中國文化研究所學報　第21卷　1990年

Middle and Upper Pleistocene Adaptations in Northeast China

Ho Chuan Kun

Jiang Peng
Jilin Institute of Archaeology

Introduction

Manchuria (northeast China) has once been claimed by Chard as "very probably a key area for human history of northeast Asia" (1974:3). In addition, he also implied that "... man seems to have been present in the Upper Pleistocene" (ibid.:3). During the last two decades, many more fossil hominid and Palaeolithic sites or palaeontological localities earlier than the Upper Pleistocene were discovered and therefore it is necessary to rethink the old materials as well as synthesize the new materials from a regional perspective. The geographic area which is essentially composed of the Songhua-Nenjiang Plain or the northern part of the Northeast China Plain, which is surrounded, like a huge horseshoe, by a series of NE–SW trending middle and low mountains. Only on southern side does the horseshoe open and merge into the southern part of the Northeast China Plain. Administratively, this natural region include the whole of Heilongjiang and Jilin provinces, the northern part of Liaoning province and a small part of the Nei Mongol Autonomous Region.

Before 1949, Palaeolithic archaeological works were carried out mostly by non-Chinese scholars. Tokunaga and Naora excavated the Guxiangtun site on a large scale during 1932 and 1939 respectively. Excavated materials include mammalian fossils and some lithic and bone tools. But the authenticity of latter materials is still questioned by most of the authorities although the original excavators insisted that their findings were unearthed from the primary contexts. More than that, the exact date of this site is uncertain. Brueil found two flakes inside the reddish layer between the Luxuan and Dalian highway during his second visit to China in 1935. These two flakes are man-made but whether they are found *in situ* as well as belonging to the reddish loam of north China has yet to be verified (Li 1988). Between 1936 and 1957, Russian archaeologists, Loukashkin and Ponosov, both surveyed and excavated mainly at the gully of Huangshan. Large amount of chipped stones and mammalian fossils were collected in disturbed deposits. In addition, Shikama (1950) also found mammalian fossils near Niuxinshan, Yingkou county, Liaoning province. This site turns out to be one of the most important "archaic" *Homo sapiens* localities in northernmost latitude in the world (Lu 1985).

Zhou (1958) has published the data of the Yushu *Homo sapiens* site and the relative date of the associated faunal assemblage by using the surface collections from Zhoujiayoufang. More importantly two skull fragments and one tibia were also discovered at the site. During the 1970s more Early, Middle and Late Palaeolithic sites were discovered as well as the fossil hominids, especially the latter. Those newly found data have undenially enriched the Palaeolithic research of northeast China but also pushed the hominid evolutionary history of this area back to half a million years ago. In order to put our Palaeolithic sites and palaeontological localities into a palaeoenvironmental context it is essential to make use of updated geological, palynological and radiometric data to trace the evolutionary changes of adaptional strategies of the early Palaeolithic foragers and the late Palaeolithic collectors during the last half million years in northeast China.

Pleistocene Environment of Northeast China

Regional Palaeogeography and Local Vegetation Patterns

Beginning in the early Pleistocene, major mountains were uplifted. The central part of northeast China was quite flat, and the lower Liao River plains were submerged by the newly emerged ocean bay. Vegetation patterns changed from warm mixed forest into warm wet forest meadow, then into coniferous broad-leaved temperate forest and finally into grassland (Zhou 1984; Zhao 1985).

During the middle Pleistocene, tectonic movements in northeast China became stronger. Xiaoxinganling Mt. and Songliao River watershed were all elevated while the central-west plains were gently subsided; lake basins were formed in the central plain and depositions accumulated as well. Older geologic strata of the early Pleistocene were uplifted and became plateaus or river terraces by fluvial downcutting and faulting activities. The subsided eastern part of this region was filled by the Pleistocene deposits (Fig. 1).

Major rivers of the last Pleistocene became desiccated and the river beds themselves were overlain by loess-like deposits. The middle and upper old Liao River flowed westward and then southward into the ocean and the lower Liaohe river plain was transgressed (Fu 1988). The west Songliao Plain became an inland lake (Fig. 2). Vegetation patterns show that the early middle Pleistocene was temperate deciduous broad-leaved forest and warm broad-leaved marshes in the eastern river plains. During the late middle Pleistocene the permafrost invaded southward into this region. Major periglacial features dotted the landscape of the major valleys of north Daxinganling. The marsh zone of the eastern Songliao Plain was subsided, while the areas south of Daxinganling and the northeastern plains were warmer than in the north. The coniferous broad-leaved mixed forested grassland has replaced the warm-broad-leaved forest. At the end of the middle Pleistocene, the drying trend became intensified and forest community types in the plains temporily disappeared.

The late Pleistocene witnessed a warming trend and permafrost began retreating northward (Jiang 1987). The northern part of this region was tundra forest while lakes and marshes were widely distributed at major plains and the landscape was mainly grassland. During the middle period, due to the impact of continental glaciers, the northern highland became tundra and the southern part and plains were dotted by a cold temperate coniferous vegetation type. The great plains of this region became grassland and were swampy in the Sanjiang Plain (Kong and Du 1982; Zhou 1983; Cui and Xie 1982).

Palaeoecology and Palaeoclimate

Middle and Upper Pleistocene (300,000–150,000 B.P.)

Representative faunal assemblages are the lower levels of Jinniushan and Miaohoushan. Thirty two different species of fossil faunas were found, typical species are: *Neomys* sp, *Trogontherium cuvieri*, *Macaca robustus*, *Hyaena sinensis*, *Panthera youngi*, *Equus sanmeniensis*, *Dicerorhinus kirchbergensis*, *Cervus grayi* and *Ssu lydekkeri*. Sixteen species are forest types (50% of the total assemblage); ten species are forest or grassland-loving types (30%); the rest of them (20%) are widespread types (Fig. 3).

Represented fossil fauna at the Miaohoushan locality are: *Clethrionomys rofucanus*, *Sinocastor zdanskyi*, *Acinonyx pleistocaenieus*, *Equus sanmeniensis*, *Megaloceros pachysteus*, *Rusa elegans* and *Homotherium ultima*. 66% of them are forest types, 23.8% are grassland type and the rest are widespread types.

The most abundant species of those two faunas are warm and humid-loving types, and some of them belong to tropical and subtropical species. The inferred palaeoenvironmental settings were forest and grassland as well as riverine microenvironments. The palaeoclimate during that time could have been 3°–4° C higher, or more than the present, and modern analogous environments could be found in southern Shandong Penninsula and northern Jiangsu province.

Representative faunal assemblages of 200,000 years B.P. were unearthed from the Anping site. Typical species of this faunal assemblage are: *Macaca robustus*, *Dicerorhinus kirchbergensis*, *Panthera youngi* and *Cervus unicolor*. They are all warm and humid climatic indicators. Until 150,000 years B.P. both the climate and natural environment became deteriorated. Warm and humid-loving species of the middle and upper units of Miaohoushan were drastically reduced in numbers while the grassland species are evidently increased. The upper and middle units of the Jinniushan site have also shown the same phenomenon-increasing local species. Those evidences indicate that during the end of the middle Pleistocene the climate in northeast China were colder and drier than the present. Such event is correlated well with the sixth stage of global deep sea oxygen isotope. Those cold-adapted faunal assemblages have never been found at any sites older than 250,000 B.P. in northeast China.

Early Upper Pleistocene (127,000–50,000 B.P.)

There are no known absolute dates for the early Gezidong faunal assemblage. Based on the faunal and geological correlations, the site has been estimated at about 100,000 B.P. Predominant species of fossil faunas are: *Microtus epiratticeps*, *Ochotona daurica*, *Ursus arctos*, *Crocuta ultima*, *Equus przewalskyi*, *Coelodonta antiquitatis*, *Gazella prezwalskyi*, *Pseudois nayaur*, *Marmota robustus*. Faunal types are predominantly grassland or montane species (67%). Cold-adapted species (e.g., rhinoceros and rodents) increase in relative frequency, which may indicate a cold and dry climatic regime.

The Shanchenzi faunal assemblage shows that temperate faunal species predominate for the first time, they are: *Marmota bobak*, *Cervus xanthopygus*, *Hydropotes inermis*, *Capreolus manchuricus*. This late assemblage reflects that the palaeoclimate of the Gezidong site was still cold and dry. The relative date of the site is estimated at 60,000–70,000 B.P. which is equivalent to the fourth stage of the oxygen isotope. Contemporaneous faunal assemblages are the upper level of the Jinniushan faunas. The dominant species of the latter site are: *Mammathus*, *Spiroceros kiakhtensis*, *Equus prewalskyi*, *Mustela altaica* and *Citellus mongolicus*. Such faunas indicate the grassland-steppe environmental settings.

Late Upper Pleistocene (50,000–10,000 B.P.)

From the global palaeoclimatic trend, 50,000–28,000 B.P. is a period of climatic amelioration. Such a trend has yet to be found from archaeofaunal assemblages in northeast China. The climate after the last glaciation (28,000 B.P.) became cooler although there was a warm episode. The cooling trend in northeast China has made the wide spread of the *Mammuthus-Coelodonta* faunas possible and such megafaunas have even once reached the north China.

Yushu and Antu faunal assemblages were distributed in northeast China around 26,000 B.P. Predominant species are of cold-adapted fauna: *Mammathus primigenius*, *Coelodonta antiquitas*, *Alces alces*, *Hydropotes inermis*. Pollen data indicate that the palaeoclimate was 5°–8° C lower than the present.

The Haicheng Xiaogushan faunal assemblage was C^{14} dated to 23,000 B.P. Identified faunal species are 29, and they are quite similar to the assemblage unearthed from the Upper Cave. Most species are montane forest types (60%), they are: felid, brown bear, hyaena and tigers. There are also some cold-adapted species (e.g., rhinoceros and lynx). This may indicate that the climatic fluctuations were rather pronounced and caused the mixture of faunas from both biological zones. Compared with the later time periods, the temperature was apparently higher than previous and later periods. Contemporaneous with this site, the Yanjiagang faunal assemblage reflects the same climatic regime because of the appearance of *Bubalus*.

Twenty thousand and fifteen thousand year-old faunas from Gulongshan and Qianyang reflect that the palaeoenvironments during that time were analogous to the modern boundary between Daxinganling and Songliao Plain in terms of the faunal and pollen record. Generally speaking, the temperature was 3°–4° C lower than the present; annual precipitation was 400 mm, which is 200 mm lower than the present. Ungulates are the predominant species among the faunas especially the horses which are represented by 6,000 isolated teeth. Pollen data from this site also show that the environmental setting was steppe or grassland.

A representative site of the latest Pleistocene (*c*. 11,000 B.P.) is Qinshantou, Jilin province. Predominant faunal species unearthed from this site reflect periglacial and grassland environmental settings. Such settings can be found in the northwestern corners of the Inner Mongolia today. Typical species are predominantly rodents, *Nyctereutes procoynoides*, *Vulpes* sp., *Equus prezwalskyi*, *Sus scrofa* and *Bison* sp.

The Qiankuo faunal assemblages are typical examples of the early Holocene of northeast China. The faunal assemblage itself has been dated to 7870–9860 B.P. Widespread species of the *Mammathus-Coelodonta* faunal assemblage disappeared because the climate because ameliorated (Xu *et al*. 1985). Compared with the modern climate at the same area, the climate during the early Holocene was still quite cold and dry. Most of the Holocene environment in this zone was grassland.

In general, paleoclimatic trends in this region during the Pleistocene epoch are as follows in terms of faunal (Fig. 3; see also Table 1) and palynological evidences (Table 2):

warm and humid ⟶ cooler and semi-drier ⟶
warm and more humid ⟶ cold and dry

Based on such trends, we are going to put our Palaeolithic sites or palaeontological localities into palaeoenvironmental contexts in order to probe the adaptational strategies of the Palaeolithic foragers and collectors in northeast China for the last half million years. The sites are described according to their radiometric and biochronological sequences (Fig. 4).

Early Palaeolithic

Miaohoushan (廟後山) Site

Miaohoushan is another earlier Palaeolithic site other than Jinniushan site and the northernmost early Palaeolithic site in northeast China. The site is located at the tributory Taizi River of middle Benxi county and southern slope of eastern Miaohoushan of Shanchenzi village (lat. 41°14′49″N, long. 124°7′50″E).

The site was found on March 1978 and was test excavated in 1978 and then was dug in 1979 and 1980 respectively. Two caves, located 32 and 350 m above the present sea level, are 100 m apart. The cave deposit, more than 10 m thick, was divided into eight layers. Units 4–6 and 7 provided fossil hominid remains including 3 hominid teeth, 74 lithic artifacts, a few bone tools, a large number of mammalian fossils, ashes and 4 charred bones. A canine (B.S.M. 7802–T6–2) of an older individual was discovered from the middle unit 5 which was assigned to *Homo erectus*; the right lower molar (B.S.M. 8001–T9–1) of another adult was found in the upper unit 6 (Table 5). Identified faunal species are 73 including 68 mammalian fossils and two species of fish. A few mammalian fossils are the extinct species of the Tertiary period which are found at units 4, 5 and 6. Representative faunas are mostly recovered from the late Pleistocene units of 7 and 8 (see Table 6). From the faunal species list and occupation levels, it is evident that the caves may have been occupied at different time periods. The stratigraphic section has been widely used as the type section of the middle Pleistocene in northeast China (Zhang and Chen 1986).

Units 1–3 is dated to 690,000 B.P.; unit 4 is 400,000 B.P.; unit 5 is 240,000 B.P.; unit 6 is 140,000 B.P. and unit 7 is 96,000–17,000 B.P. by palaeomagnetic, uranium-series and radiocarbon dating methods (Chen and Yuan 1988). There is a hiatus between units 3 and 4 which represents an erosional surface. Pollen analysis indicates that the palaeoclimate was cold (0° C or lower) and humid during the early occupations (units 4–6) while it turned into cold (−4° C) and dry during the late occupation (unit 7) (Museum of Liaoning Province 1986).

Sixty-seven lithic artifacts (Figs. 5–7) were discovered; four of them are judged to be Upper Palaeolithic finds and the rest are all Lower Palaeolithic remains. Raw materials of the lithic assemblage are predominantly greyish green quartzite sandstone, vein quartz sandstone and a few andesite (Table 7). The manufacturing technique is mainly hammerstone; the chipped flakes are irregular in shape and minimally retouched. Lithic types are mainly flake tools and fewer core tools (Fig. 8). Tools are crudely made and irregular in shape. Polyhedral choppers, large polyhedral cores and round scrapers are the predominant types. Scrapers and choppers were flaked from ventral toward dorsal surfaces. Those features may indicate the close relationship with lithic tradition of Zhoukoudian. Only one anvil-made bipolar flake was found at this locality. This may reflect cores could have been initially modified at the source and then brought into the cave. Huang *et al.* (1986) pointed out that heavy-duty tools are quite similar to those unearthed from Chonggoni, south Korea.

Bone tools were made from limb bones of large mammals. Hack marks and utilized marks can be observed on some of them but they are easily separated from those which have been gnawed by rodents. Although most of the bone pieces are irregularly shaped, they are definitely different from those bone tools which are resulted from marrow-cracking and direct anvil-crashed ones (ibid.).

A thin layer (5–10 cm) of ash was discovered at unit 6 which is composed of dark browish powder mixed with grayish white substance. Similar ashes have also been found at unit seven which is scattered in 120 × 50 × 10–25 cubic cm. Charcoal flecks are dispersed mostly in unit 6. The largest charcoal piece is 2 cm in diameter. Anatomical parts of the burnt bones are mainly limb bones. They are burnt differentially and dark brown or grayish brown in colour. Most of them concentrated near the ash scatters and some of them even show crack marks. The discovery of hominid fire use in the northernmost location of the Early Palaeolithic can further substantiate the adaptive radiation of the late *Homo erectus* to northern latitute on the one hand and the authenticity of the fire use of Zhoukoudian hominid.

Jinniushan (金牛山) Archaic *Homo sapiens* Site

Jinniushan is located 8 km southwest of Daxijiao, Yingkou county, Liaoning province (lat. 40°N, long. 120°30′E). The site is an isolated limestone-dolomite hill which is 70 meters above the present sea level. Six localities have been found and field numbers are 7401 A–F. The site was found in 1973 and excavated consecutively in 1975, 1976 and 1978 at Localities A and C by the Joint Exepedition of Liaoning Provincial Museum, Institute of Palaeontology and Palaeoanthropology, Academia Sinica and Cultural Bureau of Yingkou City (Jinniushan Combined Excavation Team 1976, 1978). The field school of the Department of Archaeology of Beijing University was led by Lu who unexpectedly discovered an almost complete fossil hominid skull and postcranials at Locality A. Unfortunately, the detailed report of this important finds has yet to be published. We will briefly describe the biocultural remains from this site in the next section based on the preliminary reports and Ho Chuan Kun's personal discussion with Lu in 1985.

The cave deposits of Locality A, located on the southeast of the hill, can be divided into six units. The cave has recently been described as "the best example of sink-hole site" (Clark and Schick 1988:440). Most of the faunal assemblages were found in units 3–6. Restudying the cave formation processes, Huang *et al.* (1987) suggested that the vertical karst cave was formed during the middle and late middle Pleistocene. Sedimentary deposits, mainly breccia, subclay and cave roof falls may not be a comfortable living floor for the Palaeolithic occupants. The secondary cave was formed during the early Upper Pleistocene. The cave was occupied as a living floor with respect to the discovery of fossil skull, postcranial bones, lithic artifacts, shell-made objects, hearths, hyaenas and modern micromammals and fresh-water molluscan shells. Interesting enough, the femur, tibia and fibula and ribs of the Jinniushan hominid are missing. Those postcranial parts may have been washed down to the lower, unexcavated cave deposit (Fig. 9). It is worth mentioning that the fresh-water molluscan shells have been frequently found at Dingcun site, Shanxi province as well as most northern Chinese Palaeolithic sites. The presence of such shells (Unionid) at the Jinniushan hominid site indicates that the palaeoclimate was quite warm and humid when those Palaeolithic foragers occupied the cave.

Jinniushan Archaic *Homo sapiens*

Hominid fossils were found for 2 m along the south wall and in an area of 1.6 square meters. All carpals and tarsals were found articulated. Thus all anatomical parts should belong to the same individual. This individual is sexed as male and aged as 18 years old (30 years old by Wu 1988) in terms of narrow ilial sciatic notch, triangular obturator foramen, deep ilium fossa, cranial suture fusion and unworn erupted third molars (Lu 1985).

The discovery of the Jinniushan fossil hominid has drawn much attention both in China and worldwide due to the location of the cave site as well as the completeness of the fossil skeleton and the transitional features between *Homo erectus* and *Homo sapiens*. Total anatomical parts of this individual are listed in Table 3.

Brief morphological comparisons with Zhoukoudian *Homo erectus* and Dali archaic *Homo sapiens*, Jinniushan fossil hominid shows the following features. The skull is nearly complete; supraorbital torus is less robust; the occipital bun is less pronounced; cranial wall (average 4.5 mm) is thinner than Zhoukoudian *Homo erectus* (average 8.1 mm) and thicker than the modern man (3.2 mm); cranial capacity of Jinniushan fossil hominid (*c*. 1390 cc) is larger than Dali (1160 cc) and closer to the modern man (average 1400 cc); maximum width of the skull is between the external auditory meatus and the parietal tuberosity (Wu 1987; 1988; Fig. 10; Table 4). Those morphological features have led authorities in China to believe that the Jinniushan fossil hominid is taxonomically "archaic" *Homo sapiens* and more advanced than Zhoukoudian *Homo erectus* and even Dali *Homo sapiens* (Wu 1987; Jia 1988; Pope 1988). On the other hand, Lu, a Palaeolithic archaeologist, believes that the Jinniushan fossil hominid "was the most complete *Homo erectus* skeleton ever found in the world" (1987:35).

