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Original Article

Archaeofaunal Remains and Stone Implements Found in *Myin Ma Hti Cave no.2* (MMH2) Located in Aung Pan Township, Shan State of Myanmar

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Abstract : Myin Ma Hti is the local name meant that the mountain horse never touches. In Myanmer, this name is very popular as the Buddhist religious place. Most pilgrims usually visit to the area of Myin Ma Hti. In 1997, a new limestone cave was discovered during the field trip of local geological team and the first explorer gave the name for the cave as Myin Ma Hti Cave No. 2. In their 1997 report, the archaeo-faunal remains and stone implements were recorded as teeth and vertebrate bones of bull, ox, deer and polished stone rings and implements that could be estimated as the Neolithic context dated as 6,000-4,000 BP. In 2019, the environmental assessment team accidentally arrived into the cave and they found some significant remains of stone tools mingled with a pile of bone fragments after the local people dug the floor of cave to build the religious stupa. Then, rescue archaeological works had been initiated to take recording and making catalogue of bone fragments and stone pieces. Most of the findings are the bone fragments and wasters of stone rings. The special findings are potential bone tools with the cut and scrape marks of edging and sharpening. The anthropogenic feature could be examined with the ash layer 3-meter depth approximately. In this report, the significance of archaeofaunal evidences and stone implements accidentally found in MMH2 will be described as the preliminary survey of prehistoric cave in Aung Pan Township, Shan State, Myanmar.

Keywords : Bone tools, Stone implements, Anthropogenic feature, Archaeofaunal remains

INTRODUCTION

The material culture of prehistoric time can theoretically be seen that equally surprising, carefully shaped bone tools, shell beads, and engraved ocher, artifacts belonged to the last 35,000 or 40,000 years of human existence, have been dated to greater than 75,000 years ago at sites in North Africa, the Near East, and the southernmost tip of Africa

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[1]. For animal resources, this may mean exploiting marrowbones on a more systematic or regular basis, or making greater use of bones that are marginal sources of marrow, such as phalanges and mandibles [1-3]. Marrow-rich long bones are the most abundant skeletal parts in all of these assemblages and were cracked and processed thoroughly for their bone nutrients [1]. Modern humans of the Upper Palaeolithic exploited small mammals at higher levels than those of Middle Palaeolithic Neanderthals [1]. Numerous innovative lithic and organic tools and weapons have no counterparts in the material culture of the Middle Palaeolithic [1].

Animals are therefore the immediate focus and knowledge of their biology and ecology is a cornerstone of zooarchaeology. Knowledge of an animal's anatomy, morphology, and physiology, the place of an animal lives, feeding habits, seasonal migrations, and reproductive habits are important for the ability to assess human exploitation patterns, exploitation technology, anthropogenic impacts, temporal and spatial changes in animal populations, environmental factors, human mobility patterns, food preferences, cooking techniques, and so on [4].

Myin Ma Hti area is located in the limestone formation nearby Kalaw and Aung Pan, Shan State. The name *Myin Ma Hti* (*MMH*) is very popular among the Myanmar pilgrims. The Buddhist shrines were constructed either inside or outside of the cave and tunnel. MMH is mostly known as the limestone karst or cave where Buddhist religious stupas were totally built nowadays. After finding a new cave in the same area, it must be called as Myint Ma Hti cave no. 1 and 2 (MMH1 and MMH2). In this report, MMH2 is mainly emphasized to describe the assessment of potential bone tools, archaeofaunal remains and stone tools. In findings from the cave modification of local people, there are significant findings such as anthropogenic feature of ash layer underneath the cave floor, archaeofaunal remains of vertebrate bone fragments and teeth, potential bone tools, and stone implements. Additionally, the bone modification of animals and human beings will be considered to make comparison between faunal and archaeofaunal remains. The nature of rodent gnawing and cut marks of human beings are very important to analyze the findings of bone and teeth. The bone tools, found in the deposition of bone fragments, were identified with the symmetrical shape of bifacial edge without the delicate decoration. The rough and tiny tools were sharpened to get the sharp edges like scrapers. Some pieces of long bone were found with the filed marks and it can be identified as the spearhead.

