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Is the Dingcun lithic assembly a “chopper-chopping tool industry”, or “Late Acheulian”?

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ABSTRACT

The famous Palaeolithic site of Dingcun (Ting-ts'un) in North China is located on the third terrace of the Fenhe River, which is one of the main tributaries of the Yellow River. After it was discovered, a series of localities with similar stratigraphic profiles was excavated in 1954. Since then, the artifacts from Dingcun have been classified as a chopper-chopping tool industry assigned to the Late Pleistocene. The authors re-examined the lithic assemblage and carried out an additional field survey at these localities. The local geomorphologic background and especially the Chinese loess-paleosol sequence re-define the chronology of the site. Uranium-series dates on mammal teeth are 160 ka–210 ka. Hence, the site is re-assigned to the late Middle Pleistocene. The Dingcun lithic assemblage is also re-classified as Late Acheulian, characterized by classic Acheulian tools such as handaxes, cleavers, and picks, with the addition of some light-duty tools, including scrapers, notches, borers and denticulates. This paper aims to present a new interpretation of the chronology and the cultural characteristics of the Dingcun site.

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1. Introduction

The Dingcun site, discovered in 1953, was the first Paleolithic site studied independently by Chinese researchers. It was also the first formal Paleolithic excavation in China, after work ceased in 1937 at the Zhoukoudian *Homo erectus* site (Jia and Huang, 1990). It also could be the first site to demonstrate that there are “Acheulian or Acheulian-like” cultural elements in East Asia and to counter Movius (1944, 1948) “two cultures theory” that the Palaeolithic of East Asia was fundamentally different from that of west and south Asia, Europe, and Africa. The scientific potential and value of the site attracted many scholars and resulted in discussions about the chronology and the cultural characteristics of the site. However, scholars held different opinions (Movius, 1956; Freeman, 1977; Aigner, 1978; Chen et al., 1984; Huang, 1987; Liu, 1988; Wang et al., 1994; Wu and Liu, 2002), and until now, there have been contradictory views about the site.

Dingcun lies in the rift zone of the Fenhe Graben, which is located in the eastern Chinese Loess Plateau in Shanxi Province (Fig. 1). Systematic surveys and excavations were carried out in 1953 and 1954 (Jia, 1955). During the field work, 13 localities were found along 15 km of the left bank of Fenhe River (numbered as 54:90–54:102), and of these, 12 were excavated. Overall, 2005 stone artifacts (except for 64 from the surface and 161 from plough-soil) were excavated, along with three human teeth, fossils of 28 types of mammals, numerous shells of the fresh-water mollusc *Lamprotula*, and various fish fossils (Pei et al., 1958). The team named the site after a nearby village, Dingcun. All 13 localities were included in this site.

The formal report of Dingcun was finished in 1958 under the direction of Pei Wen-zhong. The report not only dated the site to the Late Pleistocene because of its stratigraphy and associated mammalian fauna, but also placed the artifacts of Dingcun into a “chopper-chopping-tool complex” (Pei et al., 1958). These opinions are different from the preliminary report on the Dingcun site, which was delivered by the head of the excavation team, Jia Lan-po in 1955. In his report, based on the stratigraphy and the associated mammalian fauna, Jia defined Dingcun as a late Middle Pleistocene site, and in another article he drew attention to the handaxes from Dingcun (Jia, 1955, 1956). Henri Breuil, the doctoral advisor of Pei,

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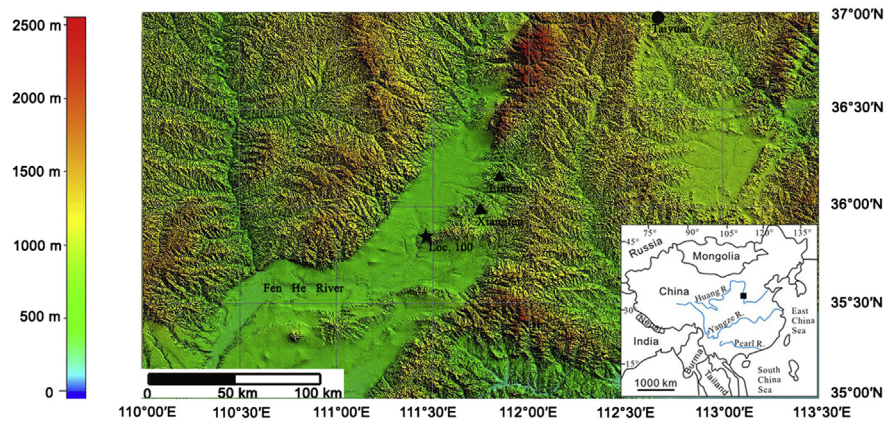


