Journal of

Experimental Pyrotechnologies

Number 1. 2008

editura universității din București®

Journal of

Experimental Pyrotechnologies

Aims

JEP is an interdisciplinary academic publication, intended to promote international collaboration among specialists working or studying pyrotechnologies and to spread information about pyrostudies.

Scope

JEP is an international publication focused on experimental archaeology but also covering subjects varying from technology to symbolism. Therefore the scope of the publication is to support any kind of experimental work and analysis in relationship with fire, and to present all kind of contributions on pyrotechnologies. All contributions will be peer-reviewed.

JEP is edited by the National University of Arts, Bucharest (CNCSIS grant 945)

Layout: Cornelia Catuna; Cover layout: Horia Lazureanu

© *editura universității din București*®
Şos. Panduri, 90–92, Bucureşti – 050663; Telefon/Fax: 410.23.84
E-mail: editura_unibuc@yahoo.com
Internet: www.editura.unibuc.ro

Publisher: Editura Universitatii din Bucuresti, Sos Panduri 90-92, Bucuresti – 050663, Tel/Fax: 00421/410.23.84, e-mail: editura_unibuc@yahoo.com. www.editura.unibuc.ro

ISSN: 1844-2013

CONTENTS

Preliminary Reports

Preliminary Reports [CNCSIS research grant 945]

News

Book review

LOOKING FOR A METHODOLOGY BURNING WATTLE AND DAUB HOUSING STRUCTURES*

A Preliminary Report on an Archaeological Experiment

Fabio CAVULLI, Laboratory of Prehistory "B. Bagolini", University of Trento
Fabio.cavulli@lett.unitn.it
Dragos GHEORGHIU, Department of Research, National University of Arts, Bucharest,
gheorghiu_dragos@yahoo.com

Introduction

The work we are going to briefly illustrate here serves for the evaluation of hypotheses developed when interpreting prehistoric pyrotechnological stratigraphies.

The starting point is that any "*reconstruction is only as good as the excavated evidence upon which it is based*" (Shafer 1984: 48), because even the application of the basic principles of civil engineering can be misleading due to the fact that modern notions such as solidity, safety and durability have, within certain limits, changed in time and were probably not given the same consideration by prehistoric builders (see Rapoport 1969). Apart from stratigraphy, the few remaining methods for investigating structures are principally based on ethnoarchaeology and experimental archaeology. These are the only tools available to help reduce the gap between data and theory.

Experimental archaeology has an imitative nature (Asher 1961), applied to objects as well as behaviours, processes and systems, in order to test beliefs, hypotheses, methodological assumptions, techniques, theories and even studies of site formation and deterioration (Ingersoll *et al.,* 1977; Shaffer 1984: 59-60; Mathieu 2002).

But "*experimental archaeology also includes 'learning by doing'*" (Mathieu 2002: 60). Experimental archaeology doesn't simply answer a question; it produces an array of possibilities and answers. When reproducing an object, a structure or a situation through experimental archaeology, the solution used is not the only one available, but one of many possible explanations. Therefore the main aim of experimental archaeology is to inspire and sensitize the archaeologist (Gheorghiu 2005).

Our research attempts to bring some new answers to a question raised some three decades ago: are the fired horizons within ancient dwellings found in the Balkans and the North Pontic area the result of an *intentional* action? Looking at the stratigraphy of a tell in this geographic area, one can see numerous overlapped layers of combustion, as if every level of dwelling was wholly fired (in reality not all the houses of a tell were burned, except for the final layers of occupation of the Gumelnita Phase B, in the Lower Danube region, when this tradition vanished suddenly from a very large geographical area).

The fired dwellings and households were mentioned in several prehistoric traditions in the archaeological literature of the middle of the last century (see for instance for Cucuteni

* The contribution of the authors is equivalent.

shape of the structure and the location of the single elements, portraying features in detail and measurement (plans were drawn up by Parau and Cavulli – see below).