MATERIALS AND METHODS

In *Taunggyi Chae* Village of Aung Pan Township, the cave located in the coordinate of 20°35′18.18″N, 96°35′35.94″E (Figs. 1A and 1B) was accidentally found in 1997 by geological research team from Taunggyi University of Shan State. They gave the name of Myin Ma Hti cave no.2 *MMH2* [5]. Here, the code MMH2 is initially used for the prehistoric archaeology in Myanmar as well as zooarchaeology. Prof. Dr Tin Thein wrote the context of prehistoric archaeological evidence in his field report and explained their findings of mammals and stone implements. Geologically this cave area is totally relied on the limestone formation and karsts. It is called as the plateau of limestone formation between the age of 290 m.y.a and 200 m.y.a [5]. The dimension of the cave MMH2 is that the mouth is 46 m wide, 10 m high and 27 m length into the interior part of the cave like tunnel (Figs. 1C and 1D). He speculated that the findings inside the cave could be related to the Neolithic Culture estimated date 6, 000 BP approximately. Most of the findings are fragments of vertebrate bone and teeth such as deer, bull, ox, and rodent together with stone rings, polished tools and wasters of stone implements. These are only as chance finds without systematic excavation or scientific sampling process yet. The oldest date he thought is around 6, 000 BP with the reference of polished stone tools and rings.

In MMH2, commonly found that the fragment of bone and stone implements could potentially be seen as the anthropogenic remains of assemblages. In 1997 field report, the stone implements were described as pebbles, scrapers and stone rings [5]. Vertebrate bone remains mingled with stone implements described in the report are mostly herbivorous as such deer *Rucervus eldii*, sambar deer *Rusa unicolor*, wild bull *Bos taurus*, porcupine *Hystrix*, Rhinoceros, boar *Sus scrofa* [5]. All of the faunal remains are fragments of teeth and bones. As for the nonvertebral remains, Gasteropods were abundantly found as land snails of Order Stylommatophora and Suborder Achatinina [5]. The association of prehistoric stone implements and the cave formation could be considered as Neolithic Age between 6,000 BP and 4,000 BP approximately [5].