Fig. 1. The location of Dingcun site (take Loc. 100 as example).

also pointed out that there were some bifaces among the “choppers” of Dingcun and assigned them to a “Late Acheulian” industry (in Pei, 1965). The American anthropologist, Leslie Freeman, visited China in the 1970s and also agreed with Breuil. After examining the Dingcun artifacts he wrote: After having seen the Ting-ts’un (now Dingcun) collections, the discovery of true Acheulian or Acheulian-like industrial complexes in China would come as no great shock” (Freeman, 1977).

To answer the question “Does the Dingcun stone industry belong to the ‘Chopper-chopping tool industry’, or the Late Acheulian?”, the authors of this paper restudied the lithic assemblage and also carried out field surveys in the Dingcun area. In the following paragraphs, we describe the geological and stratigraphic context of the Dingcun site, and following the results of restudy of the lithic assemblage, we re-assess the age and the cultural characteristic of Dingcun.

2. Geological setting and stratigraphy of the site

All 13 studied localities of Dingcun site are scattered on the third terrace (T3) on the left bank of the Fenhe River, 20–25 m above the river level, and extending over 15 km from south to north. The Fenhe flows from the city of Taiyuan and is a main tributary of the Yellow River and part of the Fenhe-Weihe Graben system. In the open valley near Dingcun, five terraces have developed.

Locality 54:100 (35°49’N, 111°25’E), where three teeth of *Homo* sp. were found, is considered as representative of the others. The profile of Loc. 100 is an example (Fig. 2). It contains 4 units. At the

bottom is a hard sandstone layer (Unit 1), ~2 m thick, which is assigned to the Lower Pleistocene. Unit II overlies Unit I unconformably and is a 20 m thick fluvial deposit. The stone artifacts, the three human teeth and the associated mammalian fossils were found in the upper part of this unit. Below the archaeological layer, which is about 4 m thick, there are layers containing abundant freshwater fossil molluscs, such as those of *Lamprotula*, and layers of small gravel and sand. Unit III is about 10 m thick and is an aeolian deposit that includes the first paleosol (S1) of the Upper Pleistocene (Malan loess) and the Holocene paleosol (S0). Unit IV, the uppermost one, is a modern tillage soil with a thickness about 0.5 m.

3. Lithic industry

3.1. Raw material at Dingcun

Hornfels was used for making 94.7% of the stone tools from Dingcun; the rest were made from a variety of rock, including chert, limestone, basalt, quartzite, shale, and sandstone (see Fig. 3; Pei et al., 1958). Hornfels is a type of fine-grained rock that was not frequently used for making Acheulian tools, as the Acheulian knapper had a preference for coarser-grained raw material (Sharon, 2008). An Early Acheulean site whose raw materials are also dominated by hornfels is located in the Vaal River basin of South Africa (Leader, 2009). In the downstream valley of the Fenhe River where Dingcun is located, there are few pebbles or cobbles suitable for tool-knapping. Therefore, the origin of raw materials of Dingcun

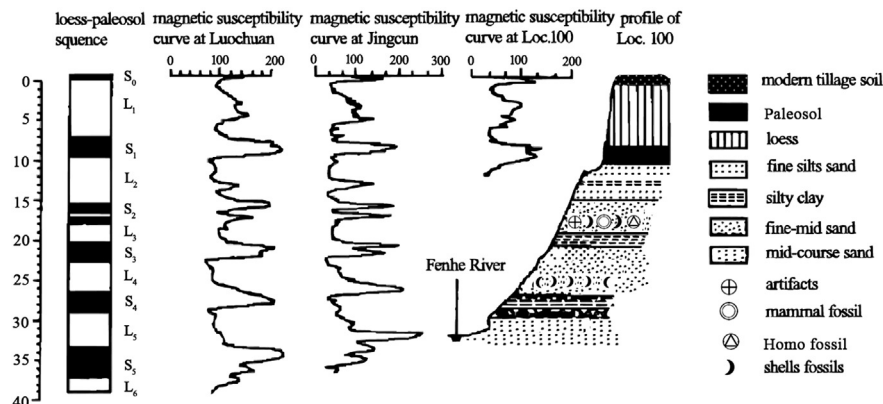


Fig. 2. Magnetic susceptibility curves at Loc. 100 and their correlation with those of the loess-paleosol at Jingcun (near Dingcun) and Luochuan profiles (after Wu and Liu, 2002).

would come from the Carboniferous-Permian hornfels outcrops near the site. The mountains that could provide the raw materials are located east of the valley and at an average altitude of 1000–2000 m. The raw materials were brought to the site through gullies which are located 7 km from the site. These gullies attracted the attention of researchers from the beginning, especially Shanugou, who was the first to identify it as the raw material source of Dingcun (Pei et al., 1958; Wang et al., 1987).

