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THE BEGINNINGS OF POTTERY TECHNOLOGY IN VIETNAM BASED ON FINDS FROM THE XOM TRAI CAVE IN THE HOÀ BÌNH PROVINCE

ABSTRACT: In the caves of South East Asia, artefacts from the Pleistocene period known as the Hoabinhian culture are found. They also include the oldest evidence of using pottery technology in this region. The adoption of the new technology can be seen as a deeper specialization within the hunter-gatherer economy. The use of pottery facilitates and accelerates the thermal processing of food (i.e., cooking or possibly roasting). In addition, some foods require prolonged or repeated cooking; otherwise, they may be toxic or difficult to digest. The article analyzes vessels fragments from the XomTrai Cave and additionally from the Hiem Cave – both in Hoà Bình Province in Vietnam. Based on physical characteristics, four formal and technological groups were distinguished, corresponding to three phases of use. The first is related to the decline of the Hoabinhian communities – the so-called Dabutian (the Da But culture), the second with the early Neolithic Phung Nguyen culture (or horizon), and the third with the early Bronze Age Go Mun culture.

KEYWORDS: Hoabinhian culture, foragers, ceramic technology, skeuomorphism, Vietnam.

1. INTRODUCTION

In the caves of Vietnam and the adjacent parts of South East Asia, artefacts (mainly lithics) from the Late Pleistocene and Holocene periods, known as the Hoabinhian culture (Colani 1927; Gorman 1971; Moser 2001; Forestier *et al.* 2015), have been found for about 100 years. This primarily concerns large, flat, and long, largely unifacial cobble tools, which are treated as a technocomplex (see Gorman 1970; Pookajorn 1990, 25; White and Gorman 2004, 437; Rabett *et al.* 2011) that existed in a tropical forest environment for more than 30,000 years. The oldest known Hoabinhian site is the Xiaodong rock shelter, Yunnan Province in southwest China dated to ca. 43 500 BP (Ji *et al.* 2016). The earliest finds in Vietnam come from the Tham Khoung Cave, Lai Chau Province, from 33 000 BP (Khol, Quitta 1978; Nguyen V. 2004; Borel 2012). In the Hoà Bình Province, the earliest material of this type came from Hang Cho Cave – ca. 19 500 BP (Yi *et al.* 2008). The oldest pottery finds in South East Asia were recorded in the youngest chronological levels of such sites. In northern Vietnam, these arte-

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facts are traditionally associated with the latest phase of this grouping (the so-called Hoabinhian with pottery) from the middle Holocene. Initially, they were referred to as the Bacsonian (Mansuy 1924; Mansuy 1925a; 1925b), and later as the Dabutian due to the finds from the Da But site (Patte 1932; Nguyen 2005). Generally, these terms describe the same pottery. The question is how the hunting-gatherer communities exploiting the jungle at that time acquired pottery vessels. Similar issues also apply to the following Neolithic and Bronze Age forest nomadic groups. The reasons for the acceptance of ceramic technology and the exact chronology of this process still remain unknown. There is also an issue why ceramics, invented in Southern China (18 or even 20 thousand BP), at first expanded in every direction but not south – to South East Asia (Kuzmin 2015; 2017, fig. 2; Tse 2018, 1-2). So far, the oldest, not very numerous finds of pottery from Vietnam are known from 9000 BP – to 6000-5500 BP and are connected with the late Hoabinhian culture or its continuation – Da But culture (Nguyen V. 2005; Nguyen K.S. 2009, 42-45; Tan 1984-1985). Moreover, the acceptance of new technology is also an intellectual process. This aspect will therefore also be analyzed from the cognitive point of view.

2. MATERIAL AND METHODS

In the Xom Trai Cave (Tân Lập commune, Lạc Sơn district, Hoà Bình Province) (Fig. 1), pottery was recorded only in the upper layers (Nguyen *et al.* 1982). However, it was not deposited in its original context. The youngest layers were mixed in modern times during the exploitation of guano, soil, etc. Thus, the chronology was determined mainly based on formal features. In total, 697 fragments were found, but none of them allowed for the reconstruction of the complete vessel form. The pottery was analyzed with the naked eye. The basis of the classification was: texture of the surface, decorations, the way of production and ceramic mass used. The type of firing was also taken into account. Based on the macroscopic observations of pottery, four formal and technological groups were distinguished, which correspond to three chronological phases of use. The first is related to the decline of the Hoabinhian communities – the so-called Dabutian (the Da But culture), the second with the early Neolithic Phung Nguyen culture (or horizon), and the third with the early Bronze Age Go Mun culture. It has been assumed that hunter-gatherer groups of Hoabinian ancestry successively used all these types of pottery. They probably took them over from neighbouring groups.

