Quaternary International 400 (2016) 58–64

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Large Cutting Tools from the Danjiangkou Reservoir Region, central China: Comparisons and contrasts with western and south Asian Acheulean

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A R T I C L E I N F O

Article history:
Available online 18 November 2015

Keywords:
Large Cutting Tools
Handaxes
Cleavers
Central China
Acheulean
Danjiangkou Reservoir Region

A B S T R A C T

The Danjiangkou Reservoir Region (DRR) in central China has been studied since 1994 and is known for its Large Cutting Tools (LCTs), with similarities to both western and south Asian LCTs of the Acheulean industrial complex. However, the origins of LCT technology in China is a much debated topic. In this paper, we address several of the major arguments used to support an indigenous development for eastern LCTs—greater thickness, a poorer Refinement Index, greater weight, and a preference for cobbles over flakes for LCT blanks. In comparisons based on a large database of Acheulean LCTs, DRR examples are shown to compare well with Acheulean technology in terms of thickness and 'refinement,' traits which we here link to raw material shapes and flaking properties. A relatively more frequent use of cobbles for blanks, however, characterizes the DRR and other Chinese LCTs, but there is also regional variability in this feature. Weight, on the other hand, is consistently larger for all Chinese LCTs, including those from DRR, although these fall at the low end of the range. Nevertheless, there are important features in common between Acheulean and Chinese LCTs which indicate either a common origin or periods of admixture culturally and probably physically. These features include the use of large flake blanks, the presence of cleavers in some industries, and the shaping of handaxes by both primary and secondary flaking. The influence of regional cultural traditions on Chinese material, geographic distance and limited migration routes, cultural drift, differences in subsistence ecology, and the demographics of small population sizes seem ultimately to be responsible for the differences, and they should not be used to obscure the commonalities.

1. Introduction

In order to contribute to the discussion on the origins of handaxe technology in China, it is important to develop a systematic methodology for comparison of this more informative type with those from western and Indian Acheulean assemblages. We have proposed such a methodology and applied it in some detail to the handaxes from the Danjiangkou Reservoir Region (DRR) and Large Cutting Tools (LCTs) in general (Kuman et al., 2014; Li et al., 2014a,b,c). We prefer the term LCT to biface for both the East Asian and Acheulean assemblages because it is a general term. It does not imply that all handaxes, cleavers and picks were used in the same way, as they were likely used in a variety of slicing, chopping, and hacking activities (including digging to cut roots) that can be grouped together as 'cutting' functions. In the early Acheulean of Africa, some sites are dominated by pick-like handaxes (Asfaw et al., 1992; Lepre et al., 2011). However, activities such as digging for roots or woodworking can also be considered as a cutting action. A second reason why we do not use the generic term of biface is because it over-simplifies the nature of both Acheulean and Asian LCTs. We instead prefer to record the extent of shaping more precisely and class handaxes as bifacial, partly-bifacial or unifacial (see Kuman et al., 2014 for the methodology). In this paper, we synthesize the results of our comparisons with

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http://dx.doi.org/10.1016/j.quaint.2015.07.052
1040-6182/

Acheulean LCT technology and provide our own perspective. Our quantitative comparative data for the Acheulean derives from 23 assemblages from Africa, four from England, 10 from India, and eight from East Asia (see Kuman et al., 2014 for detailed database).