In this paper, 1177 artifacts are described from the 2005 artifacts which were recovered in the field seasons of 1953 and 1954. These artifacts are stored at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Chinese Academy of Sciences. Other artifacts were distributed to museums, institutes or universities, in China and abroad. Through the renewed study of the artifacts stored in IVPP, we aim to achieve a renewed description and understanding of the lithic assemblage of the Dingcun.

3.2. Techno-typological analysis

Despite some limitations, Bordes' typological method has been the basic typology for the Palaeolithic research since the 1960s (Freeman, 1977; Bordes, 1979; Monnier, 2011), as it provides a universal platform for researchers to analyze Palaeolithic assemblages. Hence the authors used the Borean typology as presented in Debénath and Dibble (1994) to analyse the stone artifacts in this paper. The 1177 artifacts include 62% flakes, 25% tools, and 6% cores, with the remaining 7% broken flakes and chunks (Fig. 4). The tools can be divided into two groups. One consists of Acheulian heavy-duty tools, which include handaxes, cleavers, picks, spheroids and choppers. The other component is light tools, including scrapers, notches, denticulates and borers (Table 1). Most of the light-duty tools are retouched on small flakes (length ≤ 50 mm), but some are slightly larger. Some scrapers can be defined as massive scrapers, as at other Acheulian sites (Goren-Inbar et al., 2008). Among the 731 flakes, some flakes were believed produced by the anvil (block-on-block) method, which was described as one of the Dingcun industry's prominent features (Pei et al., 1958; Liu, 1988). However, many flakes were also struck by direct percussion, and had four kinds of striking platforms, namely, plain, point, faceted, and prepared (Fig. 9). There are some Kombewa flakes, blades, and flakes with centripetal preparation flakes scars on their dorsal faces. The number of cores is not large and includes giant cores and smaller multi-platform cores.

Table 1
Lithic typology of the studied artifacts.

	Typology	Number	% of tools	% of artifacts
Heavy-duty tools	Handaxe	13	4.8%	1.1%
	Cleaver	11	4.0%	0.9%
	Chopper	9	3.3%	0.8%
	Spheroid	13	4.8%	1.1%
	Pick	22	8.1%	1.9%
Light-duty tools	Borer	33	12.1%	2.8%
	Scraper	70	25.7%	5.9%
	Notch	37	13.6%	3.1%
	Denticulate	29	10.7%	2.5%
	Unidentified	35	12.9%	3.0%

3.2.1. Tools

Handaxes (Fig. 5: 1–5) are made on large flakes and modified in such a way that their retouch covers most of both faces. The extent of retouch is directly related to the shape of the blanks. Some are elaborately retouched including retouched proximals. Based on the measurements provided in Bordes (1979) and Roe (1964, 1968), there are flat handaxes, elongated handaxes and ovate handaxes in the Dingcun assemblage.

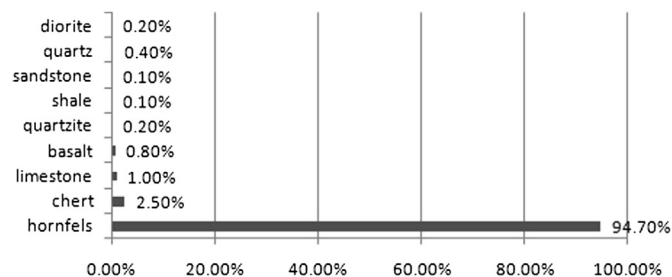


Fig. 3. Raw materials of Dingcun.

Cleavers (Fig. 6: 1, 2) are also made on large-flakes. There are two examples that show that Kombewa flakes were also used as blanks to produce cleavers. Some cleavers are retouched bifacially, while others are unifacial.

Picks (Fig. 6: 4, 5) are notable for their triangular or lozenge-shaped cross sections, and were named “big trihedral points” in China. This kind of tool was made from large thick flakes. By steep flaking from two edges of the dorsal face to the mid-ridge, the pick attains a triangular point. The ventral faces of the flakes are usually flat with few retouch scars.

