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Archaeology and mud wall decay in the Bobirwa area: an ethnoarchaeological study

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Most ancient farmers in southern Africa built with mud walls. Attacked by the elements, mud walls melt and in due time revert to soil. Ancient farmers' buildings vanish without a trace. Or do they? Archaeological studies by McIntosh in West Africa indicated that careful analysis of soil particle sizes could reveal where mud walls once stood. This paper shows that the same method works in Botswana too, so former mud walls can perhaps be detected with careful excavation and analyses.

This paper presents the results of an archaeological study of mud wall decay at Mathathane village in the Bobirwa area, Central District. The study was an attempt to examine architectural techniques for building traditional Tswana houses and their process of deterioration. The study intended to find out what happens to mud wall after its collapse and how these former walls can be identified in archaeological context. The paper also presents an experimental excavation carried out during June and August 1995. The main objectives of the study were to document all contemporary architectural techniques of Babirwa people of Mathathane; to document the deterioration process of traditional Tswana houses; to find out means of identifying former mud wall structures non-visually in an archaeological context; and to test an excavation method which was used by McIntosh (1977) in West Africa, to see if it can be applied in Botswana, southern Africa.

Archaeologists are faced with problems of identifying former mud wall structures which are now buried under the soil. These problems are increased by the fact that sometimes archaeologists do not know what type of structures they are dealing with because there are no ethnographic records to refer to. Therefore there is great need for recording all contemporary architecture, and the processes of mud wall deterioration for future record.

The present architectural techniques for building houses are very fragile. Mud wall houses built using these techniques are short lived, especially when exposed to harsh climatic conditions. So under such conditions it becomes difficult to identify former mud walls when they are buried under the soil. If former mud walls are visually not identifiable, then it is the task of archaeologists to find other ways of identifying them non-visually. In the past many structural remains have been left unidentified due to lack of appropriate excavation methods as observed by McIntosh (1977: 185):

Due to a current methodological impasse, borne of our exclusive reliance upon *visual* identification, vast numbers of humbler dwellings in less co-operative climes are simply lost to the archaeologist.

Ethnoarchaeology developed as a tool to curb the problem of lack of proper ethnographic records. It was meant to study aspects of contemporary behaviour from an archaeological perspective. Observation of contemporary societies can facilitate our understanding of archaeological material. If there are enough ethnographic sources to infer meanings from, archaeologists can be in a better position to investigate structural remains knowing exactly what type of building technology they are tracing:

it is desirable to find ethnographic analogies to throw light upon process of decay and the subsequent deployment of altered material during all phases of deterioration, and to provide any indirect clues to the recognition of former walls. (McIntosh, 1974:154)

We need to search for better excavation methods which could help in providing us with non-visual ways of identifying former mud walls. We need to know and understand all processes that take place from the construction of mud walls until their burial in archaeological context. Traditional societies are fast disappearing due to the onslaught of industrialization and westernization. The young generations are now opting for modern building technologies and materials which they say are long lasting and comfortable. So it is very important to record all cultural practices of the existing societies for future reference. Old or traditional technologies are fragile and not long lasting. They are easily affected by water, and termites' actions which are a 'pain' to the young generation. That is why they prefer modern materials and technologies which resist the above problems.

Former settlements are very informative to archaeologists and that is why they go through all this painstaking work of trying to find ways of recovering these structures. Former mud wall structures can tell a lot about settlement organization of the past people. Despite the importance of these structures very few studies, compared to other areas of study, have tried to address the problem of recognizing former mud walls in archaeological context. If we can reconstruct past settlement organization we can go on to investigate other aspect of past people's life such as their activity areas.

In carrying out this study it was hoped that it would bring to surface some issues which in future might help archaeologists in dealing with mud wall structures. There are several methods which were employed in collecting data. Oral interviews were conducted to obtain background information about the village and people of Mathathane and their architectural techniques. An excavation was also carried out to test the method used by McIntosh (1977). Visual observation of day to day activities helped me a lot in understanding some of the issues which were not raised during interviews.

Literature review

There are several written sources about Bobirwa area and Babirwa people. Most (if not all) of them have concentrated on the history of Babirwa and their socio-political relationship with other Tswana tribes of Botswana. Historical sources such as those written by Westphal (1975), Bobeng (1976), Tlou & Campbell (1984), Molelu (1985), Sekgwama (1987) and Morton & Ramsay (1990) account for the history of Babirwa and their socio-political relationship with other tribes, especially Bangwato of Khama III.

