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The Origin of Anatomically Modern Humans in China

Genetic, skeletal, and archaeological studies alike demonstrate that anatomically modern humans originated ~200–150 ka BP in Africa, and this finding cannot be questioned. Over the last 4–5 decades, however, human fossils with undoubtedly modern skeletal markers, dating to 120–40 ka BP, have been discovered in China and Southeast Asia, suggesting that those territories, too, may have been part of the region where *H. s. sapiens* arose convergently on the basis of *H. erectus*. An important fact supporting this hypothesis is that a new taxon, Denisovan (informally *H. s. denisovan*), was established on the basis of the genetic analysis of a bone sample from a phalanx of the fifth finger of a 9–12-year-old girl from Denisova Cave. Also, genetic studies show that all three taxa, African anatomically modern humans, European Neanderthals, and Central Asian Denisovans, had interbred and produced fertile offspring, implying that all these taxa formed an open genetic system with processes such as admixture and assimilation, suggestive of a single species. Based on this conclusion, the following scenario of the origin of *H. sapiens sapiens* can be proposed: 80–60 ka BP anatomically modern migrants engaged in such processes with *H. s. neanderthalensis* in Europe, Denisovans in Central Asia, and early anatomically modern descendants of *H. erectus* (informally *H. s. orientalis*) in East and Southeast Asia. The key role in the origin of *H. s. sapiens*, then, was played by migrants from Africa (informally *H. s. africanensis*), who were engaged in interbreeding and assimilation with *H. s. neanderthalensis*, *H. s. orientalis*, and *H. s. denisovan*.

Keywords: *H. erectus*, Neanderthals, Denisovans, early anatomically modern humans, pebble-flake industry, Paleolithic, Pleistocene, assimilation.

Introduction

Currently, two main alternative hypotheses on the origin of anatomically modern humans are being discussed. According to the first (African Eve) hypothesis, based on the results of genetic and archaeological studies, early modern humans originated around 200–150 thousand years ago in Africa. Proponents of this hypothesis believe that ca 80–60 ka BP, or perhaps earlier, modern humans started expanding over Eurasia replacing the indigenous population—archaic hominins—or partially mixing with them (Stringer, Andrews, 1988; and others). The second hypothesis (multiregional human evolution) suggests the origin of

modern humans in Africa; it implies that anatomically modern humans could have also originated in Eurasia populated by *H. erectus*, in the course of divergence, adaptation to special environmental conditions, and genetic drift (Wolpoff, Wu, Throne, 1984; Wolpoff, 1989, 1992; Wolpoff, Caspari, 1996; and others).

There are also other hypotheses. One of these suggests that the dispersal of modern humans over Eurasia resulted in the interbreeding with indigenous population rather than the replacement of locals by migrants; this process could have been long-lasting and widespread (Smith, 1992a, b; Smith, Hutchinson, Janković, 2012; Smith et al., 2017). A compromise hypothesis was proposed by Chinese

anthropologists and archaeologists; the idea is based on the anthropological remains discovered in China that show well-defined modern morphological markers and date back to the first half of the Upper Pleistocene. Researchers admit the possibility of the origin of early modern humans in China in the course of the evolution of *H. erectus* and gene exchange with western populations (Wu Xinzhi, 2004, 2006; Gao et al., 2010).

All the proposed hypotheses on the origin of modern humans share certain provisions. The main is the provision on the origin of the earliest modern humans in Africa, from where they expanded to Eurasia. The discovery of a new taxon (Denisovans) and the data of paleogenetic studies of the remains of *H. s. neanderthalensis* provide the grounds to propose a slightly different scenario for the origin of *H. sapiens sapiens*.

Genetic studies have shown that early modern humans from Africa, Neanderthals, and Denisovans interbred and gave birth to fertile offspring. This is confirmed by the fact that nowadays the entire human population (non-Africans) retains 1–2 % of the Neanderthal genetic heritage, and some modern populations of Southeast Asia up to 5–6 % of the Denisovan genome. Interbreeding occurred between Denisovans and Neanderthals, too. The remains of a girl (Denisova 11), whose father was a Denisovan and mother was a Neanderthal, were recovered from Denisova Cave (Slon et al., 2018). Consequently, all the three taxa—African early modern humans, Neanderthals, and Denisovans—formed an open genetic system; they could exchange genes, and it was not an interspecific but intraspecific assimilation (Derevianko, 2019).

At the next stage of the evolution of genus *Homo*, in the chronological range of 200–100 ka BP, three taxa were formed in Africa and Eurasia at a huge distance from one another, with an open genetic system and a capability to exchange genes. This inference gives the reason to assert that during the almost 3-million-year long evolution of *Homo*, all the species that were identified by anthropologists retained their open genetic system and the capability to assimilate (Derevianko, 2019, 2022).

Thus, the long phylogenetic development of the genus *Homo* in Africa and Eurasia followed the sapient line of human evolution; the development was determined by three features: open genetic system and capability of hominins to interbreed; natural and sexual selection; fluctuations of environmental conditions in the Pleistocene and the necessity to subsist in new environmental settings. The sapient evolutionary

trend, which forms the basis of the morphological and cognitive development of the *Homo* clade, distinguishes humans from the entire animal world.

The analytical findings on the issues of evolution of the genus *Homo* show that in the Late Early and the first half of the Middle Pleistocene in Africa and Eurasia human evolution occurred along the sapient lineage: these territories could have been populated by *H. erectus*, *H. heidelbergensis/rhodesiensis*, and *H. antecessor* (late European *H. erectus*), forming the ancestral basis for modern humans in Africa, Neanderthals in Europe, and Denisovans in Central Asia. In the Middle Pleistocene in China, a new taxon, informally named *H. s. orientalis*, evolved convergently on the ancestral basis of *H. erectus*.

Dispersal of *H. erectus* over the territory of China in the Early and the first half of the Middle Pleistocene

Physical anthropologists have identified certain common basic features for all *H. erectus*: small brain capacity (on average, about 900 cm³)*, low cranial vault, absent mental protuberance, pronounced frontal torus, and others. The eastern and southeastern populations of *H. erectus* diverged due to adaptation to other environmental settings and natural selection. These populations differed in certain morphological features from European and African populations. Some anthropologists distinguish them into a separate group, *Homo erectus* *senso stricto*. Others do not exclude the possibility of dividing a single taxon into two categories: African and Asian *H. erectus* (Andrews, 1984; Stringer, 1984; Wood, 1984; and others).

Homo erectus of South and Southeast Asia form a single species together with European and African *H. erectus*, but owing to their divergence and habitation in different environmental settings, each of these groups, during the Early and Middle Pleistocene, retained both ancestral (plesiomorphic) and evolutionarily acquired (apomorphic) traits (Andrews, 1984; Stringer, 1984; Turner, Chamberlain, 1989; Bräuer, 1990, 2008; Bräuer, Mbua, 1992; Rightmire, 1998a, b; 2001; Wood, 1994; and others). *H. erectus* of East and Southeast Asia, which formed a group somewhat different from that of western populations, were separated from one another by a distance of about 4–5 thousand km

**H. erectus* species is characterized by a wide range of cranial capacity, ranging from 600 to 1251 ml (Rightmire, 2004).

and in time, and lived in different environmental conditions; as a result, they had not only common but also some distinctive morphological features (Weidenreich, 1941, 1943, 1946, 1947a–c; Howells, 1980; Santa Luca, 1980; Rightmire, 1993, 1998b; and others). Some researchers distinguish subspecies among the East Asian population of *H. erectus* (Howells, 1980; and others): for example, *H. erectus erectus* (early Indonesian forms) and *H. erectus pekinensis* (Chinese). However, the distinction of subspecies or demes among the East Asian *H. erectus* population (Howell, 1999) is hardly sufficiently justified.

Archaeological evidence suggests that *H. erectus* dispersed over the China territory as early as 1.7–1.6 Ma BP. However, some available data suggest the possible emergence of hominins in this area prior to 2 million years ago. The Renzidong site in Anhui Province is dated to 2.0–2.4 Ma BP (Han, Jin, Wei, 1999), the age of the Danangou site in Hebei Province is 3 million years old (Tang, Chen W.Y., Chen C., 2000). The majority of researchers do not consider these localities as human habitation sites, and the items found there as “lithic artifacts”. Noteworthy are the stone tools found in a stratigraphic sequence in the vicinity to the village of Shangchen, 4 km north of Gongwangling (Zhu Z. et al., 2018). Researchers have no doubt that this site contains lithic artifacts, but the preliminary estimate of its age—2.1 million years—requires further research.

In China, the earliest paleoanthropological remains and stone tools were discovered at the Longgupo site near Mount Wushan. However, the issues concerning the stratigraphic sequence, the availability of processed tools, and the age estimations of the site are still debatable. The taxonomic affiliation of the Longgupo fossil is debated, too.