The occupation level of Jinniushan hominid is 56 square meters. Two ash-stained areas, mixed with burnt clays and charcoals as well as burnt bones, were found in 1984. Furthermore, a large amount of tabular broken bone fragments were discovered within a 7 meter squared area between those two ash heaps. Some of the broken bones may have been cracked for marraw and then discarded inside the cave. The distributional pattern of those biocultural remains indicates that the cave may have been occupied as a living floor. Although many Early Palaeolithic sites have been found in China, most of them were found without an intact living floor except Zhoukoudian Locality 1. Thus, the discovery of occupation floor of Jinniushan archaic *Homo sapiens* site is even more significant for studying the spatial organization within an individual site.

Faunal assemblages associated with the fossil hominid are as follows (see Table 1 for the complete faunal list):

Myosplalax (mole-rat)
Cricetulus sp. (squirrel)
Microtus brantioides
Citellus mongolicus (squirrel)
Trogonitherium sp.
Lepus sp. (rabbit)

Ochotona hyperborea (pika)
Canis sp. (wolf)
Vulpes cf. *corsac* (fox)
Ursus arctos (brown bear)
Megaloceros pachysteus (giant deer)
Pseudaxis sp.
Sus sp. (pig)
Hydropotes inermis
Dicerrhinus merki (rhinoceros)
Macaca robustus (macaque)

The cultural assemblages of the Jinniushan localities were discovered by the joint expedition of Jinniushan. Except for 7401C, excavated in 1975, the rest of the seasons was concentrated on digging the 7401A locality. But most of the excavated materials of 1975 has yet to be published. One piece of hominid humerus (147.7 cm long) was found at Locality A during 1975 (Cui and Li 1987).

Locality 7401C is a cave. The main deposits can be divided into upper and lower units, which also represent two different occupation levels. The lower unit is estimated to the Lower Palaeolithic; 15 lithic artifacts and possible man-made bone tools were found. Associated faunas are identified as 32 fossil species. Extinct species are 44% of the total faunal assemblage.

Lithic materials are mainly vein quartz and quartz. Flaking techniques are predominantly bipolar anvil technique and the evidence of the hammerstone technique has also been observed. The tool assemblage which has been made from such technique was found at Zhoukoudian Locality 1. The latest report of lithic assemblages of the latter site (Pei and Zhang 1985) described the occurrence of such flakes and cores. This may indicate that the lithic technology of Zhoukoudian and Jinniushan were closely related during the late Middle Palaeolithic.

Most secondary worked flakes are retouched unifacially from ventral toward dorsal surface. Tool types are mainly scrapers, pointed tools and burins. Scrapers are the most dominant types which can also be divided into single, double and semicircular subtypes (Fig. 10). Single, straight scraper was made by breaking one end of the bipolar anvil flake. A double scraper was made from triangular quartz flake; the left end was concave-retouched and the right end convex-retouched. Two semicircular scrapers were made of translucent quartz flakes. The secondary retouch of such flakes was worked from ventral toward dorsal surface, and the retouch was minimal. The round scraper is the most dominant tool type among Palaeolithic assemblages in China. The temporal continuity of such tool reflects the dominant role it played among the tool kits of Palaeolithic foragers and collectors.

Only one pointed tool was found and it was made of vein quartz; minor retouch is present. Such pointed tools have also been found at Zhoukoudian Localities 1 and 15, and Dingcun site.

A few worked and utilized "bone tools" were found in the lower deposit (Fig. 11). Bones are fashioned into a point by removing flakes from the tip dorsally and ventrally; and the butt was formed by removing three bone chips ventrally toward dorsal surface. Most of the retouch was concentrated on the end and side. Edge damage and utilized patterns can also be observed. Bone scrapers were made by detaching a large flake from the tabular bones and then retouched along the side which could be used as cutting edge.

Some isolated hearths are found in the lower deposit which contains burnt clays, ashes, charcoal flecks, and broken and burnt bones of different colours. Some of the burnt samples have been reported containing at least 3.10% carbon after chemical analysis (Zhang 1985). The evidence of fire suggests the fact that Early Palaeolithic foragers in northeast China may have learned to use fire even much earlier than we expected. There are some 70 palaeontological sites and Palaeolithic sites that have thus been found in north China, but only half a dozen sites have solid evidence of fire use (Ho n.d.; James 1989). Identified anatomical parts of the burnt bone fragments are mainly limb bones of rodents, lagomorphs and cervids. They could have been the main food resources of cave foragers.

The manufacturing technique of the lithic artifacts from the lower deposit are almost identical to Zhoukoudian Locality 1, especially the upper cultural units. The date of the lower deposit of Jinniushan Locality C is estimated to 300,000 B.P. by palaeomagnetism which is the late middle Pleistocene (Lu, personal communication with Ho Chuan Kun).

Among the 1974 faunal list, the species of 13 can be identified while for the rest of them only the genus can be identified. *Equus sanmeniensis*, *Megaloceros pachyosteus*, *Dicerorhinus mercki* and *Macaca robustus* were also found down to the lower deposits of Zhoukoudian. *Pseudaxis* sp. was found at unit 6 in 1975. The association of *Megaloceros pachysteus* and *Pseudaxis* sp. can be found on units 1–3 of Zhoukoudian, Locality 1. It is apparent that the lower deposit of Locality C at the Jinniushan site could be contemporaneous with the upper units of Zhoukoudian: late middle Pleistocene. The result of biostratigraphic correlation is consistent with the result of the uranium series date: 230,000–300,000 B.P. (Huang 1985; Lu 1985a, 1985b; Chen and Yuan 1988).

Although the final report on the fossil hominid and their lithic assemblages will not be published in the near future, we may have to pay particular attention to the following implications:

1. "Upper limb morphology may shed some light on the habitual level of strength exerted by the human upper limb, a shift toward more precision use of the hand and more extended positions of the elbows and fingers, and possibly changes in habitual grip positions" (Trinkaus 1986:201) as well as on the manufacture of lithic and bone tool assemblages (Marzke and Shackley 1986) and land use as well as the subsistence exploitative strategies.
2. Organizational use of the living space (e.g., hearths) as well as hominid and carnivore interaction.

Middle Palaeolithic

Gezidong (鴿子洞) Site

Gezidong site (lat. 41°15′N, long. 124°50′E) is located on Wafancun, Liaoning province. The site is 250 m above the present sea level and 35 m above the present Daliaohe. Two separate excavations were sponsored by Liaoning Provincial Museum and the Institute of Palaeontology and Palaeoanthropology, Academia Sinica during 1973–1975. In addition to ash heaps, burnt bones and fire-cracked rocks, more than 300 lithic artifacts and a few bone objects as well as 20 different species of mammalian fossils were also uncovered.

The site has two separate caves; they are 5 m apart and located on the same elevation. Cave A has both fossil faunas and cultural remains; and Cave B has only the former. Six stratigraphic units can be divided at Cave A. Units 2–3 are cultural levels and most of the lithic and faunal assemblages were unearthed from this level, especially unit 3 which shows 50 cm thick ashes. Burnt bones (subadult gazelles), charcoals, burnt clays, a few lithic artifacts and mammalian fossils are found among the ashes. Chemical analysis of the ash indicates that the carbon content is 24% (Gezidong Excavation Team 1975).

Raw materials of lithic artifacts are mainly quartz and flint (or chert) and they were obtained from basal gravels of the second terrace which is not too far away from the cave site. Manufacturing techniques of those lithic artifacts are mainly hammerstone percussion, and anvil technique is much less prevailed because only one anvil-made flake was found. Secondarily retouched lithic specimens were made from hammerstone percussion.

Tool types are predominantly scraper, point, chopper and chopping tool (Figs. 12, 13). Most of the tool forms are not standardized. The cores and flakes unearthed from Gezidong are quite similar to those from the Early Palaeolithic sites in Shanxi and Shaanxi provinces and those from Zhoukoudian Locality 1. Cores were fashioned unifacially, polyhedrally and unfacetted; flakes are irregular in shape and there are quite a few regularly shaped triangular flakes and long flakes. These all show the advanced features of lithic technology. The dominant type of the lithic assemblage is the scraper, which can also be subdivided into several classes: single straight, single convex, double end, and double edged (Fig. 12). Retouch is fashioned toward dorsal, ventral and alternately. Most of the scrapers are finely made; only a few of them have a sharp and symmetrical cutting edge. A few points were found and the retouch is concentrated mostly on the tip. There are a few choppers made of pebbles and cores; edge forms are single and double, and the former one is finely made.

Flake-dominated assemblage of Gezidong is quite similar to the upper level of Zhoukoudian, Locality 15 but is quite different from those unearthed from Sanmen Gorge of western Henan and Dingcun of Shanxi in terms of the types, sizes and lithic technology. Compared with the large tool tradition of north China, Gezidong lithic assemblage is similar in manufacturing technique but smaller in size. In comparison with the Upper Palaeolithic of north China, Gezidong assemblage is similar to Shiyu, Xiaonanhai, Laofangzi but differs from those from Shuidonggou and Xiachuan.

In general, Gezidong palaeoliths have both old and advanced features in lithic technology and may have been quite closely related to Zhoukoudian. The technological continuity of the Gezidong lithic tradition is quite evident and the discovery of northernmost location of the site can prove that the mainstream of the Chinese Palaeolithic is without question locally evolved.

Fossil faunal assemblage of the Gezidong site unearthed from Caves A and B consist of mainly *Canis* cf. *chiliensis*, *Felis* cf. *microta*, *Crocuta ultima*, *Coelodonta antiquitatis*, *Equus przewalskyi* and *E. hemionus* and other 30 species. The faunal assemblage includes the common elements of loess phase of north China as well as the *Mammuthus-Coelodonta* fauna of northeast China. The whole faunal assemblage indicates that the palaeoclimate of this region was cold and dry as well as grassland environmental settings. Compared with contemporaneous faunal assemblages from Locality 15 of Zhoukoudian, Dali and Dingcun, Gezidong faunas have fewer extinct species which may suggest that the Gezidong site could have been the latest of Middle Palaeolithic known thus far in China. Recently, reexamination of the faunal assemblage indicates that the site could be late Pleistocene instead (Han and Xu 1985).

Upper Palaeolithic

There are 19 Upper Palaeolithic sites or localities of fossil hominids and their cultural remains are found in our study area: Xiaogushan, Haicheng; upper level of Jinniushan C; upper level of Miaohoushan; Shibajianfang of Lingyuan; Gulongshan of Fuxian; Xiancheng of Jianping; Qianyang of Dandong; Zhoujiayoufang of Yushu; Mingyuegou of Antu; Yanjiagang of Harbin; Huangshan of Harbin; Guxiangtun of Harbin; Daxintun of Qiqihaer; Shibazhan of Huma and Laogouhe of Mohe. Those sites (see Fig. 2 for their locations) can be categorized as follows:

1. Sites containing hominid fossils, lithic artifacts and mammalian fossils—Yanjiagang, Xiaogushan and Qianyang;
2. Sites containing hominid fossils only—Antu and Jianping;
3. Sites found only lithic remains—Shibazhan, Laogouhe, Huangshan and Xiaonanshan.

We will briefly describe those lithic remains and hominid fossils as well as the faunal assemblages in order to understand more about the adaptive strategies of the Upper Palaeolithic in northeast China.

Zhoujiayoufang (周家油坊) Site and Yushu (榆樹) *Homo sapiens*

Zhoujiayoufang (lat. 44°43′5″N, long. 126°21′E), 36 km southwest of Yushu county, was found in 1951 during the field survey by the staff of the Geology Department, the Dongbei College of Civil Engineering. Man-made flakes, a humerus and two broken skull fragments were found in their collections. A molar of subadult and lithic artifacts were collected by Pei (1956) during the field survey in the study area. The site was named after the fossil locality. The exact date of the fossil hominid is still unsolved because the florine content of the fossil is too low and the fossil was not found *in situ*.

The fluorine content increases with the age of the fossil bone. Jiang Peng has analyzed the fluorine content of the modern and fossil bones and then compared the results with previous study. The new result shows that the florine contents of fossil horse and human bones are higher than that of modern man, modern horse and dog. Thus, the Yushu fossil hominid may be tentatively dated to the Upper Palaeolithic.

In order to solve the stratigraphic association of the faunal and hominid remains, the Jilin Institute of Geology and the staff of Jilin Provincial Museum had test excavated seven localities in 1977 (Sun *et al.* 1981). Seventy more lithic artifacts and fossil faunal assemblages were found from Localities 1, 2, 4, 7 (Tables 8A and 8B). Discovered remains include 19 lithic artifacts and 51 bone tools (28 of them were found from stratigraphic context). Lithic types are basically disc cores, pointed tools and scrapers (Fig. 14). Raw materials are mainly quartz and basalt and they could be collected from the Sungari River banks. The flaking technique is hammerstone. Bone samples from Localities 1, 4 were collected from the primary context while the faunal assemblages of Localities 2 and 7 were found from the secondary context. Wood fossils from Locality 1 has been C^{14} dated at older than 40,000 B.P. and 26,740 ± 735 B.P. at Locality 4. But a piece of leg bone of *Coelodonta* was dated to 31,800 ± 900 B.P. (Chen and Yuan 1988).

Bone tool types are ivory shovel, round scraper, pointed tool, lance and digging tool. The ivory shovel was made from a tusk and the edge is arc-shaped and smoothed bifacially. Other bone tools were made from tabular long bones. Bone tools are manufactured by direct percussion and some have been sawed, scraped and smoothed. These features evidently indicate the advanced nature of the Yushu bone technology.

The thirteen different species of periglacial mammalian fossils discovered from stratigraphic units are: *Mammuthus sungari*, *Equus przewalskyi*, *Alces alces* and *Bos primigenius*. Both lithic and faunal remains were found within the muddy clay unit of Guxiangtun Formation on the second terrace. Pollen and faunal data suggested a periglacial landscape (Jiang 1987). The discovery of this site complex has also provided us the key information about the possible northern migration route and their cultural relationship with north China.

Guxiangtun (顧鄉屯) Site, Harbin

Guxiangtun site is the only Palaeolithic locality found in northeast China before 1949. During the 1960s, most scholars were suspicious about the provenience of lithic and faunal remains. Many surveys and excavations were sponsored by Quaternary geologists, palaeontologists, palaeoanthropologists near the Guxiangtun site under the modernization movement. Fossil tree branches unearthed from the site have yielded three C^{14} dates. The result shows that the site is older than 40,000 years B.P. Therefore, the site should be regarded as the late Palaeolithic. Lithic artifacts themselves are apparently mixed with the late microlithic elements (wedge-shaped cores) but this should not negate the late Palaeolithic component of the site (Zhang 1981; Chen 1985).

The site is located near a spring, 10 km west of Harbin city. Japanese and Russian scholars have excavated this site seven times. They have found both lithic tools and bone tools as well as palaeontological finds. Only one out of several hundred bone fragments was identified by Pei (1955) as man-made. Lithic artifacts are flakes, cores and round scrapers (Fig. 15).

Fifty species of mammalian fossils were found in Guxiangtun Formation and they all belong to the typical *Mammuthus-Coelondonta* faunal assemblage.

Gulongshan (古龍山), Fuxian county

Located on the eastern slope of Gulongshan, Fuxian county, Liaoning province, this site is a fissure deposit. The site (lat. 39°41′15″N, long. 122°1′59″E) is 75 m above the present sea level. The cave was formed within Cambrian limestone. Due to recent quarrying activities, the main cave has been destroyed. The portion of the cave that remains is estimated to be 60 m long and has an inverted trapezoidal cross-section.

The deposits within the cave consist of a 4 m thick grayish white clay near the bottom level that darkens near the surface and becomes grayish yellow. The uppermost unit is a dark red clay. The bottom unit was C^{14} dated to 32,000 ± 2000 B.P. and 37,000 ± 2000 B.P.; the middle level to 20,000 year B.P. by uranium series dating; the upper unit has been radiocarbon dated to 17,160 ± 240 year B.P. (Chen and Yuan 1988). The fauna could be correlated to stages 2–4 of the deep sea core (Xu *et al.* 1984).

The cultural remains consists of six lithic artifacts, fire-cracked rocks and burned bones, bone flakes that have been chipped by hominids, and other fossils. The six lithic artifacts, one core and five flakes, are definitely man-made. The flakes are small (60 mm) and made of quartzite, based on the presence of cortex. Most of the raw materials were collected from the banks of the Huitou River. There are more than 100 chipped animal bones that were evidently made by humans. Most of them are 15 cm long. These chipped bones have a pointed end; the opposite end may be obtuse or truncated, but most have points on both ends. There is evidence of retouching at one end.

Other bone artifacts have been found at Upper Palaeolithic sites in China recently (e.g., Shiyu site in Shanxi; Jinniushan site in Liaoning; Yushu site in Jilin; and Yanjiagang site in Harbin). Most of the broken bones are recognized as not having been worked over by humans, but some of them can definitely be identified as bone tools. As a matter of fact, at those places where lithic raw materials are in short supply, Palaeolithic collectors may possibly have used bone tools. It is interesting to note that there is an interesting correlation between sites with bone tools and grassland or steppe-grassland environments.

A reconstruction of the environmental setting at Gulongshan indicates that the site may have been occupied seasonally. There are 62 species of fauna represented in the Gulongshan assemblage: 7 birds, 2 fish, 1 reptile and 52 mammals. Five community types can be identified within the mammalian fauna: open steppe types (17 species), forest-grassland or shrub types (20 species), cool-temperate/tundra types (3 species), mixed environment types (8 species), and 2 species from special environmental settings. These 5 different community types indicate the mosaic of the natural environment, but the temperate, steppe, and forest-grassland are predominant (71% of the species; see Fig. 3).

The natural landscape is roughly similar to the modern boundary between the Songliao Plain and Daxinganling. It is estimated that the mean annual temperature was 3°–6° C, which is 3°–4° C lower than at present. Annual precipitation was 400 mm, 200 mm less than it is today. Annual temperature differences were widely variable; thus, unfavourable for less cold- and warm-adapted species.

The people who lived in the Gulongshan area were collectors; the animals that they hunted were mainly ungulates, especially horses. According to MNI estimation, more than 6,000 isolated horse teeth represent at least 250 individuals. The age profile of the horses (Fig. 16) is based on a total of 151 right maxillary first molars. The age profile reflects the predominantly subadult character of this prey species. Deer, antelope, hyaena and mammoth remains are also predominantly from subadult individuals. Finally, tooth-section studies show that the outermost annual growth ring is whitish and semitranslucent; thus, it is highly possible that those game species could have been killed during the summer.

Seven species of birds are represented in the faunal assemblage. Ducks and pheasants are widely distributed in China, while *Perdix* sp. (partridge) are found only in northeastern China and the mountanous areas of northern China. *Charadrius* sp. (pelbates; plover) are adapted to relatively cold climates and presently can be found in the mountanous areas of Heilongjiang and Changbaishan in Jilin province. They can be found in the Dalian area of

Fuxian province year-round, but they are difficult to find during the winter. Plover (*Charadrius* sp.) and sandpiper (*Tringa* sp.) are migratory. They migrate to East Africa and other tropical regions for the winter.

The bird remains indicate that the Gulongshan site was occupied by *Homo sapiens* during the late spring and early winter. In addition, the fact that remains of the cold-adapted megafauna, such as mammoth, occur at the site suggests spring and autumn occupation as well.

