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REVIEW ARTICLE

# The History of Bonfire Firing Structures in Pottery Production (Ethnographic Data and Its Analysis)

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## Abstract

The article is dedicated to the comparative analysis and synthesis of ethnographic data on the bonfire firing of pottery. The information collected by ethnographers during the 19th and 20th centuries comes from various parts of the globe: Africa, North and South America, Europe, Asia and Oceania. The article discusses various methods of drying and firing vessels, the number of vessels meant for firing, types of fuel, bonfire structure, methods of post-firing treatment of pottery, etc.

It has been established that, despite the difference in natural conditions, the similarity of the structure of bonfires and firing techniques in different regions of the globe, leads to the conclusion that there are common patterns in the functioning and development of firing of clay vessels among different peoples. A hypothesis is suggested about the connection of the bonfire firing techniques with the use of cooking hearths.

The author comes to the conclusions, that, firstly, from an economic point of view the development of the traditions of open firing shows itself in the transition from the firing of one vessel to the firing of a small and then a significant number of vessels in one bonfire; secondly, that the trend of the development of bonfires structure consists in the transition from the vessels placed on the ground (very rarely) or on an individual platform (made of stone, clay or fuel) for each item to the common platform for all vessels to be fired; thirdly, that an important factor in the development of bonfires is probably the mixing of different traditions, which occurred due to the contacts of the bearers of the open firing traditions with bearers of oven-firing, on the one hand, and stove-firing traditions, and on the other hand. In conclusion, the author mentions a number of signs that make it possible to identify bonfires meant for firing vessels during the excavations of ancient settlements.

**Keywords:** Bonfires, Ethnography, Pottery Firing, Pottery Traditions.

## 1. Introduction

The firing of pottery in bonfires characterizes the use of the most primitive firing device by ancient potters, on the one hand, and, it has a tremendous diversity both of the structure of this device and the number of vessels that are fired in it, on the other hand.

In 1993 a special article was published by three authors (Bobrinsky, Volkova, Gay, 1993), devoted to the reconstruction of the history of the structural development of bonfires and some signs by which they can be identified based on archaeological materials. This topic is further developed in the present article. A number of narrow technological tasks related to the Fixative stage of the technological process in pottery and aimed at giving vessels hardness and water resistance will be considered in it on the basis of ethnographic data (Bobrinsky, 1978, p. 14; 1999, p. 11). These tasks include: 1) air drying of vessels; 2) their thermal drying, 3) the firing of the vessel itself and 4) its post-firing treatment. It is important to note that none of these narrow technological tasks is strictly

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required. But at the same time, all of them are widely represented in the practice of ancient pottery. This is especially true for the heat treatment of vessels, i.e. their firing.

After reading literature of the subject it became obvious that, despite the primitiveness of such firing, or perhaps precisely because of its primitive and unusual character, researchers had gathered a huge number of specific observations over the use of such fires by different peoples. Studies, synthesizing data on pottery from different regions of the globe, were mostly used to the extent possible in this article. These include the report of P. May and M. Tuckson on Papua New Guinea (May, Tuckson, 1982), D. Drost on Africa (Drost, 1967), H. Balfet on Tunisia, Morocco and Algeria (Balfet, 1977), R. Vossen on Morocco (Vossen, 1990), B. Saraswati and N.K. Behura on India (Saraswati, Behura, 1966; Saraswati, 1979), D. Arnold on South America (Arnold, 1978, 1985), E.M. Peshchereva on Central Asia (Peshchereva, 1959), as well as some important articles on these issues. The synthesis of all this data makes it possible to have a fairly complete picture reflecting the variety of techniques for giving vessels hardness and water resistance after bonfire firing.

### 1.1 Air Drying of Vessels

Let's start by considering the air-drying techniques for pottery. Usually, this process is divided into two stages:

a) the drying out of direct sunlight (Fig. 1) under the roof or indoors, which lasts from 1-5 days to three weeks. In this case, the vessel is often placed on a cylindrical ring made of grass (May, Tucson, 1982, p. 96-97, 201), a wooden bench (Ingaliks of Alaska - Ozgood, 1940. p. 147) or dried on a shelf above the hearth (May, Tuckson, 1982, pp. 147, 170-171, 183-184; Drost, 1968, s. 212; Podgorbunsky, 1928, p. 134).

**Figure 1.** *Air drying out of direct sunlight: India 2019 (Photo by P.R. Kholoshin)*

b) the air drying - from 1-2 days to 4-6 weeks, depending on the weather; sometimes in the sun right away (May, Tuckson, 1982, p. 156; Drost, 1968, s. 213). In the rainy period it is longer, in the warm and sunny - shorter. Very large vessels can be dried for up to two years (May, Tuckson, 1982, pp. 262-263, 319).