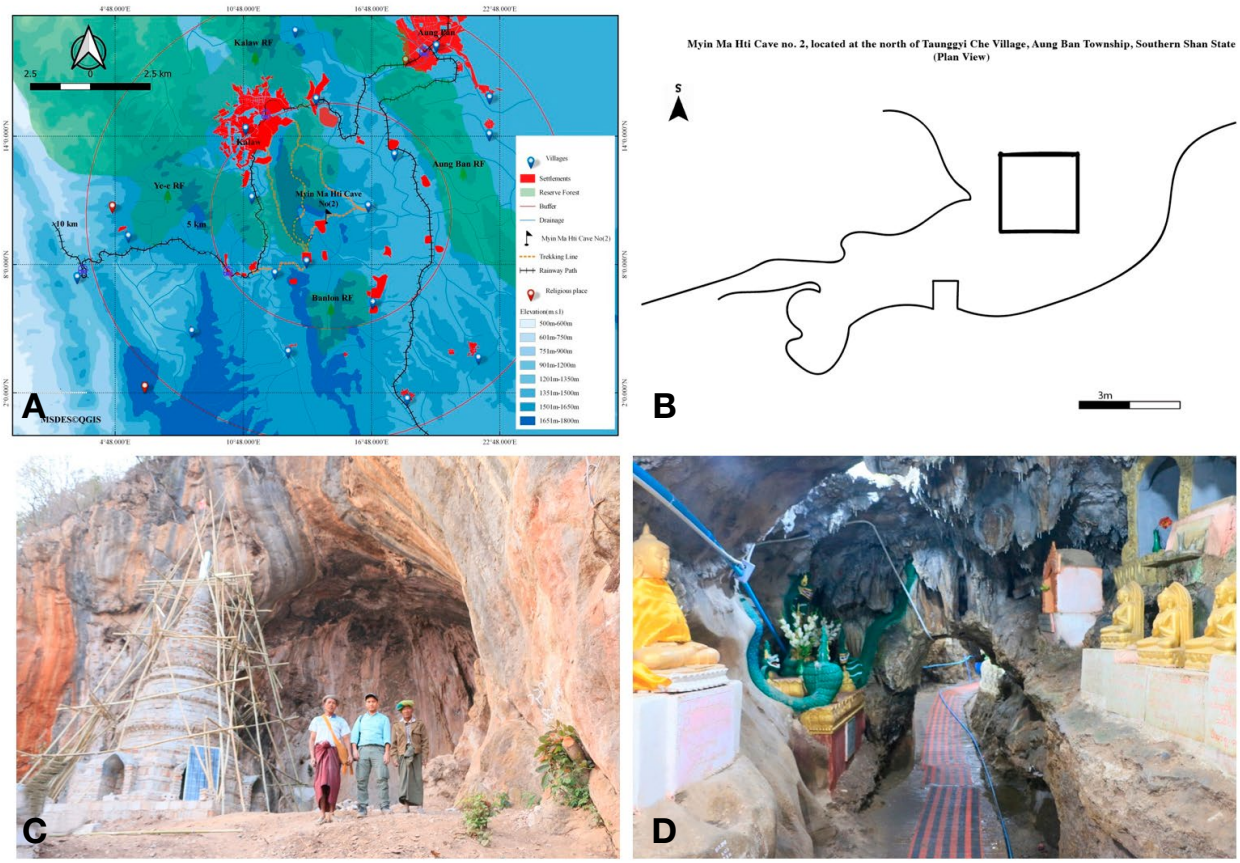

Fig. 1. (A) Elevation of the Myin Ma Hti area including MMH2 and Its Environment (Courtesy of Aung Nanda, MSDES). (B) Plan View of MMH2 with two square marks_ large one is the plinth of Buddhist stupa and the small one is of shrine for Buddha image. (C) The circular mouth of entrance of Myin Ma Hti Cave no.2 (MMH2) in which the Buddhist stupa was built. (D) Myin Ma Hti Cave no.1 (MMH1) totally modified by the construction of Buddhist shrines.

Twenty years later, in 2019, the mining projects were permitted around MMH2 area by the regional authority. Because of mining projects, the local community attempts to save their ancestors' land including the limestone range and caves as such MMH2. Traditionally the local people tried to transform their land to be religious sanctuary e.g. Buddhist stupa or monuments. Consequently, the local landowner of MMH2 also tried to build Buddhist stupa at the mouth of cave MMH2. Coincidently, after digging and preparing of the floor level, some more fauna remains and stone tool implements were accidentally uncovered. The floor of the cave was dug and cleansed to get more associations of prehistoric archaeological evidence. In this condition, Aung Nanda the field leader of Environmental Assessment Team informed heritage authority and contacted to archaeologists from Department of Archaeology, University of Mandalay for rescuing.

Research methods are different between two urgent functions such as rescue archaeology and prehistoric zooarchaeology. For the rescue archaeology, it would be sustainably preserved the *in situ* information of original findings of the cave. For the zooarchaeology, it would gradually be explored and studied in anthropogenic forms of stones and bones as well as the cultural landscape of MMH2. The challenges of immediate mining project implied local people to be worry for their farmland. Consequently, they tried to build a stupa at the mouth of MMH2. They traditionally tried to save their ancestors' land in this way. These tow causes of deterioration negatively impacted on the heritage site MMH2. This is why the rescue archaeology must be done immediately. The chance finds of MMH2 are not simple because of the anthropogenic bone fragments that could be associated with the new time line of prehistoric archaeology in Myanmar. This hypothetical point is waiting for

