapshots at the time of documentation; the status of an object may change at any time due to natural or anthropogenic influences. Furthermore, additional variations are possible, as movable objects undergo comparable processes of change to those of buildings.

Here, too, only a few examples from the wide range of recorded instances will suffice to illustrate the matter. In the southern part of the village, a large wooden chest, used for storing grain, can be classified under the first category of objects (Figure 15). Initially, its size and/or the lack of transport capacity likely caused it to remain in its original location. It is also conceivable that it simply had no use at the new location. Until 2006—and thus a considerable time after the surrounding house was abandoned—it remained in its original place and was later transported away. The documentation from 2016 can be used as a *terminus ante quem* for this event. Also included in this category are items where the process of reintegrating them into the systemic context is ongoing but incomplete. These items are at risk of deteriorating and becoming assimilated directly into the archaeological record. Examples include various agricultural tools, such as a wool comb and a wooden ladle found in the deteriorated part of the southern village section (Figure 16a–b), along with a heavily weathered cart and a metal plough in Building 1D (Figure 16c–d). Other items belonging to this group are still stored in the roof beams of buildings, such as a wooden pitchfork and a metal bucket handle, also located in the southern part of the village (Figure 16e–f), which could be buried in the event of a roof collapse. Objects of category 2, that is, items temporarily stored at a specific location until their next use, are found—at least until 2017—exclusively in the southern complex. Examples include two old wooden mortars now located in the area of the former kitchen/living space of the building, where they were not present in 2006 (Figure 17).

New additions to the inventory of Armutalan consist of objects primarily associated with seasonal activities. These include mostly agricultural tools, supplies and items used for the repair and renovation of the buildings still in use; as a result, they are almost exclusively found in the southern part of the settlement. These items are often stored together with objects from category 2, forming ensembles that combine both old and new items. For instance, between 26 August 2016 and 3 August 2017, a flexible drainage pipe was temporarily placed in the former kitchen/living area of the eastern, highly collapse-prone section of the southern building complex (Figure 18a–b); in the southwestern area of the house, which remains largely intact, paints and vehicle supplies have been stored. Additionally, some items indicate more spontaneous use; one example is a mattress foam core that has served as an impromptu sleeping spot for shepherds in the northern room of Building 1C since 2016 (Figure 18c–d).

As a direct consequence of the seasonal, time-limited use of both the clearing area and parts of the settlement, there is also a significant increase in secondary and tertiary waste throughout the settlement area. While quantities steadily decrease with increasing distance from the structures, a veil of waste covers the entire area. There are no distinct clusters in its spatial distribution, largely because the majority of items, such as beverage bottles and plastic packaging, are casually thrown into deteriorating buildings or their surroundings (Figure 19a–b). Additionally, there are discarded items related to animal husbandry, such as medication bottles or cow ear tags (Figure 19c), as well as clothing damaged during agricultural activities and left behind spontaneously (Figure 19d). Similarly to all other types of objects, these can change their documented status at any time, for instance through displacement, recycling, etc., and naturally have little to no functional connection to the place of their deposition.

3. Conclusion: from ruins to revelations

Documenting the village of Armutalan at intervals ranging from one to several years has proven effective in revealing both quantitative and qualitative changes in the material record over time. By around 2000, the main phase of settlement had ended, and since then, the material record has been anything but stable, particularly due to the periodic use of part of the settlement. It is entirely normal for a building

to serve multiple—and possibly quite different—functions throughout its lifecycle, as well as to undergo modifications and renovations. Additionally, accumulation and reduction processes have significantly altered the composition of the inventory up to the present day. The accumulations to be documented present a colourful mixture of primary and secondary refuse from both the period of active use and the time thereafter. There are also classic passive inventories consisting of usable items that, in part, are still awaiting transportation to new locations and are therefore classified as ‘de facto refuse’. Alongside these are objects brought in later for seasonal agricultural activities or simply for ad hoc use. Old and new objects have come together—and continue to do so—in close proximity, forming an ensemble that remains in a constant state of flux. Items that were originally part of the archaeological context can be incorporated into the systemic context and then returned to the archaeological context, and so forth. Despite its outward appearance of desertion, Armutalan is a living organism, with formative processes that will never cease.