In summary, the Gulongshan cave site could have been occupied by collectors as special-purpose locations from northern China during the spring. These collectors procured their food resources from the open grassland, and then moved back to north China during the winter (You *et al.* 1985).

Antu (安圖) and *Homo sapiens*

Mammalian fossils were found when local miners quarried the cave for lime at Ximenshan, Antu county in 1963. In May of 1964 the Jilin Provincial Museum had organized a joint team to excavate the remnant deposits of the cave. In addition to more fossil fauna, they have also found one fossil hominid tooth.

The cave (lat. 43°5′17″N, long. 128°55′35″E) is located 5 km southeast of Ximenshan village, Minyuegouzhen, Antu county. The cave is presently 365 m above the sea level and located on the second terrace.

The cave deposit can be divided into four units. Minor fossilized hominid tooth could be derived from the second or third unit (subclay) while the relatively heavy fossilized mammalian fauna may be derived from other units (Kuan 1982).

The tooth is a lower first premolar, well preserved and fossilized. The tooth is a creamy colour and the root is a light yellowish colour and shows the early stage of dental caries and periodontosis. From occlusal wear, the individual is judged to be a middle-aged or young adult. The tooth is assigned to early *Homo sapiens* morphologically and by their faunal correlation (Jiang 1975). Bone samples have been C^{14} dated to 28,700 ± 750 from *Coelodonta* and 35,400 ± 1800 B.P. from *Mammuthus* (ibid.). Pollen data suggested that the local environmental setting was forested grassland and the annual temperature was 3.5° C which is 5° C lower than the present.

No lithic artifacts was found when the museum team members cleaned the collection. But one mandible of a rhinoceros bears cutting marks, and two more tibias have also born many tiny pits. After comparing those marks with modern assemblages, we think those bones could be used as anvils. In addition, some bones were apparently gnawed and others were worked by human agent. Those materials indicate that Antu *Homo sapiens* may have known marrow-cracking in order to increase their diet. Based on biased samples, Antu faunal assemblage has been described as a text book example of an assemblage accumulated by hyaenas (Binford and Stone 1987).

Pollen record show that the local environment setting was forested grassland and the annual temperature was estimated at 3.5° C which is 5° C lower than the present.

Huangshan (荒山) Site, Harbin

Huangshan is located on the Daxigou, 30 km east of Harbin city. This site has been surveyed several times by foreign archaeologists and palaeontologists from 1936 to 1959. Man-made artifacts were found within loess-like deposit. In addition, scrapers, pointed tools and burins were collected from the surface (Fig. 17). Both geologic and faunal correlations indicate that those artifacts were derived from the upper Pleistocene contexts. Macrofossil samples of tree branches, collected from grayish-brown loose sandy clay in 1975, were dated at 30,000 ± 700 B.P. and 23,860 ± 600 B.P. by C^{14} dating method. The result seems to confirm the estimated date mentioned above (Wei 1979).

Associated faunas are mammoths, rhinoceros, wild horses, antelopes, deer and primitive bovids.

Laogouhe (老溝河) Site, Mohe

In 1981, archaeologists from the Heilongjiang Provincial Museum had surveyed Mohe site, according to the information provided by the local people and three lithic artifacts were collected.

The site is located on the boundary between the first and second terraces. Four stratigraphic units can be divided. Lithic artifacts were found in unit three of loess-like clay and cobbles. Fourteen lithic artifacts were discovered and they are: 4 cores and flakes, 1 scraper, 7 pointed tools, and 2 choppers. Raw materials of the lithic artifacts are mainly sandstone and quartzite.

Lithic assemblages are mainly flake tools; most of the tools are large (19.5 mm) and medium-sized (8.6 mm); tool types are simple; and they were all fashioned by hammerstone technique. Lithic artifacts from this site differ from those from Shibazhan, Huma city (see below). They could be contemporaneous or earlier than the latter site. In other words, the site may be dated to the late Pleistocene, about 10,000–30,000 B.P. (Yang 1982).

Dongdong (東洞) (East Cave) and *Homo sapiens*, Miaohoushan

The East Cave or cave B is located on the southeastern slope of the Miaohoushan and is 100 m east of cave A. The cave is 350 m above the present sea level and 25 m above cave B. The cave is 19 m long and 9 m wide. The excavated area is 24 meter square. The cave deposit is 7.5 m thick and is divided into five units. Faunal and lithic assemblages were found in unit 2 of brownish-yellow clay with limestone breccia and in unit 3. Hominid remains were discovered at the bottom of unit 2, they are: two frontals of the same infant and a minor fossilized radius of another infant. The latter individual was unearthed from unit 2 and associated with *Cervis* sp. and *Sus scrofa* only. Only one flake made of quartz-sandstone was discovered at the upper part of the second unit. This specimen is percussion flaked and it was struck by a hammerstone. The platform is triangular in outline and flake scars are present on the dorsal surface and not retouched.

Units 2 and 3 can be correlated with units 7 and 8 of cave A which are dated by uranium series and C^{14} at 100,000 to 28,040 ± 680 B.P. (Museum of Liaoning Province and Museum of Benxi City 1986). Although the cultural deposit is rather thin and is fine-grained, one fact is evident: Miaohoushan caves could have been used as a logistic location for early Palaeolithic foragers and as residential location for the Upper Palaeolithic collectors in terms of the discovery of subadult skull fragment and limb bone.

Yanjiagang (閻家崗) Site and Late *Homo sapiens*, Harbin

Yanjiagang (lat. 45°36′30″N, long. 126°18′30″E) is 50 km west of Harbin city. The site was jointly excavated by the Archaeological team of Heilongjiang, Heilongjiang Provincial Museum and Harbin City Cultural Resource Management Station during the period from 1982 to 1983. In addition to lithic artifacts and man-made bone tools, a campsite-like structure was also recovered. The site has been C^{14} dated to 22,370 ± 300 B.P. Four stratigraphic units are divided in the TA3 test trench. Cultural materials, camp-like structures and faunal assemblages were found within the loose sand of unit four.

Eight lithic artifacts were found including choppers, cores, and flakes. Choppers were made of greyish quartzite and worked unifacially; three continous flake scars can be seen on the long edge of the ventral surface. In addition, one bipolar core (?) and three black chert flakes and retouched flakes were also found. So few lithic specimens were found that this phenomenon could be related to the distance from the quarry and the gravel beds of the middle Sungari River, which may have been 10–30 m below the fossil-bearing stratum.

Five hundred and twenty-two broken bone fragments unearthed from the site show clear points of percussion, and they were broken from outside. Some broken pieces are irregular in shape and have resulted from marrow-cracking. Some tabular long bones have been worked inside and outside; and they are all shaped into pointed ends and cutting edges in order to serve different functions (Wei *et al.* 1986). Most of the anatomical parts of the fossil assemblage are: broken skulls, limb bones, vertebrae, scapula, caudal vertebrae; complete skeletons and ribs were seldomly found. The assemblage undoubtedly belongs to the *Mammuthus-Coelondonta* fauna of northeast China. Faunal species are large-sized animals, carnivores and herbivores; subadults are the predominant age-group; some bones without question were gnawed by carnivores and rodents. MNI of the assemblage includes six wild horses, five wild bovids, one giant deer, one wolf and one antelope.

Two structures are encircled by faunal remains in a semicircular pattern (Fig. 18). The camp-like structure found in test pit 4 opens toward the east, and the bone heaps are three-layered; the upper layer contains more bovid, horse and cervid long bones; while the middle and lower ones have heavy, large, long bones of rhinoceros. MNI estimation is as follows: nine rhinos, five wild horses, three bisons, four cervids, one hyaena, one wolf and two antelopes. The second bone-accumulated structure, located to southeast of the site, opens toward the south and is 40 m away from the first structure and was discovered in test pit 3. Taphonomically, such patterned structures could be arranged intentionally by collectors. The modern Yunlian River flows from southeast to northwest. The direction of the flow may have been the same in the past as indicated by the stratigraphy and geomorphology of the site location. The distributional patterns of the bone scatters at TC4 and TA3 and the direction of flow of the river do not correlate, because most bones lack the evidence of rolling and the microstructure of the sandy unit is diagonal to the bone concentrations. Based on the modern fluvial system in northeastern China, these site locations could be buried under low-energy regimes during the early summer. The main feature of this type of sedimentation process is that at the time of high water level most of the fine sands begin to settle, a process that will not disturb the distribution of the fossils. The distribution of the bones and the flow of the water at TA3 are in the same direction, while the distribution pattern and the flow of water at TC4 are in the opposite directions. Thus, the distributional patterns of bones in both test pits are not coincidental; they are related to human activities. Bone pieces are piled up and overlapped and the inner circle is more patterned than the outer circle, which may be related to the activity zone. Particularly, six bovid long bones were found articulated; four tibias were found fractured at the mid-section; distal ends are still attached to tarsals and phalanges; four more vertebrae of wild horses are also found articulated. East of this structure, several piles of hyaena's coprolites have been found (four in a pile). Both bone piles and the bone structures could have been the kitchen meals or the hunting hide because of the age structure is predominately (90%) of subadult and 10% of all other age group combined. Alternately, the site may have been the seasonal hunting and camping ground because ten meters east of bone-accumulated structures, a garbage pit of butchered bones was uncovered which may suggest that the site could have also been used as a seasonal butchering location (You *et al.* 1986; You 1989).

One heavily compressed right posterior parietal (82 CHY 1) was found in loess-like subsandy clay matrix. The skull fragment was assigned to the late *Homo sapiens* in comparison with the occipital bones discovered at Upper Cave and Shiyu. Associated faunas from the same unit have been C^{14} dated to 22,370 ± 300 B.P. (Wei *et al.* 1986).

Xuetian (學田) Localities, Wuchang County

Two localities were discovered by Heilongjiang Institute of Archaeology in 1986 during their seasonal survey. The localities are located on the southeastern edge of Songliao Plain and 35 km northwest of Wuchang county. Mammalian fossils and lithic artifact were unearthed from 3.5 m thick grayish silt deposit of Locality H8601. These remains which were found within a 8 × 8 square meter area included three broken frontals, left tibia of *Homo sapiens* and five molars, three incisors as well as broken bone fragments of mammoths, bisons and wild horses. In addition, three lithic artifacts were also found at the same deposit.

Locality H8602 is located 150 m north of Locality H8601. Mammalian fossils were found in unit 3 of lower grayish green silt deposit while no lithic artifacts were discovered from unit 2. Based on the similar lithology and the degree of rolling and faunal composition, Yu (1988) suggested that two localities could be contemporaneous.

Most of the faunas are grayish yellow, grayish blue, grayish white in colour and are heavily fossilized. The evidence of aeolian and water rolling is so slight that those fossils may be buried in primary context. Identified species are *Mammuthus sungari*, *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Bison* sp., carnivores and *Myospalax* sp. All of them are the common species of *Mammuthus-Coelondonta* faunas of late Pleistocene in northeast China. The whole assemblage indicates a cold periglacial setting. MNI estimate of the molars suggests that 21 mammoths could have been butchered as they are predominately subadults. Interestingly, most of the anatomical parts of mammoths are arranged like a ribbon in north–south direction above grayish black silt. Bone scatters are 10 m long and 0.5–1.6 m wide which is not oriented in the same direction of water flow.

Pollen analysis suggests that the palaeosetting was forest and grassland which is consistent with inference based on faunas. Two localities may be contemporaneous with Zhoujiayoufang which was introduced above in terms of stratigraphy and C^{14} dates (24,500 ± 400 B.P.). Yu (1988) suggests that those two localites could be used as butchery locations based on the MNI estimate and age structure of fauna assemblage as well as dominated anatomical parts, heads and teeth.

Upper Level of Jinniushan (金牛山) Site

Two bone tools and 25 species of mammalian fossils were found at the upper unit of Jinniushan Locality 7401 C. Bone tools include an awl and a perforated object. Bone awl was made from a bone fragment which is 66 mm long, 19 mm wide and 8 mm thick. The manufacturing process was to peck the medullary wall and then chip along both sides. The upper end of the point was struck first and then smoothed into a sharp point. The perforated object was made from a caudal vertebra which is 69 mm long, 41 mm wide and 24 mm thick. The object was made by sectioning the vertebra and then smoothing the fracture plane. Finally, it was drilled from both directions. The maximal diameter on one side is 21.5 mm and 16 mm on the other; the minimal diameter is 13 mm on one side and 10.9 mm on the other. The objects mentioned above are the first occurrence in China, and the bone awl is without question a tool, while the drilled object may be used for decoration (Jinniushan Combined Excavation Team 1976).

Xiaogushan (小姑山), Haicheng

The site was found and test excavated during the fall of 1981. Formal excavation began in the summer of 1985 under the Joint Expedition of the Liaoning Provincial Museum and the Cultural Bureau of Anshan City (Zhang *et al.* 1985). Large amounts of lithic remains and faunal assemblages were discovered.

The site (lat. 40°34′53″N, long. 122°58′30″E) is located in the southeast of Haicheng county and 30 km away from Xiancheng. Haicheng is a cave site; the deposits can be divided into five stratigraphic units and are mainly clayey loose sand. Except for the Neolithic materials found in unit 1, other four units are dated to the Upper Palaeolithic. Most of the lithic and faunal assemblages were uncovered from unit 4.

Five isolated teeth and a femur fragment of a subadult were recovered from the Upper Palaeolithic context and those fossils are still under intensive study. Besides several thousand lithic artifacts and fire-using evidences, several drilled pedants made of animal teeth and lithic materials, bone needles, bone awl and a barbed harpoon were also found (Huang *et al.* 1986). Lithic artifacts are made from vein quartz pebbles. Flaking techniques are hammerstone and direct percussion. Bipolar flakes are the major types in the lithic assemblage and are made by anvil technique. Major lithic types are scrapers, points, choppers, burins, handaxes and bolas stones. Again, scrapers are the dominant types among lithic tool category; anvils are standardized; sheroids are polyhedral. Choppers were found in large numbers and were crudely made while the points are finely made. Only a few burins were found and they are standardized and so are the handaxes.

One harpoon, one bone owl and three bone needles (Fig. 19) were also found. The harpoon with two barbs was made of deer antler because sawing, cutting and scrapping marks are present. Bone needles are made from limb bone. They were polished and the perforation was made possible by bidirectional drilling. Bone awls were also made from limb bones and the base was broken off (Fig. 19).

Quite a few perforated teeth were found and most of them are canines of small carnivores and cervids. The perforation is mostly placed on the tooth root. In addition, one piece of decorated shell object was also discovered.

The cultural assemblage, especially the decorated objects indicate that this industry can be attributed to the Upper Palaeolithic and they may have been closely related to the Upper Palaeolithic of north China. The small tool component, especially the high frequency distribution of scrapers, is reminiscent of the small tool tradition of Zhoukoudian and Xujiayao culture. Spheroids and handaxes are quite similar to the large tool tradition of Kehe-Dingcun (chopper-chopping tool and heavy triangular points). Additionally, pressure-flaked points and scrapers are comparable to those tools from Shuidonggou. Large numbers of anvils, harpoons and radially engraved decorative objects are seldomly found in the northern Chinese Palaeolithic sites.

Besides small amount of fish vertebrae, turtle carapace, shell piece and bird limb bones, most of the anatomical parts of fossil faunas are isolated teeth, broken skulls, mandibles and limb bones. Identified faunal species are *Canis* sp., *Vulpes corsac*, *Ursus* cf. *spelaeus*, *Crocuta ultima*, *Mammuthus primigenius*, *Equus przewalski*, *Coelondonta antiquitatis*, *Gazella przewalskyi*, *Bison* sp., *Bubalus* sp., *Cervus canadensis*, *Megaloceros ordosianus*, *Sus scrofa* etc.

The faunal assemblage of Xiaogushan may indicate that the local environmental setting was forested grassland. Coexisted-warm and cold-loving species may reflect local environmental shifts. The discovery of the Xiaogushan site provides us not only important new information about bone technology but also comparative data with northeast Asia and even with the New World within the time range between 22,000 to 23,000 B.P.

Jianping (建平) *Homo sapiens*

A humerus was found when staff members of the Liaoning Provincial Museum checked vertebrate fossils in the Co-operation of Jianping. Before the humerus was found, museum staff members had found some mammalian fossils from the same Co-operation. Faunal assemblages indicate that the geologic age of the site is the late Pleistocene. Museum staff members have also confirmed that the humerus and the fossil fauna were unearthed from the same deposit.

The humerus shaft is right sided, 255 mm long, creamy coloured and heavily fossilized. As the humerus is rather robust and shows well-developed ridges, it was concluded that the individual was a male adult (Wu 1961). Associated faunas are *Equus* cf. *przewalskyi*, *Equus hemionus pallas*, *Coelodonta antiquitatis*, *Spirocerus* cf. *kiakhtensis*, *Ovis ammon Linne*, *Bison priscus Bojanus* and *Bison* sp. They are the key components of *Mammuthus-Coelodonta* fauna. Thus the site could be dated to the Upper Pleistocene.

Jianping *Homo sapien* fossil was the first human fossil discovered in northeast China. The discovery of this fossil has provided both the clue and hope for the finding of more human and cultural remains in this area during the early sixties.

Qianyang (前陽) *Homo sapiens* Site, Dandong

The cave site (lat. 32°75′N, long. 124°E) is 70 km southwest of Dandong city. The entrance of the cave faces southwest and the cave is presently 90 m above the sea level. The site was found in February of 1982 with the discovery of a hominid skull by local miners quarrying the cave deposits. Preliminary morphological study shows that the skull may be contemporaneous with the Upper Cave *Homo sapiens*. The cave site was test excavated in the summer of the same year.

The cave deposit can be divided into four units: units 1, 2 and 4 are sterile and most of the cultural and fossil remains are found within unit 3 of loess-like subclay deposit. Discovered hominid fossils include a complete skull, mandible and an isolated incisor. The mandible is preserved intact with the canine, first and second premolars and first molar, but the upper end of ascending ramus is missing. There are six cusps on the occlusal surface which could be regarded as a primitive feature. The mandible is judged to belong to an eleven-year-old female from the mandibular angle and lack of robusticity, smooth cranial surface, and tooth eruption and wear pattern.

Only three lithic artifacts were found in association with the fossil hominid and fossil fauna remains. Three lithic artifacts, including one chopper and two bipolar flakes, were collected from the surface outside the cave. The former is made of metapmorphic rock and worked unifacially. The unifacial chopper is the most characteristic tool type of Palaeolithic lithic assemblages in China. Furthermore, bipolar flakes are the dominant tool type of the upper unit of Zhoukoudian Locality 1. Associated faunal assemblages are listed in Table 1.

Xiaonanshan (小南山) Site, Raohe

Large numbers of Quaternary faunal remains were found when local people were constructing the Raohe shipyard at Xiaonanshan. Having learned the news, Heilongjiang Provincial Museum sent their museum staff to the site immediately and they found more mammalian fauna, lithic and bone remains.

The site is located on the left bank of the first terrace of south Xiaonanshan, Raohe county. The stratigraphic deposits of this site can be divided into six units. Lithic and bone remains were unearthed from the second unit of light greyish brown clayey gravels.

Lithic artifacts are made of volcanic stuff, and artifact classes are single scrapers and axe-like core tools (Fig. 20). One bone point made from a scapula of a mammoth was struck from both ends as well as engraved on the thinner surface. Associated faunas are mammoths only. Dominant anatomical parts are incisors, molars, limbs and ribs. In contrast to the Mohe site, Xiaonanshan site is the easternmost Palaeolithic locality so far found in China, although fewer cultural remains were unearthed from this site. Broken bones of the mammoths were identified to different age groups. No complete bones were found from this site. Yang suggests that this site could be categorized as the "garbage refuse" (1981:52). Mammoth sample has been C^{14} dated at 13,000 ± 460 B.P. (ibid.).