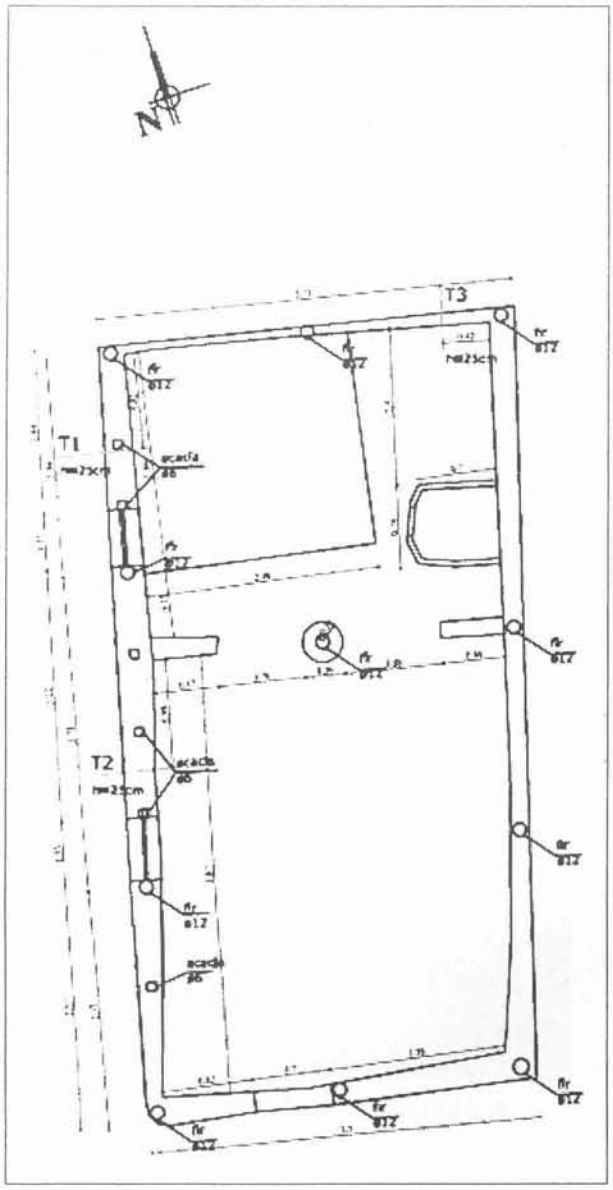

Fig. 1: Plan of the fired house (arch. Oana Parau and Dr. Fabio Cavulli). T= thermocouple.

The positioning of some objects inside the house was necessary in order to locate the whereabouts of these "finds" following the collapse of the structure. A sample of 41 "finds" was chosen, made up of pottery (5 whole vases and 6 large shards), pieces of flint (blades and flakes divided into three different groups), 1 large obsidian blade, figurines (17 intact and 8 fragments), grind-stones (1 whole and 4 fragments) and even organic material such as wheat and oat flour, animal fat, and an entire sheep.