Although the present case study might appear, from a strictly archaeological-methodological perspective, to be nothing more than just another cautionary tale highlighting the disparity between systemic reality and archaeological interpretation (*cf.* Lucas 2012: 138; Rossignol 1992: 6, 8–11; Simms 1992: 186), it is precisely investigations like these that provide a profound array of approaches and (alternative) interpretations, extending archaeological reasoning well beyond the conventional. The significance of case studies such as Armutalan lies in their capacity to shed light on the processes that shape and alter the archaeological record, thereby enhancing our comprehension of how the source material was created and facilitating its use for further analysis.

Cultural and non-cultural formation processes become tangible in terms of cause and effect and can, when explicitly formulated as a hypothesis (*cf.* Schiffer 1983: 693–696; Shott 1998; Tschauer 1996: 2, 7–10; Veit 2020), serve as a tool for intrinsic source criticism and, furthermore, as a sound foundation for explaining observations made during excavation (David and Kramer 2001: 95; Gorecki 1985; Kent 1987: 33–43; McIntosh 1974; *cf.* Lucas 2012: 113–115); for while the archaeological record may appear as a static entity at the moment of excavation (aside from interactions with the archaeologist), the trajectory from its creation to excavation is far from linear and can encompass numerous—potentially even entirely unexpected—detours, all of which are relevant for interpretation.

A settlement that was abandoned does not in any way provide a Pompeii-like snapshot of past society and should not be interpreted as if it does (*cf.* Binford 1981; Schiffer 1985). People abandoned sites for various reasons and in different ways. How they left had a direct impact on the quality and nature of the cultural remains that entered the archaeological record. In the simplest case, a settlement is left by its inhabitants and not revisited, so that natural formation processes contribute to a lasting change in the (archaeological) record; if the settlement is revisited multiple times after abandonment to retrieve useful items, reduction processes primarily shape the archaeological record, with accumulation playing a relatively minor role (*cf.* LaMotta and Schiffer 1999: 24–25; Stevenson 1982; Tomka and Stevenson 1993).

In cases of seasonal reuse, as illustrated by the example of Armutalan, the processes of accumulation and reduction in abandoned buildings and facilities tend to balance each other out: old items are removed, new ones are added, unnecessary items are discarded and damaged ones are disposed of. The result is often seemingly random assemblages of items that cannot be directly linked to specific activities or adequately represent the daily life of the society during its active use in the past, as they mainly reflect activities that took place at a later time. Should the settlement ever fully transition into the archaeological record, it is primarily the different stages of reuse that will become evident through the artefacts found on site.

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Ethnoarchaeology of buildings as a method for understanding and valuing earthen building cultures

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Abstract

The following is a reflection on how the study of earthen building cultures can inform conservation approaches to earthen building heritage. The first part is reflective on studies used to inform conservation methods at the World Heritage site of Ancient Merv, Turkmenistan, in the early 2000s and the second part provides an overview of best practices for the documentation, maintenance and conservation of earthen building cultures that the author recommends today within the context of the Sustainable Development Goals.

Key words: Earthen buildings, Traditional construction, Maintenance, Conservation, SDGs

1. Introduction

The following is a reflection on how the study of earthen building cultures can inform conservation approaches to earthen building heritage. The first part is a reflection on the specifics of conservation at the World Heritage site of Ancient Merv, Turkmenistan, in the early 2000s and the second part provides a reflection on the documentation, maintenance and conservation of earthen building cultures, informed by subsequent work and teaching in this area.

For the work at Ancient Merv, rather than a formal methodology, the following is an almost accidental account of the discovery of knowledge regarding a fragmented local earthen building culture. This was informed and shaped by the collaborative and embedded methods of an international project team working with officials and members of the local community—who were often engaged in other types of work within the international project team in a window 2001–2005. The insights are partial—shaped by the author’s own interests in a multidisciplinary role as archaeologist, conservator and earthen building researcher. At the time the research was undertaken, little attention was given to research ethics and consent; instead, conversations, tea-breaks and lunch breaks, evening and afternoon walks and social occasions allowed informal observation, questioning and an understanding of earthen building cultures to develop. This also provides a record of fragmented earthen building knowledge that will have changed in the more than two decades since the research was undertaken; and whilst further fieldwork has not been undertaken for this chapter, this does provide an update on work that was included within the author’s doctoral research and its associated publication (Cooke 2010).

