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Some observations on the supposed natural origin of the Divje babe I flute

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Abstract: The perforated bear femur discovered in the Divje babe I cave in Slovenia is probably one of the most debated Mousterian discoveries. Because the disposition of perforations makes it look like a flute, many researchers tried to find explanations as to how these perforations were made and a large number of studies have focused on demonstrating the natural character of perforations. Our paper present the route of this discovery reflected in studies with greater impact, as well as our observations after reviewing such studies. In the multitude of articles aiming at demonstrating the natural character of the flute, no bone with perforations has been proven to be similar to the Divje babe I one up to this moment. It seems that the possibility of the holes having been made by carnivores is even more difficult to demonstrate than the anthropic origin of the holes, even in the absence of visible tool marks.

Keywords: Neanderthal, Slovenia, flute, perforations

Introduction

Unlike Upper Paleolithic objects, all and any presumed symbolical discovery found in Mousterian sites or all any other objects which may bring new contributions in terms of cognitive capacities of the Neanderthals, requires more profound and more rigorous demonstrations so as to be recognized by the scientific community. Up to a certain point, this type of approach is very beneficial for the archeological research, especially when there are rigorous and scientific demonstrations which trigger logical argumentations. However, there are cases when discussions may take very long time frames as they are fueled by theories which are more or less documented. The most debated Mousterian discovery, as early as its publication, is probably a fragment of a perforated bear femur discovered in

the Divje babe I cave in Slovenia (I. Turk, 1997 a). According to morphological characteristics, the disposition of perforations makes it look like a flute while its publication as possibly being the oldest Paleolithic flute encouraged an impressive number of researchers to find explanations as to how these perforations were made. Twenty years have passed since this discovery, a remarkable number of papers have been published and this endeavor seems to continue for a long time going forward.

As this is a singular discovery for the Middle Paleolithic (all flutes accepted by the scientific community are considered to fall within the Upper Paleolithic), the regularity of the perforations and the quite interesting morphology required as detailed explanations as possible with a view to their ascribing to an anthropic action. As the

author of this discovery I. Turk emphasized, identification of some trenchant arguments on the flute being made by the Neanderthals or its origin going back to natural phenomena is an extremely difficult undertaking due to lack of traces made by stone tools, as in the case of flutes discovered in the Upper Paleolithic (I. Turk, 1997 a). As anticipated, rather a large number of studies have focused on demonstrating the non-anthropoc character of perforations, so that soon after discovering the presumed flute, in several papers have been invoked deposit taphonomy issues (Ph. Chase, A. Nowell, 1998), contestation of Mousterian character of the discovery (F. D'Errico et al., 1998 a, p. 77; M. Brodar, 1999; C. G. Dietrich, 2015), and especially the action of carnivores on the bone (Albrech et al., 1998, 2001; F. D'Errico et al., 1998 a, b, 2003; Ph. Chase, A. Nowell, 1998; C. S. Holdermann, J. Serangeli, 1998; C. G. Dietrich, 2015). Under the premise that one cannot project our modern perceptions on the character of some Mousterian artefacts, which belong to another human species, the Neanderthals, our study will not give attention to the significance of the object, even though many analyses have been made so as to demonstrate the musical potential of the discovery (D. Kunej, 1997; D. Kunej, I. Turk, 2000; M. Turk, L. Dimkaroski, 2011; L. Dimkaroski, 2014; F. Z. Horusitzky, 2014). If one takes account of the number, morphology and position of perforations, the artefact is very similar to a musical instrument, a flute. However, for the Mousterian communities, this may have different, symbolic or utilitarian meanings. The debates on the object are highly interesting, and their evolution has to be seen chronologically, starting from the first publications on the discovery and the reactions aroused in the literature and going on with highlighting new information revealed by analyses progressively conducted after the discovery. Our aim is not to exhaustively summarize all bibliographic sources, mainly because the literature is extremely rich and would take too much space for an article, but to present the route of this discovery reflected in studies with greater impact, as well as our observations after reviewing such studies.

Short Presentation of the main information regarding this discovery and their impact on literature

In 1997, I. Turk edited an extensive monographic work on the stage of researches carried out in the Divje babe I cave, located in Reka, Western Slovenia, on the bank of the Idrijca River (I. Turk, 1997a). The first excavations were made by Mitja Brodar in 1978 and 1980-1986 at the cave entrance, the sections amounting to approximately 130 m³, and they were continued by I. Turk and J. Dirjec starting from 1989 (200 m³ in the center of the cave) (I. Turk, 1997a, D. Kunej, I. Turk, 2000). The so-called flute was discovered in layer 8 during an archeological campaign in 1995 (fig. 1), layer which was not dug in full before the publication of the work mentioned, only its upper part being completed. The section dug was located in the central part of the cave where excavations will continue in the following years, until 1999 (I. Turk et al., 2001).