Daxingtun (大興屯) Site, Qiqihaer

Half a century has passed since the Angangxi was found related to the microlithic cultures. The first team of the Hydrogeology and Engineering Geology of Heilongjiang province, Museum of Liaoning province and IVPP have found lithic and faunal remains from the late Pleistocene deposit of Angangxi, southeast of Daxingtun in 1981. More survey and minor excavations were sponsored by the same institutions in 1982 (Huang *et al.* 1984) and by IVPP in 1986 (Gao 1988) which has rekindled the new research on the Angangxi culture.

The site is located 36 km southeast of Angangxi and 44 km west of Nenjiang. Geomorphologically, the setting belongs to the first terrace of the left bank of the Nenjiang. Hydraulic and aelian erosional forces have dissected the terraces into isolated sandy hills.

There are four stratigraphic units that can be subdivided. Cultural remains were unearthed from yellowish fine sand, greenish silt and the upper subclay deposits.

Besides the ash scatters and the burnt area, lithic artifacts are predominant. Sixty-eight lithic artifacts were found and the raw materials are mainly chalcedony, jasper and chert, a few volcanic rocks and quartz sandstone. Evidently the raw materials were collected from the banks of the Nenjiang River.

Lithic types are cores, flakes, choppers, scrapers and burins. Most lithic artifacts were made by hammerstone technique and others by anvil technique. Flakes are detached mainly from natural cortex and others from prepared striking platforms. Microblades are made of long flakes. Different forms of scrapers and burins show that toolkits are more predominantly flake tools. Both hammerstone and pressure techniques are applied to artifact manufacture, especially the microliths. Associated faunas are *Lepus* sp., *Ochotona daurica, Citellus* cf. *mongolicus, Equus prezwalskyi, Bison exiguus* (Huang *et al.* 1984). Two more species, *Cervus* sp. and *Muntiacus*, have been recovered in 1986 (Gao 1988). Based on the C^{14} date (11,800 ± 150 B.P.) of the bone samples from lower unitr, the site may be dated to the upper Palaeolithic.

Sedimentary and taphonomical features indicate that the site was primarily deposited. Anatomical parts of the associated faunas are broken skulls, mandibles, limb bones and isolated teeth. Complete skeletons and carnivore remains are absent. While the new excavation shows more limb, pelvic and isolate teeth (ibid. 1988). Both Huang *et al.* and Gao suggested that the site could be the overnight campsite. Lithic assemblages of the Angangxi culture may be closely related to the small-tool tradition of Zhoukoudian. The discovery of this site complex has linked the intimate relationship with north China and northeast China.

Shibajianfang (十八間房), Lingyuan

The site is located on the right bank of the first terrace of Dalinghe and the northeastern talus of Caimaoshan, 400 m southwest of Shibajiancun and 16 km northwest of Lingyuan county. Based on the report of the local villagers, Liaoning Provincial Museum sent their staff members to survey and test excavated the site in 1972 and 1973. Fourty-nine lithic artifacts and five species of mammalian fossils are found in yellowish lens deposit with intercalated thin sandy gravels (Liaoning Provincial Museum 1973). A thin ash layer and burnt bones were also reported.

Lithic artifacts are made from flint, amber, quartzite and quartz crystals. Lithic types are pointed tools, scrapers (concave, convex and straight) and backed flakes (Fig. 21). They are the most common tool types found in the Upper Palaeolithic of northeast China. Some tool types have even persisted into the Neolithic period. It is rather hard to date the site typologically. Small flake elements from the site may be attributed to the microlithic tradition. Those microblades may have been used as knives and mounted on harpoons or wooden handles. Associated faunas are rodents, cervids and bovids. Both faunal and lithic assemblages may be attributed to the late Pleistocene (Liaoning Provincial Museum 1973; Zhang 1981).

Shibazhan (十八站), Huma city

The joint expedition of the Institute of Vertebrate Palaeontology and Palaeoanthropology and the Heilongjiang Provincial Museum have discovered and excavated four more Palaeolithic localities on the second terrace of Heilongjiang tributory of Shibazhan, near Huma city in 1975 and 1976 respectively. The stratigraphic units of this site are four: lithic artifacts were unearthed from unit 3. More than one thousand lithic artifacts were discovered at this level, especially flaked tools. Lithic classes are: scrapers, pointed tools, burins, round scrapers, laurel-shape tools, microblades, flakes and cores, boat-shaped cores, tortoise scrapers, wedge-shaped cores and semilunar scrapers (Fig. 22). Most artifacts were made of medium to small sized chert (5–10 mm) (Zhang 1981). Manufacturing techniques are quite similar to Shuidonggou and Hutouliang lithic assemblages of north China as well as the microlithc lithic tradition. Both litho- and bio-stratigraphic correlations suggest that the site may be dated to the Upper Palaeolithic (*c.* 10,000 B.P.). It is also interesting to note that no fossil fauna have been reported from this site.

Daqiaotun (大橋屯) Site, Yushu County

A large amount of mammalian fossils was found by a local farmer in October, 1988. After examining mammalian fossils and one lithic artifact, the Joint Expedition of Yushu County Museum and Jilin Institute of Archaeology began to test excavate the site.

The site is (lat. 44°43′33″N, long. 126°20′9″E) 16 km southwest of Yushu county and 2 km away from Zhoujiayoufang. The tributory of the Larin River flows through this place and then drains into the Sugari River. The local loess plateau, 200–220 m high, was dissected into undulating hills. The second terrace, consisting of grayish green silt and bearing of mammalian fossils, is 10 m above the present river.

Four stratigraphic units can be distinguished: unit 4, black soil; unit 3, brownish yellow subclay; unit 2, grayish green, browish yellow medium sand; unit 1, grayish green silty sand. Most of the mammalian and lithic artifacts were unearthed from unit 1. Units 1 and 2 consist basically of the Holocene river beach deposit. It is possible that the deposits which consist of lithic and mammalian remains were reworked Guxiangtun Formation. If that is the case, it is possible that the site may be estimated to the Late Palaeolithic.

Discovered lithic assemblage includes cores, flakes, scrapers and choppers. Raw materials are mostly quartzite, vein quartz. Manufacturing techniques are predominantly direct hammer percussion. Two out of 1,925 pieces of mammalian fossils were identified as bone tools and one of them is an ivory-made scraper. Another 35 pieces bear human workmanship. The other 103 show gnaw marks and 68 of them are marks left by hyaenas. After the Pleistocene, hyaenas disappeared completely from northeast China. In that sense, the site could be dated to the Late Pleistocene (Jiang and Ho 1990).

The faunal assemblage consists of *Canis lupus*, *Vulpes* sp. *Crocuta ultima*, *Mammuthus primigenius*, *Mammuthus sungari*, *Equus przewalskyi*, *Equus* sp., *Coelodonta antiquitatis*, *Sus scrofa*, *Megaloceros ordosianus*, *Cervus xanthopygus*, *Capreolus manchuricus*, *Bison* sp., *Gazella przewalskyi*. Most of the fauna are cold-adapted species which are also the main component of Yushu fauna. Palaeoecological settings were mainly steppe and grassland (Jiang 1990).

Concluding Remarks

Palaeolithic foragers (late *Homo erectus*) may have started using fire during their northern dispersal to northeast China because some of the Early Palaeolithic sites have shown charcoal scatters and ash-stained areas (James 1989). Raw materials of lithic artifacts are predominantly quartz, chert, quartzites and other minor ones. Most of them were collected from the river beds not far away from the site. No evidence indicates that they were collected from stone quarries or transported. Manufacturing techniques of the lithic assemblages are mainly hammerstone percussion during the Early and Middle Palaeolithic. Indirect percussion technique have been used only at the Late Palaeolithic. Due to the non-isotrophic nature and the size of raw materials, it is possible that artifact types and ranges of lithic assemblages appear to have been restricted. The cores were unprepared and flakes were irregular in forms during the Early Palaeolithic which may mean that those tool types could have been made expediently. On the contrary, standardized flakes (e.g., long flake, microblade, wedge-shaped core and conical core) apparently tend to increase in frequency toward the end of the Upper Palaeolithic. Most of the microcores may be carried to the locations by collectors (late *Homo sapiens*) where the microblades were detached in order to get sharp, undamaged edges (Kelly 1988).

Initial forms of the lithic artifacts are chunks, cores, pebbles, chips, hammerstone-struck flakes, anvil-made flakes and microblades. Among them, flakes are the predominant ones in terms of lithic manufacture. The occurrences of the scrapers and pointed tools are in high frequency while choppers, burins, drills, bifaces and spheroids are low. In some special-purpose sites like Daxingtun and Xiaogushan, major tool kits are burins and bone awls instead.

In general, lithic assemblages of the northeast Chinese Palaeolithic are mainly small tools and large tools like choppers and handaxes are much less predominant. It is worth noting that "microlithisation" which has been observed in north Europe by Svoboda (1987; 1989) may also apply to northeast China. The average size of lithic assemblages is under 40 mm except those lithic specimens unearthed from Miaohoushan. In addition, small tools tend to be widespread during the interglacials with open woodland environment.

Abundant bone, antler and tooth-made tools are also present at most of the Upper Palaeolithic sites. Most of the bone tools were also frequently found in association with fur bearers (e.g., wolverine, arctic fox, wolf, beart, cave lion, hyaena, lynx and mustelid). They were fashioned into needles, awls, shovels and harpoons from long bone fragments. The perforation was done by scraping and drilling animal teeth bidirectionally. Such tool kit may be used for skin and hide working as well as the preparation of clothing. Some shell objects also show engraved marks which may suggest they could be used in non-utilitarian context and the widening of interaction networks with north China. It is entirely possible that the heavy-duty tools were either replaced by those made of osteodental materials during the glacial periods or most of our samples are biased toward special-purpose locations. Torrance (1983) suggested that organic materials were used more often when complex gears are needed for target-specific weapons since such weapons are more reliable and maintainable than the ones made of lithic materials (Bleed 1986).

From all those above-mentioned features, it is apparent that the lithic and faunal assemblages of northeast China have close relationship with those from north China because the two areas might have shared the same climatic regimes and same faunal and floristic zones during the entire Pleistocene. As we mentioned before, the lithic component of the lower level of Jinniushan belongs to the same tradition as Zhoukoudian; while the lithic specimens from Miaohoushan are similar to those unearthed from Chonggokni, south Korea (Bae 1987) and to Dingcun site which may reflect the local evolution of parallel adaptive response of the same technological tradition under the same environmental regime.

So far only one Middle Palaeolithic site, Gezidong, is found in northeast China. The average size of the lithic specimens of the total assemblage is larger than that of north China. This may be related to the local availability of raw materials because the flakes which are made of quartzite cobbles are large. But the lithic tool manufacture and inventory are similar to those unearthed from Zhoukoudian Locality 1 in terms of the predominance of light-duty tools (scrapers) and few heavy-duty tools. Both caves may possibly be used by Palaeolithic foragers as special-purpose locations. During the Palaeolithic, two technological traditions can be discerned in north China: a light-duty tool tradition (fashioned by direct percussion and indirect pressure methods), and a heavy-duty tool tradition (Jia and Huang 1985; Clark and Schick 1988). The evolutionary pattern of biocultural assemblages are apparently the same in north and northeast China during the Palaeolithic.

Although big progress has been made in Palaeolithic research in this region during the last decade, there are still not enough archaeological sites and palaeontological localities and the data base is not fine-grained enough to detect the Palaeolithic subsistence and land use patterns as well as site structures. Those goals can only be achieved if we can have tight chronological controls and fine-grained taphonomical studies (e.g., Yanjiagang and Gulongshan are two examples of the early stages of taphonomical studies; see Wei 1986). From the site distribution patterns of our limited sample, we may suggest tentatively that: 1. most Early Palaeolithic sites are restricted to the south of 45 degrees and some sites are even located 50 degrees north during the warm and humid climatic regime; 2. the Middle Palaeolithic site location (e.g., Gezidong) is even further north than those contemporaneous sites in Europe because the impact of the glaciers was much less felt in China. It is therefore highly possible that more Middle Palaeolithic sites could be found in the near future. Interesting enough, most of the Early and Middle Palaeolithic sites are found in caves while the Upper Palaeolithic sites are located more in open-air plains on the second terraces than in caves (Huang 1982). It is highly possible that open-air sites of Early Palaeolithic in our study area were located in the valleys below the caves but they have not yet been sampled. Furthermore, those caves could be used by foragers as temporary shelters in terms of thin refuse deposits (e.g., Miaohoushan). On the contrary, open-air localities located near major river terraces could be used as residential camps, because the energy expenditures could be minimized if the task group and the family unit are moving to the harvesting locale (Hahn 1987). The presence of milk tooth and associated megafaunas at open-air site, Zhoujiayoufang, and subadult frontal bones and radius at Dongdong of Miaohoushan, with small size fauna, a femur of a subadult at Xiaogushan and female subadult at Qianyang cave site may be a good indication of such energy minimization strategies. Some of the Late Palaeolithic collectors with Sinodont (three-rooted lower molar) from Dongdong, Miaohoushan and microblade technology (e.g., Shibazhan) may have moved toward the New World following the megafaunal migrations and population expansion around 20,000 years ago during the period of climatic amelioration (Turner 1987; 1989).

Acknowledgements

We appreciate with gratitute the perceptive and critical comments received from several anonymous reviewers, Dr. Desmond Clark and Glover Krantz. Many people have provided helpful discussions on the material used for this paper over the past years, including Professors Jia Lan Po, Lu Zun E, You Yu Zhu, the late Zhou Xin Xue, Yang Da Shan and Zhang Zin Hong. We owe extra thank to Professor Lu for providing us the picture of Figure 10.

Reference Cited

Bae, K.D.
1987 "The Stone Industry of the Chongokni: Lower Palaeolithic Site in Korea." *L'Anthropologie*, 91:787–96.

Binford, L.R. and Nancy M. Stone
1987 "Zhoukoudian: A Closer Look." *Current Anthropology*, 27:453–75.

Bleed, P.
1986 "The Optimal Design of Hunting Weapons: Maintainability or Reliability." *American Antiquity*, 51:737–47.

Chard, C.S.
1974 *Northeast Asia in Prehistory*. Madison: The University of Wisconsin Press.

Chen, C.
1985 "New Discoveries in Northeast China." *Current Research in the Pleistocene*, 2:93–94.

Chen, T.M. and S.X. Yuan
1988 "Uranium-series Dating of Bones and Teeth from Chinese Palaeolithic Sites." *Archaeometry*, 30:59–76.

Clark, J.D. and K.D. Schick
1988 "Context and Content: Impressions of Palaeolithic Sites and Assemblages in the People's Republic of China." *Journal of Human Evolution*, 17:439–48.

Cui, D.W. and Y.S. Li
1987 "Excavation History of the Jinniushan Site." *Fossils*, 1:3–4.

Cui, Zhi Jiu and Xie You Yu
1982 "On Late Pleistocene Periglacial Environments in the Northern Part of China." In Quaternary Research Association of China (ed.), *Quaternary Geology and Environment of China*, pp. 1167–71. Beijing: China Ocean Press.

Fu, W.X.
1988 "A Study of the Transgression Process since Late Pleistocene on the Coast Zone of Lower Liaohe River Plains and the Liaodong Peninsula." *Geographical Research*, 7:71–80.

Gai, Pei and Q. Wei

1977 "Discovery of the Late Palaeolithic Site at Hutouliang, Hebei." *Vertebrata Palasiatica*, 15:287–300.

Gao, X.

1988 "New Discoveries of Palaeoliths from Angangxi, Heilongjiang Province." *Acta Anthropologica Sinica*, 7:84–88.

Gezidong Excavation Team

1975 "Discovery of Palaeolithic Artifacts in Gezidong Cave in Liaoning Province." *Vertebrata Palasiatica*, 13:122–36.

Guo, X.D.

1984 "Preliminary Study on Quaternary Climate in China." *Journal of Glaciology and Cryopedology*, 6:49–60.

Han, D.F. and C.H. Xu

1985 "Pleistocene Mammalian Faunas of China." In R.K. Wu and J.W. Olsen (eds.), *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*, pp. 267–89. New York: Academic Press.

Hahn, J.

1987 "Aurignacian and Gravettian Settlement Patterns in Central Europe." In Olga Soffer (ed.), *The Pleistocene Old World*, pp. 251–61. New York: Plenum Press.

Ho, Chuan Kun

1985 "Changes in the Mobility Patterns of the Hunters and Gatherers during the Early and Late Palaeolithic Periods in China." Paper presented at the 50th annual meeting of the Society for American Archaeology, Denver, Colorado.

n.d. "The Earliest Evidences of Hominid Fire Use in China" (manuscript).

Huang, W.P., Y.Z. You, S.H. Gao and H.P. Wei

1987 "On the Problems of the Karst Cave and the Deposits of the Site of Jinniushan Man." *Carsologica Sinica*, 1:61–67.

Huang, W.W., R.Y. Fu, B.F. Chen, J.Y. Liu, M.Y. Zhu and H.K. Wu

1986 "Bone Artifacts and Ornaments from Xiaogushan Site of Haicheng, Liaoning Province." *Acta Anthropologica Sinica*, 5:259–66.

Huang, W.W., Z.H. Zhang, Z.D. Liao, H.N. Yu, B.J. Chu and Z.C. Gao

1984 "Discovery of Palaeolithic Artifacts at Angangxi of Qiqihaer, Heilongjiang." *Acta Anthropologica Sinica*, 3:234–43.

Huang, Yun Ping

1985 "Notes on the Discovery of the Jinniushan Ape-man." *Fossils*, 2:11–13.

James, S.R.

1989 "Fire Use in the Lower and Middle Pleistocene." *Current Anthropology*, 30:1–26.

Jia, L.P.

1988 "Recent Discoveries in Palaeolithic Archaeology in China." *The Journal of the Institute of Chinese Studies of The Chinese University of Hong Kong*, 19:1–8.

Jia, L.P. and W.W. Huang
1985 "On the Recognition of China's Palaeolithic Cultural Traditions." In R.K. Wu and J.W. Olsen (eds.), *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*, pp. 259–65.

Jinniushan Combined Excavation Team
1976 "New Material of Pleistocene Mammalian Fossils in Jinniushan from Yingkou, Liaoning Province and Their Significance." *Vertebrata Palasiatica*, 14:120–27.
1978 "A Preliminary Study of Palaeolithic Artifacts of Jinniushan, Yingkou, Liaoning." *Vertebrata Palasiatica*, 16:129–36.

Jiang, Peng
1975 "Late Pleistocene Cave Accumulations at Antu, Jilin." *Vertebrata Palasiatica*, 13(3):197–98.
1987 "Living Environment of Late Palaeolithic Man in Northeast China." *Current Research in the Pleistocene*, 4:14–16.
1990 "Palaeolithic Artifacts Found in Daqiaotun Site of Yushu County, Jilin Province." *Acta Anthropologica Sinica*, 9(1):8–15.

Jiang, Peng and C.K. Ho
1986 "Hunting Strategies of Late Palaeolithic Man in Northeast China." *Current Research in the Pleistocene*, 3:92–94.
1990 "A New Upper Palaeolithic Site from Northeast China." *Current Research in the Pleistocene*. (In press.)

Kelly, R.
1988 "Three Sides of a Biface." *American Antiquity*, 53:717–34.

