World Heritage

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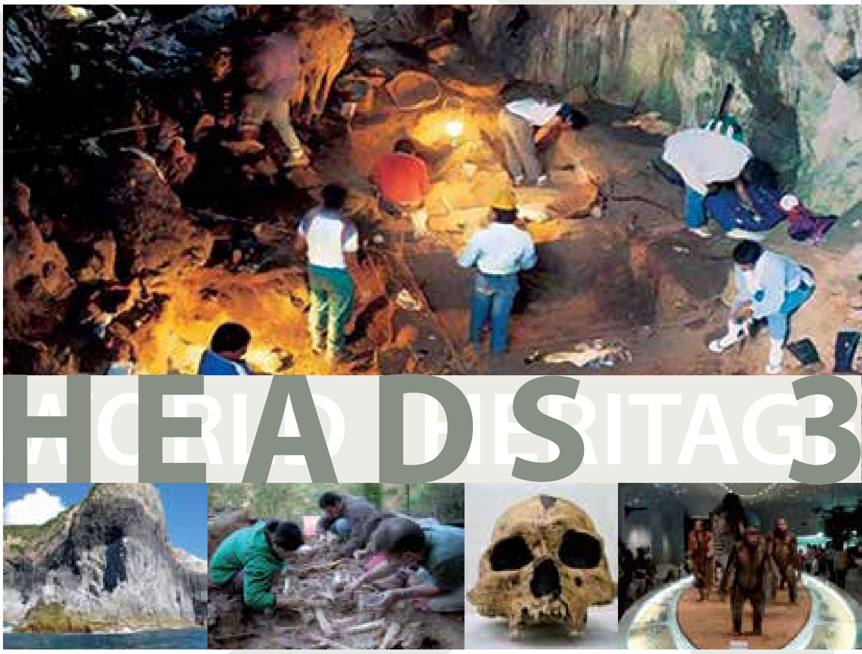

Human origin sites and the World Heritage Convention in Asia

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Human origin sites and the World Heritage Convention in Asia

Nuria Sanz, Editor
Coordinator of the World Heritage/HEADS Programme

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Supervision, editing and coordination:
Nuria Sanz, *General Coordinator, World Heritage Thematic Programme HEADS and Director, UNESCO Office in Mexico*
Sarah Ranlett, *UNESCO Office in Mexico*
Anjelica Young, *UNESCO Office in Mexico*

Coordination of the World Heritage Papers Series:
Vesna Vujicic-Lugassy, *UNESCO Culture Sector*

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Foreword

Prehistoric sites are the cornerstone for research into the origins of humanity, its evolution and social development – but they are underrepresented in the UNESCO World Heritage List. We are all familiar with iconic prehistoric sites in Africa, Latin America and Europe but less so with such sites in Asia. This must change, as Asia holds a wealth of data, which includes some startling challenges to traditional archaeological paradigms of the emergence and dispersal of modern humans. What is more, Asia hosts several renowned World Heritage sites, including the Peking Man Site at Zhoukoudian in the Peoples' Republic of China and the Sangiran Early Man Site in Indonesia.

This issue of World Heritage Papers tackles these questions head-on – exploring recent research programmes, ideas and debates that are lifting the profile of Asia in human evolution studies, while addressing the practical issues of site protection and management. The result is a fascinating compendium that reflects the international and interdisciplinary approach that inspires all work under the World Heritage Convention. Following the lead of the HEADS Thematic Programme for World Heritage*, this issue builds on the vibrant archaeological research presented at the conference, entitled 'Human Origins Sites in Asia and World Heritage Convention,' held at the Jeongok Prehistory Museum in the Republic of Korea in September 2012. This was a ground-breaking conference for human evolution studies in Asia and across the world.*

Together, we seek to ensure that Asian archaeological human origins sites are recognized, appreciated, and safeguarded for future generations of researchers. For this, we need scientific rigour, methodological innovation, public outreach along with site protection and, most importantly, international cooperation.

This issue of World Heritage Papers brings all of this together, and is another step to enhancing the implementation of the World Heritage Convention in this crucial area.

Kishore Rao
Secretary of the World Heritage Convention

Introduction

The book which the reader has in hand provides a comprehensive account of how Asian geography compelled the mobility of populations and the diversification of adaptations for a wide range of singular niches to ensure the survival of humanity since its earliest stages in Asia.

The Asian continent and geography as a whole were determined as the obligatory follow-up to the publication World Heritage Papers 33: HEADS 2: Human origin sites and the World Heritage Convention in Africa*, as this area is considered to have been, despite several scientific disputes, the first step out of Africa to be taken in human migration.*

This publication documents one of the fundamental purposes of the UNESCO World Heritage Centre HEADS Thematic Programme outlined in the HEADS Action Plan, as it represents the development of the awareness of the importance and specificity of the earliest heritage related to Human Evolution and the origin of our cultural diversity. It does this through its illustration of what is known today about the first human migrations out of Africa and the subsequent evolutionary processes that are manifest in Asia. The works in this volume familiarise the reader with other, lesser-known, geographical areas that present novel cases of evolutionary particularism in the dispersal of humans to the Far East. The subject of the first egress from the African continent continues to inspire academic research as scientific experts conduct research, striving to answer questions and fill empty spaces in scientific inquiry. These pages illuminate this scientific discourse surrounding the role of Asia in the dispersal.

New discoveries have significantly pushed back the date of the first journey and the scientific community has been obliged to re-articulate known and accepted bio-stratigraphic sequences to allow a reading that incorporates new results and previously established research in the contemporary canon of palaeontology. These new discoveries suggest new scientific hypotheses and this volume of the World Heritage Papers endeavours to fill the gaps that remain in mapping dispersal and migration routes in Asia and across the Arabian and Indo-Pakistan geographical area.

This book is a pioneer in its genre. Science, conservation, and multi-disciplinary approaches have seized this unique opportunity to contribute to our collective effort in the first occasion toward developing a full understanding of our early biological and cultural adaptations on the Asian continent and geographical area as a whole, and the role of international cooperation in this endeavour.

The discussions contained in this publication were informed by the meeting Human Origin Sites in Asia and the World Heritage Convention, *which was held at the Jeongok Prehistory Museum in the Republic of Korea from 24 to 28 September 2012. 51 scientific experts representing 19 countries and 30 institutions were in attendance.*

I cannot close this introduction without expressing my sincerest gratitude to my colleagues at the World Heritage Centre for their support throughout the successful undertaking of this project, the Jeongok Prehistory Museum for their dedication to the diffusion of knowledge to the general public and research experts alike, the HEADS Scientific Committee for their continual support in the building of bridges between scientific research and World Heritage. I would also like to thank all of the international experts whose devotion to the advancement of the study of human evolution in Asia provides the base for the book in hand. Without these parties this publication would not be possible.

Nuria Sanz
Head and Representative of the UNESCO Office in Mexico
General Coordinator of the HEADS Programme

1

The Outstanding Universal Value of human evolution in Asia

The Outstanding Universal Value of Human Evolution in Asia

Yves Coppens – Collège de France

Keynote speech on the occasion of the international meeting. 'Human origin sites and the World Heritage Convention in Asia' – Jeongok Prehistory Museum, Republic of Korea – 24 September 2012

Monsieur le Ministre,
Monsieur l'Administrateur,
Monsieur le Maire,
Dear Professor Kidong Bae,
Dear Nuria Sanz,
Dear Colleagues,

I am of course very honored to have the floor so early, in this important meeting on the prehistoric sites of Asia, and I am very happy that it takes place in South Korea, in the beautiful new Jeongok Prehistory Museum.

May I remind you, as far as space is concerned, that Asia is the largest of the 5 continents; 44 million square kilometers in comparison with the 10 million square kilometers of Europe, the 30 million square kilometers of Africa, and even the 42 million square kilometers of the Americas.

As we are at this meeting, dealing with Man, it is, I think, appropriate to start, as far as time is concerned, as early as 50 million years ago, with the Hominoidea. In every classification, Man, the genus *Homo*, is one of the taxa of the Homininae, subfamily of the Hominidae, family of the Hominoidea. And for several decades, the scientific community has accepted the idea, now well documented, that the origin of the family Hominoidea, is Asian.

Eosimias from China, *Birkinia* from Myanmar, *Siamopithecus* from Thailand, *Pondaungia* from Myanmar, *Amphipithecus* from Mmyanmar and Pakistan, and *Oligopithecus* from Pakistan, give a generous and obvious demonstration of the origin of this superfamily, the Hominoidea, all throughout the Eocene and Oligocene of Asia.

Discoveries of much later genera in Oman (geologically Oman is a part of Africa), and in North Africa (Egypt, Libya, Algeria, Morocco), give the impression and almost the demonstration, that the African branch of the Hominoidea originated from the Asian one.

But everything was then happening as if the family Hominidae, divided around 10 million years ago into Paninae and Homininae, was birthed from this African radiation and not from the Asian one.

In summary, Hominoidea was likely born in Asia, Hominidae and Homininae in Africa.

A climatic change is likely at the origin of the division of the descent of our last common ancestors, the Hominidae, into the two subfamilies I mentioned before, the Paninae and the Homininae. The reason for this division is likely environmental because the Paninae are obviously developing adaptations to covered landscapes, though the Homininae are developing, at the same time, their odd adaptation to a less covered environment: they were standing permanently upright for the first time, they were both walking and climbing, and had new behaviours and a new brain to go with them.

This part of our evolution, from roughly 10 million years ago to 3 million years ago, is documented in Africa and only in Africa.

It is possible in this evolution, to distinguish two successive steps from 10 million years ago to 4 million years ago, and from 4 million years ago to 3 million years ago: from 10 million to 4 million with *Sahelanthropus* from Chad (Brunet et al., 2002), *Orrorin* from Kenya (Senut et al., 2001), and *Ardipithecus* from Ethiopia (White et al., 1994; Hailé Sélassié, 2001); and from 4 million to 3 million, after an increase of the opening of the environment, with *Australopithecus* in Chad (Brunet et al.,1996), Ethiopia (Johanson et al., 1978), Kenya (Leakey et al., 1995), Tanzania and South Africa (Clarke and Tobias., 1995) and *Kenyanthropus* in Kenya (Leakey et al., 2001).

At the same time *Lufengpithecus* was living in China (Wu and Xu, 1985) and *Ramapithecus* and *Sivapithecus* in India and Pakistan (Barry, 1986) and I must say that I don't know clearly what has been their destinies, especially that of *Lufengpithecus*.

Descending from these previous Hominінae, appears a new step in our evolution, starting, of course, in tropical Africa because the ancestors were there.

This third step is due to a third climatic change (Coppens, 1975), a second increase in the opening of this landscape, and this new opening, a real drought, gave rise, from 2.7 million years on, to:

1) a robust *Australopithecus* in the Afar ecological niche, *Australopithecus garhi* (Asfaw et al., 1999),
2) another robust *Australopithecus* phylum in the south of Ethiopia, Kenya, Tanzania and Malawi, *Zinjanthropus aethiopicus* (Arambourg and Coppens, 1967) and *Zinjanthropus boisei* (Leakey, 1959),
3) a third robust *Australopithecus* phylum, in the south-African paleogeographic province, *Australopithecus prometheus* (Clarke, 2012) and *Paranthropus robustus* (Broom and Robinson, 1952),
4) a gracile *Australopithecus* phylum in the same south-African province, *Australopithecus africanus* (Dart, 1925), and *Australopithecus sediba* (Berger et al., 2010),
5) and an odd gracile invention again, starting probably in the east African biogeographical province, *Homo* (Leakey et al., 1964; Groves and Mazak, 1975) with a more complex, larger brain and a less specialized dentition to enable them to eat anything, including meat.

And this is almost the end of the exclusive role (from 10 million years ago to 2.5 million years ago) of Africa.

So, one of these genera, the last I mentioned, *Homo*, more mobile, more curious, better equipped, and more numerous, began to move almost as soon as it appeared.

By that I mean as soon as 2.5 to 2.7 million years ago, *Homo habilis* or *Homo rudolfensis* (if *rudolfensis* is different from *habilis*), spread all over Africa, and through the Middle East, by way of Bab-el-mandeb or by way of Sinai, or by way of both, all over Eurasia; may be Asia first, and for climatic reasons, Europe after.

In summary, 2.5 million years ago, we are back to Asia. And it is the reason why, from Israel (Yiron), Georgia (Dmanisi), through Pakistan (Riwat), India (Masol), Malaysia (Lunggong) to China (Longgupo, Longgudong, Renzidong) and Java (Modjokerto), stone tools, bones with cutmarks, and human remains are said to be 1.8 million years old, sometimes 2 million years old, sometimes 2.5 million years old.

I am conscious that this group of sites is very heterogenous and that the reality must be much more complex. I just wanted to tell you that, following the way I am understanding the chronology of the hypothesis 'Out of Africa' and *Homo*'s behaviour, I have not been surprised by the dating of Riwat, Masol, Longgupo nor by the status of *Homo georgicus* (Dmanisi) or *Meganthropus* (Java) described sometimes as *Homo rudolfensis.*

In summary, the earliest *Homo* from Asia come from Africa, but likely came very early, and they are anatomically closer to *Homo habilis* or *Homo rudolfensis* than to *Homo ergaster* or *Homo erectus.*

And, as you know, after this very early fascinating beginning, Asia has been answering the Hominid quest wonderfully: Erq-el-Ahmar and Ubeidiyeh in Israel, Nahr el Kebir and the Oronte Valley sites in Syria, Sangiran in Java, Yunxian, Chenjiawo and Gongwangling in China are more than, or around, 1 million years old. Nadaouiyeh in Syria, Hathora and Netankheri in India, Tham Kuyen and Tham Hai in Vietnam, Kedung Brubus and Trinil in Java, Mata menge and Dozo Dhalu in Flores, Hexian and Zhoukoudian in China, many sites in Korea, are several hundreds of thousands years old, and all these famous sites are documenting the long Palaeolithic period, the evolution of *Homo,* and its diversification in Asia.

Eurasia is, as a matter of fact, an immense territory, and the early hominid populations were very small, which means that these populations were soon divided and isolated from each other, in such a way that they could develop, by genetic drift and reduction of variability, the phenomenon of speciation.

It was the time of:

1) *Homo neandertalensis* in Europe first, and then in the Middle East (Tabun or Kebara in Israel, Dederiyeh in Syria), and eventually to central Asia (as far as Uzbekistan and the boundary between western Mongolia and Siberia),
2) a new Hominid called Denisovian, descending from Neandertal and found in Siberia,
3) the endemism of *Homo erectus* in Java, becoming clearly different from his continental relatives,
4) *Homo floresiensis*, the dwarf hominid species of Liang Bua in Flores, descending from Java Man,
5) *Homo sapiens* emerging early in continental Asia.

The diversification of hominid by vicariance into Neandertal, Denisova, Java Man, Flores Man, and Modern Man was expected and I am pretty sure that we will find or recognize more new species here and there in the future.

It is the transition *Homo erectus/Homo sapiens* which presents a problem.

I have never been entirely satisfied by the hypothesis 'Out of Africa 2', explaining that *Homo sapiens*, born in Africa, has been following the same evolutionary way (or ways) as their ancestor (hypothesis Out of Africa 1), 2 million years after them, and has been meeting (and mixing) with the previous populations peopling the whole continent of Asia for more than 2 million years without any problem!

Are we facing *Homo sapiens* coming genetically from *Homo erectus* in Asia and becoming *Homo sapiens sapiens* there (as elsewhere)?

Or are we facing *Homo erectus* becoming *Homo sapiens* in Asia, but receiving, much later, the arrival of *Homo sapiens sapiens* from Africa?

Or are we facing *Homo erectus* in Asia, receiving the early arrival of *Homo sapiens* from Africa?

I like the first option, I have called it the 'Out of Nowhere' hypothesis but, in Science, to like, even to love, is not enough.

The majority of our colleagues have adopted, more or less, the second option, the one they called the 'Out of Africa 2', that they have dated between 85,000 years ago and 55,000 years ago. Their reasons are good genetically speaking, but less robust chronologically.

Homo sapiens in Africa is 500,000 (to 600,000) years old (and called *Homo rhodesiensis*); *Homo sapiens* in Asia is as old as that, if not older (the Yunxian *Homo erectus,* 936,000 years old seems, for instance, to already exhibit some *sapiens* features).

Homo sapiens sapiens from Kibish, Ethiopia, is 190,000 years old and it is true that the *Homo sapiens sapiens* in Asia, appears younger, but the ancient discovery and dating of the skull of Mugheret El Zuttiyeh (called Galilean Man), in Israel, places it at 90,000 to 100,000 years old (Valladas et al., 1988). The discovery of Zhirendong remains in China, probably 100,000 years old (Liu et al., 2010), the recent discovery in India, in the upper Pleistocene of the Narmada valley, of a 75,000 year old humerus (Sankyan et al., 2012), and the recent discovery in the North East of Laos (Tam Pa Ling) of a skull 50,000 to 60,000 years old (Demeter et al., 2012) are bringing more and more embarrassing data, that the geneticists are trying to explain (Eriksson et al., 2012).

I don’t have the answer.

I think, at last, that it would be interesting, for our purposes, not to forget the important upper Pleistocene and Holocene discoveries of *Homo sapiens sapiens* remains or of their tools, in Asia, in Salkhit, north east Mongolia (30,000 years old) that I described with our colleague Tsevendorj, in Zhoukoudian, upper cave, in China, in Korea, in Japan, and in Siberia.

In Siberia the remains from Mamontovaia Kouria (40,000 years old), from the Yana river (30,000 years old), and from Berelek, Djuktai, Uski, and Malta could be the remains of the discoverers of America, through Alaska and the Yukon.

And after having started with the earliest Hominoidea, 50 million years old, I would like to finish this talk by the latest Homininae, at least the latest people associated with Ice Age fauna, Mammoths, woolly Rhinos, Przewalski's horses, muskoxen, bisons and so on; they are 6,000 to 3,000 BP and are coming from the Pribilof islands, St. Paul and St. George, in the Bering Strait, and from the island of Wrangel, in the extreme north east of Siberia, in the Arctic Ocean, but it is still Asia…

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2

Scientific Perspectives: Asia and HEADS

The evolution of modern behavior in East Asia

Nicholas J. Conard
Department of Early Prehistory and Quaternary Ecology – University of Tübingen – Germany

'A successful theory of modern human origin must encompass the Far East as well as Africa, western Asia and Europe' (Klein 2000)

Abstract

This paper addresses the record of human evolution in East Asia and considers how it both resembles and differs from the record in Africa and western Eurasia. The East Asian record preserves an array of regionally specific patterns of adaptation and evolution that are ultimately unique and warrant consideration in this light. In the contexts of the HEADS Thematic Programme's goal of establishing regional balance in identifying potential World Heritage sites, this paper touches upon a number of themes, narratives and research questions that help to define East Asia's early heritage and its contributions to human evolution. The paper also considers when behavioral modernity may have emerged in East Asia.

Introduction

Like the many other major parts of the Old World, research in paleoanthropology and Paleolithic archaeology in East Asia began in the late nineteenth century. This research tradition started in dramatic fashion with Eugene Debois's discoveries of skeletal remains of *Pithecanthropus erectus* in Trinil on the banks of the Solo River on Java in 1891 (Dubois, 1892; 1896; de Vos, this volume). Dubois' remarkable early success and sustained effort over decades to find evidence of early man in Southeast Asia shifted scientific attention about the origins of humans from Europe to the Far East. It was only with Raymond Dart's remarkable identification of *Australiopithecus africanus* at Taung that researchers gradually began to see Africa as the continent on which key phases of human evolution occurred (Dart, 1925).

Despite Dubois' brilliant, large-scale systematic research, his work did not motivate many local or western researchers to emulate his effort. The fields of paleoanthropology and Paleolithic archaeology scarcely existed in the Far East, and only rarely did western scientists attempt to conduct research in remote regions of East Asia. With the work of von Königswald at Sangiran in the 1930s more well preserved remains of *Pithecanthropus erectus* could be recovered, but their provenience was often poorly documented.

It was not unitl the 1920s that Paleoltihic research began in China under the lead of Teillard de Chardin at the Upper Paleolithic site of Shuidonggou in the well stratified loess deposits along the Yellow River in the Ningxia Autonomous Region in north central China. In the 1920s work at Zhoukoudian began and continued into the 1930s on a remarkable scale leading to the recovery of paleontological finds, hominin fossils and lithic artifacts in the 27 meter thick deposits of Locality 1 (Jia, 1984). The 6 skulls, numerous teeth and postcranial remains formed the basis of the description of Peking Man, *Sinanthropus erectus* (Jia, 1984). Excavations at Locality 15 in the 1930s the documented a long sequence of Middle and Late Pleistocene strata postdating the sequence from Locality 1, and research at Zhoukoudian Upper Cave completed the sequence with discoveries of skeletal remains of modern humans and rich Upper Paleolithic finds dating as far back as about 30 ka BP (Chen et al., 1992). The international, interdisciplinary team at Zhoukoudian during the 1920s and 1930s included the key researchers who influenced the fields of paleoanthropology and Paleolithic archaeology until near the end of the twentieth century. Research by scholars including Black, Pei, Jia, Weidenreich, Breuil and many others assured that Zhoukoudian would become the main point of reference for our understanding of human biological and cultural evolution in East Asia.

During this first phase of ambitious systematic research, von Koenigswald and Weidenreich recognized the essential similarities of the fossil hominins from Trinil, Sangiran and Zhoukoudian and used the term *Homo erectus* to characterize these specimens.

With the start of World War II research came to a halt and tragically the vast majority of the finds from Zhoukoudian were lost in the days following the invasion of Pearl Harbor when Chinese and American scientists tried to export the fossils to the United States. Although the Japanese military controlled Beijing the fossils had been housed in the Rockefeller Hospital under American control. The crates were packed and loaded by Chinese and American workers onto a military vehicle for export, but the shipment was lost or destroyed in the chaos of the early days of the US involvement in the war. Casts of some of the key specimens survived, but in the subsequent 70 years no trace of the fossils has turned up. The current director of the Zhoukoudian Museum, Mr. Yang, requested during my visit to the site just before the HEADS meeting in September 2012 in South Korea that UNESCO support Chinese authorities in trying to locate the lost finds. He pointed out that a member of the group of people who loaded the crates into a US military truck in 1941 is still alive and is presumably the last witness to this important event. Even if such an initiative failed to locate the finds or discover their fate, such a working group could perhaps clarify some of the events associated with this important disappearance, while at the same time drawing renewed attention to the importance of casting programs, digital archives of fossils as well as the potential fragility and ephemeral nature of the moveable heritage of human evolution. While Zhoukoudian is probably the most dramatic and tragic example of fossils and important finds being lost or destroyed, it is by no means the only such example.

In the years following World War II research began gradually in most areas of East Asia, with important discoveries in China and insular Southeast Asia. Important work included Movius' model related to the spatial and temporal distribution of core and flake industries and the definition of the 'Movius Line' defining the geographical limits of the Acheulean (Movius, 1948). Subsequent decades identified the outline of cultural evolution during the Lower, Middle and Upper Paleolithic and stressed the importance of the long-lived core and flake traditions of East Asia. As research progressed, scholars recognized different technological traditions and increasingly used radiometric dating to augment stratigraphic and biostratigraphic age estimates. Today distinct settlement histories are recognized in China, Korea, Japan and the Southeast Asian archipelagos.

Origins of modern humans in East Asia

In the context of this paper, the questions of the origins of modern humans and behavioral systems based on the manipulation of symbols and symbolic artifacts are of central importance. This question can be viewed within the framework of at least four models:

1) In situ local evolution from *H. erectus* (multiregional /traditional view)
2) In situ evolution with hybridization with incoming modern humans (view in East Asia today)
3) Out of Africa and complete replacement (western view from the 1990s)
4) Out of Africa with a degree of hybridization (western view today)

While East Asian colleagues in the past tended to emphasize the role of local evolutionary continuity and deemphasize the importance of the Out of Africa model, today the differences between eastern and western views of the emergence of modern humans are increasingly coming together. In part as a result of research on ancient DNA, scholars in the west are now prepared to acknowledge a degree of hybridization between archaic and modern humans. Many researchers in East Asia maintain the view of multiregional origins of modern humans, while agreeing that the process was accompanied by hybridization to some extent. In general, the contrasting views that in the past characterized eastern and western research traditions are now becoming less well defined. This process has accelerated in recent years with improved research facilities and improved interdisciplinary research teams using state-of- the-art methods in East Asia. This trend is particularly clear in China where, since the start of the new millennium, great advances have been made in the fields of human evolution and Paleolithic archaeology.

When considering the pattern of human biological and cultural evolution in East Asia, the Chinese record is the most complete and plays a central role. Some of the key hominin fossils that document the later phases of Pleistocene evolution include the following sites with current age estimates.

Xujiayao	Shanxi Province	125-100 Ka BP
Maba	Guangdong Province	120 Ka BP
Xuchang	Henan Province	100-80 Ka BP
Zhirendong	Guangxi Autonomous Region	100-113 Ka BP
Liujiang	Guangxi Autonomous Region	ca. 50 Ka or 153-68 Ka BP
Salawusu	Inner Mongolia Autonomous Region	ca. 50-40 Ka BP
Gezidong	Liaoning Province	ca. 50-40 Ka BP
Tianyuandong	Municipalty of Beijing	40 Ka cal. BP
Zhoukoudian Upper Cave	Municipalty of Beijing	ca. 27 Ka BP

Given the vast area under consideration, the number of well preserved and well dated fossils is not high. Interestingly, modern humans are well documented in East Asia at sites including Tianyuandong and Zhoukoudian Upper Cave in the Bejing region by roughly 40 cal. BP. This is approximately the same period that modern humans spread across Europe and replaced the indigenous Neanderthals. In China the specific nature of the spread of modern humans and the extinction of archaic hominins is still open to debate. This record of human evolution leaves open a number of key questions related to the contribution of indigenous hominins to the makeup of modern humans in East Asia.