According to I. Turk (1997b), level 8 distinguishes very well from the other layers as it is strongly cemented and impregnated with carbon-phosphates which form a breccia. Upon discovery, the flute was caught in this breccia. Almost all bones in the layer were horizontally oriented and no traces of cryoturbation were observed. As for their surface, one must state that they are strongly weathered, brittle and more often leached (I. Turk et al., 1997b; Kunej, I. Turk, 2000). For this layer there have been published four absolute dating which situate it at around 43,000 B.P. (D. Erle Nelson, 1997). With regards to archeological discoveries, the flute was found in an area with few tools, close to a fireplace.

The context of the discovery is quite clear and we will insist on it precisely because there have been many studies which referred to this aspect as constituting a problem (F. D'Errico et al., 1998 a; M. Brodar, 1999; C. Dietrich, 2015). The flute was discovered near a fireplace located in quadrat 20, spit 19 (fig. 1); the earth around it contained ashes and coal traces. It was found at a depth of 261 cm, located at 12-24 cm inside the breccia, and the author suggested that its contemporaneity with the fireplace cannot be excluded (I. Turk, B. Kavur, 1997). Nevertheless, the discovery is well recorded similarly to all other objects found in the central excavation of the cave. This is easy to

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notice in the latest synthesis published under the coordination of the discoverer (I. Turk, 2007, 2014a). There are tables with descriptions of each object found in the site. Both the flute and other lithic objects were found at the same depth, whereas in level D1 (corresponding to layer 8), along with the flute, other 19 lithic objects were found, of which two cores and several flakes (J. Turk et al., 2014, tab. 4.1, p. 49; M. Turk, I. Turk,

2014, tab 5.7, p. 71). The whole sediment in the central part of the cave was sieved with water using sieves of different sizes (I. Turk, J. Dirjec, 1997; I. Turk, 2007, 2014a). Identification was made of 26 layers in total, and upon excavation completion the bedrock was not reached. Of all these layers only 2 and 3 are Aurignacian, the rest are classified as Mousterian (D. Kunez, I. Turk, 2000).



Fig. 1 –Divje Babe I flute images and the hearth beside the flute was discovered (after I. Turk, 1997, figs. 11.1 and 10.10)

The flute is made on a fragment of a cave bear cub diaphysis. Its surface is slightly altered, the extremities are broken in and the fractures are smooth and rounded, similar to most bones at the site (I. Turk et al., 1997). The special quality of the object is rendered by two well visible perforations on one side, located rather interestingly in the core of the bone and positioned lineally. Other two fragmented perforations located on the same surface as the ones already described, as well as a perforation located on the opposite side, complete the morphology of the object. Upon its removal from the breccia it was slightly affected and an exfoliation is therefore visible on the proximal side

(I. Turk et al., 1997). One has to highlight the fact that the author of the discovery does not firmly support the anthropic origin of the holes; on the contrary, he tries to find explanations for their origin and also alleges the action of the carnivores. Therefore, as early as the first publications, explanations are given as to the fact that the taphonomic analysis of the bear limbs in the central part of the cave showed the carnivores' action on them. The percentage of the bones having gnawing traces is significant, the bear cubs' femurs being the most affected. Moreover, most holes and indentations are found on femurs as well (I. Turk, J. Dirjec, 1997).

The flute benefits by a detailed description. One may notice post-depositional phenomena which destroyed potential traces required to identify how the holes were made. Therefore, on the front side there are some indentations and some shallow “cuts” of which origin is difficult to identify due to a poor preservation; the front side is speckled as a consequence of the impregnation with carbon-phosphates; the inside of the bone is hollow, the medullar cavity has the same color as the outside, which implies the disappearance of the spongy tissue prior to impregnation with carbon-phosphates (I. Turk, J. Dirjec, B. Kavur, 1997). Taking into consideration that the bone keeps neither traces of holes nor of spongy tissue removal, analysis is also made of animals which may have perforated the bone, perforations most likely made by molars or premolars of carnivores, such as wolves or hyenas, (I. Turk, J. Dirjec, B. Kavur, 1997). However, the authors of the study are rather cautious in terms of ascribing the holes to an anthropic action. Thus, they end chapter 11 of the first synthesis stating that both variants, i.e. man and animals, have to be considered: “Nevertheless, the pierced femur is the only example among 600 femurs of juvenile cave bears found at the site in the course of excavations” (I. Turk et al., 1997, p. 175).