Huang Wanbo and colleagues initially classified the paleoanthropological finds from the Longgupo site as a new subspecies of *H. erectus*/*H. erectus wushanensis* (Huang Wanbo, Fan Qiren, Gu Yumin, 1991). In the course of further research, Huang Wanbo and his colleagues decided that the mandible of Wushan man was older than that of *H. erectus*, shared certain features with the lower jaw of *H. habilis* and *H. ergaster*, and the stone tools are close to the Oldowan industry. Other researchers classified this fossil as *H. indeterminate*, believing that the fossil shared some common features with *H. habilis* and *H. ergaster* (Huang Wanbo et al., 1995; Wood, Turner, 1995). There is an alternative point of view, according to which this find belongs to *Paleopithecus* (Etlar, Zhou, 1998; Etlar, Grummer, Wolpoff, 2001).

The issues of dating this locality are controversial, too. Based on paleomagnetic data, layers 7 and 8, in which the teeth were found, have been attributed to the Oldowan episode (1.96–1.78 Ma BP). For layer 4, dates of 750 ka BP and 1.02 ± 0.12 Ma BP were generated on the deer tooth (Huang Wanbo et al., 1995; Chen Tiemei, 2004).

The Yuanmou site, discovered in the early 1970s in the vicinity of the village of Shangnaban, 5 km southeast of the county town of Yuanmou in Yunnan Province, is considered equally problematic (Jia Lanpo, 1989; Zhang Xinyong, Zhou Guoxing, 1978; Zhou Guoxing, Hu Chengzhi, 1979; Ji Hongxiang, Li Yanxian, 1979). Two upper incisors were found at the site. In 1984, the diaphysis of the tibia of a young female individual was found in the same area. Zhou Guoxing, Huang Wanbo, Di Huang (1991), Wu Rukang (1990) and his colleagues (Wu Rukang et al., 1999) expressed doubts about the attribution of this bone to an Archanthropus. Later, at the University of California, Zhou Guoxing conducted a comparative study of the Yuanmou tibia with fossils of *Australopithecus afarensis*, *H. habilis*, *H. ergaster*, *H. erectus*, and *H. sapiens*, and came to the conclusion on the closest similarity of the fossil under study to KNM-ER-1500 (Zhou Guoxing, 2004; Zhu R.X. et al., 2008). According to Zhou Guoxing, the paleoanthropological finds from Yuanmou represent to the earliest *H. erectus* in China. The age estimations of these fossils arouse debate. Some scholars provide the dates of 1.7 ± 0.1 Ma BP (Li Pu, Jian Fang, 1984) and 1.6 ± 0.1 Ma BP (Cheng Guoliang, Li Suling, 1977). There is a paleomagnetic date of about 1.7 Ma BP (Zhu R.X. et al., 2008). Other researchers suggested that the Yuanmou fossil should be associated with the Middle Pleistocene (Aigner, 1981). F.C. Howell attributed these finds to the Middle Pleistocene (1986: 460). Reiterated paleomagnetic and lithostratigraphic studies have shown that the archaeological and anthropological finds are no older than 700 thousand years (Hyodo et al., 2002).

In Lantian County, Shaanxi Province, in the north of China, quite a number of Paleolithic sites were discovered in the mid-1960s, of which 27 were attributed to the Middle Pleistocene. Among them, the two sites with paleoanthropological finds: Gongwangling, 16 km from Lantian, and Chenjiawo, 11 km northwest of this city, approximately 35 km from Xi'an, were subjected to the most profound studies. The distance between the sites is approximately 21 km. Both are located on the Gongwangling Uplands in the northern foothills of the Qinling Range,

in the Baihe River basin, a tributary of the Weihe, which flows into the Yellow River.

In the vicinity to the village of Chenjiawo, a well-preserved mandible of an elderly woman was discovered at the foot of the red loam layer. Wu Rukang (Woo Ju-kang, 1964) pointed out its morphological similarity to the mandibles of *Sinanthropus* from Zhoukoudian 1 cave. The bones of an elephant, tiger, red wolf, wild boar, sika deer, small rodents, and other animals were recovered from the same lithological horizon with the mandible. In terms of faunal composition, the site is close to the lower horizons of Zhoukoudian 1 and 13.

Particularly important hominin remains—a skull cap, a large part of the maxilla with two teeth, and several small bone fragments—were found at Gongwangling.

Wu Rukang (Woo Ju-kang, 1964, 1966) and his colleagues (Wu R., Wu X., 1999) analyzed the paleoanthropological finds from Lantian and inferred that the age of the *Archanthropus* was over 30 years, the brain case was extremely small—about 780 cm³. According to Wu Rukang, the jaw from Chenjiawo and the skull from Gongwangling belonged to the same species as *Sinanthropus* and Javan *Pithecanthropus*, but showed different subspecific features; the scientist designated the new finds as *H. erectus lantianensis*.

The age of the Lantian remains controversial. The Gongwangling site is considered the oldest, and the site of Chenjiawo is younger. The majority of researchers believed that these sites fall within the chronological range from 600 ka to 1 Ma BP, the age of the jaw from Chenjiawo was approximately 650 thousand years, and the Gongwangling skull was 750–800 thousand years old (Ma Xinghua, Qian Fang, 1978; Ma Xinghua et al., 1978). However, other scientists attributed the finds from Gongwangling to the period of about 1 Ma BP, and those from Chenjiawo to 530 ka BP (Wu Xinzhong, Wang Linghong, 1985). The results of subsequent paleomagnetic studies, supported by data from the analyses of loess-soil sequences and faunal remains, made it possible to date the most ancient culture-bearing horizon, containing Lantian *Homo erectus* fossils and stone tools, to within 1 Ma BP (An, Ho, 1989). The emergence of bifacial technology in China can also be attributed to that period.

In 1979, on the top of a cape overlooking the Hanshui River, a tributary of the Yangtze, 40 km from the city of Yunxian in Hubei Province, a local resident found a fragment of an elephant tusk in the course of agricultural work. In 1989, the curator of the Yunxian

Museum dug a test pit at this place and discovered a well-preserved *Archanthropus* skull in limestone breccia under the arable land. In the 1990s, Chinese scientists have conducted field research at that place for several years.

From 1999 to 2002, the materials from the Yunxian site were studied jointly by Chinese scientists and researchers of the Prehistory Laboratory of the National Museum of Natural History and other scientific centers of France, under the direction of Professor A. de Lumley (Le site..., 2008). Two well-preserved human skulls, stone tools, and various Lower Pleistocene faunal remains were recovered from this site. Layer 3, which contained the skulls, was dated through various techniques within the range of 984–780 ka BP and attributed to the Santa Rosa episode of the Matuyama Chron of the reverse polarity. The age of the skulls is 936 thousand years (Ibid.).

The Yunxian skulls were identified as belonging to *H. erectus*, but given certain specific features, these *Archanthropes* were classified as the *H. erectus yunxianensis* subspecies (Li Tianyuan et al., 1994; Li Tianyuan, Ai Dan, Feng Xiaobo, 1996). French and Chinese scientists re-examined the skulls and compared them with other paleoanthropological remains (Le site..., 2008). They came to the following conclusions: the skulls belonged to a male and a female; the brain cases were 1152 and 1123 cm³, respectively, which is greater than the value of *H. erectus* from Sangiran, close to the upper values of *H. erectus* from Zhoukoudian, and corresponds to the average values of the well-developed Asian *H. erectus* and European *H. heidelbergensis* (Ibid.).

The researchers compared the Yunxian skulls with the skulls of *Archanthropes*, *Paleoanthropes*, and *H. sapiens sapiens*, and inferred that the Yunxian hominins differed both from ancient forms (*H. habilis/rudolfensis*, *H. georgicus*, *H. ergaster*) and from younger ones (*H. neanderthalensis*, *H. s. sapiens*). They belonged to a polyform group that lived 1.0–0.3 Ma BP. It is difficult to distinguish particular types with common features in the group. The greatest spatio-temporal proximity was traced between the Yunxian fossils and the Lantian remains. In addition, the Yunxian hominins fall within a wide range of Eurasian *H. erectus* and *H. heidelbergensis*, but possess specific features that make them recognizable among all the others. However, the grounds to distinguish Yunxian man as a separate subspecies are insufficient (Ibid.).

The fossils from Zhoukoudian Cave are of great importance for establishing the continuity in the

evolutionary development of *H. erectus* in China in the Middle Pleistocene. The remains of more than 45 hominins were found: 6 skulls, 12 skull fragments, 12 mandible parts, 157 teeth (73 individual), and about 14 postcranial fragments. Fossils and stone tools were found in layers 1–11 and 13 of the cave (Black, 1927a, b; 1932; 1933; Zhang Senshui, 1985, 1989; Jia Lanpo, 1980). Anthropological remains were most often recovered from cultural layers containing stone tools, ash, and charcoal fragments.

The fossils from Zhoukoudian Cave are unique: cranial and postcranial remains of individuals of various ages were found in a single site (at least 20 % of the fossils belonged to adolescents). The anthropological finds were recovered from cultural layers that were accumulated in the range of 400–450 ka BP (layer 2 is dated to 221 ± 84 BP, and layer 12 to 669 ± 84 BP). The anthropological finds were studied by many experts in physical anthropology; the research results have been presented in a large number of publications, including monographs.

The most informative comparative material in addressing the issue of continuity in the evolution of *H. erectus* are cranial fragments, which have been studied for about 90 years (Black, 1927a, b; 1933; Dubois, 1933; Ariens-Kappers, 1934; Weidenreich, 1941, 1943, 1946, 1947a–c; Ariens-Kappers, Bouman, 1939; Broadfield et al., 2001; Holloway, Broadfield, Yuan, 2004; Wu Xiujie, Schepartz, Liu, 2009; Wu Xiujie, Schepartz, Norton, 2010; and others).