To date, handaxe-bearing sites have been documented from south to central China and in a northern region that borders central China (Fig. 1). DRR is located in central China within the south-eastern margin of the Qinling Mountains, which are traditionally used as the boundary between north and south China (with the eastern Qinling region considered to belong to central China). This distribution of handaxe-bearing sites occurs across a range of habitats with dates from at least 0.803 Ma to the late Pleistocene. This reflects a variety of successful, if ephemeral, subsistence adaptations that involved LCTs, and it also suggests that movements of the populations concerned may have been complex through time and space. However, the commonality for all sites is their context in river terrace deposits. Thus far, all are open-air occurrences, and no LCTs have yet been located in cave deposits. This distribution suggests that these populations migrated along river systems in China, practicing subsistence ecologies adapted to such environments, which today range from subtropical to temperate habitats. Although there are few site-formation studies on these sites (with some exceptions–e.g., Pei et al., 2015), the low density of artefacts in relation to the large excavated areas can nevertheless be said to reflect small and mobile populations of hominids that left a widespread but rather light footprint (see Table 8 in Li et al., 2014b for artefact densities in DRR sites). In both DRR and Bose in particular, supporting evidence for this opinion can be seen in the fact that artefact densities are low in all sites across the two large study areas (W. Wang et al., 2014; Li et al., 2014b). Although the site contexts are not in gravels that would concentrate stone tools and especially the larger pieces such as LCTs, this is nevertheless a consistent pattern. These regions may have hosted small populations living in inter-montane basins that fostered relatively greater isolation of populations. In the northern Chinese handaxe-bearing regions such as Luonan and Dingcun, populations may have been larger and less geographically isolated. These assemblages also show clearer affinities to Acheulean technology in terms of large flake blanks for LCTs and typical cleavers (Wang, 2005; Yang et al., 2014).

2. The DRR: materials and chronology

The DRR is the largest man-made lake in Asia. Due to the construction of dams for the South-to-North Water Transfer Project, extensive surveys have been made of terrace deposits that were to be flooded. In this paper we discuss the comparative data analysed from 120 LCTs collected by C.L. in 1994 (Table 1), mainly from terraces of the Han River and secondarily from the Dan River (Kuman et al., 2014). Over two-thirds of these tools derive from Terrace 3, with the remainder from Terrace 2. Palaeomagnetic dating places the Terrace 3 deposits at <780 ka, while sedimentological analysis narrows the period to the S5-S4 palaeosol period of northern and central China, dating from 621 to 374 ka (Li et al., 2014a). Two ESR dates on sedimentary quartz at the Shuangshu site further narrow the age to 651 ± 65 ka for Layer 4 and 518 ± 52 ka for Layer 3 (Li et al., 2014b), indicating that Terrace 3 belongs to the earlier half of the Middle Pleistocene. For Terrace 2, OSL and TT-OSL results for sedimentary quartz date the deposits to 100 to 50 ka (Liu and Feng,