Considering this information in relation to which one may easily observe the balanced character of descriptions and the caution of the authors, who use the expression *suspected bone flute* in the paper published in 1997 and dedicate a large space to the object description and the hypotheses on the descent of the holes, a surge in demonstrations regarding the non-anthropic nature of the perforations occurred soon after the presentation of the discovery. The significant number as well as the categorical nature of the demonstrations generated such a strong echo that I. Turk and his collaborators’ later analyses were either ignored (most times) or minimized.

The first criticizing studies were published by F. D’Errico and his collaborators in two articles (F. D’Errico et al., 1998 a, b); in both of them the conclusions were the same, i.e. the holes were made by carnivores. The analysis of the authors cited above is based on the comparison of the Divje babe discovery to faunistic materials originated in sites without material culture, namely two caves in Spain, Arrikrutz and Troskaeta. Of

the bones analyzed, 99 fragments have holes indicating carnivores’ actions, some of them having two or more holes. A perforation in a bear skull at Leztxiki, discovered in a Mousterian level, is compared to traces found on the bones in the two sites without material culture, while results demonstrate that they are the result of the action of carnivores. The study of the bone fragments also implied microscopic analyses as well as a record of bone holes depending on their number and the anatomic elements on which they were identified. The conclusion is that the morphology, the sizes and the holes on the flute are similar to the ones observed on the fauna in the sites uninhabited by people and, correlated with the lack of tool marks, they represent proofs for their natural descent. However, the analysis of the bones in the two studies, also reflected in the graphics published, makes no references to important aspects defining the flute: alignment of holes and their position. In both articles, the perforations are presented yet not located on the surface of the bones. What we find revealing are the examples of bones with holes offered in the graphics of the articles (F. d’Errico et al., 1998 a, b), which we suspect to be the most suggestive examples found by the authors in the fauna analyzed: there is no example of two-middle-hole femur or another type of similar bone (fig. 2/1). In addition, in the examples given, not all traces are holes, part of them being mere indentations. The only demonstration which may be associated to the articles is that some carnivores may produce holes on bones, which is not necessarily a new fact. As for cultural classification, they explain that the spatial and stratigraphic position do not represent proofs of the flute being of the same period with the fireplace close to it or the objects found (F. d’Errico et al., 1998 b). This aspect has to be explained by type of site, sedimentation process and duration of living there; the cave was visited only seasonally by human communities. This is the reason why the number of tools found is not very large; however, the impossibility to prove their contemporaneity does not necessarily mean that there is no connection between them.

Ascribing the holes on the femur in Divje babe I to the action of carnivores was approached in several articles, some published in 1998, soon after the discovery was introduced in the scientific circuit, yet the microscopic observations from F.

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D'Errico and collaborators' studies are missing in these articles (1998 a, b, 2003). Publications of Ph.

Chase and A. Nowell (1998), Albrecht et al. (1998, 2001), C. S. Holderman și J. Serengeli (1998), and