The cave yielded six human skulls: Zhoukoudian V was found in layer 3, Zhoukoudian II, X, XI, and XII in layer 8/9, and Zhoukoudian III in layer 11 (Lin, 2004). The dates derived for these fossils aroused significant disagreement. The ESR-dates of all the samples fall within the range from 0.28 to 0.58 Ma BP (Huang Peihua et al., 1993; Grün et al., 1997). The Zhoukoudian V sample produced the youngest date of 0.28 Ma BP; while the Zhoukoudian III sample the oldest date of 0.58 Ma BP; the samples of Zhoukoudian II, X, XI, and XII were dated to ca 0.42 Ma BP. The $^{230}\text{Th}/^{234}\text{U}$ dating of the speleothem with the aid of thermal ionization mass spectrometry (TIMS) of the uranium series showed the age of the cranial samples from 0.4 to 0.8 million years (Shen et al., 2001). However, the age of the sample of Zhoukoudian V falls within the range of 0.4–0.5 million years, the youngest age of the samples from the lower layers is 0.6 million years, and the oldest age is 0.8 million years.

Wu Xiujie and co-authors calculated the size of the brain case of the most ancient skull Zhoukoudian III to

be 915 cm^3 , the sizes of samples Zhoukoudian II, X, XI, and XII to be 1072 cm^3 on average, and the size of the youngest cranium Zhoukoudian V to be 1140 cm^3 (Wu Xiujie, Schepartz, Norton, 2010). Thus, the *H. erectus*-like hominins from Zhoukoudian Cave show a stable increase in brain capacity, which was 1058 cm^3 on average. Besides, the scholars provide data on the cranium capacity of the modern population of China, ranging from 1110 to 1600 cm^3 (1382 cm^3 on average). They note the most progressive morphological features in Zhoukoudian V, distinguishing it from other specimens and indicating the evolutionary development towards sapienization.

The Zhoukoudian culture-bearing layers containing anthropological materials are dated within the range of ca 400 thousand years. Most researchers note the features typical for *H. sapiens*, the closeness of their morphology, as well as the similarities and differences from the remains of *H. erectus* found in other regions of Eurasia and Africa. These issues have caused some discrepancies in the researchers' conclusions.

Wu Xiujie and co-authors noted that the analyses of skulls from Zhoukoudian Cave revealed certain distinguishing features possibly separating African *H. erectus* from that of Asia (Ibid.: 2010). Some researchers believe that the skulls from Zhoukoudian Cave demonstrate unique morphological and morphometric features that are absent in African and other Asian fossils of *H. erectus*, although, in general, Chinese and southeastern *H. erectus* form a single whole from the morphological point of view (Kidder, 1998; Antón, 2002; Kidder, Durband, 2004). According to other scientists, some morphological features identified exclusively in Asian *H. erectus* have also been noted in African *H. erectus* (Bräuer, 1990; Bräuer, Mbua, 1992; Rightmire, 1998a; and others). Most anthropologists emphasize the amazing morphological unity of Asian and African *H. erectus* in the main parameters (Etler, 1996; Weidenreich, 1946; Wu Xinzhi, Poirier, 1995), although some scholars point to minor morphological changes associated with chronological differences in the fossils (Wolpoff, 1999; Wu Xiujie, Schepartz, Norton, 2010).

Dispersal of *H. erectus* over the territory of China in the second half of the Middle Pleistocene

The sites of Hexian, Chaoxian, Jinniushan, Panxian Dadong, Hualongdong, and others containing anthropological finds belong to the second half of

the Middle Pleistocene. Unfortunately, it is hardly reasonable to consider these sites in accordance with their chronological position; each site produced very different date estimations. In this paper, these are analyzed in sequential order from north to south.

The archaeological sites of Jinniushan and Dali are the most archaeologically significant in the northern part of China. At Jinniushan, the main anthropological materials were found at locus A, together with stone tools, Pleistocene faunal remains, and hearths. In total, 51 specimens, including cranial and postcranial fossils, have been documented: a skull, cervical and thoracic vertebrae, ribs, wrist bones, phalanges, a coccyx, and a calcaneus, among others (Wu Rukang, 1990; Lü Zun'e, 1995, 1996, 2003; Ho Chuan Kun, Jiang Peng, 1993; and others). Human bones were found over an area of 1.6 m², at a depth of 2 m. The carpus and tarsal bones were located in the anatomical order, indicating that they belonged to a single individual. Initially, Wu Rukang (1988) identified the Jinniushan human fossils as the remains of a male ca 30 years old. Subsequent analysis of the skull and patella morphology, as well as metric data, executed by Lü Zun'e revealed the presence of distinct female traits. Taking into account the narrow ischiofemoral space, triangular obturator foramen, prominent iliac fossa, fused cranial sutures, and the presence of unworn third molars, the age of the individual was determined around 18 years old (Lü, 1985).

He Chuankun and Jiang Peng carried out a comparative analyses of the Zhoukoudian *H. erectus* and the archaic *H. sapiens* from Dali and compiled a morphological characteristics of the Jinniushan man's remains: the skull is almost complete; the supraorbital ridge (torus susorbitaire) and the occipital protuberance (chignon occipital) are less pronounced; the cranium (4.5 mm thick on average) is thinner than that of *H. erectus* from Zhoukoudian (8.1 mm thick on average), and thicker than that of modern humans (2.3 mm); the cranial capacity of the Jinniushan fossil (ca 1390 cm³)* is larger than that of the Dali hominin (1160 cm³), and close to that of modern humans (1400 cm³ on average); the maximum width is between the external auditory meatus and the parietal tubercle (He Chuankun, Jiang Peng, 1993).

Some researchers classify the Jinniushan hominin as one of the earliest archaic *H. sapiens* and consider it to be more evolutionarily advanced than *Sinanthropus* from Zhoukoudian 1 and *H. sapiens* from Dali (Wu

Rukang, 1988, 1990; Jia Lango, 1988; Pope, 1988). Other scientists believe that the Jinniushan hominin was an intermediate form between *Sinanthropus* and *H. sapiens sapiens* (Lü Zun'e, 2003). There are also other viewpoints on the taxonomic affiliation of this individual.

The age of the site of Jinniushan is also controversial. The faunal assemblage from the low layers at Jinniushan is similar to that from the upper cultural horizons at Zhoukoudian 1. The dating analysis of a sample from layer 8, containing paleoanthropological materials, carried out in the laboratory of the Peking University, has shown the age of 310–240 thousand years. Another sample was dated by the U-technique to 286 ± 36/28 thousand years. Thus, the fossil can be dated in the range of 310–240 thousand years, and the average date is 280 ka BP (Ibid.). Another sample from layer 8 was dated to 187 thousand years (Chen, Yang, Wu, 1994). Gao Xing and C. Norton estimated the age of the site of Jinniushan in the range of 300–170 ka BP (2002). Notably, the paleoanthropological materials from this site are probably the earliest in China; these fossils can be attributed to archaic *H. sapiens* or a transitional form between *H. erectus* and anatomically modern humans.

In northern China, in Dali County, Shaanxi Province, in the late 1970s and early 1980s, excavations were carried out at the site of Dali, locus 78006 A. The site yielded a human skull, stone tools, and bones of Pleistocene animals. Close to this locus, another one, locus 78009, yielded a small amount of faunal remains and artifacts (Wang Yongyan et al., 1979; Wu Xinzhi, 2004; Wu Xin-zhi, 2009; Keates, 1994, 2000, 2001a, b; and others).

The most significant find at Dali was a well-preserved human skull. Many publications provide descriptions of this hominin and determine its place in the taxonomic series among other Middle Pleistocene fossils. I would like to point out the research that provides the most detailed metric analysis made by Wu Xinzhi (2009, 2014; Wu Xin-zhi, 2009). Based on a comprehensive study of the Dali skull, its morphological features, as well as comparison with other Middle Pleistocene fossils, the researcher made the following conclusions:

- 1) The Dali skull has many morphological features that indicate its intermediate position between *H. erectus* and anatomically modern humans. The skull is characterized by a mosaic combination of features of these taxa;
- 2) Some features of the Dali skull are closer to those of modern humans than to many other Middle

*According to other data, the cranium capacity was 1260 cm³ (Lü Zun'e, 2003).

Pleistocene human skulls; these features even fall within the range of modern human morphology;

3) Some morphological characteristics of the Dali fall within the range of Middle Pleistocene human variations in China, Eurasia, and Africa;

4) Many features of the Dali fossils are more closely related to those of other Pleistocene *Homo* individuals in China than to those of contemporaneous hominins in Eurasia and Africa;

5) Some morphological features of the Dali skull are closer to those of contemporaneous individuals in Eurasia and Africa than to the remains of other representatives of *H. erectus* in China (Wu Xin-zhi, 2009: 234).