Spheroids (Fig. 7: 1, 2) are a tool type that occurs in Dingcun and was previously identified and described by Pei (Pei et al., 1958). Different from other kinds of tools, the raw material of spheroids is mainly limestone. Included among the artifacts we restudied are five well rounded spheroids that could be considered as bolas (Inizan et al., 1999).

Choppers (Fig. 11: 3) had been regarded as the commonest tool of the Dingcun industry. Nonetheless, re-examination of the collection indicated that few artifacts could be considered as choppers. Here, we considered as choppers only those artifacts made on pebbles, cobbles and chunks. In the report of 1958 all the cleavers that are made on flakes were regarded as complex choppers.

Borers (Fig. 8: 1–3) are small, using small flakes as blanks. Apart from the hornfels, chert is also an important raw material for making borers. In most cases, the tool-makers chose to retouch the distal ends for borer modification, but some retouch occurs on the proximal part.

Notches (Fig. 8: 4–6), like the borers, are made on small hornfels or chert flakes. Most were produced by retouching a notch on one edge of the flake or on both edges. Both Clactonian types of notches and complex notches occur in the Dingcun assemblage. The difference between the two groups is that the Clactonian notches

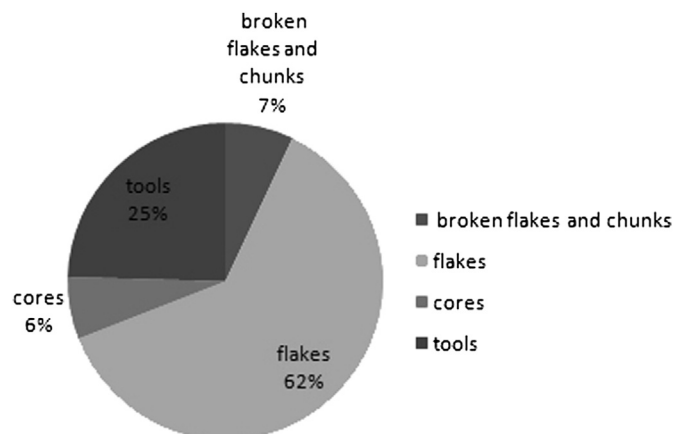


Fig. 4. General structure of Dingcun industry.

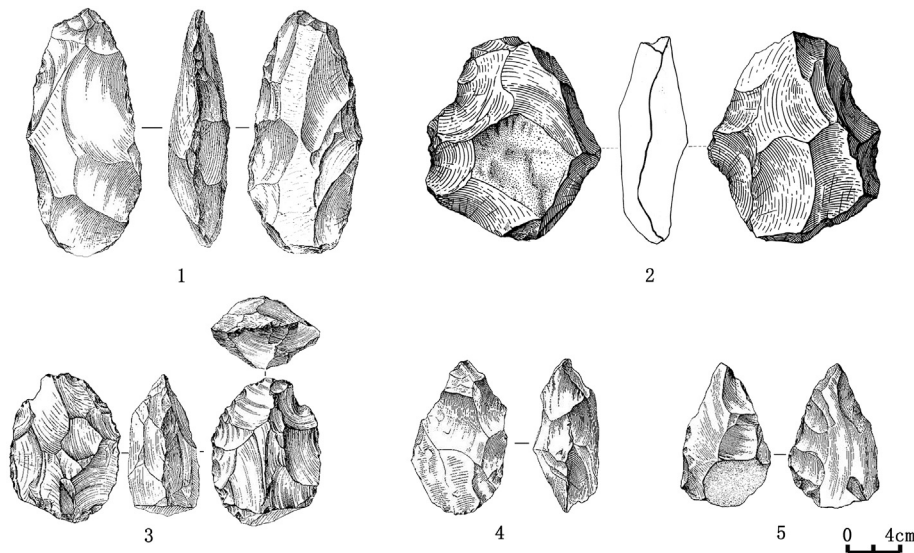


Fig. 5. Examples of handaxes at Dingcun (1, 3, 4, 5 after Pei et al., 1958).

were always made with a single blow and the complex ones with several blows (Debénath and Dibble, 1994).

Denticulates (Fig. 8: 7, 8) are also made on small flakes, but a few are slightly larger (length ≥ 50 mm). The raw materials of this type include hornfels, chert and quartzite. Most of the tools are formed by a series of continuous notches on the edges of the flake, but some are modified on the transverse distal edges.

The scrapers (Fig. 8: 9, 10) of Dingcun vary greatly in size: some are small but others are much larger and can be called massive scrapers (Fig. 6: 3). Irrespective of size, all the scrapers are made on flakes and retouched either on the edge of the blank or on the transverse distal edges.