In contrast to this accidental discovery and documentation from the early 2000s, the second part of the chapter reflects on best practices for the documentation, maintenance and conservation of earthen building cultures. These are shaped by work undertaken on other sites, sometimes as a researcher and often as a consultant, working to support heritage and conservation project development. This is included as a recommended framework for researching increasingly recognised—and now much more highly valued—earthen building cultures around the world, whilst also noting their increasing vulnerability within a context that recognises the role of heritage within the United Nations Sustainable Development Goals (SDGs) and other frameworks in securing social equity within a rapidly escalating climate crisis in which earthen building cultures are uniquely threatened.

2. Merv, Turkmenistan: local earthen building culture

Turkmenistan has a very long history of using earth as a building material. This is manifested in extensive multi-period archaeological sites which represent the process of construction, use and subsequent erosion from the Neolithic onwards, through to the survival of upstanding built earthen heritage of mediaeval, later and contemporary construction. Using the Köppen-Geiger Climate Classification, Turkmenistan has a cold, desert-arid climate, with very little annual rainfall and extreme desert temperatures of up to 50° C (164° F) in summer and -10° C (14° F) in winter. Eighty per cent of the landmass is formed by the Kara-Kum Desert and the whole region is seismically active.

I had the opportunity to undertake work in Turkmenistan as part of a larger international project, first under the leadership of Georgina Hermann and, during the period of my involvement, under the leadership of Tim Williams through the Institute of Archaeology, University College London. These projects were only the most recent in a very long lineage of international work at Merv, most famously through the Soviet-era YuTAKE archaeological missions from 1946 onwards. The context of the project was one that was shifting from an archaeological remit to a broader focus on heritage management following the inscription of Ancient Merv as a UNESCO World Heritage property in 1999 (under Cultural Criteria II and III, UNESCO 886), following Turkmenistan's independence from the Soviet Union in 1991 and the growing use of archaeology and heritage within nation-building.

The shift in focus from archaeology to heritage management and conservation involved a number of different projects: the rapid documentation of the standing structures and city walls, surveys of past extant excavation trenches, limited excavations to support conservation works and education and outreach, among many others. Part of what emerged from my involvement was a focus on existing knowledge systems regarding earth building to understand past uses, conservation needs and practices of maintenance and repair. The focus was on the surrounding villages that were embedded within the landscape; for example, as traditional custodians of shrines, those involved in traditional land uses of grazing and herding and those involved in the maintenance of irrigation and agricultural use of the landscape.

The Archaeological Park of Ancient Merv is in the Baýramaly District, 27 km east of the provincial capital city, Mary. The setting of the archaeological park in the early 2000s was characterised by small-scale agriculture and former collectivised village communities (*kolkhoz*) established from the 1930s onwards. For the purpose of gathering this material, the most important of these communities was the Ancient Merv *kolkhoz*, which was considered one of the oldest *kolkhoz* in the Merv Oasis. This *kolkhoz* was characterised by the use of a variety of different materials and techniques for the construction of single-storey rectangular structures to create family compounds.

3. Contemporary earth building culture

At the time of this research, there were no legal requirements for construction to follow, although social, cultural and economic factors result in a general, overall homogeneity despite the use of a mixed range of materials and methods. For example, the use of fired bricks (*galtak/bishen kerpic*) of a standard size (c. 240 × 124 × 60 mm) introduced from about the 1950s; cement (introduced throughout the 20th century, imported from Iran, Kazakhstan or Uzbekistan and then manufactured outside the Turkmen capital, Ashgabat), and earth in construction. There was evidence for a number of different earthen building traditions used for both load and non-load bearing construction. These included mudbricks (*gala kerpic*), placed earth and rammed earth (*paksha*), with earthen mortars, plasters and renders (*suwoq/suwool gelina*). The *gala kerpic* were generally small (240 × 124 × 60 mm), formed in the same moulds (*galep*) as modern fired bricks, and referred to as 'Russian bricks'. Sometimes there was alternating *paksha* and



Figure 1. Traditional, historical earthen building heritage in Ancient Merv, Turkmenistan.
Photo L. Cooke.