The findings made by Wu Xinzhi allow us to conclude on the mosaic morphology of the Dali skull. The skull shows common features with Chinese *H. erectus*, anatomically modern humans, and Eurasian and African hominins. Despite the mosaic morphology of the skull, the scholar hypothesized that Dali fossil was an intermediate form between *H. erectus* and anatomically modern humans. Wu Xinzhi also noted that the presence of brow ridge in Dali skull, similar to those of Bodo, Kabwe, and Petralona, supported the idea of the possible gene flow between the ancient populations of China and Europe.

Many scholars agree that the Jinniushan and Dali fossils show common morphological features, and according to uranium dates, these were quite close chronologically. Some researchers explain the greater robustness of the Dali skull, as compared to the Jinniushan skull, by sexual dimorphism (Kaifu, 2017). The fossils were classified as archaic *H. sapiens* and interpreted differently: *Homo daliensis* (Bae, 2010) and late archaic *Homo* (Kaifu, 2017). After the discovery of the skull in Harbin, northern China, researchers proposed to combine the Jinniushan and Dali fossils into a new taxon *H. longi* (Ji et al., 2021).

The issue of the origin and taxonomic status of the Jinniushan and Dali fossils arouses debates. C. Groves (1994) proposed to classify these paleoanthropological finds as *Homo heidelbergensis*. He argued that these fossils showed a combination of morphological features typical of both *H. erectus* and *H. sapiens*. Many *H. sapiens* traits were identified in the Dali skull, which provided solid grounds to classify this hominin as *Homo sapiens* (Johanson, Blake, 1996).

In the southeastern part of China, faunal remains and anthropological finds (but no stone products) were found in Longtan Cave, Hexian County (Huang W.-P., Fang, Ye, 1981). The collection of human fossils included: a cranial vault, facial and parietal fragments,

left part of the mandible containing the second and third molars, the left upper molar, the left lower first and second molars, the right premolar, and five isolated teeth (Wu Xinzhi, Poirier, 1995). Many researchers rightly considered the Hexian fossils to be unique both in terms of morphological features of the skull and dental system (Antón, 2002; Cui, Wu, 2015; Durband, Kidder, Jantz, 2005; Etler, 1996; Wolpoff, 1999; Kaifu, 2017; and others). The occipital bone of the Hexian specimen is wide, which distinguishes it from the narrow occipital bones of *H. erectus* from Zhoukoudian (Antón, 2002; Cui, Wu, 2015; Durband, Kidder, Jantz, 2005). The Hexian skull fragment shows the greatest similarity to the cranial finds from Zhoukoudian Cave, but at the same time it exhibits a number of distinguishing secondary features including the gracile structure of the postorbital region. The greatest similarity is noted between the Hexian skull and the Zhoukoudian V skull, which dates back to the final Middle Pleistocene (Wu Xinzhi, Poirier, 1995). The researchers consider this fact as the evidence of the undoubted morphological continuity between these fossils.

Noteworthy is the peculiarity of the mandible and the whole dental system of the Hexian hominin. Most researchers attribute *H. erectus* fossils from China to one morphologically distinct homogeneous taxon. Some of the existing differences are explained by the chronological position, divergence, or sexual dimorphism (Wu Xinzhi, 2004; Zhang Y.Y., Liu, 2002). But then, how can we explain the fact that the Hexian fossil, which shows an undeniable similarity to *H. erectus* fossils from Zhoukoudian and especially to Zhoukoudian V, exhibits a completely different dental system? Anthropologists note that in the process of evolution, the *H. erectus* population of East and Southeast Asia in the Pleistocene showed a trend towards a decrease in the robustness of teeth and jaws (Kaifu, 2006; Zanolli, 2013). The Wu Liu and co-authors gave a more detailed description of the mandible and dentition of the Hexian specimen, which showed its differences from *H. erectus* (2017).

Experts believe that the structural pattern of the Hexian mandible is plesiomorphic, as evidenced primarily by the corpus robustness and a subparallel and low-positioned mylohyoid line separating the swollen subalveolar planum from the shallow subalveolar fossa. As compared to early *Homo*, several features, such as moderately curved dental arcade, a well-developed lateral prominence placed at the M₂-M₃ level, and multiple mental foramina, are derived. The dental enamel surface and strong, stout root structure of the Hexian fossil are primitive for the

Homo clade. The markedly crenulated “dendrite-like” enamel-dentine junction of the molars is apparently a feature specific to continental Asian *H. erectus*. Metrically and nonmetrically, then, the Hexian fossil is more primitive as compared to most *H. erectus* fossils of the late Middle Pleistocene, specifically owing to large and archaic crowns and roots.

The dentition of the Hexian specimen differs significantly from the fossils from Zhoukoudian Cave. The scholars also concluded that it lacks any jaw characteristics typically associated with the Neanderthal lineage (Ibid.: 2017). The researchers pointed to the similarity of the Hexian jaw with the mandible of Penghu 1 discovered in the Taiwan Strait (Chang et al., 2015), and suggested that both finds are paleodemes, belonging to a local population morphologically distinct from classic *H. erectus*. They argue that this conclusion aligns with the notion that combinations of primitive and evolving traits cannot be arranged in a chronological sequence, since the younger populations were not necessarily more developed than the older ones.

Wu Liu et al. (2017) proposed an alternative interpretation: the owners of these jaws could have been genetically related to unknown paleodemes with robust jaws. They retained the dentition of the earliest hominins, who initially populated this region around 1.7–1.6 Ma BP; hominins of this type might have inhabited the territory of China along with *H. erectus* evolving towards sapienization.

Kaifu Yousuke analyzed the Hexian and Penghu 1 fossils and inferred that, in terms of the general evolutionary trend, these primitive and robust mandibles and teeth suggest the existence of another distinct regional population of *H. erectus*, whose evolutionary history and origin is currently unknown (Kaifu, 2017: S424).

Thus, the analysis of dentition morphology of the Hexian individual suggests that, along with *H. erectus* communities evolving towards sapienization, the territory of China was inhabited by a population of *H. erectus* that resided in complete isolation and retained the archaic morphological traits inherent in the first settlers of East Asia. The question arises about the reasons that did not allow this *H. erectus* group to evolve along the *H. sapiens* lineage, same as representatives of this taxon developed in other regions of China. The whole territory of China, particularly its southeastern part, where the Hexian fossil was found, revealed the typical pebble-flake industry, which, despite the absence of stone tools at Hexian, excludes the possibility of dispersal

of another, archaic evolutionary line of *H. erectus* over this area.

The dentition of the Hexian hominin, along with morphological traits similar to those of *H. erectus* in China, has shown certain archaic features that resemble the fossil of Penghu 1. The answer to the question of the taxonomic affiliation of the Hexian and Penghu 1 fossils is provided by the discovery of a new taxon in Denisova Cave in the Altai. After divergence from Neanderthals, the morphologically and genetically evolving Denisovans migrated from the Levant to Central Asia, where they intermixed with indigenous population—the Central Asian *H. erectus*. As a result of the hybridization, they acquired an archaic dentition. About 350–300 ka BP, representatives of this morphologically and genetically developing taxon dispersed not only over Central Asia, but also in adjacent regions, including the western part of China, which is confirmed by the finds of Hexian and Penghu 1 (Derevianko, 2022, 2024a–d). This issue will be discussed in more detail in the paper that will be published in the next issue of the journal.

The age of the site of Hexian remains controversial. The faunal collection of the cave includes bones of animals that lived both in cold and warm climatic conditions of the second half of the Middle Pleistocene. Initial U-series dating of the animal bones yielded a chronological range of 130–220 ka BP (Chen T.M. et al., 1987; Chen T.M., Yuan, 1988). The ESR-dating of the animal teeth produced an age of 160–220 thousand years (early uranium uptake) and 350–250 thousand years (linear uranium uptake) (Huang Wanbo et al., 1995). Dating through ESR and U-series techniques, which make the derived date series more homogeneous, made it possible to establish the age of the hominin fossil sample as 412 ± 25 thousand years (Grün et al., 1998).

In 1982 and 1983, a human occipital bone and a maxilla were found in Chaoxian County, 50 km southwest of the Hexian site (Xu et al., 1984; Wu Xinzhi, Poirier, 1995). These fossils from the Chaoxian site were recovered from cave deposits of the Yinshan Mountain near the village of Yinshan in Anhui Province. No stone tools were found at this site, same as at Hexian. U-dating of samples from layer 2, where the fossils were found, yielded an age of 160–200 thousand years (Chen T.M. et al., 1987). An additional analysis of eight stalagmite carbonate samples and three bone samples from the same layer produced an age of more than 310 thousand years (Shen G.J., Jiu, Jin, 1997).

Wu Xinzhi and F. Poirier (1995) attributed the Chaoxian occipital bone and maxilla to archaic *H. sapiens*, who had, unlike *H. erectus*, some derived features, but at the same time they noted that the fossils were more robust and archaic than modern *H. sapiens*. According to Sh.E. Bailey and Wu Liu, the Chaoxian hominin dentition is archaic and lacks the derived features identified in Neanderthals. The teeth are large; the occlusal morphology retains primeval features observed in the hominins from Hexian, Xujiayao, Tongzi and some others (Bailey, Wu, 2010). Wu Xinzhi (1990), taking into account the chronological position and morphology, included the Chaoxian fossil in the same group with the finds from Dali, Jinniushan, Xujiayao, Maba, and others, whom many Chinese researchers classify as archaic *H. sapiens*; this group is considered by the same scientists as an intermediate link between *H. erectus* and anatomically modern humans.