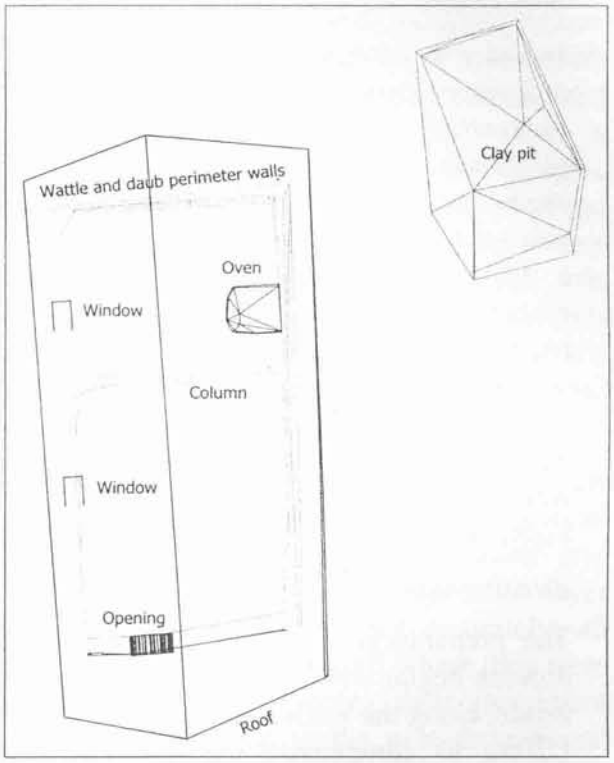

Fig. 2: 3D reconstruction.

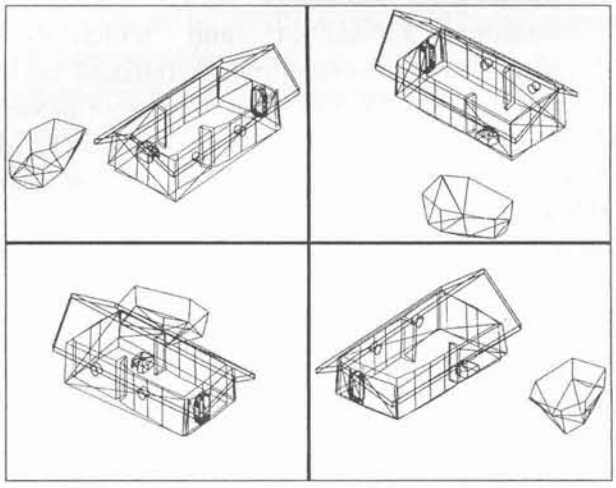

Fig. 3: 3D reconstruction.

All objects have been described in a simple table with the following fields: "ID", "Object Definition", "Material", "Length (cm)", "Width (cm)", "Thickness (cm)", "Weight (g)", "Colour", "Munsell Code", "Photo Number", "Floor", "Y", "X", "Z" (Cartesian coordinates). These objects were plotted by means of the Total Station.

tradition Petrescu-Dambovita and Florescu 1959), but it is only in the early 1990s that the phenomenon was perceived as having been intentional (see Tringham and Krstič 1990; Tringham 1992). The literature which followed (Stevanovič 1997; Chapman 1999; Stevanovič 2002) supported this assumption.

How the intentionality of this process could be demonstrated? In order to answer this models of destruction resulted from accidental fire as well as from intentional ones were compared with the results form archaeological excavation. Intentional burning was in the form of a controlled burning process and protection of the surrounding buildings.

Since ethnographical examples of intentional fired wattle and daub houses are missing in Europe, the only Medium Range Theory method available is experimental archaeology. The first experiment to build and fire a house dates back 1958 (Coles 1973: 55 ff.), and the rationale of this experiment was to demonstrate the analogies associated between the fired remains and the archaeological data.

The final aim of our work was to examine and clarify the processes of building, maintenance, abandonment, collapse, deterioration and deposition of building materials.

In order to achieve this, a single experiment was not enough, indeed various attempts and archaeological experiments were required. Arguably, we are now at the beginning of a process which aims to explain the way of life in prehistoric settlements; a way of life that includes the destruction of buildings (see Gheorghiu 2001).

Methodology: looking for a protocol for experimental archaeology

Questions

There are some fundamental questions which arise from the current excavations of prehistoric settlements, especially in the Lower Danube area: why not all houses show evidence of burning? How was it possible to control an accidental fire within a very compact built structure or high-density settlement area?

These questions cannot be solved only on theoretical grounds but instead require experimentation. Following experimentation, the evidence can then be later re-approached theoretically.

By experimentation we mean the firing of a replica of prehistoric wattle and daub buildings, using the plans of the excavations (see Todorova 1982; Comsa 1990). For this experiment we chose as a model a Chalcolithic wattle and dub house with a central pillar. This was constructed in the village of Vadastra, Olt County, southern Romania.