Figure 2. Archaeological evidence of earthen building cultures within the excavation of the City Walls, Merv, Turkmenistan. Photo L. Cooke.



Figure 3. Adapting contemporary maintenance approaches for conservation, Merv, Turkmenistan. Photo L. Cooke.

gala kerpic construction; however, at the time of the research, the *pakhsa* construction was in decline, with individuals planning to replace the older, eroding *pakhsa* buildings with new structures which combine *gala kerpic* and fired bricks (Figures 1-8).

In the village locations surrounding the archaeological park, most new construction used concrete as a building platform and a majority of the mudbrick buildings had fired brick facades. When fired and mudbricks were combined in the same structure, every fifth brick course was connected, and/or the face of the structure was built up in fired bricks. The use of *gala kerpic* was considered an economic way of adding overall height to a structure, using the fired bricks for the foundation and bottom courses and then *gala kerpic* for the rest of the wall, whilst *gala kerpic* were used for interior walls. In this way, a



Figure 4. Contemporary earthen building culture in Ancient Merv Kolkhoz, Turkmenistan. Photo L. Cooke.

majority of the buildings appeared from the exterior to consist solely of fired brick construction. The utilisation of fired bricks in combination with *gala kerpic* was attested to utilising both the thermal characteristics of the *gala kerpic* alongside the perceived benefits of reduced maintenance offered by fired bricks; although, interestingly, it was comfort and ‘livability’ rather than the economics of thermal regulation that were key, as both electricity, and gas were free at the time the research was undertaken.

The older buildings in the villages had large flat roofs constructed with large wooden poles, and a reed lattice, upon which layers of mud plaster were placed. These roofs had a 30 cm slope on both sides in order to facilitate water run-off and drainage pipes were also installed. These flat roofs continued to be used for the storage of winter fuel and fodder, such as camel thorn. Whilst the flat roofs are most often associated with those structures comprising *gala kerpic* or *paksha* construction, a number of buildings with a fired brick exterior also had flat earthen roofs. A roofing superstructure could be erected over the earlier roofs, and more commonly, new construction utilised pitched (inverted V-shaped) roofs. These roofs were constructed out of roofing timbers and covered with corrugated metal (and in some instances, asbestos) sheeting. These inverted pitched roofs were expensive and considered ill-suited to the local climate, as they did not moderate the diurnal and annual temperature fluctuations. However, they were often utilised as a result of socio-economic perceptions of these having a higher status.

For storage and ancillary structures, and for non-load bearing walls comprising *gala kerpic* and *paksha*, the exterior and interior surfaces were not always coated in earthen plasters or renders, and non-load bearing walls often had a capping of loose brushwood and earthen plaster.



Figure 5. Contemporary earth building culture in Ancient Merv Kolkhoz, Turkmenistan. Photo L. Cooke.

Earthen buildings were built from about May (the end of the rainy season) and generally finished in November (the start of the rainy season). *Pakhsa* tended to be carried out only in high summer, and the main masonry component of the building was normally completed in one month, after which the interior, exterior, flooring and roof would be finished. Earthen construction used the silts that accumulated from the cleaning of irrigation canals and ditches. Preference was given to locations with 'sweet soil' (earth free of salts, agri-chemical residues and without too much sand). Earth was mixed and prepared in a *handek* either on or off-site, depending on proximity to water and the nature and type of earth available on site. The preparation and mixing of the basic earth mix would generally take three days, with the soil, water and *saman*/straw mixed and left on day one and two, ready for use on the third day. At this stage, the mixture would be tested to ensure it was suitable by stretching it in a rectangle, which two people would pull: if it broke in the middle, the mixture needed more work. Using this basic earth mix, construction could occur as mudbricks or plasters, although the top layer of the earth plasters contained much finer straw than the layers underneath. *Paksha* was a drier, less humid mix and with no straw additions.