3.2.2. Flakes and cores

Flakes (Fig. 10) form a significant component of the Dingcun lithic assemblage. Based on their size, the flakes can be classified into two groups: >50 mm and <50 mm in length. Each accounted for about 50% of the assemblage. Technologically the flakes are classified into three groups. The first ones are produced by the block on block method. Some scholars experimented with this method, and claimed it could have been an important knapping method at Dingcun (Pei et al., 1958; Liu, 1988). The width of all these flakes is larger than their lengths. Further experiments are needed to test the importance of this in the Dingcun industry. The second type was produced by direct percussion, including the by-

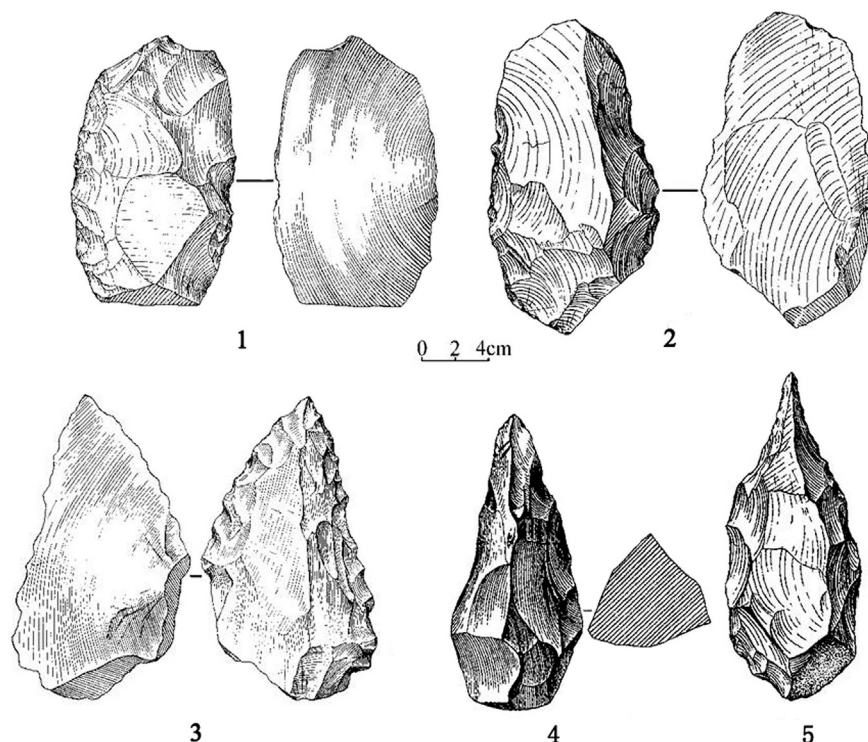


Fig. 6. Cleaver, massive-scraper and picks, Dingcun (after Pei et al., 1958).

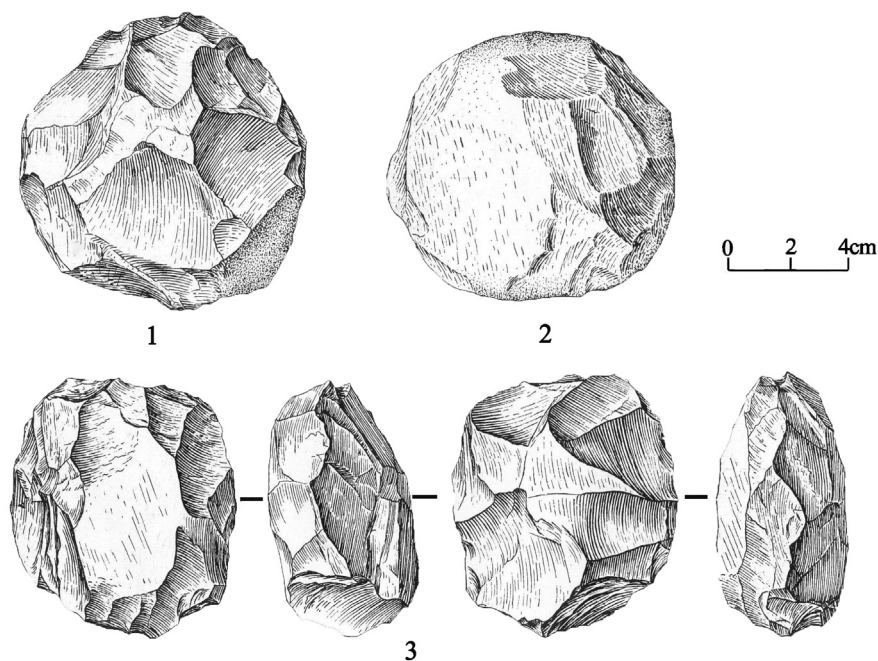


Fig. 7. Examples of spheroids (1,2) and discs (3) at Dingcun (after Pei et al., 1958).

products of tool retouching. Other technological methods discernible on flakes are those of the Kombewa and that of the truncated-faceted flakes. It is difficult to state that Levallois technology was used in Dingcun, as we did not find Levallois cores in the assemblage.