### 1.2 Thermal Drying of Vessels

The next narrow technological task is drying the vessel either on the interior or both on the interior and exterior directly in contact with fire. In order to dry the vessel *on the interior*, it is placed on the bottom and coconut leaves or some other fuel are burned inside of it – Mailu village, Central Province in Papua New Guinea (May, Tuckson, 2000. p. 52), the Ogbomosho tribe in Africa (Fig. 2a)[1]. Small vessels could be hung upside down on sticks in order to dry them both on the interior and exterior (Fig. 2b). Female potters often put a vessel vertically or horizontally on burning leaves - the tribes of Sanda-Timne and Mende in Sierra Leone or let them stand from half an hour to several days over burning straw - the Fulup tribe, put upside down on the hearthstone – the tribes of Losso, Ekoi, Bena–Lulua, Kikuyu (Drost, 1967, s. 215-216, 222). The last two methods of thermal drying are also known in New Guinea – the vessel was placed on three stones or coral over the coals of a burnt-out fire (May, Tuckson, 2000. p. 84, 96), in Polynesia (Groves, 1960. p. 13), among the Athapaskans of Alaska (Anderson, 2019. p. 136). The Komi-Zyryans practiced thermal drying in a Russian stove before firing (Chudova, 2001, pp. 53-54). The Yakuts used a method of firing vessels on sticks at the fire (Podgorbunsky, 1928, p. 134), but perhaps it is more correct here to talk about the thermal drying of the vessel.

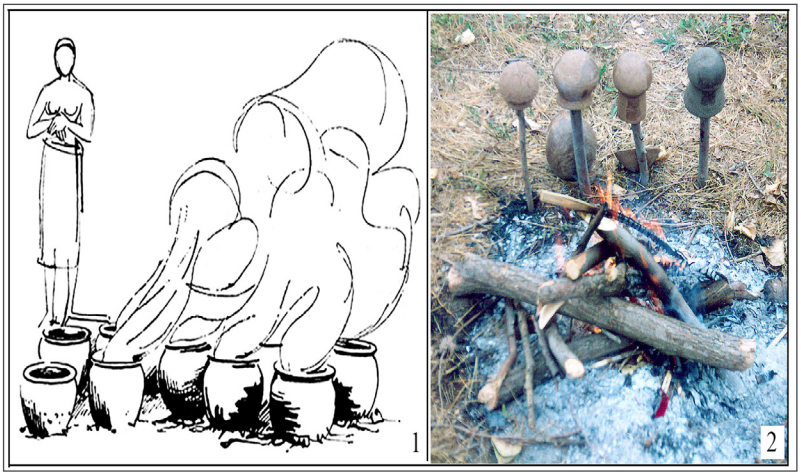

**Figure 2.** *Thermal drying: 1 - drying of the vessel on the interior (Drost, 1967, s. 220, fig. 45); 2 - drying of experimental vessels at the bonfire on sticks (Photo by Yu.B. Tsetlin)*

## 1.3 Firing of Vessels

Thermal treatment of vessels by firing is the main method of giving them mechanical hardness. In practice, this problem was solved in several ways in ancient pottery production.

### *1.3.1 Individual Firing of the Vessel in Bonfires*

In this case, each vessel is fired from beginning to end separately from other vessels in an individual bonfire (Fig. 3). This method was widely used in New Guinea, Africa, Siberia and even Europe. Here are some examples.

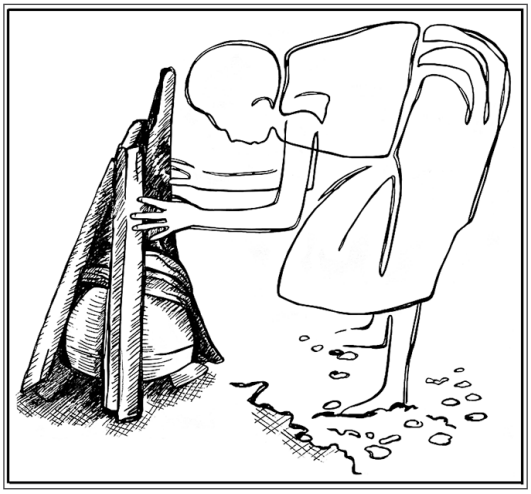

**Figure 3.** *Individual firing of the vessel, Milne Bay province, Papua New Guinea (photo-based sketch: May, Tuckson, 2000. p. 39)*

1) Very rarely the vessels are put directly on the ground with the fuel on top and around them so that the pot is partially or completely covered – the African tribes of Gogo and Iraku in Tanzania (Drost, 1967. s. 220-221, Figs. 46, 47).

2) Usually the vessel is placed on burning coals or on one or three stones (or coral) on the bottom or upside down and surrounded with fuel. Usually such firing does not last more than 20 minutes. This method is identified in New Guinea on Mailu Island, province East Cape, Panaeati Island and Brooker Island (May,Tuckson, 2000. p. 52, 96, 105, 150-151, 329); in Alaska, on Nunivak Island and in the area of the Yukon-Kuskokwim Delta (Anderson, 2019. p. 137).

