THE MOVIUS LINE: FACT OR FICTION?

Susan G. Keates

Institute of Biological Anthropology, University of Oxford, 58 Banbury Road, Oxford OX2 6QS, England

ABSTRACT

The debate about whether or not the Movius Line is a realistic representation of differences in stone tool technology between Western and Eastern Asia has been revived because of recent discoveries of bifaces in China, Korea and Japan. This paper reviews some of the pertinent artefactual and chronological evidence from Eastern Asia.

The Movius Line (Coon 1966:48) is thought to demarcate a geographic and cultural boundary between Acheulean (handaxe and cleaver) and non-Acheulean (chopper/chopping-tool) technologies (Movius 1944, 1949). It is important to remember that this hypothesis was developed at a time when far less was known of lithic assemblage variability in Eastern Asia (East and Southeast Asia) than is known now. Based on contemporary data, flake tools appear to be the characteristic tools rather than choppers or chopping-tools, although several authors have noted that Eastern Asian Palaeolithic technology continues to be classified as a chopper chopping-tool technology (e.g., Mulvaney 1970; Ikawa-Smith 1978; Yi and Clark 1983; Zhang 1985; Keates 1994, 1995, 1997). The belief that an absence of Acheulean bifaces in Eastern Asia denotes behavioural inferiority compared to regions where these do occur has persisted in the literature since Movius' (1944, 1949) examination of local artefact assemblages and collections. Lithic technology was interpreted as increasing in complexity west of the Movius line, while east of this hypothetical line a record of conservative, unspecialised and 'non-progressive' core artefacts was to be found (Movius 1944:101, 1949:408, 411; see also Teilhard 1941:60, 86; Sieveking 1960; Coon 1962:48; Heekeren 1972:76; contra, e.g., Bryan 1983; Pope 1988; Pope and Keates 1994).

This assumes that only standardised technologies producing symmetrical (and diagnostic) artefacts such as Acheulean bifaces (handaxes) are representative of advanced hominid behaviour. There is some recognition of this assumption in China and abroad (e.g., Huang 1987; Huang and Qi 1987; Renfrew and Bahn 1991:384; Hou *et al.* 2000), but bifaces are very rare artefacts in the Chinese Palaeolithic (Pope 1982:179; Keates 1994; and see Zhang 1985, 1989; An 1990) and no Acheulean assemblages have been discovered (Zhang 1985, 1989; Pope 1988; Pope and Keates 1994; and see Pei 1965; Aigner 1981). Yi and Clark (1983:190) proposed that the presence of handaxes in northeast Asia "allows us to reject conclusively the notion of a relatively homogeneous chopper-chopping-tool area". While this statement is to some extent true, especially in view of the greater exploitation of flake rather than core tools in the region, it is important to consider the number of bifaces compared to other artefacts in the individual assemblages.

It is also pertinent to carefully evaluate the depositionary context and chronology of bifaces in order to study claims of early Pleistocene age and to monitor any temporal changes in their frequency. Huang (1987) claims that the majority of Chinese bifaces are Middle Pleistocene artefacts, but most specimens are surface discoveries (Pope and Keates 1994). Biface localities are most concentrated in central China (An 1990), for example in the Fenhe (Fen river) Valley, and less so in the south of North China and in the southern region of South China (and see Huang 1987).

A further point needs to be raised. As a result of recent radiometric dating of early hominid specimens from Java, it has been suggested that the Acheulean did not become established in Eastern Asia because hominids migrated from Africa to Eastern Asia prior to the development of the Acheulean at 1.4 mya (Swisher *et al.* 1994). However, the earliest known bifaces, from the Natoo Formation in East Africa, are dated to about 1.65 mya (million years; Roche 1995; Roche and Kibunjia 1994). Leaving aside the issue of the controversial dating by Swisher *et al.* (1994; see Keates 1998 for a review), their opinion ignores the palaeo-environmental circumstances which pertained in Eastern

Asia. These need to be considered in interpretations of hominid behaviour in this (or any other) region (see, e.g., Ikawa-Smith 1978; Pope 1988; Keates 1998). It also presumes that early *Homo erectus* migrated only once from Africa to the East and that biface technology cannot develop independently.

WHAT IS A BIFACE? WHAT IS A HANDAXE?

In discussions about bifacial artefacts it is necessary to include a review of the literature because the terms biface and handaxe are often used interchangeably to refer to the same kind of artefact type. Leakey (1971) uses the term biface at Olduvai in preference to handaxe because it can describe a wider rage of specimens. Other authors refer to the Olduvai bifaces as both handaxes and cleavers (e.g., Roe 1994:149), while Inizan *et al.* (1992) use the term Acheulean biface to refer to artefacts of handaxe morphology. It has also been pointed out that the bifaces in Developed Oldowan B assemblages (Middle and Upper Bed II) "... differ from the Acheulean bifaces by being more variable in morphology within each site ,... " (Jones 1994:261).