The process of construction involved the creation of a platform that consists of prepared earth (*komkowsy*) or, for more recent construction, concrete. This platform could be constructed several months prior to commencing the rest of the construction in order for it to dry and settle. Foundations would then be dug and built through the platform, and on top of this foundation asphalt paper or liquid bitumen was often added as a capillary barrier. *Gala kerpic* were laid with a mud mortar and, depending on the position in the structure (and whether or not fired bricks are utilised), the exterior was coated in a mud plaster, whilst the interior was coated in a thin whitewash (traditionally lime or gypsum based, but more recently, a synthetic paint).



Figure 6. Contemporary earth building culture in Ancient Merv Kolkhoz, Turkmenistan. Photo L. Cooke.

Paksha walls were built up in layers of descending height: 1st = 90–100 cm, 2nd = 70–80 cm, 3rd = 60–70 cm, 4th = 50–60 cm. After two or three days of drying, the wall is levelled, following another 7–10 days for each layer to dry prior to proceeding with the next. Wood was used in between the *paksha* lifts. This was often tamarisk, but mulberry was preferred, as it is very strong and not attacked by insects (mulberry wood was also used for reinforcement when concrete was used for construction). After one year, the *paksha* wall was considered dry, and the cracks that had formed during the drying out process were then filled with earthen mortar/plaster, after which the entire wall might be coated in a thin lime-wash.

Gala kerpic tend to be made off-site, utilising locations adjacent to modern irrigation canals, which have quantities of upcast silts available; in contrast, earth is transported and *paksha* is mixed on-site ready for construction. In addition, material from older eroding buildings is sought out and recycled for earthen construction. The reuse of the older material is attributed to the easier workability of the already ‘cooked’ older material; additionally, there are benefits in using material that has already been worked and to which materials such as straw have been added. In other instances, the material from older eroding buildings is used for the construction of the building platforms.

The most common additive to the basic earth and water mix was finely chopped wheat straw (*saman*) for use in *gala kerpic* manufacture and for earthen plasters. The straw is chopped into very small pieces 0.5–1.0 cm in length and 0.1–0.2 mm in width. The *saman* used in earthen plasters is a by-product of flour and bread-making and is ideally left to rot for twelve months prior to use; after mixing, it is left for one to two days, normally until it smells—this was locally attested to prevent the straw from sticking to the plastering tools.



Figure 7. Contemporary earth building culture in Ancient Merv Kolkhoz, Turkmenistan. Photo L. Cooke.

Construction involved a master builder alongside both skilled craftsmen and family members. At the time of the research, there were perhaps 50 different people in the local area with the skills required to build with earth, including masons, helpers and workers. Most male family members had been involved in the construction or maintenance of dwellings, outbuildings and additional structures in the family compound. There was very little formal training among the owner builders regarding techniques, although there was a great deal of knowledge about the sourcing of suitable earth and simple methods for testing the suitability of earth used in construction (such as the pulling of the earth, the length of straw and the degree of mixing). Women were often, but not always, attributed with internal decoration (painting and applying whitewashes and wallpaper) and the construction of earthen bread ovens (*tamdyrs*). The division of labour was associated with traditional Turkmen family life, reflecting the traditional saying: 'The world is a man's house, while the house is a woman's world' (Blackwell 2001: 149).

For *gala kerpic* buildings, the ideal was to maintain walls and roofs through the reapplication of mud plaster every year, and for *paksha* buildings through the reapplication of a thin lime/gypsum wash, alongside the corrective repair of areas of more substantial damage. However, the regularity with which this occurred depended on economic factors and the availability of labour. The maximum period without maintenance for walls with no capping was generally one year; otherwise, depending on orientation, an interval of up to 10–20 years for the reapplication of earth plasters and 4–5 years for lime/gypsum washing.

The requirement for maintenance of the earthen surface finishes depended on the type of earthen construction method used, with *paksha* structures often lacking an exterior render, as well as the function



Figure 8. Contemporary earth building culture in Ancient Merv Kolkhoz, Turkmenistan. Photo L. Cooke.

of the structure. Structures that were not lived in, such as cattle and storage areas, may not have had an exterior surface finish. Although the timing and regularity of maintenance were not directly associated with ritual or religious activities, there is the possibility that, in the past, some of the maintenance activities were associated with particular events, such as New Year / Nowruz (see Blackwell 2001).