The late Middle Pleistocene anthropological remains from China demonstrate both definitive *H. sapiens* traits and plesiomorphic ancestral features in morphology. Mosaic morphology is largely the result of two main factors: divergence in the dispersal of some groups of late *H. erectus* and assimilation with hominins from adjacent territories, primarily with Denisovans. Mosaic craniofacial and dentition morphology noted in hominins populating China in the Late Pleistocene demonstrates a complex pattern of morphological diversity. This provided the grounds to hypothesize the existence of several hominin species in China (Liu et al., 2013; Xing et al., 2015, 2019; Li et al., 2017; Chen F. et al., 2019), which could have included late archaic *H. sapiens*, early unknown humans, Denisovans, and another unknown group (Xing et al., 2015; Li et al., 2017; Chen F. et al., 2019).

In my opinion, the territory of China in the late Middle Pleistocene could have been settled only by *H. erectus* evolving along the *H. sapiens* lineage and by the Denisovans migrating in small groups from Central Asia and the Altai. The archaic Denisovan dentition is revealed in individuals of that time; this feature was identified on the skulls from Xujiayao, Dingcun, and other sites, along with modern morphological features such as shovel-shaped incisors typical of the modern Chinese population.

The Maba skull with the U-date of 125–129 thousand years presents a profound interest to researchers. The morphological analysis of this fossil has been carried out with great detail (Wu Xinzhi, Wu Maolin, 1985; Wu X.Z., 1988; Wu Xinzhi, Poirier, 1995). The fragments of frontal, parietal, occipital and facial bones of the skull are available (Wu Xinzhi, Poirier,

1995; Wu Xiu-Jie et al., 2011). The frontal bone is huge and rather thick (10 mm). The supraorbital torus and occipital angle are similar to those of *H. erectus* from Zhoukoudian. The Maba skull retained most of the calvaria and the upper facial parts (Wu Xinzhi, Poirier, 1995). The Maba skull bones at their thinnest point are thinner than those of Dali and similar to the bones of Xujiayao (Wu X.Z., 1988). The available uranium data suggest the age of Maba in the range of 119 to 169 thousand years (Yuan, Chen, Gao, 1986; Chen T.M., Yuan S.X., 1988; Wang L.H., 1989).

The teeth from the Panxian Dadong cave site in Guizhou Province in southwestern China date back to the late Middle Pleistocene. The cave belongs to a large karst system consisting of interconnected caves. Excavations were conducted there from 1992 to 2005, and revealed lithic artifacts, a large number of bones, and four animal teeth (Special..., 1997). Notably, in the lithic assemblage, some researchers identified the artifacts manufactured using the Levallois technique (Huang W. et al., 2015). It cannot be excluded that some changes in the pebble-flake industry of the genetically and morphologically developing *H. sapiens* could have been induced by the contacts with Denisovans.

Human teeth have been discovered at the site in various strata and across different years. Scientists conducted a study of the teeth, which, in their opinion, is not sufficient to determine their taxonomic status (Liu et al., 2013). Anthropologists believe that the upper central incisor and canine have more archaic features than the lower and upper premolars. The canine shows a symmetrical, incisor-like crown along with a slightly elevated central ridge on the lingual surface. The latter trait is considered more apomorphic than that of *H. erectus* from Zhoukoudian. The features of the lingual surface of the upper central incisor are regarded as archaic. The prominent basal elevation and well-developed finger-like projections of this tooth make it similar to early *Homo* specimens. The combination of primitive and apomorphic traits in the four fossils from Panxian Dadong is probably due to their differences in age (the specimens were discovered in different cultural layers). In general, the teeth from Panxian Dadong demonstrate both primitive and derived features, making them comparable to Middle and Late Pleistocene fossils found across East and West Asia and Europe.

Studies in the Hualongdong cave site, Dongzhi County, Anhui Province, is of great importance for understanding continuity in the evolution of hominins in China. Initially, fieldworks at the site began in 2006, and were continued annually from

2014 to 2019. In the course of excavations, a large number of stone tools, bones of Pleistocene animals, and paleoanthropological fossils were recovered (Gong et al., 2014; Tong et al., 2018; Wu Xiu-Jie et al., 2019; Wu Xiujie, 2023; and others).

The excavations at Hualongdong revealed two main strata of deposits: the one of carbonate-cemented cave breccia and the other consisting of loose clay mixed with gravel. The available U-Th dates on speleothems suggest that the breccia's maximum age is in the range of 330.5 ± 14.5 thousand years. The youngest age of the calcite crust formed around the void in the cave is 274.8 ± 9.2 thousand years. Thus, the average age of the finds is about 300 thousand years. Faunal remains of animals of the second half of the Middle Pleistocene confirm the proposed age of the site. Some bones bear cuts marks associated with the activity of hominins that inhabited the cave.

Unique remains of hominins were found in the brecciated deposits of Hualongdong Cave (Wu Xiu-Jie et al., 2019): eight skull fragments, seven isolated teeth, three femoral diaphyseal fragments, and a partial skull of an HLD 6 adolescent. The frontal bone indicates low and thick skull bones. The femur diaphyses exhibit a thick cortex and cross-sectional proportions of Middle Pleistocene hominins.

The HLD 6 skull has been preserved in the form of 11 fragments, which include a significant portion of the frontal bone, the left parietal bone, the maxilla, and the left zygomatic bone, as well as the posterior temporal region, the palatine bones, and the lateral left sphenoid bone. The mandible retains the right side, the posterior left part, and the ramus to the condylar neck. The estimated age of individuals from Hualongdong Cave is 13–15 years old. The skull and the mandible of HLD 6 were thoroughly examined by Wu Xiujie et al. (Ibid.). The endocranial capacity of the skull was approximately 1150 cm^3 , which is generally consistent with that of late Middle Pleistocene hominins of the same age (Ibid.). The HLD 6 individual exhibits a low vault (without parietal sagittal keel and angular torus), a low and broad nasal aperture, a prominent supraorbital torus, and the absence of third molars. While the maxilla lacks a zygomatic incisor, a large medial pterygoid tubercle is present.

A large amount of information was derived from studying the morphology of the facial part of the skull (Wu Xiu-Jie et al., 2021). The entire maxilla and its dental arch were reconstructed on the basis of four fragments. The scan of this reconstruction enabled the researchers to create a virtual reconstruction of the skull using high-precision computed microtomography

(Wu Xiu-Jie et al., 2019; Fig. 2; 2022: Fig. 2). They concluded that the face of the HLD 6 adolescent demonstrated moderate prognathism. The analysis of all fragments of the facial part of the skull has shown that the HLD 6 face morphology retains some archaic features and demonstrates certain *H. sapiens* traits. Moreover, while previously studied Upper Pleistocene finds, such as the Dali skull and Panxian Dadong teeth, displayed the features resembling modern humans (Wu Xin-zhi, 2009; Liu et al., 2013), the adolescent from Hualongdong Cave has even more pronounced *H. sapiens* features. According to the researchers, this individual is the first late Middle Pleistocene hominin whose facial part has the largest number of morphological characteristics similar to those of anatomically modern humans. The HLD 6 facial morphological type with such a number of derived features was identified among the Middle Pleistocene hominin fossils from China for the first time (Wu Xiu-Jie et al., 2022: 18).

Chinese anthropologists examined the HLD 6 mandible as thoroughly as its facial part (Wu Xiujie et al., 2023). When the mandible was found, it consisted of four jaw fragments and an isolated first molar (Wu Xiu-Jie et al., 2019). Later, in the laboratory, the researchers managed to find a part of the right mandible ramus, which matched the previously recovered fragments. A comprehensive analysis of the morphological features of the mandible and its comparison with similar Pleistocene fossils revealed some archaic features. The results of geometric morphometric analysis point to mosaic morphology of the HLD 6 mandible.

The study of the nearly complete skull and mandible of HLD 6 has shown a combination of features typical of Middle Pleistocene hominins of East Asia (Wu Xiu-Jie et al., 2019, 2022). Preliminary examination of the HLD 6 dentition revealed a simplified occlusal morphology, most similar to that of modern humans.

The mosaic morphology of paleoanthropological finds from China dating back to the late Middle Pleistocene hampered an unambiguous differentiation of fossils into taxonomic groups due to their varying degrees of preservation, insufficient information, lack of date estimations for some specimens, and the possible subjectivity of researchers' approach to assessing morphological markers (Liu, Wu X.J., 2022; Liu et al., 2022; Wu Xiu-Jie et al., 2022). With discoveries of new fossils and emergence of new analytical techniques, scholars sometimes changed their point of view. In one case, researchers subdivided the available fossils into several groups

(Liu, Wu X.J., 2022), while in the other case, they did not exclude the possibility of simultaneous dispersal of several species over the territory of China in the late Middle Pleistocene, only some of which can be attributed to the hypothetical ancestors of *H. sapiens* (Liu et al., 2013; Liu, Wu X.J., 2022; Xing et al., 2015, 2019; Chen F. et al., 2019). Given the morphological diversity of hominins, some researchers do not exclude the possibility of sapienization in some areas of China and the dispersal of more archaic hominins in other areas (Chen F. et al., 2019; Li et al., 2017; Mounier, Lahr, 2019).