Building technique

(For the building technique see the paper by Gheorghiu, this volume)

Drawing and 'preparing' the house

In August 2007, following the construction of the experimental house, the structure was surveyed in two different ways. Firstly, descriptive plans were sketched of the ground floor, the upper floor and the roof and front and side elevations of the structure were also surveyed. Secondly, three-dimensional points were taken with Total Station (EDM) which were then transferred to CAD software in order to obtain a 3D model of the house (Figs. 1-3). This technique is rather schematic but more precise with regards to the volumetric

A group of flakes was wrapped up in textile cloth, tied with leather string and placed upstairs; simple piles of flakes were placed on both floors.

In order to control the collapse of the house and to recognise the elements during the excavation of the deposit, four aluminium plates were fixed with iron wire to the ceiling joints and two more at the end of the ridge pole of the roof. Each plate was identified by a different number of holes. This method, probably useful as far as following the twisting of the structure during collapse, revealed itself to be useless due to the slow burning of the structure: the beams had burned completely before the collapse of the walls and apparently the plates did not fall together with the structure.

Burning down the house!

The preparation of the house for the firing process begun with the stacking of the wood inside, along the walls of the two rooms, up to 1.20m, to compensate the absence of the wooden furniture, household objects and inflammable materials which exist in a traditional household, and which were inferred from archaeological remains or the iconography of the ceramic miniature models. A total of 6 tons of semi-dry wooden trunks and 200 kg of straw were positioned inside and around the house.

A parallel experiment to the combustion of the structure was undertaken by Dr. Romeo Dumitrescu, who attempted to test the combustion of a domestic sheep, strategically placed inside the house, prior to burning.

The experiment was carried in August; a month characterized in Southern Romania by high temperatures of approx. 35-40 °C, and the day chosen was without the air turbulence which could have had influenced the combustion process. It should be noted that the wattle damped had been subjected to a heavy rain storm two days before the experiment.

At 5:30 p.m. a fire was started within the structure using approximately 10 kg of embers, a volume estimated to represent the fuel of a prehistoric hearth and/or an oven. The fire soon spread from the inside to the house perimeter, where it was deliberately extinguished (Fig. 4). After 10 minutes. the recently repaired and still wet plastered ceiling of the first room collapsed, which created the conditions for the ignition of the roof. Most of the wooden structure of the roof fell in within 30 minutes, however, several beams were only partially consumed (Fig. 5).

Fig. 4: Beginning of the combustion process. (Photo: G. Serseniuc)

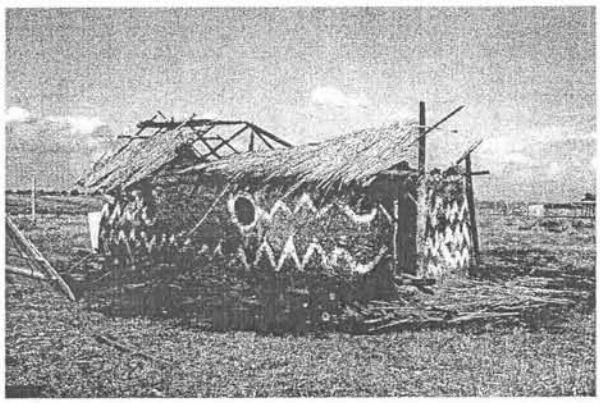

Fig. 5: Collapsing of the roof. (Photo: G. Serseniuc)

The most intense zone of combustion continued for over three hours, mainly within the back room. In this room the fire was refuelled with 150 kg of straw and continued to burn for almost seven hours. In this room was a wooden platform, which had, been constructed in order to support the animal carcass.

One noticed a reddish colour on the inner surface of the walls to the height of the stacked wood. At the same time the clay had been transformed into ceramics around the base of

the central pole, with the average temperature measuring around 700°C (with a maximum of 768°C), using three Platinum-Rhodium thermocouples). Other experiments have achieved similar temperatures (see Coles 1973: 66).