Other literature about Bobirwa discusses locations of archaeological sites discovered in the area. Fletemeyer (1976) and van Waarden (1980) are some writers who have written on the archaeology of Bobirwa. Fletemeyer did a survey around Bobonong where some Iron Age sites were discovered while van Waarden carried out an excavation near the confluence of the Motloutse and Limpopo at a place called Leeukop. What she did was give a brief description of the location of other sites in the vicinity of Leeukop. There is also a description and short report on some excavations carried out in the area. There is no mention of any attempt to identify former mud wall structures except where they were visible in archaeological context.

All of the above-mentioned sources dwell much on the history of Bobirwa. Though there are mentions of archaeological excavations that were carried out in the area, none of them address the problem of identifying former mud walls. There are very few written sources which mention something about traditional Tswana houses. Lepekoane (1994) gives

information about architecture of Bakgalagadi people. She examines material and technology for building and processes of deterioration. Larsson & Larsson (1984) document traditional housing as it existed at the time of the study. Larsson (1990) examines the transition from traditional to modern housing in Botswana.

These sources provide the bases for discussion on the architectural technologies of societies in Botswana but they fail to proceed to discuss the problem of recognizing these structures in an archaeological setting. Due to a shortage of sources on the subject of mud wall decay and their identification, more information is obtained from other sources which deal with works on mud wall houses conducted outside the country. Studies of decay processes of building materials (McIntosh, 1974, 1977) shed light on some of the non-cultural processes affecting cultural materials and formation of the archaeological record. These studies provide the basic framework of my study. In his paper McIntosh (1974) wanted to find visual ways of identifying former mud wall structures, and in another paper (1977) he is concerned about non-visual ways of identifying these former structures.

David's (1971) ethnographic study among the Fulani people in Cameroon looks at the archaeological problem of interpreting domestic structures. Kramer (1979) and Hodder (1982) provide a theoretical framework on ethnoarchaeological enquiry. Their works outline the process of ethnoarchaeological study and the need for ethnoarchaeological information. McLeod (1992) gives the environmental change at Bobonong, Bobirwa, in eastern Botswana. His information can be important when we look at the environmental factors affecting the preservation of mud walls in archaeological context. Agorsah (1985) also gives a comparative study on the issue of mud walls and archaeology.

All the above information from works done outside the country provide vital information to this study. They are relevant to my study because bits and pieces of information obtained from them, when combined, make a whole body of information which guided me on how to deal with different aspects of traditional Tswana houses. They helped me to be on the lookout for certain characteristics which have been observed in other countries.

History of Babirwa

This section attempts to discuss the history of Babirwa people and their migrations. Babirwa people have moved from place to place before they finally settled in their present settlements permanently. It is hoped that this section might shed light on why Babirwa people have different types of building technologies. The Babirwa people might have adopted or copied some building technologies during their encounter with different people of different cultures.

The region called Bobirwa is the area which lies between the Shashe River, Tuli Block and a North-South line approximately 28° 15' E (Sekgwama, 1987). The area encompasses the villages of Bobonong, Gobajango, Lentswe-le-Moriti, Mathathane, Molalatau, Mothabaneng, Semolale and Tsetsebjwe. The area of focus is Mathathane village, located 60km east of Bobonong and about 30km south-west of the Motloutswa-Limpopo confluence (Fig. 1).

Most historical sources discuss the history of Babirwa from the period of the Mambo empire of Zimbabwe. Babirwa originated in Nareng which lies in the south of Bolobedi in Letswalo country around Phalaborwa (Molelu, 1985). Babirwa people present at Nareng date back to between 1510 and 1599 (Westphal, 1975). Babirwa moved from Nareng under their chief, Tshukudu, to the Blauwberg area in the former Transvaal. It was while they were at Blauwberg that they started breaking up around the 1820s (Westphal, 1975).

The group that left Blauwberg headed for Zimbabwe under the leadership of Dauyatswala and his brother Makhure. This group was not welcomed in Mambo's country.

The two brothers decided to leave the place to seek refuge somewhere else. At the last moment Makhure refused to go with Dauyatswala. Dauyatswala together with his followers moved back to the Transvaal. Makhure was given a piece of land in Zimbabwe to live with his followers. They lived for a while before they were attacked by the Ndebele of Mzilikazi, who was running away from Shaka's rule, in 1837 (Westphal, 1975). They fled to the present day Botswana led by Sekoba, one of Makhure's sons. Sekoba was accompanied by his brothers Makala, Mbalane and Bolamba who in most traditions is mentioned alongside Sekoba as the leader of the group (Bobeng, 1976; Molelu, 1985; Sekgwama, 1987).