Late Middle Pleistocene hominins showed a considerable morphological diversity, although each available fossil—fragments of skull, cranial-zygomatic and maxillo-dental sections of face, skeleton fragments—had fairly well-defined derived *H. sapiens* features suggesting the evolution of the late *H. erectus* towards sapienization. The human fossils from Hualongdong demonstrate the most noticeable derived *H. sapiens* features and attract great attention of researchers; the age of the fossil of about 300 thousand years makes it possible to assume that HLD 6 might have been a representative of the first ancestral group that can be classified as modern humans. The HLD 6 fossil was an undoubted intermediate link between plesiomorphic and apomorphic morphological types (Wu Xiujie et al., 2023).

Hominins of China in the first half of the Late Pleistocene

Over forty localities containing Upper Pleistocene hominin fossils have been reported from China (Dennell, 2014, 2020; Wu Xinzhi, Poirier, 1995; Martín-Torres et al., 2017). Among them, several fossils—Lingjing, Xuchang, Luna, Fuyan (Daoxian), Zhiren, Huanglong—have been classified as early modern humans. Scientists define their taxonomic status differently: some believe that these fossils represent early modern humans who evolved by convergence on the ancestral basis of *H. erectus*; others classify them as modern humans that migrated from Africa or Southeast Asia.

The Lingjing multi-layered site was discovered in Xuchang County, Henan Province, central China, in 2007; it was excavated for several years (Li et al., 2019). The site is located at a water source. The earliest cultural layers with paleoanthropological remains contained a pebble-flake lithic industry dating back to the early stage of the Upper Pleistocene. Hominins

made stone tools mainly from quartz (Ibid.). In 2014, in culture-bearing layer 11, researchers discovered two crushed and disconnected crania—Xuchang 1 and Xuchang 2. The fossil remains were found in association with bones of Pleistocene fauna, including horses, cloven-hoofed ungulates, giant deer, gazelles, and rhinoceroses. The layer also contained stone tools (Li et al., 2017). The anthropological finds were dated by OSL-method to 105–125 ka BP; the age of overlying layers 10 and 9 was 100 and 90 thousand years, respectively.

Among the fossils from this site, the Xuchang 1 cranium is the best preserved, consisting of the nearly complete neurocranial vault and a portion of its base (Ibid.). The fossil exhibits well-preserved fragments of the parietal, occipital, and temporal bones, as well as a considerable number of small fragments of the frontal bone sufficient for structural localization of the transverse supraorbital region. The Xuchang 2 skull includes the posteroinferior part of the neurocranium with an almost complete occipital bone and petrotympanic fragments of the temporal bones. Three poorly preserved fragments of another skull were also recovered from layer 11.

According to the researchers, skulls Xuchang 1 and Xuchang 2 are characterized by a mosaic combination of morphological traits, revealing the continuity with populations represented by Middle Pleistocene fossils not only in China, but also in some westward areas of Eurasia. It seems quite natural, because, despite the divergence, the morphological development of hominins in Africa and Eurasia in the Middle Pleistocene proceeded followed a *H. sapiens* lineage. Owing to geographic remoteness of these hominin habitats, different environmental conditions, and possibly different degrees of genetic drift, both common and distinctive features were developed in the hominins. The fossils of Xuchang 1 and 2 display some traits that can be traced in Neanderthals. But other specific features of these skulls resemble early modern humans, primarily the gracility and neurocranium capacity. The size of the skull of Xuchang 1 is approximately 1800 cm³. This size significantly exceeds that of *H. erectus* (about 900 cm³ on average) and Neanderthals (1400 cm³). The size of the Xuchang 1 skull fits well into the variation series of the skull size of modern humans. The skull of Xuchang 2 is somewhat smaller; however, judging by the width of its base, it falls within the average range of Late Pleistocene humans.

The skulls of Xuchang 1 and 2 are characterized by a prominent supraorbital ridge, but it is smaller than

that of Neanderthals and some early modern humans. Moreover, these fossils, like the Late Pleistocene early modern humans, display a constant thickness of this ridge, with minimal lateral expansion. The gracility of the skulls is indicated by the moderate thickness of the parietal bones, the small occipital protuberance of Xuchang 1, limited by the two middle thirds of the occipital bone; Xuchang 2 lacks the occipital protuberance.

It has been reported that the skulls of Xuchang 1 and 2 demonstrate both plesiomorphic ancestral features of Middle Pleistocene hominins, along with derived characteristics that bring them closer to modern humans and distinguish them from Neanderthals. Evidence of the evolution of Chinese *H. erectus* along the *H. sapiens* lineage is the encephalization of hominins in the Middle Pleistocene, which caused the large brain case of Xuchang 1. The researchers specifically noted that this process was reflected in the combination of a wide base with a low vault, which points to the continuity with earlier hominins who populated the east of Eurasia in the Middle Pleistocene. At the same time, scientists noted the two clearly Neanderthal features: in theinion region and in the ear labyrinth structure. This suggests the interaction between the Eurasian populations in the late Middle to early Late Pleistocene (Ibid.). Notably, the typical Neanderthal structure of the ear labyrinth was identified in the Denisovan individual from Obi-Rakhmat Cave (Derevianko, 2025); this feature is also reported in early modern humans (Razhev et al., 2024).

In 2016, scholars identified premeditated scratches and traces of ocher on one of the bones discovered in Lingjing in 2009 (Li et al., 2019). Hominins used animal bones and horns as retouchers at this site.

Of particular interest are 44 teeth recovered from Fuyan Cave in Daoxian County, Hunan Province, southern China. The cave belongs to a complex karst system consisting of several interconnected and consecutive cavities. Large-scale excavations in the cave were carried out in 2011–2013 (Liu et al., 2015).

In various publications, the teeth from the cave are referred to either by the name of Fuyan Cave or by the name of Daoxian County. I will use the name of the cave. The researchers compared the teeth from Fuyan Cave with various Late Pleistocene dentition samples from Africa, Europe, and Asia, and inferred that the Fuyan teeth are smaller than those from Africa and Asia and are closer to European Late Pleistocene teeth, as well as to the teeth of modern Europeans. The roots and crowns of the Fuyan teeth demonstrate morphological traits characteristic of

H. sapiens (Ibid.: 698). M. Martín-Torres and co-authors carried out a comparative analysis of the Fuyan teeth and the teeth from Qafzeh Cave and concluded that the derived features of the former were closer to the teeth of modern humans (2017). A thorough and comprehensive study of the dentition of the Fuyan hominins provided solid grounds to attribute the recovered remains to anatomically modern humans. The dentition of the Fuyan individual indicates that modern humans populated southern China in the early Late Pleistocene.

The age of the fossils from Fuyan Cave remains controversial. Nine speleothem samples from layers 2 and 3, and two samples of a small stalagmite from the upper part of layer 1, cementing the underlying layers, were collected for the age estimation of layer 2, in which the fossils were found. These samples were carefully prepared to isolate a pure fraction suitable for ^{230}Th isotope dating. Eight fragments of speleothem dripstones from layer 2 provided the dates of a wide chronological range of 556–120 ka BP, while the sample from layer 3 a date of older than 600 ka BP. Two samples from a stalagmite from the surface of layer 1 yielded an age of 80.1 ± 1.2 ka BP and 79.5 ± 2.8 ka BP (Liu et al., 2015). Because layer 1 covered completely the underlying layer 2 from any disturbances, the researchers accept the date of 80 ka BP as the youngest for layer 2; hence, the age of the Fuyan fossils is estimated in the chronological range of 120–80 ka BP.

A different interpretation was proposed by V. Michel and co-authors. These researchers doubted the correctness of the sample selection for analysis, as well as the fact that layer 2 was not mixed, and proposed the date of 43 ka BP for the layer where the teeth were found as more reliable (Michel et al., 2016). R. Dennell considered the presence of the Upper Pleistocene faunal remains to be a quite sufficient ground for recognizing the youngest age of the Fuyan fossils as 80 thousand years; he also admitted that the finds could have belonged to an earlier period (2020: 293).

Zhiren Cave differs from many others by the thickness (up to 20 m) of its soft sediment layer. The cave is located in the Guangxi Zhuang Autonomous Region in southern China (Liu et al., 2010b). It is a karst cavity in Triassic deposits, located at an altitude of 34 m above the Hejiang River and 179 m asl. In the rear part of the cave, there is a chamber that was filled with loose deposits in the Early Pleistocene. Subsequently, most of them were removed, probably by water flows. Traces of these deposits remained on the walls and ceiling of the cave. Later, the cave was refilled with the younger soft sediments.

Traces of sedimentation hiatus have been identified by ring-shaped dripstone formations overlying loose sediments. Several hiatuses were recorded. The age of the two upper dripstone formations was determined by the uranium method to oxygen isotope stage 3 (28–52 ka BP on average). A series of dates in the range of 87 to 74 ka BP were derived for the underlying horizon. The soft sediments of layer 2 containing two molars and the external part of a human mandible belonged to section B and were dated to the range of 110–55 ka BP. W. Liu and his colleagues determined the age of the fossils to be ca 100 thousand years (Ibid.).

