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On the Hypothesis of the Origins of Pottery Shapes

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ABSTRACT

The hypothesis of the origins of pottery shapes based on long-term experiments, ethnographic, archaeological data and primitive e cooking practices is discussed in the article. The experiments conducted have shown that it is possible to get a fully preserved clay vessel which could serve as a prototype of initial pottery shapes in the process of cooking meat food coated with clay of a specific composition in the oven. This assumption is indirectly confirmed by the results of a special study of the earliest ceramics in the Amur region. It is suggested in the article that the first clay vessels were used for cooking hot food over an open fire for ritual purposes.

Keywords: *origins of pottery, experiment, ethnography, pottery firing, cooking, the earliest ceramics of the Amur region*

INTRODUCTION

Formulation of the Problem

An opinion has been expressed on several occasions in the archaeological literature that the origin of pottery was a polycentric process (**Tsetlin, 2013, 2018**), i.e. it appeared time and again in different regions of the globe, in different climatic and cultural and economic conditions. Ways of the origins of pottery were probably not the same depending on specific conditions of place and time. Meanwhile we can definitely speak about two such centers. One of them was in the Near East, another one – in South-East Asia probably including the Russian Far East (**Tsetlin, Petrova, 2020**).

Besides that different theories on the development of the process have been expressed in the literature. The oldest of them was so called "basket" theory which appeared in the XVIIIth century. It was supported by sporadic ethnographic evidences and partly was further confirmed by linguistic data (**Trubachev, 1966, p. 176**). Though the basket theory of the origins of pottery has been repeatedly and rightly criticized, references to it can be found in a specialized literature (**Semionov, Korobkova, 1983, p. 191-192**).

In the 1980-1990s a new theory on the origins of pottery was formulated by A.A. Bobrinsky (**Bobrinsky, 1981a,b; 1993, 1997; 1999, p. 75-104; 2006**). Using ethnographic, archaeological and experimental data he revealed so called pre-pottery stage in the history of pottery which was characterized by the production of vessels made of clay mixed with organic inclusions (first and foremost with poultry and livestock manure), and the proportion of those organic inclusions in the composition of pottery paste was higher or roughly the same as that of clay. The most interesting conclusion of this theory was that vessels made of mixture of clay and poultry manure in a high concentration, as multiple experiments had shown, could be used for cooking hot food without preliminary firing. It was connected with a phenomenon discovered by A.A Bobrinsky (**Bobrinsky 1999, p. 85-89**), the phenomenon of "self-cementation" of clay particles under the influence of chemical components contained in poultry manure.

Later thanks to joint studies of A.A.Bobrinsky and I. N. Vasilieva this theory was corrected (**Bobrinsky, Vasilieva, 1998, 2012**). In particular, they have found that in many regions of Eastern Europe the earliest Neolithic ceramics were not made of clay mixed with organic inclusions but of so called claylike plastic raw material, lake and river silt sediments. A basic characteristic of those sediments was high contents of water plant and animal organic inclusions, clamshell fragments, small bones and fish scales. Some sorts of silt mainly found in foothill areas on the contrary contained small amounts of organic inclusions, but instead light rounded and sharp edged sand of different size was abundant in them. Thanks to such a complex

natural composition both "valley" and "mountain" silts could be used not only for making vessels, but also could be intentionally fired. They didn't require additional mineral and organic tempers which was the most important. Massive use of silts and rough sandy loam for making vessels was registered in the earliest ceramics of the Far East (**Tsetlin, Medvedev, 2015**).

All these formulations dealt mostly with the technological side of the origins of pottery: types of plastic raw material, its composition and firing. However another side of the process (vessel's shape development) hasn't been properly studied so far. Based on a large amount of ethnographic data a common opinion which might be correct is expressed that at initial stages clay vessels' shapes copy the shapes of earlier non-clay (stone, wooden, wicker etc.) vessels. (**Tsetlin, 2013; 2018**). The use of silty raw material discovered in the ancient pottery once again provoked new experiments with wicker vessels coated with silt. Such experiments were conducted by I.N. Vasilieva, interestingly an outer or an inner surface of baskets made of reed or both of them were coated with silt or clay. Then they were fired in a bonfire. Vessels from silt and clay for making which baskets were used as convex moulds were fully preserved after firing. (**Vasilieva, 2006, p. 429-431**).