2.1. The Da But type pottery

The exact chronology of such finds is the subject of a debate (see discussion below). The oldest are dated to 9000 BP. Finds associated with this grouping (see Nguyen V. 2005) comprise thick-walled pottery. Eighty-three fragments classified in this way were found, including 75 body sherds and eight rims. They have a thickness of approx. 6 to 20 mm. Thinner specimens are the near rim parts, while the body sherds are clearly thicker. There were no base or bottom parts recorded. The rims are straight, sometimes slightly bent outwards. Their shape suggests that the vessels they came from had large diameters, ranging from 30 to 60 cm. Body sherds in section have very gentle semicircular shapes; hence, they were pot-shaped or barrel-shaped vessels. Both the size and thickness suggest that they were tall specimens – at least about 50 cm. The texture of the outer surface was shaped by bark impressions or possibly by processing with small spatula impressions (see Ha V.T. 1984-1985, 135; Nguyen V. 2005). They comprise parallel grooves impressed by the individual fibres (Fig. 2: 1-3). Most often, however, they crossed to form a specific irregular grid. Only at the rim was there a part without them – in one case, a specially separated smooth band was found (Fig. 2: 4). There were found six body sherds with a differently developed surface. It is not exactly smooth – it was polished with a bunch of grass or leaves – as evidenced by longitudinal lines with clearly visible fine parallel lines left by plant fibres. Characteristically, the inner surface of most of the vessels was also processed in this way. The clay fabric was tempered by adding coarse-grained (up to 4 mm in diameter) river sand. The grains have a smooth, rounded shape, which makes the clay stick to them poorly. That is why such pottery is brittle and not very resistant to mechanical damage. The inner surfaces of the vessels also show a few tiny pores indicating the presence of an organic admixture. It is unclear whether it was intentionally added or whether uncleaned clay was used. The vessels seem to be made of previously prepared bands (or coils), which is evidenced by specimens showing an evident change in thickness – this is probably where they were connected. In addition, the presence of fragments with a shape similar to