A majority of houses also had an earthen *tamdyr* (bread oven). These were constructed with a ring of fired bricks, with mud plaster on either side. Then, earth—prepared like the mudbrick mix—was placed by hand to build the body of the oven and the whole structure was then coated in earthen plaster. There was anecdotal evidence to suggest that women constructed and maintained the earthen ovens, whilst men dismantled them to avoid bad luck. The fuel used in the *tamdys* was waste leftover from the growing of cotton, as this burns slowly, which is considered ideal for bread baking.

A very different use of earth was also represented in Turkmen funerary rites, where burial occurred beneath a low earthen mound (Blackwell 2001). The body was carried to the burial place on a ladder, and the ladder was left jutting out of the mound. In some places, these funerary mounds are also coated in an earthen plaster, which is reapplied annually. Showing similar patterns associated with the changing nature of domestic earthen buildings, this earthen plaster was also being replaced with a thin cement capping.

Within traditional Turkmen society, there is a rich symbolism associated with earth buildings. Blackwell's (2001) folklore study of spontaneous women's songs analysed them from a contemporary cultural context. Within these songs, there are references to buildings and the home; furthermore, the use of metaphors associated with earthen buildings is significant. For example, earthen walls can both

protect and entrap, and earthen structures can be linked to prosperity; however, like the earthen burial mounds, they may erode away (Cooke 2010).

This deep understanding of local contemporary earthen building culture was used for understanding and adapting conservation approaches for use within the Archaeological Park. Examples include the repair and maintenance of the earthen roof on the Mausoleum of Ibn Zeid, the development of conservation reburial/backfilling strategies and temporary conservation works (Cooke 2010).

4. Approaches to understanding earth building cultures

A comprehensive understanding of earthen building cultures should inform the conservation of earthen heritage. In all cases, the materials and techniques of construction, maintenance and repair have been adapted to local needs, and the variety of different earthen construction methods and associated component materials (timber, biomaterials, stone, etc.) reflect important local building knowledge. The conservation approaches advocated should broadly encompass documentation, maintenance, conservation, analysis and training, and can be applied as a broad framework.

4.1. Documentation

The most effective approach to documenting earthen built heritage relies on understanding local knowledge systems, archival research (historic photographs and maps) and photographic archives and documentation. This can be used to create a heritage inventory of the standing structures and, within conservation planning, to understand risk, vulnerability, maintenance and repair needs, etc.

Local knowledge systems are critical for understanding earthen building systems. A detailed study of the range of local building techniques and a glossary of local building terms should be developed as part of understanding the value and significance of the structures. This includes (among others) knowledge of earthen material sources, local additives to the earthen building mixes (straw, animal by-products, fibres), associated materials (fired brick, stone, timber and local biomaterials for formwork, framing, roofing and lower wall bases), tools for construction, as well as the local earthen building cycle (such as the timing for material preparation, construction timelines and traditional repair schedules).

Where local knowledge is retained, it is important to work with communities with remaining craftspeople and builders, and with their consent, document and record their earthen building systems. This can include (but is not limited to) videography, photography, audio recording and cultural mapping—which is especially important for locating earth and associated building materials. Local knowledge is often held individually, but where groups of craftspeople, builders and/or communities are involved, earth-building workshops can be used to record this knowledge.

It is useful to prepare local glossaries of earthen building terms—collating and recording the terminology and language used (see, for example, Knoll *et al.* 2019). Informed consent is critical when recording endangered material knowledge, and processes should align with suitable regional research and ethical frameworks.

Archival research is also critical for understanding earthen buildings. Where historic photographs exist for buildings or settlements, they provide a key baseline from which interpretations of construction and use can be based, and through which understanding of current rates of loss and change can be considered. These methods are very well-established within building recording and conservation work (Cooke 2011). Maps can also record the shape and form of historic buildings, settlements and historic land-use patterns (agriculture, water sources, quarries); map regression is a key tool for understanding historic and current land use, spatial patterns and change over time.