3) Much more often, the vessel meant for firing is placed on a platform made of palm leaves, branches of trees or several layers (from one to four) of wood arranged crosswise. Sometimes fuel is also put in the vessel. The firing lasts 15-30 minutes, rarely about an hour. The maximum temperature was maintained for a shorter time during firing. Such firing is identified in New Guinea in the village of Waria, Agarabi, Sawos (Tshuosh), on the Panaeati Islands and Brooker Islands (May, Tuckson, 2000. p. 96, 145, 156, 226), it is characteristic of the African female potters of the Sarakole tribe (Drost, 1967. s. 221-222, 224) and the Yakuts of Siberia (Podgorbunsky, 1928, p. 134). All these variants of individual firing of vessels are typical for home production. The women make and fire vessels as and when necessary. Such production cannot even be called seasonal, because in most cases it is not connected to a specific time of the year (excluding, for example, the rainy season in a tropical climate zone).

### *1.3.2 Transition to the Firing of a Group of Vessels in Bonfires*

In addition to the individual firing described above, ethnographers often detect the firing of 2-4-6 vessels in a small bonfire (Fig. 4:1-2). Such firing is widely represented in the pottery of Papua New Guinea. So, in the village of Bosman and Pila (Madang Province) 2-3 vessels are fired together, the firing lasts from 10 minutes to an hour; on the Amphlett Islands (Milne Bay Province) large vessels are fired one by one, and several small ones together. The firing lasts 40 minutes (May, Tuckson, 2000. pp. 75-76, 177, 202). Potters of the Motu tribe in Polynesia practiced firing vessels in bonfires in the 1950s. Three to five pots were fired together, they were placed on a platform made of softwood and surrounded with dry wooden bars. The intense heat was maintained for a few minutes only (Groves, 1960. p. 13, 17). D. Arnold describes the firing that he observed in Guatemala: three stones are placed around the fire, on which two dishes (comals) prepared for firing are placed. Pine chocks are laid under them, and the entire structure is covered with pine bark from above (Arnold, 1978. p. 335). Women of Serbia and Kosovo fired vessels for their own consumption in the cooking hearth. In doing so they fired some vessels only partially (Carlton, 2008 p. 61).

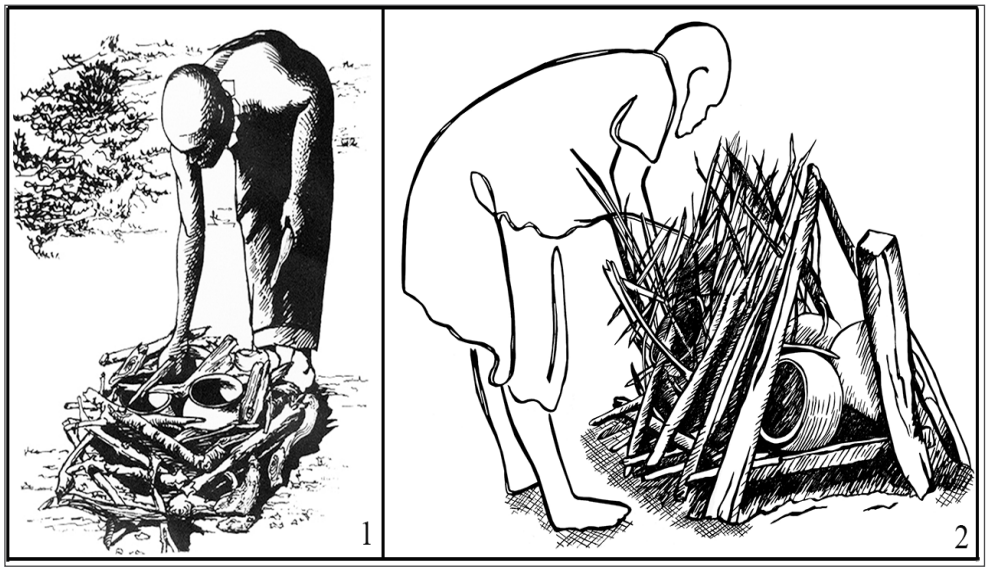


**Figure 4.** *Transition to firing of a group of vessels: 1 - firing of two vessels (Drost, 1967, s. 220, fig. 46), 2 - firing of four vessels, West Sepik province, Papua New Guinea (photo-based sketch: May, Tuckson. 2000. p. 38)*

### *1.3.3 Alternative Traditions of Individual Firing of Vessels*

In addition to such simple cases very curious variants of these traditions are known in New Guinea. For example, on the island of Hus (Manus Province), the vessel meant for firing was placed on 3 stones. Up to 10 vessels were fired consecutively in the same bonfire during the day. The firing of one vessel lasted about 30 minutes, and then it cooled in the bonfire (May, Tuckson, 2000. p. 329). A separate platform of approximately 65 X 65 cm was made for each vessel in the village of Garuh (Madang Province). It was covered with leaves. One vessel was placed on each platform, and they were all fired simultaneously. The firing lasted 40 minutes. A similar firing technique was detected in the same province among potters of the linguistic group of Peka (May, Tuckson, 2000. pp. 183-184, 191). The potters of the Lower Congo after thermal drying of several vessels place them mouth up so that each individual pot is surrounded with a new layer of fuel and dry branches are placed above all of them, which are set on fire (Drost, 1967, s. 222).