Among the group were also Sekoba's uncles, Serumola, Legong, Mphago and Maunatlala. It is not clear from the sources whether these men were full brothers or half brothers of Makhure. This group broke up with Sekoba and his followers, settling at Lephokwe while the Bolamba's group settled in the present Tuli Block (Bobeng, 1976; Sekgwama, 1987).

Some sources claim that Sekoba's group settled first at Gubadwe Hill near Gobajango and that is where Babirwa began spreading over the area which is today called Bobirwa, including the Tuli Block. Babirwa did not live under the authority of Sekoba for long. They broke from Sekoba and lived in scattered, isolated settlements. Only those who were loyal to Sekoba remained with him. Sekoba's group went to settle at Majweng Hills. Bolamba and his followers settled at Zembefonyi near the present day Lentswe-le-Moriti. Maunatlala settled his people in Lepokole Hills in the northern part of Bobonong. Serumola moved his people and settled at Lephale Hills in the Tuli Block and Makala settled East of Mapungubwe. The people of Kgwatalala and Mbalane settled on the hill called Lekhubu-la-Mbalane in the vicinity of the present day Semolale.

In their settlements Babirwa were continually attacked by the Ndebele forces raiding and looting their cattle. In the 1860s Sekgoma sent his newly formed age-regiment of Mafolosa and Matshosa to Bobirwa. These age-regiments were to group Babirwa in one place. Because of the attacks and resentment of Sekgoma's rule, Babirwa migrated to the Transvaal and joined other Babirwa people there. They stayed in the Transvaal until 1894 when they were attacked by the Boers, whereupon Babirwa returned to their settlements in Botswana. Sekoba's group, who were by then led by his son Madikwe, settled at Majweng Hills in the north-eastern part of the present day Bobonong.

In the 1890's Malema became the leader of the people of Bolamba who settled in the region now called the Tuli Block in Zembefonyi, next to him was Mmadima at Pitseng, near Ghadi Pan, and within the same region Serumola and his followers settled at Lephale Hill. The people of Serumola must have been the ones from whom Mathathane people descend. According to oral information Mathathane village was established in the 1930s under the leadership of Serumola (M. Mangogola, personal communication). At the moment they are still ruled by Serumola's grandson, Richard Serumola.

Prior to their occupation of Mathathane, Mathathane people were among the Malema people who were forced to leave the Tuli Block by Khama III in 1920. In 1906 Khama III had sent his son-in-law Modisaotsile Mokomane as a chief representative to group Babirwa people and place them in one village. Modisaotsile established the present Bobonong in 1909 and was joined by other small groups which were loyal to Khama III (Bobeng, 1976; Sekgwama, 1987).

In 1919 Khama sent Modisaotsile to go and remove Malema's people from the Tuli Block to pave a way for the British South African Company's white settlers who were to settle in the Tuli Block (Tlou & Campbell, 1984; Morton & Ramsey, 1990). Khama had

ceded the area of Tuli Block in 1895 to the British government who had passed it to the BSA Company.

Malema refused to leave the place, and as a result Modisaotsile used force. His regiments burnt the fields of Malema's people. Malema fled with his people to Transvaal and returned later. Upon their return Malema settled at Molalatau and Serumola settled with his followers at Lephale Hills for a while and then moved to Mathathane. This is the village of focus in this paper.

Methodology

A considerable amount of data was collected using different research methods. First, documentary analysis was carried out to obtain information about the history of the village and the people of Mathathane and their architectural techniques. Very few sources mention materials used and techniques for building traditional Tswana houses. Larsson & Larsson (1984) and Lepekoane (1994) provided information on the traditional housing techniques and materials in Botswana. Among information obtained from work done outside Botswana, McIntosh (1974, 1977) and other sources gave guidelines for field work and comparative information for analysis.

Oral interviews were conducted on traditions and history of the people of Mathathane. These interviews were aimed at providing information on the stages undergone by a traditional house from the construction of the house up to its collapse, and the materials and technologies of building a traditional house. The target group was men who knew how to build a traditional Tswana house and all women who knew how to build houses. Emphasis was placed on women because they are responsible for building mud walls and for the general maintenance of the house. Questions were also directed towards obtaining information on the problems of mud walls and how people overcome these problems. I had the opportunity to observe some houses in the process of construction. This helped me to understand in great detail some issues about mud wall house construction such as materials used and the way these materials are arranged or mixed during the process of house construction.