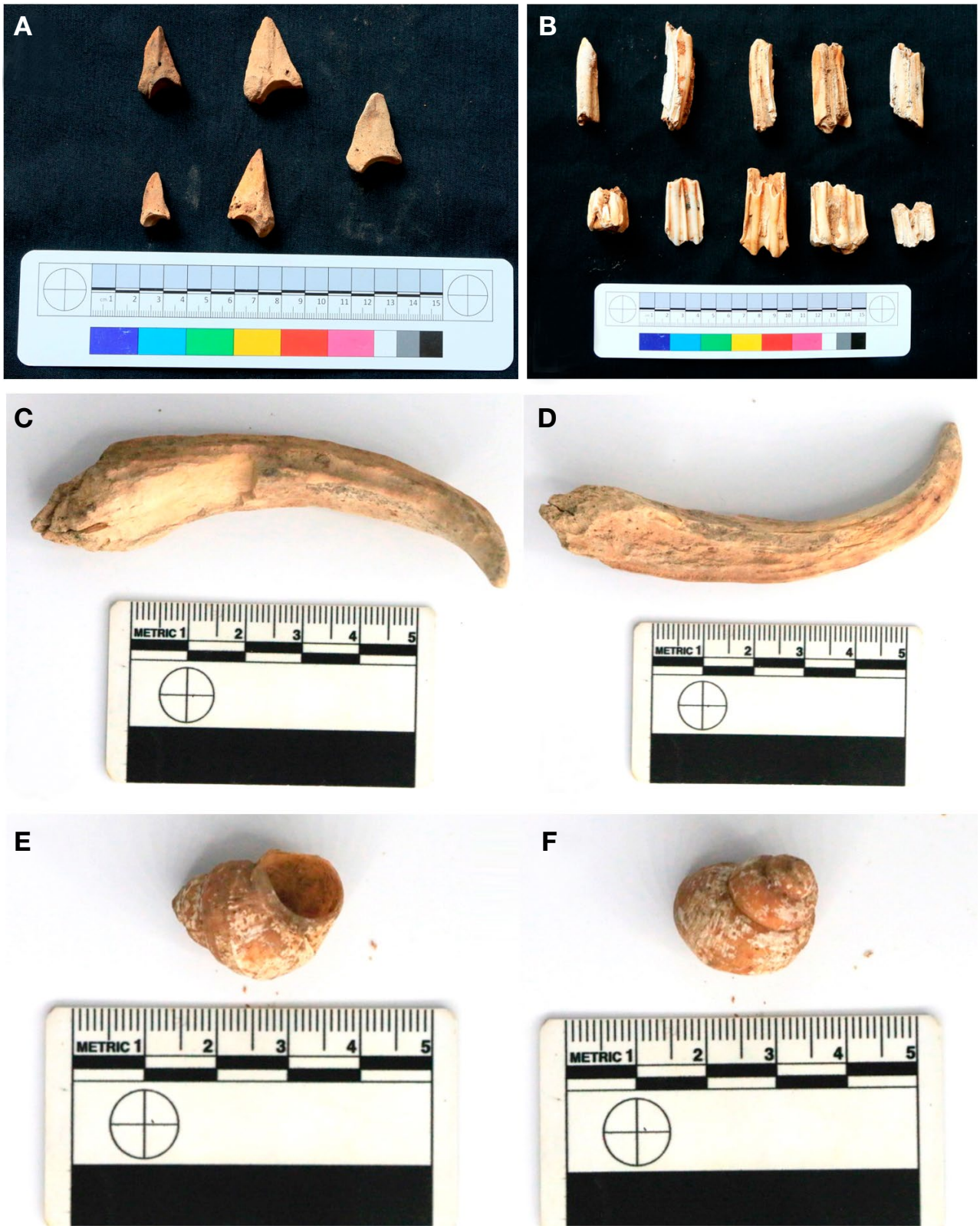

Fig. 2. (A) Herbivores' hoof cores of the Order Artiodactyla. (B) Fragments of the teeth of *Hemibos triquetricornis* unearthed from the floor deposition while the local people removed and prepared for the platform of stupa. (C) and (D) Horn of deer *Rucervus edlii* (?). (E) and (F) The faunal remains of nonvertebrate are those of Gasteropods, land snails of Order Stylommatophora and Suborder Achatinina.

the further scientific research on the archaeofaunal samples and the lithic technology.

RESULTS

1. Archaeofaunal remains and stone tools

In 2019 rescue archaeological work in MMH2, some faunal remains were collected from the deterioration of modern construction for the Buddhist Shrine. There are Carnivores' teeth (premolar and canine) and claw of Family Felidae, mandible fragments of Genus *Canis*, crocodile tooth, Herbivores' hoof cores of the Order Artiodactyla (Fig. 2A), teeth, ribs and limbs of *Hemibos triquetricornis* (Fig. 2B), Phalanx of *Sus Scrofa* and horns and antlers of *Rucervus edlii* (Figs. 2C and 2D). The faunal remains of nonvertebrate are those of Gasteropods, land snails of Order Stylommatophora and Suborder Achatinina (Figs. 2E and 2F).