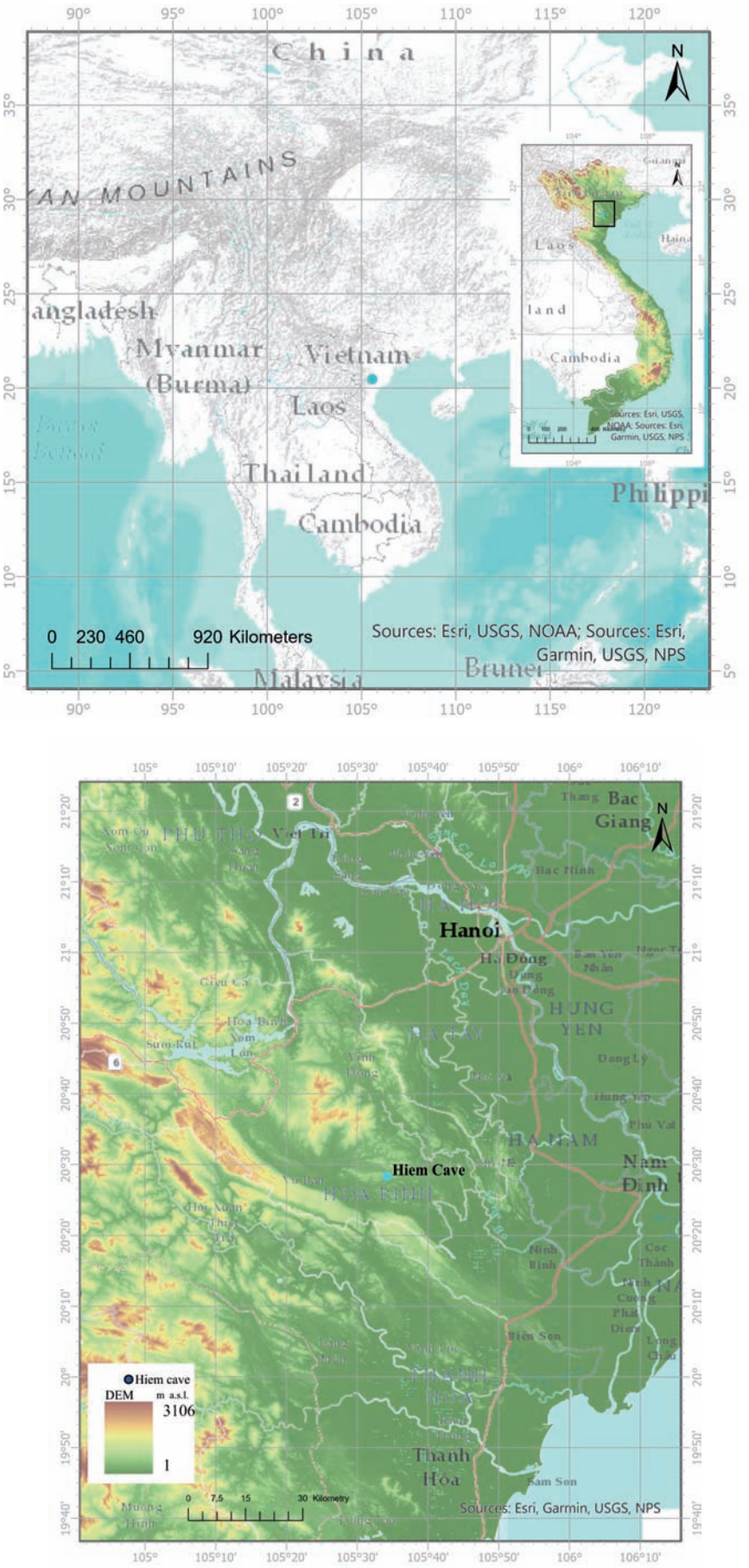

Fig. 1. Site locations plotted on the map of northern Vietnam

Fig. 2. Xom Trai, Vietnam. Ceramics of the Da But type

a rectangle was recorded – hence they probably broke along the lines of the joins between bands. The colour of the vessels in question ranges from black through tawny to brick red. Thus, firing took place in a changing and inconsistent atmosphere. It seems that it was not fully controlled. Different colours may be visible in the section of one sherd: from brick red and tawny to black. However, the pattern of their occurrence may be different. Hence, the atmosphere could have been reducing first and then oxidizing – or vice versa.

Probably these forms were fired in hearths; therefore, the type of firing depended on the strength and direction of the wind. These vessels do not produce a loud sound when struck, and they are not very hard. Hence, they were probably fired at a relatively low temperature. In combination with the empty pores resulting from burnt plant admixture, it made the fabrics less compact. Some fragments have traces of fire or secondary firing. However, it is not clear why they were formed. Is may be a result of the vessel's use (for example for cooking) or post-depositional processes.

2.2. The Phung Nguyen culture pottery

This grouping is dated to around 2000-1500 BC (Higham 1996, 86-89; Nguyen V. 2010). Within the collection classified in this way, two formal and technological groups were distinguished.

The first of them is thin and medium-walled pottery with a polished surface. Eighty-six such fragments were found, including 85 body sherds and one base. The pottery in question is characterized by a thickness from 4 mm to approx. 10 mm. This significant variation suggests that the vessels of this group were used for different purposes. Its main features are polished outer surfaces and the absence of any decoration (Fig. 3: 1-4). All analyzed specimens were fired in an oxidizing atmosphere – and this is a clear distinctive feature of this group. They are coloured in various shades of red. The clay fabric contained sharp-edged quartzite fragments and grog. The obtained material consists mainly of body sherds and one unseparated base.

The second group is pottery with shiny surfaces: 85 fragments classified in such a way were found, including 69 body sherds and 13 rims (Figs. 4; 5). This material has a sherd thickness of approx. 3 to 10 mm. All vessels classified in this way were fired in an oxidizing atmosphere and they have a distinctive brick-red colour. The basis for distinguishing this group was the clear shine of the surface. The method of obtaining it has not been determined. Probably, however, such an effect was achieved by smoothing it with a hard and flat tool. It was found that in some cases, the inner and outer surfaces were covered with a thin film (less than 0.5 mm thick) darker than the inside of the vessel wall's section. In one case, the inner surface was slipped with white kaolinite clay (Fig. 4: 2). On the outer side of the same fragment, only selected parts covered with such ornament were decorated. The clay

Fig. 3. Xom Trai, Vietnam. Pottery of Phung Nguyen culture. First group

Fig. 4. Xom Trai, Vietnam. Pottery of Phung Nguyen culture. Second group

Fig. 5. Xom Trai, Vietnam. Pottery of Phung Nguyen culture. Second group.
Fragmentarily preserved vessels

fabric was tempered with sharp-edged quartz grains, but also biotite and muscovite were added. As a result, the bright surfaces gained an additional shiny element. This group is also characterized by elaborate decoration (Figs. 4: 1, 2). Several repetitive motifs were used. The stamped decoration was made of circles impressions (probably made using hollow plant stems) placed on the upper edges of the thickened rims. On

the surfaces of the vessel walls, however, impressions in the form of triangles or small holes were made. The execution of engraved lines, both straight and curved, was also noted. In addition, impressions of tree bark were used or imitated by making a hatch pattern of parallel lines (most likely by tapping with a small spatula) (Fig. 4: 4). These motifs were composed by distinguishing zones filled with decoration with the help of deeply engraved lines (Figs. 4: 1, 2; 5). As a whole, they formed curvilinear patterns created with semi-spiral motifs. As already mentioned, in one case, this zone was additionally covered with kaolinite.