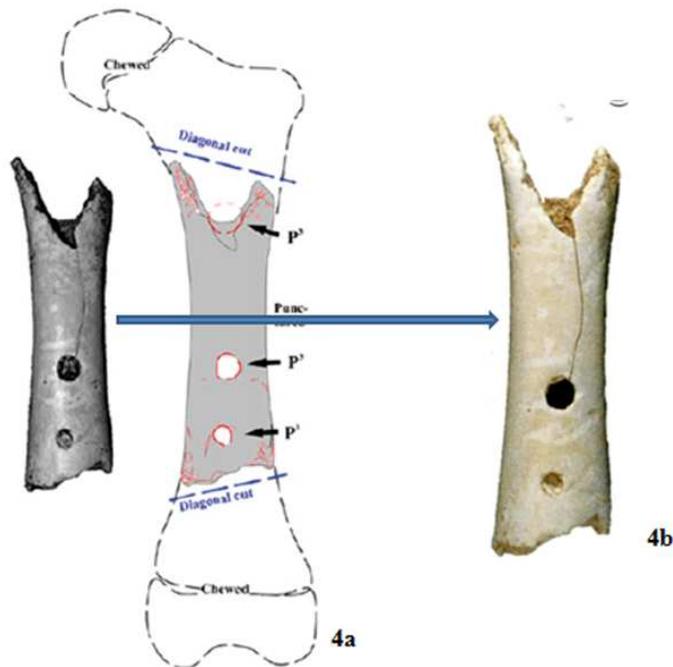
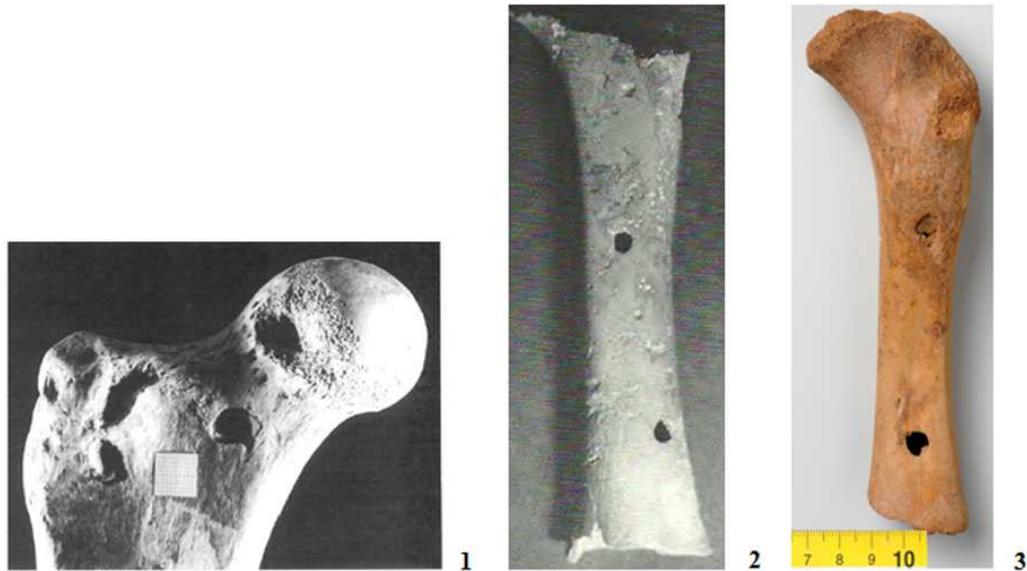


Fig. 2 - Examples of bear femurs with holes provided as an argument for carnivores intervention: 1- Troskaeta, after F. D'Errico et al., 1998 b, fig. 4; 2-Lieglloch, after G. Albrecht et al., 1998, fig. 4; 3 – National Museum of Slovenia, after I. Turk et al., 2014, fig. 13.1; 4a, Peștera cu Oase, after C. Dietrich, 2015, fig. 5/5; 4b-Peștera cu Oase, after M. Pacher, J. Quilès, 2013, fig. 12.7/g (different scales).

I. Morley (2003, 2006) are also critical, there are few elements which distinguish these studies. Given the similitude of the demonstrations and particularly the similar conclusions, i.e. the origin of the holes in relation to carnivores' actions, we will insist only on some articles, especially because, after their publication, some specialists have offered extensive answers in this respect (M. Otte, 2000; F. Horusitzki, 2003; I. Turk, 2014a).

Ph. Chase and A. Nowell (1998) explain the regularity of the holes by destructions occurred in the deposit, assuming that the post-depositional processes increased them. They conclude that the discovery is a bone chewed by carnivores and, being the only Mousterian discovery of this type, it does not provide solid evidence in favor of the music origin of that time (*Certainly, taken alone, in the absence of any other Mousterian flutes, this specimen provides very weak evidence for the origins of music at that time* (p. 552)). Actually, many other studies on flutes mentioned that there is no other similar object discovered in Middle Paleolithic. What is constantly overlooked is the fact that neither among the examples of perforations made by animals is there any bone similar to the flute. Taking into account that the carnivores were certainly more numerous than the Neanderthals, if the perforations on the flute had indeed been the result of a natural behavior of carnivores, numerous bones similar to the flute should have been found; however, no similar example is given (fig. 2). Ph. Chase and A. Nowell's study (1998) is rather harshly criticized by M. Otte (2000) who considers that the discovery was handled *a priori*, being questionable and doubtful, and such endeavor is inappropriate.

G. Albrecht and collaborators (1998, 2001) also try to explain the position of the holes in the middle of the bone as a consequence of carnivores' behavior, carnivores which pierce the thinner area of bone (fig. 2/2). Some bones are thinner on their length axis and this is why some holes are positioned in line. In this respect he gives the example of a rib discovered in the Ramesh cave, which has several holes in the middle (Albrecht et al., 1998, fig. 3/5, p. 7; fig. 5, p. 9). However, these holes are of different sizes on both sides and there are traces of destruction around them, having therefore extremely little resemblance to the bone in Slovenia. Compared to other criticizing studies, a different element is constituted by G. Albrecht

and collaborators' experiments on the methods of perforation (Albrecht et al., 1998). Starting from the ascertainment that the holes were most likely made by a hyena, a rather bizarre image of a hyena skull keeping a femur in its mouth is offered; in this image one may easily see how difficult it would have been for an animal to position the bone and therefore create holes (Albrecht et al., 1998, fig. 14, p. 16). Similar to Ph. Chase and A. Nowell's study (1998), statements are made that there are no similar objects discovered in Middle Paleolithic so as to authenticate the discovery (*there is no verified cave bear bone flute, which could serve as an authentication of the object from Divje babe I. Furthermore, at the moment there is no even another known flute from other Middle Paleolithic made of other materials* (p. 12)).