An excavation was carried out on a contemporary house which had collapsed. This house was abandoned in 1979 (S. Machete, personal communication). The excavation was carried out to test McIntosh's (1977) method of excavation that he used in West Africa. It was done to see if the method could be used in Mathathane, Botswana, southern Africa.

Oral interviews were carried out at Molepolole during December 1995 to do a comparative study on the building techniques. Questions asked were mainly concerned with building materials and types of houses that people build in Molepolole. The purpose of these interviews was also to see who was responsible for which part of the house during construction, and how these houses deteriorate. The interviews were also done to find out what remains after the total collapse of mud wall houses. The main objective of interviews at Molepolole was to find out if there are similarities in the building techniques and materials with those found at Mathathane. This was done to see if Botswana generally build houses in similar ways. This would help to judge whether the method of excavation being tested could apply countrywide.

Architecture in Mathathane and Molepolole

There are three types of architecture or building techniques in Mathathane. These are wattle and daub technique, puddled mud block (wet brick), and mud brick (dry). Wattle and daub is a technique in which structures are of sticks and twigs woven under and over upright poles and then covered with mud. The technique is often utilized by the Pedi people of

northern Transvaal. The technique is cheap and easy but is labour intensive. It is cheap because all the materials needed are found from natural resources. It is labour intensive because it needs a lot of poles, sticks and twigs which have to be cut from the bush and carried to the village. It also needs a lot of cow dung and clay to cover the poles inside and outside the wall frame of poles.

Women are responsible for collecting and mining soil and cow dung to cover the poles. Men are responsible for cutting and collecting poles, twigs and sticks and for making the framework. They are also responsible for making the roof structure which women would thatch. The technique is being abandoned because of a shortage of trees to provide poles and also because of the changes taking place in terms of building technology. It is still utilized by only a few people who are said to have come recently from South Africa.

Dry mud bricks is a technique in which houses are built from mud bricks. The bricks are traditionally made by women from wet soil, but today men also make mud bricks. The soil is not mixed with cow dung. These bricks are left to dry before they can be used. Women make walls by making layers of bricks which are joined together by mortar made of a mixture of soil and cow dung. Men are responsible for collecting poles to make roofing. This type of building is an improvement on the indigenous method of building by puddle mud blocks. Compared to other techniques it is often used at present.

Puddled mud block includes making puddled blocks and making a wall with them while they are still wet. The blocks are sometimes referred to as wet bricks. The blocks are made from a mixture of soil and cow dung. The wet blocks are put on top of each other in a few layers and then left to dry. The raising of the wall continues after the previous layer has dried up. The technique is the oldest among the three. Houses built using this technique are said to be strong and long lasting because of the addition of cow dung to the blocks. Like the wattle and daub technique, it is also a tedious one because of time spent and the amount of cow dung that is needed to make the whole wall. It takes a long time to complete a single house because one has to wait while a few layers dry up. The technique is also being abandoned in favour of mud bricks.

In all these techniques plastering is made of a mixture of soil and cow dung. Cow dung is added to the soil to strengthen it so that it resists water. Maintenance of the house is done regularly to prolong the life span of the house. After heavy rains women re-plaster their house walls and new grass is added to the roof when the old ones become worn out. There are generally two types of thatching. Tswana thatching involves the use of grasses which are easily found. The technique is simple but the result is not long lasting. The Boer thatching is strong and long lasting. The technique is practiced mostly by skilled men. It involves the use of stronger grasses. It is a newly adopted technique.

The life span of the traditional Tswana house according to Larsson & Larsson (1984) is 20 years on average, but 50 years is not an impossibility. The oldest house observed at Mathathane is 46. According to oral information a house can stay for more than 70 years if it is properly maintained.

The Bakwena people of Molepolole utilize two techniques: the puddled mud block and mud bricks. Only few people still use puddle mud blocks. It was mainly used while people were still at Ntsweng. Mud brick is used often. Women are responsible for making mud walls and plastering them. Men are responsible for making roofing frameworks. Thatching is done by both men and women.

A complete family used to have at least four houses. *Ntiwana* (small house) for fire, the main house for parents, children's house and *sesoa*. The ordering of houses was uniform in the whole community with men (fathers) facing the kraal. Like in Mathathane, puddled mud block technique involves making walls with wet bricks. In the case of Molepolole,

before they begin erecting the wall they place stones in a circle. These stones become the base of the house. The idea behind the use of stones is that they make the house strong and resistant to rain water. These stones are covered with mud and prepared neatly such that the puddled mud blocks will be able to stand on them.