Two larger fragments of vessels were recorded in the examined material. The first case is a small biconical specimen decorated with a zonal ornament (Fig. 5: 1). The second one was a form with a straight-edged rim, and the outer surface was also decorated with this kind of ornamentation (Fig. 5: 2). There were also noted four thickened rims from vessels with inwardly folded walls (bowls?). In three cases, their upper edges were decorated with a stamped decoration (Fig. 5: 3). Two straight-edged rims were slightly bent outwards. It should be added that a pottery disc found in this cave is characterized by a similar firing and clay paste (Fig. 4: 5).

Due to the careful and sophisticated masnner of manufacture, and in some cases also very thin walls, it seems that such pottery was used not only for thermal treatment but also for direct consumption. It cannot be ruled out that its use was rather prestigious than purely utilitarian.

2.3. The Go Mun culture pottery

This grouping can be widely dated around 1500-500 BC (Ha V.P. 1993; Higham 1996, 97-100). Four hundred and forty-three such classified fragments were found, including 438 body sherds, one base, and four rims – medium and thin-walled fragments were noted among them (Figs. 6, 7). They are characterized by a thickness ranging from 4 to 7 mm. Some of the analyzed fragments are secondarily fired, and additionally, they are friable, which is caused by prolonged exposure to humid conditions. In addition, the pottery is mainly fragmented. Hence the shape of the vessels from which the sherds recovered came was not determined. In three cases, it was noted that the body sherds were parts of biconical forms. In one case, this was additionally emphasized by a surrounding cordon (Fig. 6: 4). The only recorded bottom has a strongly separated base (Fig. 6: 6). The rims have various edges: twice straight and slightly thickened (Fig. 7: 4), while another one has a marked surrounding cordon (Fig. 6: 7). The outer surfaces of the vessels are covered with a decoration made by impressing tree bark (Fig. 7: 3) or using a small spatula (Figs. 6: 1-2, 5-6; 7: 1, 2). They are parallel lines created as a result of the impression of the fibres. Most often, they form a kind of grid. A different depth characterizes these impressions – therefore, they were probably made using the bark of various tree species. On larger fragments, they create geometric patterns using triangular motifs. In one case, the imprints were found to be made by a cord (Fig. 6: 3). It seems that decoration covered almost whole vessels except for the rim parts. Very few fragments without decorations were found. The inner surfaces were smoothed with plant bunches – as evidenced by traces of strokes identified several times. The pottery in question is characterized by a colour ranging from black through brown to light red. The firing could therefore take place in an oxidizing, reducing, and variable atmosphere. Compared to the previously described groups, this pottery was clearly harder, which indicates that the firing temperature was significantly higher. An admixture of grains up to about 2 mm in diameter was noticed in the clay fabric. The presence of sharp-edged quartz sand was found – grog or particles of sandstone appeared sporadically. The vessels were made by hand. Rectangular-shaped fragments were recorded multiple times, suggesting that the vessels were made of bands.

2.4. Pottery from the Hiem Cave

Similar ceramics comes from the Heim Cave (Xã Bình Hẻm commune, Lạc Sơn district, Hoà Bình Province) inhabited by people of the Hoabinhian culture also (see Masojć *et al.* 2023). Only three pottery fragments were found there. The first one is a fragment of a rim (Fig. 8: 1). It was thickened by applying thin layers of clay on both sides, which were subsequently smoothed. The surface below it is covered with wide vertical grooves visible on the inner and outer surfaces; they were probably made with the paddle and anvil technique. The described fragment is grey in colour, which is probably the result of secondary firing. The ceramic fabric was tempered with sharp-edged quartz (the grains' diameter reaches up to ca. 2 mm). The object may be connected with the Da But culture of the late Hoabinhian populations.

Fig. 6. Xom Trai, Vietnam. Ceramics of Go Mun culture

Fig. 7. Xom Trai, Vietnam. Ceramics of Go Mun culture

Another fragment, a part of a body sherd (Fig. 8: 2), is decorated with an ornament of vertical lines – probably impressed tree bark (bamboo shoots?). The vessel from which the fragment comes was fired in a changeable (first reducing and then oxidizing) atmosphere as the inner and outer surfaces are brick-red and dark brown, while the break displays a black colour. The ceramic fabric contains an admixture of sharp-edged quartz sand. Small amounts of mica (possibly present in the sand) were probably also added, which is substantiated by small glistening grains seen on the surfaces. It seems that this artefact may be identified with the Phùng Nguyên culture. It corresponds to the second group recognized in the Xom Trai cave.