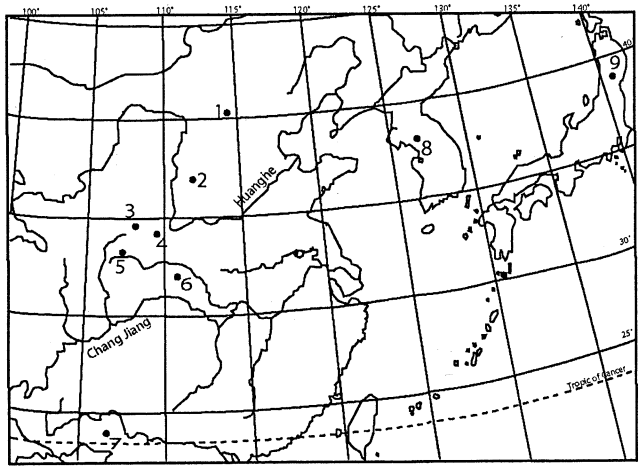
Chinese workers also vary in their terminology for bifaces. Hou *et al.* (2000:1622) refer to "Acheulean bifacial handaxes" and, in the same paper, also to "Acheulean-like tools" found at the Bose localities in southern China. This terminology of Acheulean artefacts is inconsistent and confusing, and, moreover, handaxes are by definition bifacial. An artefact from Liangshan (Shaanxi province) is described as a handaxe by Huang and Qi (1987) in the Chinese text and as a biface in the English abstract, while An (1990) identifies bifaces in China as primary (*yuán*, also meaning original/ primitive) handaxes in the Chinese text and as proto-handaxes in the English abstract. An (1990) defines proto-handaxes as bifaces, unifaces and also those specimens with a triangular cross-section, also called heavy trihedral points by other authors (e.g., Qiu 1985; Wang *et al.* 1994). Li *et al.* (1998) refer to two bifaces from Yunxian (Hubei province) as bifacially pointed cobble tools, one of which they compare to a partial handaxe. According to Li (1997), if a rigorous standard is applied, one and not several specimens can be classified as a handaxe at Dingcun (Shanxi province). In island southeast Asia two kinds of bifaces have been distinguished by Keates and Bartstra (2001): pointed partial bifaces and pointed bifaces. Most of the former derive from southwest Sulawesi and one specimen is from southwest Halmahera, while the latter are mostly from Java. The pointed partial bifaces resemble less extensively flaked bifaces from several localities in China and Africa, while the more extensively modified pointed bifaces show some similarities to Acheulean bifaces.

The terminology applied to bifaces reflects variations in biface morphology and variations in lithic classification of different authors. From this short review it is apparent that further comparisons of bifaces from the various Eastern Asian localities and from Africa and Europe are necessary if we are to achieve a standardised definition of bifaces and handaxes, and thus promote clearer communication between researchers. For now, I would propose to refer to bifaces which conform to the classic symmetrical Acheulean morphology as Acheulean bifaces, while those which do not should be called bifaces.

EAST ASIA

China

Bifaces in China are either single occurrences or, in most cases, occur in low frequencies. Examples (Figure 1) include a bifacially flaked pointed specimen from Liangshan, in the upper reaches of the Han river in Shaanxi province (Huang 1989). This bifacially flaked pointed specimen can also be described as a pick (see Huang 1989, Figure 8). Another biface from the Liangshan area is compared to bifaces from Olduvai Gorge in East Africa (Huang and Qi 1987). Liangshan is thought to date to the Middle Pleistocene (Huang 1989), but no radiometric dates are available. Two bifaces were recovered from the Qianxian and Laochihe localities in Shaanxi province (Figure 1), the former found on the loess surface and the latter perhaps derived from a Middle Pleistocene deposit (Huang 1987, 1989: Figures 5 and 2). These specimens show more extensive flaking than some others referred to as bifaces, and are examples of the wide range of morphological variation of bifaces in Eastern Asia. Of the five proto-handaxes from Hunan province illustrated by An (1990), one represents a biface, while the other specimens resemble picks in their less extensive modification



1. Donggutuo; 2. Dingcun; 3. Qianxian; 4. Laochihe and Pingliang; 5. Liangshan; 6. Yunxian; 7. Bose; 8. Chongok-Ri and Kumpari; 9, Kamitakamori and Sodehara.

Figure 1: Some localities in East Asia with bifaces.

and general morphology. Two bifaces from the Middle Pleistocene Yunxian hominid fossil locality (Figure 1) are surface discoveries, one of which with its pointed and partially flaked morphology could be called a pick, while the second specimen can be classified as a biface (see Figures 18, 19 and Plate I, 2a, b in Li *et al.* 1998). There are also a number of localities in central China where bifaces have been found more recently, and which may date to the Late Pleistocene (Wei Qi pers. comm. 1999; Wang Youping pers. comm. 1999).

The earliest bifaces from China, one of which could be compared to a handaxe, derive from Donggutuo (locality T1), a late Early Pleistocene (at least 1 mya) open-air locality in the Nihewan Basin, northern China (Keates 1995, 2000a; Pope and Keates 1994:Figure 1). The Donggutuo specimens are two pointed bifaces of small dimensions (49 x 42 x 19 mm and 63 x 40 x 33 mm) and in chert (Keates 1995, 2000a:Figure 62:5, 6). A large pointed biface in quartzite (170 x 90 x 62 mm) from Pingliang, a locality 2 km east of the hominid locality of Lantian, Shaanxi province, central China (Tai 1966; see, e.g., Zhang 1985, Figure 9.3 A) (Figure 1) is thought to derive from the same red clay layer as the Gongwangling *Homo erectus* and other artefacts (Tai 1966). This would date the specimen to *c.* 1 mya (Wei 1995), but it appears not to have been excavated from the deposit (see Tai 1966) and it seems unclear if it was a surface find or if it was found in direct association with the red clay (see Zhang 1985, 1989; Keates 1995), although Huang and Hou (1997) argue that it was found *in situ*. The Pingliang biface has also been classified as a protobiface or pointed chopper (Zhang 1985, 1989), as a 'partial biface' (Freeman 1977:100), and as "... (a quartzite biface resembling an early Acheulian handaxe from Africa)..." (Clark and Schick 1988:443). Huang and Hou (1997:4) refer to the specimen as "A handaxe ... showing Acheulian affinity, [which] may be the oldest handaxe reported from East Asia ...".