There were also debates on the human type which made the flute; in this regard, M. Brodar (1999) alleges that the modern man lived in the cave before the disappearance of the Neanderthals, since four bone point fragments were found in the Mousterian layers and the flute has to be therefore ascribed to *Homo sapiens*.

After this first stage with numerous criticisms, there came a period in which they diminished; however, the impact left in the literature was quite strong; so every time the Divje babe I discovery is mentioned, the criticizing comments in the studies are also added (not to mention that it was rather the criticisms in particular that were mentioned). What changed in publications was the multiplication of bone analyses made by I. Turk and his collaborators (D. Kunej, I. Turk, 2000; I. Turk, 2007, 2014a, b; I. Turk et al., 2001, 2003, 2005; M. Turk, L. Dimkaroski, 2011; Tuniz et al., 2012). There is a remarkable difference with regards to how this subject is approached: even though the rather negative criticizing studies do not necessarily introduce a convincing demonstration, they tried to demonstrate mainly the animals' intervention on the bone, by identification of some bone examples, while I. Turk and his collaborators' studies analyzed both anthropic and natural possibilities; their articles are supported by various experiments (I. Turk et al., 2001) and analyses conducted with modern equipment (I. Turk et al., 2005, Tuniz et al., 2012)

As a response to the first negative articles published on the discovery, two thorough studies are published on the taphonomy of the deposit and

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the fauna in the site, especially because in the meantime layer 8 in which the flute was discovered was excavated in full in the central part of the cave (Kunez D., Turk I., 2000; I. Turk et al. 2001). Thus, after the fauna was studied, statement was made that out of the 600 bear cub femurs, only 10 have approximately the same size as the flute, and of these 10 only one is perforated in the center and on both sides; the others have no holes. As regards to the extremities of the flute which were chewed by carnivores, one may not assume the exact date of this action, after or before the holes were made, or at the same time (Kunez D., Turk I., 2000). As far as traces left by carnivores and weathering are concerned, it is specified that these agents are not the ones to have made the flute but rather have transformed it (Turk et al. 2001). Detailed descriptions are made of the experiments carried out with dentition replicas of possible carnivores which may have produced such holes (wolf, hyena, bear skull moulds). I. Turk and collaborators (2001) concluded that the perforations were made separately, not at the same time; figure 14, p. 37, even shows an interesting sketch of the animals' teeth which may have produced the holes, namely hyena and wolf molars and premolars, as well as the morphology of these holes. The authors rightly wonder why a carnivore stopped after making the holes, since the purpose was to break the bone and reach the marrow, and, after making several perforations, very little was left to chew before the bone was destroyed. The tests made indicated that in most cases the holes appear on the convex side of the bones, not on the right side, as in case of the flute (I. Turk et al. 2001). Taking account of the experiments conducted, they consider that it was unlikely that a carnivore made one or more holes without breaking the bone: *The probability that an undetermined carnivore pierced a bone several times and gave it the coincidental form of a flute without fragmenting it into pieces is very small. If this probability were greater, it is likely that there would have been more such finds, since there were at least as many beasts of prey in the middle Paleolithic as people* (Kunez D., Turk I., 2000, p. 246).

Nonetheless, the analyses made progressively by the discoverer and his team were neglected by some authors. These two studies described above, appeared in 2000 and 2001, are completely ignored in an article published in 2003 by F. d'Errico and

his collaborators (d'Errico et al., 2003), who continue the undertaking started and analyze, microscopically included, the flute and the 77 perforated bones discovered in Divje babe and other four sites in Slovenia. The results indicate that the holes were made by carnivores because the bones analyzed have various traces of animals' actions. As much as in the previous articles (F. D'Errico et al., 1998a, b), despite the specification that there are bones with two or several holes of similar morphology and sizes as in the case of the flute, the authors do not insist on placing the holes on the bone (epiphysis and diaphysis) area. However, stating that there are many holes on the Divje babe bones comes in contradiction with what I. Turk and collaborators (2001) had already put out about holes missing in the fauna analyzed. In this respect, I. Turk (2014a) assumes that F. d'Errico and collaborators (d'Errico et al., 2003) took notice of the punctures marks on the bones as well. Similarly to the first articles published and looking at the picture enclosed, we also are of the opinion that a difference between holes and punctures marks has not been made.