Archaeofaunal remains could be classified with the marks of cutting, chewing, gnawing, scraping as well as trampling. A groove or striation observed on a bone is a type of modification produced by carnivore gnawing, by human butchery, by trampling damage, by root etching, by insects, by microorganisms (bacterial or fungal action), or by rodent gnawing [6]. Faunal remains can be well preserved, poorly preserved, or only slightly altered depending on the mode of death (cf. [7]) [8]. As an apparent consequence of intensive butchery, the material remains could highly be fragmented [8]. Bone tools extracted from the MMH2 are typologically different from the tool made of metal, wood and bamboo. They look mostly like the shape of stone tool with the evidence of sharpening edge. It may show the relationship between stone and bone tool technology.

In MMH2, human butchery, making tools and animal gnawing are randomly mixing together because the original layer of cave floor had been already destroyed. Some bone fragments are disarticulated and truly loss of valuable information about prehistoric context. Stone implements were also found in and around the cave. Generally, there are polished hand-adz and rings. The type of stone could be imported from the remote area because they are pebbles mostly available nearby the river or stream. Furthermore, the wasters of stone tool can easily be found not only in the cave but also in surrounding area. It indicates that this cave could also be the site of stone tool industry.

DISCUSSION

1. Bone-based technology in Southeast Asia and MMH2

"Bone tool" is a generic term used to identify implements made of various animal tissues that include bone, tooth, antler, and ivory [9]. The early appearance of bone tools in the African Middle Stone Age were found together with pigments and personal ornaments has been used to support the linking the origin of human species in Africa around 200,000 years ago with the gradual emergence of modern culture on that continent [9]. The anthropogenic nature of the material can only be confirmed based on the comparison with a large reference collection comprising fauna modified by the nonhuman agents, microscopic analysis of natural, experimental, and archaeological wear patterns, and quantification of striation width and orientation on archaeological and experimental specimens [9].

Bone-based technology appeared to become more widespread in Southeast Asian region between the terminal Pleistocene and mid Holocene approximately 11,000-4000 BP [10]. In east Java, the first prehistoric bone tool industry to be reported in the region was the *Sampung*, after the site of the same name near the town of *Ponorogo* (cf. [11]) [10]. The major archaeological sites from where anthropogenic bone implements have been recovered in Southeast Asia are described that there are 16 sites in Malaysia including 10 sites of East Malaysia and 6 sites of West; 10 sites in Thailand; 6 sites in Vietnam; 13 sites in East Java [10]. Total is 45 archaeological sites where bone tools were recovered. The oldest date is 39,600 ± 1000 BP in West Mouth, Niah of East Malaysia and the youngest date is 2300-1700 BP in Noen-U-Loke, Thailand [10]. The largest number of collected bone tools is 250 including edge tools, point-tools and worked bone from Khok Phanom Di (4000-3500 BP), Thailand [10].

In findings from MMH2, there is a pile of bone fragments including both of tiny pieces and large parts. Most of the fragments have the modified marks probably made by rodent gnawing (Figs. 3A and 3B). In contrary, some pieces of bone could be anthropogenic mostly like bone