Another matter at issue in this article will be one more aspect of the problem of the origins of pottery which sort of falls in-between: on the one hand it refers to pottery technology, on the other to vessel's shape. The idea is the following.

The facts of cooking meat food by roasting are well known according to ethnographic data. For this purpose a pit of a proper size with a flat bottom was made. A fire was built in it, then meat wrapped in leaves was placed on charcoals. It was covered with ash over which another fire was made. The roasting lasted all night (**Narrative of an Expedition.., 1865, p. 168**). There is even more interesting fact about the primitive hunters who (just like modern tourists) cooked meat and fish on charcoals in ovens, previously coating food with a layer of clay (**Peoples of the world.., 1956, p. 107-108**). As a result the clay coating exposed to temperature was partly fired, and meat or fish was roasted and edible. Absolutely the same way modern housewives roast meat in the oven, the only difference is that they use metal foil or thick paper instead of clay.

The prevailing opinion in modern science is that the pottery "inventors" were women and by all appearances it is right. The fact that the most primitive people familiar with pottery making delegated it to women supports this view. It was also women who cooked food in vast majority of cases. The sustainable combination of these two facts in different tribes including those at a low level of economic development enables to suppose that at least in some parts of the globe ***the origins of pottery could be related to the culinary activities of women*** (A.A. Bobrinsky wrote about such a possibility earlier-**Bobrinsky, 2006, p. 419**).

The hypothesis to be considered assumes that in hunting and gathering societies of the forest zone in primitive times meat food (mostly game probably) was cooked coated with clay and in ovens dug into the ground. Thanks to this procedure clay coating could be fired and fully preserved after removing roasted game from it given that the composition of clay raw material was properly determined and the firing regime was observed. As a result a practically finished vessel appeared with a well fired outer side and ready to be used at least potentially as a container for subsequent cooking of hot food on an open fire.

Description of Experiments and Conclusions Derived from them

Together with Helena V. Volkova we have been conducting experiments in simulating the above-mentioned way of cooking meat food for the last four years (2017-2020) on the basis of the Samara experimental expedition for the study of ancient pottery (expedition leaders are N.P. Salugina and I.N. Vasilieva).

Running the experiment we have relied, firstly, on ethnographic data about the primitive regimes of pottery firing (**Drost, 1967, p. 214-234**), secondly, on the experience we gathered in previous pottery firing experiments, thirdly, on the results of learning the technology of the earliest pottery.

Main Rules to Run the Experiment

An oven dug into the ground 40-50cm deep and about 100-140cm in diameter was used for experiments in all cases. A wooden platform was made on the bottom of the oven (either branches 2-3 cm in diameter or flat wooden planks were used). These planks were covered with a layer of fresh leaves to prevent ash from sprinkling through the wood of the platform otherwise it could block its burning. The leaves were covered with a layer of cold ahs 1-2 cm thick on which a chicken was placed coated with a layer of pottery

paste of a certain composition (***different variants of pottery paste were tested during experiments***). The coating was made in the technique of random patch building. Then fuel wood was placed around in the shape of a shallow "well" which was filled with ash covering the coating with a layer 5-7 cm thick. After that the whole pile was once again covered with fuel wood on the sides and from above. Then thin dry twigs were placed on the bottom of the oven over the perimeter of the pile which were set on fire preferably at the same time. The fuel wood started to burn after the twigs. As fuel wood burned through another portion was put over the perimeter. The layer of ash which covered the coating with a chicken inside kept it from direct contact with fire creating a reducing firing atmosphere. The experiment lasted from 3 to 5 hours altogether.