During the firing of the stacked wood, the thick layer of embers produced was covered up by part of the perimeter walls which had fallen down during the night, generating an anaerobic combustion, similar to the firing of the wooden platform.

After the completion of the firing one noticed that the walls had a ceramic veneer or coating varying from 3 to 10 cm, depending on the exposure and intensity of the heat (Fig. 6). The majority of the wall fragments fell down inside the built perimeter. The visuality of the fire attracted the cattle herds of the village. Over the next few days other animals such as insects, birds and dogs used the ruins as a shelter.

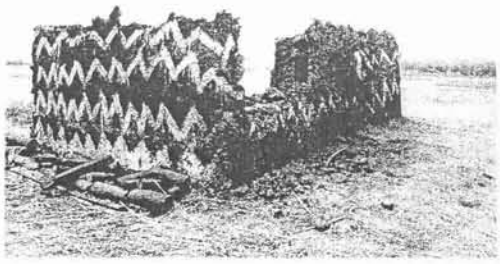

Fig. 6: The house at the end of the firing process. (Photo: D. Gheorghiu)

By October 2006 all the walls had collapsed and the amount of unfired and fired clay left on the soil surface formed a deposit 40 cm in thickness. Unusually no plants had colonised the fired surface (Fig. 7).

Fig. 7: The collapsed house in October 2006. (Photo: D. Gheorghiu)

Excavation

At sometime in the near future, the project will conclude with the excavation of the remains of the burnt and collapsed house. This is not an optional step, but it is necessary in order to understand the depositional and post-depositional processes that such a structure undergoes: the stratigraphic evidence of the burning and collapse of the structure and subsequent weathering reveal how layers and lenses of charcoal, ash, sediment, burnt and unburnt daub fragments are forming and changing, how the structural elements are preserved in this process and how far they can be still interpretable.

The deposition formed by the remains of the house will be excavated in the same way as an archaeological deposit. An excavation grid will be established; every single thin layer will be excavated and drawn separately; all the artefacts finds will be left where they were found in order to discern their movement during collapse and in the post-depositional period. Particular attention will be paid to plaster remains. All the daub, in large fragments or in small pieces, will be weighed in correspondence to a grid made up of squares with sides measuring 50 cm. Even the sediment used for plastering, which was not burnt, will be collected and weighed in order to compare it with proper daub. All the fragments will be studied with special attention given to their morphology, measurements, prints, colour, weight, position, orientation and so on, as to have a geo-database of the remains.

All documentation of "archaeological" evidence will be processed in a GIS platform.

Conclusions: what did we expect to gain from the excavation?

The opportunity of comparing excavation data with experimental data is irreplaceable if we wish to comprehend the processes behind the formation of such a deposit and if the structure was burned intentionally or accidentally. The comprehension was made

easier by manipulating the data into a GIS programme. The advantage of this experiment is, of course, knowing the building materials used, the nature, quantity, weight of every element and their original position before the burning and destruction of the structure. This gives us the possibility of a better understanding of the dynamics of collapse of a house. It is therefore comprehensible that particular attention will be paid to daub remains, wooden beams and charcoal layers. This can only be done by means of identifying the elements and their characteristics and considering there three dimensional positions both within the structure and, later, as part of the deposit.

Comparing this controlled experiment (the reproduction) with actual archaeological remains, we hope to be able to detect some important details concerning the similarity between both examples. From our experimentation we have formulated a number of research questions:

- Is it possible to calculate the original height of the walls of excavated buildings?
- Is it possible to recognize the position of the entrance or other openings?
- Is there evidence of the presence of an upper floor?
- What was the maximum temperature of the fire?
- How is it possible to evaluate it in an archaeological deposit?
- Is chemical analysis the only way possible to record such activity?
- Was the house intentionally burned?
- Were the walls completely plastered internal and externally?
- What are the dynamics behind the collapse of a wattle and daub wall?
- Was the plastered wall hardened intentionally by fire during its building?
- Was the framework of the wall made up by branches or small poles and boards?
- How many tons of hardened daub can we find in a destruction layer of a house?
- Is the structure collapsing inside or outside the perimeter?
- What are the signs in the stratigraphy of a collapsed structure that might suggest that still useful building materials was removed and recycled for another construction?
- Finally, and fundamental to this experiment, how many buildings escaped intentional firing?