The archaeological record

Although with every year new sites are being documented in East Asia and especially in China, Zhoukoudian with its many localities continues to serve as a major point of reference for human evolution. Other key regions are the Nihewan Basin with it impressive record of all phases of the Paleolithic beginning by 1.66 Ma and the localities of Bose that have produced assemblages with bifacial tools that are often viewed as refuting the strict concept of a Movius Line separating the geographic distribution of Acheulean and non-Acheulean assemblages. While the topic lies outside the focus of this paper, Wang (2005) has suggested that, although handaxes occasionally are found in southern China, the region is better characterized by the long-term presence of assemblages rich in cobble tools. This broadly defined region corresponds to the subtropical forest zone where bamboo may have played a role in the Paleolithic toolkits. Wang views the more northerly region of China as characterized by assemblages rich in small flake tool during the evolution of the *Homo erectus* lineage. Levallois technology is usually lacking, and although some sites have produced large assemblages of flakes, there is no clear separation of what in the west could be considered a Middle Paleolithic from the preceding Lower Paleolithic. In general, the continental record of East Asia shows a great deal of technological continuity and few, if any, well defined cultural entities comparable to those of the late Middle Pleistocene and early Late Pleistocene of Africa and western Eurasia.

A major break in the record is often said to occur with the start of the Upper Paleolithic and the appearance of blade and later micro-blade assemblages. This point of view is supported by an array of symbolic artifacts that have been known from Upper Paleolithic stratigraphic contexts since the first half of the twentieth century. The relationship between the appearance of laminar lithic assemblages and symbolic artifacts, however, is not straightforward.

The excavation of Zhoukoudian Upper Cave in the 1930s provided the best known and perhaps most important early discovery of symbolic artifacts associated with an Upper Paleolithic core and flake industry (Pei, 1939) (Figs. 1, 2). Interestingly, these early symbolic artifacts are found in association with core and flake assemblages rather than laminar assemblages. Even today the assemblage of ornaments from Zhoukoudian Upper Cave provides the richest record of perforated stones, bones and shells, as well as a small number of bone tools (Pei, 1939). Excavations at Shuidonggou Locality 2 in the Ningxia Autonomous Region , have yielded a blade industry accompanied by ostrich eggshell beads and bone tools (Gao et al., 2002) (Fig. 3). Both the key assemblages from Zhoukoudian Upper Cave and Shuidonggou date to between 24 and 30 Ka BP, placing them in the early phase of the Upper Paleolithic. These sites have long served as defining sites for the Chinese Upper Paleolithic, but current research is beginning to document a more diverse record of Upper Paleolithic adaptations.

Another site to yield symbolic artifacts is Xiaogushan Cave in Liaoning Province, where archaeological layer 3 dating to ca. 30-20 Ka BP poduced several tooth pendants found in association with artifacts belonging to a core and flake industry (Liaoning et al., 2009) (Fig. 4).

Figure 1: Zhoukoudian, Upper Cave. The cave contained numerous skeletal remains of modern humans in association with diverse organic artifacts and multiple forms of personal ornaments. After: Wang 2005.

Figure 2: Zhoukoudian, Upper Cave. The site contained the numerous skeletal remains of modern humans in association with diverse organic artifacts and multiple forms of personal ornaments. After: Pei 1939.

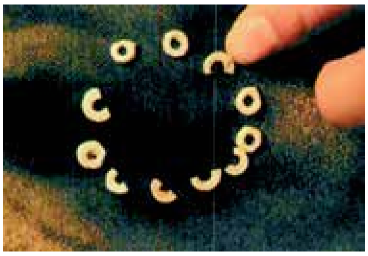

Figure 3: Shuidonggou (Loc.2) (Ningxia). Ostrich egg shell beads found with a blade bone industry dating between 24 and 30 Ka BP, Institute of Ningxia Autonomous Region. After Gao et al. 2002.

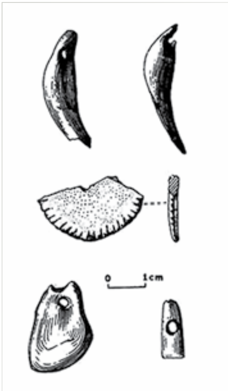

Figure 4: Xiaogushan Cave. Layer 3: ca. 30-20 Ka BP, Tooth pendants recovered with a core and flake industry. Liaoning et al. 2009.

This being said, some sites, such as Laonainaimiao in Zhengzhou, which has recently been excavated by the Archaeological Institute of Zhengzhou and Peking University, preserve indications of a more gradual transition (Fig. 5). The site provides a high resolution record with 13 separate find horizons within a 4 m thick loess deposit dating to ca. 45 Ka BP. This sequence documents flake based assemblages using an inclined knapping strategy (Conard et al., 2004) lacking both Levallois and platform cores. Quartzite and quartz represent the main raw groups. These lithic assemblages provide a uniquely detailed record of human technological behavior in association with hunting of horse, bison and deer. The faunal remains are well-preserved and some show artificial modifications. Radiometric dates document rapid sedimentation and suggest that all of the find horizons formed within roughly one millennium (Zhengzhou et al., 2012).

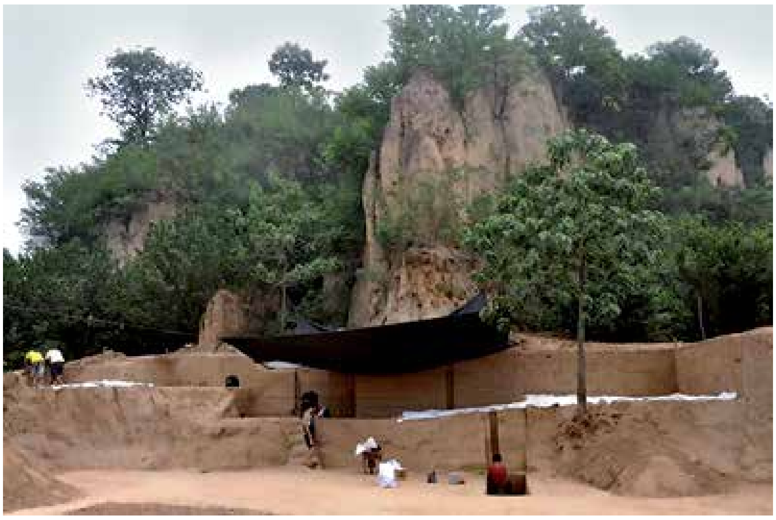

Figure 5. Laonainaimiao near Zhengzhou, Henan Province. Excavations by the Archaeological Institute of Zhengzhou and Peking University. After Zhengzhou et al. 2012.

Perhaps still more important for discussions about the early record of symbolically based behavior is the site of Zhaozhuang in the Henan Province also near Zhengzhou. The site was also excavated by colleagues from the Archaeological Institute of Zhengzhou and Peking University under Youping Wang's direction. The site dates to about 35 Ka cal BP and preserves evidence of symbolic behavior in the context of a flake based assemblage. This observation again contradicts the general assumption that complex symbolic behavior correlates with the presence of laminar lithic assemblages. At Zhaozhuang, researchers excavated a large pile of chipped quartzite artifacts covering about one square meter with the head and tusks of a full-grown elephant resting upon it (Fig. 6) (Zhang et al., 2011; Zhengzhou et al., 2012). Wang and colleagues point to the intentional nature of the discovery and argue that these findings reflect a form of early ritual behavior.

The early settlement of Japan also warrants consideration in the context of identifying complex cultural behavior in East Asia. Although the false claims of the presence of Acheulean technology of Lower Paleolithic age have been refuted, the question of the earliest settlement of Japan remains a focus of important research. The small artifact assemblages at Lake Nojiri document the presence of people in Japan slightly before 40,000 years ago at an age roughly comparable to the early settlement of Europe and Australia by modern humans. The early assemblages in Japan are all based on flake production and occasional bone tools with microblade assemblages appearing in the record of Hokaido about 25,000 years ago (Ono, this volume). The makers of the microblade assemblages are assumed to originate from Siberia and to have reached Japan in multiple waves of migration including possible arrivals via more southerly routes in addition to the spread of microblade technology from the north. The earliest phases of Japanese archaeology are just coming into focus through research in recent decades, but the consensus view argues that the first inhabitants of Japanese islands were anatomically and culturally fully modern. As was the case with the first people to reach Australia, the earliest Paleolithic inhabitants of Japan must have possessed great skills in seafaring. Given that most of the key early Japanese assemblages lack organic preservation, few organic artifacts have been recovered in Paleolithic contexts on the Japanese archipelago.

Figure 6: Zhaozhuang in Henan Province. Here the skull of an elephant was recovered resting upon a pile of chipped quartzite, shown in the photo with the excavator Youping Wang.

Returning to the Henan Province, new excavations from Peking University and the Archaeological Institute of Zhengzhou are challenging long held views about the evolution of laminar technology in China. Traditionally, microblade assemblages have been viewed as arriving late in China, perhaps in connection with expansion of technological traditions from Siberia. Excavations at the open-air site of Xishi in central Henan document the gradual evolution of microblade assemblages (Zhang et al., 2011). Here fieldwork in

2010 produced rich concentrations of laminar artifacts from a knapping workshop dating to about 25 Ka BP, which is earlier than other known assemblages of microblades. This early microblade and bladelet site is on the southern limit of the distribution of microblade assemblages, which seemingly contradicts the assumption that the makers of such assemblages originated from Siberia.

The further evolution of microblade technology can be seen at Lijiagou open-air site on the second terrace of the Chunban River (PKU and Zhengzhou, 2011). Here a very small microblade technology, early examples of crude pottery, a single partly polished stone adze, and a faunal assemblages containing remains of horse, bison and large and small cervids document the region's Epipaleolithic adaptations dating to the terminal Pleistocene (Figs. 7, 8).

Figure 7: Lijiagou open-air site on the second terrace of the Chunban River. Core for microbladelets.

Figure 8: Lijiagou open-air site on the second terrace of the Chunban River. Core for very small microbladelets.

Conclusions

One of the most remarkable aspects of East Asian archaeology in recent decades is the improvement of excavation methods over this vast area. Especially in China, new results of the kind discussed here from the Zhengzhou region of Henan Province are increasingly demonstrating the importance of mainland East Asia for our understanding of human evolution. With the economic prosperity of China, scientific research has quickly caught up with the leading western countries and is now of comparable standards. Also the East Asian tradition of respecting one's scientific predecessors has decreased to the point where critical scientific discourse is increasingly accepted in academic settings. These improvements and increased openness in the scientific culture in much of East Asia provide extremely promising conditions for further innovative research in the coming years.

East Asian, African and western Eurasian records of the emergence of complex behavior, as viewed via the presence or symbolic artifacts, differ. While generalizations about such vast regions are inherently tenuous, one could summarize the situation as follows. Africa shows a record of gradual evolution of symbolically based cultural behavior over the course of the Middle Stone Age (McBrearty and Brooks, 2000). Europe preserves a record of a radical increase in the use of symbolic artifacts as modern humans expanded across the continent around 40,000 years ago and drove the indigenous Neanderthals to extinction with relatively little interbreeding. Here, the full spectrum of symbolic finds, such as three dimensionally formed personal ornaments, figurative depictions, mythical imagery and musical instruments, appears very suddenly (Conard 2008; 2010). Rightly or wrongly this florescence of symbolic artifacts and numerous technological innovations in general and Paleolithic art in particular has been used to define the so called 'human revolution' (McBreary and Brooks, 2000; Bar-Yosef, 2002). As was the case with Southwest Asia, the record in East Asia documents a different and perhaps less radical change in the symbolic nature of the human adaptations. Also the Australian record, while including evidence for burials and personal ornaments from the start, lacks early examples of artistic expression.

From this point of view the European record represents more of an exception than the rule for the nature of the early Upper Paleolithic. This being said, if we look more closely to the archaeological findings, we see that each continent preserves a mosaic picture of the evolution of symbolic artifacts and what has often been referred to as behavioral modernity (Conard, 2007; d'Errico and Stringer, 2011). Despite differences in the record, I assume that behavioral complexity and the manipulation of symbols were well established during the East Asian Upper Paleolithic. Rather than imagining a single point source for the evolution of symbolic cultural behavior similar to that of all known historic and contemporary societies, I favor polycentric models for the evolution of modern behavior. This view rejects the model that the evolution of cultural practices based on the manipulation of symbols appeared only once like flipping a light switch. I prefer instead to view different regions as contributing to the pattern of cultural evolution in their own ways. Perhaps the vast continent of Africa is the root of this process, while Europe preserves the record of particularly remarkable sudden change as modern humans moved across the continent. In East Asia a wide array of personal ornaments made from different materials and a range of organic artifacts become relatively common with the beginning of the Upper Paleolithic. The evolution of symbolic expression, however, was complex with different regions showing different signals and different kinds of symbolic artifacts, as mentioned above, for example, with the finds at Zhaozhuang.

Assuming that important cultural innovations in the realm of symbolic artifacts occurred in East Asia, new research should help to fill the gaps in the current record. Today, systematic research including meticulous excavations and state-of-the-art analyses are making the East Asian record more central to international research. There is every reason to anticipate this trend to continue, so we can expect the East Asian record of the Paleolithic to play a key role in the years and decades to come.

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The Outstanding Universal Value of sites related to human evolution in Asia: the Acheulean as a case study for cooperation

Margherita Mussi
Department of Archaeological and Anthropological Historical Sciences of Antiquity – Università degli Studi di Roma 'La Sapienza' (University of Rome 'La Sapienza') – Italy

Abstract

The archaeological record of Asia is long and complex, offering ground for cooperation based on experiences acquired not only at the scale of the continent, but also outside it. This is especially true for the Middle Pleistocene record, and namely for the Acheulean. This cultural complex is well documented in the Near East and in India, but earlier sites and major archaeological sequences have been investigated in Africa. The preservation of Pleistocene sites occurs in different settings: in Asia fluvio-lacustrine basins, alluvial sequences, long-lasting caves have all been investigated and offer potential for future research, even if eroded areas do not allow the study of stratified sites, and problems also arise in terms of chronology. Innovative dating techniques are being worked out, leading to a re-assessment of the age of the deposits; while new methods of analysis allow the accurate evaluation of site formation processes and taphonomic issues. It is stressed that new narratives are also needed to convey to a larger audience the outcome of scientific research, and to make widely understood the Outstanding Universal Value of Asian sites and their potential for future research.

Introduction

Asia is by far the largest of all continents, extending from the Arctic to the Equator and beyond. It is also the most diverse in geography, climate, and history. Accordingly, I will focus only on parts of this enormous landmass and surrounding islands, and namely on the mainland affected by the Indian and East Asian monsoon. The time period under consideration will not include the final part of the Upper Pleistocene, when anatomically modern humans are assumed to have settled all over Asia. This will allow testing early human adaptation to environments very different from the lowland and highland savannahs of Africa. Reference will also be made to other parts of the continent, including the Near East, which is not linked to monsoon Asia in geography, environment or history of studies. Even if this is part of Asia, the local archaeological record is better understood when Africa and Europe are also included. Remaining Southwest Asia will mostly stay in the background, except for Dmanisi. New research is ongoing, notably in the Arabian Peninsula, but elsewhere Palaeolithic investigations have been generally quite limited over the last decades, and the patchy record needs to be updated.

The earliest human peopling is well established in the Near East, including the Caucasus, starting at 1.8 Ma at Dmanisi and 1.0-1.4 Ma at Ubeidiya, Israel. Some sites in the basin of El Kowm also are well-known early Middle Pleistocene sites. A mixed landscape of open parkland with surrounding forested hills had developed when the earliest hominins entered the region (Bar-Yosef and Belmaker, 2011, and references therein). The evidence is much slimmer farther East. In Dennell's words (2009, p. 119) 'evidence for hominins before 1 Ma across the vast expanses of the Indian subcontinent, Central Asia, mainland and Southeast Asia and China is at present very thin'. The only substantial evidence documenting the human peopling of parts of the continent earlier than 1.6 Ma comes from Java and from northern China, most notably from the Nihewan Basin. Recent research also allowed India to make a new entry into the Lower Pleistocene record (see below). This happens when the archaeological landscape changes dramatically, i.e. with the Acheulean, which has been discovered at a high number of sites, mostly in India but possibly also elsewhere.

The Acheulean – What's in a name?

The Acheulean developed over more than 1.5 million years, and is the longest lasting Palaeolithic industry. It is also the one with the widest geographical distribution, spreading over Africa and Eurasia. The Acheulean was first defined in Europe (see below), but it was eventually recognized to have originated in Africa. Discoveries in Eastern Asia happened later, and it is only in the last few decades that Acheulean industries have been recognized in China and elsewhere. This allows the expanded use of sophisticated methodologies developed elsewhere in the Old World over more than one century of research, including the definition of Acheulean itself: it is now expected to be more than simply a lithic assemblage of whichever composition and technical characteristics, provided that bifaces, in whatever percentage, are part of the repertoire.

Accordingly, the Acheulean of Asia is an excellent case study for cooperation in developing shared methodologies to preserve the Outstanding Universal Value of sites related to human evolution. Examples taken from the archaeological record and scientific developments in Africa and Europe will help put the Acheulean of Asia into perspective.

Europe

The Acheulean was first recognized in Europe at the end of the nineteenth century by Gabriel De Mortillet, who was a geologist and who later became a leading archaeologist (Nicole, 1901). Following a geological methodology, he used tool-types as index fossils, relating them to the best-known and most typical locality. This allowed him to characterise prehistoric periods, and to put them in a chronological sequence. In 1872, in his *Classification des diverses périodes de l'âge de la pierre*, he described a number of prehistoric lithic collections from northern France, taking St. Acheul as a type site (now a suburb of Amiens). Accordingly, he defined an '*Epoque de St. Acheul*', with a characteristic implement, or index fossil: the *coup-de-poing* – 'handaxe' in English. 'Biface', which usually refers to the same tool type, started to be used later, i.e. in 1920 by Vayson de Pradenne. The name *Acheuléen*, translated in English as Acheulean or Acheulian, was similarly introduced in the 1920s.

Through time, Acheulean superseded previous terminologies and came to include 'Chellean' and 'Abbevillian'. The latter names had been in use for some time for industries with rougher and 'more primitive' bifacial tools, apparently belonging to an earlier stage of human development - stages which were eventually found to lack stratigraphic consistency. While other parts of De Mortillet's nomenclature became obsolete, *l'Epoque de St Acheul*, renamed 'Acheulean', has ever since remained in full use.

Over half a century, Acheulean became a label widely accepted for lithic industries with handaxes discovered in large parts of Western and Central Europe, in the Middle East, in North Africa, in sub-Saharan Africa, and in parts of Asia. In 1969, G. Clark set a classification of industries by 'Modes'. Industries characterized by bifaces were labelled as 'Mode 2' industries, a terminology which is now used as a shorthand for Acheulean industries by the archaeologists who prefer Clark's system.

The 'Acheulean success' is linked to the very characteristic and easily recognizable *coup-de-poing*/handaxe/biface: a large, heavy, symmetrical, usually pointed tool which catches the eye. This iconic tool had even attracted attention before De Mortillet's times, and well before Boucher de Perthes and Lyell established the very antiquity of man in Europe. In 1797 John Frere sent a letter to the Society of Antiquaries of London describing '...weapons of war, fabricated and used by a people who had not the use of metals... The situation in which these weapons were found may tempt us to refer them to a very remote period indeed, even beyond that of the present world...'. The letter came with two handaxes from Hoxne (Suffolk), which are now on display at the British Museum, and was published in 1800 (Frere 1800). Admittedly, the finds of John Frere did not attract much attention at the time, and De Mortillet remains the founding father of the Acheulean.

Africa

Collections including handaxes have been made in East Africa since the last decade of the nineteenth century, when they were shipped back to European museums (Leakey, 1931; Mussi, 1973). Around 1905, handaxes, recognised as similar to those of France, were also collected at Stellenbosh, close to Cape Town. At the time, and throughout the first part of the twentieth century, developments in African archaeological research were strongly linked to those in Europe. In M. Kleindienst 's words (1962, p. 81) at the time of the IV Pan-African Congress on Prehistory in 1959, 'work in Africa is an outgrowth of the European tradition of prehistory'. Attempts were made to discard the imported terminology and forge a local nomenclature, most notably in South Africa (Goodwin and Van Riet Lowe,1929; Van Riet Lowe, 1952), where 'Stellenbosch' was introduced as an alternative label. In East Africa L.S.B. Leakey (1931) preferred to describe a 'Kenya Chellean' (later to be dismissed, just as was the European 'Chellean') and a 'Kenya Acheulean' as well. In 1967, formal recommendations were eventually made in favour of the 'Acheulian industrial complex' (Bishop and Clark, 1967).

A major change in global perspectives happened after 1971, when Mary Leakey's excavations at Olduvai Gorge Beds I and II were published. The new excavations and new dating techniques established the far greater antiquity of the Acheulean of Africa. Since, it has been well evidenced not only that industries with handaxes are widespread all over the continent, but also that they are nearly one million years older in Africa than in Europe. Kokiselei in Kenya, at 1.78 Ma so far is the earliest of all sites (Lepre et al., 2011). To make a chronological comparison, in Europe early evidence from southern Spain has been dated back to 0.9 Ma at Estrecho del Quípar, and close to 0.78 Ma at Solana del Zamborino (Scott and Gibert, 2009), while in Italy, France and elsewhere the record is more recent.

The African Acheulean starts earlier than in the other continents, and accordingly characterizes a longer part of the Pleistocene record. This led to methodological refinement in the definition and subdivision of this lithic tradition/complex. The focus solely on handaxes was found to be unsatisfactory. To evidence change, *débitage*, knapping techniques, raw material procurement strategies should all be taken into account. Sharon (2009; 2010) also underlines that cleavers, which are not so important in a European perspective, are on the other hand, characteristic of many African assemblages. A clear-cut distinction is established between the Acheulian found at African sites earlier than 1Ma, and also at 'Ubeidiya; and the later Acheulean, with large flakes (LFA), i.e. with flakes larger than 10 cm, which is a distinct segment of the Acheulean techno-complex. In the Large Flake Acheulean there is a high frequency of handaxes and cleavers shaped with minimal retouch, on flakes struck from the so-called 'giant cores'. Currently, a distinction between Large Flake assemblages, and non-LFA and cleaver-less assemblages, is also made outside Africa, with LFA understood to be later-occurring.

Asia

In the Near, East, the same succession of Acheulean assemblages is found as in Africa: at 'Ubeidiya, *c.a.* 1.5 Ma, large flakes are not a primary technological constituent and cleavers are absent; while at Gesher Benot Ya'aqov, at 800 Ka, handaxes and cleavers were mostly made on large flakes. Farther east, the Acheulean of India is mostly of LFA type.

Outside the Near East, or parts of it, handaxes occur in great number only in India, where the first collections were made as early as in Europe. An amateur archaeologist, Robert Bruce Foote reportedly found in 1863 a cleaver in a lateritic gravel pit at Pallavaram near Attirampakkam, in the area of Chennai, in the southwest of the subcontinent (Misra, 1978). Similar finds were made in the following years, but actual scientific investigation only started half a century later. Currently, hundreds of Acheulean occurrences are known to exist, including large-scale sites (Dennell, 2009; Gaillard et al., 2010; Petraglia, 2010). They are especially well documented in peninsular India. Elsewhere, the assemblages are much sparser: in the remaining Eastern Asia the Acheulean is described as 'patchy' and usually made by small scatters (Bar-Yosef and Belmaker, 2011).

The age of most of the Indian record is contentious: Gaillard et al. (2010) suggested an age greater than 600 Ka for some sites, but this led to heated debate as other scholars remained just as unconvinced by the dating techniques and contextual evidence, as well as by the proposed chronology, questioning them on various grounds (Chauhan, 2010). Recently, new research at Attirampakkam, in the area of the very first discoveries in the eighteenth century, led to the investigation of an Acheulean site dating to at least 1 Ma, and possibly to 1.5 Ma (Pappu et al., 2011).

Most of the controversy over the age of the Acheulean sites in India has arisen from the dating techniques used to assess the antiquity of discoveries. This is not unique to Asia: the early European and African records have also been through ebbs and flows of dating and re-dating processes, as in the case of the earliest peopling of Europe, or of the dates of Olduvai and of other major sites. In India the problem is made more acute by erosional processes over vast areas, as in the Deccan, which make finding secure stratigraphic sequences difficult. Tephrochronology has been used in the Rift Valley as a key factor in asessing the age of the Early and Middle Pleistocene record of Africa, and has also been used in parts of Europe. In the Indian subcontinent, tephra have only exceptionally been found and dated in relation with Middle Pleistocene sites. An important marker horizon is the tephra of the Toba super-eruption. The ashes from the volcano in Sumatra reached India, but this only happened at 74 Ka, apparently with limited impact on the prehistoric peopling (Petraglia et al., 2012).

Another wind-blown deposit, which allows the potential for dating, is tektite fallout. Tektites are gravel-size, or smaller, naturally occurring rounded elements, composed of glass which is high in silica resembling obsidian. It is believed that they are produced when a large meteorite or other extra-terrestrial body impacts the Earth (McCall, 2001). The material is projected into the atmosphere and then falls over vast expanses on the ground. The areas where tektites occur are called 'strewnfields'.

Only four strewnfields are known, on different continents and with different ages. Two were the result of an impact during the Quaternary: one, of limited extent, is located in West Africa, while the other, which is by far the largest, is the Australasian strewnfield. It extends over most of Southeast Asia, including the Philippines and other islands, encompassing the Indian Ocean and reaching Australia, covering over approximately one tenth of the Earth's surface. Southeast Asian and Australian tektites have the same age of *c.a.* 0.77-0.78 Ma (Ar-Ar and fission track) - that is, the Australasian strewnfield very conveniently marks the Lower to Middle Pleistocene boundary over an enormous area and within different stratified deposits. The presence of tektites has been used to indirectly date prehistoric sites, including Sangiran, which was inscribed in the World Heritage List in 1996 as 'one of the key sites for the understanding of human evolution' (http://whc.unesco.org/en/list/593: Sangiran Early Man Site). At Java, the rich collection of *Homo erectus* remains was started at the very beginning of the research on human origins, that is, at the time of Eugène Dubois in the late nineteenth century. Much effort has since been made to properly assess the age of the remains found when activities in the field were in a pioneering stage. The methodology was much different from that of today, relying on workmen and without the presence of actual scientists. Tektites recovered from the Kabuh Formation of Sangiran, where many important human fossils had been discovered, seemed, at some point, useful for narrowing down the age of the deposits (for discussion: Dennell, 2009; Rolland et al., 2013). However, tektites are light and primarily found in a derived position, with redeposition sometimes occurring long after the end of the Middle Pleistocene. The Kabuh Formation characteristics are those of a fluvial environment, and the age if the tektite is not in itself relevant, not even as a maximum age. Furthermore, the provenance of the two tektites described from the formation is not fully assessed.