The next specimen is a fragment of a body sherd decorated with bark impressions (Fig. 8: 3). The fragment was fired in an oxidizing atmosphere, which is substantiated by its brick-red colour. Sharp-edged grains of quartz sand and small fragments of calcareous rock are visible in the ceramic body. The fragment may be connected with the early Bronze Age Go Mun culture.

Generally, in the Hiem cave, the ceramic artefacts show the same culture sequence as in the Xom Trai cave.

Fig. 8. Hiem. Vietnam. Ceramics fragments: 1 Da But culture; 2 Phùng Nguyên culture; 3 Go Mun culture

3. DISCUSSION AND CONCLUSIONS

3.1. Chronology

Pottery from caves with Hoabinhian stone artefacts has traditionally been treated as one of the manifestations of the slow process of Neolithisation in the South East Asia region (Mansuy, Colani 1925). According to J. Moser, the vessels made this way appear in the declining and final stages of the Hoabinhian – i.e., in the youngest layers in caves and rock shelters. For this reason, they were most susceptible to later, and especially modern, destruction. Therefore, their chronology is difficult to establish clearly. Its appearance is to be evidence of a slow abandoning of the hunter-gatherer economic model. It is supposed to be part of a broader process of economic change leading to the domestication of plants. The beginnings of this phenomenon date back to around 7000 BP (Moser 2001, 33-34). According to V. Nguyen, the earliest (very sparse) Hoabinhian pottery comes from the Con Moong Cave and is dated to around 9000 BP. It comes from a layer defined as the III cultural level, dated to 8500-9200 BP (Nguyen K.S. 2009, 42-45, Fig. 5, Photo 4). Such pottery could be associated with the people of Da But culture, whose beginnings are dated to 8000 BP and declined in around 4000 BP. According to this researcher, they were actually groups of the Hoabinhian culture population that changed their economic strategies. The latter is shown by the adoption of new technology for vessel production. However, the pottery itself was to appear mainly in its prime, i.e., around 6500-5500 BP. At that time, fragments decorated with vertical strokes occurred. In turn, imprints of tangles appear in the younger stage (Nguyen V. 2005). Ha V. T. sees these issues similarly, but for him, the strokes on the earliest Hoabinhian pottery were created as a result of imprinted bark or creeper. Later, however, cord imprints appeared (Ha V.T. 1984-1985, 135). The pottery found in Lai Cave, in turn, has cord imprints and traces of small spatula but is also better fired than the forms from Con Moong. It was considered a bit younger than the Da But culture - but it is also associated with the Neolithic period (Phan 2009, 57-59, Photo 5). Similar pottery finds from Spirit Cave in Thailand appeared around 7000 BP (Gorman 1970, 96-98; 1971, 303). Further obtained dates are Banyan Valley Cave (5360 +/- 120 BP, cal. BP 4406-3960) in Thailand, Laang Spean (ca. 4290 BC or 6240 +/- 70 BP, cal. BP 5616-5461) in Cambodia, and Pada-Lin Caves (7740 +/- 125 BP, cal. BP 6864-6393) in Myanmar (Lim 2018, 1-2).

3.2. Genesis

The emergence of pottery in the late Hoabinhian population is part of adopting this technology by hunter-gatherer communities. This phenomenon has been the subject of ongoing discussions in recent years. In general, it can be indicated that before 10000 BP, pottery was used in large areas – in Japan, China, and the Russian Far East. It was from these areas that it would spread westward through Siberia. Along with this cultural current, it reaches the Mesolithic groups of the forest zone of central, eastern Europe and the circum-Baltic zone (for example the Ertebølle culture), creating the so-called Mesolithic with pottery (Jordan, Zvelebil 2009; Gibbs, Jordan 2013; Hommel 2009; Gronenborn 2011, 73; Cohen 2013; Kuzmin 2015; 2017; Dolbunova *et al.* 2022). Despite discussions about the correctness of dating, the finds of pottery from southern China are most likely the oldest – around 18000 BP, even up to 20000 BP (Boaretto *et al.* 2009; Kuzmin *et al.* 2009; Cohen *et al.* 2017; Wu *et al.* 2012; Kuzmin 2017, Fig. 2; Lim 2018, 1-2). Moreover, in this area, one can look for inspiration for the Da But culture groups. However, it should be noted that the Chinese finds are much earlier – the process of accepting the new technology was therefore very long. Characteristically, towards the north and later to the west, this process was much faster. Generally, it is indicated that the Da But type pottery resembles the finds of the south Chinese Ding Shi Shan culture developing in Guangxi Province dated to 9000-7000 BP (Zhu *et al.*, 2021). The same applies to stone tools and the burial rite (Chung 2011, 32-33). Characteristically, the younger pottery of the Phung Nguyen culture refers to the contemporary cultures of southern China – especially to the Tian region (Chung 2011, 35-36). It seems, however, that the new technology does not necessarily mean a profound change in the economy of that time. On the contrary, it is within the scope of the hunter-gatherer economy that it enables fuller exploitation of resources. First of all, it significantly facilitates and accelerates the thermal processing of food (i.e., cooking or possibly roasting). Of course, it is possible to achieve this without pottery. However, it requires more work and is less effective – for example; one can throw hot stones into organic vessels filled with water (Nelson 2010).