The cores in Dingcun form a small component of the lithic assemblage, but are important for gaining additional insight into the possible modes of raw material acquisition and the knapping technology of the Dingcun industry. The size of the cores varies

significantly, with giant, large and small, dimensions. The size of the giant cores, of which the length or width are more than 200 mm, show the origins of the flakes which were used to produce large-flake tools (Goren-Inbar et al., 2011), of which the large ones have a length or width of >100 mm. At the same time, small cores that produced small size flakes also exist at Dingcun (Fig. 11: 1). Lengths and widths are less than 100 mm. The cores can be classified into single platform cores and multi-platform cores. The latter are more common.

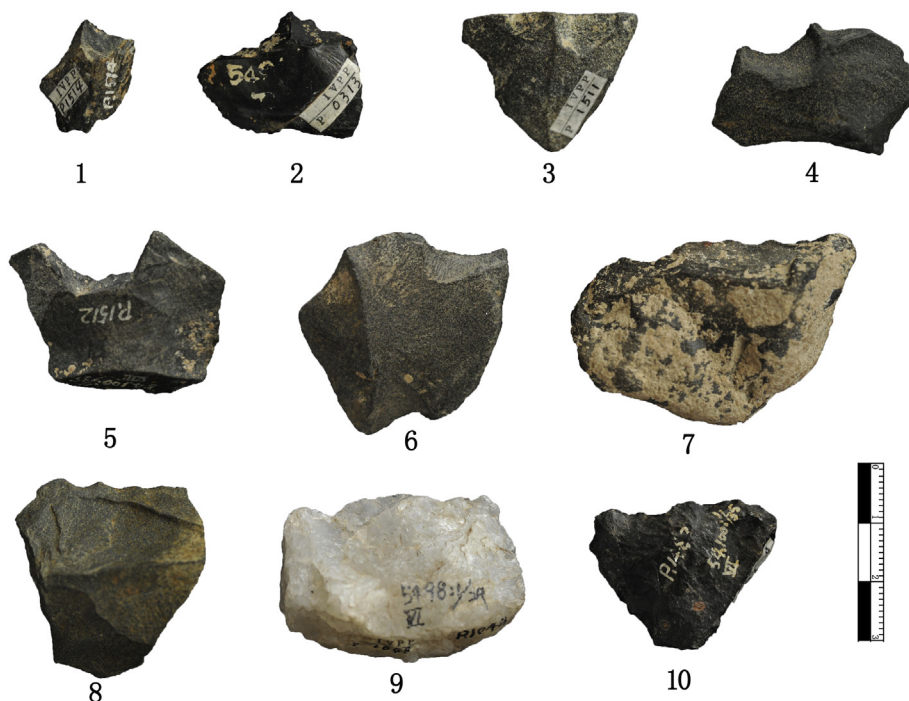


Fig. 8. Examples of light-duty tools at Dingcun.



Fig. 9. Examples of different kinds of flake striking platforms at Dingcun.

4. Discussion and conclusion

4.1. Chronology of the site

The Dingcun excavations raised many questions about the chronological assignment of the site. In the preliminary report, Jia

(1955) assigned the Dingcun site to the Middle Pleistocene on the basis of a reddish loam layer, which is situated above the culture layer. Later, in a formal report, Pei placed the Dingcun site around the same age as that of Sjava-osso-gol (Salawusu), which was assigned to the Late Pleistocene (Pei et al., 1958). This conclusion differed from Jia's, but catered to the opinion of Movius (1956). From then on, there



Fig. 10. Examples of flakes at Dingcun.