A synthesis of the contributions on the discovery from Divje babe I is published by I. Morley in 2006. As it is only a republication of a study from 2003, the information was not updated and we are provided with a truncated image of the phenomenon since no notice was taken of articles put out by I. Turk and collaborators (evidently, he also supports the idea that the perforations were not made by carnivores).

Except experiments involving moulds of carnivores' skulls, the author of the discovery conducts multiple experiments so as to identify possible methods to produce holes by people, holes which are similar to the flute holes. The best results were obtained by combining several technical produces (I. Turk et al., 2003). The attempt to identify possible traces and thus to prove the most exact origin of the perforations is carried on using modern equipment. To this end, in addition to microscopic studies, the flute is analyzed with Multi Slice Computed Tomography (MSCT) (Turk et al. 2005) and X-ray Computed Micro-Tomography (MCT) (Tuniz et al., 2011). The purpose was to check possible connections between the thickness of the bone and the position of the holes, considering that animals test the soft parts of the bone surface and the perforations are

naturally made where the bones are thinner (Turk et al., 2005). The results suggest that all holes could not have been produced by carnivores (a single one at the most), and most traces around the holes, previously ascribed to carnivores, are results of post-depositional phenomena (Turk et al. 2005; Tuniz et al., 2011)

The abundant publications are completed by two extensive volumes, both coordinated by I. Turk, in which all results of the Divje babe I cave researches are summarized. The first volume appears in 2007 and consists of geological and paleontological studies (481 pages), whereas the second appears in 2014 and refers to all archeological discoveries made in the cave (457 pages). There is a detailed description of all artifacts. There are very large tables showing several characteristics of each individual piece (inventory number, discovery venue coordinates, dimensions, weight, raw materials, description etc.). These are all solid proofs of a huge volume of work. One chapter in this last paper contains the answer of the author with regards to the negative studies previously published.

As one may notice from this review of the main publications, the opinions are different; however, irrespective of how wide-ranging the criticisms presented above were, they may not be compared with the latest study published on the discovery from Divje babe I, on which we will insist further.

Latest explanation: Hyenas made the perforations and the flute is not Mousterian

An article published in 2015 by C. Dietrich came to our attention in particular as it may be edifying in terms of how an archeological object is analyzed. The author states that he made two great “discoveries”, which may clarify the controversies in connection with the Divje babe I piece: the flute is not Mousterian and it was the hyenas which made it.

The first observation relating to the cultural affiliation of the flute seems to us the most questionable, since it is not provided any arguments in this respect. Therefore, as we will further show, many affirmations in the article have no supporting demonstration, while some of them are rather odd.

The article starts with an enumeration of the sites in which, according to C. Dietrich (2015), Mousterian flutes are believed to have been

discovered: Potočka Zijalca, Istállóskö, Mokriška Jama. For each particular location, the sentences are written so that the reader can understand that these discoveries were wrongly classified as Mousterian. For instance, the first sentence in the article is: *The first ‘Neanderthal cave bear bone flute’ from the Middle Paleolithic was believed to have been discovered in the 1920s from Potočka Zijalka Jama Cave (i.e. Potok Cave) [1]* (p. 1). In reality, all these settlements enumerated have always been published as belonging to the Upper Paleolithic, the only discovery considered to be Mousterian being the flute from Divje babe I. Moreover, throughout the article, the author continuously affirms that these sites’ classification as belonging to the Aurignacian is an outstanding discovery and therefore he gives the reader the most erroneous impression that they were ever believed to be Mousterian. This attempt to mislead the readers was probably made as an introduction to the debunking the cultural affiliation of the Divje babe I flute: *Another juvenile bear cub femur with holes from Divje Babe I Cave, Slovenia, a small cave bear den (cf. [25]; figure 5(4)), where also Neanderthal Mousterian layers were believed to be present [26], was declared twice incorrectly as the ‘oldest instrument’, a 43 140 BP old ‘Neanderthal flute’ from layer 8 [26,27] (figure 5(4)). This was already contradictory to the results of the archaeological inventory that is well acceptably declared to be solely of, again, Cro-Magnon human Late Paleolithic origin, and not of Mousterian (cf. [28])* (p. 4-5). What makes the author so confident about the discovery not being Mousterian? We may have expected new deposit dating or analyses etc, yet nothing of this nature is cited. The author argues his ascertainment by quoting a single article by M. Brodar (1999), completely ignoring all analyses made on the cave deposit as well as dating or archeological discoveries at the site, all extensively published in various studies (I. Turk, 1997a, 2007, 2014; G. Bastiani et al., 2000). Should we understand from this undertaking that a part of the bibliography (which is actually a single article) is valuable for his demonstration, while the other much more consistent part may be neglected as it is *a priori* worthless? Why would we not believe the discoverer who supervised the archeological researches in Divje babe I at the time of the flute was found and who obviously knows the context

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the best! Not citing all bibliographical sources regarding the cultural affiliation creates the false impression that only the articles mentioned exist and raise serious issues of professional deontology.