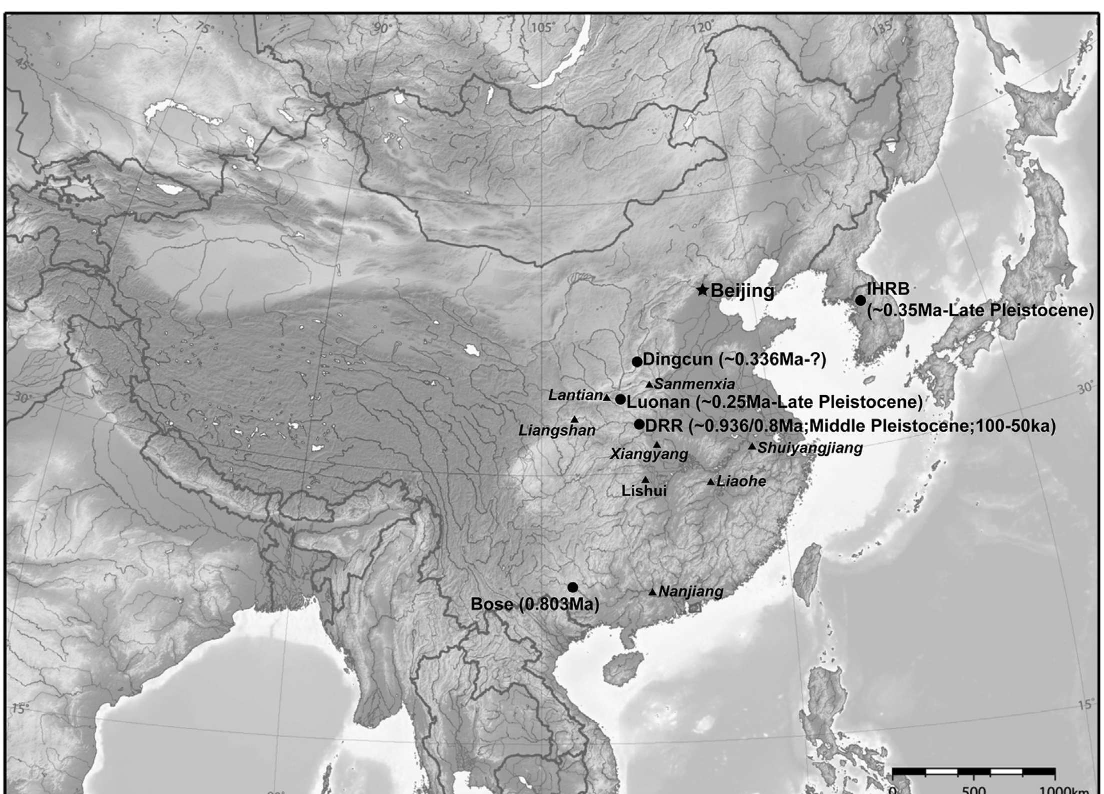

Fig. 1. Sites reported for East Asia where large cutting tools, especially handaxes, have been reported thus far. Sites in italics are less well understood and published mainly in Chinese. Bose and Nanjiang are in south China (Liu, 2013). Lishui, Liahe, Shuiyangjiang and Xiangyang are in the northern part of south China (Li, 1983; Li and Xu, 1991; Chu, 1998). Liangshan, DRR and Luonan are in central China (Huang and Qi, 1987). Sanmenxia and Dingcun are in the southern part of north China (Huang, 1964; Yang et al., 2014). DRR lies within the southern margin of the Qinling mountains, while Luonan lies within its northern margin. Sites with more than one date indicate either a range of ages within a terrace or separate ages for different terraces (e.g., DRR).

2014), confirming the later Pleistocene age which had previously been noted for this terrace (Huang et al., 1996).

A variety of raw materials was locally available to the DRR hominids. In addition to quartz phyllite and trachyte, quartz, quartzite, sandstone, chert and other igneous rocks are also present in gravels close to the sites. In complete assemblages recovered from excavations, these varied rock types are used, with quartz in particular being worked for small tools (e.g., at Shuangshu–Li et al., 2014b). However, quartz phyllite dominates LCT production across Terrace 3 of the Han River, with 80% made in this raw material. A further 20% are made in trachyte and other materials. Such selectivity for certain raw materials is also characteristic of African Acheulean sites where a variety of raw materials is present. It is undoubtedly related to the flaking properties of the selected rocks and the desire for large blanks for LCT production.

In selecting quartz phyllite, trachyte and other igneous rocks in the DRR, flatter oval cobbles were preferred for LCTs. Quartz phyllite belongs to the schist family of rocks, formed through the

Table 1
Metric and weight data available for handaxes in Africa, Western Europe and Asia. Measurements for Rietputs 15 have variable sample sizes because of breaks that particularly affected some tool measurements as these LCTs were retrieved from mining operations. The minimum ages published in Gibbon et al. (2009) are used as most accurate due to new statistical modelling available for cosmogenic nuclide burial dating (Gibbon, pers. comm.). The EF HR sample from Olduvai measured by Kuman was done in the Kenya National Museum in Nairobi in 2009 and not all handaxes were available. We, W and T in the sample size column stand for Weight, Width and Thickness. Weight is in grams and measurements in mm. References: A) Beyene et al. (2013); B) recorded by Kuman; C) Gibbon et al. (2009); D) Leakey (1971); E) Roe (1994); F) Kuman (1994); G) Kuman (1998); H) Field (1999); I) Leader (2013); J) Leader (2009); K) Petraglia and Shipton (2008); L) Potts et al. (1999); M) Marshall et al. (2002); N) Szabo et al. (1990); O) Norton et al. (2006); P) Huang (2003); Q) W. Wang et al. (2014); S.J. Wang et al. (2014); R) Wang (2007); S) Kuman et al. (2014); T) S.J. Wang et al. (2014).