Photography of earthen buildings is critical to recording their current condition; photographic standards should follow regional best practices and guidelines; for example, making use of photographic scales, ranging rods and colour charts. The latter is particularly important given the local variations in earthen building systems (mudbrick, placed and rammed earth and earth mortars and plasters/renders) and their component materials. Sketch recording, measured drawings and photogrammetry/SFM, as well as terrestrial or UAV scanning, can also be used and should align with 3D standards for GIS (referencing appropriate regional standards in heritage documentation). On site, annotation and interpretation of images can provide a useful record, whether in hard-copy or digital hand-held formats.

4.2. Maintenance

The most effective long-term approach for the earthen structures is to keep them in use and ensure regular maintenance and repair using appropriate earthen materials and traditional methods. It is well known that when earthen structures do fall out of use, they can be particularly vulnerable to accelerated erosion and decay, as traditional maintenance and repair patterns are disrupted (Cooke 2010).

Maintenance work for earthen buildings and structures should be based on an understanding of the materials and construction techniques employed in their original construction. This includes knowledge of the inclusions within the earth used for construction and the variations likely across the different earthen construction techniques, as well as associated component building materials (timber, local biomaterials, stone, etc.).

Maintenance normally involves the repair of eroded surfaces (through replastering, surface recompaction, etc.), the filling of missing mortars and the renewal of roofs, wall footings and openings (windows and doors). Particular attention should be paid to wall bases/footings, and wall tops/roofs, as these are areas vulnerable to water penetration (rainwater goods). Depending on the orientation and local climate, surfaces may also be vulnerable to accelerated erosion and abrasion as a result of windblown sand or rain. A glossary of deterioration can be useful for agreeing on approaches to documenting current conditions as a means to establish short, medium and long-term maintenance needs. Local climatic changes as a result of the climate crisis also need to be observed, and maintenance schedules and approaches adjusted as needed.

New materials required for maintenance work include earth, timber, local biomaterials and stone. These should be sourced locally, making use of local knowledge of material sources (e.g. agricultural land or upcast from irrigation channels). The best materials for maintenance work are also likely to be those salvaged from other buildings/structures that are no longer in use and for which there is no conservation need.

New materials required for maintenance work should also make use of any surviving local building knowledge to ensure that they match the appearance and characteristics of the original construction. If local craft knowledge is not available, then regional craft knowledge should be referred to. It is important to maintain and repair like-for-like, avoiding, for example, the replacement of placed earth (cob) with mudbrick (adobe), or the replacement of earth mortars with lime mortars, and vice versa. It is also important to ensure that original detailing associated with traditional earthen buildings is included in rebuilt and repaired walls. These details reflect local building knowledge and often provide weathering protection for earthen structures.

4.3. Conservation

When earthen structures do fall out of use, they can be particularly vulnerable to accelerated erosion and loss as traditional maintenance and repair patterns are disrupted. Should a decision be made at a later date to undertake a conservation scheme (whether to retain a structure for its original use or through adaptation and reuse), the scheme should be based on an understanding of the materials and construction techniques employed in the original construction. As with maintenance approaches, this includes an understanding of the inclusions within the earth used for construction and the variations likely across the different earthen construction techniques, as well as associated component building materials (timber, local biomaterials, stone, etc.).

Conservation normally involves extensive repair of eroded surfaces (through replastering, surface recompaction, etc.), the infill of missing parts (such as the repair to wall bases, the infill of voids, etc.) and the renewal of roofs, wall footings, projecting horizontal stone bands and openings (windows/doors). Particular attention should be paid to the design, materials and detailing of wall bases/footings and wall tops/roofs, as these are areas vulnerable to water penetration.

New materials required for conservation work should be sourced locally, making use of local knowledge of material sources (e.g. agricultural land, upcast from irrigation channels, etc.). The best materials for conservation work are also likely to be those salvaged from other buildings/structures that are no longer in use and for which there is no maintenance need.