The female potters of the Shipibo-Conibo tribe in Peru made a large platform of two parallel logs in the bonfire, several vessels were placed on them with an interval. Each vessel was covered with a separate pile of bark and fired individually (De Boer, Lathrap, 1979. p. 10).

On the Fiji Islands pots were fired in groups of 3-4 vessels with a gap between each group. The vessels were placed on a platform made of coconut leaves, twigs and grass and the same fuel was laid round and over them. The firing lasted about 25 minutes, then the pots cooled in the bonfire for several more hours (Le Blanc, 2011. pp.67-68).

### *1.3.4 Firing of a Group of Vessels in the Bonfire*

Of course, such firing was most fully preserved until recently and confirmed by a large amount of

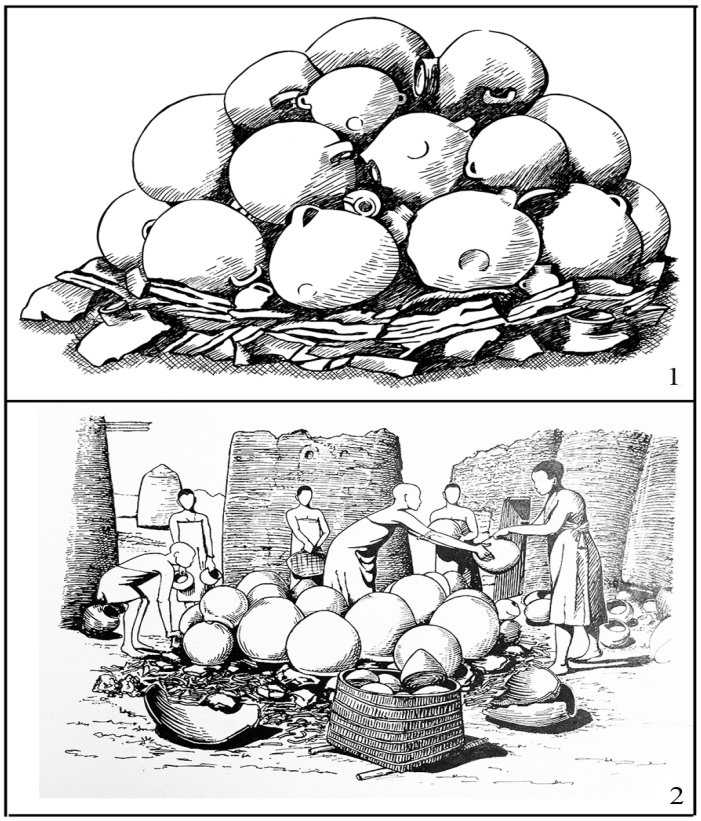

**Figure 5.** *Laying a group of vessels meant for firing in the bonfire: 1. Socogito village, Guatemala (photo-based sketch: Arnold, 1978, p. 356, Fig. 13), 2. Western Africa (photo-based sketch: Bobrinsky, Volkova, Gay, 1993. p. 29)*

ethnographic information from different regions of the globe (Fig. 5: 1-2).

Firing of a group of vessels means simultaneous firing of many vessels in the bonfire. It is characterized by the following main features: 1) in most cases vessels are fired on a big platform made of fuel, or on a platform made of clay, stone or ceramics; 2) most often vessels are stacked on the platform in several layers, forming a pyramid; 3) a large number of vessels are fired together.

I will give some of the most telling examples of firing of a group of vessels. In Botswana (Africa) fired pots are placed at the ground level (a metal sheet is used as a platform now, but this is not essential). The vessels are laid on their side, they are not set upright. The fuel is cow manure mixed with light fuel (sawdust, grass, twigs and leaves), which is added as it burns out. Firing lasts about an hour, and then the vessels are removed red-hot and cool in the air (Thebe, 2017. p. 158).

Women engaged in pottery making in Zair (Africa) use a flat area for a bonfire, paved loosely with fragments of old jugs and pots as well as stones. Eucalyptus branches are laid between them. Vessels meant for firing covered with branches and dry grass are placed on this platform. The firing lasted only 25 minutes (Misago, 1994, p. 587).

According to Marie-André, women In West Africa set up a round bonfire with a diameter of about 2 m. The bottom layer of fuel 20 cm thick consisted of twigs. Supports of large flat stones and large fragments of vessels were placed on this layer. The vessels meant for firing were placed in several layers, which were also interlaid with fragments of vessels (Drost, 1967. s. 225).