However, not even the studies cited by C. Dietrich in favor of his affirmations are accurate. Moreover, they are interpreted contrary to what cited authors allege. For example, a work by Borut Tošcan includes an affirmation that there is no connection between a Mousterian context and the bones from Divje Babe I: *Therefore, there is no evidence for a Neanderthal (Mousterian) context and the cave bear remains, which even occur in several older and younger Late Pleistocene layers (cf. [25])* (p. 5). As cited by the author, the work is difficult to identify. The article entitled *Remains of large mammals from Divje Babe I its stratigraphy, taxonomy and biometry* is published in 2007, not in 2011, while in the work *Opera Instituti Archaeologici Sloveniae 21*, B. Tošcan publishes another study in partnership with J. Dirjec, entitled *Big climatic changes revealed by tiny fossils. Palaeoenvironment at the boundary between the Early and Middle Würm in the surroundings of Divje babe I*. Considering that the study in 2011 refers to an analysis of small mammals, it is likely about the publication in 2007, which by no means concludes on the lack of a Mousterian context, yet precisely on the fact that the cave was alternatively visited by both people and carnivores (B. Tošcan, 2007, p. 265). Citing some bibliographic sources with no connection to such assertions may be easily noticed in numerous cases, such as the case of mistakenly including M. Otte (2000) in the group of the authors who doubt the discovery of the flute in Divje Babe I; in addition, C. S. Holdermann and J. Serangeli (1999) are classified among the researchers who bring forth arguments in favor of the authenticity of the flute, which is totally the opposite. Furthermore, a figure with hyena dentition is cited in M. Turk and L. Dimakaroski's article in 2011, even though no scheme of this type exists (it is likely to refer to fig. 14 in I. Turk et al., 2001). As there are too many examples of wrong quoting, which fail to support the information in the text or produce great confusion, we will no longer insist on them, as they would take too much space in this study.

Coming back to the discovery context, even though no explanation except M. Brodar's article (1999) is offered, the conclusions are extremely

trenchant: *There, where they are dated absolutely (Divje Babe Cave I) are without archaeological context at all, and simply of cave bear den use during the MIS 3–5d* (p. 14). Should we understand from this that the almost 700 lithic pieces and the 20 fireplaces (the latter being discovered only in the Mousterian levels) do not represent for C. Dietrich (2015) and archeological context or in the author's conception do the pieces and the fireplaces fail to be deemed as anthropic traces? One has to bear in mind that in numerous caves the archeological materials are few because they functioned as seasonal residences, yet, this thing does not limit their importance and they should be treated as very prosperous sites because they offer information on the type of habitat and environment exploitation by the Paleolithic communities, not to mention the fact that they may constitute important discoveries (M. Cârciu et al., 2002).

The second demonstration made by C. Dietrich (2015) refers to the holes made by hyenas. This undertaking is similar to the F. d'Errico and collaborators' one (1998a, b, 2003) and relies on the analysis of many fauna collections in some sites without material culture, located in Germany and Romania, in which bear bones are preponderant. The femurs with holes identified in the collections studied are compared to the so called Paleolithic flutes. From a paleontological point of view, the article is obviously valuable and, most holes in the bones are certainly produced by carnivores. Furthermore, unlike other articles presented above (F. d'Errico et al., 1998a, b, 2003, G. Albrecht et al., 1998, P. Chasse, A. Nowell, 1998), this one is based only on femurs and offers a complete image on the destructions following animals' action on various bones. In addition, the perforations could not evidently have been made with canines. This phenomenon is clearly demonstrated on the article. Nevertheless, in comparison with the rigor of the paleontological study, the archeological study suffers considerably.