Bifaces have also been recovered from the river terrace localities of Bose (also: Baise) in western Guangxi Zhuang Autonomous Region, southern China (Figure 1). Archaeological investigations of the Youjiang river terraces since 1973 (Li and You 1975) have found flakes, choppers, chopping-tools, bifaces and other lithic artefacts (Huang *et al.* 1988, 1990; Huang Weiwen pers. comm. 1989). Artefacts were discovered in terrace III (Huang 1989). The majority of the Bose artefacts collected from about 100 localities (n > 6,000) are surface finds (Huang and Hou 1997). The artefact bearing portion is the upper part of Terrace IV (there are a total of seven river terraces) which has also produced tektites (Yuan *et al.* 1999). This upper part is formed of laterised soil and clay and shows evidence of widespread faulting producing several platforms (Yuan *et al.* 1999; Hou *et al.* 2000). The upper part of terrace IV is 7-10 m thick and artefacts occur with tektites within 0.2-1 m soil thickness (Hou *et al.* 2000). The lower part is basal gravel (Yuan *et al.* 1999). At the Lakui locality artefacts were found in reworked sediments and considered to be contemporary, being found *in situ* in the gravel and also distributed over four of the faulted platforms (Yuan *et al.* 1999). The Bose artefacts were manufactured in quartzite, quartz, sandstone and other materials (Huang and Hou 1997).

In excess of 100 bifaces had been found up to 1989 in the Bose area and all bifaces were surface finds (Huang Weiwen pers. comm. 1989). Some years later Huang and Hou (1997) refer to "More than 100 handaxes ..." from Bose, i.e., the frequency established in 1989. After enquiries as to how many of these artefacts could be classified as handaxes, it was found that there were less than about four, with other bifaces perhaps best described as picks, choppers and chopping-tools (pers. observ.; see, for example, Huang and You 1997:Figure 7). One of the bifaces recovered from Bose resembles an Acheulean handaxe (Keates 1996) and was found on the surface (Huang Weiwen pers. comm; Keates 1996). Huang Weiwen (pers. comm. 1999) has stated that "The handaxes from [the] Bose sites are similar with Western Acheulean [handaxes] technologically and typologically." There are few illustrations in the literature of the Bose handaxes, and those which have been published are repeatedly shown (*cf.*, Huang 1992:Figure 273:3; Huang and Wang 1995:Figure 9; Huang and Hou 1997:Figure 7). It is conceivable, based on this author's research of Chinese Pleistocene archaeology, that only the "best", that is the most convincing, but not necessarily representative, specimens have been published.

Investigations in the years from 1988 to 1996 at three localities in the Bose area by Hou *et al.* (2000:1625) recovered 991 artefacts from "Gaolingpo (n = 770 *in situ* artifacts), Bogu (n = 26), and Xiaomei (n = 36)." and from other localities (24 localities have been recorded in the Bose area), of which most are from excavations (84%). The majority (91%) "of the bifacial LCT ["ovate large cutting tools"] sample (n = 35 specimens) was from the western third of the Bose basin" ... "sites 1 through 14)" (Hou *et al.* 2000:1622, 1623, 1625). Unifacial LCTs total 64 specimens, bifacial LCTs total 35 and non-LCTs total 74 specimens; no data have been published on the overall composition of the assemblages (Hou *et al.* 2000). Bose biface technology is considered "Acheulean-like" and is linked to the selection of large-sized clasts of raw material which Hou *et al.* (2000:1622) suggest became available as the result of the tektite fall and subsequent environmental changes, including forest burning. This hypothetical scenario is, however, unconvincing. For example, it seems unrealistic to assume that

raw material of dimensions large enough to make the bifaces was not available and visible in this river area "previous" (see below) to hypothetical dramatic habitat changes.

The age of Bose was initially based on linking the artefact-bearing laterised soil with an earlier Pleistocene antiquity (e.g., Huang *et al.* 1988). More recently, the tektites found in association with the Bose artefacts have been dated to 0.732±0.039 mya (Guo *et al.* 1996) and to 0.803±0.03 mya (Hou *et al.* 2000). Any evidence of associating tektites with archaeological materials in stream deposits should, however, be carefully weighed. In island Southeast Asia, redeposition of tektites has repeatedly been demonstrated, including tektites from the Sangiran hominid locality in central Java. The isotopic determinations date the tektites and not the deposits from which they were recovered or the archaeological materials (see Harrisson 1975, 1978; Bartstra 1983 and pers. comm. 2000; Pope 1988 and pers. comm. 2000; Keates 2000b). The Bose tektites shown to this author by Huang Weiwen, the principal investigator of the Bose localities, show signs of what appears to be fluvial abrasion, in contrast to the artefacts which are in very good condition (Keates 2000b). Moreover, the Bose tektites are small and light (pers. observ.), which would make movement of these specimens within and between deposits more likely compared to the artefacts. Moreover, small lithic debitage or refits have not been reported.