Further questions await answers either through excavation or future experimentation!

Acknowledgements

The authors would like to thank Dr. Romeo Dumitrescu for financing the house building and combustion project and for participation with the firing experiments.

Many thanks also to Oana Parau for the 3D reconstruction and assistance in recording the artefacts from the fired house. Last but not least our thanks to the wonderful team of fine artists who helped us in the process of destruction: Marius Stroe, Dragos Manea, Ionela Tudoran, Stefania Stroe and Stefan Ungureanu.

References

ASHER, R., 1961: Experimental Archaeology. *American Anthropologist*, 63: 793-816.

CHAPMAN, J., 1999: Deliberate house-burning in the prehistory of Central and Eastern Europe. In Gustafsson A., and Karlsson H., (eds.), Glyfer och arkeologiska rum – en vanbok till Jarl Nordbladh, pp. 113-126, Gotarc Series A, Vol.3.

COLES, J., 1973: *Archaeology by experiment*, New York, Charles Scribner's Sons.

COMSA, E., 1990: Complexul Neolitic de la Radovanu, *Cultura si Civilizatie la Dunarea de Jos* VII, Calarasi.

GHEORGHIU, D., 2001: Tropes in material culture. In Gheorghiu D., (ed.), *Material, Virtual and Temporal Compositions: On the Relationship between Objects*, British Archaeological Reports, Archaeopress, Oxford.

GHEORGHIU, D., 2005: *The Archaeology of Dwellings. Experiments and theory*, Bucharest, Editura Universitatii.

INGERSOLL, D., YELLEN, J. E., MACDONALD, W., 1977: *Experimental Archaeology*. Columbia University Press, New York.

MATHIEU, J. R., 2002: *Experimental Archaeology. Replicating past objects, behaviours, and processes*. British Archaeological Reports, International Series, 1035, Archaeopress, Oxford.

PETRESCU-DAMBOVITA, and M., FLORESCU A. C., 1959: *Sapaturile arheologice de la Trusesti (Raportul de sapaturi din 1954-1957), Materiale si cercetari arheologice*, Editura Academiei, Bucharest, pp. 147-155.

RAPOPORT A. 1969: *House Form and Culture*. Prentice-Hall, Englewood Cliffs, New Jersey.

SHAFER, G. D., 1984: *Neolithic Building Technology in Calabria*, Italy. Ph.D. thesis, State University of New York at Binghamton.

STEVANOVIČ M., 1997: *The Age of clay. The Social dynamics of house construction*, Journal of Anthropological Archaeology 16, pp. 334-395.

STEVANOVIČ, M., 2002: Burned Houses in the Neolithic of Southeastern Europe. In Gheorghiu D. (ed.), *Fire in Archaeology*, Archaeological Reports, International Series, 1098, pp. 55-62.

TODOROVA, H., 1982: *Kupferzeitliche Siedlungen in Nordostbulgarien*, C.H.Beck, Muenchen.

TRINGHAM, R., 1992: Households with faces: The Challenge of Gender in Prehistoric Architectural remains, In Gero, J. and Conkey, M. (eds.), *Engendering archaeology. Women in Prehistory*, pp. 93-131, Blackwell, Oxford and Cambridge.

TRINGHAM, R., and KRSTIČ D., 1990: Conclusion. Selevac in the wider context of European prehistory, In Tringham, R., and Krstič, D. (eds.), *Selevac. A Neolithic village in Yugoslavia*, pp. 567-617, Monumenta Archaeologica 15, University of California Press, Los Angeles.