The blocks are made from a mixture of cow dung and soil. Cow dung is used to give the blocks strength and resistance to rain. A few blocks are put on top of each other and left to dry. The process of building continues as described in the case of Mathathane. And similarly, the technique is now being abandoned in favour of the mud bricks which are now being used almost by 99% of the community. Reasons given for the abandonment of the technique (like those given at Mathathane) is that the technique needs a lot of cow dung. It takes a very long time to complete one house because you have to wait for the different layers to dry up.

Bakwena people of Molepolole, just like Babirwa people of Mathathane, make dry mud bricks in the same way. They do not add cow dung to the mixture which is to be used in forming these bricks. Many bricks can be made in a single day. The making of bricks can be carried out every day until the required number is obtained. These bricks are then left to dry. When bricks are dry they are made into a wall. First a small trench of about 10 cm to 15 cm is dug in which the first layer, which forms the base, is placed. Layers of bricks are put one on top of the other and joined by mortar made of a mixture of soil and cow dung.

Men are responsible for collecting roofing materials while women make and plaster walls. In Molepolole when it comes to Tswana thatching, both men and women are involved nowadays. In the past Tswana thatching used to be purely women's responsibility. The other type of thatching, Boer thatching, is purely men's responsibility and usually for the few skilled men in the village.

Deterioration process

The materials and technologies used for building traditional Tswana houses are mostly fragile and could not last for a very long period. They are affected by several factors. Erosion by rainfall is important. Wood (organic matter) decays in the structures. Usually materials used for roofing will decay. This will mean that the wall becomes exposed to rainwater which causes erosion and cracking in the wall. Termites also affect the wall because they eat the cow dung in the plaster making it loose. Hence it separates from bricks and falls down. During the rainy season certain amounts of wall particles are eroded away from the wall as a result of water splashing against the wall. A certain amount of particles (coarse ones) build up around the base of the wall. Small finer particles can be washed away by rainwater or can be swept away as a result of daily cleaning of the compound. The continuous splashing of rainwater against the wall causes undercutting in the wall. Eventually, as a result of the effect of water, the wall begins to crack. Usually cracks are first observed at corners (in a rectangular house) and at places where the roof poles meet the wall. At the same time as the walls get cracked the roofing materials also start to deteriorate.

As the roof decomposes the rate of particles washing from the wall and cracking also increases. At first these problems are mitigated by regular re-plastering of the wall and re-thatching of the roof. The wall can be re-plastered for a certain period of time after which the original plaster, because of insects, separates itself from the bricks. When the house has reached this stage, it is abandoned or given a secondary use such as a fire house. At this stage it is no longer given the required maintenance. The house will start decaying at a faster pace. The wood materials usually used for roofing will decay until the roof collapses. This then exposes the wall to rain water and the sun which causes further erosion and

cracking. The wall will fall bit by bit until there is nothing left standing. After some time only a mound of soil will be recognizable. Stages of house deterioration can thus be summarized as follows:

- a) The abandonment of the house.
- b) The decay of roofing material.
- c) Cracking and erosion of the wall.
- d) Roof structure collapses.
- e) The wall starts to collapse.
- f) Total collapse of the wall.
- g) Mound of soil marks where house used to be.

Experimental excavation

An experimental excavation was carried out at Mathathane to test McIntosh's (1977) method of identifying former mud wall structures non-visually. McIntosh has done studies of mud walls in Hani village in West Africa trying to find out a way of solving the problem of identifying former structures in archaeological context. In McIntosh's excavation method (McIntosh, 1977) some simple tests were applied to show that soil constituents differ significantly in each wall feature. Three tests were employed during the excavation.

The first test, gross fraction analysis, requires the use of a scale with large pans, a sieve of 5 mm aperture and several headpans. Various gross fractions of the soil removed from each excavation context are sieved and weighed. The material caught by the sieve is collected separately from the loam soil that passes through the sieve. The weight of all fractions is totaled and the percentage of the total calculated. The resulting figures are then contrasted with all other excavation contexts.

The loam soil is the subject of the second test: standard granular analysis. The test requires the use of a scale to the nearest gram and a graduated sieve set. A sample of 1.5 kg loam soil was taken from each excavation context. The sample has to be sun dried in a spot sheltered from the wind. This material is then shaken and sieved using different sieve sizes and then weighed to the nearest gram in the laboratory. The percentage of total sample weight is then contrasted with counterparts from other excavation contexts.