In India potters who burn vessels in a simple bonfire first prepare a round platform consisting of logs, straw, dry leaves and cow patties, clay vessels are placed on top of it, and a large layer of fuel is again placed around and on top. More fuel is added as it burns out. Firing lasts 6-10 hours. After it is over, the vessels are left to cool before being taken out of the ash, which also takes at least a day (Hussain, Naik, 2015, p. 424).

As for the number of vessels meant for firing, it is very different and depends primarily on the economic form of pottery production. If we speak about home production, one or 2-3 vessels can be fired, as it was shown, a few more vessels, but still within a dozen will be fired when working to order. But with the market form of production, the number of vessels

meant for firing can be from two to three dozen to several hundred or more. For example, if we speak about handicraft production, male potters in Africa fire up to 250 vessels in a bonfire (Drost, 1967. p. 224), in Peru – sometimes up to 350 vessels (Chávez, 1984-1985. pp. 170-172), Nepalese potters fire more than 300 vessels only in the so-called small bonfires (personal message from A.V. Kashkin), and in India - up to 1000 vessels (Saraswati, Behura, 1966, p. 112).

It is important to note that a number of anachronisms have been preserved in firing of a group of vessels. These include:

1) firing vessels in the hearth as women potters did in Serbia (Carlton, 2008) and Central Asia (Peshchereva, 1959. p. 40), or in the place of a household bonfire (the village of Lumi, Sepik Province, New Guinea) (May, Tuckson, p. 297);

2) In the same New Guinea, in the village of Kaiep, Terebu, Samap (Sepik Province) each of 20 vessels meant for firing was placed on 3 stones and they were covered with one layer of fuel. When it burned out, burning pieces of wood were put into each vessel and the firing continued for some time (May, Tuckson, pp. 305-306).

3) laying fuel both inside and outside each vessel. It is known in the village of Rawa (Madang Province) and Banaro (Sepik Province) in New Guinea (May, Tuckson, p. 194, 248).

The same practice is widespread among the African tribes of Wolof, Sarakole, Asaba, Ekoi, Selle, Xosa, etc. To increase the heat inside the vessels, they are often filled with highly flammable material. So, the Wolof and Sarakole fill the vessels with straw, Nankanya do it only with pots with a wide mouth, narrow-necked jugs, on the contrary, remain empty. Potters of Asaba put pieces of wood in a pot, Ekoi from the Cross River - shavings, Selle - dry grass, and Xosa - dried cow patties (Drost, 1968. s. 222).

It is important to note that there are cases, often described in the ethnographic literature, when a *permanent* bonfire for firing vessels gradually takes on weakly pronounced characteristics that are already typical for the *oven* firing structure. This shows itself in the following. The initially flat area of a permanent bonfire used by female potters of Ghana (Africa) eventually gets a small depression due to repeated removal of ash. This depression was not filled in, but was used to place fuel (Molina et al., 2018. p. 124). Later, when the potters of the next generation needed to build a new permanent bonfire, they already didn't do it on a flat platform, but in a small depression, which they made on purpose, simply copying the shape of the old bonfire. Such a small depression made almost no sense functionally, but they kept making it and there are many examples of this in ethnography. I will give only some, based on the materials of the African continent and Central Asia.

A female potter of the Rundi tribe (Burundi), places a certain number of fired pots with the mouth down in a flat depression which remains open, then lays the branches crosswise on which she puts the pots to be fired (Drost, 1967. S 222); the Kotoko female potters (Chad) make depressions in the ground which are 30 cm deep and have a diameter of 200 cm, the vessels are placed on a thick layer of straw and are completely covered with straw and wood. The firing lasts about three hours (Drost, 1967. s. 228). Women living in Bugufi on the shore of Tanganyika Lake make a flat depression about 250 cm long, 125 cm broad and 23 cm deep. The bottom is covered with wood and grass. Pots are placed on top of them, close to each other, followed by an intermediate layer of grass and a second row of pots, surrounded with the same grass, and finally everything is covered with wood (Drost, 1967. s, 229). According to R. Vossen, in Morocco the bonfires 10 to 30 cm deep had a diameter of about 2.5 m and their perimeter was lined with stones (Vossen, s. 168-171, Abbs. 20-23).

The firing of vessels, observed by N. A. Kislyakov near the village of Safidoron in Tavil-Dar in Central Asia, was carried out on the edge of the village. First, the women made a small oval-shaped depression in the ground and threw crushed dung patties into it, on which vessels prepared for firing were placed (Cave, 1959, p. 41).

According to my calculations of quantitative data available in the ethnographic literature, such slightly recessed bonfires include structures with the depth-diameter ratio less than 0.3. All structures dug into the ground with the depth-diameter ratio more than 0.3 and all structures above the ground level with a permanent enclosing wall belong to the oven structures.