Moreover, some foods require prolonged or repeated cooking; otherwise, they may be toxic or difficult to digest (Nguyen G.D. 2011, 23). In addition, the recognized diet of the Hoabinhian groups, as well as the Da But culture population, was to consist mainly of products from the exploitation of water-bodies – they were snails and crabs (Nguyen V. 2004, 454-462; Nguyen G.D. 2011, 22-29). They also require thermal treatment – which was significantly facilitated by pottery vessels (see analysis: Craig *et al.* 2013). Thus, the adoption of pottery was an innovation that can be seen as a deeper specialization within the hunter-gatherer economy. Semi-nomadic groups of people known as Negritos, Maniq, or Semang, living in the jungles of South East Asia, function similarly to this day (Brandt 1961; 1965; Gomes 1982; Higham 2013). According to the results of ethnoarchaeological research and recent genetic studies, they are distant descendants of the Hoabinhian communities (Pookajorn 1991; 1994; Hongo, Auetrakulvit 2011; McColl *et al.* 2018). Probably such hunter-gatherers left pottery in the caves. And they probably also used the vessels of successive sedentary agricultural cultures (Phung Nguyen and Go Mun). It is probable that groups with different economic strategies operated at the same time but occupied different ecological niches (see discussion: Higham 2017). This model residually survived until the 20th century. Rice – the essential crop could only be cultivated in plains and valleys. The mountain ranges remain covered with rainforest to this day.

Thermal treatment as the main cause of the appearance of pottery is also indicated by the shapes of the earliest vessels recorded in various cultures. Vessels with a conical or semicircular bottom occur in the Mesolithic and the Neolithic from China to Europe (Hommel 2017). They were designed to maximize the use of the hearth's temperature (see discussion Crombé *et al.* 2011, 478). Apart from the pointed or slightly semicircular bottom (and, of course, the rim), they could have been surrounded by fire or embers on all sides. In order to stabilize them, they did not have to be driven into the ground (apart from the very tip) – three/four correctly positioned stones in the hearth are enough to hold them upright. Notably, they also accumulated temperature, which had a positive effect on thermal treatment. However, it is essential to note that cooking is more important in a cold climate – warm foods (especially semi-liquid ones) warm one up. This saves energy used to maintain a constant body temperature. Without such foods, the diet would have to be more caloric. Therefore, their consumption significantly improved the energy balance of both individuals and entire groups. This appears to be the primary cause of the rapid widespread of pottery in Siberian areas. The further south, avoiding body overheating

becomes the more significant problem (especially in the warm season). Therefore, the adoption of pottery technology in the south was delayed. It allowed for better exploitation of the environment – but it did not significantly improve the energy balance.

3.3. The nature of innovation

It has long been pointed out that in traditional societies, technology was inextricably linked with ideology, and technological know-how cannot be separated from social, mythological or cosmological context (Hawkes 1954; Gell 1992). Such an approach to prehistoric artistic expression is also confirmed by Aristotle's reflections on the tendency of people to imitate – mimesis (Poetics 1447a-1450a). According to this philosopher, it is the basis of the learning process and cognitive activity. He also understands art as imitation. Its quality (regardless of the media used) is to be manifested precisely by resembling the phenomena represented as closely as possible. Therefore, it was assumed that the form and ornamentation of ceramics were, at the same time, the result, materialization, and record of the way of thinking. It seems impossible to make any object without any prior idea or plan. Such a hylomorphic model of creation, i.e., combining form (*morphe*) and matter (*hyle*), goes back to the origins of dividing activity into episteme and techne, presented in the Nicomachean Ethics by Aristotle. In a very general framework, this corresponds to the modern division into theory and practice. According to T. Ingold, such assumptions mean that the creative process – action - remains undervalued. The processing of matter is also a creative mental operation (Ingold 2010) – it concerns ceramics also.