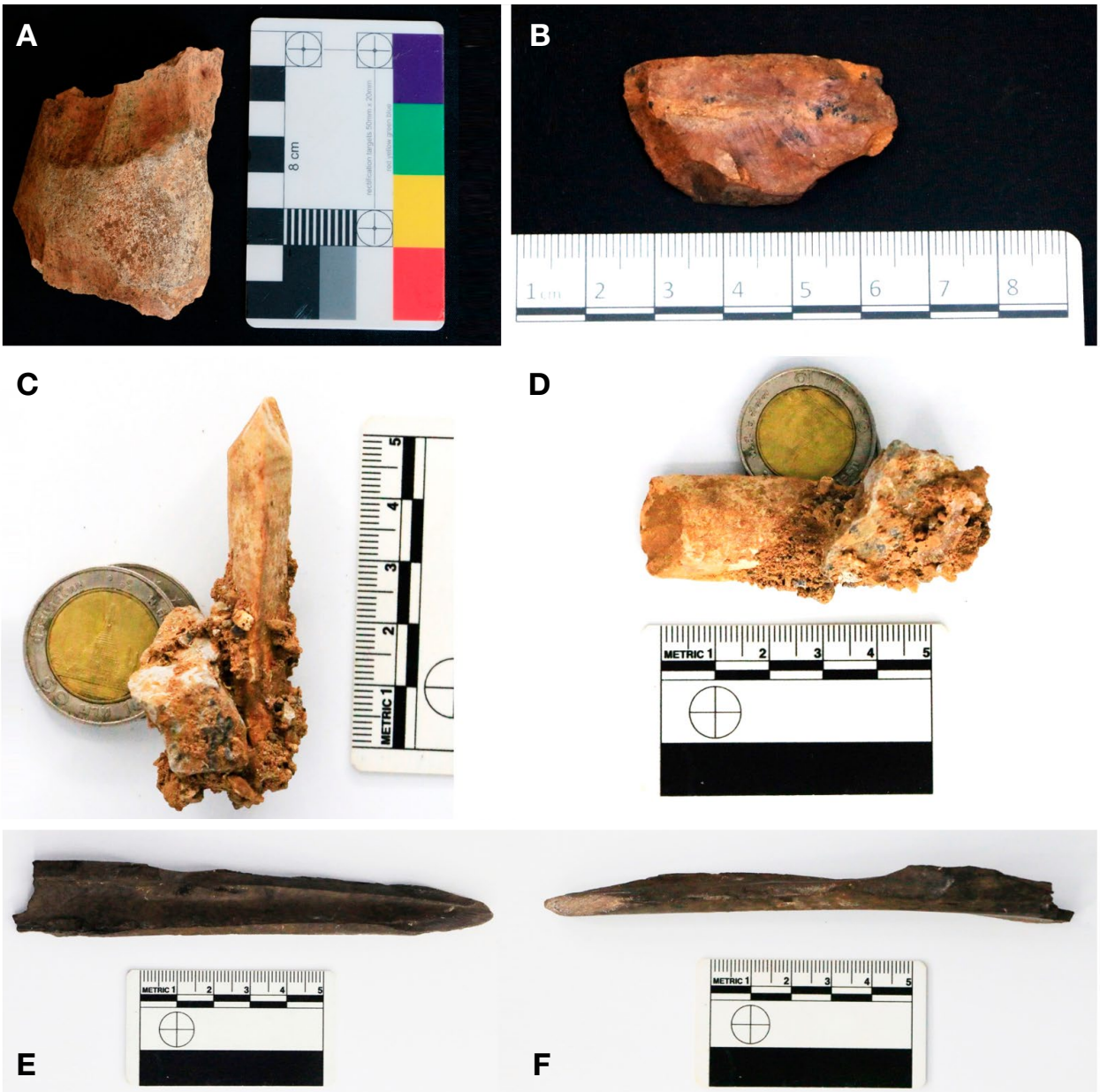

Fig. 3. (A) Rodent gnawing at the edge of bone pieces. (B) The cut mark and linear mark make sense controversial between cut marks of human and gnawing of rodents. (C) and (D) Bone artifact uncovered from the cave floor. It shows the bifacial edge known as bone tool potential man-made tool in fossilized condition. (E) and (F) Bone tool with the edge like spearhead found in the sediment removed from the cave floor.

tools with bifacial edges (Figs. 3C and 3D). For instance, the diaphysis of bone was modified as spearhead that the marks of striation could undoubtedly be seen at the edge of spear point (Figs. 3E and 3F). There is one more example that the tiny bone edged tool was collected from the inner part of the cave. It was fossilized on the wall of limestone cave. It could be modified by human for bone tool with bifacial edge. There are some more piles of bone fragments uncovered by removing the floor level for the construction site of Buddhist shrine. They will be waiting for the scientific studies in near future. The potential bone tools from MMH2 are mostly edge tool like scrapers. But pointed tools are the most represented in bone tools categories. The use of pointed tools has continued to dominate in daily

working from the Neolithic period [12].