Description of Specific Experiments and Conclusions Driven from them

A total of 6 experiments have been conducted over a period of 4 years: two of them in 2017, two in 2018, one in 2019 and one more in 2020.

Experiment № 1. This experiment was conducted in 2017 during the Samara experimental expedition for the study of ancient pottery. This year the expedition has moved from Pribrezhny village (the Samara region) to the territory of the Samara state social-pedagogical university training camp. Since there was no proper work site yet to study pottery firing on the grounds of the training camp we had to use a metal outdoors grill with higher than normal walls. A broiler chicken weighing 1,5 kg was bound with packthread, wrapped in gauze and then coated with a layer of natural ***silty clay*** without tempers. Twigs and branches were used as fuel. As the firing took place in the grill the temperature couldn't be registered with the help of thermocouple. The firing lasted 3 hours. The coating developed cracks outside but it was completely raw inside. However the chicken was well roasted. The experiment was considered a failure since the coating was not preserved.

Experiment № 2. The experiment was conducted in 2017 in Pribrezhny village where vessels and experimental models were fired in the oven and kiln at the same time. A chicken was dressed in bandages, then covered with a coating of ***sandy river silt*** without tempers (**Fig.1**). The experiment was conducted in the oven dug into the ground with pine bark as fuel, the burning lasted 5 hours (**Fig.2**). Due to high heat capacity of pine bark compared to pure fuel wood the temperature in the oven rose to the beginning of red-hot stage and from the colour of the coating it was clear that the firing atmosphere was semi-reducing. Its upper part was all in cracks but partly intact while its lower part remained practically unfired. The experiment was considered a failure.

Fig.1. *Experiment № 2. The chicken was dressed in bandages, coated with river silt with a lot of sand and roasted under the layer of ash. The fuel was pine bark. Undestroyed half of the coating.*

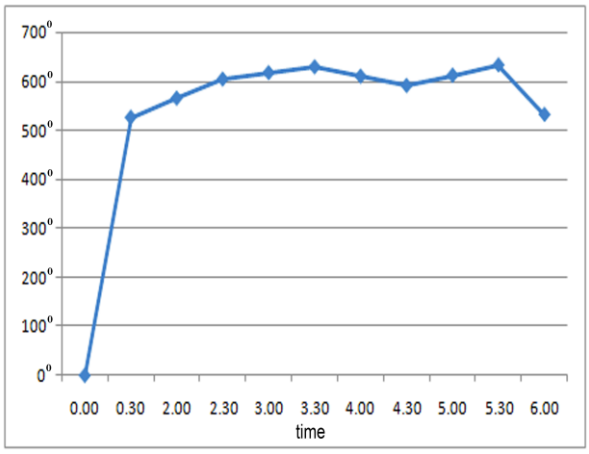

Fig. 2. *Experiment № 2. Temperature timeline.*

Experiment № 3. In 2018 the training camp was provided with a special work site to study pottery firing which had a bonfire, two ovens (one dug into the ground, another one made of bricks on the ground) and a kiln. The experiment was conducted in the oven dug into the ground. ***River***

silt rich in organic inclusions without tempers was used for the coating (**Fig.3**). The burning lasted 5 hours (**Fig.4),** wood was used as fuel. As a result the coating broke up into small pieces, the chicken became charred, dry and inedible. The experiment was considered a failure.