Tektites were also found in the Bose basin of southern China, embedded in layers where handaxes were also discovered. In this case, the association with the archaeological remains seems quite sound. Abundant charcoal was also detected, which is interpreted as suggestive of 'an episode of woody plant burning and widespread forest destruction initiated by the tektite event' (Hou et al., 2000, p. 1624). Accordingly, the tektite fallout is contemporary with the event, which is at the base of the sequence, and the allows dating of it (but cf. Langbroek, 2004) for reservations on the actual concurrence of tektites and implements).

The preservation of stratified sites

Taphonomic issues

Difficulties in dating the Acheulean record of India arise from taphonomic issues, as well as the scarcity of deposits suitable for current dating techniques. Dating Attirampakkam to the Lower Pleistocene has only been feasible because of the development of new techniques, still in a pioneering stage, namely cosmic-ray exposure dating. This dating method is based on the accumulation, in exposed quartz material, of rare nuclides produced through nuclear reactions induced by high-energy cosmic radiation (Pappu et al., 2011). Paleomagnetic dating, which is a long-established method, was also performed, but it is well known that this method can only determine either a positive or a negative paleomagnetic signature. It needs further definition, which happens by fitting a number of paleomagnetic determinations into stratigraphic sequences; and/or supporting paleomagnetic results with other methods, as it happened in the case of Attirampakkam with cosmogenic nuclide dating.

India also lacks the extensive loess deposits of northern Eurasia, which have covered and protected a multitude of prehistoric sites. Admittedly, the loess also hides and conceals, but correlations over vast expanses, paleoenvironmental research, and absolute dating can all be performed with the presence of loess deposits. Tectonic activity, elsewhere in the world, is the origin of basins that are progressively deepened and filled by fluvio-lacustrine deposits. Melka Kunture, in a semi-graben depression of Ethiopia, is a well-known example of this. It is a mostly continuous Early and Middle Pleistocene sequence with a high concentration of archaeological occurrences, starting with the Oldowan, continuing with the early, the middle and the late Acheulean, then with the Middle Stone Age, and eventually with the Late Stone Age and up to historic periods (Chavaillon and Piperno, 2004). The chronology was assessed through 40 Ar/39 Ar determinations on volcanic tuff, and coupled with paleomagnetic investigation (Morgan et al., 2012). Even in such a setting, discontinuities in the record are the rule rather than the exception, and erosional surfaces have been detected. All the same, this kind of site provides exceptionally long lasting and well dated evidence. In Northern China, the earliest human settlement – definitely not Acheulean – was discovered in a similar, tectonically controlled setting, within the fluvio-lacustrine deposits of the Nihewan basin, in Northern China, west of Beijing (Li et al., 2008; Zhu et al., 2004). The Nihewan Basin beds are *c.*150 m in depth, with Pliocene strata at the base. The known archaeological levels, as assessed by high-resolution magnetostratigraphy, belong to different time-periods, from *c.* 1.66 to 1.21 Ma. That is, over nearly half a million years, the area attracted, again and again, small human groups. The human presence was probably only intermittent, when favorable conditions allowed expansion from farther south, as underlined by Dennell (2009, p. 183). Given the size of the investigated area and the thickness of deposits it is reasonable to expect more discoveries in the future.

At the other geographical extreme of Asia, the basin of El Kowm, in central Syria, is another outstanding repository of the Pleistocene archaeological record. The deposits have quite a different origin, even if tectonics are indirectly involved. This arid part of the Middle East is endowed with a cluster of perennial springs, along a system of faults, which allowed the development of a uniquely attractive environment over an area of some hundreds of square km (Jagher and Le Tensorer, 2011). The abundance of high-quality flint outcrops was another advantage. The archaeological sequence possibly starts earlier than that in the Jordan valley, as at Aïn el Fil an equid species is documented, which is more archaic than at 'Ubeidiya. The associated lithic industry is 'Oldowan-like' (Jagher and Le Tensorer, 2011). After 1 Ma there is a long Acheulean sequence, followed by Middle Palaeolithic sites, early Upper Palaeolithic sites, and later by Geometric Kebaran, Natoufian and PPNB sites. The uppermost part of the sequence, after the last interglacial, is well dated by ESR and other methods, while earlier evidence only fits into the chronological scale by relying on comparisons with better-dated localities of the Levant, such as Tabun. Erosion, and most notably deflation, is responsible for gaps in this remarkable sequence. As everywhere else, the record was preserved when protected by a cover of sediment. In the case of El Kowm, in some instances the cover happens to be made by aeolian deposits, but much more frequently hydrological deposits accumulated during the spring months, over a few tens of meters, lithics and other remains were encapsulated within travertines and preserved, allowing detailed investigation.

Caves, which are easily spotted on the landscape, have long been known as the typical place to look for prehistoric evidence. Karstic cavities, and other cavities, offer natural protection to the animal species, including humans, who settle there – or they provide a reasonably stable container for deposits that originate outside, and are conveyed inside by gravity or other natural processes. It is a conservative environment, but all the same a variety of sedimentary and other processes, including biological ones, are constantly at work. This happens in a constricted setting, and the cumulative effect of various agents and processes usually produces an intricate record – which, in turn, requires a very careful and sophisticated approach to be sorted out at the time of excavation. Caves, which appear as stable and immovable, are also subject to destruction, due to erosion of the rock cliff where they open, or to the collapse of the vault, as in the case of Qesem Cave in the Levant. They figure prominently in the European record, as large stretches of the continent are characterized by the mountain ranges where they develop. However, they mostly contain deposits of Upper Pleistocene age, while those with earlier sediments occur less often and/or are less frequently preserved. They also happen to be hidden by slope deposits, and are only reopened by chance, as was the case of Grotta Guattari in central Italy. Notwithstanding these problems, they are the focus of much archaeological research. Four caves of the Levant (Tabun, Jamal, el-Wad and Skhul) and their terraces, which have been investigated over nearly a century, are at the core of the recent nomination of Mount Carmel to the World Heritage List (http://whc.unesco.org/en/list/1393: Sites of Human Evolution at Mount Carmel: The Nahal Me'arot / Wadi el-Mughara Caves). The compounded evidence of the caves of Mount Carmel gives information on some 500,000 years of human evolution, starting with the upper Acheulean at Tabun. Accordingly, the Acheulean also occurs in the Middle East at cave sites, even if less frequently than the open air sites. Modern research and much effort has put the record, which had suffered from the practices of early researchers, back into a scientific setting.

Another cave with Middle Pleistocene deposits which was excavated a long time ago is Zhoukoudian Locality 1.40 km from Beijing, also on the World Heritage List (http://whc.unesco.org/en/list/449: Peking Man Site at Zhoukoudian). Inadequate digging techniques in the early stages of research and the loss of the extremely rich anthropological record during the Second World War were major obstacles to comprehending the meaning of this extraordinary site, with lithic assemblages which were quite different from the contemporary Acheulean. The dating has long been an especially difficult issue, which now seems, at least in part, solved thanks to scientific efforts and to newly-developed dating techniques (Shen et al., 2009; Zhou et al., 2000). There is fresh evidence that the human presence at the site goes back to an early stage of the Middle Pleistocene, and that the deposits accumulated over 300,000 years or even longer.

The Rock Shelters of Bhimbetka in the Madhya Pradesh of India were inscribed on the World Heritage List in 2003 (http://whc.unesco.org/en/list/925). They are composed of five clusters, each containing many hundreds of cavities, with remarkable evidence of Mesolithic and more recent rock art. The justification for the inscription rightly stresses the quantity and quality of cave art, and the long-lasting tradition of painting on cave walls, started by prehistoric hunter-gatherers. The presence of Acheulean is mentioned only cursorily in the 'Long Description'; furthermore, in the accompanying, more extensive documents prepared for the nomination, which are available at http://whc.unesco.org/en/list/925/documents/, it is written only that 'Bhimbetka is exceptional in the fact that in at least one of the excavated shelters (III F-23), continued occupation is demonstrable from 100,000 BP (Late Acheulian) to 1000 CE'. Bhimbetka F III-23, together with nearby cave F III-24, and possibly a few more unpublished shelters, actually is a unique cluster of caves with Acheulean layers, unparalleled elsewhere in Asia. Unfortunately, only preliminary information is available (Misra, 1978; 1985). While handaxes and cleavers were found in the hundreds, there is no radiometric dating, and the age of '100,000 BP' is just a guess estimate.

Valleys produce a different record, and different problems, as both fluvial erosion and deposition, or re-deposition, occur. Flowing water happens to cover archaeological remains with sediment, contributing to site preservation within a stratified context. However, dynamic processes are involved. More often than not the subtle balance between erosion and sedimentation ends, laying derived deposits and derived archaeological remains. Examples exist all over the world, and the archaeological research is constantly faced with the need to define the level of disturbance and sorting, making the best possible use of the lasting, if incomplete, evidence. Alluvial sequences, to start with, give chronological depth to the Palaeolithic record. In north-western Europe, the Somme Valley is where the *Epoque de St. Acheul* was first defined. Some of the so-called 'classic' Acheulean sites of Europe, such as Abbeville and Cagny-la-Garenne were discovered within a series of nine terraces, with covers of loess and paleosol developments (Tuffreau and Antoine, 1995, and references therein). Through time they were eventually related to glacial-interglacial cycles. Notwithstanding the detailed Quaternary record, which is the outcome of generations of geologists and archaeologists working in the valley and surroundings, absolute dating (ESR, U-series) and paleomagnetism has proven decisive to establishing a firm link with the MIS cycles. The geology and climate of India are vastly different, and the approach to settlement in valley systems has not been the same in this region. In central India, Chirki in the Pravara valley has been investigated, but it has proven difficult to put it into a fine chronological grid, even if there is some faunal evidence – rather exceptional at any Pleistocene open-air site of India – and attempts of dating by Th230-U234 were made (Petraglia, 1998).

A different approach was used in the Hunsgi-Baichbal valleys of southern India, which were thoroughly investigated over several decades by K. Paddaya and his associates. The area was purposefully selected because of the semi-arid climate and the lack of perennial streams (Dennell, 2009, and references therein). In a quarter of a century of continuous and meticulous research, 200 Acheulean occurrences were discovered, and a substantial number were excavated. The long-term research allowed rare insight into settlement systems. The sites were classified in a rather articulate way, with residential sites, food processing sites, caches, workshops. Hypotheses were also put forward on long-term and continuous occupation by the human groups of the final Middle Pleistocene who produced handaxes. Petraglia (2010), however, has a different perspective: after his calculation, if a long chronology of 750,000 years of duration is taken into account for the settlement in the Hunsgi-Baichbal valleys, the archaeological evidence points to no more than 1 site every 3,826 years; if a short chronology of 250,000 years is preferred instead, there is up to 1 site every 1,275 years, which is far from 'continuous' all the same. However, even in this carefully selected setting, at several sites there is evidence for disturbance and re-deposition.

Site formation processes

Site formation process are clearly a major issue in Palaeolithic (and later) archaeology. Scientists have long been acutely aware of the need to sort out the effect of natural processes and taphonomy, which otherwise would produce bias in the record. To cite an example related to excavations of half a century ago at Olduvai, Mary Leakey did not take the archaeological evidence at face value, and critically evaluated some of the sites. Describing WK Hippo Cliff, at the base of Bed IV, with lithics and the partial skeleton of a hippo, she makes the following statement (Leakey and Roe, 1994, p. 36): 'owing to the nature of the deposit, it was impossible to determine whether this was a butchery site where the artefacts were contemporary and genuinely associated with the skeleton or whether they were washed into the same river bed by floods, in common with the fragmentary remains of other animals, all of which could have been derived from a nearby site'.

Techniques have developed since then, allowing a scientific approach to the problems of derived sites. This, in turn, makes an evaluation of site potential possible, and allows the gathering of useful information even when the record is mixed and incomplete. In the case of early excavations, made when a more limited array of techniques were available, geological sections or residual deposits can be re-investigated, and geomorphological, pedological, sedimentological, and other analysis, such as thin section analysis, can be performed. Better and more complete results, however, are produced when more than just the stratigraphy is available, such as when questions are asked at the time of excavation. Geoarchaeological investigation at Shi'bat Dihya1, a site of the Wadi Surdud in Western Yemen, is a case study and an example of modern good practices. The archaeological evidence was dated at approximately 55 Ka by optically stimulated luminescence (OSL) (Delagnes et al., 2012). At first glance, the setting in a floodplain, in a small Quaternary tectonic basin cut by the Wadi Surdud and its tributaries, was favourable for site preservation. The archaeological deposit formed a thin layer of artifacts, embedded in a fine-grained alluvial sequence, and all stages of tool production were represented. The refitting rate was relatively high, artifacts derived from the same block of raw material were in close proximity to each other, and the pieces were not abraded.

To evaluate the integrity of the site, various methods were used (Sitzia et al., 2012): fabric analysis, to test the existence of preferred orientations of artifacts; particle size analysis, to evaluate the hydraulic sorting; and spatial analysis for the distribution remains. The orientations of the major axes of the artifacts was found to be polymodal, but with two modes dominating. The particle size analysis suggested a truncated assemblage with a composition significantly different from the initial one, as evidenced by the scarcity of implements less than 10 mm long. The distribution map showed that the concentration of the artifacts varied in space, forming bands, while on vertical projection they formed ripples, as those which are typical of the influence of slow to moderate currents. The conclusion was that the site had undergone significant transformations by fluvial activity. The relative paucity of small pieces was the effect of hydraulic sorting of the lithic assemblage during the flooding of the wadi. The concentrations of the conjoined pieces did not correspond to *in situ* knapping spots but rather to secondary concentrations originating from the redistribution of knapping spots. Pieces of the same initial concentration can be found close to each other in secondary clusters after a brief transit along the riverbed. Even in this case, geomorphological processes had significantly altered the archaeological record.

The lack of sites with handaxes in Eastern Asia and the Movius line

The apparent absence of handaxes and cleavers in Eastern Asia has long been the focus of much discussion. It was Hallam Movius who, in the 1940s, first underlined the lack of refined bifaces east of India. The so-called 'Movius Line', which marks a dichotomy and a supposed geographic boundary for the diffusion of the Acheulean, and has since been much debated (Lycett and Bae, 2010, and references therein). Quite recently, finds of handaxes in China and Korea have re-opened the question, even if the percentage of bifaces is much lower than in African and Indian sites, and even if surface collections are more frequent than actual excavations (Norton et al., 2006 and references therein), there are also morphological differences. Shipton and Petraglia (2010), who tested part of the easternmost biface inventories, further found them metrically distinctive, notably in weight.

There seems to be a growing consensus, at least among scholars looking to Asia from a Western perspective, that the easternmost handaxes are not the equivalent of an expansion of the Acheulean. Petraglia and Shipton (2008) actually do not totally rule out an Acheulean dispersal in East Asia, exemplified, so far, only by the bifaces and cleavers of the Luonan basin; but they conclude that, if this ever happened, it was a short-lived event, and Acheulean manufacturing methods were rapidly abandoned. Norton et al. (2006, p. 534) believe that, notwithstanding the new discoveries, the 'Movius Line', should not be discarded; and that the 'conspicuous lack of biface-bearing sites in East Asia is still prominent, despite over 80 years of paleoanthropological research in this region of the Old World'. Lycett and Bae (2010, p. 524) agree, as 'much of Movius' original archaeological observation on the East and Southeast Asian Early Palaeolithic… still holds true'. Bar-Yosef and Belmaker (2011) stress that, in their opinion, there is simply no Acheulean in southeastern Asia, not even in China, where the record is extremely patchy. The independent invention of the handaxe-like implements is another issue, which has been raised again and again, since the times of Movius himself, to account for the presence of bifacial implements far away from where they usually occur. Dennell (2009) does not exclude the possibility that the Bose bifaces might be a local development.

To end with the Movius line, it is probably safer to say, with Chauhan (2010), that the question remains thus far unresolved. Furthermore, as Bar-Yosef and Belmaker (2011) rightly underline, the 'Movius Line' is not a dichotomy unique to Asia: in Europe too, the Acheulean is well known in the western part of the continent, but notwithstanding a conspicuous amount of research by generations of archaeologists, farther East it more or less disappears and non-biface industries are prevalent. The time is over for a negative connotation – which after Lycett and Bae (2010) characterized an early stage of the debate – linking the lack of handaxes to a supposed 'monotony' of industries outside the Acheulean world.

In search of narratives for the Palaeolithic record of Asia

The emergence or explicit construction of narrative(s) is an important phase, or a step, in conveying the Outstanding Universal Value of sites related to human evolution, both to the general public and in the framework of nomination files to the World Heritage List. The state of the record is quite different in different parts of the Old World and Asia.

Powerful narratives have emerged in Africa, in the Levant and especially in Europe, where the process probably started earlier. The Neanderthals have provided rich ground for interpreting European 'diversity', once it became clear that they were rooted in the continent, even if they were able to expand outside of it. The encounter – or lack of encounter – with later, anatomically modern humans is a major scientific topic that will not be discussed here, but which has become a prominent subject with the general public and in fiction. Outside scientific and learned circles, encounters with Neanderthals, among other palaeolithic narratives, have long been popular in books, and later in comics and movies, sometimes as whole sagas. Cave art, which allowed the development of a dedicated tourism in parts of France, Spain, Portugal, and recently in the United Kingdom, is another major theme. In 1977, Jean Combier, better known as an archaeologist notably excavating at Solutré, was able to establish a list of *c.* 50 novels, '*oeuvres littéraires à theme préhistorique*', written in French or in English. Most, if not all, were centred on Europe. Prehistoric fiction has now vastly expanded beyond the European boundaries; inventories can be found in specific web sites (e.g. http://www.trussel.com/f_prehis.htm) and PhD dissertations have been devoted to this topic. The popularisation of prehistory has become a problem in itself, as more often than not it conveys unsupported ideas and models to the general public, which is not always able to make a distinction between fun and science. However, it is also a sign of vitality and interest that cannot be overlooked.

Elsewhere, popularisation is not so prominent, and the approach is more closely linked to archaeological science. In the case of Africa, 'Out of Africa' is possibly the best-known narrative, but 'Africa as the Cradle' is also well recognized and widely understood. More attention is also emerging in Ethiopia, where many important discoveries have occurred during the last few years, and have been appreciated by a wider audience of local students and tourists as well (Mussi, 2012).

The main characteristics and values of Bhimbetka, Sangiran, Zhoukoudian, the World Heritage sites of Asia mentioned above, are made clear in the documents used at the time of nomination, and available online. A narrative can be extrapolated, which is straightforward and effective, but also rather simple. Bhimbetka is described making mostly reference to wall art and to the continuity of traditions with modern inhabitants of the area; while at Sangiran and Zhoukoudian it is the importance of the Pleistocene human remains discovered there that is stressed. In the Near East, explicitly scientific narratives were conveyed in the nomination files of Mount Carmel (http://whc.unesco.org/uploads/nominations/1393.pdf), i.e. is at the time of a nomination that happened more recently than the other ones. Most notably, in the documents available online, it is stated that, 'the caves of Mount Carmel include the southern extremity of the Neandertal range, as well as the northernmost known remains of EAMH [Early Anatomically Modern Humans] dating to ca. 80,000-120,000 BP, thus being the only locality of a unique overlap in prehistoric human dispersal. The archaeological layers … bear unique witness [of] … the roots of our cultural and evolutionary diversity.' A map is provided, with the geographic extension of both Neanderthal and Early Anatomic Modern Humans peopling, as it is known today. This allows the clear definition of the overlapping distribution in the Levant. More also is written, about the length of the recorded human presence (500,000 years, starting with the Acheulean), and about the complex social organization evidenced at the Natufian sites of Mount Carmel, just before the major transition to agriculture and to a settled life. Interestingly, the documents explicitly take into account the actions undertaken by UNESCO in order to identify and fill the gaps in the World Heritage List. Mention is made, accordingly, of the HEADS Action Plan since 2010 and of previous recommendations by the Prehistory Working Group in 2008.

Outside nomination files, other narratives have been more or less explicitly worked out for Asia. This is especially evident in the so-called 'Multiregional evolution' hypothesis of *Homo sapiens*. It stands in opposition to the 'Out of Africa' model, as it is surmises that there is no single population origin for modern humans. Instead, evolution everywhere on Earth led towards 'sapientization', while genes were also exchanged among the different regions of the world. After this hypothesis, there is a degree of regional continuity in human peopling and human evolution, going back, in the case of Asia, as far as Zhoukoudian's *Homo erectus*. The anthropological evidence from other parts of Asia, such as Java, is also included. In recent times, the theory was further developed by M. Wolpoff (2002), who is one of the major proponents of this approach, firmly rooted in the Asiatic record. Outside of physical anthropology circles, the continuity from Zhoukoudian onwards has been perceived not only in human evolution, but in tool tradition as well, as elaborated in a book by Jia Lanpo (1980), directed to the general public of the 1980s.

The multiregional approach, which privileges Asia, is the outcome of the 'Asia first' approach which, in turn, was started much earlier. In a different and broader perspective, Eugène Dubois was strongly influenced by previous hypotheses when he went searching for human origins in the Far East and eventually at Trinil. Later, the discoveries at Zhoukoudian became central to the development of anthropology and archaeology, and even entered theological debates with Teilhard de Chardin. In the 1930s, when Louis Leakey was already working in Kenya, Asia was understood to be, by far, the largest repository of human fossils. Africa was dismissed as marginal to evolution, notwithstanding Raymond Dart, Taungs and other discoveries in South Africa (for a comparative history of studies: Bordes, 1968; Dennell, 2009). The approach changed dramatically after 1959 when the first fossils were found at Olduvai. The balance has since totally shifted from Asia to Africa – and the Pleistocene record of this part of the world is now simply overwhelming. There are after-effects of this complete change in the main route of human evolution, and attempts are rather bravely made, once again, to focus on Asia, e.g. by Dennell and Roebroeks (2005). It has also been rightly underlined that much more scientific effort has been invested, in the last fifty years, on Africa than on Asia. For the time being, however, an 'Out of Asia' narrative of human evolution cannot resurface with much success – even if, in the Abbé Breuil's saying, '*Le berceau de l'humanité est un berceau à roulettes*'.

Because of its vastness, Asia is also a continent of very diverse environments, from tropical jungle to the glaciated Arctic. In the case of Yana (Pitulko et al., 2004), the archaeological record testifies to Pleistocene human adaptation to extreme habitats: at 71°N, and beyond the Polar Circle, it is extraordinary evidence of human capabilities at 27,000 BP – admittedly, at the time of Anatomically Modern Humans. This arctic settlement, even if on a very limited and seasonal basis, implies that high-latitude Beringia could also be peopled, which was the route for the colonization of the Americas. In the Upper Pleistocene, Asia was also the continent where human species were the most diverse: not only with *Homo neanderthalensis* in the Middle East and at high latitudes, and *Homo sapiens,* at some point, almost everywhere else; but also the enigmatic Denisovians or the Altai, and the controversial Flores 'hobbit'. Accordingly, there is ample ground for new narratives.

Concluding remarks

Pleistocene archaeology was discovered as early, or earlier, in Asia than elsewhere. This includes the Acheulean, which in Africa and Europe has been the focus of many developments in scientific methodology. There is no equivalent to the Rift Valley with volcanic marker horizons, but conservative environments allowing site preservation such as caves, basins, and alluvial deposits, are well known in Asia. It is safe to assume that future research will allow the discovery of more Pleistocene sequences. A few Middle Pleistocene sites, with or without Acheulean industries, have been inscribed on the World Heritage List, while more deserve scientific attention.

Tool types are no longer used as index fossils, and this means that the iconic handaxe has lost its status as a shorthand for the Acheulean. Newly developed approaches analyze industries with bifaces in a comprehensive way. In Africa and the Near East the 'large flakes', including cleavers, have proven important to better defining a later phase of the Acheulean. The method has recently been applied in Europe and Asia, where it will help to place Acheulean sites of India into a sequence.

The chronology has proven contentious more often than not, but is beginning to be better assessed, after the development of new techniques such as cosmogenic nuclide dating; and the refinement of old ones, such as the use of tektites as a dating element. Site taphonomy is an issue that is increasingly important to assess the extant record, in the case of Acheulean sites as in the case of other lithic complexes. Procedures and analysis developed elsewhere in the Old World are applied in a sophisticated way to the Asian record and allow the re-investigation of sites excavated in the infancy of archaeology.

Narratives, which are important to convey information on the Outstanding Universal Value of a site or sites, somehow lag behind. The 'Out of Africa' model is not fully accepted from an Asian perspective, which opens interesting scenarios for future scientific developments. However, the rich record of Asia offers ample ground for other narratives, which can make use of some unique features of the archaeological documentation. This has already happened with nomination of Mount Carmel, which explicitly takes into account the recommendations of the international scientific community.

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The Significance of archaeological research in South Korea for human evolution; the case of Chongokni Paleolithic site, regional cooperative priorities in relation to research and conservation

Kidong Bae
Jeongok Prehistory Museum – Hanyang University – People's Republic of Korea

Abstract

Research of human evolution in East Asia has been going on for more than one century, but it was not until recently, quite late in the twentieth century, that attempts of diverse explanations of human evolutionary processes in this region have been made in related fields. However, human origins in this region, and their dispersal into this part of the world, should be one of the most critical topics in human evolutionary studies because various ecological zones that hominins adapted during the Pleistocene are in this region. Among the major topics concerning human evolution in general are: when did the first hominins appear in East Asia? How were the adaptive processes in the tropical environment different from those in previous ecological stages of dispersal? When the first hominins moved toward the temperate zone of East Asia, what were the cultural adaptations to this environment, which humans had never experienced before? What were the evolutionary processes within East Asia from the earliest ancestors to late *Homo erectus* in this region? When and how did modern *Homo* appear in this region and what were the accompanying cultural patterns? What were the two fundamental different adaptive processes which appeared at the turn of Holocene?, etc.