Kong, Zhao Chen and Du Nai Qiu
1982 "The Climate in Sanjiang Plain during the Past 36,000 Years." In Quaternary Research Association of China (ed.), *Quaternary Geology and Environment of China*, p. 172.

Kung, Yu
1982 "On the Palaeolithic Cultures in Northeast China." *Archaeology and Cultural Relics*, 2:31–37.

Li, G.D.
1988 "Studies of Regional Differentiation and Type of Primitive Culture in Liaoning." *Journal of Liaoning University*, 2:92–96.

Liu, D.S. and M.L. Ding
1985 "China's Quaternary Stratigraphy and Plio-Pleistocene Boundary." *Journal of Stratigraphy*, 9:239–51.

Lu, Zun E
1985a "A Major Find of Hominid Fossils." *China Reconstruct*, 9:34–35.
1985b "The Discovery of Jinniushan Ape-man and Its Significance." *Journal of Peking University*, 2:109–11, 78.
1987 "Cracking the Evolutionary Puzzle—Jinniushan Man." *China Pictorial*, 4:34–35.

Marzke, M.W. and M.S. Shackley

1986 "Hominid Hand Use in the Pliocene and Pleistocene Evidence from Experimental Archaeology and Comparative Morphology." *Journal of Human Evolution*, 15:439–60.

Museum of Liaoning Province and Museum of Benxi City
1986 *Miaohoushan: A Site of Early Palaeolithic in Benxi County, Liaoning.* Beijing: Wenwu Press.

Pei, W.C.
1955 "Chinese Palaeolithic Cultures." In M.R. Guo *et al.* (eds.), *The Discovery and Research of Chinese Hominid Fossils*, pp. 53–89. Beijing: Science Press.

Pope, G.G.
1988 "Recent Advances in Far Eastern Palaeoanthropology." *Annual Review of Anthropology*, 17:43–77.

Sun, J.Z.
1982 "Classification of the Quaternary Glacial Stages in Jilin Province." *Acta Geologica Sinica*, 2:171–86.
1983 "Issue of Paleolithic Archaeology of Songliao Plain." *Bulletin of Heilongjiang Cultural Relics*, 2:48–55.

Sun, J.Z., Y.Z. Wang and P. Jiang
1981 "A Palaeolithic Site at Zhoujiayoufang in Yushu County, Jilin Province." *Vertebrata Palasiatica*, 3:281–90.

Svoboda, J.
1987 "Lithic Industries of the Argo, Vertesszollos, and Bilzingsleben Hominids: Comparison and Evolutionary Interpretation." *Current Anthropology*, 28:219–27.
1989 "Middle Pleistocene Adaptations in Central Europe." *Journal of World Prehistory*, 3:33–70.

Tokunaga, C. and N. Naora
1932 *Report of Digging at Hochiakou, Kuhsiangtung, Kirin, China.*
1939 "Fossil Remains Excavated at Ku-hsiang-tung, Near Harbin." *Pal. Sin.*, Series C, Vol. 7, Fasc. 4.

Torrance, R.
1983 "Time Budgeting and Hunter-gatherer Technology." In G. Bailey (ed.), *Hunter-gatherer Economy in Prehistory*, pp. 11–22. Cambridge: Cambridge University Press.

Trinkaus, E.
1986 "The Neanderthals and Modern Human Origins." *Annual Review of Anthropology*, 15:193–218.

Turner II, Christy G.
1987 "Telltale Teeth." *Natural History*, 96:6–11.
1989 "Teeth and Prehistory in Asia." *Scientic American*, 260:88–96.

Wei, H.P.
1986 "Palaeolithic Culture Features, Taphonomic Patterns and Palaeoecology of Liaoning Province, Northeast China." *Prehistory*, 1–2:152–58.

Wei, Q.

1979 "The Age of the Huangshan Stratum, Harbin." *Acta Stratigraphica Sinica*, 3:208–13.

Wei, Z.I., D.S. Yang, K.P. Yin, Q.X. Ne and H.L. Yu

1986 "Late Palaeolithic Locality, Yanjiagang, Harbin." *Cultural Relics of the North*, 4:8–15.

Woo (Wu), Ru (Ju) Kang

1961 "Fossil Human Humerus from Chienping (Jianping), Liaoning Province." *Vertebrata Palasiatica*, 4:287–89.

Wu, Ru Kang

1987 "Is 'the Jinniushan Man' the Ape-Man?" *Guangming Daily News*, 14 June, p. 3.

Wu, R.K.

1988 "The Reconstruction of the Fossil Human Skull from Jinniushan, Yingkou, Liaoning Province and Its Main Features." *Acta Anthropologica Sinica*, 7:97–101.

Xia, Y.M. and P.F. Wang

1987 "The Palaeobotany and Palaeoclimate in the Songnen Plain: A Study on the Late Tertiary-Pleistocene Spore Pollen Assemblages." *Acta Geographica Sinica*, 42:165–77.

Xu, Q.Q., C.Z. Jin and C.T. Li

1985 "Climatic Changes and Megafaunal Extinction before 10,000 Years in Northeast China." *Geology of Jilin*, 1:38–42.

Xu, Q.Q., C.Z. Jin and X.X. Zhou

1984 "Correlation between Gulongshan Faunal Assemblage of Northeast China and Deep Sea Sediment." *Kexue Tongbao*, 12:746–47.

Yang, D.S.

1981 "Palaeolithic Locality of Xiaonanshan, Yaohe." *Bulletin of Heilongjiang Cultural Relics*, 2:48–55.

1982 "The Chipped Stone Tools Discovered at Mohe." *Bulletin of Heilongjiang Cultural Relics*, 1:1–4.

Yang, W.C. and Y.P. Fu

1979 "Preliminary Study of Quaternary Stratigraphy of Miaohoushan Cave Site, Shanchenzi, Benxi County." *Bulletin of Liaoning Geology*, 2:10–15.

You, Y.Z.

1989 *Taphonomy for Prehistoric Archaeology*. Beijing: Cultural Relics Publishing House.

You, Y.Z., Q.Q. Xu, Y. Li and C.K. Ho

1986 "Seasonality and Site Structure of Late Palaeolithic Sites from Northeast China." *Current Research in the Pleistocene*, 3:97–102.

You, Y.Z., Y. Li, Y.F. Sun and J.M. Wang

1985 "Cave Remains of the Gulongshan Culture in Dalian and Palaeoecological Study." *Prehistory*, 1:68–73.

Yu, H.L.
1988 "A Brief Study of Late Palaeolithic Localities at Xuetian Village of Wuchang County, Heilongjiang Province." *Acta Anthropologica Sinica*, 7:255–62.

Yu, H.L. and Y.Z. You
1988 "Research on Site Structure and Taphonomy of Yanjiagang Site." *Kaogu Yu Wenwu*, 4:1–8.

Zhang, Chen
1987 "Diary of Yanjiagang Excavation." *Fossils*, 1:4–5, 8.

Zhang, S.S.
1985 "The Early Palaeolithic of China." In R.K. Wu and J.W. Olsen (eds.), *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*, pp. 147–86.

Zhang, Z.H.
1981 "The Human and the Culture of the Palaeolithic Period from Liaoning District." *Vertebrata Palasiatica*, 19:184–92.

Zhang, Z.H. and C. Chen
1986 "Two Earliest Palaeolithic Site in Northeast China." *Current Research in the Pleistocene*, 3:102–3.

Zhang, Z.H., R.Y. Fu, B.F. Chen, J.Y. Liu, M.Y. Zhu and H.K. Wu
1985 "A Preliminary Report on the Excavation of Palaeolithic Site at Xiaogushan of Haicheng, Liaoning Province." *Acta Anthropologica Sinica*, 4:70–79.

Zhao, Jing Bo
1985 "Periglacial Vegetation and Quaternary Glaciers." *Geological Review*, 31(6):551–58.

Zhou, M.Z.
1958 *Pleistocene Mammalian Fossils from the Northeastern Provinces.* Special Publication, No. 3, Institute of Vertebrate Paleontology, Academia Sinica. Beijing: Science Press.

Zhou, T.R.
1983 "Palaeogeography (I)." In Editorial Committee of Chinese Physical Geography, Academia Sinica (ed.), *Chinese Physical Geography.* Beijing: Science Press.

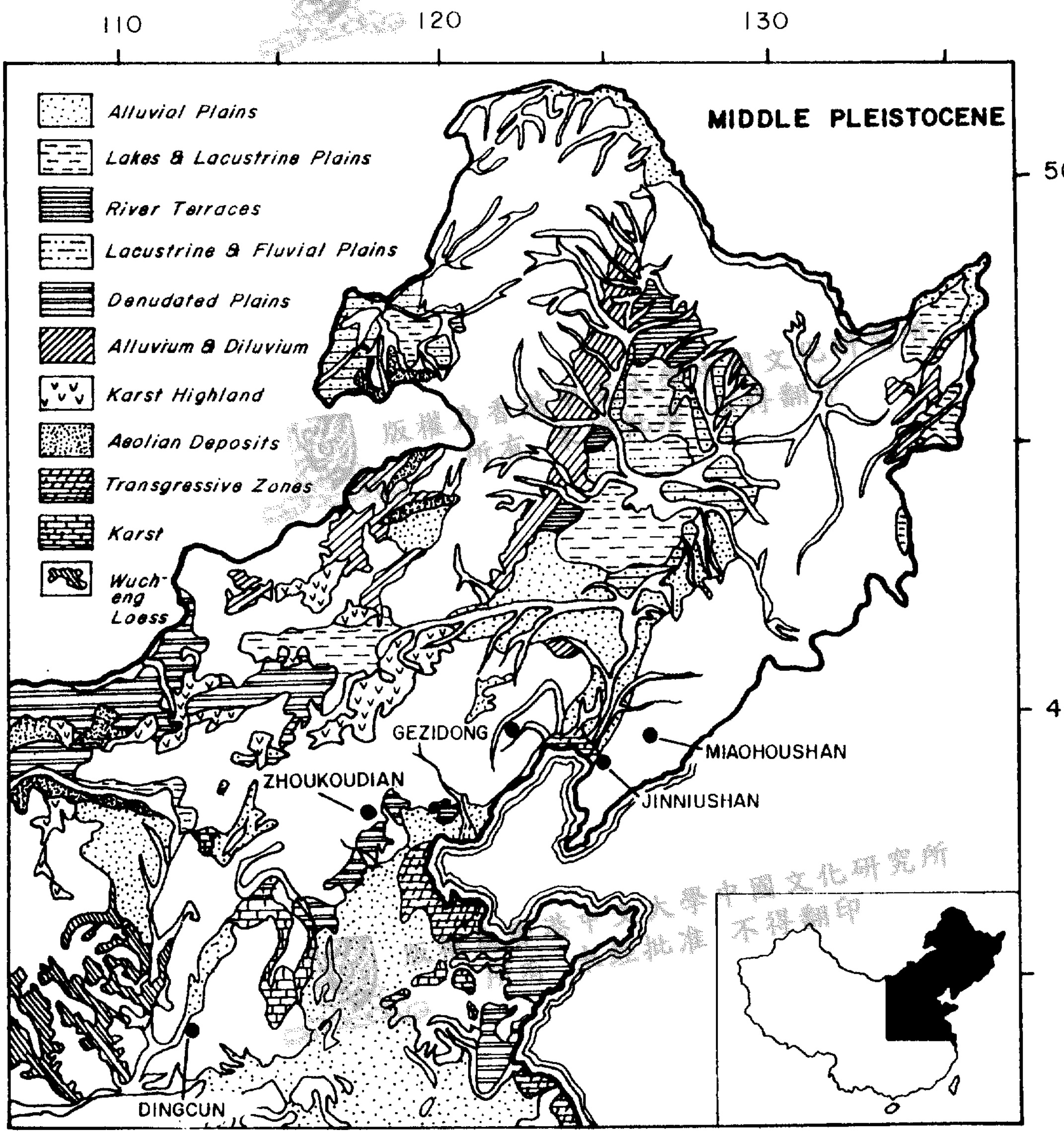

Figure 1. Middle Pleistocene topography and Early Palaeolithic site locations (after Zhou 1984)

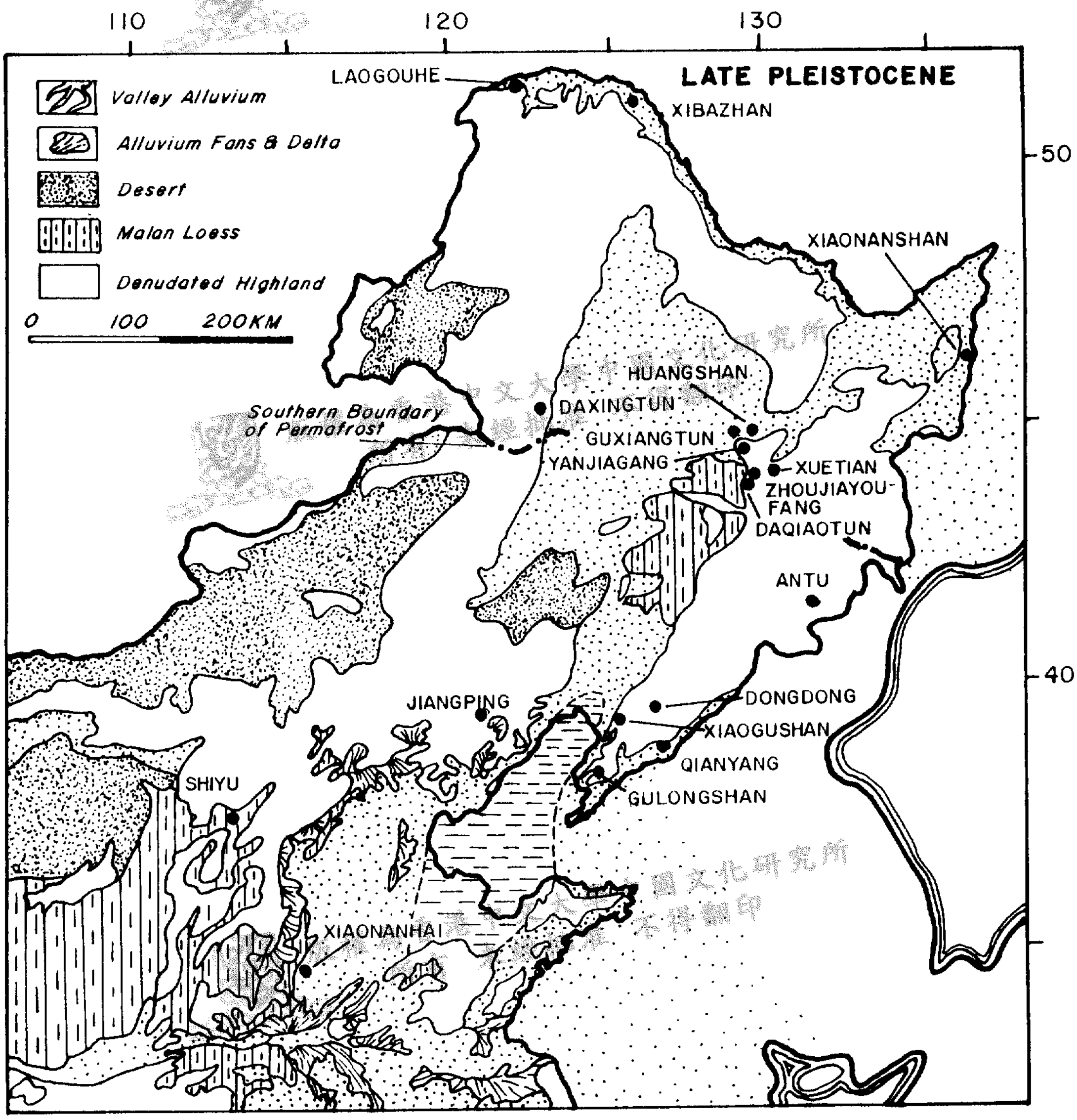

Figure 2. Upper Pleistocene topography and Late Palaeolithic site locations (after Zhou 1984)

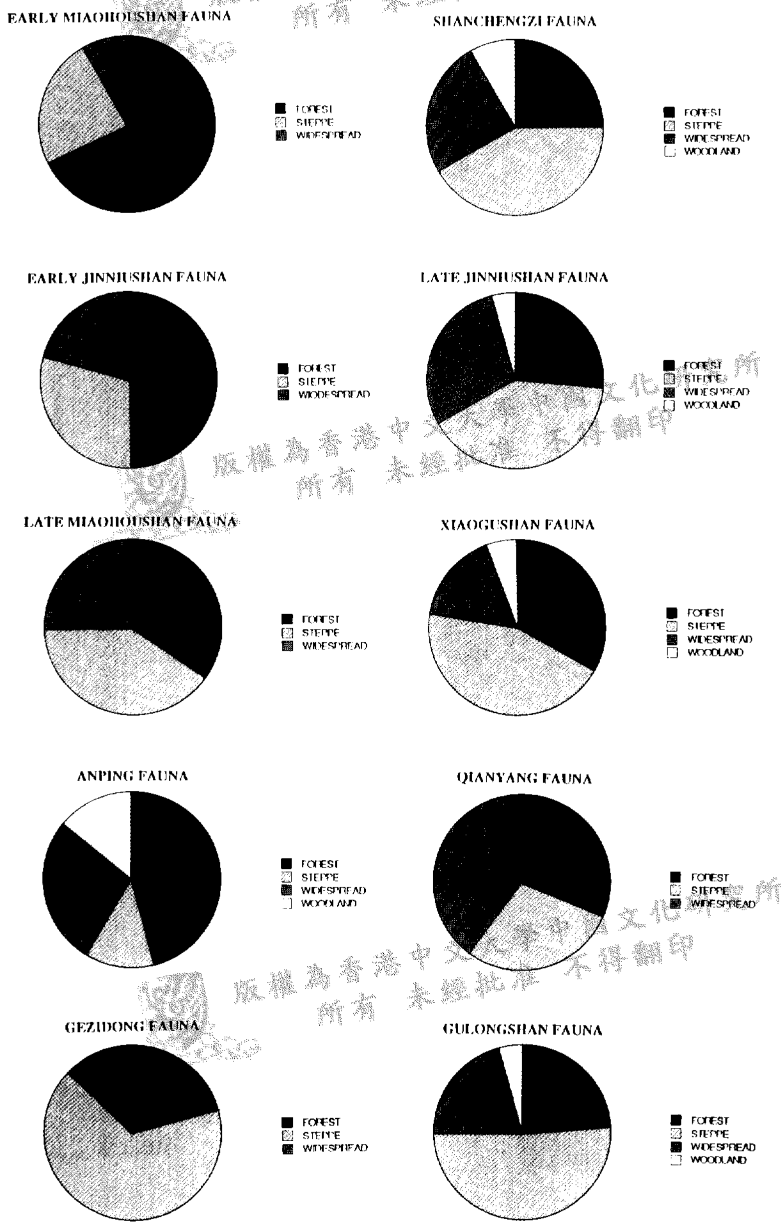

Figure 3. Pie diagrams of Pleistocene palaeocommunity types in northeast China (after You 1989)