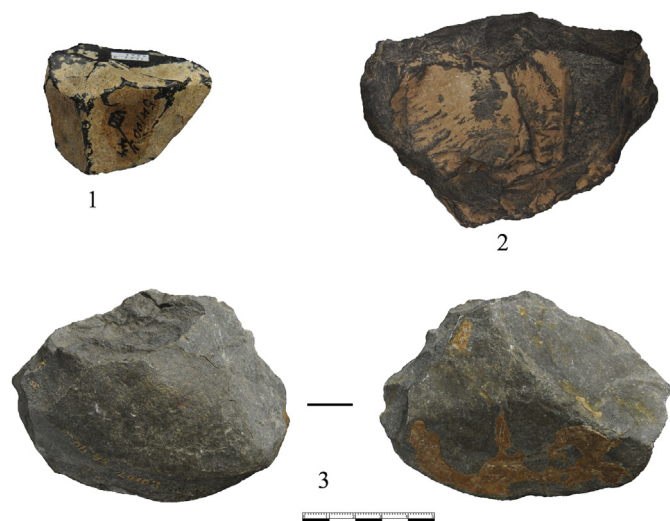


Fig. 11. Core (1) and chopper (2), Dingcun.

were two different viewpoints on the chronology of Dingcun: one placed Dingcun in the Middle Pleistocene (Jia, 1955; Yang, 1979; Liu and Ding, 1984; Wu and Liu, 2002), and the other in the Late Pleistocene (Movius, 1956; Pei et al., 1958; Wang et al., 1994; Li, 2001).

Being a pioneer of the Loess research, Liu Tungsheng was also concerned with the age of Dingcun, particularly because intensive research into the loess-paleosol sequence of the Loess Plateau provides an effective dating tool for northern China loess area (Kukla et al., 1988; Kukla and An, 1989; Ding et al., 1991, 1994; Liu et al., 1994; Lu and An, 1997). He pointed out that the Dingcun site belonged to loess-paleosol Cycle II, or MIS 6–7 (Liu and Ding, 1984). Because Dingcun is located along the terrace of Fenhe River in the Loess Plateau hinterland, it is appropriate to use the Chinese loess-paleosol sequence to determine the age of Dingcun. The magnetic susceptibility study of the profile at Loc. 100 of Dingcun shows corresponding matching curves between the profile at Luochuan (the type section of the Chinese loess-paleosol sequence) and the Jincun profile near Dingcun (Wu and Liu, 2002) (Fig. 2). This correlation helps determine the chronology of the layer with the human teeth and stone artifacts, and places it about 4.5–9 m below S1, or paleosol/soil 1. As S1 is dated to 73–128 ka, the Dingcun assemblage has to be older than 128 ka.

During the recent field survey, the age of formation of the various terraces was established according to the loess-paleosol sequence. Along the gully near Loc. 100, we defined T4 and T5 and there are several paleosol layers above the fluvial deposit at T4 and T5. At T4 there are 3 paleosol layers (S1–3), and at T5 there are 7 paleosol layers (S1–7). According to the loess-paleosol sequence, we can calculate the latest date of the formation of the terraces. Thus, T4 can be dated to >336 ka, the basal age of S3; and T5 can be dated to >787 ka, the basal age of S7 (Ding et al., 1991, 1994). Hence the age of T3 is older than 128 ka and younger than 336 ka.

Other dating methods were also used at Dingcun, such as Uranium-series (U-series) dates and Amino Acid dating (Chen et al., 1984; Zhou, 1989). The U-series dating used mammal teeth and is a reliable method with a time range from a few hundred to up to 350,000 years (Walker, 2005). Using mammal teeth from the cultural layer of Dingcun for U-series dating, the result obtained is 160 ka–210 ka (Chen et al., 1984). These dates correspond to the stratigraphic interval between the base of S1 and S3, i.e. 128 ka–336 ka. The chronology of Dingcun is therefore secure and can be assigned to the Middle Pleistocene, and thus, the Dingcun site is late Lower Paleolithic.

4.2. Lithic industry

Although some scholars proposed that Dingcun is a site that included handaxes (Jia, 1956; Pei, 1965; Freeman, 1977; Huang, 1987), the consensus now is that Dingcun contains a chopper-chopping tool cultural assemblage with numerous choppers, as the formal report proposed. In that report (Pei et al., 1958) the handaxes were termed complex choppers. Picks were termed giant triangular points and cleavers were considered as “scrapers”. As a result, the Dingcun industry became an exceptional cultural entity: “No comparable industry is ever known before both in China and in Europe” (Pei et al., 1958).