Hou *et al.* (2000:1622) believe that "... the targeted manufacture of LCTs signifies an important advance in hominin behavior (enhanced planning and technical competence) for which evidence has been lacking in the early stone technology of East Asia." Firstly, LCTs seems a rather loaded term for what in fact are artefacts with less elaborate modification compared to later European handaxes. Secondly, by accepting that only stone tool technology which produces Acheulean artefacts is indicative of early hominid behavioural complexity, Hou *et al.* (2000) adopt an Afro-centric position, and disregard the evidence of a continuous and generally informal Pleistocene technology in China (e.g., Pope and Keates 1994). This, moreover, ignores the palaeoenvironmental conditions in which Eastern Asian hominids lived (Keates 1998). Whatever their age may be, what the bifaces from Bose demonstrate is simply that where large clasts of raw material were available, hominids in some places made large tools, including bifaces. This is also indicated at Dingcun (see below). However, although there were constraints on clast size at Donggutuo (Keates 1995, 2000a), hominids manufactured bifaces.

Bifaces were recovered during investigations of the river terrace locality complex of Dingcun in the Fenhe Valley, Shanxi province, beginning in the 1950s (Pei *et al.* 1958) (Figure 1). The age of the Dingcun localities is late Middle Pleistocene based on uranium-series dates of Dingcun hominid locality 100 (0.160-0.210 mya; Chen *et al.* 1984; Chen and Yuan 1988; Wang 1989) and palaeomagnetic dating of locality 97 and locality 100 (*c.*0.120 mya; Liu *et al.* 1995; Keates 2001a). Some of the localities are earlier (e.g., Pei and Chia 1958; Jia 1980:85; Keates 2001). The radiocarbon (>0.041 mya) and amino-acid racemization evaluations (0.070-0.090 mya; Wang 1989; Zhou 1989) of locality 100 may be interpreted as minimum ages.

Liu's (1988) analysis of 1932 artefacts from Dingcun describes 10.7% as handaxes and trihedral points (total tool frequency is 149). The handaxes may be the "handaxe-like implements" of Qiu (1985:193). Renewed investigations of the Dingcun area have recovered a small number of bifaces, and Wang *et al.* (1994; and see Qiu 1985) refer to these as big points and heavy trihedral points. Some of these are similar to Acheulean bifaces (Wang *et al.* 1994:Figures 10:1, 3, 30:2, 3, 32:5; and see Qiu 1985: Figure 10.6), but are perhaps best compared to bifaces from Olduvai and Stellenbosch (eastern and southern Africa; pers. observ.). This can also be said with reference to one of the most frequently illustrated bifaces from Dingcun, which, incidentally, is a surface find (see, for example, Qiu 1985:Figure 10.7). The eleven large points from Dingcun include five large trihedral points and six pick-like specimens (Aigner 1981:211; Qiu 1985). The availability of fine grain hornfels (sourced from 7 km distance) of relatively large clast size, which was used to manufacture most of the Dingcun artefacts (e.g., Qiu 1985; Liu 1988) may have been an important contributing factor in producing the bifaces.

Korea

Bifaces have been recovered from Chongok-Ri (Chongok-ni) in the northern part of Korea (e.g., Chung 1984; Choi 1987; Figure 1). Chung (1984:895) refers to a "Mindel-Riss Interglacial or Riss Interstadial" age estimates of this river terrace locality, but the Chongok-Ri artefacts are now thought to have been redeposited and are younger in age (Pope and Keates 1994). Most of the "Acheulean type stone artefacts" (n = 686) were found on the surface of five localities in clay (Chung 1984:895). Of these specimens, 37 are referred to as bifaces and also as "Acheulean type handaxes", and eight as cleavers (Chung 1984:897). Other artefacts include polyhedral stones, choppers and chopping-tools, scrapers, flakes and "other shapes" (Chung 1984:901). Excavated artefacts (n = 1851) include five handaxes, five cleavers, seven picks as well as flakes, spalls, points and other tools (Chung 1984). The artefacts were manufactured in quartz and quartzite (Chung 1984). Of the 14 bifaces illustrated in Chung (1984), three can be classified as bifaces (see Chung 1984:Figures 2:1, 4:1, 12:2), while others resemble pick-like specimens. This indicates that an independent assessment

of those bifaces which have not been illustrated may not identify significantly more specimens which could be described as bifaces (and see below: Bae 1999). Nelson (1983) writes, based on data by Bae (1980), that only four specimens out of a total of 1418 lithic artefacts from Chongok-Ri are handaxes and that artefacts within the deposit are widely dispersed. Sohn (1983:196) makes the observation that most of the 50 bifaces referred to by Yi and Clark (1983) are surface finds, and that most of these bifaces are "flake cores" with a ratio of 5 bifaces to 85 choppers and chopping-tools.