Such an early date and the attribution of the fossils to early modern humans raised objections from some researchers (Dennell, 2010; Kaifu, Fujita, 2012; and others). Further studies of the cave deposits through paleomagnetic sounding, stratigraphic observations, and OSL-dating made it possible to more accurately determine the chronological position of the Zhiren Cave fossils, in the range from 106 to 110 ka BP (Cai et al., 2017).

The mandible from Zhiren Cave demonstrates a derived modern human anterior symphyseal morphology with a projecting tuber and distinct mental fossae. The combination of progressive symphyseal pattern with relatively small crowns and moderately developed lateral tubercles, in the view of several specialists, opposes this fossil to those of all late archaic *Homo*. However, its lingual symphyseal surface and the robustness of corpus are typical of later Pleistocene archaic humans.

The researchers compared the abovementioned fossils dated to the second half of the Middle Pleistocene from Africa, Western Eurasia, and China to the Late Pleistocene anthropological finds from North Africa and Europe (mostly Neanderthals) and to younger individuals up to early modern humans; it was inferred that the Zhiren fossils demonstrated the oldest derived morphology of modern humans in East Asia. Anthropologists argued that the age and morphology of the human remains from the cave suggest that anatomically modern humans emerged in East Asia as a result of either migration and subsequent assimilation, or continuous evolutionary development of ancient human types in this area and gene flow between populations.

Significant morphological diversity and the recorded plesiomorphic features suggest that the Zhiren fossils belong to “gracile *H. erectus*” or to some kind of hybrid with representatives of *H. sapiens* populations that arrived in East Asia at that early period (Dennell, 2010, 2014, 2020).

Martinón-Torres and colleagues (2017) inferred that the fossils from Zhiren Cave, despite some archaic features, should be classified as modern humans.

Huanglong Cave is located in the Yunxi County of Hubei Province. The cave is a huge karst cavity; its estimated length is over 400 m, the entrance is 27.8 m wide and 11 m high. The Dashui River flows 50 m from the cave entrance. The cave was excavated in 2004–2006 (Wu Xianzhu et al., 2006; Liu et al., 2009, 2010a). Five culture-bearing layers were identified in the cave. Seven hominin teeth and stone tools were found in the main cultural layer 3. The researchers found out that the inhabitants of the cave used fire.

The excavations in the cave yielded 36 stone tools and some bone items. The cave contained a lot of faunal remains. In total, about three thousand bones of Upper Pleistocene animals were found, belonging to 91 species, 20 % of which represented extinct taxa. Notably, traces of cuts, scraping, artificial crushing and fracturing were noted on 40 bones of the collection.

Seven hominin teeth can be regarded as the most significant finds. The researchers provided detailed descriptions of morphological features of these fossils, compared them to the dentitions of hominins of the Middle and Upper Pleistocene, and inferred that most of the features were typical of modern humans. The teeth are quite gracile, their main morphological traits, despite of some archaism, correspond to the teeth of modern humans. Moreover, these teeth demonstrate some dental traits of modern East Asian populations. C.G. Turner (1990) established eight features that were most common and pronounced in modern East Asians, especially in the Chinese. Three of these features (shovel-shaped incisors, double shovel-shaped upper central incisors, interradical enamel extension of upper molars) were identified by the analysis of human teeth from Huanglong Cave, which retained some dental features of the Late Pleistocene humans (mostly robust upper anterior teeth). Martinón-Torres et al. believed that “Huanglong Cave fossils represent robust evidence of the presence of *H. sapiens* in China during the early Late Pleistocene” (2017: S439).

Age estimations of the fossils from Huanglong Cave are disputable. The first results were derived by U-series dating of two rhinoceros teeth— 94.7 ± 12.5 to 79.4 ± 6.3 ka BP (Wu Xianzhu et al., 2006). U-series dating of a stalagmite sample from the horizon containing the anthropological fossils provided the age of the latter in the range of $103,739 \pm 1616$ to $103,119 \pm 1348$ BP. Estimations of the age of the rhinoceros tooth yielded a young date of $44,180 \pm 3280$ to $34,780 \pm 4540$ BP. Subsequently, new dates—81 and

101 ka BP—were generated, which were accepted by many researchers (Shen G.J. et al., 2013).

In Luna Cave, which (like Zhiren Cave) is located in the Guangxi Zhuang Autonomous Region in southern China, two teeth were found *in situ*: the upper right second molar and the lower left second molar (Bae et al., 2014). The teeth were recovered from a stratigraphic sequence that, based on several uranium series, fell within the time range from 126.9 ± 1.5 to 70.2 ± 1.4 ka BP.

The researchers classified the LNDM2 tooth as metrically closest to those of modern Mesolithic and Neolithic humans. The tooth falls within the range of late Neanderthal tooth sizes; its metric indicators do not coincide with those of the teeth of earlier hominin populations. According to geometric morphology, this tooth is believed to be similar to those of a group of chronologically recent human populations and is most closely related to the teeth of Koreans of the Joseon Dynasty.

The researchers argue that the LNDM2 tooth, with its convex walls, does not fully correspond to the Upper Paleolithic and Mesolithic modern *H. sapiens*. In terms of geometric morphology, it shows certain similarities with recent modern humans and is close to the tooth of Ternifine 3. In general, as per C. Bae et al., metric and geometric morphometric analysis of the LNDM2 tooth indicates its closest affinity with modern *H. sapiens*.

Other sites dating back to the first half of the Late Pleistocene have also been discovered in China. Martín-Torres and colleagues refer to four more sites—Ganqian, Tongtianyuan, Dingcun, and Jimuyan—which they consider promising to assess the evolution of modern humans. However, owing to the low information content of the fossil morphology and/or uncertainties regarding their age, the scholars consider them less significant than those from the caves of Fuyan, Luna, Zhiren, and Huanglong (Martín-Torres et al., 2017: S435).

Discussion

The hypothesis of a continuous evolutionary development of Pithecanthropus-Sinanthropus (*H. erectus*) in East and Southeast Asia from the arrival of these hominins to the area till the origin of modern humans was proposed by F. Weidenreich—one of the greatest anthropologists of the first half of the 20th century. He relied on the results of detailed studies of paleoanthropological finds from Indonesia

and China. He paid a particularly great attention to the unique fossils from Zhoukoudian (Weidenreich, 1941, 1943, 1946, 1947a–c, etc.). The researcher carried out a comprehensive analysis of all available paleoanthropological materials from Zhoukoudian, and made original casts of the skulls, which, after the tragic loss of the originals during the Japanese aggression in China, are considered the only sources for studying these fossils. Weidenreich identified 12 morphological features that, in his opinion, indicate continuous human development in East Asia. He also distinguished four possible phylogenetic evolutionary lines of human development—Africa, Europe, East Asia, Southeast Asia and Australia (Weidenreich, 1946).

The most consistent supporter of the hypothesis of continuity in the evolutionary development of hominins since the initial dispersal of *H. erectus* over the territory of China is Wu Xinzhi. Back in 1998, based on extensive paleoanthropological materials, he developed a hypothesis that was best known as “continuity with hybridization” (Wu Xinzhi, 1990). The findings of his studies of cranial remains indicated that the evolutionary development of humans in China during the Pleistocene was continuous. He also did not rule out genetic drift, which could have been concealed by hybridization processes during the subsequent migrations.

Wu Xinzhi noted that all ancient skulls found in China demonstrated many common features indicating evolutionary continuity (2004, 2006). Furthermore, the crania showed morphological features of both *H. s. erectus* and *H. s. sapiens*. This suggests a gradual transition from one subspecies to another (Wu Xinzhi, 2004: 131, 133), and that *H. sapiens sapiens* is a chronological subspecies of *H. sapiens erectus*.

The uncertainty about the possibility of dispersal of hominins with clearly expressed derived features of modern humans in China in the first half of the Upper Pleistocene is connected not only with the subjective approach and the lack of generally accepted criteria for the selection of *H. sapiens* markers in fossils, but also with the lack of undoubted evidence that fossils were found *in situ*, as well as the unreliable dating, and other problems (Norton, Jin, 2009; Bae, 2010; Dennel, Martín-Torres, Bermúdez de Castro, 2011; Kaifu, Izuhō, Goebel, 2015; Kaifu, 2017; Dennel, 2020; and others).

In China, more than 70 sites with anthropological remains dating back to the range of 200–40 ka BP have been discovered (Wu Xinzhi, 2004, 2006; Gao et al., 2010). The studied fossils, despite their morphological variability, lead to the conclusion that there was an

undoubted continuity in the evolutionary development from *H. erectus* to anatomically modern humans.

There are two leading hypothesis on the hominin dispersal over the territory of China. Hypothesis 1 implies that under the favorable environmental conditions this process was continuous (Zhu R.X. et al., 2004; Ciochon, Bettis, 2009; Ao et al., 2010). According to hypothesis 2, the dispersal of hominins was disruptive and recurrent; moreover, as a result of divergence, some populations became isolated from each other and subsequently merged again (Dennell, 2010; 2013a, b; 2014).