Fig.3. *Experiment № 3. The chicken was dressed in bandages, coated with river silt with organic inclusions, roasted in the ashes. The fuel was firewood. The coating was completely destroyed.*

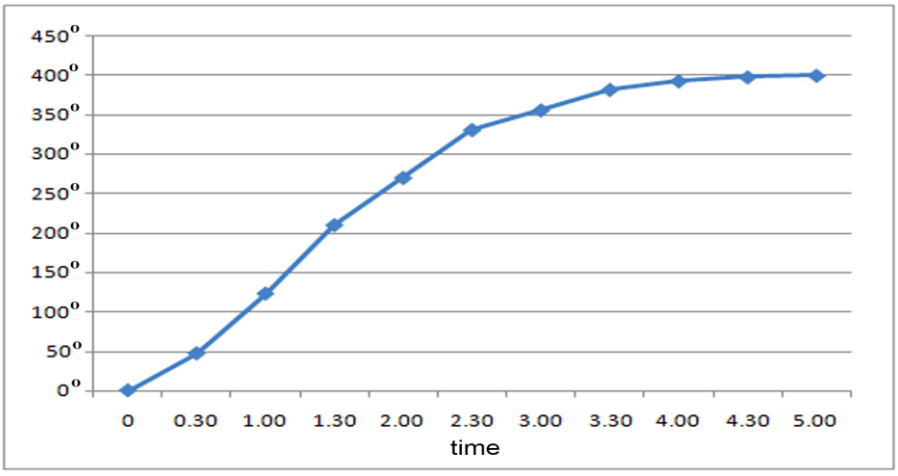

Fig.4. *Experiment № 3. Temperature timeline.*

Experiment No 4. It was conducted in the oven dug into the ground. Pottery paste of a mixture of ***river silt and fine river sand in concentration 1:3*** was used for the coating. The burning lasted 3 hours and 10 minutes. Due to a fault of the thermocouple the temperature was not measured. As a result the whole coating broke up into pieces, but the chicken was well roasted and unburned. The experiment was also considered a failure.

Experiment No 5. It was conducted in 2019 in the oven dug into the ground. An unplucked chicken together with feathers was used for the experiment (**Fig. 5**). The coating was made of a mixture of natural ***clay and moist cow dung in concentration 1:1.*** Firewood was used as fuel. The burning lasted 3 hours and 45 minutes. The temperature was very unstable due to wet and cool weather (**Fig. 6**). The outside of clay coating was all covered with cracks going in different directions. However, as it turned out, they were not internal. When the coating was divided in two halves horizontally it became clear that feathers had stuck deep in clay and had been fully preserved. It prevented us from taking the

chicken out of the coating. One side of the coating (on which it was lying) was flat, another one was convex. The flat side was practically unfired, the clay was raw. The upper thinner side was burned. Samples of the coating from upper and lower sides passed residual plasticity test. The sample from the lower part fully preserved residual plasticity and the sample from the upper part totally lacked it. The chicken was edible. On the whole this experiment could be considered more successful.

Fig.5. *Experiment № 5. The chicken with feathers was dressed in bandages and coated with pottery paste of a mixture of clay and dung, roasted in the ashes. The fuel was firewood. The coating was undestroyed, but had surface cracks.*

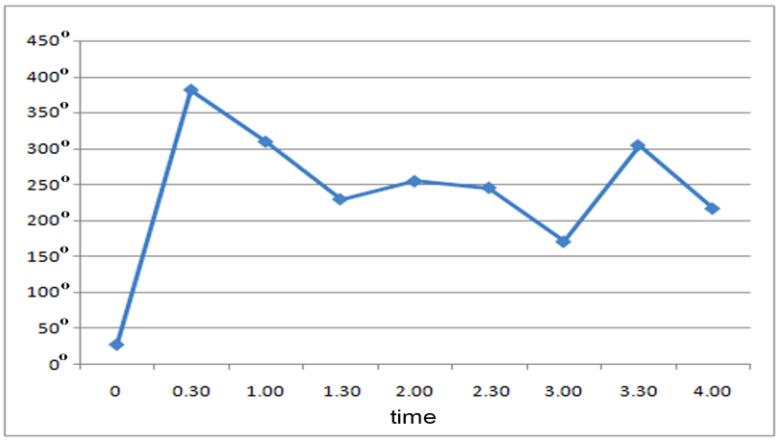

Fig.6. *Experiment № 5. Temperature timeline.*

Experiment No 6. It was conducted in 2020 in the oven dug into the ground. A chicken without feathers was wrapped in nettle with stems and bound with packthread (**Fig. 7**). The coating was