The third test is measuring the dimensions of potsherds incorporated in the wall materials. The sherds are measured across the longest dimension and then across the dimension perpendicular to that. Then the arithmetic mean is calculated. For simplicity the average deviation of potsherds can also be calculated. The third test was carried out because of the assumption that sherds incorporated in mud walls will be smaller than those found in the surrounding soil (McIntosh, 1977).

In his results McIntosh found that ironstone was heavily represented in the rapid collapse. The standard granular analysis showed that the wall stumps comprised of coarser clay fractions. He also found out that it was easy to distinguish the natural ground from other constituents of the wall. McIntosh's results, if put in graphical form, will produce distinctive patterns which can show that constituents differ significantly in each feature. His results proved that the method works. My excavation method is as described above. The only difference is that there was no pottery found in my study hence no pottery calculation and measurement of potsherd dimensions.

Due to the time factor and labour constraints it was difficult for me to set up another excavation outside the house to achieve a controlled experimental situation. In order to obtain this kind of situation, layer 5 (natural soil) was used as the control. It would have been a good thing to have a control situation outside the house, but as mentioned above I was unable to do so.

A collapsed house measuring 3.7 m was located at Mathathane and excavated (Fig. 2). Not the whole house was excavated. Prior to excavation a preliminary test trench 0.5 m wide was dug. The purpose of this trench was to provide a preview of soil profiles and thus make the layer by layer excavation in the main trench easier. A trench adjacent to the 0.5 m test trench was prepared. It measured 1 m by 5 m. This trench provided the materials for soil analysis. Excavation was carried out systematically with one layer excavated at a time (Fig. 3). The materials excavated were subjected to two tests. Firstly they were subjected to the gross fraction analysis. This test requires the use of a scale precise to the nearest gram, pans and sieves of 5 mm size. The excavated material was sieved and weighed. Materials caught in the sieve were collected separately from the loam soil which passed through the sieve. After all materials from each context were weighed, the resulting figures were compared (Fig. 4 and appendix).

The loam soil that passed through the sieve was subjected to the second test, standard granular analysis. The test requires the use of a scale and a graduated sieve set. The graduations used in this study were 2 mm, 0.85 mm, 0.71 mm, 0.25 mm, 0.125 mm, 0.075 mm and <0.075 mm. A soil sample of 1.25 kg was collected from each context and brought to the University of Botswana, Gaborone, for further analysis. These samples were dried in a place where they were protected against wind. The samples were sieved by the use of a shaking machine which was fitted with the graduated sieve set. Materials passing through and being caught by the different sieves were then weighed and their percentages calculated. The resulting percentages from each category were then compared (Fig. 5 and appendix).

Results

The gross fraction analysis percentages of material caught by the sieve varies greatly in some categories. This is due to the different particle sizes. The results show that materials from the interior collapse are coarser than other materials. This is shown by their high percentage of 36% of materials caught by the sieve. The grass layer has got the second highest number of materials caught in the sieve. This is because it is a layer of organic materials. Some have decomposed while some have not hence larger size of particles. The floor and foundation layers have equal amounts of materials caught in the sieve. Both layers have been subjected to human selection so that might be an explanation for their uniformity.

Results from the second test as shown in Figure 5 produced patterns of variations in particle sizes in all contexts. This variation in particle sizes might be due to the effect of human action on the former layers. The upper four layers were all introduced by action of human beings while the bottom layer which has got a peculiar pattern is natural. That is why the natural layer differs from others because it has not been disturbed, its particles are still *in situ*.

When compared to McIntosh's results it is clear that in both excavations, results from different contexts are distinct from each other. This is explained by the fact that in his excavation, McIntosh found that rapid collapse was heavily comprised of coarser materials. The standard granular analysis also shows that wall stumps were heavily comprised of coarser clay fractions. This is the same as the results from this study: it shows that materials from collapsed walls are coarser than other materials as shown by the high percentage of 36% of material caught by the sieve (Fig. 4). The standard granular analysis in this study has shown that the natural layer has a different pattern from other contexts, as also shown by McIntosh's results (McIntosh, 1977).

The results of this excavation show that different layers have their own particular soil signature which can be seen from archaeological excavations. The collapsed materials are coarser because finer particles have been washed away by water while the wall was still standing or after its collapse. Since a particular soil signature can be seen from different layers, mud walls can be recognized non-visually using the above method. The results from this study show that if proper excavation methods and soil tests can be employed, archaeologists in future might be able to recognize or identify former mud wall structures in archaeological context. The results also have made me believe that McIntosh's excavation method in West Africa can be applied in Botswana, given the same building techniques and materials as found in his study. There is clear indication that former mud walls, when excavated and properly analyzed, will always produce a different pattern from natural soil.