As mentioned above, the adoption of the pottery manufacturing technology was most likely due to its utilitarian qualities very useful in the hunter-gatherer economy system. However, the decoration or the way of working the surface was already a choice that could have had completely impractical reasons. It seems that they may be evidence of the intellectual processes taking place at that time. For many decades, there has been a discussion about the ways of thinking of the traditional culture's people (Goody 1988). It was assumed that the traditional or archaic way of thinking (Lévi-Strauss 2001) clearly differs from the modern, i.e., rational mind. Despite various opinions on this subject, it is possible to point out significant structural differences characteristic of primary languages. It is pointed out that such a phenomenon may result in a different way of reasoning and acting (see Sapir 1978; Lee Whorf 2002). In general, according to L. Lévy-Bruhl, the languages of primitive peoples precisely describe shapes, position, movement, and manner of operation in the space of individual objects, people, and animals. Thus, they have a visual character; hence the descriptions refer primarily to the sense of sight (Lévy-Bruhl 1992, 182-195; see also Lévi-Strauss 2001, 9-27). Moreover, according to F. Boas, they were characterized by a not very extensive network of abstract concepts – they referred to really functioning phenomena (Boas 2010, 180-182).

Assuming that prehistoric communities used languages of this kind, it determines the method of analyzing archaeological artefacts. Since the intellectual, cognitive apparatus of that time described real objects in great detail, the texture of the vessels also had to be noticed and constituted a crucial distinctive element. As already pointed out, the surfaces were formed by tree bark impressions. Moreover, they could form a kind of grid or net. This does not result from the requirements of pottery technology, and it was a completely conscious choice. Visually they resembled vessels made of organic materials. Most likely, they were prepared from tree bark – often in the form of interwoven bands. In the case of the Hoabinhian, there is no archaeological evidence for this, but it appears that wickerwork was one of the oldest technologies known to humankind. The traces of its use are known already from the Palaeolithic in Europe. The oldest traces are connected even with the Neanderthals (Hardy *et al.* 2020). The most spectacular examples are the braided hairdos of figurines representing women, e.g., the famous Venus of Willendorf, Austria (Soffer *et al.* 2000; Svoboda 2008, 210-211, Figs. 38, 41). The imprints of wickerwork on clay accidentally scorched in hearths are also known from that time (Adovasio *et al.* 1996; Adovasio *et al.* 1999; Králík *et al.* 2008). Similar finds also come from the Palaeolithic and Mesolithic layers in Spain's Coves de Santa Maira cave (Aura Tortosa *et al.* 2019). This technique was most likely used to make vessels, mats, clothes, and other everyday items. The weaves used also forced the creation of specific patterns – most often, they used rectangular or triangular motifs. As it seems, this is the primary cause of the so-called geometric patterns.

The oldest Hoabinhian artefacts, which can be interpreted as an artistic expression, are also decorated in this way. In the Xom Trai Cave in the Late Pleistocene layers, two flat stones covered with an

engraved decoration were found (Fig. 9). The former was decorated with a zigzag motif repeated many times, while the latter had triangular motifs (Nguyen V. 2015, 136-137, Fig. 94: f, c). Characteristically, this type of ornamentation was created on stone and bone objects from the Palaeolithic and Mesolithic periods in Europe (Płonka 2003; 2012, 125-164). Thus, the transfer of wickerwork patterns to products of other raw materials is a long-lasting phenomenon over huge areas. Therefore, the long use of wickerwork techniques had an impact on the manner perception of the world. It is pointed out that when people draw, paint, etc., they present what they see, but through the prism of the information, they have about the represented object (Popek 1985, 25-27, 42-43, 55, 69; Arnheim 2013, 347 -357). Recreating wickerwork weaves was, therefore, an expression of knowledge about their construction.

The existence of such a phenomenon is used in contemporary design. This phenomenon, referred to as skeuomorphism, is perceptible when previously known objects are made with the use of new materials or techniques. Such artefacts often contain elements whose presence is not connected in any way with the technological process. Hence, it is a specific kind of imitation. In the case of pottery products, skeuomorphism has been recorded in the European Neolithic (Sherrat 1997, Fig. 4: 1; Palaguta 2009), and this phenomenon was perceptible until the Migration period (Gralak 2018a). It was also widely noted that the newly developed pottery technology referred to previously functioning forms of vessels made of organic materials (Rice 1999; Brown 1989). We can also consider vessels covered with impressions of cord as an example of the phenomenon of skeuomorphism. This surface treatment method is known in large areas of Eurasia. Its appearance may be associated with the widespread pottery technology in the early Holocene among hunter-gatherers (Yanshina 2016, 7; Hommel 2017, 17). Characteristically, in Indo-European languages, lexical similarities were found between the vocabulary describing weaving (and similar to its wickerwork) and pottery. This indicates that a large part of vessels was originally made of organic substances – in techniques requiring weaving (Kowalski 2014, 387-401). Confirmation of such assumptions are finds of vessels of the late Mesolithic Jomon culture in Japan. It was found that individual decorative motifs correspond to different methods of tying and braiding the cord (Zhushchikhovskaya 2007). A similar situation was recorded in the early Bronze Age in the Central Asian Andronovo culture. According to I. W. Rutkovsky, individual decoration motifs on pottery correspond to different methods of making mats or basketry vessels (Rutkovsky 2013, 42, Fig. 3). Moreover, the way the lines are made resembles

Fig. 9. Xom Trai, Vietnam. Stone artefacts

a cord impression. Most likely, then, the pottery of the Andronovo culture is an imitation of forms made using a different technique. This is evidenced by finds from the Qäwrighul cemetery in the Tarim Basin in China. Due to the unique natural conditions, objects made of organic materials have been preserved there perfectly. There were also found basketry vessels very similar in form to pottery vessels of the Andronovo culture. Most likely, these were their prototypes (Mallory, Mair 2008, 136-140, Fig. 60).