At Kumpari in central Korea (Figure 1), unifacial (sic) and bifacial handaxes have been recorded in frequencies of two and six specimens, respectively; a total of 1230 artefacts were found at locality A and 1,177 artefacts at locality B (Bae 1999:231, 258). The artefacts also include cores, choppers, picks, cleavers, flake and other tools such as scrapers (Bae 1999:231). They derive from fluvial deposits and may date to the early part of the Late Pleistocene (Bae 1999:254, 260). Quartzite and vein quartz were the major raw materials selected for artefact manufacture and the bifaces were made in fine grain quartzite (Bae 1999:258, 259). Two of the specimens are described as "handaxe, uniface" and as "handaxe, biface", but should be called picks (see figures in Bae 1999:179). More extensively modified specimens are described as "handaxe, biface" (n = 3) and one "handaxe, pointed" (Bae 1999:214). Two of these are bifaces, while one is a triangular point and the other a bifacially flaked and pointed artefact resembling a trihedral point (see figures in Bae 1999:214). In their morphology and low frequency, Bae (1999:259, 261) compares the Kumpari handaxes to those from Chongok-Ri. The bifaces from Chongok-Ri (Pope and Keates 1994) and Kumpari resemble bifaces from Lantian and Yunxian and some are similar to pick-like artefacts from Dingcun (*cf.* Tai 1966; Aigner 1981; Li 1991; Li *et al.* 1991). Gai (1983) compares the Chongok-Ri artefacts to those from Kehe (of late Middle or early Late Pleistocene age) and Dingcun.

Japan

The bifaces believed to be of Middle Pleistocene age and presumed to represent evidence of the earliest hominid occupation of the island chain were discovered at, among other localities, Kamitakamori, Miyagi prefecture, in northern Japan, where research has been conducted since 1992 (Kajiwara *et al.* 1999; Figure 1). Palaeomagnetic stratigraphy and TL and ESR dates of tephra layers dated the Kamitakamori bifaces to approximately 430,000-610,000 years (Kajiwara *et al.* 1999). However, because one of the investigators at Kamitakamori and other early Japanese sites, Shinichi Fujimura (former deputy director of the Tohoku Paleolithic Institute), produced fake caches and planted a number or all of the artefacts, the government has launched an official investigation. Since this investigation was launched, Fujimura has admitted to planting artefacts at 33 sites in Japan (Yomiuri Shimbun 2001). A re-excavation of the Kamitakamori locality was scheduled for November 2001 (Tsutomu Soda pers. comm. 2001). Based on my recent research visit to Japan, there appears to be no evidence for hominid activity on the islands that pre-dates *c.*100,000 years ago.

CONCLUDING REMARKS

The number of localities in East Asia where bifaces have been recorded are still few and biface frequencies are low in contrast to flake tool assemblages. The occurrence of bifaces does not invalidate the Movius Line, but indicates a more complex pattern of regional hominid behaviour than previously thought. What needs to be addressed is why standardised tools (including bifaces) were manufactured and what they were used for. One factor which may be involved is the quality of the raw materials available for tool manufacture (e.g., Zhang 1990). Both the size and tractability of raw materials used for tool manufacture at a number of northern Chinese localities dating to the late Early Pleistocene (Donggutuo and Xiaochangliang) and early Late Pleistocene (Xujiayao) indicate that the selection of fine-grained materials such as chert appears to be significant in explaining the manufacture of the small frequencies of standardised tools (Keates 1995; Pope and Keates 1994). Yet, of at least 14,000 stone artefacts from Donggutuo and Xiaochangliang, only two are bifaces. It has been suggested that standardised lithic technology in Eastern Asia was a behavioural response to open environments (Pope 1988), but more substantial research needs to be conducted for a comprehensive reconstruction of palaeoenvironmental variation in this region (Keates in prep.). A factor relevant in trying to explain the generally unstandardised stone tool assemblages in Eastern Asia is the hypothesis of a predominantly non-lithic tool technology, especially in the more forested regions of Southeast Asia (e.g., Gorman 1970; Heekeren 1972:77, 82; White 1977; Ikawa-Smith 1978; Pope 1988; and see Forde 1934:17).

It has been suggested with reference to early *Homo sapiens* from China and possible bifaces at Dingcun that biface technique could have diffused from Europe to northern Asia (Foley and Lahr 1997). This ignores the possibility that the technique of producing bifaces (or any other technique) could have developed from indigenous technology in Eastern Asia. This is not to deny the possibility that during the later Pleistocene hominids migrated from Europe to China (and vice versa) based on hominid morphology (especially the Jinniushan *Homo sapiens*: Pope 1989, 1991). One final comment. Small

frequencies of bifaces from Indonesia (see above) appear to be Late Pleistocene in age (Keates and Bartstra 2001), and of later age in Australia (Rainey 1991).

ACKNOWLEDGMENTS

I would like to thank the Organizing Committee of IPPA for inviting me to participate in the IPPA Melaka Congress. My sincere thanks also to the assistants of the Organizing Committee in Malaysia whose tireless and well-coordinated efforts contributed greatly to make the Melaka Congress and the post-Congress tour most rewarding and memorable events. My thanks also to Huang Weiwen (Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Academia Sinica, Beijing, People's Republic of China), for letting me examine artefacts and tektites from Bose and for information about the Bose locality. I am also grateful to Wei Qi (IVPP) and Wang Youping (Department of Archaeology, Peking University) for sharing their knowledge on Chinese archaeology and for letting me study artefacts in their collections. The author gratefully acknowledges funding by the Wheeler Fund Committee, the Meyerstein Research Awards for Archaeological Research, and the Sasakawa Fund (University of Oxford)

REFERENCES

Aigner, J. 1981. *Archaeological Remains in Pleistocene China*. München: C.H. Beck.