Summary and conclusions

This paper presented the different architectural techniques for building and materials used in traditional Tswana houses in Bobirwa. The different stages through which a mud wall house goes from the beginning of construction until its total collapse have been presented. The paper also discussed the application of a new excavation method which can help in identifying buried former mud wall structures.

It is shown both in literature and oral information that with good maintenance, traditional Tswana houses can last up to 50 years or more. Batswana rely on the use of cow dung to strengthen the mud that they use for building to make it water resistant so that it lasts longer. Despite the fact that in places where there are termites, cow dung is often attacked by these insects, Batswana continue to regard cow dung as an important component of their building materials. The study proved that mud walls can be identified non-visually by studying the particular soil signatures in different layers, especially when there are signs of human disturbance.

Oral information revealed that at Mathathane, people utilize three types of building: wattle and daub, puddled mud block and mud brick. While in Molepolole, Bakwena use mud bricks mainly, with few people still using puddled mud blocks. The method that the study sought to test was carried out in a house built of mud brick. So, since at Molepolole they utilize the same building technique, the same methods should also be applicable. It is hoped that the information obtained from this study has raised some questions which should provide a basis for more research on mud wall structures in Botswana. There are still more avenues to be exploited in the future to develop more comprehensive methods of identifying archaeological former mud wall structures. This study focused on one village. Similar studies could be carried out in other villages within the same district to check the method. Other studies could be carried out in other districts for comparison. And also the study could be extended to other house types such as wattle and daub and puddled mud block.

Finally an experiment can be carried out. One can build a mud house and then observe its stages of deterioration. This can give more appropriate information because one can regulate the variables of deterioration and the conditions of the house. The person doing the experiment can then record the extent to which fine materials are washed away and can measure exactly what remained because he/she will be having a record of materials used.

Appendix

Table 1. Gross fraction analysis.

| CONTEXT | Passed % | Caught % | TOTAL kg |
|--------------|----------|----------|----------|
| Collapse | 64 | 36 | 629.3 |
| Grass | 82 | 18 | 297 |
| Floor | 89 | 11 | 430.7 |
| Foundation | 89 | 11 | 473 |
| Natural soil | 76 | 24 | 294.9 |
| TOTAL kg | 1677.2 | 447.7 | 2124.9 |

Table 2. Standard granular analysis.

| LAYERS | 2 mm | 0.85mm | 0.71mm | 0.25mm | 0.125 | 0.075 | <.075 | TOTAL (g) |
|--------------|-------|--------|--------|--------|--------|-------|-------|-----------|
| Collapse | 3 | 11 | 4 | 34 | 24 | 13 | 11 | 1253.3 |
| Grass | 3 | 12 | 4 | 38 | 23 | 14 | 6 | 1253.5 |
| Floor | 4 | 16 | 4 | 36 | 25 | 10 | 5 | 1253.4 |
| Foundation | 3 | 13 | 3 | 38 | 35 | 5 | 3 | 1228 |
| Natural soil | 6 | 12 | 4 | 51 | 15 | 9 | 3 | 1251.2 |
| TOTAL (g) | 219.8 | 815.1 | 233.4 | 2485.5 | 1504.9 | 636.7 | 344 | 6239.4 |

Notes

Mr. Baloi is currently a school teacher in Tutume. His thesis was written in 1996 under the supervision of Karim Sadr. The original contains five photographs of mud walls in various stages of decay, which have been omitted here for space. All other illustrations have been included. The text was lightly edited for grammar.

Oral sources

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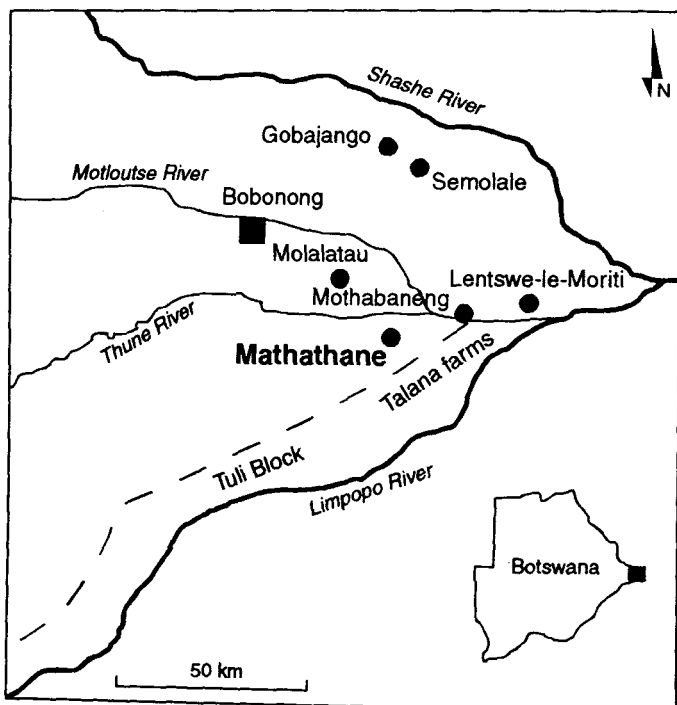