The curvilinear patterns appearing on the Phung Nguyen horizon vessels are entirely different. They can probably be associated with the beginnings of the bronzisation process (see Vandkilde 2016). During this period, the earliest traces of metallurgy occurred in South East Asia (Higham 1996, 87; White, Hamilton 2014) including Phung Nguyen horizon sites (Huyen 2004, 190). Characteristically, wherever the civilization of the Bronze Age appeared, metal objects occurred with a repeatable set of decorative motifs (see Gralak 2015; 2018b). These were curved lines, circles, and spirals of various shapes. It seems that they were transferred to pottery as an expression of a fascination with the new technology. Importantly this type of ornamentation is typical for the whole of South East Asia at that time. This kind of pottery surface treatment is known as the incised and impressed (i&i) style. Elaborate wavy designs were created by two incised lines filled with impressed or incised small motifs (Bellwood 2005, 131-132; Rispoli 2007; White 2011, 35-36).

As can be seen in the example of the late Hoabinhian finds, the phenomenon of skeuomorphism can be related to the very beginnings of the use of pottery. Characteristically, it functioned before and was perceptible by transferring wickerwork patterns to stone and bone artefacts. Thus, skeuomorphism is one of the oldest recognized mechanisms building material culture.

Another issue is the use of pottery itself. Clay firing was known as early as in the Late Pleistocene Palaeolithic. This is how the hearths in the Klisoura Cave in Greece were made, or the figurines known from the European sites of Dolne Vestonice, Tamar Hat, Vela Spila, Kostënki or Majna, and even sculptures from La Tuc d'Audoubert and Montespan, or a clay plate from Kapova Cave (Shulgan Tash) (see Hommel 2013; Kuczyńska-Zonik 2014).

It remains an open question how the innovation of making vessels in this way emerged. It can only be presumed that organic vessels were initially only sealed with clay, i.e., had surfaces coated in this way. This allowed them to come into contact with fire (embers) without any more serious damage. Probably this feature and accidental firing in the hearth were the reason for the emergence of new technology. Such a process of conceptualization of firing pottery vessels is indicated by finds from the Coves de Santa Maira cave in Spain. Some of the fragments of fired clay found there most likely just covered basketry vessels (Aura Tortosa *et al.* 2019, Fig. 5). It seems that the original techniques of forming pottery vessels are a derivative of such actions, consisting of sealing an organic form – basketry (textile), wooden or leather one (see discussion Bobrinsky 1978, 193-209; Tsetlin 2006, 1-2; 2013; 2018; 2020). In turn, the pottery of the Gromatukha culture, dated to 12000-11000 BP, from the Russian Far East, is characterized by a specific manufacturing technology, which was defined as a sandwich technique. It consists of two layers of pottery, between which there was originally an organic admixture (Yanshina 2016, 3-4). This is probably a reminiscence of sealing the walls of the vessel with clay. One may also wonder whether the techniques of forming pottery vessels from coils or bands do not result from previous methods of constructing basketry vessels (see Jordan, Zvelebil 2009). It is also pointed out that shaping vessels from clay sheets, in turn, imitates the methods of forming vessels of bark or leather (Hommel 2013, 6). It can also be assumed that the ability to make pottery resulted from a long process of technological progress – not a sudden breakthrough. According to K. G. Harry *et al.* (2009) in the North American (Arctic) Thule culture, clay pots made below the sintering temperature (600˚C) were used until the 19th century. They were dried in the sun or by fire. They allowed for cooking only due to a large amount of organic admixture and sealing with blood and fat. Similar techniques have also been reported among other hunter-gatherer communities in North America and South Africa (Harry *et al.* 2009). In general, it can be seen that the clay did not have to be fired to be used in the construction of vessels. This suggests that similar techniques could also have been used prior to the emergence of strict pottery forms.

In conclusion, the oldest pottery finds from Vietnam evidence a long-term cultural process – of global reach. It can also be assumed that conceptualizing a new technology was conditioned by intellectual processes also characteristic of many other cultures. The reason for the later adoption in relation to the neighbouring areas was a warmer climate and related different consumption strategies.

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