Current archaeological data in South Korea is believed to suggest a couple of important lines of evidence for understanding evolutionary processes in this region; one such line of evidence can be found in material culture, namely lithic industries, which often form the basis of cultural distinctions in deep prehistory. Among these, handaxes stand out as an iconic, and often indexical, tool form in early human prehistory. The first finds of bifacial handaxes at the Chongokni site in 1979 ignited new discussion of Movius' well known dichotomous explanation of the Paleolithic 'tradition' in the Old World. At present, the origin of modern *Homo* in East Asia has been one of the most popular topics in anthropology. Patterns of Late Paleolithic evidence in the Korean peninsula suggest that modern *Homo* in East Asia dispersed through two different routes: North and South. The heterogenic character of the late Paleolithic industries in the peninsula can be considered to represent a mixed culture of two different Paleolithic traditions. It indicates that two different groups of modern *Homo* merged in the Korean peninsula.

The Chongokni site is one of the most extensively investigated Paleolithic sites in East Asia, not only for archaeological but also for geological perspectives. In addition to morphological research on its lithic industry, geological research on the formation processes of basalt in the basin, tephras from the Japanese archipelago, loess from northern China, post-depositional transformation, etc., have been conducted for the chronology and site formation processes of the site. Hominin occupation at the site is considered to begin sometime during the mid-Middle Pleistocene on the basis of chronometric age dates obtained by various methods.

Human evolutionary research in East Asia with emphasis on South Korea

Overview

Human evolutionary research was begun in Asia by Eugène Debois' research of Human origins in Indonesia in the late nineteenth century. Since that time, an enormous quantity of Paleo-anthropological and archaeological data have been accumulated by various multi-national and national investigations in different regions in Asia. *Homo erectus* has been identified at many localities in China and Indonesia and more *Homo sapiens* fossils have been found in the wider area (Klein, 2009; Dennel, 2009, Glantz, 2010). Paleolithic localities of different ages are numerous in many countries in this region. It is a general understanding that *Homo erectus* dispersed quite far north in Asia, which is a cold temperate environment; they were not limited to tropical, subtropical and warm temperate zones. In pursuit of human evolution in different environments, Northern Asia is the first region in which *Homo* adapted to severe cold conditions.

Each country has quite a different history of the development of human evolutionary study. Paleolithic archaeology and the study of fossil man have been a part of archaeology in most countries. Fossil man finds would be great academic and social interests, even if the site itself may not be attractive at all. Paleolithic stone artefacts and small fragments of fossil man may not seem fantastic to ordinary people comparing the finds to beautiful celadon and grand ancient architect in historical times. In spite of the great scientific importance of evidence, academic research and preservation of sites is not a high social and governmental priority. As the economy grows and becomes more globalized, social interest increases, but human evolutionary sites remain in danger of being destroyed by development due to the lack of spectacular features on the surface of sites.

At the beginning stages of the research of important sites, western archaeologists initiated campaigns of research in many countries. Even today, the number of archaeologists and anthropologists in this field is few in most countries. In countries which experienced communist social regimes after WWII, extremely limited research has been carried out by international specialists. After WWII in China, the first visit of western archaeologists and paleoanthropologists took place in the mid-1970s and was lead by Clark Howell (Freeman, 1977). In spite of rich data and activities elsewhere, for almost 40 years, Chinese specialists had developed their own terminology and theories of human evolution and Paleolithic archaeology. In Japan, countless Paleolithic

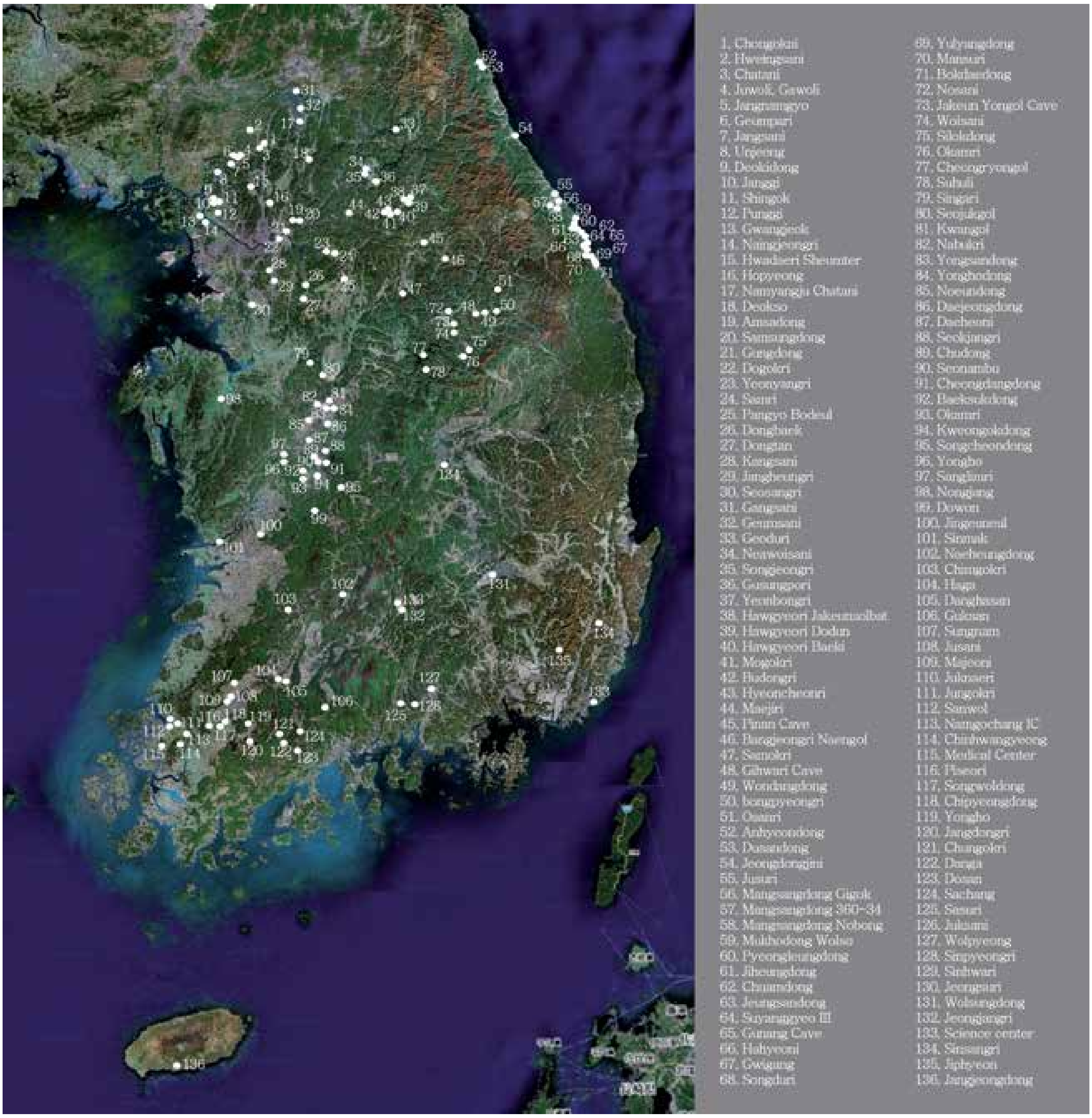

Figure 1. Map of distribution of Paleolithic site in the Korean peninsula.

sites, mostly Upper Paleolithic, have been found since the first, the Iwajuku site, just after WWII. Paleolithic studies in Japan were some of the most elaborate, in terms of age dates and typology. Human evolutionary studies in Korea started in the early 1960s. The finds at the Seokjangni by A. Mohr, an American archaeologist, initiated Paleolithic archaeology in Korea. Since that time, more than 200 localities have been identified in Southern Korea alone and are considered to be very crucial evidence in understanding hominin dispersal in Northeastern Asia.

Human evolutionary studies in the Indian subcontinent and Southeast Asia have made progress through local and multi-national projects. Some new finds of hominin fossils and new early age dates of stone industries in the Indian subcontinent are particularly important for understanding the arrival of early *Homo* populations and material culture. Knowledge about *Homo* in Indonesia has been expanded greatly by multi-national research in many different localities. Many more *Homo* fossils were found at different localities and improved dating accuracy. It is especially notable that the discovery of the so-called 'Hobbit', *Homo florensis* in Indonesia would be one of the most puzzling finds in human evolutionary studies (Widianto, 1993). However, it remains a big question with no concrete evidence of early humans in the continental part of the Southeast Asia as of yet, in spite of some questionable claims.

Current issues

Several critical issues can be raised in the study of Human evolution in Asia. First of all, what is the earliest evidence of human presence in this region? Current data indicates that the earliest examples are those in Indonesia, but there are some claims of older finds in different areas, namely, India and China. Do these early finds represent *Homo erectus* or possibly any earlier form? And are they really different from *Homo ergaster* in Africa? The next question is, what is the most-likely route of dispersal, from Africa or Near East? Another important issue is how *Homo* dispersed across Asia and what was the major pressure to migrate. Furthermore, not only movement to the East, but movement to the North and South should also be considered as key factors in understanding hominin dispersal and adaption to different environments.

Discussion about the 'Movius Line' has been one of the most popular and critical issues in Paleolithic archaeology in Asia (e.g. Shick, 1994; Norton and Bae, 2009). Acheulean vs. non-Acheulean or Acheulean vs. Chopper-chopping tool industry has been one of key concepts in this discussion. In spite of a long history of discussion, there is not yet consensus; variations on two different primary views still appear in many papers. One of the more fundamental issues in Paleolithic archaeology in East Asia is the large-scale pattern of lithic industries between South and North. In Southeast Asia, the number of stone industries is not great and extremely few have been thought to be from the early ages of the Paleolithic. Even in Late prehistory periods, stone tool technologies have not been well developed; Hoabinian culture looks quite different from elaborately fashioned blade technology and microlithic technology (Higham, 2003). Blade and microblade technology appeared only in the northern part of East Asia. In China, blade technology does not appear in the southern part of the Hwanghe basin. Obviously, there have been a great variety of, and differences in, adaptations to different ecological systems in processes of human evolution in Asia. In particular, in the Pacific region, human dispersal to remote islands is a very important topic to be discussed. When, how and why did humans move to islands in the Pacific region and how did they survive in limited ecosystems, as the case of the hobbit in Flores indicates, are important questions. Another topic we need to consider is the earliest evidence of occupation of high altitude sites in the Himalaya Mountains, even though this occupation would be much later than habitation in lowland areas (Mohapatra and Singh, 1979; Rendell and Dennell, 1985; Convinus, 2007).

These topics have been pursued in many academic research projects and; they could be considered as basic criteria for preservation policies as well. In spite of a recent increase in the archaeological and paleoanthropological data in this vast area, it is simply not enough to definitively answer these questions of human evolution in this part of the World. Preservation of important sites and the stimulation of further academic research at new and existing sites are critical missions for World organizations such as the UNESCO World Heritage Centre, as well as for local governments.

Paleolithic research in South Korea

Few hominin fossils have been found in southern Korea, while many localities have yielded various types of stone industries in the last half century. Human bone fragments were found at the Sangsi cave site, but identification of other such remains have been problematic. Lithic sites are found in major river valleys and mountain slopes, however hardly any faunal fossils are found at open-air sites except some limestone caves in Korea, due to the high acidity of soils and rapid erosion processes.

The Sokchangni site in the Keum river basin was the first site discovered in the southern part of the Korean peninsula and, along with the Kulpori site in North Korea, opened a new stage of prehistoric archaeology in Korea (Sohn, 1967; 1972; 1978).

Opening remarks on the occasion of the Meeting, 'Human Origin Sites in Asia and the World Heritage Convention' 24 September 2012

Administrator Kim, Chan
Cultural Heritage Administration of Korea – Republic of Korea

Director Bae Ki-Dong of the Jeongok Prehistory Museum,
Ms. Nuria Sanz, Chief of Latin America and Caribbean Unit from UNESCO World Heritage Centre,
Mayor Kim Kyu-sun of Yeoncheon-gun County,
International scholars from the academic field of prehistoric sites,
Distinguished guests,
ladies and gentlemen,

It is with great pleasure that I welcome you all to this meeting in such a meaningful year, that of 2012, which marks the 40th anniversary of the World Heritage Convention. I sincerely thank all of you for being here today to participate in the meeting.

My special thanks also go to the experts from the academic field and museums, as well as local government officials who provided their generous support for hosting this meeting.

As you may know well, the prehistoric sites have served as a key to the research of the human origins, evolution, development, culture and history in human history, seen either from a theoretical or scientific standpoint.

From the perspective of World Heritage inscription, however, truth be told, the value of prehistoric sites has drawn not as much attention as those of buildings and monuments, so far.

In this sense, I believe this meeting is very timely and imperative, as a venue for shedding another light on the value of prehistoric sites from the World Heritage perspective.

As far as I know, there are two World Heritage sites in Asia from where human remains were unearthed, which are Peking Man Site at Zhoukoudian in China and Sangiran Early Man Site in Indonesia.

Through this meeting, I hope, scholars and experts would share in-depth and productive presentations and discussions, based on which the universal value of prehistoric sites in Asia as future World Heritage sites are to be revealed both academically and practically, and thereby the sites being inscribed on the World Heritage List in the future.

I heard that in the program, you have an excursion planned to visit local historic sites in Yeoncheon, Demilitarized Zone, Changdeokgung Palace, and particularly, the mountain fortress of Namhansanseong, which the Korean government plans to submit for nomination in 2013.

I hope you have enjoyable moments when visiting those heritage sites and wish you to have a memorable time being mesmerized into the beauty of Korea's cultural and natural heritage.

Once again, I would like to extend my sincere gratitude to all of you for your precious time and contribution for this meeting.

Thank you.

Several localities of stone artefacts and limestone caves of Pleistocene faunal remains in South Korea were reported in the 1970s. It has been claimed that the Turubong caves, Cheongwon (Lee, 1983; 1996) and the Chommal cave, Jecheon (Sohn, 1980), exhibit evidence for human involvement in the formation of the extensive faunal assemblages on a basis of indisputably anthropogenic stone artefacts. However, the most important find in the history of Paleolithic archaeology in South Korea was the Acheulean-type industry from the Chongokni site in 1978 (Bae, 1983; 1988; 2012; Clark, 1983; Yi ,1984; 2010), which will be discussed in the following section. Many new localities have followed in the Hantan-Imjin river basin where the Chongokni site is situated in the middle reaches of the river and similar types of handaxe industries have been found through excavations at some of these localities (Norton et al., 2006; Bae et al., 2012).

Paleolithic localities were found during rescue archaeology of the submerged area of the Chungju Dam in the Namhan river basin during the early 1980s. Among them, the Suyanggae site and the Keumgul cave sites are of particular importance. Tanged points found at the Suyanggae site were considered some of the oldest in Far Eastern Asia as well as the origin of similar tool types in Maritime regions and Japanese archipelago (Lee, 1989). It is notable that stone industries with handaxes were found in the Keumgul cave along with Middle Pleistocene fauna (Sohn, 1984; 1985; Kong, 1987). Uranium series dates obtained from a bear molar fell in the range for the late Middle Pleistocene.

Since the early 1990s, numerous Paleolithic localities have been found in most of the southern part of the peninsula due to rapid social and industrial development. Even though there are some variations in the density of stone artefacts at a single locality due to differences in behavior and formation processes, Paleolithic industries are commonly found on river terraces and hill slopes along major river basins, while some are also found in remote mountain ranges too. Evidently, during the Upper Paleolithic, most of the ecological zones, definitely including the Yellow Sea Basin, were populated by modern *Homo*. Before the Upper Paleolithic, the distribution pattern of lithic localities varies in different parts of the peninsula; denser in the central part, with fewer localities in the southern part. Many Early Paleolithic localities with handaxes have been found in the Hantan-Imjin River Basin (HIRB) and in the lower reach of the Han River Basin in the central part of the peninsula (Norton et al., 2006; Bae et al., 2012). Tectonic changes caused by volcanic activity in the Chugaryong Valley during the Middle Pleistocene are responsible for the relatively high concentration of early industries in this region, although few early industries with handaxes were found in the southern part of the peninsula. It should be noted that many early Paleolithic sites had experienced re-deposition by colluvium processes from original geological contexts that often leave no remains.

It is not clearly known when the first hominin came to the Korean peninsula, but the Kommonmoru cave site in the northern part of the country has been dated to one million years old on a basis of the composition of the faunal assemblage from the cave. At present, it is very likely that hominins appeared by the mid-Middle Pleistocene because earliest hominin occupation at sites, for example the Chongokni site, are estimated to be of Middle Pleistocene age on basis of chronometric age dates, without mentioning earlier ages obtained by the cosmic ray method (26Al-10Be) (Lebatard, 2011; Bae et al., 2012). Some branches of populations appeared in northern China, Nihewan, Beijing and the Hwanghe Basin, possibly moving to the peninsula via the Yellow Sea Basin during glacial periods and along the coastal plains of northern Yellow Sea during interglacial periods.

No distinctive technological change has been observed in Early Paleolithic industries. Although ‘Middle Paleolithic’ is often mentioned for describing some stone industries from lower layers below layers of blade industries or other Upper Paleolithic forms, no technological implication can be made for the chronology of industries prior to the Upper Paleolithic ‘expedient’ tool type with very limited retouch on primary chunks or flakes, is common in early stone industries not only in Korea but in China too. Except for the development of the handaxe and cleaver, few typical types of shaped tools appeared in early stone industries. Various types of polyhedral cores and various stages of cores appeared commonly in stone industries. In this regard, early stone industries in Korea and China may represent a tradition of ‘non-retouched flake tool’ (Bae et al., 2012).

Blade technology appeared around 35,000 BP in the peninsula (Chang, 2002; Bae, 2010). It definitely diffused from Siberia and Mongolia due to a lack of blades in the South of the Hwanghe River Basin in China, while the evidence of early blade industries has been found in Manchuria and Inner Mongolia. However, populations from southern China are thought to have migrated into northeastern China and the Korean peninsula during the Upper Paleolithic through the exposed Yellow Sea Basin. Genetic analysis of modern populations strongly supports northeastern movement of southern Chinese populations from around 30,000 BP to 25,000 BP (Hong et al., 2005). The heterogenic nature of Upper Paleolithic culture in the Korean peninsula, elaborate tool kits with blade technology and flake tool industries on quartzite or vein quartz, probably represents two different population groups with different technologies moving into the peninsula throughout the Upper Paleolithic (Bae, 2010). Micro-blade technology is believed to have appeared by 25,000 BP on the basis of results from AMS dating (Bae and Bae, 2011) and is often considered to have originated from Siberia via Inner Mongolia, in particular from the Baikal region. Along with tanged points which are presumably part of a hafted tool, micro-technology was probably used for making hunting gear for big game. Big game such as mammoth, wooly rhinoceros, bison, etc., in the Siberian plains may have moved southward when grassland environments expanded during the glacial periods as was indicated by presence of mammoth molars in the central western coast of the peninsula.

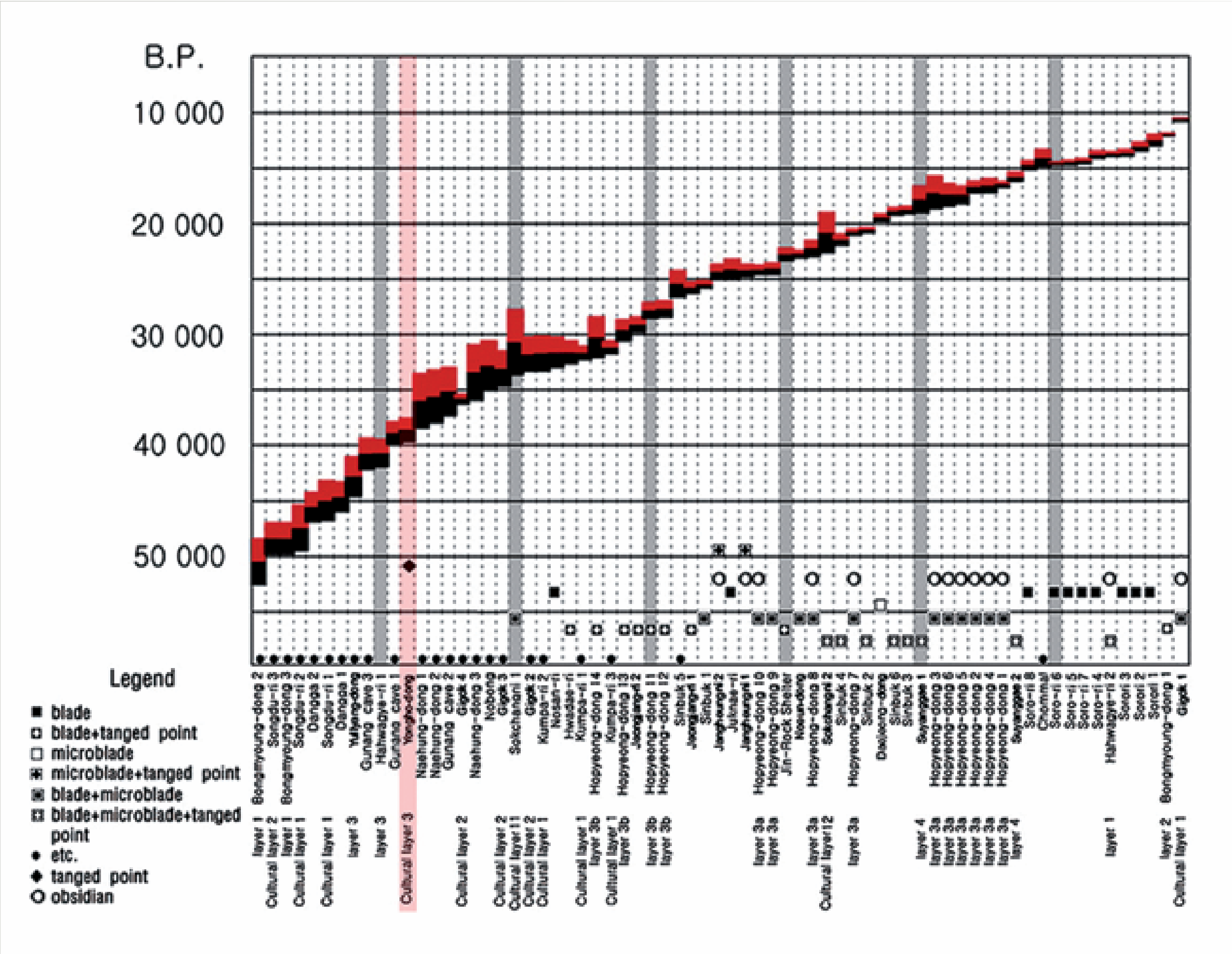

Figure 2. ^{14}C dates obtained from Paleolithic sites on the Korean Peninsula (Modified from Bae, 2010).

Current knowledge of archaeological patterns in the Korean peninsula, especially in the southern part of the peninsula, indicates that the patterns in the peninsula are somewhat similar to those on the Chinese mainland, but significant differences are observed in the mechanisms of dispersal and mixture of stone tool cultures from different origins. As expected, influence from the northern part of East Asia was more intense than that on the Chinese mainland, especially during the Upper Paleolithic.

Chongokni (Jeongokni) Paleolithic Site: significance to human evolutionary researches in East Asia

History of research and significance

The Jeongokri (Chongokni) Paleolithic site is well-known in the field of Paleolithic archaeology because the first Acheulean type handaxes were found there, for the first time in East Asia, in 1978 (Kim and Chung, 1979; Kim and Bae, 1983; Bae et al., 1995; Bae et al., 2001). Almost 20 excavation campaigns were carried out at the site during the last 30 years and a huge collection of stone artefacts was formed, including various types of handaxes, by series of archaeological research projects. Because of the handaxes and cleavers, the conventional hypothesis of World Paleolithic Traditions had been challenged and a serious discussion of the validity of the hypothesis has continued up to present-day.

The dichotomous hypothesis of Acheulean and Chopper-chopping tool culture was created by H. Movius in the 1940s (1944) and has been used as an explanatory model for patterns of Paleolithic industries in the East and West. Since the first finds at the Jeongokri (Chongokni) site, handaxes have been found at many sites in China as well as in Korea. At present, more than 20 sites have yielded some sort of handaxes in Korea (Bae, 1994; 2002a; Bae et al., 2012). Mostly these handaxe sites were concentrated in the central part of the Korean peninsula; in particular, in the Hantan-Imjin river basin and the lower reaches of the Han River. At present, handaxes and cleavers are some of the most common tool types characterizing early Paleolithic industries in Korea. However, because handaxes from the Jeongokri (Chongokni) site are the most diverse and characteristic, the stone industry from the site has been referred to as the most typical one of similar Paleolithic industries from East Asia. Diverse forms were found including handaxe-ovate and -pointed forms along with cleavers. River cobbles of veined quartz and quartzite were the most common material for making artefacts including bifaces. Except for handaxes, few tool types show refined technology of shaping, therefore it is often mentioned as an example of an 'expedient' type of industry.

The Jeongokri (Chongokni) site is one of the most intensively investigated Paleolithic sites ever in East Asia, alongside the famous Zhoukoudian site in Beijing, China, for the understanding of chronology of the site and formation processes of the deposits. Extensive joint scientific research, not only by Korean scientists but also by international scientists from Japan and France, was carried out for understanding the formation of the sediments and age of the stone industries of each layer of the site. Currently, an age of 350,000 BP has been estimated for the earliest stage of Paleolithic industry on the basis of sedimentation of loess deposits at the site in conjunction with OSL dates and tephra chronology at the site (Bae, 2002b; Bae et al., 2006).

The site was designated as National Monument No. 265 immediately after the first excavation of the site in 1979. An area of about 800,000 sq meters was protected by the National Heritage Law of Korea and a Buffer Zone of 500 meters was established to reduce disturbances. It is the biggest prehistoric site in Korea that has been designated as a National Historical Monument up to the present day. The Chongokni site was divided into 4 localities with Locality 4 situated on the opposite side of the other localities.