Locality	Country	Age (Ma)	*N*	Weight			Thickness			Refinement Index (T/W)			References
				Mean	*SD*	*Median*	*Mean*	*SD*	*Median*	*Mean*	*SD*	*Median*	
Africa													
Konso KGA6-A1 Loc.C	Ethiopia	~1.75	4							0.41	0.13		A
Rietputs 15 Pit 1	So. Africa	1.72 ± 0.16	9				40.89	6.62	40.00	0.59	0.12	0.59	B,C
Konso KGA4-A2	Ethiopia	~1.6	19							0.55	0.13		A
Olduvai EF HR, Bed II	Tanzania	1.6	22W&T				46.91	10.25	45.5	0.56	0.15	0.51	B,D
Olduvai EF HR, Bed II	Tanzania	1.6	29	601.80	210.2								E,D
Sterkfontein	So. Africa	~1.6	10				47.00	9.51	47.50	0.63	0.13	0.61	B,F,G,H
Canteen Kopje basal EA	So. Africa	>1.5	7	402.90									I
Canteen Kopje EA	So. Africa	~1.5	30	399.70	225.2								I
Konso KGA 10-A11	Ethiopia	~1.45	16							0.53	0.10		A
Konso KGA7-A1,A2,A3	Ethiopia	~1.4	17							0.58	0.11		A
Rietputs 15 Pit 5 (A)	So. Africa	1.32 ± 0.21	74W/78T				42.00	9.70	40.00	0.53	0.10	0.52	B,C,J
Konso KGA 12-A1	Ethiopia	~1.25	30							0.54	0.15		A
Canteen Kopje Victoria W.	So. Africa	>1.0 Ma	35	618.00	108								I
Averages for available data, Early Acheulean				**505.60**			**44.20**			**0.55**			
Olorgesailie M1, FB	Kenya	0.99–0.97	15	180.87	116.11	137.00	34.60	8.44	33.00	0.60	0.14	0.56	K,L
Olorgesailie, M1, I3	Kenya	0.99–0.97	57	225.12	197.48	158.00	33.54	9.28	31.00	0.56	0.12	0.55	K,L
Olorgesailie M6/7, DE89A	Kenya	0.97–0.78	60	877.82	381.80	804.50	46.23	10.43	46.00	0.45	0.11	0.45	K,L
Olorgesailie M6/7, H9AM	Kenya	0.97–0.78	10	770.00	426.54	760.00	36.20	7.53	33.50	0.37	0.09	0.39	K,L
Grotte des Ours	Morocco	~0.4	40	390.40	133.39	383.00	43.81	6.79	43.60	0.57	0.10	0.55	M
STIC	Morocco	<0.7	82	704.68	292.96	677.00	54.64	10.64	54.50	0.59	0.12	0.56	M
Olduvai, Masek Beds	Tanzania	0.7–0.4	125	375.02	153.24	345.00	41.25	7.75	40.70	0.53	0.09	0.51	M
Elandsfontein	So. Africa	probably <0.6	232	355.54	250.65	302.50	40.13	11.19	38.75	0.53	0.10	0.52	M
Amanzi Springs	So. Africa	Middle Pleist?	133	751.41	356.82	730.00	53.69	11.22	53.40	0.58	0.10	0.57	M
Doornlaagte	So. Africa	probably >0.6	44	1147.93	527.55	1038.50	59.03	11.76	59.20	0.57	0.10	0.55	M
Averages for available data, Africa Acheulean ca 1.0 to 0.4 Ma				**577.88**			**44.31**			**0.53**			
West Europe													