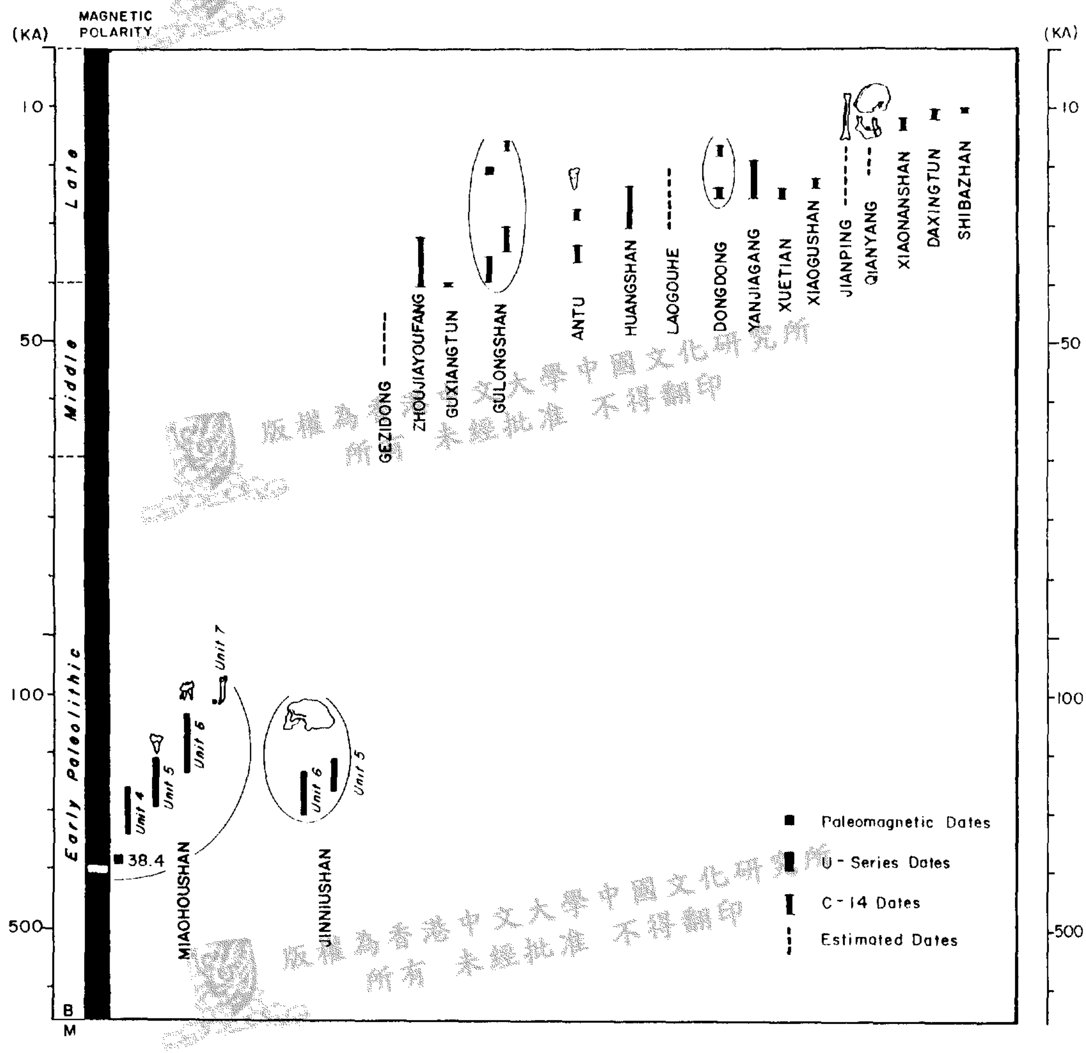

Figure 4. Chronological sequence of Palaeolithic sites and associated hominid fossils in northeast China based on radiometric, isotopic and faunal data (see text for references)

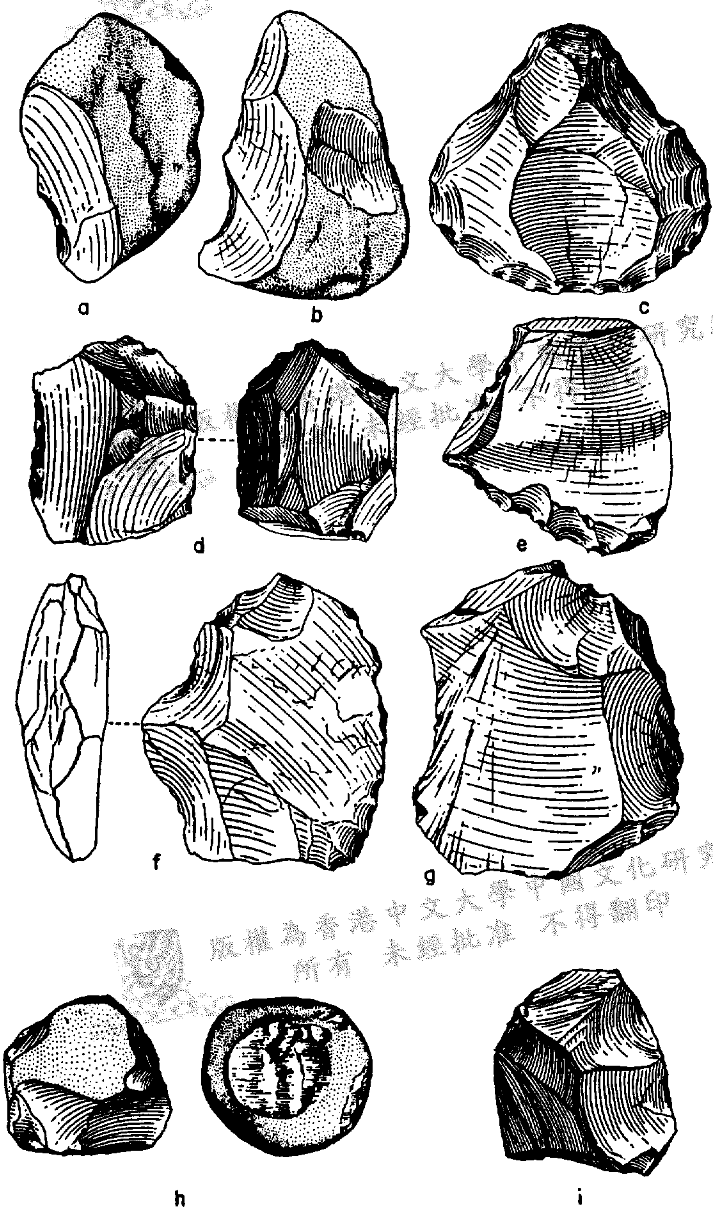

Figure 5. Characteristic artifact types in Early Palaeolithic assemblages from Miaohoushan (after Museum of Liaoning Province 1986). a–h. choppers; i. spheroid; j. core

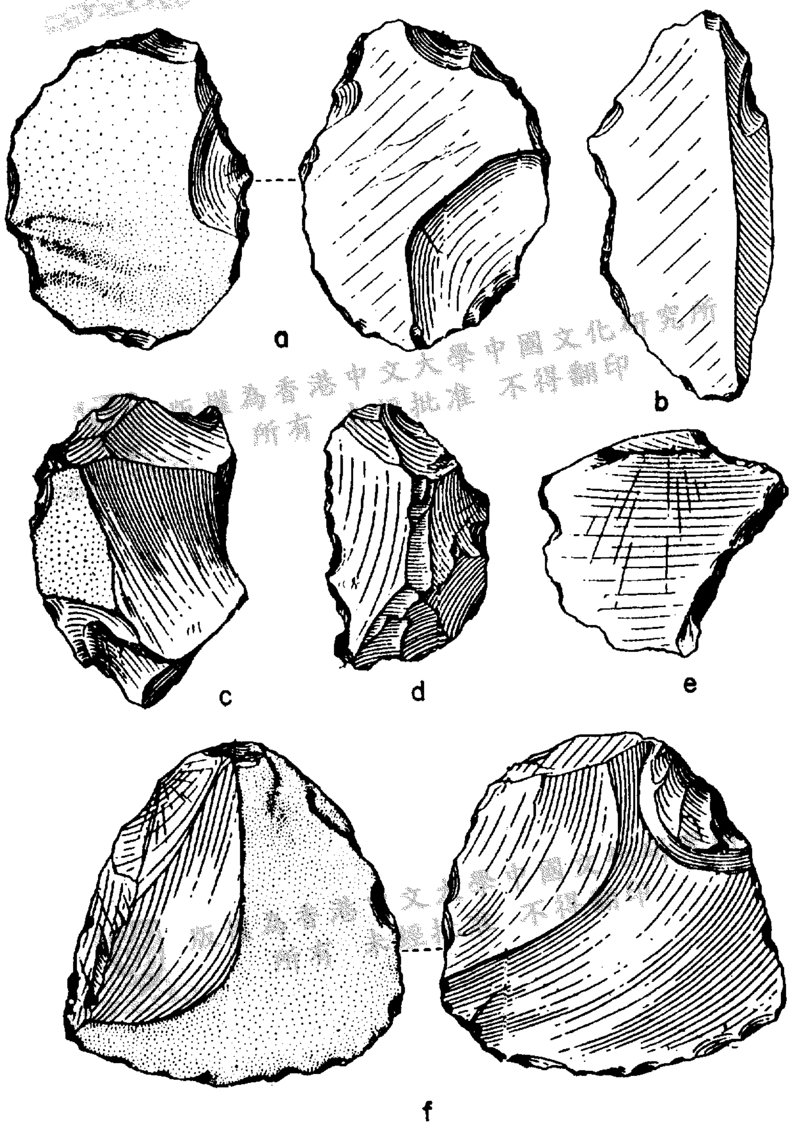

Figure 6. Characteristic artifact types in Early Palaeolithic assemblages from Miaohoushan (after Museum of Liaoning Province 1986). a, d. double scraper; b, e. concave scraper; c, f. chopper

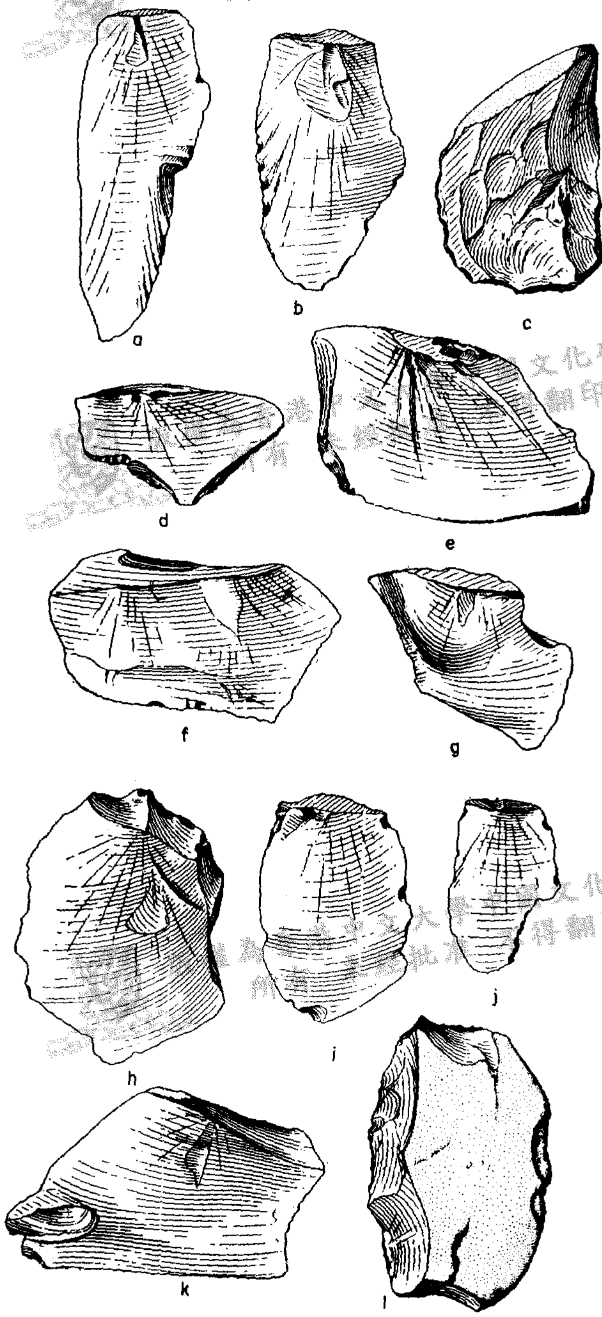

Figure 7. Characteristic artifact types in Early Palaeolithic assembalges from Miaohoushan (after Museum of Liaoning Province 1986). a–b, i–j. hammer-struck flakes; c. percussion-struck flake; d–g, k. anvil-struck flake; h, l. chopper

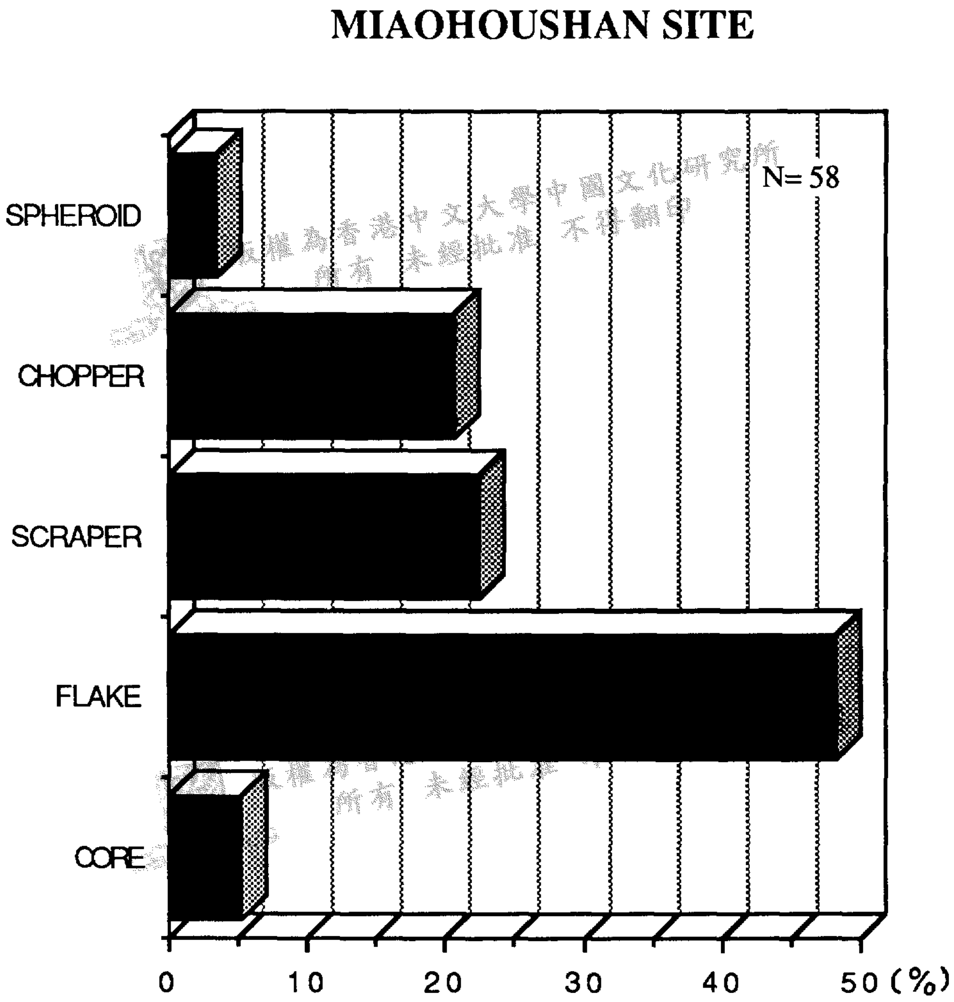

Figure 8. The frequency distribution of artifact types in Early Palaeolithic assemblage from Miaohoushan (Museum of Liaoning Province 1986)

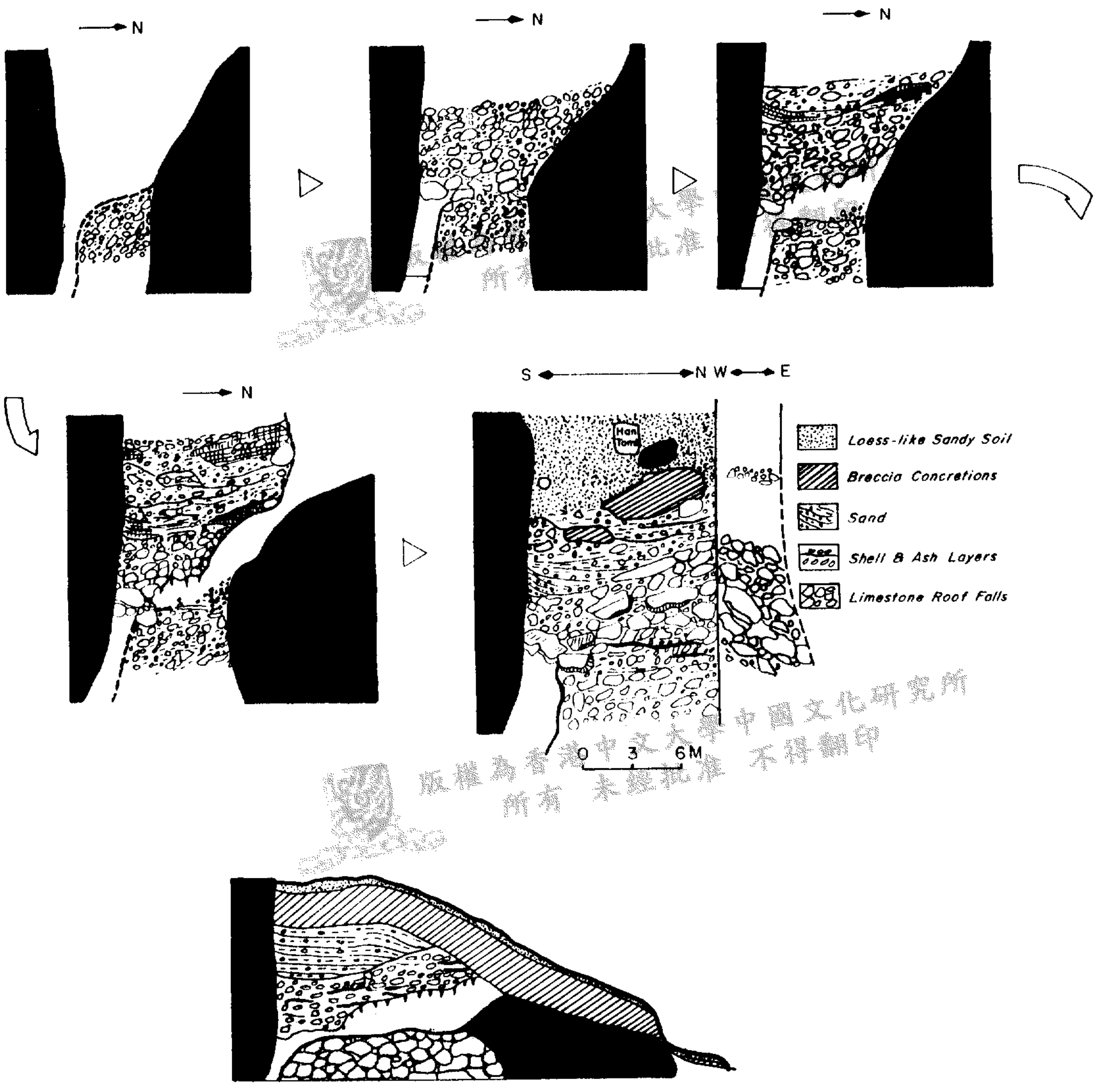

Figure 9. Vertical sections showing stages in the formation of Jinniushan cave and their fossiferous deposits (Huang *et al.* 1987)