One of the leading researchers of the Asian Paleolithic, R. Dennell, relying on the analysis of fossils from Fuyan, Zhiren, Luna, and other sites, supports the idea of other scholars that *H. sapiens* inhabited the south of China 80 ka BP, although this inference is not ultimate. He believes that these populations originated most probably from Southeast Asia; *H. sapiens* representatives were recorded in the caves of Lida Ajer (Sumatra) and Tam Pa Ling (Laos) as early as 73–63 ka BP (Dennell, 2020: 294–295).

This conclusion is based on the results of genetic studies by S. Oppenheimer and other researchers, who assume that modern humans could have arrived in Melanesia and Australia around 70 ka BP (2004a, b; 2009; 2012). Among archaeologists, one of the convinced supporters of this assumption is P. Mellars (1989a, b; 2005a, b; 2006a, b; etc.). However, there is no archaeological evidence of the possible dispersal of modern humans from Africa to Southeast Asia 70–40 ka BP. As an evidence in favor of the said assumption, Mellars and co-authors give information about the discovery of geometrically shaped tools at the Patne (India) and Batadomba (Sri Lanka) sites, similar to the Howiesons Poort industry from South Africa (Mellars, 2013; Mellars et al., 2013). But the researchers do not take into account that the Howiesons Poort industry in Africa is dated to 70–60 ka BP, while the sites in India and Sri Lanka are no older than 40,000 years. In addition, sites with the Howiesons Poort industry have not been recorded in the transit area from Africa to South Asia. Moreover, N. Boivin and co-authors have proven that geometrically shaped tools from Africa and South Asia have only an external resemblance (2013). Anthropological remains found in the transit area between Africa and Southeast Asia also do not confirm the dispersal of early modern humans 70–40 ka BP. I have considered this issue in detail in a number of monographs (Derevianko, 2011, 2020, etc.).

The proposed hypothesis on the dispersal of modern humans from Africa to Southeast Asia 120–80 ka BP

should be confirmed by convincing evidence of the emergence of such humans in Eurasia in the late Middle to early Upper Pleistocene. At present, two Eurasian localities with anthropological finds are known that some researchers attribute to anatomically modern humans: Misliya in Israel and Apidima in Greece.

The earliest anthropological find possibly representing early modern humans is the left half of the maxilla from Misliya Cave, dating to 194–177 ka BP (Hershkovitz et al., 2018). The fossil has preserved most of the alveolar and zygomatic processes (each half of the jaw contains one alveolar and one zygomatic process), part of the palate, nasal floor, as well as a complete left dentition starting from the first incisor (represented by a broken root) to the third molar (Ibid.: 456).

Analysis of this fossil has yielded some important insights.

1. The incomplete maxilla of Misliya 1 shows no derived skeletal or dental features of Neanderthals (Ibid.: 458–459).

2. Comparison of the dental component of the Misliya 1 fossil with the maxillary and mandibular teeth from Qesem Cave in Israel, dating back to 400–220 ka BP, revealed a number of differences. In particular, Qesem incisor I² has a more developed lingual tubercle than that of Misliya specimen. The Qesem upper canine displays more pronounced shoveling, along with the presence of a lingual tubercle, and a canine mesial ridge. All these morphological features, which distinguish the Qesem anterior teeth from those of Misliya 1, are most often found in Neanderthals.

3. Misliya 1 resembles younger Levantine *H. sapiens* fossils from Skhul and Qafzeh in most dental features, and differs from them in the degree of hypocone reduction.

4. Misliya 1 is the oldest evidence of expansion of *H. sapiens* clade out of Africa.

We can hardly agree with the last conclusion. The earliest fossil remains, whose morphological features are sometimes defined as modern, come from Northeast Africa (Jebel Irhoud); their age is ca 300 thousand years (Hublin et al., 2017; Richter et al., 2017). However, these fossils can be attributed to modern humans only relatively. Researchers of Misliya Cave compared its early Middle Paleolithic industry with the Middle Stone Age technocomplexes of the Maghreb (Jebel Irhoud), East Africa (the formations of Gademotta and Kulkuletti in Ethiopia, Kapthurin in Kenya). However, the Misliya lithic industries demonstrate only feeble distant resemblance to the

Middle Stone Age industries of East and Northeast Africa; and even under the widest assumption, it is impossible to find any manifestations of continuity with the Jebel Irhoud industry. No convincing evidence of morphological similarity of the Misliya human remains with African fossils dating back to the late Middle to early Upper Pleistocene were found either.

The taxonomic status of fossils discovered at the Apidima cave site in southern Peloponnese, Greece, is uncertain. Two skulls, ca 160,000 years old, were discovered in the breccia that filled the space between the walls of Apidima A Cave. M.-A. de Lumley attributes the skulls of Apidima 1 and Apidima 2, as well as human remains from Grotte du Lazaret, to the population of developed European *H. erectus* in the stage of Neanderthalization. In her opinion, they preceded the classic Neanderthals (Lumley, 2019). Lumley dates classic Neanderthals in Western Europe to 120–37 ka BP. G. Bräuer and co-authors hold a similar point of view on the taxonomic affiliation of the anthropological finds from Apidima Cave. The authors infer: “Thus, from our results it can be concluded that the Apidima crania should be classified as early Neanderthal and taxonomically, as *H. sapiens neanderthalensis* based on a concept of *H. sapiens s.l.*” (Bräuer et al., 2020: 1390).

In Europe, the earliest sites of modern humans date back to ca 45 ka BP. In the transit area from Europe to China, no sites of early modern humans older than 40–45 ka BP have been reported. Thus, there is no convincing evidence of the arrival of early modern humans in China in the course of their migration from Africa 120–40 ka BP.

The noted homogeneity of lithic industry of hominins bracketing the period from the initial occupation of this area by *H. erectus* up to 40 ka BP, when the blade-based industry emerged in the area, is regarded as one of the important pieces of evidence for the convergent evolution of modern humans—*H. sapiens orientalis*—on the ancestral basis of *H. erectus* in the territory of China in the early Upper Pleistocene.

Experts in the Chinese Paleolithic have no doubt that the development of the Paleolithic industry in this area differed significantly from that in Africa and Europe. The main feature of the Chinese Paleolithic was the continuity of development from the early to the terminal Paleolithic. Even when the blade industry emerged at some sites in northern China ca 40 ka BP, the traditional pebble-flake industry continued to be produced with some innovations at most sites. Of course, this does not mean that the industry was

extremely archaic and that the hominins of East Asia lagged behind the hominins of Europe in cognitive development. It was as effective for the subsistence of hominins as the industry of western regions of Eurasia. Hominins who settled in China began to use the technique of bifacial working of lithic implements and to produce tools of the Acheulean handaxe type earlier than in Europe. This technique of making bifaces, which originated around 1 Ma BP, could have appeared and disappeared in the Middle Pleistocene, and then appeared again, which alterations could apparently be explained by the change in hominins’ adaptation strategies due to environmental changes in their habitat (Derevianko, 2018).

The continuity in the development of lithic industry among the hominins of China in the Paleolithic was manifested above all in the primary reduction, dominated by three techniques of producing blanks: *chuijifa* (the technique of striking a core with a hammer stone), *zajifa* (detaching flakes using an anvil), and *pengzhenfa* (striking a core against a stone anvil). Disc-shaped and orthogonal pebble cores were used; Levallois reduction technique was absent. Flakes served mainly as blanks for tool manufacturing. Moreover, in certain areas and periods, hominins preferred either small or large flakes in tool manufacturing. Researchers characterize the Paleolithic industry of China as homogeneous, but with certain differences in the industries of the North and South; the border line between them was the Qinling mountain range.

Researchers distinguish local variants (cultures) in the industries of South and North; this situation refutes the assertion about the technical and typological homogeneity of the Paleolithic industry in China. The specificity of the Paleolithic industry in China, the pebble-flake trend, was determined mainly by the lack of the Levallois technique of primary reduction. Blade and Levallois technique emerged in the northern regions of China ca 45 (43) ka BP as a result of the Denisovan (*H. s. altaiensis*) migration to this region from Mongolia and partly from the Altai.

Thus, from the time of the initial occupation of China territory by *H. erectus*, this taxon evolved towards sapienization, which was expressed in the continuity of the human morphology and lithic industry throughout the Early, Middle, and Upper Pleistocene (in the chronological range from 1.7 (1.6) to 0.04 Ma BP). Fossils dating to the early Upper Pleistocene, despite their small number and severe fragmentation, can be attributed to early modern humans (informal name *H. s. orientalis*) based on

their main morphological traits. These populations, as well as *H. s. africanensis*, *H. s. neanderthalensis*, and *H. s. denisovan*, retained an open genetic system. In this regard, a new scenario of the evolution of anatomically modern humans *H. sapiens sapiens* can be proposed. This species originated during the migration of modern humans (*H. s. africanensis*) from Africa to Eurasia 80–60 ka BP, on their morphological and genetic basis. In Eurasia, they assimilated *H. sapiens neanderthalensis* in Europe, *H. sapiens denisovan* in Central Asia, and *H. sapiens orientalisensis* in East and Southeast Asia (Derevianko, 2011, 2019, 2022, etc.).

I realize the complexity of the issues discussed in this article, but I believe that the data obtained from the discoveries made by experts in physical anthropology, archaeology, and genetics provide sufficient grounds to consider the complicated fundamental problem of the origin of modern humans in the proposed scenario.

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