### *1.3.5 Mixed Traditions of Firing Vessels in Bonfires*

Along with such anachronisms, examples of building bonfires with a more complex structure are known in ethnography. In particular, there is a description of a very original bonfire for individual firing of a vessel: on the island of Panaeati, a woman builds a platform made of wood placed crosswise in the bonfire, three

stones (or coral) are placed on it, and a vessel meant for firing is laid on its side on these stones(May,Tuckson,p. 96-97). The reverse is also known. In the same New Guinea, in the village of Mindire (Madang Province) 4 stones are placed at the corners of a square with a side of 1-2 m for firing several vessels (up to about two dozen). A platform made of wood is built on them and covered with palm leaves. Vessels covered with large tufts of dry grass are placed on it. Firing lasts 25-30 minutes, the vessels are removed still red-hot and they cool in the air. Approximately the same method of building a bonfire is used by female potters of the village of Aibom in Central Sepik Province (May, Tuckson, pp. 170-171, 238).

The Tikar and Rundi tribes in Africa placed stones or sherds of old vessels on the lower layer of fuel, or, on the contrary, the lower layer of the platform consisted of old fired or flawed vessels placed upside down, and the upper layer consisted of fuel wood, on which new vessels meant for firing were placed (Drost, 1967. s. 222, 225). In Tunisia, the layer of fuel was covered with stones, on which vessels meant for firing were placed (Balfet, 1977. p. 335).

Potters from Guatemala first made a platform of twigs, it was covered with sherds of old pots, and then they put vessels meant for firing on them (Arnold, 1978. p. 342).

All the cases described above already reflect a *mixed* state of the pottery traditions *inside bonfire firing itself*, associated, on the one hand, with the tradition of placing vessels on an incombustible platform of stones, corals, large fragments of crushed vessels or of the intact old vessels, and on the other hand, with the tradition of placing a vessel to be fired on the platform (often multilayered) made of wood or light fuel arranged crosswise.

### *1.3.6 Mixing of Traditions of Firing Vessels in Bonfires and in Ovens*

According to ethnographic data, there are cases reflecting the mixing of traditions not only within the framework of bonfire firing itself, but also the mixing of traditions of firing vessels in a bonfire and an oven. This is manifested in the incorporation of some elements of the oven into structure of the bonfire.

For example, the female potters of Central Asia edged the borders of the bonfire with stones and lumps of clay. A wall of dung patties was made on top of the stones along the perimeter (Peshchereva, 1959. pp. 40-41). The batch of vessels to be fired was enclosed in a temporary wall of old broken vessels in the Canary Islands and Peru (Druc, Velde, 2021. p. 181) (Fig. 6:1). There in Peru some potters built a wall 30-50 cm high of stone and raw brick along the perimeter of the bonfire at a distance of 20 cm from the batch of vessels meant for firing. The gap between the wall and the vessels was filled with dry manure (Chávez, 1984-1985. pp. 170-172). In India, potters built bonfires with two horizontal channels running along the bottom of the bonfire and intersecting at right angles (Fig. 6:2). These channels were not dug in the ground, but were made thanks to a special placement of fuel. The firing in this case lasted from 12 hours to several

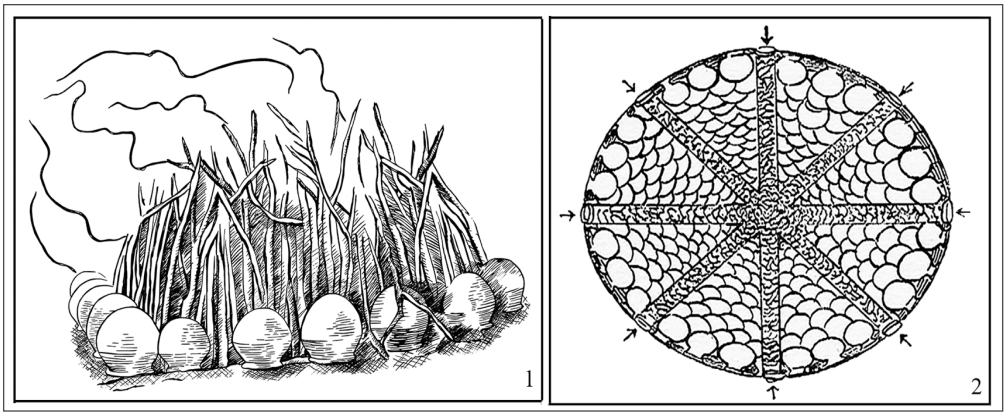


**Figure 6.** *Mixing of traditions of firing in bonfire and in oven: 1 - the Canary Islands (photo-based sketch: Lara, 2018, p. 85 Fig. 11c), 2 – layout of horizontal flues in bonfire, India (Saraswati, Behura, 1966. p. 105)*

days (Saraswati, 1979, p. 10; personal observations of P.R. Kholoshin in 2019).