Boxgrove	England	~0.5 Ma	182	288.81	132.42	282.50	30.59	5.66	30.50	0.38	0.05	0.37	M
Broom Pits	England	0.29–0.23 Ma	241	359.90	258.00	292.00	36.22	10.20	35.60	0.45	0.09	0.43	M
Corfe Mullen	England	0.5–0.38 Ma	131	346.63	191.04	299.00	37.94	12.30	34.30	0.51	0.16	0.45	M
Cuxton	England	0.43–0.23 Ma	205	370.32	252.36	304.00	44.15	11.80	43.00	0.61	0.13	0.59	M
Averages for available data, European Later Acheulean				**341.42**			**37.22**			**0.49**			
South Asia													
Anagwadi	India	Middle Pleist.	15				45.73	6.04	45.00	0.60	0.08	0.58	K,N
Fatehpur V	India	0.35–0.16 Ma	11	455.45	246.74	465.00	40.91	11.36	40.00	0.52	0.13	0.56	K,N
Gulbal II	India	0.35–0.16 Ma	12	902.50	385.84	822.50	47.50	9.65	45.00	0.51	0.06	0.50	K,N
Hunsgi II	India	0.35–0.16 Ma	18	1041.94	551.14	927.50	52.22	10.60	50.00	0.55	0.10	0.58	K,N
Hunsgi V	India	0.35–0.16 Ma	45	669.00	349.60	590.00	48.44	9.99	50.00	0.56	0.11	0.57	K,N
Mudnur VIII	India	0.35–0.16 Ma	9	1302.22	204.56	1245.00	61.11	9.28	60.00	0.58	0.13	0.55	K,N
Teggihalli II	India	Middle Pleist	9	324.56	375.11	215.00	33.86	11.54	28.50	0.47	0.13	0.43	K,N
Yediyapur I	India	0.35–0.16 Ma	10	443.00	230.30	380.00	36.00	5.16	40.00	0.46	0.09	0.44	K,N
Yediyapur IV	India	0.35–0.16 Ma	11	626.82	415.00	415.00	42.73	11.04	40.00	0.54	0.13	0.50	K,N
Yediyapur VI	India	0.35–0.16 Ma	21	591.19	563.49	505.00	42.86	13.09	40.00	0.51	0.11	0.50	K,N
Averages for available data, Indian Acheulean				**706.30**			**45.14**			**0.53**			
East Asia													
IHRB	So. Korea	<0.35 Ma	58				60.19	12.92	60.00	0.65	0.14	0.63	O
Bose	China	~0.8 Ma	64				73.14	12.26	74.00	0.62	0.13	0.62	P
Bose–Fengshudao excav.	China	~0.8 Ma	5	1105.20	453.97	1054.00	76.69	15.27	76.47	0.71	0.10	0.73	Q
Bose–Fengshudao surface	China	~0.8 Ma	99	1132.33	485.64	1062.00	67.42	14.03	67.43	0.58	0.13	0.57	Q
Luonan	China	<0.5 Ma	236	979.00	470.61	946.50	58.41	13.46	58.91	0.61	0.14	0.60	R
DRR (T3)	China	Middle Pleist	45We/51W&T	929.00	394.81	844.00	45.45	10.53	45.00	0.46	0.10	0.45	S
DRR (T2)	China	Late Pleist	21	848.19	284.45	830.00	51.52	25.15	47.00	0.50	0.23	0.44	S
Lantian	China	70–30,000	5	802.70	521.62	855.70	56.40			0.65			T
Averages for available data, East Asian Acheulean				**966.07**			**61.83**			**0.59**			