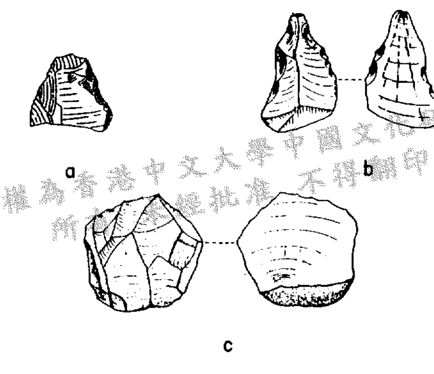

Figure 10. Jinniushan archaic *Homo sapiens* skull and limb bones were found *in situ* (courtesy of Lu Zun E) and artifact types (after Archaeological United Team 1978). a. single straight scraper; b. double scraper; c. semilunar scraper

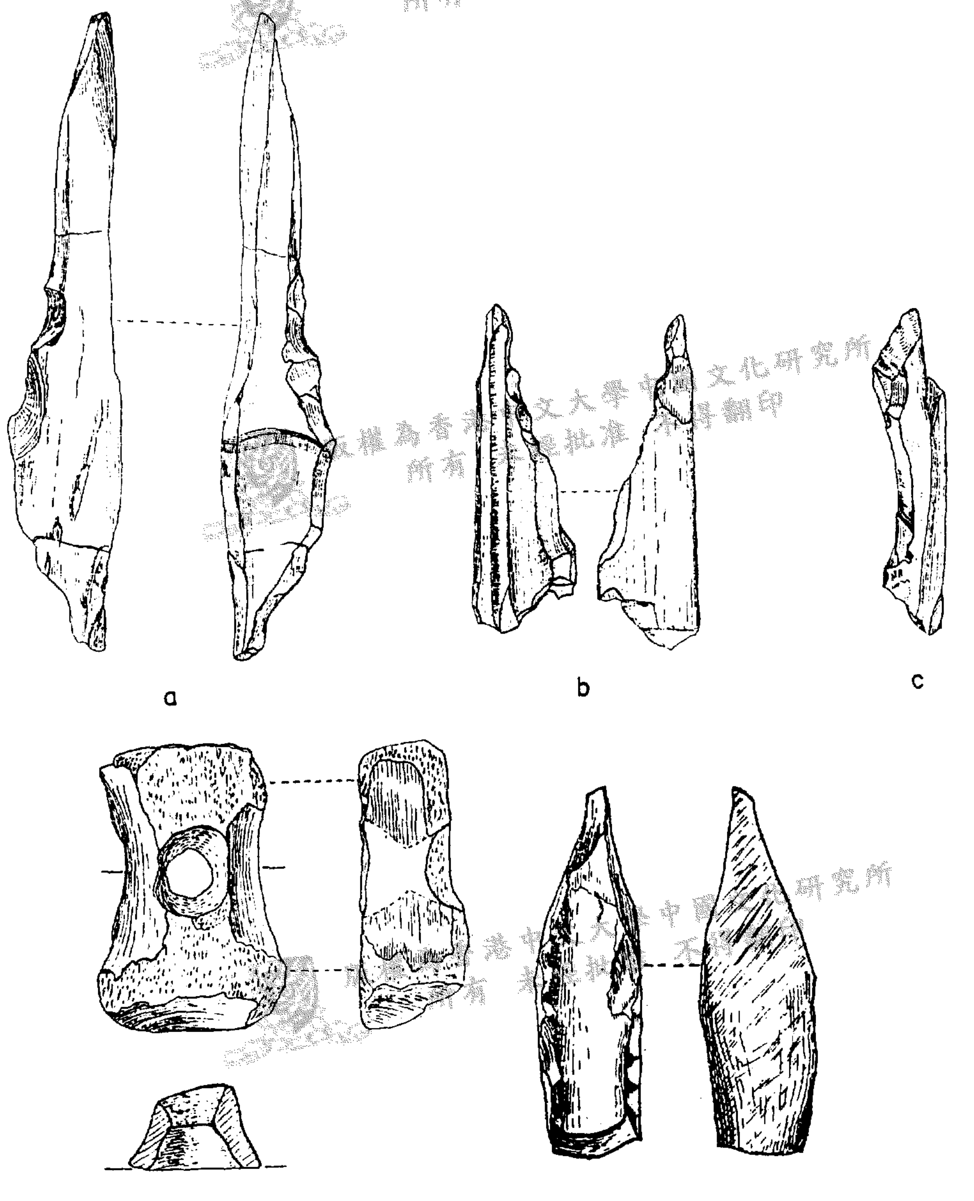

Figure 11. Bone tools from Jinniushan Locality C (after Archaeological United Team 1978).
a–c. early occupation; d–e. late occupation

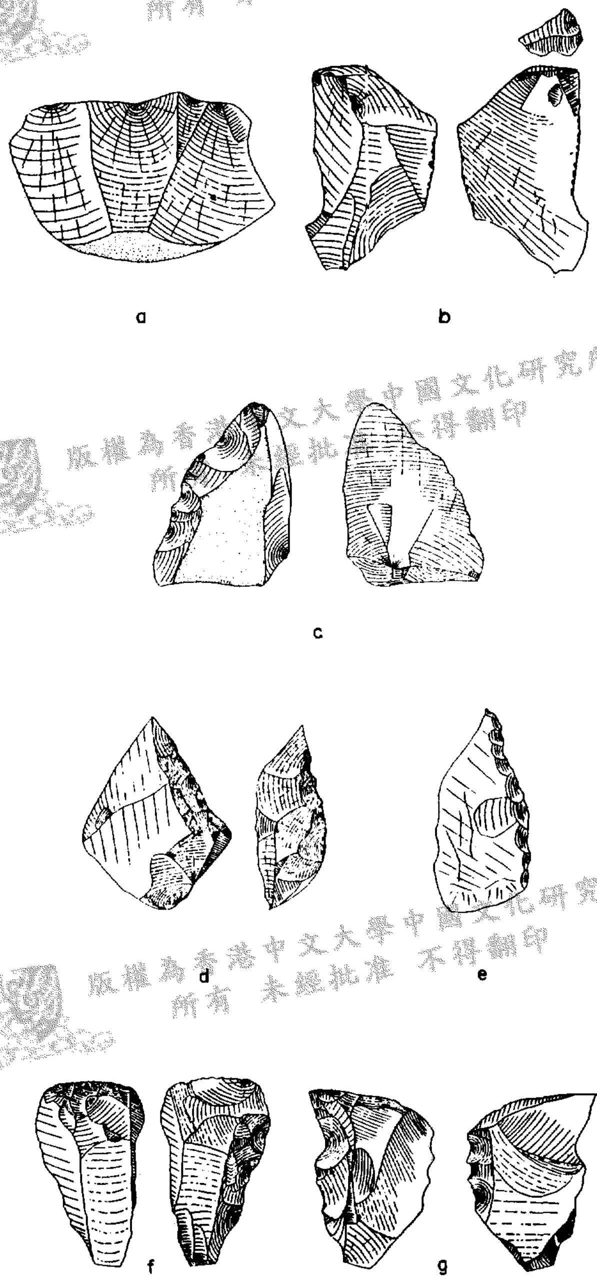

Figure 12. Artifact types in the Middle Palaeolithic assemblage from Gezidong (after Archaeological Team of Provincial Museum of Liaoning and IVPP 1975). a. core; b. utilized flake; c. single convex scraper; d, e. single straight scraper; f. double scraper; g. pointed tool

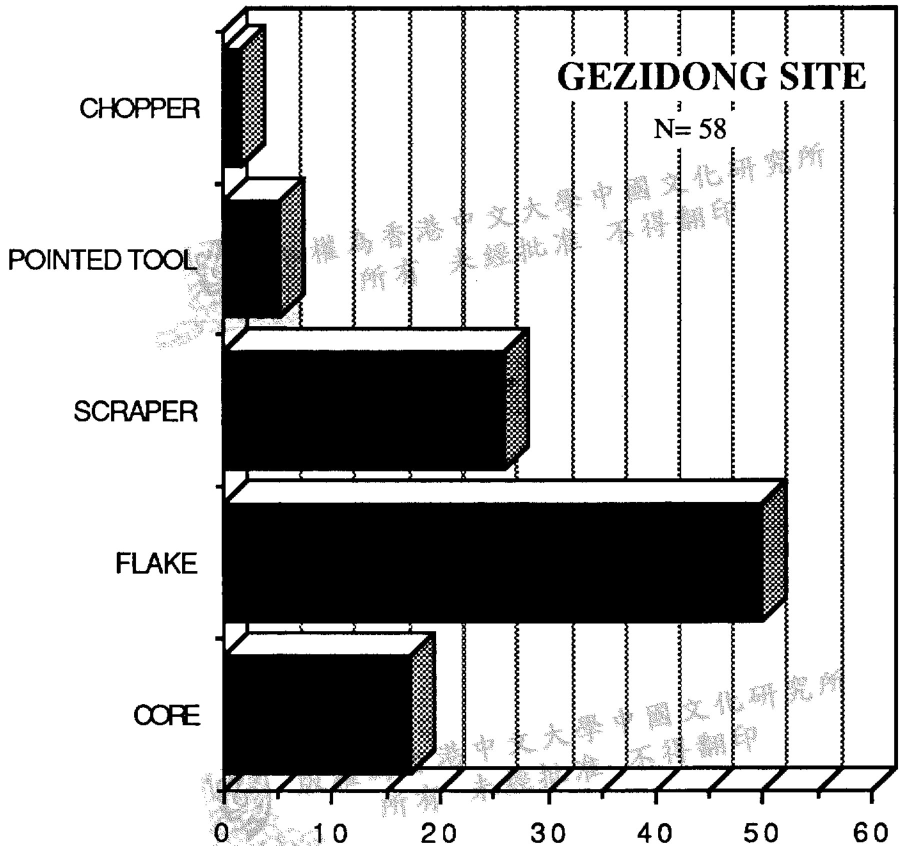

Figure 13. The frequency distribution of artifact types in Middle Palaeolithic assemblage from Gezidong (after Archaeological Team of Provincial Museum of Liaoning and IVPP 1975)

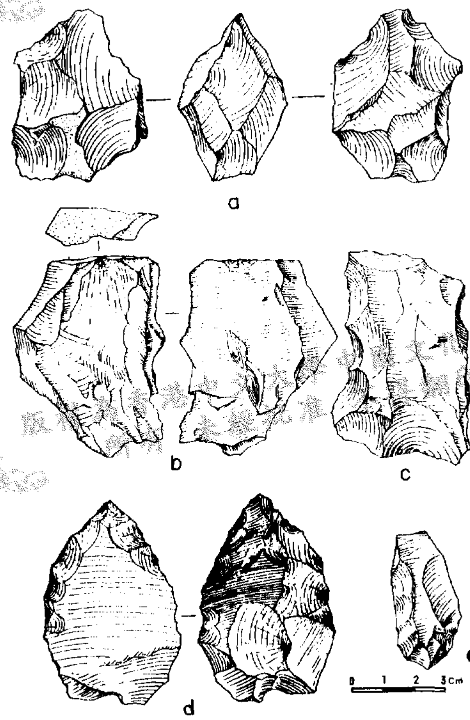

Figure 14. Artifact types in the Late Palaeolithic assemblage from Zhoujiayoufang (after Sun *et al.* 1981)

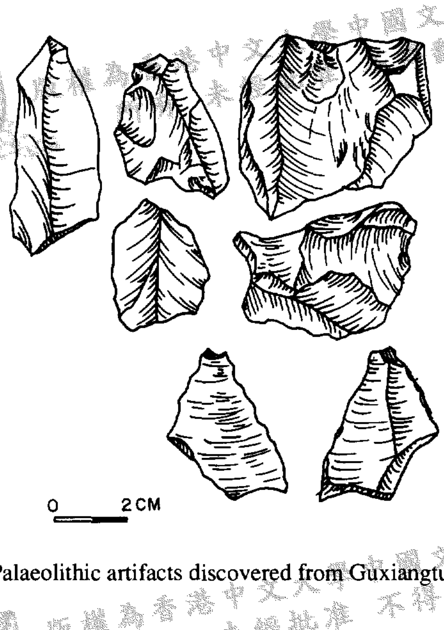

Figure 15. Late Palaeolithic artifacts discovered from Guxiangtun (after Sun 1983)

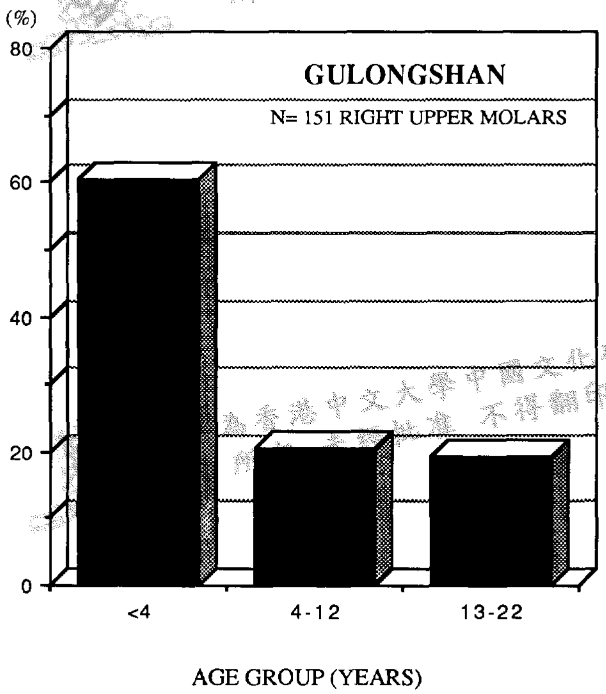

Figure 16. Age profile estimated from upper molars of horses from Gulongshan (You *et al.* 1985)

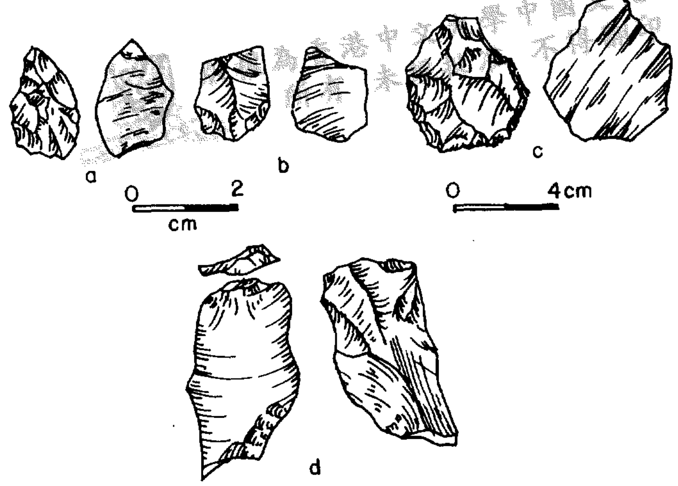

Figure 17. Artifact types in the Late Palaeolithic assemblages from Huangshan (after Sun 1983).
a. pointed tool; b, c. round scrapers; d. flakes

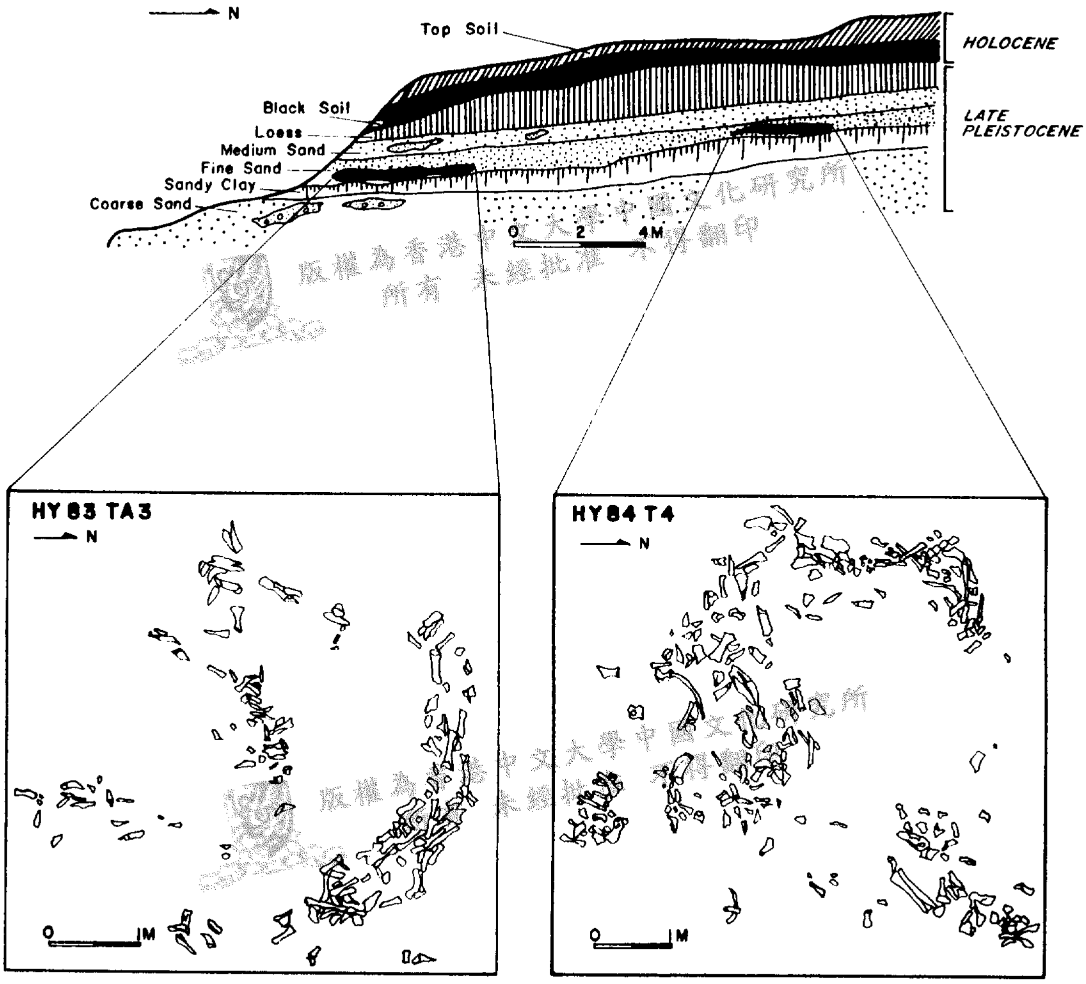

Figure 18. Stratigraphic profile and planview of two bone-accumulated structures of Yanjiagang site (after Yu and You 1988)

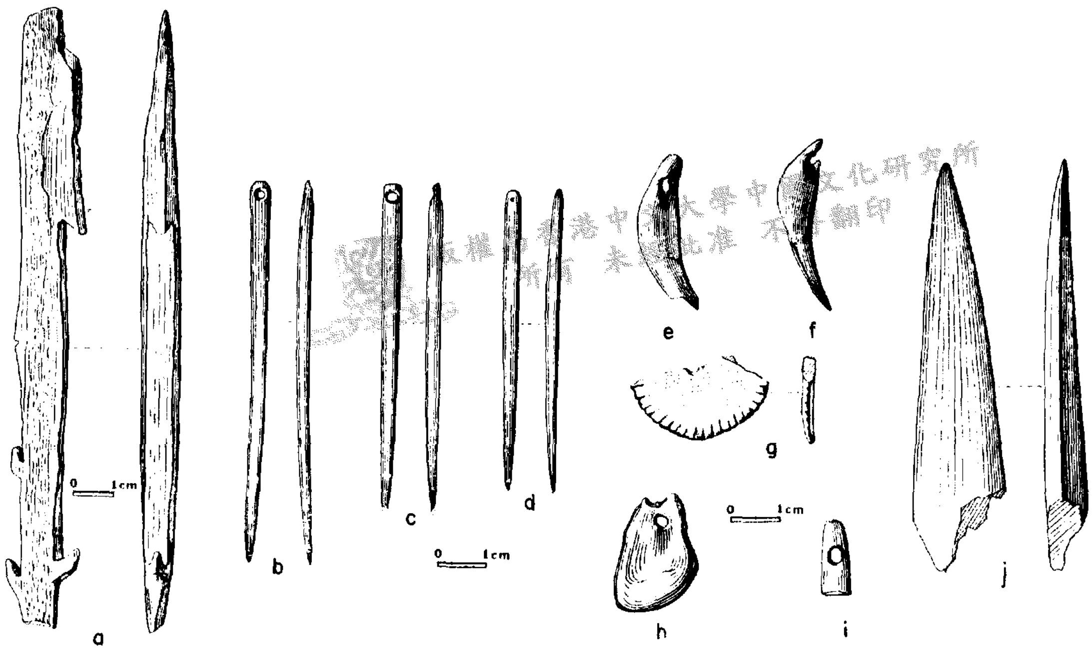

Figure 19. Harpoon (a), bone needles (b–d), perforated teeth (e–f, h–i), engraved shell (g) and bone point (j) from Xiaogushan (after Huang *et al.* 1986)