made by double patch building from pottery paste of natural ***clay with standard plasticity to which fine river sand was added in concentration 1:1.*** According to my previous experiments such a composition of pottery paste almost completely eliminated shrinkage of the coating during drying and firing processes. First the sand was soaked in water for two hours and finished pottery paste was left to rest for 9 days. The chicken and the coating were placed vertically and a special hole was left in the lower part of the coating for draining down dripping and moist. A platform was made from a single layer of wooden planks in the oven dug into the ground, hazel leaves (2 cm) were placed inside which were covered with a thin layer of cold ash. A wooden peg was driven into the center of the platform and the chicken was skewered on it vertically with the hole in the coating beneath. In fact the coating was situated in the oven with its bottom up. A well from wooden planks full of hot ash and charcoals was built around the coating. Then the well was covered with another layer of firewood and set on fire. The burning lasted 4 hours with the constantly rising temperature and reducing firing atmosphere (**Fig. 8**).

Fig.7. *Experiment № 6. The chicken is bound with packthread, wrapped in a layer of nettle also fixed with packthread, coated with pottery paste of a mixture of clay and sand in a large concentration, roasted in the ashes. The fuel is firewood. The coating was practically undestroyed.*

As a result it became clear that clay coating with the capacity of about 3 liters was almost fully preserved (**Fig. 7**). The only defect was a little hole 4-5mm in diameter made by a thick nettle

stem in the upper part of the coating. After the chicken was taken out of the coating the vessel made by firing remained intact. Two samples were tested for *residual* plasticity: the sample from the upper (bottom) part totally lacked residual plasticity and the sample from the lower (rim) part fully preserved it. Most part of the chicken was edible. As the vessel was fully preserved the experiment was considered a success.

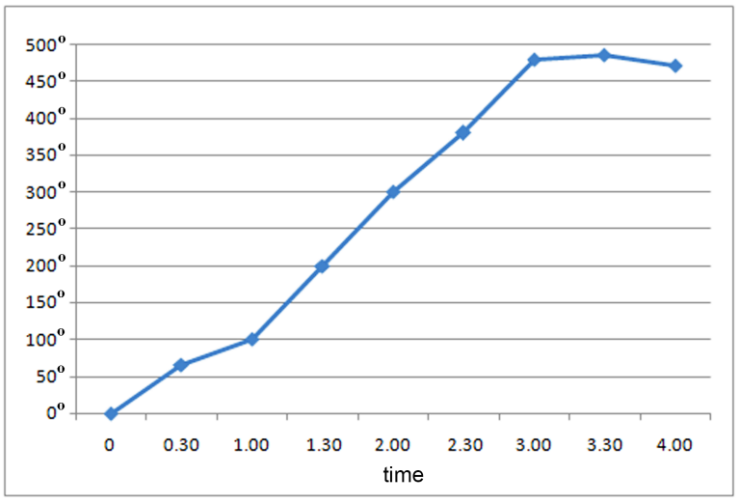

Fig.8. *Experiment № 6. Temperature timeline.*

CONCLUSION

The set of experiments conducted enabled to come to the following conclusions:

- The roasting of meat food in clay coating largely practiced by hunters and tourists both in the past and nowadays inevitably leads to the destruction of clay coating.
- To keep it a set of rules should be strictly followed which is impossible without consistent knowledge and practical skills of its maker.
- First of all clay coating with meat should be placed on the platform and separated from it and fuel with a layer of ash 5-7cm thick to keep the reducing firing atmosphere and to avoid direct contact of the coating with an open fire.
- The temperature in the oven should rise slowly and the heating of the coating with meat should be gradual. Otherwise thermal shrinkage of the coating's outer side and its absence from the inner side will lead to its cracking and rupture.
- It is important to make an elastic insulation between meat meant for roasting and the coating which would allow a little shrinkage of the inner side of the coating. A layer of nettle was used as such insulation in our experiment.
- The pottery paste either natural or specially prepared of a very low plasticity with a minimal thermal shrinkage should be used for coating meat meant for roasting. It will prevent clay coating from rupture. The experiments conducted have shown that plastic natural clay (including silty clay), river silt rich in organic inclusions (even in combination with fine sand with an average concentration ratio) are unsuitable as a material for the coating, pottery paste of a mixture of natural clay and moist manure in a large concentration also turned out to be of questionable use for it. Either artificial pottery pastes of a mixture of clay and a large amount of sand (not less than 1:1) or ready natural loam with lots of mineral inclusions too are in line with the requirements of minimal shrinkage in the process of drying and especially firing. The experiments conducted have shown that only compositions of such sort ensured the best result.
- In such a way, ***it seems appropriate to draw a general conclusion that in principle the appearance of ready clay vessels in the process of cooking in the oven is quite likely as one of the possible ways in which the earliest clay vessels' shapes might have originated.***

Comparison with archaeological data

At present the earliest ceramics on the territory of the Russian Federation come from the Amur region and is related to the Osipov archaeological

culture, revealed by A.P. Okladnikov and subsequently studied by A.P. Derevianko and V.E. Medvedev. Ceramics belonging to the Osipov culture were studied by Yu.B. Tsetlin in the "History of ceramics" laboratory of the Institute of Archaeology of the Russian Academy of Sciences in the context of scientific projects № 12-06-00186A and № 15-06-00246 supported by the Russian Foundation for Basic Research (project manager – V.E. Medvedev).

The analysis of ceramics from Gasia settlement with carbon dating ^{14}C 12960 ± 120 years ago (Le-1781) highlighted some very interesting details which seem important in connection with the above-mentioned experiments.

Firstly, it is notable that local potters used natural silty raw material with sharp edged mineral inclusions up to 1,5-2 mm in size in concentration about 1:1 in more than 40% of cases (**Fig. 9**). Pottery paste didn't have any temper besides an organic solution used for plasticizing the raw material.

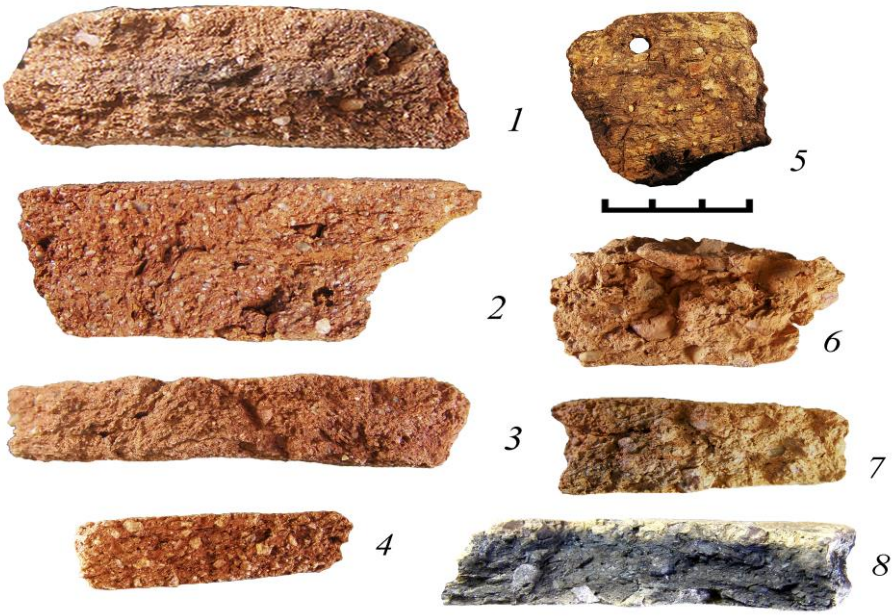

Fig.9. *Examples of readily available natural raw material from which the earliest pottery was made: 1-4 Gasia settlement, mountain silt with natural inclusions of sharp edged sand in concentration 1:2 – 1:1; 5-8 – rough sandy loam with large clay and rock inclusions in concentration 1:3 – 1:2.*