Depending on the local conditions and type of repair, it is important to consider the junctions and joints between old and new work, as well as issues such as the moisture content of new and old materials, to avoid differential drying and prevent unintended consequences where new materials may perform differently than older earthen building fabric. It is important to remember that older earthen building fabric and materials have eroded and may still be eroding; consequently, they are more friable, with an eroded surface and potentially with a reduced wall thickness.

As with maintenance, new materials required for conservation work should also make use of any surviving local building knowledge to ensure that they match the appearance and characteristics of the original construction. If local craft knowledge is not available, then regional craft knowledge should be referred to. It is important to maintain and repair like-for-like, avoiding, for example, the replacement of placed earth (cob) with mudbrick (adobe), or the replacement of earth mortars with lime mortars, and vice versa. It is also important to ensure that original detailing associated with traditional earthen buildings is included in rebuilt and repaired walls. These details reflect local building knowledge and often provide weathering protection for the earthen structures.

4.4. Analysis

There are numerous approaches that can be used for the analysis of earthen building materials. These are often used to understand their current condition and potential repair materials, as well as to identify potential sources of materials for new construction. Simplified field tests are often the most useful; this includes (but is not limited to): observation (general characteristics and qualities of the clay including colour, consistency, texture, presence of aggregates and their size and type, etc.), shrinkage (e.g. to understand how clays swell and contract on wetting and drying) and settlement/sedimentation tests (quantities of sand, silt and clay in an earthen mix).

A range of characterisation approaches can also be used; for example, thin-section analysis and X-ray diffraction (XRD) to identify and quantify the crystalline phases present in these materials. This aids in understanding mechanical properties, durability and susceptibility to decay. Any testing is limited by

access to samples (for historic materials) and replication (of laboratory-prepared sample materials for scaled-up use for maintenance and repair).

No matter what approach is taken, it is important to understand the inherent variability and lack of overall consistency of earth as a building material—where, for example, an earthen building mix for adobe/mudbrick will never be homogeneous and will vary from brick to brick and within each brick. This inherent variability underlines the importance of documenting and understanding local knowledge systems relating to earth and other traditional building materials.

4.5. Training

It is important to consider reinstating traditional maintenance and repair patterns, but where knowledge has been lost, it is possible to provide training in materials, repair and use. National and international standards have already been developed for earthen buildings; for example, the ECVET (European Credit system for Vocational Education and Training) includes standards for all stages of earthen construction and repair, including materials and construction approaches, as well as maintenance, repair and conservation. Regional and national earthen building networks and groups can also be critical in establishing baseline data on traditional building practices and in supporting training, workshops and awareness raising. These should include all stages of earthen construction and repair, including materials and construction approaches, as well as maintenance, repair and conservation.

5. Conclusion

I have argued elsewhere (Cooke 2015) that earthen buildings contrast with the notion of a ‘fixed’ point-in-time at which heritage structures are observed and conserved to maintain a ‘current’ condition. In most cases, the reaction of water with clay particles or the abrasion of surfaces by wind contributes to the reworking of surfaces. As such, an earthen building is never ‘stable’ but is in a constant state of change. Essentially, earthen building cultures provide a key example of the interplay between tangible and intangible heritage; their longevity is reliant on human interaction as a cultural heritage process, rather than a singular conservation product.

Since the early 2000s, earthen buildings have shifted from a low status within the hierarchy of building materials and heritage sites to a much higher one—both as a record of the past and as a resilient material central to an emerging low-carbon, regenerative building and architectural practice. The value of studying, collaborating and co-producing with earthen building cultures lies in understanding the role of the human touch in daily and annual maintenance, repair, rebuilding and conservation.

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An ethnoarchaeological approach is essential for studying the construction processes of past societies. However, this line of research has been relatively underexplored to date. This book brings together a diverse collection of case studies in the ethnoarchaeology of buildings from a wide variety of geographical contexts, from North (Morocco, Egypt) and East Africa (Ethiopia) to Central America (Mexico), Amazonia (Ecuador, French Guiana), the Andes (Argentina) and territories across Europe (Germany, Spain) and Asia (Turkey, Turkmenistan). Together they offer valuable insights and implications for archaeological research into domestic, traditional and vernacular architecture, associated social practices, their history, and the conservation of this scientific and cultural heritage.

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