### *1.3.7 The Mixing of Traditions of Firing in Bonfires and in Stoves*

as in the previous case, is manifested by incorporation of individual elements of stoves in the structure of bonfires. Both permanent walls along the perimeter and a permanent dome are integral to the structure of stoves as specialized firing devices (Bobrinsky, 1991. p. 96). I will give some examples when elements of the stove structure incorporated into bonfires were not permanent, but temporary. In Mali a mound of vessels meant for firing and fuel was covered with

**Figure 7.** *Mixing of traditions of firing in bonfire and in stove: 1 - firing vessels under the cover of sherds (Gallay, Huysecom, Mayor, 1998. Pl. 2, 7), 2 – firing vessels under the cover of the sheets of glass wool, India, 3- India, vertical heating flue (2-3 - Photo by P. R. Kholoshin)*

large sherds of old vessels (Fig. 7:1). The top layer of fuel was additionally coated with clay in India, as a result of which a temporary artificial dome was made over the vessels meant for firing (Saraswati, 1979. p. 10), and nowadays the bonfire is covered with sheets of glass wool from above (Fig.7:2). Another feature of stove (and later pottery kiln) structures for firing is the construction of a central vertical heating flue either by special arrangement of vessels, or using a special ceramic pipe (Fig. 7:3).

This concludes the description of the main traditions of firing vessels.

### 1.4 Post-Firing Treatment of Vessels

Such treatment is carried out either by potters or by the consumers of pottery themselves in order to reduce their moisture permeability. There is a lot of evidence about it in the cited literature. All this evidence can be narrowed down to two main ways: 1) coconut milk, yams, taro, papaya or breadfruit, bananas, watered milk or sorrel were cooked in a fired vessel, or fatty food was cooked twice; 2) the surfaces of the vessel (often still hot) were rubbed with taro leaves, banana pulp and sweet potatoes, sago juice, raw batatas or sticky sap of the bark of a certain tree.

## 2. Conclusion

Summing up the analysis of ethnographic data, it is important to note that, despite the different natural conditions, the similarity of the bonfires structure and methods of firing vessels in different regions of the globe allows us to conclude that different peoples have some *common patterns in the functioning and development* of bonfire firing.

### 2.1 Firstly, they Include Some Patterns in the Development of the Traditions of Bonfire Firing itself

1. The burning of fuel not only around the vessels, but also inside them during firing (Fig. 8:1, 8:2) comes from the tradition of thermal drying of the vessels on the interior by making a fire inside the vessel. Later it is replaced by lining the vessel with fuel only on the exterior (Fig. 8:3).

2. The connection of individual firing of vessels in a bonfire with household heating devices shows itself in drying and firing of vessels in the cooking hearth or in the place of the former household bonfire.