An, Z. 1990. The proto-handaxe and its tradition in China. *Acta Anthropologica Sinica* IX:303-11 (in Chinese with English abstract).

Bae, K. 1980. Chong' gong-ni Palaeolithic site excavation report. In W-Y. Kim (ed.), *Archaeology in Korea 1979*, Vol. 7. Seoul: University Museum, Seoul National University.

Bae, K. 1999. *Excavation of the Kumpari Palaeolithic site, Paju, Central Korea 1989-1992*. Ansan: Hanyang University.

Bartstra, G.-J. 1983. Some remarks upon: fossil man from Java, his age, and his tools. *Bijdragen tot de Taal-, Land- en Volkenkunde* 139:421-34.

Bryan, A.L. 1983. Comments. *Current Anthropology* 24:403.

Chen, T. and S. Yuan. 1988. Uranium-Series dating of bones and teeth from Chinese Palaeolithic sites. *Archaeometry* 30:59-76.

Chen, T., S. Yuan and S. Gao. 1984. Using the uranium method to investigate important Palaeolithic dates in northern China. *Acta Anthropologica Sinica* 3:259-69 (in Chinese with English abstract).

Choi, M-C. 1987. Le Paléolithique de Corée. *L'Anthropologie* 91: 755-86.

Chung, Y-W. 1984. Acheulean handaxe culture of Chongok-Ni in Korea. In R.O. Whyte (ed.), *The Evolution of the East Asian Environment*, II:894-914. Hong Kong: Centre of Asian Studies.

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.

Coon, D.S. 1962. *The Origin of Races*. New York: Alfred C. Knopf.

Coon, D.S. 1966. *The Living Races of Man*. London: J. Cape.

Foley, R. and M.L. Lahr. 1997. Mode 3 technologies and the evolution of modern humans. *Cambridge Archaeological Journal* 7:3-36.

Forde, C.D. 1934. *Habitat, Economy & Society*. London: Methuen.

Freeman, L.G. 1977. Paleolithic archeology and paleoanthropology in China. In W.W. Howells and P. Tsuchitani (eds.), *Paleoanthropology in the People's Republic of China*, pp. 79-113. Washington: National Academy of Sciences.

Gai, P. 1983. Comments. *Current Anthropology* 24:192.

Gorman, C.F. 1970. Excavations at Spirit Cave, North Thailand: Some interim interpretations. *Asian Perspectives* XIII:79-107.

Guo, S., X. Hao, B. Chen and W. Huang. 1996. Fission track dating of Paleolithic site at Bose in Guangxi, South China. *Acta Anthropologica Sinica* 15:347-50 (in Chinese with English abstract).

Harrisson, T. 1975. Tampan: Malaysia's Palaeolithic reconsidered. *Modern Quaternary Research in Southeast Asia* 1:53-69.

Harrisson, T. 1978. Present status and problems for Palaeolithic studies in Borneo and elsewhere. In F. Ikawa-Smith (ed.), *Early Paleolithic in South and East Asia*, pp. 37-57. The Hague: Mouton.

Heekeren, H.R. van. 1972. *The Stone Age of Indonesia*. Verhandelingen Kon. Inst. Taal-, Land- en Volkenkunde 61. The Hague: Martinus Nijhoff (2nd edition).

Hou, Y., R. Potts, B. Yuan, Z. Guo, A. Deino, W. Wang, J. Clark, G. Xie and W. Huang. 2000. Mid-Pleistocene Acheulean-like stone technology of the Bose Basin, South China. *Science* 287:1622-6.

Huang, W. 1987. Bifaces in China. *Acta Anthropologica Sinica* VI: 61-68 (in Chinese with English abstract).

Huang, W. 1989. Bifaces in China. *Human Evolution* 4:87-92.

Huang, W. 1992. Studies on the pebble tool industries of Early Man in South China. Re-examination of Paleolithic finds from the Nyu sites, Oita Prefecture, Japan. *Researches of the Japan Association of Paleological Studies*. Kyoto: The Paleological Association of Japan, Inc. 3:407-15 (in Japanese with English abstract).

Huang, W. and Y. Hou. 1997. Archaeological evidence for the first human colonisation of East Asia. *Bulletin of the Indo-Pacific Prehistory Association* 16:3-12.

Huang, W., J. Leng, X. Yuan and G. Xie. 1990. Advanced opinions on the stratigraphy and chronology of Baise stone industry. *Acta Anthropologica Sinica* IX: 105-112 (in Chinese with English abstract).

Huang, W., Y. Liu, C. Li and X. Yuan. 1988. Tentative opinions on the age of Baise stone industry. In Guandong Provincial

Museum and the Museum of the Qujiang County, *Treatises in Commemoration of the 30th Anniversary of the Discovery of Maba Human Cranium*, pp. 95-101 and 236-37. Beijing: Cultural Relics Publishing House (in Chinese with English abstract).

Huang, W. and G. Qi. 1987. Preliminary observation of Liangshan Paleolithic site. *Acta Anthropologica Sinica* VI:236-44 (in Chinese with English abstract).

Huang, W. and D. Wang. 1995. La recherche récente sur le Paléolithique ancien en Chine. *L'Anthropologie* 99:637-51.

Ikawa-Smith, F. 1978. Introduction: The Early Paleolithic tradition of East Asia. In F. Ikawa-Smith (ed.), *Early Paleolithic in South and East Asia*, pp. 1-10. The Hague: Mouton.