Figure 20. Single scraper and core discovered from Xiaonanshan locality (after Yang 1981)

Figure 21. Characteristic artifact types in the Late Palaeolithic assemblages from Shibazhan (after Zhang 1981). a. tongue-shaped microblade; b, h. wedge-shaped core; c. convex scraper; d. core; e. single straight scraper; f. core; g. semilunar scraper; i. scraper

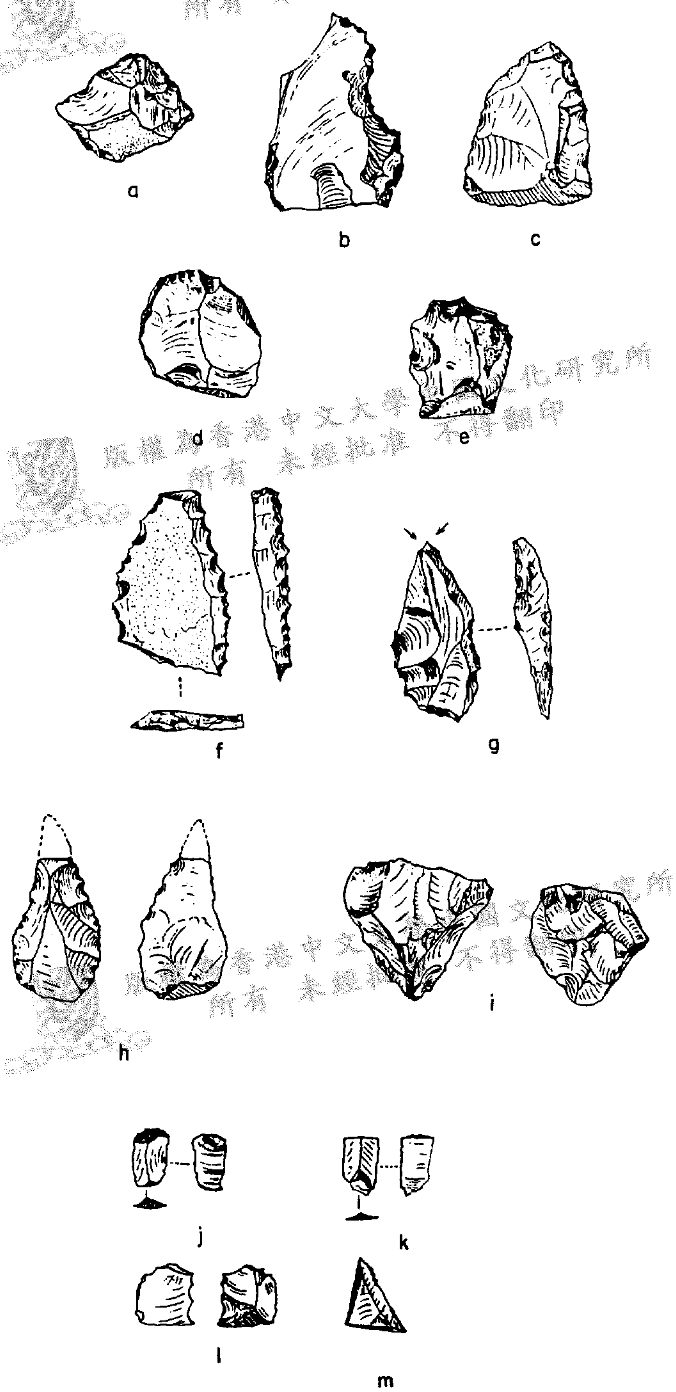

Figure 22. Characteristic artifact types in the Late Palaeolithic assemblage from Shibajianfang (after Zhang 1981). a–e. scrapers; f–g. backed flakes; h. pointed tool; i. core; j–m. flakes

Table 1. Pleistocene fossil mammals of northeast China

Taxon	Sites* 1	2	3	4	5	6	7	8	9	10
INSECTIVORA										
Erinaceus europaeus									x	
Erinaceus olgae			x							
Crocidura lasiura	x					x				
Neomys sp.		x								
Sorex cylindricauda					x					
Scaptochirus moschatus	x					x				
Mogera sp.					x					
Miniopterus cf. *schrebersi*	x									
Murina cf. *leucogaster*	x									
Myotis sp.					x		x			
Rhinolophus pleistocanicus					x					
Rhinololhus ferrum-equinum					x					
Hipposideros sp.					x				x	
PRIMATES										
Macaca robustus	x	x	x							
LAGOMORPHA										
Lepus europaeus					x					
Lepus wongi	x	x								
Lepus sp.				x	x			x	x	
Ochotona daurica				x	x				x	
Ochotona koslowi	x								x	
Ochotona sp.							x		x	
RODENTIA										
Citellus sp.									x	
Citellus cf. *mongolicus*						x				
Marmota robustus	x		x					x		
Marmota bobak					x					
Sinocastor anderssoni	x									
Sinocastor zdanskyi	x									
Sinocastor sp.		x								
Trogontherium cf. *cuvieri*		x								
Cricetulus cf. *griseus*	x						x			
Cricetulus cf. *varians*	x		x			x	x			
Cricetulus cf. *barabensis*						x				
Cricetulus sp.				x	x	x				
Myospalas armandi					x			x	x	
Myospalas psilurus		x				x		x	x	
Myospalas fontanieri	x				x		x	x	x	
Myospalas minor					x					
Myospalas sp.				x		x			x	
Microtus brandtoides	x							x		

Table 1. Pleistocene fossil mammals of northeast China (*Contd*)

	Sites*									
Taxon	1	2	3	4	5	6	7	8	9	10
Microtus epiratticeps	x	x		x	x		x			
Microtus sp.				x		x				x
Apodenus sylvaticus					x					
Mus musculus										x
Rattus sp.				x	x	x	x			x
Hystrix lagrelii		x		x						
Hystrix sp.					x					
CANIVORA										
Canis lupus			x		x		x	x	x	x
Canis variabilis	x	x								x
Nyctereutes sinensis		x	x		x		x	x		x
Vulpes corsac			x	x	x		x	x	x	x
Cuon cf. *alpinus*	x							x		x
Cuon dubius	x									
Cuon sp.		x					x			x
Ursus arctos	x	x		x	x	x	x			x
Ursus spelaeus					x		x			
Ursus sp.									x	x
Martes anderssoni	x									
Martes sinensis	x									
Mustela altaica	x					x				
Mustela sibirica	x	x				x	x	x	x	
Mustela eversmanni					x					x
Mustela contricta	x									
Meles meles leucurus	x		x		x	x	x			
Meles cf. *meles leptorynchus*					x					x
Meles sp.									x	x
Lutra sp.							x			x
Hyaena sienesis	x	x								
Crocuta ultima	x			x	x	x	x	x	x	x
Homotherium ultima	x	x								
Felis chinensis	x			x						
Felis cf. *microtus*									x	x
Lynx lynx				x			x		x	x
Panthera youngi	x	x	x							
Panthera tigris				x			x			x
Panthera pardus				x						x
Acinonyx pleistocaenicus	x									
Acinonyx sp.							x			x
PROBOSCIDEA										
Mammuthus primigenius							x	x		x
PERISSODACTYLA										

Table 1. Pleistocene fossil mammals of northeast China (*Contd*)

	Sites*									
Taxon	1	2	3	4	5	6	7	8	9	10
Equus hemionus				x				x		x
Equus przewalskyi				x	x	x	x	x	x	x
Equus sanmeniensis	x	x					x			
Dicerorhinus kirchbergensis	x	x	x				x			
Coelodonta antiquitatis				x		x	x	x		x
ARTIODACTYLA										
Ssu lydekkeri	x	x								
Sus scrofa			x		x		x	x	x	x
Moschus moschiferus					x					
Moschus moschus var. *pekinensis*	x		x		x		x			
Moschus moschus plicodon					x					
Megaloceros pachyosteus	x	x								
Megaloceros ordosianus					x		x	x		x
Cervus sp.					x					x
Cervus unicolor	x		x							
Cervus grayi	x	x		x	x					
Cervus manchuricus										x
Cervus canadensis	x						x	x		x
Cervus xanthopygus					x					
Alces alces								x	x	
Hydropotes inermis var. *pleistocenica*					x	x				
Capreolus manchuricus		x	x		x	x				x
Spirocerus kiakhtensis					x	x				x
Gazella przewalskyi				x	x	x	x	x		x
Pachygazella sp.					x		x			
Capra sp.					x					
Nemorrhaedus goral					x	x	x			
Pseudois cf. *nayaur*				x						
Bubalus wansjocki					x	x		x		x
Bubalus teilhardi	x									
Bubalus bubalus	x									x
Bison (Parabison) exiguus								x		
Bison sp.		x								
Bos taurus										x
Bos primigenius										x

(from Museum of Liaoning Province and Museum of Benxi City 1986)

*Sites: 1. Miaohoushan 2. Jinniushan 3. Anping 4. Gezidong
5. Shanchenzi 6. Upper Jinniushan 7. Xiaogushan 8. Yanjiagang
9. Qianyang 10. Gulongshan

Table 2. Pleistocene climatic phases and vegetation patterns of northeast China based on pollen record (Xia and Wang 1987)

Epoch	Pollen zones	Pollen assemblages	Climatic phases	Dominant vegetation
Upper Pleistocene	XIII	Artemisia-Chenopodiaceae-Gramineae (Ephedra and Lycopodium)	Cold and dry	Periglacial steppe
		Pinus-Betula-Artemisia (Ulmus and Coryius)	Warm, cold and subhumid	Meadow steppe
	XII	Pinus-Picea-Selaginella-Fern spore	Cold and humid	Temperate parkland
	XI	Artemisia-Chenopodiaceae-Polypodiaceae	Cold and dry	Steppe
Middle Pleistocene	X	Pinus-Betula-Salix-Gramineae	Warm and subhumid	Woodland and steppe
	IX	Pinus-Picea-Chenopodiaceae-Gramineae	Cold and humid	Dark coniferous forest and steppe
	VIII	Pinus-Betula-Ulmus-Compositae	Warm and subhumid	Broad-leaved woodland, parkland
	VII	Ephedra-Tamarix-Chenopodiaceae	Cold and dry	Steppe
Lower Pleistocene	VI	Picea-Salix-Polygonum (Betula-Ulmus-Quercus)	Warm and subhumid	Broad-leaved woodland
	V	Betula-Artemisia-Gramineae	Warm, cold and subdry	Steppe
	IV	Artemisia-Compositae-Chenopodiaceae	Cold and dry	Woodland

Table 3. Anatomical parts of Jinniushan archaic *Homo sapiens* (Huang 1985)

Anatomical parts	Side	Numbers
Skull		1
Vertebrae		
cervical		1
thoracic		4
Ribs	?	2
Ulna	L	1
Carpals		
capitate	L	1
lunate	L+R	2
triquetrum	L	1
scaphoid	L	1
trapezium	R	1
trapezoid	R	1
hamate	R	1
pisiform	R	1
Third metacarpal	L+R	2
Proximal phalanges		4
Metaphalanges		2
Distal phalanges		1
Coccyx	L	1
Patella	L	1
Tarsals		
calcaneus	L	1
cunieform (1, 3)	L	2
cuboid	L	1
Metatarsal (1, 2)	L	2
Distal phalanges	L	6
Medial phalanges	L	1

Table 4. Metric measurements (mm) of Jinniushan archaic *Homo sapiens*

	Lu (1989)	Wu (1988)
g-op (L)	207	206
(W)	148	148
L/W	72.0	71.8
ba-b	123	123
L/H	59.4	59.7
W/H	82.6	83.1
g-g (op)	597	603
po-po (b)	302	308
n-o	363	362
i-i	58	59.2
i-o	40	39.3
n-pr	74.2	74.2
zy-zy	148	148
n-pr<FH	89	89
n-ns<FH	86	86
Cranial capacity (cc)	1,335	1,400
Thickness of		
Frontal squama	5.0	5.0
Parietal tuberosity	6.5	6.0
Cerebellum	3.0	
Temporal squama	6.0	4.0
Thickness of browridge		
Lateral	13.8	13.8
Central	11.4	10.4
Internal	14.5	14.3
Malar height	50, 48	51, 48
Orbital width (mf-ek)	50	52
Height	36	35
W/H	72	67.3
Occipital foramen		
L	50.7	
W	34.5	
Dental arch length (pr-alv)	61	
Dental arch width	67.8	
Radius		
Maximum length	260	
Ulna		
Length	260	
Width	22, 14.2, 21.4	
Longitudinal crest arc	37.2	

Table 5. Tooth and upper limb measurements (mm) of *Homo erectus* (?) and *Homo sapiens* from northeast China

Site	Length	Width	Thickness
MIAOHOUSHAN			
Canine (BSM 7802-T6-2)			
Crown		8.7	
Root	15.7		
Right lower molar (BSM 8001-T9-1)	11.56	10.80	
Femur (BSM 8301-T7-1)			240
DONGDONG			
Radius	170.8		
ANTU			
Right first lower premolar (Field cat. No. 501)			
Crown	6.9	7.1	4.0
Root	16.0		
JIANPING			
Humerus	255		

Table 6. Faunal species list from different stratigraphic units of Miaohoushan

	Units					
Taxon	9	8	7	6	5	4
INSECTIVORA						
Crocidura wongi				x		
Miniopterus cf. *schreberii*					x	
Pipistrellus sp.					x	
CHIROPTERA						
Murina cf. *leucogaster*					x	
PRIMATES						
Macaca robustus Young					x	
Homo erectus					x	
Homo sapiens				x		
LAGOMORPHA						
Lepus wongi					x	
Ochotona koslowi					x	
Ochotona daurica		x				
Marmota complicidens Young		x		x		
Sinocastor zdanskyi					x	
Sinocastor anderssoni					x	
Cricetulus varians zdansky			x			x
Cricetulus cf. *grisens*			x			
Clethrionomys rofucanus					x	
Microtus brandtioides					x	
Microtus epiratticeps		x				
Myospalax fontanieri		x	x			
CANIVORA						
Canis variabilis					x	
Nystereutes sinensis	x					
Cuon dubius					x	
Ursus arctos					x	
Meles cf. *leucurus*		x	x			
Meles chiai					x	
Mustela cf. *sibirica*		x	x			
Hyaena sinensis				x	x	
Crocuta ultima		x		x		
Homotherium cf. *crenatiders*					x	
Panthera cf. *tigris*		x				
Panthera youngi					x	
Acinonyx sp.					x	
Felis chinensis		x				
Martes sp.	x					
PERISSODACTYLA						
Dicerorhinus mercki				x	x	x
Equus przewalskyi		x				

Table 6. Faunal species list from different stratigraphic units of Miaohoushan (*Contd*)

Taxon	Units 9	8	7	6	5	4
Equus sanmeniensis				x	x	x
ARTIODACTYLA						
Cervus grayi		x				
Cervus canadensis				x		
Cervus unicolor					x	
Megaloceros pachyosteus				x	x	x
Megaloceros ordosianus		x				
Hydropotes inermis var. *pleistocenica*		x		x		
Bubalus sp.			x		x	
Bubalus wansjocki			x			
Bison sp.		x				
Capra sp.		x				
Gazella przewalskyi		x				
Capreolus manchuricus		x				

(from Museum of Liaoning Province and Museum of Benxi City 1986)

Table 7. Different uses of raw materials for lithic artifacts at levels 4–6 of Miaohoushan site

	Primary artifact category					
Raw material type	Cores	Flakes	Scrapers	Choppers	Spheroids	Total
Quartz sandstone	3	27	12	9	1	52
Andesite	–	1	1	3	–	5
Quartzite	–	–	–	–	1	1
Total	3	28	13	12	2	58

(Source: Museum of Benxi City and Museum of Liaoning Province 1986)

Table 8A. Faunal species list from different localities of Zhoujiayoufang

	Tested localities					
Taxon	1	4	5	6	2	7
LAGOMORPHA						
Myospalax psilulus M-Edwards	x				x	
CARNIVORA						
Crocuta ultima Matsumoto	x					
Panthera tigris Linnaeus	x				x	
PROBOSCIDEA						
Mammuthus primigenius	x				x	
Mammuthus sungari	x					
PERISSODACTYLA						
Equus przewalskyi Poliakov	x				x	
ARTIODACTYLA						
Coelodonta antiquitatis	x				x	
Capreolus manchuricas	x					
Alces alces	x					
Bison exiguus Matsumoto	x					
Bos primigenius	x				x	
Gazella przewalskyi					x	

(Source: Sun *et al.* 1981)

Table 8B. Lithic artifact counts from different localities of Zhoujiayoufang

	Tested localities					
Lithic category	1	4	5	6	2	7
Disc core	1					
Prismatic core	1					
Flakes	4					
Debitage	9					
Bone tools	8	7			3	10

(Source: Sun *et al.* 1981)

Table 9A. Faunal assemblages of Angangxi, Qiqihaer

Taxon	1981, 1982	1986
LAGOMORPHA		
Lepus sp.	x	
Ochotona daurica	x	
RODENTIA		
Citellus cf. *mongolicus*	x	
Cricetulus cf. *griscus*	x	
Microtus epiratticeps	x	
PERISSODACTYLA		
Equus prezwalskyi	x	
Equus sp.	x	x
ARTIODACTYLA		
Bison (Parabison) *exiguus*	x	
? *Bos* sp.	x	
Bovidae		x
Cervus sp.		x
Muntiacus sp.		x

(Source: Huang *et al.* 1984; Gao 1988)

Table 9B. Lithic assemblages of Angangxi, Qiqihaer

	Numbers	
Lithic category	1981, 1982	1986
Cores		
hammer-struck	5	7
anvil-struck	2	
indirect percussion	1	
Flakes		
hammer-struck	39	19
bipolar	2	8
broken		17
Chopper	1	
Scraper	9	5
Burin	9	3
Microblade point		1
Total	68	60

(Source: Huang *et al.* 1984; Gao 1988)

中國東北地區更新世中期及晚期的適應模式

（中文摘要）

何傳坤　　姜　鵬

中國東北地區對研討舊石器中期及晚期的採獵古人類向高緯度地區適應模式具有關鍵性的作用。本文以區域研究的觀點將1949年以前外國舊石器考古學家所發表的文獻予以重新考察，而且將近二十年以來中國舊石器考古學家所發現的資料作一初步的整合分析。本文在描述了位於不同古環境及不同時期的舊石器遺址或是地點之後，發現東北地區所出土的古人類化石及舊石器技術叢與華北地區不但關係密切而且也呈現出區域的連續性。