Fifty years later, it is important to point out two important influences that shaped that investigations (and perceptions) of the Early Paleolithic in East Asia. The first was that there was a fundamental difference between the Paleolithic record from East and Southeast Asia on the one hand, and western Asia, Africa and Europe on the other (Movius, 1948). According to this view, the early Palaeolithic inhabitants of East Asia were primitive and backward, and could make only simple (Mode 1) flake and core assemblages, unlike their more “progressive” and “advanced” counterparts to the west, who were “dynamic” and thus able to make Acheulean bifacial assemblages and later, Middle Paleolithic, prepared core assemblages. The second influence was the reaction by Chinese researchers in the decades following the establishment of the New China against western terminology, which was seen as an imposition of western ideas upon Chinese evidence. At that time, the researchers applied typological schemes influenced by de-westernization, which meant that Chinese scholars tried to avoid using western terminology (Huang and Hou, 2009), such as handaxes and Acheulean (Freeman, 1977). As a consequence, objects described here as bifaces and cleavers were classified as different kinds of choppers, and thus the artifacts from Dingcun were regarded as a chopper-chopping tool industry (Pei et al., 1958). This in turn supported the concept of the Movius line which had identified two zones within the Paleolithic world: an East and Southeast Asian zone characterized by pebble chopper/chopping tools, and another zone with handaxes comprising the rest of Eurasia (Movius, 1948). However, if one applies internationally accepted typological categories to the Dingcun lithic assemblage, the result is a higher frequency of handaxes than those of the previous studies (Liu, 1988). Re-examination of the assemblage shows that handaxes form 4.8% and cleavers form 4.0% of the Dingcun tool assemblage (Table 1).

Handaxes are widely regarded as the hallmark of the Acheulean culture and an indicator of advanced cognitive abilities (Iovita and McPherron, 2011). However, some scholars think that handaxes can no longer be the only index-fossil for the Acheulean (Monnier, 2011), as handaxes can occur in non-Acheulean contexts.

Dingcun can be defined as an Acheulean site, not only because of the presence of handaxes, but also due to other Acheulean tools including cleavers and picks. The cleavers of Dingcun are viewed by some scholars as typical Chinese ones (Lin, 1992; Wang, 2006), but we suggest that they are similar to other Acheulean assemblages in other parts of the world. The picks are a most representative tool with a fine retouched point and a large triangular shape, and all these characteristics make the Dingcun picks conspicuous. The spheroid in the Dingcun assemblage is a kind of tool which is unquestioned since the very beginning of the research of the site (Pei et al., 1958). Considering the above, the existence of the Acheulean tool-kit in the Dingcun site is a well-established phenomenon.

Besides the typical Acheulean tools that are made on large flakes, the small flakes and light-duty tools made on flakes are also an important component of the Dingcun industry although they were

neglected in the past. As at other Late Acheulian sites, the frequency of tools made on small flakes is greater and prepared core technology is present (Haslam and Roberts, 2011). Scrapers form the majority of the light-duty tools, although they differ drastically from elaborately retouched scrapers of the Middle Paleolithic period ones. The notches, borers, denticulate and prepared cores of Dingcun give some clues to the development of Middle Palaeolithic.

The assemblage composition of Dingcun is as Breuil and Freeman had proposed – an unquestionable Late Acheulian site (Pei, 1965; Freeman, 1977). In the Dingcun lithic assemblage, the classic Acheulian tools and an incipient Middle Palaeolithic technology coexist, a phenomenon that was previously ignored. This conclusion implies some degree of contact with other groups outside China that also used an Acheulian technology that others may wish to investigate.

4.3. Conclusion

The localities of the Dingcun site that were found and excavated in 1953–54 are on the T3 of Fenhe River and share a similar stratigraphic profile. Based on the Chinese loess-paleosol sequence and the results of U-series dating, the age of the site is of Middle Pleistocene, and falls between MIS 6–7. Considering the characteristic of the Dingcun site, the typology and technique of the lithic assemblage, we suggest that the chronological assignments and the cultural characteristic have been wrongly defined for a long time, and that the Dingcun site should be assigned to the Late Acheulian. Not only the Dingcun site has been misread, but also many other sites in China and East Asia. For a long time, Chinese researchers purposefully avoided using western terminologies when studying oriental sites. On the other hand, during the 1960s–1970s, Bordes and many other western scholars took more than ten years to build up a general typological system, but the Chinese scholars did not participate in this effort. As a result, the situation became “East is east and west is west, and never the twain shall meet”, as the poet Rudyard Kipling wrote (Kipling, 1895). Therefore, we constructed two completely different academic worlds of pre-history. During Palaeolithic time, our ancestors lived in a world without the concept of nations and political power, and without these artificial boundaries between the west and the east. So, we suggest, it is now time to give up these misleading concepts, and to see the prehistoric record as it actually is.

Acknowledgements

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