3. Anachronisms of individual firing of the vessel are manifested: 1) in the consecutive firing of vessels in

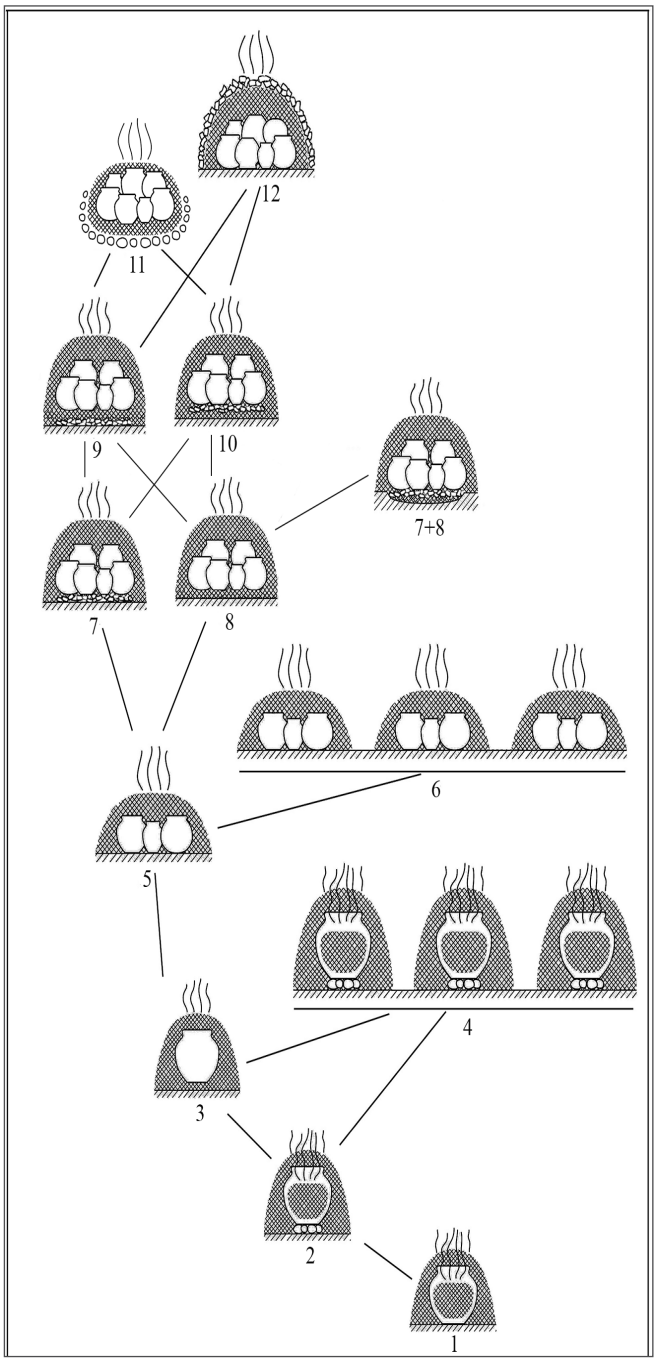


**Figure 8.** *General schema of the development of bonfires meant for pottery firing*

the same bonfire; 2) in the construction of separate platforms for several simultaneously fired vessels (Fig. 8:4); 3) in the firing of several vessels on one platform, when each vessel is covered with a separate portion of fuel; 4) in the firing of 2-4 vessels in one bonfire (Fig.. 8:5); 5) in simultaneous firing of several groups of vessels with 3-4 items in each of them (Fig. 8:6).

4. Further development is associated with the firing of several dozens, hundreds and even more vessels in one bonfire (Fig. 8:7, 8:8). Apparently, these gradual changes were associated with the transition of potters from home and specific order production of vessels to the work on the market.

5. As already noted above, the unintentional deepening of the bonfire's bottom, resulting from the removal of ash after each firing, leads to the fact, that young potters when building a new bonfire simply copy the old one, as a result of which such a depression is artificially made from the very beginning (Fig. 8: 7+8). It serves as the border of the bonfire and the space for laying fuel and placing vessels.

### *2.1.1 Secondly, the Processes of Mixing Traditions Play a Great Role in the Development of Firing Techniques*

1. *The mixing of different bonfire traditions* is manifested in the construction of a platform made of

fuel on several stones or the distribution of fuel on top of a platform made of stones, sherds or vessels (Fig. 8:9) and vice versa, in placing vessels to be fired on stones or fragments of ceramics laid on top of a platform made of fuel (Fig. 8:10).

2. *The mixing of bonfire and oven traditions* is manifested in the construction of two intersecting horizontal heating flues. In the ovens, such flues function as an air control in order to raise the temperature on the vessels being fired. The same mixing is reflected in the construction of a temporary wall (made of clay, stones, raw bricks or old vessels) around the perimeter of the bonfire (Fig. 8:11), since such a permanent wall is integral to the oven structure.

3. *The mixing of bonfire and stove firing traditions can be traced:* firstly, in the construction of a vertical heating flue in the bonfires, because it is during firing in a stove (and later in pottery kiln) that vessels are often placed along the periphery of the chamber, leaving the central space free for the flow of hot gases; secondly, in making a temporary dome of clay, sherds and other materials over the bonfire, contributing to the concentration of heat on the vessels meant for firing (Fig. 8:12).

### *2.1.2 Thirdly, the General Conclusions about the Development of the Traditions of Bonfire Firing Are as Follows*

1. The general trend of the ***economic*** development of the bonfires is manifested in the transition from firing one vessel to firing a small and then a significant number of vessels in one bonfire.

2. The general trend of the ***structural*** development of bonfires meant for firing ceramics consists in the transition from placing vessels on the ground (very rarely) or on a separate platform for each item (made of stone, clay or fuel) to the construction of a single platform for all vessels to be fired.

3. The development resulting from the ***mixing of traditions*** takes place, most likely, due to the contacts of the bearers of the traditions of bonfire firing with bearers of oven-firing, on the one hand, and stove-firing traditions, on the other hand.

### *2.1.3 Some Archaeological Attributes of the Bonfires for Pottery Firing*

It is well known that various traces of any bonfires are frequently found during archaeological excavations of sites of different times, primarily early man sites. Which of these bonfires are more or less likely to be associated with ancient pottery production? Here we can point out some of the attributes outlined as their importance decreases:

1) The most reliable attribute of a bonfire meant for pottery production is wasters, i.e. fragments of vessels deformed under the influence of high temperature.

2) Numerous fragments of vessels exposed to “secondary” fire (Bobrinsky, Volkova, Gay, 1993. pp. 14-15).

3) Traces of a fired platform made of clay or stones at the base of the bonfire, or “paving” with ceramic fragments discolored by temperature from the upper side.

4) The perimeter of the bonfire with a diameter of more than one meter lined with stone with traces of temperature exposure from the inside.

5) Big piles of ashy residues around the bonfire.

6) Bonfires meant for pottery production are usually located outdoors and are noticeably larger in size compared to household ones.

At the same time, we should bear in mind that any of these attributes, taken alone, cannot serve as a reliable basis for conclusions. The more of these attributes will be detected in one place, the more reliable conclusion will be drawn, respectively.

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