2. Rodent gnawing

The well-stratified and undisturbed sediments proved to be exceedingly complex and quite disturbed as a result of the activities of rodents and people [13]. Some specimens could be examined and ascribed to the following categories of bone modification: carnivore digestion; raptor digestion; disease, injury, or trauma; and rodent gnawing [14]. Bone fragments can also be examined for (1) the paired grooves characteristic of rodent gnawing, (2) carnivore damage in the form of dental scrapes and punctures, and (3) patterns of breakage and corrosion indicative of biological processing (e.g., spiral fracture, cortical peeling, digestive acid etching) [14]. Types of bone modification can be observed with the paleontological or archaeological collections studying the *linear marks* to make comparisons between different types of mark to identify the process by which the observed feature was made [6]. The linear marks with *U* shaped cross-section are commonly made by animal chewing [6]. Rodent gnawing is typically seen with a characteristic of humans when using the incisors on the surface of bones because the width of the incisor marks depends on the size of the animal or human. But human incisor marks always seem to be narrower than the actual incisor width [6]. Rodent incisor marks are usually formed by the upper incisors in fossils. The upper incisors generally have a flatter cross-sectional profile than the more pointed lower incisors [6]. Rodent gnawing is common on broken edges of bone. Transverse marks on long bone diaphyses are also common, as are inferior borders of mandibles, but gnawing of articular surfaces and epiphyses is less common [6]. When humans chew bones, six types of damage occur: 1) Bent ends; 2) Curved shape at the very end of thin bones; 3) Crenulated edges; 4) Punctures on broken edges: double arch shaped; 5) Puncture marks on bone surfaces: triangular shaped; 6) Linear marks or grooves on bone surfaces: shallow, transverse, or oblique [6]. Cuts and scrapes that more likely to occur during secondary butchery are distinguished from trampling abrasion and carnivore gnawing by the context of the specimen by the location, frequency, and repetitiveness of the marks on the specimen [15]. In figures 3A and 3B, the mark of rodent gnawing can clearly be seen and another one shows the complicated situation between anthropogenic cut marks and animal gnawing.

3. Rescue archaeology and further study

Recently MMH2 had been done for the rescue archaeology with the activities of awareness among the local villagers and the important findings were systematically recorded. Rescuing process has been done by the collaboration of academic institutions and local community. But interpretation of recorded evidences found in MMH2 has not been completed because of some requirement of research facilities. It is still alive ongoing work.

It might be the first discovery of bone-based technology in Myanmar prehistoric archaeological sequence. There are three main parts concerning the hypothetical points of MMH2 bone technology_ 1. Could it be prehistoric bone midden because of 3 m thickness of depositions? 2. Can it be correlated with Southeast Asian bone tools and bone-based technology discovered in MMH2? 3. Can relationship between the anthropogenic features of stone and bone be more analyzed in MMH2?

For this rescue archaeological fieldwork, the result shows that the hypothesis of prehistoric bone tools in Myanmar archaeology has ringed the alarm for academic and heritage authority. The methods and research facility would be come out for the further studies and laboratory processes as well as the international collaborative research project in near future. Presently, the association of archaeofaunal evidence had been dated as Prof. Tin Thein's (1997) speculation on correlation with stones, faunal remains and geological landscape. Archaeologically this case report initiates the beginning of prehistoric bone-based technology in Myanmar archaeology.

Stone and bone might be very familiar with our ancestors through many ages from Middle Pleistocene to Holocene Epoch. Depending on these two types of material, the prehistoric society lived for their survival and creation of tools and parietal art. But stone is very popular among the prehistoric archaeological researchers because of their durability. Actually, bone is rarely known among the archaeologists and scholars in Myanmar. Even in academic institutions, the lectures and modules about prehistoric bone and bone-based technology are in a few number and graduate research papers as well as dissertation were not focused on the context of anthropogenic bone and bone tools.

MMH2 is the important finding to come out the new thinking of Myanmar prehistoric archaeology with the archaeoforna and the association of stone implements as well

as the sediment of bone midden. Bone scrapers abundantly found by digging the cave floor are complicated with the animal gnawing. But the cut marks and scratching on the surface and edges of bones are clearly be realized as the tools and gnawing. Typology of bone tools shows the rough type very similar to the edges of stone tools. Therefore, it can describe that the bone midden and polished stone tools are found together with the deposition of ash layers including the tiny bone scrapers and spearhead showing the prehistoric subsistence remaining inside the MMH2 cave although no scientific dating had been done.

Nowadays, after this report, the new information of prehistoric archaeology will be developing together with the anthropogenic bone material and archaeofaunal evidences in some other associated regions. MMH2 is also waiting for the further investigation not only of local scholars but also of the international cycle of archaeologists and researchers. Material evidence that can tell more about Myanmar prehistoric archaeological sequence, accidentally found in MMH2, have been preserved in rescue archaeology with the help of local villagers, third party association of Myanmar Archaeology Association MAA and the academic staffs from the Department of Archaeology, University of Mandalay.

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