Imamura, K. 1996. *Prehistoric Japan*. London: UCL Press.

Inizan, M.-L., H. Roche and J. Tixier. 1992. *Technology of Knapped Stone. Préhistoire de la Pierre Taillée, Tome 3*. Meudon: CREP.

Jia, LP. 1980. *Early Man in China*. Beijing: Foreign Languages Press.

Jones, P.R. 1994. Results of experimental work in relation to the stone industries of Olduvai Gorge. In M.D. Leakey with D.A. Roe (eds), *Olduvai Gorge, Volume 5*, pp. 254-98. Cambridge: Cambridge University Press.

Kajiwara, H., T. Kamada and Y. Yokoyama. 1999. The oldest lithic artefacts in Japan. http://www.tfu.ac.jp/kekyushitsu/kajiwara/Paleo.html

Keates, S.G. 1994. Archaeological evidence of hominid behaviour in Pleistocene China and Southeast Asia. In J.L. Franzen (ed.), *100 Years of Pithecanthropus - The Homo erectus Problem*, pp. 141-50. *Courier Forschungsinstitut Senckenberg* 171.

Keates, S.G. 1995. The Significance of the Older Palaeolithic Occurrences in the Nihewan Basin, northern China, in the Context of Important Early and Middle Pleistocene Northern Chinese Localities. D.Phil. dissertation. University of Oxford.

Keates, S.G. 1996. On earliest human occupation in Central Asia. *Current Anthropology* 37:129-31.

Keates, S.G. 1997. Analysing modern human origins in China. In G.A. Clark and C.M. Willermet (eds), *Conceptual Issues in Modern Human Origins Research*, pp. 294-303. New York: Aldine de Gruyter.

Keates, S.G. 1998. A discussion of the evidence for early hominids on Java and Flores. In G.-J. Bartstra (ed.), *Bird's Head Approaches*, pp. 179-191. Rotterdam: A.A. Balkema, *Modern Quaternary Research in Southeast Asia* 15.

Keates, S.G. 2000a. *Early and Middle Pleistocene Hominid Behaviour in Northern China*. Oxford: Biddles Ltd. BAR *International Series* 863.

Keates, S.G. 2000b. Technical Comments. *Science* 289:503.

Keates, S.G. 2001. Perspectives on 'Middle Palaeolithic' settlement patterns in China. In N.J. Conard (ed.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age*, pp. 153-75. Tübingen: Kerns Verlag.

Keates, S.G. in prep. Chronology and palaeoenvironment of Pleistocene localities in northern and southern China. In C. Shen and S.G. Keates (eds), *Current Research in Chinese Pleistocene Archaeology*.

Keates, S.G. and G.-J. Bartstra. 2001. Observations on Cabengian and Pacitanian artefacts from island Southeast Asia. *Quartär* 51/52:9-32.

Leakey, M.D. 1971. *Olduvai Gorge. Volume 3*. Cambridge: Cambridge University Press.

Li, T. 1991. Unearthing of Chaoxian man's fossil skull. *China Cultural Report* 5:1.

Li, T., Z. Wang, W. Li, X. Ma, K. Hu and W. Liu. 1991. Investigation and excavation of the fossil place at the outfall of Quyuan River, Yun County, Hubei Province. *Jianghan Kaogu* 2:1-14 (in Chinese).

Li, Y. 1997. Some problems of the Dingcun industry. In Y. Tong, Y. Zhang, W. Wu, K. Li and L. Shi (eds), *Evidence for Evolution - Essays in Honor of Prof. Chungchien Young on the Hundredth Anniversary of His Birth*, pp. 39-49. Beijing: China Ocean Press (in Chinese with English abstract).

Li, Y., H. Jin, T. Li, X. Feng and W. Li. 1998. The stone artefacts from the Yunxian man site. *Acta Anthropologica Sinica* 17:94-120 (in Chinese with English abstract).

Li, Y. and Y. You. 1975. On the discovery of palaeoliths in Baise, Guangxi. *Vertebrata PalAsiatica* 13:225-8 (in Chinese).

Liu, C., P. Su, Y. Li and X. Zhou. 1995. Paleomagnetic study at the sections of Paleolithic site in Dingcun. *Journal of Chinese Antiquity* 4:20-6. (in Chinese).

Liu, Y. 1988. The reobservation of stone artefacts in Dingcun. *Acta Anthropologica Sinica* VII:306-13 (in Chinese with English abstract).

Movius, H.L. 1944. Early man and Pleistocene stratigraphy in southern and eastern Asia. *Papers of the Peabody Museum of American Archaeology and Ethnology* XIX:1-125.

Movius, H.L. 1949. The Lower Paleolithic cultures of southern and eastern Asia. *Transactions of the American Philosophical Society* 38: 329-420.

Mulvaney, D.J. 1970. The Patjitanian industry: some observations. *Mankind* 7:184-7.

Nelson, S.M. 1983. Comments. *Current Anthropology* 24:194-5.

Pei, W. 1965. Professor Henri Breuil, pioneer of Chinese palaeolithic archaeology and its progress after him. In E. Ripoll Perello (ed.), *Miscelanea en Homenaje al Abate Henri Breuil* 2:251-69. Barcelona: Instituto de Prehistoria y Argueologia.