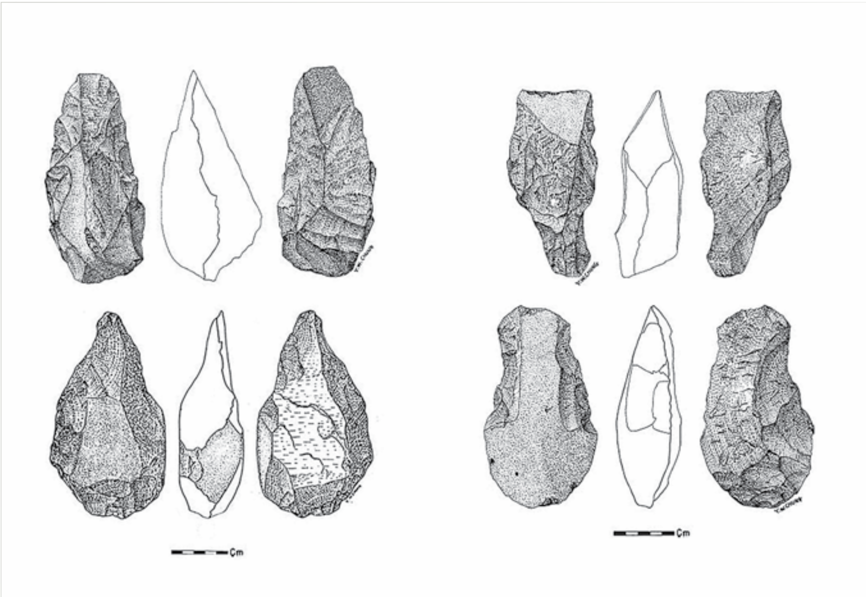

Figure 3. Handaxes and Cleavers from survey in 1978.


Figure 4. Stratigraphy of E55S20 Pit, 2000.

Geology and Formation Process

The geology of the HIRB (Hantan-Imjin River Basin) differs from that of the lower reaches of the Han River Basin. In the HIRB, a basalt plateau formed on top of the Precambrian Gneiss up to the point where the Imjin and Hantan rivers merge with the Han River in the Paju area. The HIRB appears to have been rejuvenated during a relatively short period of time after basalt filled the bottom of the basin during the Quaternary, as indicated by the presence of many hanging valleys along the basalt cliffs. This may be the reason why many more Paleolithic localities have been identified in the HIRB than in the Paju and Gimpo areas. The majority of the Korean bifaces are from sites located along the HIRB.

It had been generally assumed that several basalt flows from two small volcanoes, named Orisan and Geumbulrang in the Cheolwon-Pyounggan Plateau in the central part of the Chugaryong Valley, moved farther than 90 km to the Munsan area where the Imjin and Han rivers merge. However, recent geological research in the HIRB by a joint Korean-Japanese research team identified only two primary lava flows: the Chongok basalt and the Chatan basalt (Nagaoka, 2006). The Chongok basalt was dated to 0.5 Ma by K/Ar and fission track dating analyses (Matsufuji et al., 2005; Nagaoka, 2006). The Chatan basalt was dated to 0.15 Ma by K/Ar analyses (Nagao et al., 1984; Itaya and Nagao, 1988; Ryu et al., 2011). The two basalt flows are distributed in different localities, though the Chatan basalt can be found stratigraphically above the Chongok basalt near the Eundaeri village, located north of the Chongokni town. Sediment is present between the two basalt flows at the Eundaeri locality.

The Hantan River cut down the basalt plateau almost vertically leaving many hanging valleys on the edge of the plateau. This erosion process probably occurred abruptly at a certain point in time after down-cutting began. It has been very famous since ancient times for the splendid landscape of basalt cliffs that are observed along the Hantan and Imjin river basin. This is the only Quaternary basalt in the central part of Korea.

The sediment at the bottom was formed under alluvial environmental conditions when the ancient Hantan river was braiding or meandering on top of the basalt, while upper fine sediment is believed to be of aeolian origin (Naruse et al., 2006). Considering some areas of basalt do not show any evidence of alluvial action, it is posited that river channels were shallow and stayed lower than parts of the basalt plateau. Similar aeolian sediment structure is observed at many localities in central China, in particular sites along the Yangtze river basin and in the Shangtung peninsula (Naruse et al., 2008). Loess from the northern part of China and Inner Mongolia had been deposited across a wide area of East Asia, thicker near the source but gradually thinner moving farther into remote areas, such as the Korean peninsula and the Japanese archipelago.

Alternative layers of brownish loess and reddish soil appeared in the sequence of the deposit and are considered to represent climatic cycles (Naruse et al., 2003; Hayashida, 2003; Kim et al., 2004). It is notable that vertical cracks are often observed in the reddish soils. In spite of disputes about their origin in the past, it is generally believed that the cracks formed under periodical episodes of dryness in the local environment. Great variations in the structure of sediments have been observed at many different excavation pits in a same locality. It is believed that original sediments have been transformed by post-depositional processes caused by surface water the period of the deposition of fine clay.

Development Stages of Stone Industries

Despite these difficulties, four broad stages of stone artifacts from Chongokni have been proposed based on the location of the artifacts found in different stratigraphic layers from the alluvium at the base to the upper most clay deposit. In this text, 'Stage' does not mean any particular technological development, but the order of stages represents the chronological sucession of some stone artifact assemblages in the stratigraphy. Stage I, the earliest stage, represent artifacts found in the sandy-clay deposits and those above the Chongok basalt, while stone artifacts, found in the lowest level of the fine clay sediment above the fluvio-lacustrine deposits, are assigned to Stage II. Stage III includes all artifacts from the fine clay deposit that are higher than the lowest horizon of artifacts from Stage II. The artifacts from the upper most layer near the present surface are assigned to Stage IV (Bae et al., 2012). The Stage IV artifacts are generally found in relatively high concentrations in a single horizon and appear to be less disturbed. A good example of this is the artifacts from the Chongokni E95N65 pit, where some conjoined pieces were found with many small pieces of debitage during the 1994-1995 excavation (Bae et al., 1995). Nevertheless, because of the variation in the depositional histories of different areas of the Chongokni site, it is difficult to further evaluate the nature of the morphological and/or artifact type variation within the stratigraphic profile without more detailed lithic analyses (but see Yoo, 2007).

The sequence of these four stages of stone industries is made in correlation with overlying layers which clearly represent the order of sedimentation at the site. No change in typical lithic technology and composition of tool type has been observed throughout the stages. However, the size of artefacts from the Stage IV is relatively smaller than those of the previous stages and lower cultural layers. Cores from Stage IV appear to be more exhausted and are smaller as well as more patterned. No blade technology has been observed even in Stage IV, the upper most in the stratigraphy. Most of stone tool assemblages from cultural layers of excavation pits consist of heavy duty components such as handaxes, cleavers, picks, choppers, polyhedrals, etc. and some small pieces with minimal retouch for edge modification.

Although there are some concentrations of artefacts in thin single horizons, artefacts were loosely associated and some are isolated in a group of several pieces. Even though fine sediments look relatively less disturbed, in particular in the case of excavation units like E55S20 pit, at some excavation units artefacts were moved significantly in the horizontal level even to different lower layers due to surface erosion processes and bioturbation in the past.

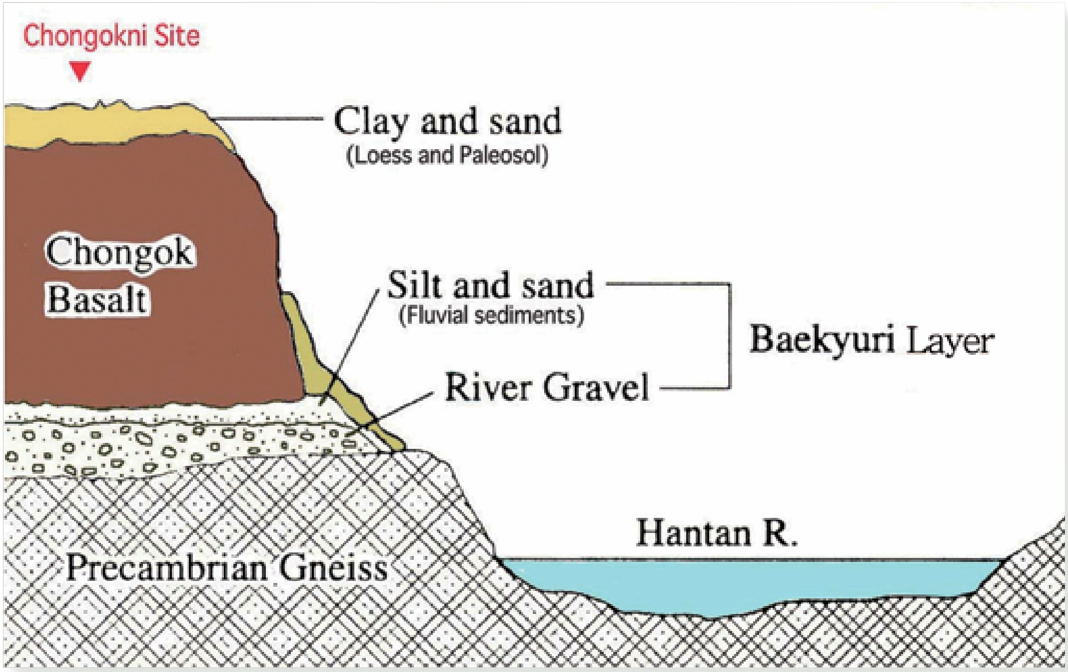

Figure 5. Geological section of the Hantan river near the Chongokni site.

Figure 6. Sampling for soil analysis in E55S20 Pit, 2002.

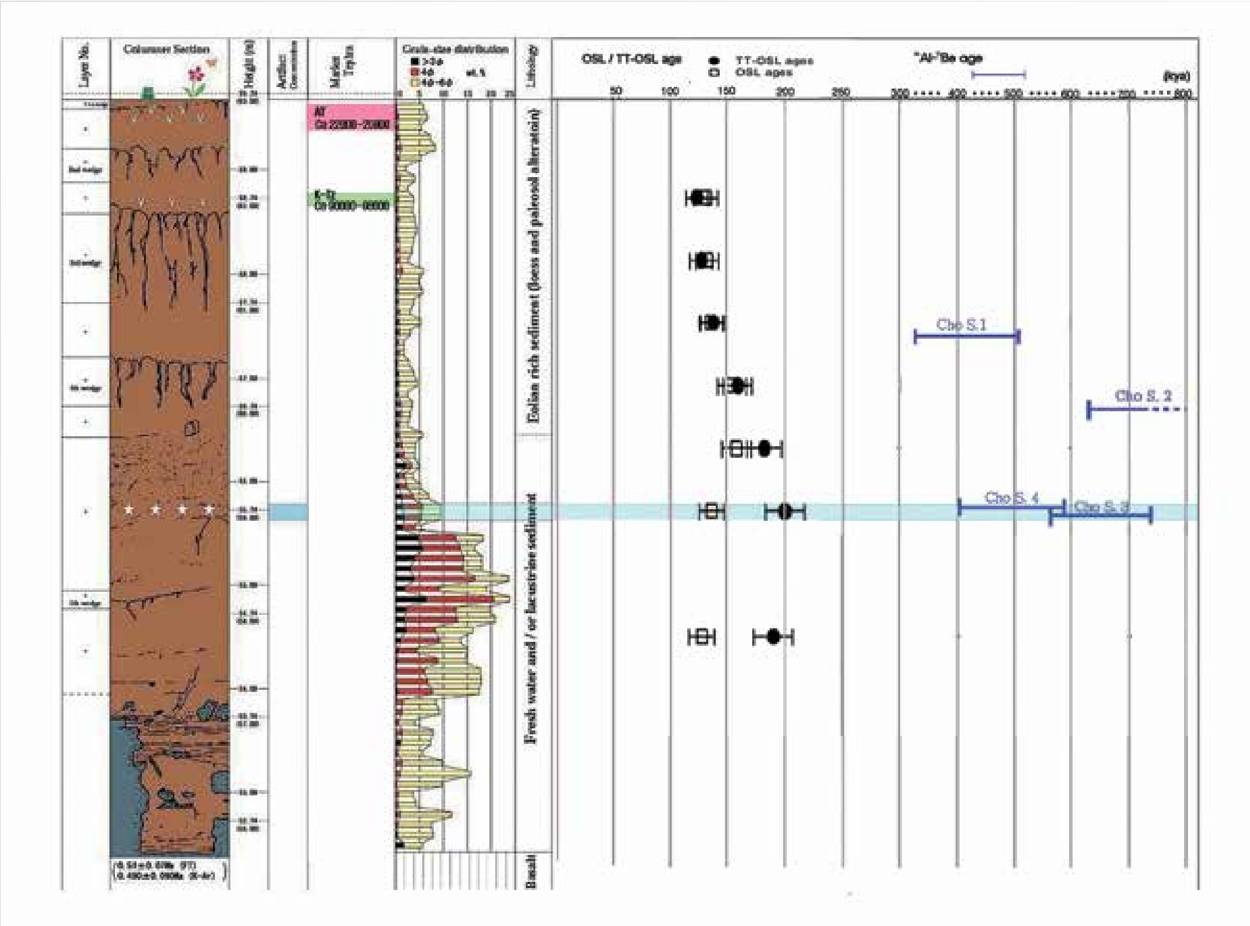

Figure 7. Chronometric dates of samples from pit E55S20 from Chongokni.

Dating and chronology

In the HIRB, the excavation pit that has received the most attention for chronometric reconstructions is pit E55S20 of the Chongokni site (Bae, 2002b; Norton et al., 2006). The base of E55S20 was dated by fission track dating to about 0.5 Ma (Danhara et al., 2002). The lower-middle level of the clay deposit was dated to older than 0.16 Ma and around 0.2 Ma by OSL (Naruse et al., 2008) and TT-OSL (Kim et al., 2008; 2011). In addition, two different volcanic tephras were identified in the upper levels of the E55S20 profile, with approximately 70 cm separating them (Danhara, 2008). The upper tephra was identified as AT which dates to ~25-22 Ka, and the lower tephra was identified as Ktz (Kikai-Toruzawa) which dates to ~95-90 Ka (Norton et al., 2006). These two tephras were identified in the Malan loess in Shandong Province, China, also separated by approximately 70 cm (Eden et al., 1993). Calculation of the sedimentation rate of loess deposit at the Jeongokri site was made on the interval of the two tephra horizons in the stratigraphy of the E55S20 pit; sedimentation of 70 cm thickness in about 70,000 years. If this sedimentation rate could be reasonably accepted as continuous, the beginning of loess sedimentation at E55S20 is thought to date to between 350-300 Ka. This estimation of age dates has been supported by the results from OSL dates. Because artifacts were found in the lowermost level of loess deposition, it is thought that the earliest hominin occupation of Chongokni should minimally date to the mid- Middle Pleistocene (Matsufuji et al., 2008; Norton et al., 2006; Norton and Bae, 2009).

In addition to the TL, OSL, and tephra studies at the HIRB sites, radiocarbon dates were also obtained on organic remains collected from holes created by burrowing animals (Vasilchuk et al., 2002) and charcoal, possibly burnt by lava (Yi, 2010). However, they are not relevant for estimating age of the archaeological industries in the sense of context and determining a date range for the samples. Most recently, 26Al-10Be isotopic analyses was conducted on a few pieces of stone artifacts from the E55S20 pit from Chongokni and Jangnamgyo (Bae et al.,2011; Lebatard, 2011). Somewhat surprisingly, the 26Al-10Be analyses suggested the stones from Chongokni dated to 0.8-0.4 Ma, which is much older than anticipated and actually conflicts with the fission-track dates for the Chongok basalt (0.5 Ma). The results of the 26Al-10Be studies for the Jangnamgyo site also resulted in fairly old dates (0.45-0.25 Ma). We are currently investigating why the 26Al-10Be dates are so much older than the results from the other dating methods.

Application of various dating methods has resulted in a wide range of chronometric dates for the HIRB sites, even for the case of Chongokni's E55S20 pit. At any rate, on the basis of results from fission-track, OSL, K/Ar, loess and tephra chronology, the Chongokni deposits appear to date from the mid- Middle Pleistocene to Late Pleistocene (as noted by the presence of AT tephra in the upper levels of deposit). Based on dates from the earliest occupation of the E55S20 pit, Chongokni is considered to be 350 ka (Norton et al., 2006; Norton and Bae, 2009), the lowest artifact levels at Chongokni should be among the oldest cultural layers of any of the HIRB sites at present. It should be noted that a handaxe-yielding cultural layer originally identified at Chongokni, and referred to as 'Stage I' (Kim and Bae, 1983), is considered to predate the lowest artifact horizon of pit E55S20. The cultural layer of Stage I is present below clay sediment, but above the fluvial sandy deposits. Because the higher part of the clay layer is considered to date to c. 0.35 Ma, it is thought that Stage I could be older than this. Presumably, hominins appeared not quite as late as the formation of basalt plateau at the Chongokni. In the meantime, it is necessary to accumulate more chronometric age dates using more advanced methods for Paleolithic localities in the HIRB as well as the Chongokni site. Nevertheless, more detailed chronometric studies are needed to better bracket the first and last appearing dates of hominin occupation at Chongokni and, more widely, the HIRB sites.

Deposits of the E55S20 pit represents a long sequence of sedimentation, longer than 350,000 years on the basis of current results of age dates. Several questions need to be pursued in future research, many are: there any developments of stone tool technology? Why is there no evidence for blade technology at the Chongkni site despite the presence of AT tephra in the upper part of the deposits? Were there any changes in adaptive strategies as the river moved away from the basalt plateau towards its present position?

Preservation: the Prehistoric Festival and Heritage Education

Figure 8. Performance by Mr. Mu Sejung at the 11th festival, 1993.

Why a festival at the site?

The Prehistoric festival at the site began in 1993, and eventually became very helpful for the site literacy among ordinary people who do not know much about the Paleolithic. The festival, which was purely a volunteer venture until 2000, was intended to promote and publicize the Chongokni site and Paleolithic archaeology. The festival was initiated and coordinated by Professor Bae Kidong who had conducted excavations as field-master under the late director, Prof. Kim Wonyong in the early stages of research and had been the excavation director since early 1990s.

The first festival was coordinated to commemorate the opening of a small site museum at the site, and the 20th festival in 2012 attracted almost a million people at the site for its five days. Owing to the successful annual prehistoric festival at the site in the last 20 years, local people have become aware of the importance of the site and realized that it could bring some economic benefits to local society. In fact, the Jeongok Prehistory Museum should be considered the most important achievement resulting from the popularity of the festival. In addition, the local government purchased most of the land with financial aid from the central government and has set up a plan of preservation and use since late the 1990s.

History of development

Major objectives of the festival were to make the public in adjacent regions recognize the value of the site and to develop ways to use it as an archaeology park through heritage education programs and various performance art events. Although organizers have changed several times during the last 20 years, the major objectives have been consistently pursued through diverse formats and strategies. The most immediate and critical objective was attracting as many people as possible in the early stage of the festival by means of performance art and exhibitions in addition to heritage education programs. It was

Figure 9. The fashion show of the 9th Festival, 1995.

Figure 10. Butchering a pig, at the 9th festival.

believed that public presence at the site and public attention to the site would eventually call the attention of central and local governments to this unassuming prehistoric site.

During the early years from 1993 to the 7th festival in 1999, Professor Bae Kidong initiated the organization of the festivals. In 1993, a field museum was established by Prof. Bae Kidong at the field station, which was given by the late President Park Jeonghee, with help from interested people and organizations to provide the basic information of the Jeongok site to visitors. The festival was coordinated with the field museums' opening ceremony. At the ceremonial festival, many famous archaeologists and heritage specialists were present to see a famous performance artist, Mu (shaman) Sejung's dance of 'Prehistoric People's Journey to Modern Days' as well as the exhibition. After the first event was held on April 11th 1993, the festival was moved to the Children's Day week, the first weekend after May 5th every year to enable more people, particularly more families, to come to the site with their children. People realized that the educational programs provided were of high quality and participation to the festival also did not cost much for a family holiday. Local associations of farmers, NGO organizations and concerned people volunteered to carry out diverse programs of heritage education, exhibitions and performing arts.

Since the 8th festival in 2000, the Yoenchon county government has provided funding, because they realized the importance of the festival for the local community. In the year of 2003, the festival was awarded a prize as one of the best in the Gyounggy Province. Every year, bigger and bigger crowds gathered for popular events of the festival, although heritage education has always been at the core of the festival's programs. From the 17th festival in 2009, an International Expo and Workshop of Heritage Education has been organized annually by the Institute of East Asian Archaeology. Museums and heritage organizations from various countries including the very remote countries of Kenya and Chile, have implemented practice their own programs of heritage education at the Chongokni site and have created workshops for the exchange of programs and ideas for improving heritage education in each of the participating organizations. This exchange has also provided diverse and interesting programs for the millions festival-goers international.

The annual festival has provided the community with an opportunity to enhance the image of the town nationwide in addition to providing a great contribution to the preservation of the Chongokni site. It has attracted huge crowds as well as political attention including the governor of the Gyounggy Province who is responsible for significant decisions related to policies which dictate preservation of the site. The most significant being the establishment of a field museum at the site, which had been desired

Figure 11. The 2nd International Expo of Heritage Education, 2011.

for a long time, as a center for cultural heritage research and other activities including heritage education. It was an exceptional political decision considering the huge investment in a remote rural area of low population.

The development of the Jeongok prehistoric festival can serve as a valuable model for the development of new heritage education events which will enhance public awareness and encourage efficient site preservation and use.

The Jeongok (Chongok) Prehistory Museum and Archaeology Park

Site museum and preservation

The greatest achievement of the prehistoric festival is the new Jeongokri site museum which was opened in 2011. The Jeongok Museum is a critical factor in preserving an important site through the exhibition and education of associated heritage for visitors and the general public. Because architecture itself is often considered a monument of a particular site, it can symbolize the significance of the site. It is especially important for prehistoric sites where no particular structure can be seen on ground. Particularly for preservation of prehistoric sites, a beautiful museum is an essential part of the strategy of preservation.

However, it may not be an easy mission to build a fancy museum to upgrade the social value of a site due to the high cost of construction of the building and exhibitions. Especially for prehistoric sites in remote areas of low population density, it may be a very complicated process to make to final decisions with governments and related communities. However tricky and tedious it may be to have a museum, it is effective for better practice of preservation: decision makers should know enough about the social value of a particular site for local and international communities. A museum can be a platform for dissemination of related knowledge and physical use of the site. The case of the Jeongok Prehistory Museum is one of the best examples to comprehend the whole complicated process and the role in the local community for the preservation of a prehistoric site.

Background History of Jeongok Prehistory Museum

Figure 12. Jeongok Prehistory Museum.

Backgroud History

A exhibition hall, named 'Jeongok Kuseokki Yujeokkwan (Jeongok Paleolithic Site Hall)', was established in 1993 for visitors at a small field office. Several panels on the history of excavation and Paleolithic archaeology were displayed on the walls. Stone artefacts from the Chongokni site were exhibited in showcases. The exhibition was coordinated with help from various organizations, concerned people and archaeologists. It was the tiniest museum in Korea, but it was the only one to show information about the Chongokni site to visitors.

However, visitors made complaints to the county office about poor quality and accessibility due to limited space and lack of regular funding for maintenance. These visitor complaints demonstrated that public awareness of the Jeongok site was growing. After 10 years of campaigning for establishment of a site museum, a master plan for a site museum and prehistoric park of the Jeongokni site was completed in 2003 by the Institute of Cultural Properties and Hanyang University with a grant from the Yeoncheon County

Figure 13. Provincial Governor KIM Moonsoo at the opening ceremony in 2011.

Figure 14. Exhibition Hall, the Jeongok Prehistory Museum.

(Bae et al., 2003). Huge crowds during the annual festival and the impressive wall of sediment in excavation pit E55S20 were critical factors for the final decision to invest over 40 million US dollars to make the establishment of the Joengok Prehistory Museum happen.

Site and museum

The architecture of the museum represents a strong message of its contents and the objective of the construction to the public. In the case of the Jeongok Prehistory Museum, architects intended the building to represent an image of 'prehistoric men and culture in nature'. Visitors are often surprised at the elaborate structure of the stainless steel building and expect interesting things inside when they approach to the museum. As the museum building is constructed at the edge of the basalt cliff, it looks like a gate to the prehistoric site when approaching from the Hantan River. The museum's architecture symbolizes a 'Gate to the Prehistoric Past'. The design concept of the architecture of the museum building is eco-friendly, which gives an image of prehistoric life in an ancient nature at the site. To create harmony with the landscape of the flat basalt plateau, the architecture is designed in a horizontal and aerodynamic-rounded shape.

Exhibition and heritage education

As a field museum of a Paleolithic site, the main objective of the exhibition is to provide archaeological and anthropological knowledge of the Jeongokri (Chongokni) Paleolithic culture in a framework of the human evolutionary process in the world. Lively reconstructions of hominins create a clear view of the evolutionary stages, hominin behavioral evolution and different environments are major components of the permanent exhibition. A reconstruction of excavation pit E55S20 of the Chongokni site as well as handaxes were the most important key elements.

In the educational hall, the 'Kid's Archaeo-Lab' provides a space for kids to enjoy the famous 'Ozzy Man' by experiencing a scientific analysis of human anatomy and archaeological objects. More specialized educational programs are prepared in the eco-garden in front of the museum building, for example prehistoric cooking, tanning, tool making, hunting etc. In addition, five conical huts and experimental excavation halls are expected to be used for special education programs in prehistoric archaeology including stone tool making, natural history, geological survey, human anatomy, etc. Many more pedagogical programs have been developed. The museum also makes visits to schools and military bases for outreach programs in archaeological education.

Through permanent and special exhibitions and museum education, the Korean public is made aware that human evolution is a new topic but interesting one, and in doing so they foster an appreciation of the social value of the Jeongok Paleolithic site. The local community begins to realize the site museum could promote identity and make a profound impact on the community economically as well as culturally.

Conclusion: significance and priorities for preservation

In the history of research during the last half century, the Jeongokni site is one of the most important finds in the Paleolithic archaeology of East Asia as well as in Korea because the Acheulean-typed bifaces from this site provided new evidence with which to approach global patterns of early Paleolithic and hominin adaptation during the Pleistocene. Since the new finds, although similar types of tools have been found at some sites in China, such as those in the Bose and Luonan regions, the significance of the Jeongokni site remains that it initiated new discussions of the validity of Movius' dichotomous hypothesis of Acheulean vs. Chopper-chopping tool culture in the Old World. In addition, various types and techniques of bifaces including some types of cleavers were observed and similar typological patterns of industries were found at many different localities in central Korea. The stone industry from the Jeongokni site represents Acheuelan-typed biface industries of Early Paleolithic in the Korean peninsula and allows for the extension of this pattern of the Early Paleolithic Age to be extended to the Chinese mainland too. It is also of great importance that some of the results from scientific analysis of the sediments at the site represent environmental changes during Middle and Upper Pleistocene in East Asia. Several Pleistocene tephras blown from Japan were identified in loess deposits which evidently originated in Northern China or Inner Mongolia. The sediments at the Jeongokni site are considered invaluable sources for understanding environmental structure and changes during the Pleistocene.