metamorphosis of slates and mudstones. Due to the preferred orientation of quartz crystals, this rock has a foliated structure, which lends itself well to bipolar splitting and flaking. For handaxes from both terraces collected in 1994, 31% are made on split cobbles or bipolar-struck flakes (Kuman et al., 2014). Experiments by HL have confirmed that splitting and bipolar flaking produces thinner blanks suitable for LCTs, and fracture by throwing can also produce thin flakes in this raw material (Li et al., 2014b).

3. Comparisons

Several arguments have been made to support the interpretation that Chinese handaxes arose through a process of indigenous development from earlier Mode 1 industries. These will be considered in turn.

1) *East Asian handaxes are thicker than those in the Acheulean* (Schick, 1994; Norton et al., 2006; Lycett and Gowlett, 2008; Norton and Bae, 2008; Lycett and Bae, 2010; W. Wang et al., 2014). In our comparative data for DRR Terrace 3 (Table 1), the mean value for handaxe thickness is 45.5 mm, which is almost identical to the mean for Indian handaxes, at 45.14 mm, where the Acheulean nature of the industries is well accepted. The African data has somewhat smaller values. Early Acheulean handaxes from 1.75 to 1.1 Ma have a mean of 42 mm, while those from 1 to 0.4 Ma have a mean of 44.31 mm. African Acheulean handaxes are predominantly, although not exclusively, made on flakes. This contrasts with a number of the Asian assemblages where cobble blanks are more common. For the Terrace 3 sample, 39% of the 51 handaxes are made on cobbles. The western European handaxes in our sample are thinner (average 37.22 mm), but they are overall later in time and are largely made on flint or chert (Ashton and McNabb, 1994; White, 1995; Marshall et al., 2002). As a whole, East Asian handaxes show a significantly higher mean thickness value of 61.83 mm, which is increased significantly by the greater thickness of handaxes from Bose, south China. This is an industry where the handaxes are widely recognised to have greater differences with the Acheulean (e.g., Shipton and Petraglia, 2010; W. Wang et al., 2012, 2014) and thickness appears to be related to both raw material properties and subsistence ecology (see Discussion). Overall, the T3 handaxes from DRR are currently the only East Asian sample that falls within the Acheulean range. The recent addition of DRR to the published comparisons thus shows the significance of sampling to such arguments. And in particular, the selection of flat cobbles by the LCT-makers and the use of some bipolar splitting and flaking have a direct influence on thickness values.
2) *The Refinement Index (Thickness/Width) is lower for East Asian LCTs* (Lycett and Bae, 2010). As Table 1 shows, the averaged index of 0.53 for Indian assemblages matches well with African Acheulean sites between 1.0 and 0.4 Ma. However, the averaged index for East Asia is high. This is due in large part to the heavier and thicker handaxe values for Bose, but also to the high value for Luonan, where interestingly LCTs are made on good quality quartzite and are widely seen as most like those in the Acheulean (Wang, 2005; Petraglia and Shipton, 2008; Shipton and Petraglia, 2010; Gao, 2012). The dating of Luonan sites from Terrace 2 has achieved good consensus (Wang and Huang, 2001; Wang, 2005; Lu et al., 2007, 2011, 2012; Sun et al., 2014; Xing, 2014), and currently they are grouped in the later half of the Middle Pleistocene (Fig. 1). However, what is very striking for East Asia is that both DRR terraces show quite ‘refined’ values: 0.46 for Terrace 3, and 0.50 for Terrace 2. For Terrace 2, this could be due to the small sample size, but for Terrace 3 the data is more robust. It seems apparent that these values are related to the flat oval cobbles used for LCTs and the frequent use of bipolar flaking and splitting to produce LCT blanks.
3) *East Asian LCTs are heavier* (Shipton and Petraglia, 2010). Table 1 shows a clear rank order in averaged handaxe weights. The European sample is the lightest, followed by African material of all ages, then by South Asian handaxes, and finally by quite heavy average values for East Asia. This is a significant pattern for China and may have more than one explanation—for example, differences in preferred raw material size, a greater use of cobble blanks, and/or the imprint of local cultural tradition. However, both DRR terrace samples fall at the lowest end of the range for weights in East Asia. And it is also notable that Indian handaxes are intermediate between average weights for Africa and East Asia. If this pattern is not related to ecological differences, it could point to the influence of regional cultural traditions in the technological learning process.
4) *Cobbles are used more often than flakes for handaxes* (Corvinus, 2004; Norton et al., 2006). This perception applies in part for the Chinese assemblages where published data is available. Cobbles are used as handaxe blanks in varied proportions in different samples: 72% at Bose (Huang, 2003); 38% at the Bose site of Fengshudao (W. Wang et al., 2014); 36% at DRR (Kuman et al., 2014); 23% at Luonan (Wang, 2007). For Acheulean assemblages, large flakes are very commonly used for LCT blanks (Sharon, 2010). Some exceptions occur. For example, at Rietputs 15 ca 1.3 Ma (Leader, 2009; Leader et al., 2015), hornfels handaxes are made in roughly equal proportions on flakes and cobbles, in contrast with 95% of lava handaxes which are made on flakes; and at Ubeidiya, handaxes from the earliest Acheulean levels are made on cobbles (Bar-Yosef and Goren-Inbar, 1993). However, the overall Acheulean pattern is one of domination by flake blanks, particularly where lavas are used, but also where large quartzite cobbles and boulders are flaked for LCT blanks. Overall, the use of larger numbers of cobbles for Chinese LCTs is part of the variability seen in some East Asian assemblages, although this can also be a variable trait within the Acheulean.