Pei, W., and L. Chia. 1958. Geological and stratigraphical observation of the Tingtsun sites. In W. Pei, J. Wu *et al.* (eds), *Report on the Excavation of Palaeolithic Sites at Ting-tsíun Hsiang-fen-hsien, Shansi Province*, pp. 2-14. Institute of Vertebrate Palaeontology and Palaeoanthropology Memoir 2 (in Chinese with English abstract).

Pei, W., J. Wu, L. Chia, M. Chou, H. Liu and C. Wang. 1958. *Report on the excavation of Palaeolithic sites at Ting-tsíun Hsiang-fen-hsien, Shansi Province*. Institute of Vertebrate Palaeontology and Palaeoanthropology Memoir 2:1-111 (in Chinese with English abstracts).

Pope, G.G. 1982. *Hominid Evolution in East and Southeast Asia*. PhD dissertation, University of California, Berkeley.

Pope, G.G. 1988. Recent advances in Far Eastern paleoanthropology. *Annual Review of Anthropology* 17:43-77.

Pope, G.G. 1989. Lecture given at the Department of Biological Anthropology, University of Cambridge, England, 8 November 1989.

Pope, G.G. 1991. Evolution of the zygomaticomaxillary region in the genus *Homo* and its relevance to the origin of modern humans. *Journal of Human Evolution* 21:189-213.

Pope, G.G. and S.G. Keates. 1994. The evolution of human cognition and cultural capacity: A view from the Far East. In R.S. Corruccini and R.L. Ciochon (eds), *Integrative Paths to the Past*, pp. 531-67. Englewood Cliffs: Prentice Hall.

Qiu, Z. 1985. The Middle Palaeolithic of China. In R. Wu and J.W. Olsen (eds), *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*, pp. 187-210. London: Academic Press.

Rainey, A. 1991. Some Australian bifaces. *Lithics* 12:33-6.

Renfrew, C. and P. Bahn. 1991. *Archaeology*. London: Thames and Hudson.

Roche, H. 1995. Les industries de la limite Plio-Pléistocène et du Pléistocène ancien en Afrique. In *Congreso Internacional de Paleontologia Humana*, Orce, Spain, 3a Circular, p. 93.

Roche, H. and M. Kibunjia. 1994. Les sites archéologiques plio-Pléistocènes de la Formation de Nachukui, West Turkana, Kenya. *Centre de Recherches Academie Scientifique* 318, Series II:1145-51.

Roe, D.A. 1994. A metrical analysis of selected sets of handaxes and cleavers from Olduvai Gorge. In M.D. Leakey with D.A. Roe (eds), *Olduvai Gorge, Volume 5*, pp. 146-234. Cambridge: Cambridge University Press.

Sieveking, A. de G. 1960. The Palaeolithic history of Kota Tampan, Perak. *Asian Perspectives* II(2)(1958):91-102.

Sohn, P-K. 1983. Comments. *Current Anthropology* 24:196.

Swisher, C.C. III, G.H. Curtis, T. Jacob, A.G. Getty, A. Suprijo and Widiasmoro. 1994. Age of the earliest known hominids in Java, Indonesia. *Science* 263:1118-21.

Tai, E. 1966. The paleoliths found at Lantian man locality of Gongwangling and its vicinity. *Vertebrata PalAsiatica* 10:30-4 (in Chinese).

Teilhard de Chardin, P. 1941. Early Man in China. *Institute de Géo-Biologie Publication* 7:1-99.

Wang, J., F. Tao and Y. Wang. 1994. Preliminary report on investigation and excavation of Dingcun Palaeolithic sites. *Journal of Chinese Antiquity* 3:1-75 (in Chinese).

Wang, L. 1989. Chronology in Chinese palaeoanthropology. In R. Wu, X. Wu and S. Zhang (eds), *Early Humankind in China*, pp. 392-409. Beijing: Science Press (in Chinese).

Wei, Q. 1995. Thinking over the stratigraphic age of the Lantian Homo erectus. *Journal of Chinese Antiquity* 4:34-7 (in Chinese).

White, J.P. 1977. Crude, colourless and unenterprising: Prehistorians and their views on the stone age of Sunda and Sahul. In J. Allen, J. Golson, and R. Jones (eds), *Sunda and Sahul*, pp. 13-30. London: Academic Press.

Yi, S.B. and G.A. Clark. 1983. Observations on the Lower Paleolithic of Northeast Asia. *Current Anthropology* 24:181-202.

Yomiuri Shimbun. 2001. Archeologist admits faking finds at more than 30 sites. *The Daily Yomiuri,* 30 September 2001, p. 2.

Yuan, B., Y. Hou, W. Wang, R. Potts, Z. Guo and W. Huang. 1999. On the geomorphological evolution of the Bose Basin, a Lower Paleolithic locality in South China. *Acta Anthropologica Sinica* 18:215-24 (in Chinese with English abstract).

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

Zhang, S. 1989. The Early Palaeolithic of North China. In R. Wu, X. Wu and S. Zhang (eds), *Early Humankind in China*, pp. 97-158. Beijing: Science Press (in Chinese).

Zhang, S. 1990. Regional industrial gradual advance and cultural exchange of Paleolithic in North China. *Acta Anthropologica Sinica* IX: 322-33 (in Chinese with English abstract).

Zhou, Y. 1989. Amino acid dating of Peking man and Dingcun man. *Acta Anthropologica Sinica* VIII: 177-81 (in Chinese with English abstract).