The HIRB is the only place of tectonic movement during the Pleistocene in the Korean peninsula. This is the critical reason why many early Paleolithic sites of handaxes have been found there. Well-preserved geological contexts of sites, significant finds of Acheulean typed handaxes, extensive scientific research for age dates and geological processes of formation among others. are of great importance for Paleolithic archaeology. The stone industry from the Chongokni site is believed to represent typical 'Early' Paleolithic industries in East Asia, when considering in conjunction with occasional finds of similar forms in Central China. It may represent the far eastern form of the Asian version of the Acheulean, or Chongoknian, which I prefer, at the time of mid-Middle Pleistocene.

The history of preservation of the Jeongokni site is very unique. As the site is situated in a remote town near the DMZ with very poor accessibility due to the high military presence, the site was well preserved at the first stage of the designation of national historical monument status despite the fact that this huge piece of land, more than 800,000 square meters for designated area and 500 meter from the boundary for buffer zone, was situated very near to the densely populated town. However, social development in the area raised conflicts between local government and community due to strict regulation of construction and the restriction of any possible disturbances of sites in the designated area and buffer zone. For two decades, various efforts in increasing public awareness of the significance of the heritage have been made through the heritage education programs of the annual festival and campaigns for a site museum. At present, the Jeongok site and the Prehistoric Museum are considered to be among the most valuable resources for the local community. The strategy of preservation of the Jeongok site would be one successful example of how to embed academic value of an important prehistoric site into the public consciousness.

Preservation of archaeological sites should be the first and fundamental mission of a society. In every country there are hurdles to overcome in order to preserve archaeological sites. Many archaeological sites do not have interesting or monumental aspects for the general public; only rubble at sites, nothing seen on surface of prehistoric site. However, cultural contents in rubble, potsherds and pieces of stone artefacts at archaeological sites could be reinvented in forms of popular culture by concerned and talented specialists in the associated societies. It is the role of specialists in cultural heritage, archaeologists and museum/ heritage specialists, to make the heritage accessible and popular among the general public without harming the heritage or site. As we move in deeper and deeper into the digital world, archaeological parks equipped with museums in a beautiful landscape could provide a wonderful space for people to physically interact with and imagine man's past.

Creating a festival is one example of such outreach, as in the case of the Jeongokri (Chongokni) site. The beautiful museum is the one that we have dreamed of for a long time, since the opening of the small museum in 1993. Mr. Mu Sejung's shaman dance of 'Primitive Man's adventure in Modern World' at the first festival made this dream come true 20 years later. It is hoped the Jeongok model of site preservation through active public use can be used as an example at many critical sites in many developing countries, for our rich and happy future.

Although there are a great number of human evolutionary sites in Asia, only two are inscribed on the World Heritage List and two on tentative list at present. It is necessary to foster a rigorous international discussion about how we can improve social understanding of human evolutionary sites and build up systems of preservation of important sites in Asia. The developments at the Chongokni site during the last 20 years are a good practical example, from a strategic point of view. Compared to more recent archaeological sites, human evolutionary sites are extremely rare, fragmentary and fragile. In this regard, effective action needs to be taken for the preservation of valuable evolutionary sites in Asia through the development of a policy of inscription before they are destroyed by the development of rapidly changing societies.

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Out of Africa and the evolution of human populations in Asia: thoughts about the nomination of prehistoric sites to the World Heritage List

Michael D. Petraglia
School of Archaeology – University of Oxford – United Kingdom of Great Britain and Northern Ireland

Abstract

The dispersal of humans and earlier ancestors out of Africa and into Asia is a key topic in human evolutionary studies. The earliest dispersals into Asia appear to range back to nearly 2 million years, whereas the migration of our own species from its African homeland probably occurred over a period ranging from 130 to 60 Ka. The fossil and archaeological record in support of these multiple dispersal events is remarkably limited, and DNA evidence is mostly confined to an understanding of the movement of *H. sapiens*. Nevertheless, the Asian landmass contains significant localities, many of which can help us to address important questions in palaeoanthropology, such as the relationship between climate change and hominin demography, the evolution of cognition and symbolism and the evolution of behavior. To date, relatively few Asian sites have been placed on the World Heritage List, though this situation can clearly be rectified by paying greater attention to the many key sites in the region. An examination and assessment of rock art districts throughout Asia is one of the potential avenues that could prove to be productive in nominating archaeological sites to the World Heritage List. Rock art sites and districts are spatially large entities, and often co-occur with significant archaeological deposits and human skeletal remains. As a case example, the rock art district of Bhimbetka (India), currently on the World Heritage List, is evaluated here to demonstrate how such a nomination is of value for preserving significant archaeological sites and landscapes. We demonstrate that Bhimbetka is not a unique example, and provide a case study from the Kurnool District of southern India, which has played a major role in many of the key topics of interest to palaeoanthropologists, Palaeolithic archaeologists and geneticists.

Introduction

The dispersal of hominins out of Africa and the subsequent colonization of Eurasia have been highlighted as significant themes by the HEADS World Heritage Thematic Programme of UNESCO. Yet, upon conclusion of a World Heritage Convention meeting on Africa, Sanz (2012a, p. 240) correctly notes that there is a considerable gap with respect to our knowledge of continental dispersals and the effect that environmental fluctuations had in structuring hominin populations. Owing to the poverty of high-quality and interdisciplinary field programmes, the same can be said about the Asian archaeological record, despite the fact that the 'Out of Africa' theme has been a hot topic in human evolutionary studies for the past two decades. Though we can anticipate radical changes in our knowledge about the Asian record and its relation to Out of Africa dispersals as more field work is conducted in the future, some information is currently present to at least formulate a broad outline about hominin movements through time.

One of the earliest sites for documenting the movement of early *Homo* outside of Africa is the site of Dmanisi, in the Republic of Georgia, which is currently being considered for inscription as a World Heritage site. At Dmanisi, an early artifact industry dates to ca. 1.85 million years ago (Ma) (Ferring et al., 2011). Mode I, or Oldowan-like tool users, have also been documented as far east as Majuangou, in the Nihewan Basin of China, where a date of 1.66 Ma has been obtained (Zhu et al., 2004). *Homo erectus* eventually reached Indonesia by ca. 1.6-1.5 Ma ago (Swisher et al., 1994), as documented at the Sangiran site, which is currently inscribed on the World Heritage List. Somewhat later, dispersals from Africa are documented by Acheulean tool users, who produced large bifacial implements referred to as handaxes and cleavers. The Levantine site of Ubeidiya indicates the presence of Acheulean tool users by ca. 1.4 Ma (Bar-Yosef and Goren-Inbar, 1993). Acheulean tool-users spread to the Indian subcontinent by ca. 1.5-1.0 Ma (Pappu et al., 2011). Later Acheulean dispersals, at ca. 800 thousand years ago (Ka), are marked by advanced biface technologies, represented at sites such as Gesher Benot Ya'aqov in Israel (Goren-Inbar et al., 2000).

The earliest dispersal of *H. sapiens* out of Africa is documented in the Mount Carmel caves of Israel, which has recently been granted World Heritage status. Here, fossils representing *H. sapiens* are present between 130-70 Ka (Shea, 2008). Yet, this evidence has been traditionally been interpreted to represent a 'failed' dispersal event (Oppenheimer, 2012). An alternative interpretation is that Middle Palaeolithic sites across the Arabian Peninsula and India represent a broad and successful movement of modern humans out of Africa (Petraglia et al., 2010; Boivin et al., 2013). Geneticists have traditionally supported a successful movement of modern humans out of Africa by about 65-60 Ka on the basis of mitochondrial DNA (Macaulay et al., 2005). More recent whole genome analysis suggests that the dispersal out of Africa may coincide with the Levantine fossils and Middle Palaeolithic sites across southern Asia, i.e., between 130-90 Ka (Scally and Durbin, 2012), though examination of mitochondrial genomes from contemporary and fossil populations places the separation of Africans and non-Africans to no earlier than 95-62 Ka (Fu et al., 2013). The recovery of ancient DNA from Neanderthals and from the Denisova Cave specimen in Siberia, now supports the view that some interbreeding occurred between archaic hominins and *Homo sapiens* as they spread across Asia (Stewart and Stringer, 2012).

The geography of hominin dispersals is of some importance to consider. The prevailing theory has been that modern humans swept rapidly out of Africa along coastlines, thereby skirting inhospitable environments such as deserts (Stringer, 2000), and thus implying many sites are now submerged along the continental shelf. However, an alternate hypothesis is that modern humans (and earlier hominins), utilized terrestrial routes for their dispersal, taking advantage of interior river valleys and lacustrine settings during humid periods (Boivin et al., 2013).

Topographic variation and environmental change probably exerted strong influences on the tempo and route of human dispersals (e.g., Groucutt and Blinkhorn, 2013). Significant fluctuations of environments over the Pleistocene would have influenced the structure of Pleistocene populations as they moved across Asia (Dennell, 2009; Petraglia et al., 2010). In humid, inter-glacial periods, southern latitudes across Asia would have facilitated hominin expansions, such as across Arabia, which would have had grasslands and plentiful rivers and lakes, such as the Jubbah Palaeolake basin (Petraglia, 2011; Petraglia et al., 2012a) (Figure 1). However, at the same time, major river systems and tropical rainforests in South East Asia may have acted as a barrier to movement, as adaptations in these ecological contexts may have required sophisticated weaponry (Boivin et al., 2013). During arid periods, when deserts expanded, human populations may have contracted to refugia, such as has been suggested at the Arabian sites of Jebel Faya, near the Persian Gulf (Armitage et al., 2011) and at Shi'bat Dihya, in the elevated regions of Yemen (Delagnes et al., 2012) (Figure 2). Arid periods would have thus forced populations into smaller geographic zones, and some populations may have experienced extinctions owing to inhospitable environments. In some regions, such as India, a mosaic of environments was always present, thus supporting human populations, unlike Arabia which experienced much more dramatic environmental changes (compare Figure 1 and Figure 2). Yet, increased aridity in other regions of Asia may have led to new opportunities, such as in South East Asia, where the dense tropical forests turned into fragmented woodlands and grasslands (Boivin et al., 2013). Thus, an important consideration in Palaeolithic studies concerns the degree to which populations may have been temporary visitors or permanent occupants in any particular region (Dennell, 2003).

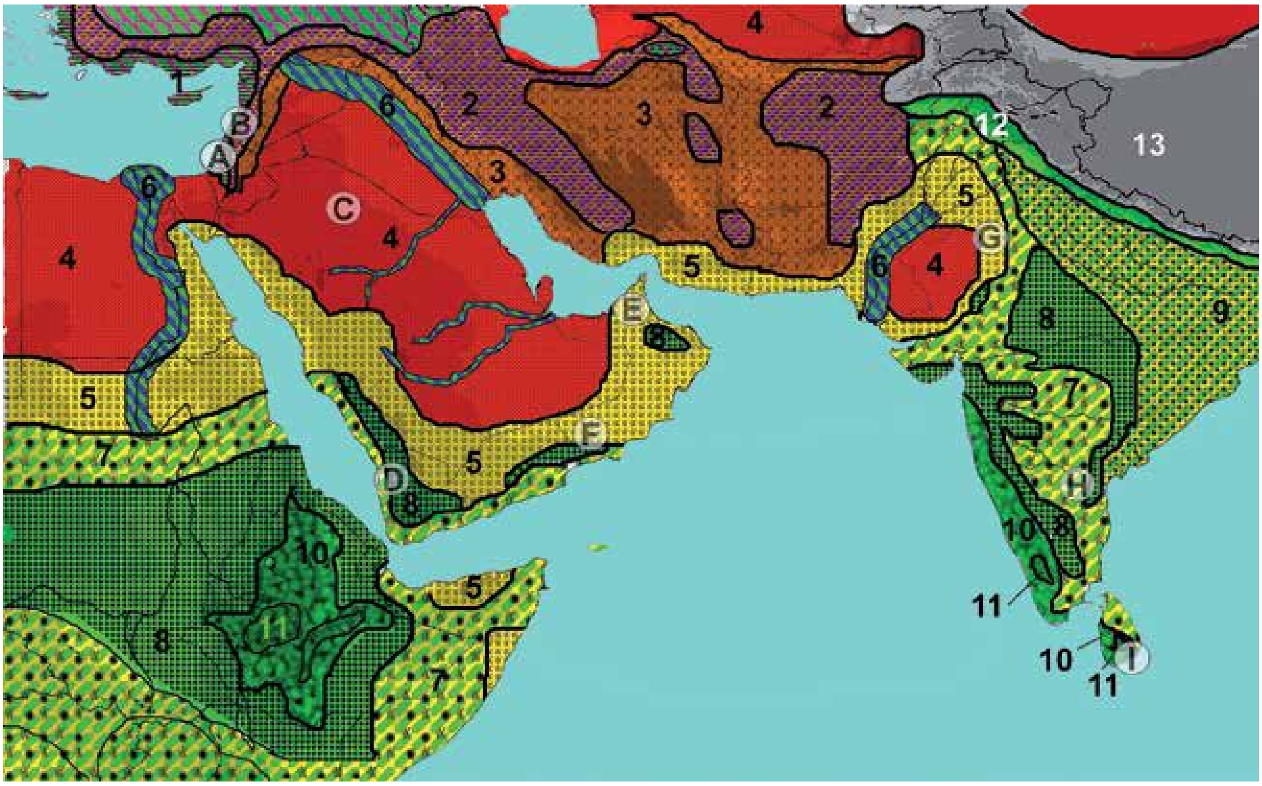

Figure 1: Vegetation zones of Eurasia in a humid period. Numbers 1-13 represent different vegetation communities. Of note here is the decreased size of deserts (no. 4) and the large extent of Sahel vegetation (no. 5), savannas (no. 7), dry tropical woodlands (no. 8). Such zonation would have facilitated dispersals and been ideal environments for foraging populations. Among key sites mentioned here are: (C) Jubbah Palaeolake; (D) Shi'bat Dihya; (E) Jebel Faya; (H) Jwalapuram (see Boivin et al., 2013 for details).

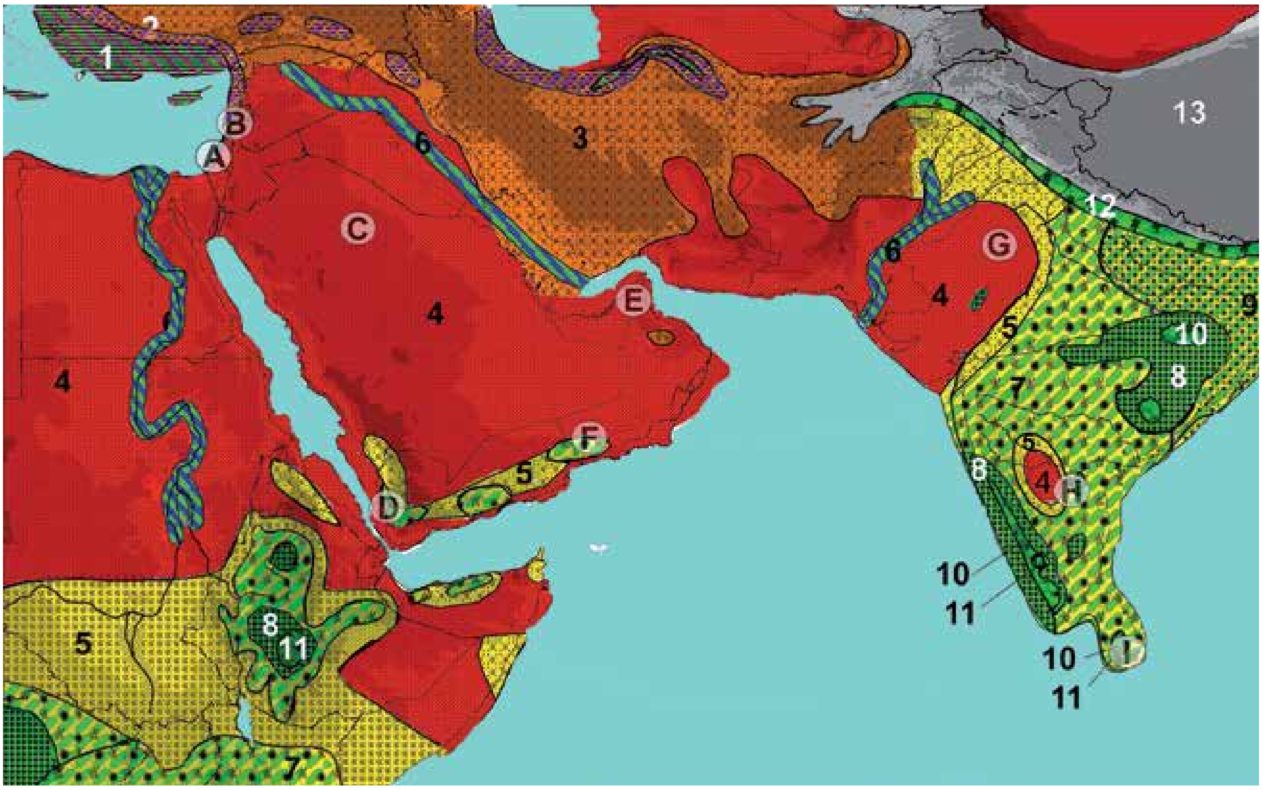

Figure 2: Vegetation zones of Eurasia in a dry period (see Figure 1 for key). Compare to Figure 1, which shows a dramatic environmental change in some regions. Of note is the large size of the desert zone (no. 4). Increased sizes of deserts would have forced populations into refugia, perhaps as at Shi'bat Dihya (D) and Jebel Faya (E). Note that Arabia would have been generally inhospitable, whereas the Indian subcontinent retains an ecological mosaic, allowing populations to adjust to changing conditions (see Boivin et al., 2013 for details).

A consideration of Asian sites and landscapes

As outlined in the above summary, Asia is an important region in considering human evolutionary events and processes. Many key events in human evolution played out over this massive geographic area, measuring some 17 million square miles in size. In considering routes of movement and hominin adaptations, it is important to emphasize that the Asian landmass is topographically and environmentally heterogeneous, and includes hyper-arid deserts, dense tropical forests, and cold arctic steppes. Asia contains the highest mountain ranges in the world and the lowest topographic depressions and seas. Such geographic and environmental features would have strongly influenced population dynamics across the Pleistocene.

Asia enjoys a long history of palaeoanthropological and archaeological research, and it includes famous localities, such as at the UNESCO sites of 'The Peking Man Site at Zhoukoudian' in China and the 'Sangiran Early Man Site' in Indonesia. These historically well known sites are now accompanied by other important Asian sites, nominated or tentatively listed on the World Heritage List, such as the Dmanisi Hominid Archaeological Site (Georgia), the Mount Carmel cave sites (Israel), the archaeological sites in the Lenggong Valley (Malaysia), the Palaeolithic sites in the Cagayan Valley (Philippines) and the Tabon Cave complex (Philippines). Yet, considering the enormous size of Asia and the wealth of archaeological sites in this region, much more could be done to nominate and protect important cultural sites and landscapes – one of the main goals of the HEADS Programme. Indeed, one can easily think of prominent sites with significant fossil remains and archaeological deposits that deserve recognition – such as Shanidar Cave, in Iraq. However, there are numerous other, lesser known, but significant sites and landscapes that deserve equal attention and evaluation. One example that readily comes to mind is the spectacular Sri Lankan cave and rockshelter sites of Fa Hien, Batadomba Lena and Kitulgala Beli-lena, which have produced well-preserved and stratified deposits with rich ecological data, microblade and bone technologies and symbolic items such as engraved pieces and beads ranging over the last 40,000 years (Deraniyagala, 1992; Perera et al., 2011).

One of the problems that pervades an understanding of the archaeological record of Asia is that many regions are either poorly known, or when sites are identified, the rigorous standards of interdisciplinary, scientific research have not been performed, including, for instance, ecological reconstructions and application of chronometric dating. Indeed, in considering sites for nomination to the World Heritage List, Dennell (2012) has highlighted the importance of adequate dating methods and the recovery of well-preserved sources of material evidence and environmental data. Tryon (2012) has emphasized the fundamental importance of the geological record and the integrity of its archaeological finds for determining which sites may achieve Outstanding Universal Value status.

Evaluation of World Heritage Listing of key human origin sites in Asia comes at a critical time in world history. The economies of Asia are booming and all forecasts suggest that this region will be a global leader in agricultural output and industrial development. The large and populous countries of China and India, in particular, are developing at a rapid rate. Development of new forms of agriculture, the unprecedented construction of dams and roads and the sprawling urban growth of cities has a major downside for those interested in Asian prehistory. Agricultural development and dam building, for instance, has significantly impacted and destroyed numerous archaeological sites in India, including landscapes with some of the most significant Acheulean sites in the subcontinent (Paddayya, 1996).

The aim of the remainder of this paper is to consider the nomination and protection of archaeological sites in Asia. Rock art landscapes will be examined below, attempting to demonstrate that often times these aesthetically pleasing places co-occur with significant archaeological resources that range across the Pleistocene and Holocene. This evaluation will centre on sites in India, though we believe that an integrated approach to rock art landscapes and archaeological sites has broader utility across the world.

Rock art districts – a potential tool for archaeological property nomination and protection

Paintings and engravings are recognized as a core dimension in the HEADS World Heritage Thematic Programme, as graphic representations and depictions play a role in understanding human conceptual thought and beliefs by traditional societies (Sanz, 2012b). Indeed, graphic depictions, which occur in great abundance within and across rock art sites and landscapes should be of interest to researchers engaged in the HEADS Programme given that these types of cultural resources are relatively common across the Old World and encapsulate many prehistoric archaeological sites. Although rock sites and landscapes are in fact ubiquitous across the world, only 35 rock art landscapes currently occur on the World Heritage List (as of May 2011).

Of central interest to archaeologists, it is recognized that rock art sites should be evaluated in relation to their broader cultural landscapes, thus placing emphasis on human activities in their natural environment. Indeed, the listing of rock art sites in relation to their surrounding landscapes has the benefit of potentially preserving large numbers of archaeological sites. For example, at least 400 settlements have so far been documented in the 30,000 hectare core area of the Mapungubwe Cultural Landscape of South Africa. Based on such findings, we can therefore expect that a large number of archaeological sites will be present in other rock art landscapes, such as in the 1,980,400 hectare core area of the Kakadu National Park (Australia) and the 7,200,000 hectare core area of Tassili n'Ajjer (Algeria) (see Sanz, 2012a, Table 28.1). And, yet, despite the fact that rock art sites and landscapes are of potential significance for understanding and protecting prehistoric human activities and occupations, few of the listed properties have been subject to systematic archaeological surveys and multidisciplinary investigations. Moreover, many of the listed rock art sites, with their potentially valuable archaeology, have not played a role in addressing key topics in human evolutionary studies, such as dispersal and mobility patterns, adaptations through time, and the evolution of cognition and behavior. Here, we will illustrate the potential benefit of evaluating rock art sites and landscapes in relation to their environmental contexts and their prehistoric archaeological resources.

India and its rock art districts

Rock art studies in India have a long tradition which extends back into the mid-nineteenth century, thus leading to the identification of numerous rock art zones (Blinkhorn et al., 2012) (Figure 3). The plentiful rock art sites across the region consist of paintings and petroglyphs that exhibit a high level of stylistic variability, though the relationship between these rock art traditions and their cultural geography has not been detailed. Rock art studies have mainly been confined to investigation of those in north-central India, where surveys have identified at least 2,000 decorated rockshelters (Pradhan, 2001). Other studies

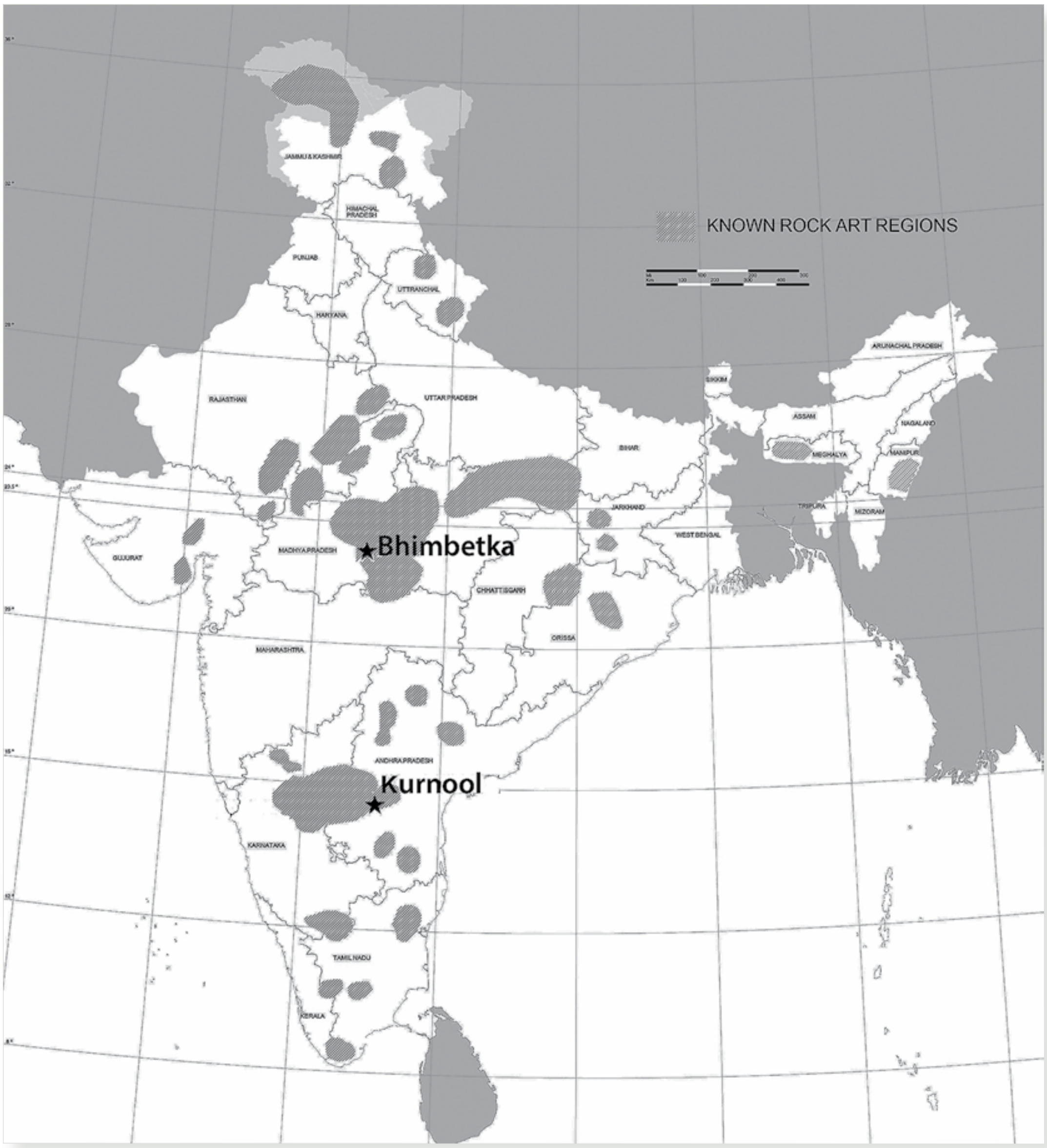

Figure 3: Known rock art regions in India (after Blinkhorn et al., 2012: Figure 11.1). Bhimbetka is on the UNESCO World Heritage List. A number of similar rock art landscapes are preserved across the region, such as in the Kurnool District. Many of these rock art landscapes contain prehistoric archaeological sites that extend into the Pleistocene, and range over many periods of the Palaeolithic.

have shown that rock art sites are, however, more widely distributed across India and in many cases they are as numerous as those in the northern part of the country. The great majority of rock art research concentrates on interpreting the meaning of the imagery (e.g., Mathpal, 1995; Camuri et al., 1993), including documentation of rituals, dancing, hunting, fauna, pastoral activities and military engagements. Some effort has been placed on examining the relationship between rock art images and the activities of modern tribal groups (e.g., Ghosh, 1984).