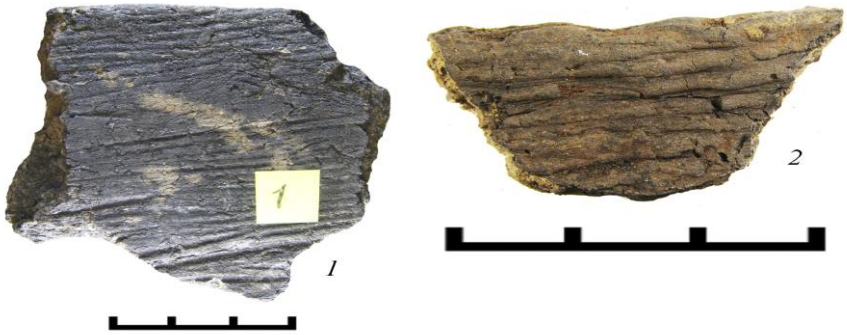

Fig.10. *Traces on the inner side of vessels of the Osipovskaya culture presumably left by packthread which fastened leather insulation to a convex mould.*

Secondly, vessels were made in the technique of patch building on a convex mould in more than 75% of cases and to prevent silt from sticking to the mould the potters used leather insulation which probably for the purpose of fixing was tied up with a special packthread (**Fig. 10**).

Thirdly, vessels from Gasia settlement in 80% of cases were fired for a long time in a reducing firing atmosphere at temperature of no more than 505-550 degrees Celsius.

Fourthly, according to fragments of clay vessels found during excavations both in Gasia and other settlements belonging to the Osipov culture (Gosyan, Hummy and others) the number of vessels wasn't big. Except for such sites as Goncharka 1 for example where more than 2000

fragments of the Osipov ceramics were found (**Shevkomud, Yanchina, 2012, p. 148**).

In such a way all characteristics revealed in the oldest ceramics completely correspond to the above-mentioned experiments. In particular, it was pottery paste with lots of mineral tempers in combination with a layer of nettle as soft leather insulation tied up with a rope and a long low-temperature firing that ensured the best result during experiments.

I would like to mention two more issues. First. We can consider as experimentally proved that to keep clay coating intact it has to be made of pottery paste of low plasticity which in natural conditions exists mainly as mountain silt with a lot of sand or rough sandy loam with lots of different large mineral inclusions. Natural materials of this sort are readily available mostly in the foothills and mountain areas of Karelia, the Caucasus, the Altai and the Amur region. It suggests that the evolution of pottery in such areas might be connected with cooking by method of coating food with pottery paste of similar composition. Consequently these are areas where searching for appropriate fired clay fragments look promising irrespective of their looks which could be rather like samples of clay coating than like pottery sherds.

Second. According to plentiful ethnographic data group meals were mostly predominant in primitive times (**Semionov, 1993. p. 100-163**). However, vessels from Gasia settlement due to their sizes couldn't possibly perform such a function as on the average their diameter was about 20 cm, as it was determined by the rim fragments, that is the full capacity was no more than 5-6 liters and work capacity was even less, about 4-5 liters. Despite such small capacity an absolute majority of vessels from Gasia settlement, as we managed to find out, was used precisely for cooking hot food. Based on probable group meals, small capacity of vessels and their small number in the settlement it can be suggested that cooking in them over an open fire was not aimed at feeding members of a primitive group but served a particular ritual purpose for which such a number of vessels was enough.

In conclusion I would like to stress once again that given the current state of our knowledge a suggestion expressed in this article can be regarded only as a more or less probable hypothesis which reflects one of the possible ways in which the ancient pottery might have originated.

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