Fig. 1. The study area, Bobirwa.

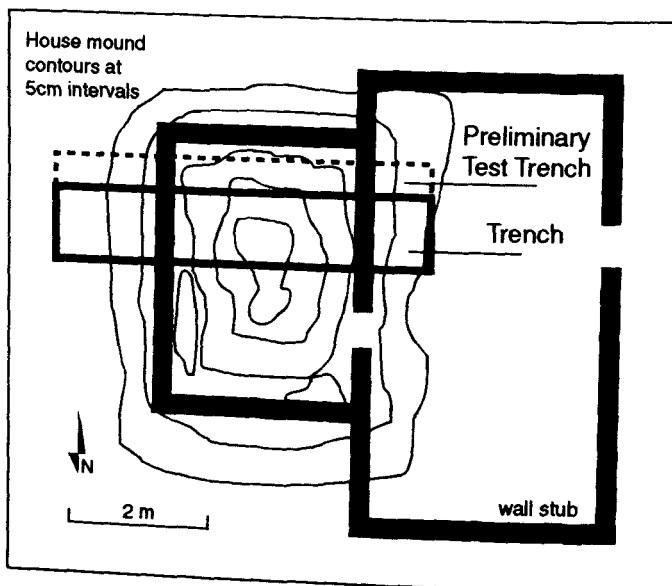


Fig. 2. The excavated house at Mathathane.

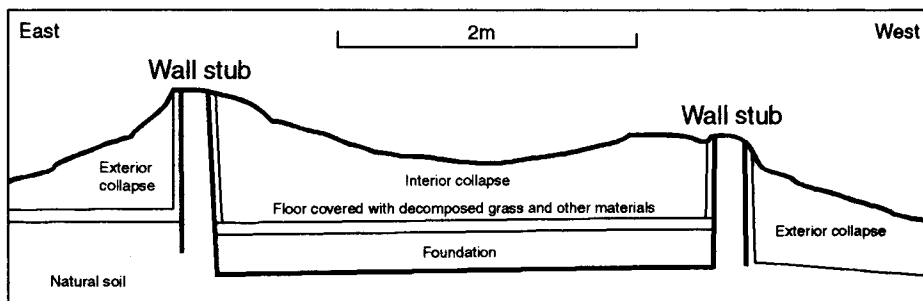


Fig. 3. The excavated trench in section.

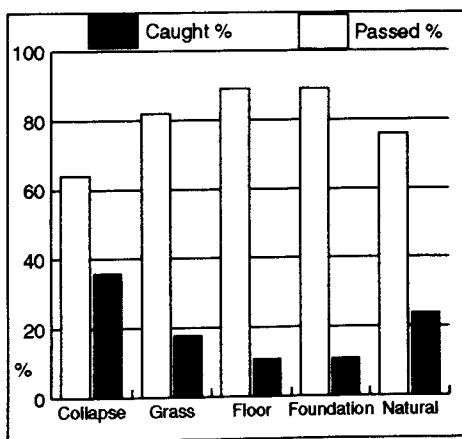


Fig. 4. The results of gross fraction analysis.

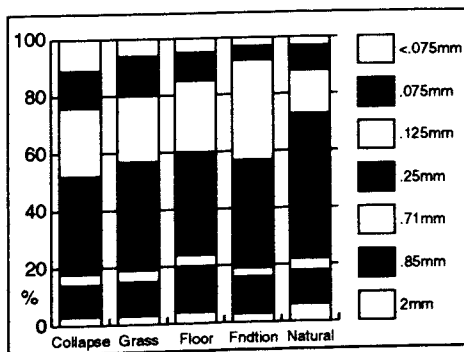


Fig. 5. The results of standard granular analysis.