The author starts from the discovery that the studies on flutes have failed to take account of the carnivores which may have made the holes on the bones: *All former archaeological, ecological focus cave bear 'bone flute' studies forgot all four cave bear predators—steppe lions (Panthera leo spelaea), leopards (Panthera pardus spelaea), Ice Age spotted hyenas (Crocuta crocuta spelaea) and Ice Age wolves (Canis lupus spelaeus)—which are*

known now to be cave bear killers, and main consumers in mountain regions, where mammoth steppe megafauna were absent [4,18–21] (p. 9). However, as early as the first publications, the analyses on the Divje babe I flute referred to the fact that the holes may have been produced by carnivores. Additionally, the hyena was continuously cited, so that, in the first synthesis work on the flute, after analyzing the carnivores' dentition, it was affirmed that the holes may have been made by hyenas' premolars: *They could only have been made by carnivores with stronger teeth, e. g. a hyena with premolars. Lower P_4 and upper P^3 of a hyena are very suitable in shape and size for the hole in the suspected flute. (...)The other suitable tooth is upper P^3 left of cave lion or leopard* (I. Turk, 1997a, p. 174). Furthermore, the metal moulds utilized in experiments were made using hyena, wolf and bear maxillaries' shape and size. One of the criticisms brought to I. Turk's publications relates to citing canines in connection to perforation process. It is indeed difficult to imagine how an animal could use its canines to make holes on a thick bone, mainly because all studies supported the idea that the cavities and the holes were made by molars and premolars of some carnivores, and we totally agree with C. Dietrich's demonstration in this respect (2015). On the other hand, the flute's discoverer (I. Turk et al., 2001) relies on the experiments conducted when he considers that the shape of the holes matches only the traces left by canines on the bones: *The test showed that the form of the holes on the flute could only have been produced by canine teeth. Test holes made with carnassials of a wolf and cave hyena were more oval and rhomboid in shape* (M. Turk, L. Dimkaroski, 2011, p. 256). Nonetheless, the teeth which could have produced the holes are difficult to be exactly identified and they are different from study to study.

Although Table 1 shows the analysis of a rather consistent number of sites, the comments in the article offer us nothing more than the number of the perforated bones found at one single site, Weiße Kuhle, where 13 femurs are perforated. Even though we deal here with a natural behavior of carnivores, hyenas in particular, the percentage or the number of perforated bones in relation to the entire fauna analyzed is of paramount importance. For a convincing demonstration, the bones with at least two perforations in the middle are also

essential. Given the fact that what defines this discovery is the number of perforations, their regularity and alignment on the middle area of the bone, we find no example of a flute similar to the Divje babe I one in the rich graphics provided by C. Dietrich (2015). Therefore, figure 4 shows some bear bones, most with punctures on extremities, whereas figure 5 shows that, except the flute and a femur from the Peștera cu Oase (fig. 2/4a), the rest have only one hole (of which one is even fractured as a result of perforations (fig. 5, 6 b,c). As for the example of the femur with two holes from the Peștera cu Oase (Oase Cave), this is published by M. Pacher and J. Quillè (2013). It is very visible in figure 12.7/g that there is only one hole on the bone, the second being only a puncture (fig. 2/4b). This is actually the same thing as observed in the critical studies cited before: no difference is made between punctures and holes.

Conclusions

The large debates on the Divje babe I flute have been triggered by the following main characteristics of the object: special morphology (number of perforations and their location), the Mousterian context and the lack of processing traces. In nearly all studies, it was stated that no other similar Mousterian object was found and a new discovery of this type would help validation of the flute. However, if this a Mousterian invention, considering the reduced density of populations and therefore the limited communication between Neanderthal communities, spread of some concepts may not be compared with phenomena specific of Upper Paleolithic. There is an extremely low chance of a similar discovery in Middle Paleolithic, possibly if one found a place inhabited by the same communities discovered in the Divje babe I cave.

However, if it was a species of carnivores which made the flute, considering the natural biological behavior, there are very good chances that similar objects be discovered. In the multitude of articles aiming at demonstrating the natural character of the flute, no bone with perforations has been proven to be similar to the Divje babe I one up to this moment. Moreover, even though many studies specify that there are bones with two or more holes, in the illustration indicated there are no examples of this kind. The bones with middle holes have only one perforation, associated mostly with one or two cavities, while the majority of the

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examples given have holes and cavities on the (epiphysis and metaphysis) extremities. By the regularity and position of the perforations on the flute, there are no further debatable issues. Admitting that the perforations were made by animals, the experts should have found at least one similar bone in all these fauna collections studied.

If one considers all studies on the possibility of the holes having been made by carnivores, including the experiments made by I. Turk, this endeavor is even more difficult to demonstrate than the anthropic origin of the holes, even in the absence of visible processing traces. It is unlikely that the Divje babe I discovery be the only such example made by animals, while the failure to find similar examples represent arguments in favour of the perforations having made by human communities who seasonally lived in the cave.

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