4. Discussion

In this comparative study, we can see that there are both degrees of overlap and of distinctiveness for Chinese LCTs with those in the Acheulean. Although metric values are dependent on the nature and size of samples, as well as the influence of specific raw materials and their flaking properties, there are nevertheless some trends which can be discussed.

While East Asian handaxes as a group are thicker than those in Acheulean assemblages, this is in large part driven by raw material differences, as the average for DRR handaxes from T3 is close to African examples from 1 to 0.4 Ma. It is also nearly identical to the average value from India, which is only marginally higher than the African average for that period. DRR LCTs are dominated by flatter, oval cobbles of quartz phyllite that are often split and flaked with bipolar technique, but even when cobbles are used as blanks, their flatter shapes help to create relatively thinner handaxes and cleavers. The Refinement Index also appears to be very dependent on raw materials, as DRR Terrace 3 handaxes have an even lower ratio of thickness relative to width than any Acheulean sample. The range of values for handaxes, regardless of geographic location, also shows how highly variable this trait is. This is further evidence that raw material and blank types are driving this phenomenon, more than any attempt at ‘refinement’. The trait is probably better studied through the identification of soft-hammer flaking.

The greater weight of Chinese handaxes is, in contrast, a trait distinctive from the Acheulean. Only four Acheulean assemblages overlap with the values from China, but interestingly, three of these are from India. Part of this phenomenon may relate to the greater use of cobble blanks for Chinese handaxes. Bose is a particularly striking example in this regard, with 72% and 38% of the handaxes in different samples made on cobbles (Huang, 2003 and W. Wang et al., 2014 respectively). Two factors can be discussed as influencing these trends. Raw materials at Bose are often large but various authors have noted that they also tend to be flawed, making it difficult to strike large flakes, due to inclusions and joints that can cause flaking failures (Xie and Bodin, 2007; Zhang et al., 2010). In addition, Bose lies in the most humid geographic zone of all the handaxe sites, and its Early Pleistocene sediments are deeply weathered, vermiculated soils (Yang et al., 1996; Yin et al., 2006; Yuan et al., 2008). This suggests that the Bose hominids at 0.803 Ma would have relied relatively more on woodland resources in their subsistence ecology (see Kuman et al., 2014 for a fuller discussion). For Luonan, which is also known for its Acheulean-like cleavers, it is less clear why quartzite handaxes have greater mean thickness and weight than in all but one Acheulean assemblage. While they are generally said to be of good quality, no detail is available about their variability. However, they are also not among the heaviest of the East Asian examples, and only 23% of handaxes are made on cobble blanks (Wang, 2007). The greater weight of Luonan handaxes may well be due to the development of a regional tradition.

5. Conclusion

In the Acheulean, side-struck flakes are the characteristic blanks for LCTs. Although this is common knowledge, exact figures are not easy to find in the literature, and there is also much variability that may relate to the specific shape of raw materials and how flaking is approached. In the DRR, side-struck flakes are rare but can occur when raw material allows it. However, regardless of striking direction, the use of large flakes in East Asia is a systematic technological feature. This observation is supported for the DRR combined figure for Terraces 3 and 2, where 32% of handaxe blanks are large freehand and bipolar flakes (v. 36% cobbles, see Kuman et al., 2014). For Bose, figures of 62% of LCTs on large flakes are published for Fengshudao by W. Wang et al. (2014) and 28% for different localities by Huang (2003). The large differences for Bose are due to the sampling of different localities and/or use of excavated v. surface material. Thus the large flake aspect of Chinese LCTs exists, even if at a lower frequency than is found in the Acheulean.