Chronological sequences have been suggested for rock art in India, falling into broad phases, such as: Upper Palaeolithic/ Mesolithic; Neolithic/Chalcolithic/Megalithic; and historical (e.g., Neumayer, 1993). In the absence of chronometric dating, the degree to which stylistic sequences represent true chronologies remains open to question and debate. Unfortunately, rock art has rarely been incorporated into broader archaeological studies in India. And, despite the potential co-occurrence between rock art sites and archaeological remains, little systematic research on their relationship has been conducted. Though the potential is high to identify exfoliated rock art in stratified and dateable archaeological deposits, no clear evidence has yet been produced to demonstrate their links.

The aim here will be to examine how rock art sites and districts in India may be used as a context to potentially nominate sites for inclusion on the World Heritage List, exploring the relations between rock art landscapes and archaeological resources. First, we shall critically examine the Rock Shelters of Bhimbetka, which has been on the World Heritage List since 2003. Following this, we will examine recent multidisciplinary investigations in the Kurnool District of southern India, which has a wealth of rock art sites and archaeological localities ranging over the Upper Pleistocene and Holocene. We attempt to make the point that these rock art sites and their archaeological deposits can be used to address a range of key topics in human evolutionary studies, such as dispersal processes and the evolution of modern human behavior.

Rockshelters of Bhimbetka: re-assessing a World Heritage site

The region collectively known as Bhimbetka and its environs contains at least 700 rockshelters, many of which contain rock art and archaeological remains (Wakankar and Brooks, 1976). The Bhimbetka rockshelters are in north-central India (Figure 3), in the foothills of the Vindhyan Mountains. The site was inscribed for World Heritage Listing in 2003, the core area measuring 1,893 ha, and the buffer zone measuring 10,280 ha. The nominated site includes 400 rockshelters in five clusters. The rockshelters were inscribed on the basis of two criteria [(iii)(v)] of the World Heritage Convention. The justification for criterion (iii) was that the site reflects a long interaction between people and their landscape, as demonstrated by the quantity and quality of the rock art. The justification of criterion (v) was that the site is closely associated with a hunting and gathering economy as demonstrated in the rock art and in the relicts of this tradition in the local Adivasi villages on the periphery of the site.

The nomination of Bhimbetka was a key historical moment in Indian heritage studies in that a set of rockshelter sites in India was formally recognized by the central government and the international community. Indeed, the Rockshelters of Bhimbetka, as a set of prehistoric resources, was afforded the same ranking and protection of other, highly significant, Asian sites important for their contribution to human evolution, namely Zhoukoudian (China) and Sangiran (Indonesia). The recognition of Bhimbetka was also an important achievement for the Archaeological Survey of India (ASI) and the scholars involved in this nomination process as this prehistoric site was placed alongside India's most recognized World Heritage sites and monuments (e.g., Ajanta Caves, Ellora Caves, Agra Fort, Taj Mahal). The delineation of a core and buffer areas at Bhimbetka, measuring some 10,280 ha, was also significant given the recognition that the area was in need of official protection and preservation.

While there is just cause to celebrate the inclusion of the Rockshelters of Bhimbetka on the World Heritage List, a critical re-assessment of this nomination is warranted. Such a critique may be useful for updating the listing, and guiding future nomination processes of other rock art sites, in light of the goals and aims of the HEADS Programme. Although the nomination of Bhimbetka was justifiably defined on the basis of rock art [criterion (iii)] and continuity with ethnographic traditions [criterion (v)], the site may also meet other criteria in consideration of its significant archaeology. Even though the history of archaeological research is reviewed in the sites official description, the absence of detailed information about Bhimbetka's significant archaeological resources, such as its important stone tool assemblages, is an obvious omission in the nomination package. This is so despite the fact that the archaeology overlaps with the inferred production of the rock art, spanning from the Historic period to the Mesolithic. And, indeed, the archaeology of the shelters demonstrates a much greater time depth, with excavations revealing stratified Palaeolithic deposits (Wakankar, 1975). Rockshelter IIIF-23, in particular, shows an occupation span that includes the Mesolithic, the Upper Palaeolithic, the Middle Palaeolithic and the Late Acheulean in deposits ranging more than 3 m in depth (Misra, 1985) (Figure 4). These stratified deposits are accompanied by rich and diverse stone tool assemblages from all levels. The Mesolithic lithic industry is accompanied by querns and grinders, bored stones, ground pigments, bone tools, and human skeletal remains. Boulder rearrangements in the lower levels potentially indicate of space use and structural arrangements. Radiocarbon ages range across the Holocene and the terminal Late Pleistocene (see Kennedy, 2000), and more recently, initial Optically Stimulated Luminiscence (OSL) ages place occupation to >41 and >47 Ka (Bednarik et al., 2005; Haslam et al., 2011). Bhimbetka thus contains significant archaeological deposits, which are relevant for understanding the criteria for which the site was nominated. Moreover, given their extraordinary preservation and their time depth, the archaeological deposits and cultural remains are also of importance for addressing a number of questions about human adaptations and behaviour through time, thus additional criteria of the Convention may be considered in this case.

The buffer zone of the Rockshelters of Bhimbetka was delineated as 10,280 ha. As recommended in an ICOMOS evaluation in 2003, the core area and the buffer zone should be re-evaluated in light of its wider cultural resources. It is apparent that there are other significant rock art sites and archaeological sites within and outside of the buffer zone. Indeed, there is also the possibility of a serial nomination, as there appears to be other significant rock art sites and landscapes in the Central Vindhya range as well as other highly significant archaeological sites, such as the dense clusters of Acheulean sites found in the Raisen District (Jacobson, 1985). This would necessitate renewed surveys in the region and a potentially significant enlargement of the geographic zone. Given that two other rock art sites with archaeological deposits in Madhya Pradesh (i.e., Darakai-Chattan and Chaturbajan Nala) are currently being considered as part of a serial nomination (Sanz, 2012b), further attention to these issues appears to be warranted.

Several key points, potentially relevant to the nomination of sites as part of the HEADS Progamme, emerge from a brief evaluation of the Bhimbetka rockshelters.

One general point is that while sites can, of course, be nominated to the World Heritage List on the basis of rock art alone, a far stronger case can be made if archaeological sites were included. Integrated rock art and archaeological studies are a way forward, with both scientific and practical benefits. An integrated rock art-archaeology nomination recognizes the importance of archaeological resources associated with rock art districts. In many cases, archaeological sites may directly contribute

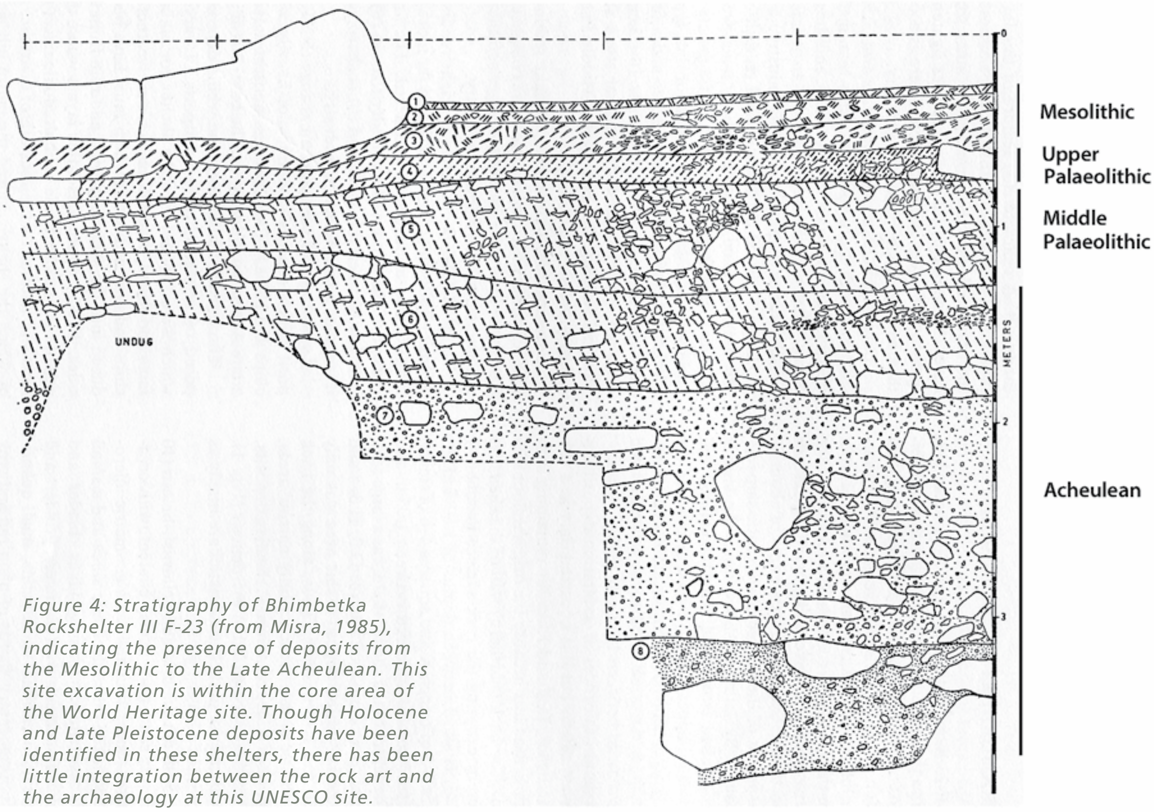

Figure 4: Stratigraphy of Bhimbetka Rockshelter III F-23 (from Misra, 1985), indicating the presence of deposits from the Mesolithic to the Late Acheulean. This site excavation is within the core area of the World Heritage site. Though Holocene and Late Pleistocene deposits have been identified in these shelters, there has been little integration between the rock art and the archaeology at this UNESCO site.

to an understanding of the rock art itself, though in some cases, the archaeological deposits may pre-date the graphic representations. Such evaluations of site history are important since the origin and evolution of symbolic representations can be better understood. An added benefit of integrated nominations concerns the protection of a far greater number of sites. In many cases, such integrated studies will likely protect many thousands of sites that span the Pleistocene. This is especially relevant in India, where land clearance and development are occurring at an unprecedented rate.

A second and more specific point is that the geography of the Bhimbetka nomination could be reconsidered, potentially nominating a greater range of rock art sites and archaeological sites within its core area and buffer zone. A serial nomination would also be of potential value, as other significant rock art sites and archaeological resources are present in the region.

A third general point is that India contains a number of potential rock art landscapes and districts that rival and complement those found at the World Heritage site of Bhimbetka. This point will be further elaborated upon below, using the Kurnool District as a case example.

The Kurnool District – an example of a region with globally significant rock art and archaeology

As we have noted above, numerous rock art sites and districts are found across the subcontinent. One such region is the Kurnool District in Andhra Pradesh, south India (Figure 3). The aim here is to demonstrate the potential importance of an integrated approach to the study of rock art and archaeology and to highlight how the cultural resources within this district contribute to significant questions in human evolutionary research on a regional level and on the international stage.

The rock art sites so far investigated in the Kurnool District are located in three interconnected drainages, i.e. the Jurreru Valley, the Yaganti Valley and the Katavani Kunta Valley. Systematic field surveys since 2003 have located 88 rock art sites, with many shelters underlying large quartzite boulders (Figure 5). Images on rock shelters are often red pictographs, with

Figure 5: The Jurreru River Valley, Kurnool District. The background shows the quartzitic plateau. Boulders detach from the plateau and tumble downslope. Rock art sites and archaeological deposits co-associate under these shelters. The foreground is the alluvial floodplain, where archaeological sites associated with the Toba volcanic ash have been excavated.

a variety of depictions, including animals and humans (Figures 6 and 7). Some rock art sites are found in caves, such as in the historically famous Billasurgam Cave complex (Taçon et al., 2010; 2013; Blinkhorn et al., 2010; 2012). Many hundreds (probably thousands) of rock art sites in the Kurnool District remain undocumented. Based on observations and recordation, at least five different styles of rock art associated with varying time periods have been identified. The earliest surviving pictographs are naturalistic outline paintings of animals and human-like figures, sharing strong similarities with Magdalenian rock art of Western Europe and transitional Palaeolithic-Neolithic rock art in China (Taçon et al., 2010, p. 346; Taçon et al., 2012). The later phases reflect regional concerns and associate with agricultural communities from the Neolithic and in later time periods, although some forms of rock art may be related with hunter-gatherers who lived alongside settled communities.

In order to better understand the origin and development of the rock art and the relationship of the imagery to symbolism and human site and landscape behaviours, an integrated programme of study has been initiated. The aim is to study the rock art in relation to changes in environment and material culture, dating sites through excavation and chronometric methods. We have recently undertaken excavations in the Billasurgam caves (Petraglia et al., 2009a; Haslam et al., 2010), where a nested diamond pattern petroglyph was identified (Taçon et al., 2013). Radiocarbon dating of the petroglyph revealed an age of ca. 5000 Ka, which we interpret as having been produced by Mesolithic foragers, just prior to the introduction of Neolithic lifeways. Excavations have also been performed at the Jwalapuram Locality 9 rockshelter, in the Jurreru Valley (Petraglia et al., 2009a) (Figure 8). The rockshelter is adorned with pictographs that are consistent with evidence of human occupation in

Figure 6: A rock art site in the Katavani Kunta Valley, Kurnool District. Note that the shelter surface is elaborately painted with red pigment.

Figure 7: Close up of the images depicted in Figure 6, showing a variety of images, including humans.

Figure 8: Excavation of the Jwalapuram Locality 9 rockshelter, Kurnool District. This rock art site yielded stratified deposits and radiocarbon ages extending to c. 35 Ka. Abundant microblade industries were recovered throughout, representing one of the longest sequences of microlithic industries in the world. Red ochre was also recovered from the deposits, providing a potential connection with the rock art.

Figure 9: Examples of beads recovered from the Jwalapuram Locality 9 rockshelter.

Figure 10: Excavations on the Jurreru River floodplain, at Jwalapuram Locality 22, near the Jwalapuram rock art shelters. Here, Middle Palaeolithic industries were excavated directly under the Toba ash, dating to 74 Ka. Note Prof. Ravi Korisettar being interviewed by a camera crew on behalf of the National Geographic Society. The archaeological research in Kurnool has drawn intensive media coverage (see: http://toba.arch.ox.ac.uk/media.htm).

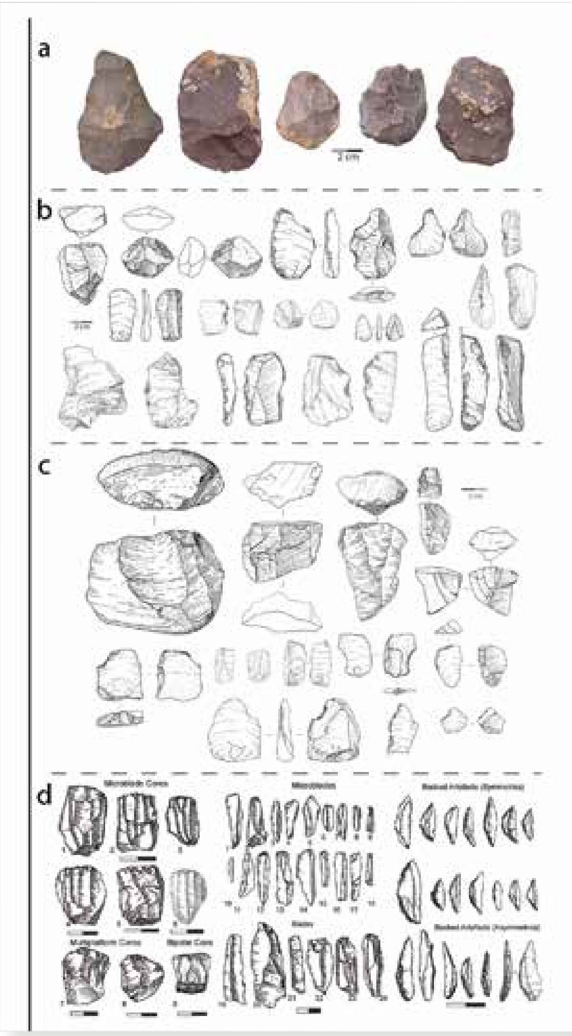

Figure 11: Stone tool assemblages represented in the Jurreru River Valley, Kurnool District. Late Acheulean (A), Middle Palaeolithic, pre-Toba (B), Middle Palaeolithic, post-Toba (C), Microlithic (D) (after Petraglia et al., 2012b).

the Holocene, though faded rock art could conceivably date to the Pleistocene. Excavations in the shelter produced 53,000 lithic artefacts and radiocarbon dating revealed that the microblade industries extended back to ca. 35 Ka (Clarkson et al., 2009). The excavated assemblage also contained cremated human remains, beads, and worked bone (Figure 9). A striated red ochre crayon, ochre fragments and detached ochre-coated quartzite spalls are present throughout a layer dated to 20-12 Ka. The ochre fragments and detached ochre-coated quartzite spalls likely associate with personal symbolic display and artistic activities on the rockshelter itself during the Late Pleistocene.

The rockshelter excavations and the rock art studies have made significant contributions towards understanding the prehistory of the Indian subcontinent, allowing study, for the very first time, the evolution of symbolism and modern human behaviour. The rockshelters and caves in the region are also accompanied by open-air sites along the valley margins and in the lower-lying river floodplain (Petraglia et al., 2009a; Shipton et al., 2010) (Figures 5 and 10). Excavations have revealed the presence of Middle Palaeolithic assemblages above and below volcanic ash that has been identified to represent the Toba Super-eruption of 74,000 years ago (Petraglia et al., 2007). Overall, archaeological surveys and excavations in and around the rock art district have revealed the presence of stone tool industries representative of Palaeolithic time periods (i.e., Late Acheulean, Middle Palaeolithic, Late [Upper] Palaeolithic) (Figure 11).

The Kurnool District sites have become the focus of international debates on dispersal processes. Information is published in scholarly and in public form and in the pages of high impact journals, such as *Nature*, *Science* and *PNAS*. One of the main debates concerns the timing of the dispersal of *Homo sapiens* out of Africa. On the one hand, Mellars (2006) contends, on the basis of mitochondrial DNA and archaeological evidence, that modern humans reached India about 60,000 years ago, using microblade assemblages, and accompanied by symbolic items, such as engraved objects. On the other hand, on the basis of comparative analysis of assemblages in Africa and India, our team has argued that modern humans reached the subcontinent prior to the Toba eruption, surviving its environmental consequences (Petraglia et al., 2007, 2012b; Clarkson et al., 2012). In the later view, the microblade assemblages do not associate with Howiesons Poort assemblages of southern Africa, but rather, the microblade stone industries are a local innovation produced for more efficient capture of game, and perhaps a consequence of climatic deterioration and population pressure (Petraglia et al., 2009b).

In this brief summation, we have attempted to illustrate that the Kurnool District contains rock art that is significant, complementing and rivaling the World Heritage site of Bhimbetka. Moreover, we associate the rock art and the archaeology, suggesting that Indian sites, such as those found in the Kurnool District, can contribute to major topics in human evolutionary studies, including questions about dispersal processes, the evolution of modern human behaviour and the evolution of symbolism.

Conclusion

The HEADS Programme has rightly concerned itself with identifying human origin sites in Asia that may be potentially nominated to the World Heritage List. One of the thematic aims of the HEADS Programme is the identification of sites that may contribute to a better understanding of dispersal processes. It has hopefully been demonstrated in this brief overview that there are many potential sites and landscapes in Asia that are of exceptional cultural importance. Here, we have centered on cultural resources in India, suggesting that greater attention should be paid to the relationship between rock art sites and archaeological resources, including at the UNESCO site of Bhimbetka. An integrated approach to rock art and archaeology has scientific advantages, and such types of linked nominations for the World Heritage List rest on a firmer intellectual foundation. Moreover, on the practical side, an integrated approach between rock art landscapes and archaeological sites leads to the protection of a greater number of cultural resources, especially important in this day and age when many historic properties are being threatened and destroyed by modern development.

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3

Historical Overview

The history of palaeoanthropological research in Asia: reasons and priorities for future cooperation in research and preservation of sites and collections

John de Vos
Department of Geology, Naturalis Biodiversity Center – Netherlands

Abstract

The theoretical foundation for palaeoanthropology was built in the nineteenth century. From the beginning there was a controversy over whether Man took part in evolution. The question was: is Man separated from the animals or not? Robert Chambers (1844) was the first to suggest that Man descended from the Apes, but that position was not generally accepted at the time. After the publication of Charles Darwin's (1859) famous book *On the Origin of Species* the idea that Man descended from the Apes began to gain traction in scholarly circles, but until 1887 there were no fossils which could prove this. Some scientists began to theorize that Asia was the cradle of Mankind.

It was Eugène Dubois who led an expedition to The Dutch East Indies (present-day Indonesia) and found there his transitional form, the *Pithecanthropus erectus*, at the site of Trinil on Java in 1891-1892, consisting of a molar, a skull-cap and a femur. The site of Trinil became famous and arguably merits inclusion on the World Heritage List. However the layer yielding fossils is currently below the water level of the river. What remains are the fossils, the publications, the unpublished notes, drawings, photographs, etc. These are as valuable as the site itself, and show the development and evolution of the scholarly and scientific pursuits at the site.

It is recommended here that in addition to sites, the attendant materials and documentation, such as fossils, published and unpublished papers, photographs and notes of the excavators and scientists who worked on a site, which show the development and evolution of the site, must be included in the criteria for the judgment of the nomination of a site to The World Heritage List.

Introduction

Until the 1960s, there was a general consensus that Southeast Asia was the cradle of Mankind. This was caused by the finds of hominins, for exemple: *Pithecanthropus erectus* by Eugène Dubois (1894) at Trinil in Java during 1891/1892, *Sinanthropus pekinensis* at Zhoukoudian near Beijing in China by Davidson Black (1926), *Homo soloensis* at Ngandong , during the 1930s by the Dutch Indies Geological Survey (Oppenoorth, W.W.F., 1932), and the finds of Ralf von Koenigswald in Sangiran, and in Java, also during the 1930s (von Koenigswald, 1940). Prior to these finds, even before these finds there was in the nineteenth century, a discussion about the evolution of 'Man' and theoretical speculation that the cradle of Mankind was in Asia. The first part of the paper will show that, in the light of the discussion of the nineteenth century about the cradle of Mankind, Dubois' choice of Asia was a logical and a practical one.

After the 1960s, after the finds of *Homo habilis* in Olduvai (Leakey et al., 1964) and especially after the finds in the Turkana area and in the Afar Triangle (Lucy, *Australopithecus afarensis*) (Johanson et al., 1978), general consensus on the cradle of Mankind shifted to Africa, just as Darwin had predicted in 1871 and James Burnett, Lord Monboddo (1774) had a century earlier (Broom, 1925; Clarke, 2012). However, after the discovery of *Homo floresiensis* and the hypotheses, that: *Homo floresiensis* is descended from *Homo erectus* by Brown et al. (2004); or an island form descended from *Homo erectus* by van Heteren and de Vos (2008); or even an unknown Asiatic *Australopithecus* because of the long arms (Mike Morwood in Bower, 2005); or descended from *Homo habilis* (Groves and Cameron in Wong, 2005), attention has turned back to Asia, although it is not considered as the cradle of Mankind at this moment.

Furthermore, the purpose of this paper is to show that the value of a site is not always the site itself, but what is left behind by the excavators and researchers in the form of fossils, notes, publications, site maps, photographs, etc. All of these documents give a picture of the site and show the development and the evolution of the site. It is not only the

site which must be protected, but also the aforementioned documents which constitute the site's remains in the context of a few case studies of sites, restricted to Java, this will be discussed.