A second similarity with the Acheulean is the purposeful convergent shaping of handaxes with both large primary scars and smaller secondary scars that are used to regularise an edge. This is well demonstrated for DRR (Kuman et al., 2014; Li et al., 2014a), as well as for Bose (Hou et al., 2000; Huang, 2003; Zhang et al., 2010). A third similarity is the presence of cleavers in Chinese assemblages, particularly at Luonan (Wang, 2005, 2006), but also at DRR. In contrast with African Acheulean sites where cleavers can occur in large numbers, they are less numerous, but both classic cleavers and atypical examples occur (see Kuman et al., 2014 and Li et al., 2014a for examples).

Unfortunately there are very few hominid finds from the Chinese handaxe sites to help clarify the origins of this technology as indigenous or through contact with the West. One informative exception is two crania from Yunxian, Terrace 4 at DRR, dating to at least 0.8 Ma. These specimens have been published as having a combination of both archaic (*Homo erectus*) and modern (*Homo sapiens*) features (Li and Etler, 1992; Etler and Li, 1994; Zhang, 1998; Vialet et al., 2010). Thus they do not possess typical *Homo erectus* anatomy and could suggest some admixture with western populations, local evolution, or a combination of the two. At the younger handaxe site of Dingcun, Pei et al. (1958) also described three hominid teeth as more advanced than the teeth of *Homo erectus*, and with some traits similar to Neanderthals. The Dingcun LCTs are made in hornfels and are clearly late Acheulean in technology (Yang et al., 2014; and personal observations). These poorly understood hominid associations suggest that we should keep an open mind on the origins of handaxe technology in China. In particular, we should consider the movements of small immigrant populations over great distances that could both create and complicate the archaeological signatures we are seeing. And these movements need not only have been unidirectional. Considering the great distances involved in the proposed movements between west and east, the geographic restrictions that limit the routes of migration, and the adaptations to differing environments, we should not expect the East Asian material to look exactly like the Acheulean but to have its own character. In other words, we should expect important technological similarities but know that regional cultural traditions, adaptations to regional subsistence ecologies, and raw material differences (see also Bae, 2014) will create variations in the industries which may mask a shared origin and admixture. We see the commonalities in large flake production (when raw material allows for it), in the presence of cleavers (in both DRR and Luonan), and in handaxe shaping. There is overlap in some features and differences in others. Western researchers who visit open-air handaxe-bearing excavations in China are struck by the low density of finds per square metre, in contrast with Acheulean sites in Africa where the technology originated and was widespread between 1.7 and 0.3 Ma. While some of this phenomenon is undoubtedly due to site formation processes that winnow smaller material from alluvial sites, this alone cannot explain the widespread nature of this pattern, and it is logical to expect that Asian territories were less densely populated in the Early Palaeolithic. In the migration model for the population of China by early *Homo*, we should consider that the great distances encountered, the demographics of small populations, and cultural drift should have a significant influence on the nature of the archaeological assemblages. Given the current advances in our understanding of the human genome, continuity with hybridization (Wu, 1998, 2004) is a plausible explanation for the technological similarities of China's handaxe-bearing sites with the Acheulean.

Acknowledgements

We thank Profs Gao Xing and Robin Dennell for their invitation to contribute to this special issue. This research was initially funded by the China-South Africa Bilateral Programme in Palaeosciences, through grants provided by the Ministry of Science and Technology of China to Professor Liu Wu (IVPP, Beijing) and by the National Research Foundation of South Africa to Professor R.J. Clarke (University of the Witwatersrand, Johannesburg, grant number 68625). We thank them for their support and interest in the archaeology. From 2014, the research has been funded by grants in the same programme to Gao Xing (IVPP) and K. Kuman (NRF grant number 88480). CL and HL (China-South Africa Joint Research Program-7) acknowledge the following for support: Chinese Natural Science Foundation (grant number 40972016), the Cultural Relics Protection Research Project of Hubei Reservoir Area of South-North Water Diversion Foundation (grant number Nk02), and the Chinese Government Graduate Student Overseas Study Program (grant number [2013]3009).

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