Perspectives on the evolution of Man in the first half of the nineteenth century

Cuvier (1796)

One of biology's most important concepts is that of extinction. Although there were already some ideas about extinction, it was Georges Cuvier (1769-1832) who, in 1796, compared a skull of a mammoth from Siberia with the skull of a recent African and Indian elephant. Cuvier came to the conclusion that the skull of the mammoth from Siberia was different from the African and Indian elephant. He came up with three hypotheses: 1) the mammoth is still living somewhere; 2) the mammoth is a transitional form; and 3) the mammoth became extinct. Cuvier could not believe that the mammoth was still living somewhere. That it was a transitional form was also impossible, as his beliefs dictated that God had created the earth with all the creatures on it and that was perfect. Cuvier concluded that the mammoth was extinct. According to Cuvier, who was raised in a society with one revolution after another, the extinction was caused by a catastrophe. Although not directly linked, this was consistent with biblical notions, such as the narrative of the great flood. However, if animals continuously became extinct, fewer and fewer animals would roam on the earth. So, the question became, where are the new creatures coming from? Jean-Baptiste de Monet Lamarck (1744-1829), a contemporary of Cuvier and also living and working in the Jardin des Plants in Paris, had already formulated a theory of evolution, which is known as the theory of inheritance of acquired characteristics, in other words, characteristics were passed down to descendants from their ancestors (Lamarck, 1809). The best known, and often used, example of this is the neck of the Giraffe. It was Cuvier, who did not believe in evolution, who contested this model vehemently. Charles Lyell (1797-1875), the founder of modern geology, who was raised in a society which was rather stable, did not place primacy on catastrophes but rather came up with the idea that geological processes were gradual. He formulated the actuality principle (1830-1833), which states that geological processes of today also took place in the past, for example: the slow accumulation of sedimentary deposits and formation of mountains. Thomas Robert Malthus (1766-1834) observed (1798) that there were more offspring than there were full grown individuals.

Robert Chambers (1802-1871)

In 1844 a book with the title: *Vestiges of the Natural History of Creation* was published under the name of 'John Churchill' (Princes Street, Soho, London). It was later revealed that Robert Chambers, rather than 'John Churchill' had written the book. In this book, Chambers proposed a hypothesis on the nature of development over time. The book integrated known theories of astronomy, natural history, geology, chemistry, phrenology, political economy and anthropology. It marks the first attempt to combine the natural sciences with the history of creation. Briefly put, he described the development of the universe, the planets, the earth and life on the earth in the following way: the earth originated from a gas cloud, which condensed until it formed a spherical shape with a hard surface and life on this planet progressed along a developmental scale from simple primitive forms to more complex, more advanced forms. According to Chambers, there was a law concerning the development of organic life, in such a way that in the course of its development every animal goes through a number of stages, which are similar to mature forms of different orders of animals which fall lower on the aforementioned developmental scale. [This is based on, or inspired by, a popular treatise of Friedrich Tiedemann (Chambers 1844, p. 201), who argued that the younger stages are a repetition of the recent full grown forms of progressive higher-level organisms.] As an example Chambers wrote (p. 198): 'Thus, for instance, an insect, standing at the head of the articulated animals, is, in the larva state, a true annelid, or worm, the annelid being the lowest in the same class. The embryo of a crab resembles the perfect animal of the inferior order myriapoda, and passes through all forms of transition which characterize the intermediate tribes of crustacean'. On page 199 Chambers wrote: 'Nor is Man himself exempt from this law. His first form is that which is permanent in the animalcule. His organization gradually passes through conditions generally resembling a fish, a reptile, a bird and the lower mammalian, before it attains its maturity. At one of the last stages of his foetal career, he exhibits an intermaxillary bone, which is characteristic of the perfect Ape; this is suppressed, and he may then be said to take leave of the simial type, and become a true human creature'. [The intermaxillairy bone in Man is so small and so integrated with the other cranial bones, that for a long time it was thought that Man did not have one, and that the absence of this element could be used to differentiate Man from Apes]. The author continues: 'Even, as we shall see, the varieties of his race are represented in the progressive development of an individual of the highest order, before we see the adult Caucasian, the highest point yet attained in the animal scale'. Based on languages, Chambers assumed that the human race is one (p. 294). If humans are a single race, he then wondered, in what part of the earth it most probably originated? He posited that if he traced the lines in which the principal tribes appear to have migrated backwards he would find the origin of the race; he traced it to the north of India. Although, the author stated (p. 296-297), 'After all, it may be regarded as still an open question, whether mankind is one or many lines'. The book caused one of the biggest controversies of the nineteenth century. In particular, the idea that Man descended from the Apes led to the confrontation between religion and science. The book garnered a lot of critics. One of the main critics was the Cambridge geologist, Reverend Adam Sedgwick (1845). Most of his review was a lengthy critique of the factual geological basis of *the Vestiges*, but he also wrote, '… if what the book said were true, the Bible was a lie and eternal life a comforting fable'. Chambers' book promoted the idea that Man was also part of this evolution.

The discussion about the evolution of Man in the second half of the nineteenth century

Richard Owen (1855)

The anatomist Richard Owen (1855) threw all his anatomical knowledge in the battle to prove that Man's link with the Apes was nonsense. He did this by pointing out that the heavy brow ridge of the great Apes is missing in modern Man. This characteristic was considered by Owen as typical for the chimpanzee. Man would have had heavy brow ridges, if descended from the great Apes; this is obviously not the case, thus Man could not be descended from the great Apes.

Neanderthal Man (1856)

One year later, in 1856 a skull was found with large brow ridges in the Feldhofer Cave in Neanderthal, near Dusseldorf, Germany. It came into the possession of Dr. Johann Carl Fuhlrott, a teacher at the Gymnasium of Elberfeld. After studying the skeleton, Fuhlrott (1859) concluded that it was from a massive, robustly built Man who lived long ago. A most remarkable feature of the skull is the heavy brow ridges which also are different from the skulls of recent *Homo sapiens*. Fuhlrott took the skeleton to Hermann Schaaffhausen, professor of anatomy at the University of Bonn who was also convinced that the remains were very old and human. Their strange morphology was caused by deformation, but the dolichocephalic form of the skull was, according to Schaaffhausen (1858), not comparable to any modern race, not even to the most 'barbaric'. The heavy brow ridges, which are characteristic of the great Apes, were, according to Schaaffhausen, typical for the Neanderthal Man. The skull therefore must have belonged to an original wild race of north Western Europe which lived a long time ago. Fuhlrott (1859) wrote an article about the remains of Neanderthal Man with the opinions expressed above. The editors, however, stated that they did not endorse the statements of Fuhlrott.

Charles Darwin (1809-1882), *On the Origin of Species* (1859)

In the same year, Charles Darwin published *On the Origin of Species*. Darwin had the books of Lyell and Malthus with him on his journey with the Beagle. With the help of these books as well as the ideas of Lamarck and his own observations, he formulated his evolution model of Natural selection, in which he set out a theory of evolution, characterized by gradual development with natural selection as the chief mechanism. In his *On the Origin of species* Darwin did not write much about the evolution of Man (in his *Origin* Darwin never used the word evolution, but development), although he knew of the skull from the Neanderthal. The only thing he wrote in the first edition, found almost on the last page, (1859: 488) is: 'Light will be thrown on the origin of Man and his history.' In the 6th edition he went slightly beyond this by writing: 'Much light will be thrown on the origin of Man and his history'. However, he and others drew the conclusion that there is no separation between Man and Apes.

Continuation of the Neanderthal debate

After Darwin's *On the Origin of Species,* the skull of the Neanderthal became a centre of debate. Prof. Wagner (Moerman, 1977, p. 39) from Gottingen wrote that the skeleton must have belonged to an 'old Dutchmen,' as the skull looked like a skull in Blumenbach's collection which came from Marken, Urk or Schokland, and which had a retreating frontal and relatively large brow ridge. Pruner-Bey (Moerman, 1977, p. 36) in Paris, 1863, considered the skull to be a Celtic, while Blake in 1864 (Moerman, 1977, p. 36) thought rickets caused the peculiarities. Davis considered the strange form of the skull to be caused by early fusion of the sutures of the skull. Another opinion was that it was an aberration; a skull from an idiot, or that it was from an insane individual with hydrocephalus (Moerman, 1977). Prof. August Franz Joseph Karl Mayer of Bonn (1864; in Moerman, 1977, p. 38) considered the skeleton to belong to a 'Mongolian Cossack,' a member of to one of the hordes driven from Russia through Germany into France in 1814. Childhood rickets and horse riding would have caused curvature of the legs, he suggested. Prof. Rudolf Virchov (1872) followed the opinions of Blake and Mayer and considered the skull and skeleton also to be pathological, with deformities caused by rickets, but nonetheless human.

Thomas Henry Huxley (1863)

Thomas Henry Huxley examined in his book *Evidence as to Man's Place in Nature* of 1863, as the title indicates, the place of Man in Nature. In Chapter II 'On the relation of Man to the Lower Animals' he makes an exhaustive comparison of the Man-like Apes and Man. He starts with the embryology: via the skeleton and the anatomy of the brains he comes to the conclusion: ' …–that the structural differences which separate Man from Gorilla and the Chimpanzee are no so great as those which separate the Gorilla from the lower Apes,' he continues, '...–then, there would be no rational ground for doubting that Man might have originated, in one case, by the gradual modification of a Man-like modification of a Man-like Ape; or, in the other case, as a ramification of the same primitive stock as those Apes'. In Chapter III, Huxley discusses some remains of fossil Man, like the skull of Engis and the skull Neanderthal. He comes to the conclusion that the skull is very different from recent Man. According to Huxley, depending upon what way you looked at it, it has Ape-like characteristics; it is the most Ape-like skull which had been found thus far. He continued that Professor Schaaffhausen remarked that the skull, in its present form, has a brain capacity of 1,033.24 cc, and this falls within the mean of brain capacities of Polynesians and Hottentots, as they had been measured by Morton. So, in any case, the Neanderthal bones can be considered an intermediate form between Man and Ape. Huxley concluded that there are no skulls which approach Apes in character. But he wonders, 'Where, then must we look for primaeval Man? Were the oldest *Homo sapiens* Pliocene or Miocene, or yet more ancient? In still older strata do the fossilized bones of an Ape more anthropoid, or a Man more pithecoid, than any yet known await the researches of some unborn palaeontologist? Time will show'. Huxley could not know that the palaeontologist who would go on to show that this Eugène Dubois had already been born and walked as a five year old boy in Eysden, Limburg, the Netherlands.

William King (1864)

In contrast William King (1864), an Anglo-Irish geologist at Queens College Galway, was the first to propose, without giving scientific arguments, that the bones found in Neanderthal, Germany in 1856 were not of human origin, but of a distinct new species, and called it *Homo neanderthalensis*, perhaps even the type specimen of a new genus.

Ernst Haeckel (1868)

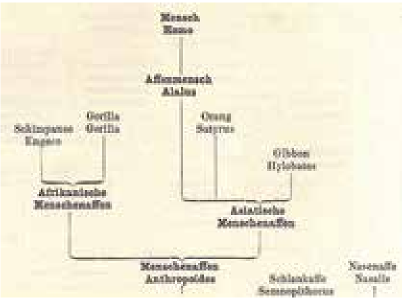

Figure 1: Phylogenetic tree of Haeckel, With the Orang-utan as ancestor.

Ernst Haeckel, founder of embryology and responsible for biogenetic rule that 'the ontogeny is a short repetition of the phylogeny', published in 1868, in his enthusiasm for Darwin and the evolution theory, created a phygenetic 'tree' showing a line from the Apes to Man (*Homo sapiens*), with a hypothetical ancestor, the Ape-Man, which he called *Pithecanthropus*. As Haeckel believed that speech was characteristic of recent Man, he called the transitional form *alalus*, the speech-less. According to Haeckel (1877) the Apes (Anthropoids) diverged into a branch of African Apes and Asiatic Apes. The Asiatic Apes were divided into three branches: one to the Gibbons (*Hylobates*), one to the Orang Satyrus (the orang-utan) and one branch to Man (*Homo*) with the hypothetical ancestor, the Man-Ape (*Pithecanthropus*) in between (Figure 1). Although he favored South Asia as the cradle of Mankind, he did not commit himself, stating that we can only suppose (1874). According to Haeckel, the origin of Man was supposedly in the Diluvial time, in a hot zone of the world, on the continent of tropical Africa or Asia or maybe a sunken continent, which spread from East Africa (Madagascar and Abyssinia) to East Asia (Sunda Islands and far India). From this 'Paradise' known as Lemuria, the races of Man spread over the globe. According to Haeckel there was no need for fossils to show that Man also took part in evolution; study of embryology was satisfactory (Theunissen, 1989).

Charles Darwin and *The descent of Man* (1871)

After the heated debates that *On the Origin of Species* sparked concerning the evolution of Man, Darwin found himself obliged to say something about the evolution of Man. Since 1838 he had gathered notes and in 1871 he published the book *The Descent of Man, and Selection in Relation to Sex*. In his introduction he wrote, 'The sole object of this work is to consider, firstly, whether Man, like every other species, is descended from some pre-existing form; secondly, the manner of his development; and thirdly, the value of the differences between the so-called races of Man.' He continued, 'The conclusion that Man is co-descendant with other species of some ancient, lower, and extinct form, is not in any degree new'. Modestly he refers to others by writing, 'Lamarck long ago came to this conclusion, which has lately been maintained by several eminent naturalists and philosophers; for instance, by Wallace, Huxley, Lyell, Vogt, Lubbock, Buchner, Rolle, etc., and especially by Heackel'.

In part I Darwin spent eight chapters justifying his position that Man descended from the Apes. Like Chambers and Haeckel, Darwin also points to embryology. Chapter IV, 'On the manner of development of Man from lower form', is, in this respect, very interesting. In this chapter he says something about the evolution of Man, namely 'The causes which have led to his [Man] becoming erect.': 'As soon as some ancient member in the great series of the Primates came, owing to a change in its manner of procuring subsistence, or to a change in the conditions of its native country, to live somewhat less on trees and more on the ground, its manner of progression would have been modified; and in this manner of progression would have been modified; and in this case it would have had to become either more strictly quadrupedal or bipedal. ...Man alone has become a biped'. According to Darwin the free use of arms and hands, partly the cause and partly the result, indirectly led to a change of other structures. The use of artefacts caused the canines to become smaller, while the physical brain capacity became larger as mental capacity was used more.

In Chapter VI, Darwin comments on the 'Birthplace and Antiquity of Man.' He writes 'We are naturally led to inquire where the birthplace of Man at that stage of descent when our progenitors diverged from the Catarhine stock. The fact that they belonged to this stock clearly shows that they inhabited the Old World; but not Australia nor any oceanic island, as we may infer from the laws of geographical distribution. In each great region of the world the living mammals are closely related to the extinct species of the same region. It is therefore probable that Africa was formerly inhabited by extinct Apes closely allied to the gorilla and chimpanzee; and as these two species are now Man's nearest allies, it is somewhat more probable that our early progenitors lived on the African Continent than elsewhere'. He continues by saying: 'But it is useless to speculate on this subject …'. Concerning the place of origin, Darwin stated, 'At the period and place, whenever and wherever it may have been, when Man first lost his hairy covering, he probably inhabited a hot country; and this would have been favourable for a frugiferous diet, on which, judging from analogy.'

In the time of Darwin there were no fossils that showed that Man had also taken part in evolution. About this Darwin stated, 'With the respect to absence of fossil remains, serving to connect Man with his Ape-like progenitors, no one will lay much stress on this fact, who will read Sir C. Leyell's discussion, in which he shows that in all the vertebrate classes the discovery of fossil remains has been an extremely slow fortuitous process. Nor should it be forgotten that those regions which are the most likely to afford remains connecting Man with some extinct Ape-like creature, have not as yet been searched by geologists'.

Darwin already knew of the skull from Neanderthal. He wrote about this: 'In Europe the ancient races were all, according to Schaaffhausen 'lower in the scale than the rudest living savages;'' they must therefore have differed, to a certain extent, from any existing race. The remains from Les Eyzies described by Prof. Broca, though they unfortunately appear to have belonged to a single family, indicate a race with a most singular combination of low or simious and high characteristics, which is 'entirely different from any other race, ancient or modern, that we have ever heard of'. It differed, therefore, from the quaternary race of the caverns of Belgium'. Darwin continued: 'Prof. Broca found that skulls from graves in Paris of the nineteenth century were larger than those from vaults of the twelfth century, in the proportion of 1484 to 1426; and Prichard is persuaded that the present inhabitants of Britain have 'much more capacious brain-cases' than the ancient inhabitants. Nevertheless it must be admitted that some skulls of very high antiquity, such as the famous one of Neanderthal, are well developed and capacious'.

Although Darwin never said it in so many words, he thought that the evolution of Man proceeded in a straight line.

The state of the art at the end of the nineteenth century

Darwin discussed the evolution of Man, but did so on theoretical grounds, without using fossils to support his argument. In his opinion, Mankind originated in the tropics, where it had lost its fur, and the ancestor of Man could still be found there, where Great Apes live: Gorilla and chimpanzee in Africa; Gibbon and Orang-utan in Southeast Asia. For Ernst Haeckel fossils were not necessary, as proof that Man took part in the process of evolution could be found in anatomy and embryology. He introduced the name *Pithecanthropus* as a theoretical 'missing link' between Apes and Man. In his opinion Man could have descended from Orang-utan in Southeast Asia. During the nineteenth century the evolution of animals became accepted, but the evolution of Man remained controversial.

Lydekker (1879) had described a primate fossil, an incomplete jaw with a number of teeth, from the Siwalik Hills in British India which seemed to cast some light on human descent. According to Lydekker, this primate, which he named *Palaeopithecus sivalensis*, could be regarded as a predecessor of the chimpanzee (in those days put in the genus *Anthropopithecus*, then the scientific genus name for the chimpanzee). Yet, he added that the fossil also showed a resemblance to both the gibbon and the human. The gibbon from Asia was another candidate in the evolutionary line to Man. Other finds were a mandible, found by Eduart Dupont in 1866 in a cave called La Naulette (1866). Topinard (1866) described among other things the lack of a chin in this specimen, which he considered as having an Ape-like character. But together with two skeletons found in the cave of Spy (Belgium) (1887) these fossils were now recognized as Neanderthals, or ascribed to a (primitive) race of modern humans

(Erickson, 1976). Thus, none of the fossils found until 1887 were considered evidence of Man's evolution. In that year, with the theoretical knowledge mentioned above, Eugène Dubois sailed to the Dutch East Indies in search of the transitional form.

Beginning of palaeoanthropology as a science

Eugène Dubois (1858-1940)

The life of Dubois has been described extensively by Theunissen (1989) and Shipman (2001), based on the notes and archives of Dubois. Here a short summary will be given. Dubois was born in 1858, one year before Darwin published his famous *On the Origin of Species* and two years after the find of the Neanderthal skull. Dubois was born in Eysden, Limburg, The Netherlands, where his father was apothecary and mayor. From his bedroom Dubois could see the St. Pietersberg, where in 1780 the famous mosasaur was found. He became very interested in paleontology, and especially in the evolution of Man. This topic was heavily discussed in the second half of the nineteenth century. From 1877 to 1884 Dubois studied medicine at the University of Amsterdam, where he became reader in anatomy in 1886 (Theunissen, 1989). He often quarreled with his supervisor. He did not like the laboratory work; Dubois was really a field Man. To be outside in the field made him happy. He made a proposal to the government to do paleontological research in the Dutch East Indies. Of course this was denied. At that moment it was a crazy idea to search for the transitional form. To follow his dream, he signed on as a medical doctor in the Dutch Indies Armies, and sailed, on the S.S. Amalia, with his wife and young child to the Dutch East Indies in 1887.

Sumatran Caves

The first place at which he was stationed was Pajacombo in the Padang Highlands, Sumatra, Indonesia. When his colleague took over his duties, the first thing he did was to search in the caves, in the surrounding area (Theunissen, 1989). It was Wallace who suggested the caves to be the place where 'Diluvial Man' could be found. This supposition was not illogical, as the Neanderthal skull, the mandible of La Naulette and the Spy skulls were all discovered in caves. Dubois visited a lot of caves which are listed by Hooijer (1947). The bulk of the fossil material comes from three caves: The Iida Ajer near Pajakombo, the Sibrambang Cave and the Djamboe cave (de Vos, 1983). The Lida Ajer cave is of special interest because the excavation of this deposit is well documented by Dubois in one of his unpublished reports. The excavation of Lida Ajer (Ngalau Lida Ajer, West Coast of Sumatra) started on the 15th of July, 1888 (de Vos, 1983). From the unpublished report we can learn (de Vos, 1983, p. 418), 'that the Lida Ajer Cave is situated in a limestone deposit South of the village of Sitoedoeh Batoe (old spelling), as indicated in the geological Atlas of Verbeek. The entrance of the cave is about 150 m above the valley of the river Batang Babuwe' (de Vos, 1983). Most of the collected materials are teeth, bones being rare. Almost all bones and teeth-roots show traces of gnawing activities presumably by porcupines (de Vos, 1983), but at least Dubois had gathered proof that fossil mammals occurred in the caves of Sumatra.

The fossils which were found consisted of species, like *Homo sapiens , Pongo pygmaeus, Hylobates*, which are still present in Sumatra (de Vos, 1983). This fauna, a tropical rain forest fauna was too young to contain the ancestor of Man. The expedition has failed. However, Dubois wrote a paper (1889) 'About the desirability to do research of the diluvial fauna of The Dutch East Indies,' in which he stated that the possibility to find fossils was proven. Further he stated that the Germans had their Neanderthal skull, the English were doing research in the Siwaliks, the French La Naulette and if the Dutch did not commence research in the field of paleontology, they would quickly find themselves to be far behind in that field research. In the end he said, more or less, maybe the Dutch can find the ancestor of Man. His superiors were sensitive to this argument and Dubois was freed of his military duties and was assigned to do palaeontological work in Sumatra and, if necessary, in Java. For doing this work he was granted two sergeants and between 25 and 50 laborers (convicts). While Dubois was in Sumatra, he found a Human skull from a cave in the marble quarry called Wajak (old spelling: Wadjak), situated in the South of Middle Java. In the eyes of Dubois, the Sumatran cave fauna was too young to include any human forerunners. His enthusiasm was tempered and he lost interest and never described the fossils or published his notes.

Wajak

Van den Brink (1982) and Storm (1995) gave a full account, based on notes and unpublished reports, of the excavations of Dubois at Wajak. From their work we can learn that, 'The first announcement of the human fossils from Wajak was published in 1889'. In the meeting of the 'Koninklijke Natuurkundige Vereeniging in Nederlandsch- Indië' on 13 December, Mr. C. Ph Sluiter (1888) read out a letter from Mr B.D. van Rietschoten, in which the latter wrote that he had found the skull of a Man or something like it (Storm, 1995). An abstract of this letter is stored in the files of the Dubois Collection, currently housed at Naturalis Biodiversity Center, Leiden, The Netherlands. It includes a sketch of the Wajak site that was reproduced by Van den Brink (1982) and is dated 31 October, 1888.

The skull was sent to the Koninklijke Natuukundige Vereeniging, and subsequently to Dubois, who was at that time still in Sumatra. The complete Wadjak I skull was rather mineralized, but one could see that it was from a recent *Homo sapiens*. It was surprising that it was big and heavy, which set it apart from the recent Javanese. According to Dubois (1890), in his letter from 11 April, 1889 to Sluiter, the skull was different from the 'Malay type' and resembled more the 'Papuan type', It was the Wajak skull which convinced him to go to Java. He immediately went to the site and started to excavate. He found parts of a second skull, the so-called Wajak II, and mammal fossils.

The mammal fossils were rather recent or Holocene, including: *Macaca fascicularis, Trachypithecus cristatus, Hystrix javanica, Rhinoceros sondaicus, Sus scrofa, Tragulus javanicus, muntiacus muntjac, Rusa timorensis, Bos sondaicus* and/or *Bubalus bubalus.* They were described by van den Brink (1982) and mentioned by Storm (1995). This fauna was also too young to contain the ancestor of Man. Dubois again lost interest and never published his notes.

Kedung Brubus

Dubois had knowledge of sites on Java which contained extinct mammals. Junghuhn had collected some fossils on Mount Pati Ajam in the Japara Residency. In 1857, he described three fossil elephants from this 'Battlefield of Giants', as he called it: *Elephas primigenius*, which was the most abundant, *Mastodon elephantoides* and *Elephas*. Sloet van Oldruitenborh had described (1859) some fossils that he had collected near Dessa Teguan in the vicinity of Pandan in the Kendeng Hills. The Javanese painter Radèn Saléh (1867) had described fossils collected in 1866 and 1867 on Mount Pandan and in Kedung Lumbu (near Kedung Brubus) in the Kendeng Hills. The collections of Junghuhn, Radèn Saléh and most other collectors were sent to the National Museum of Geology and Mineralogy (now known as Naturalis Biodiversity Center) in Leiden, the Netherlands. Based on these collections the geologist Karl Martin, director of the museum, described the following species: the proboscideans *Stegodon trigonocephalus* n. sp., *Stegodon bombifrons* (Siwaliks), *Stegodon cliftii* (Siwaliks), *Euelaphas namadicus* (Narbada), and *Euelaphas hysudricus* (Siwaliks); the suid *Sus hysundricus* (Siwaliks); *Bison sivalensis* (?) (Siwaliks); the bovid *Bos* sp.; and the deer *Cervus lydekkeri* n.sp. (Theunissen et al., 1990). His analysis of the fossils led Martin to the conclusion that the fossil mammal fauna of the Kendeng Hills, Mount Pati Ajam and Ngembak was equivalent to the tertiairy fossil fauna of the Siwalik Hills and of Narbada in British India, described by the British paleontologists H. Falconer, P.T. Cautley, and R. Lydekker (Theunissen et al., 1990).

Disappointed by the Wajak Cave, he went to the sites with extinct mammals, like the *Stegodon trigonocephalus,* which had already been mentioned and visited. He bellieved that if there were a transitional form, it must be in the layers where the extinct mammals had been found.

Dubois wrote monthly reports. In the monthly report of June 1890 (Dubois, Monthly report June 1890, unpublished) we can read that the search for fossils started on 25 June. The first locality which was visited was near Kedung Brubus, where excavations had been carried out in 1866 by Radèn Saléh, near the former duku Kedung Lumbu (de Vos and Sondaar, 1982). Shallow holes at two or three places in the teak forest were clear signs of these excavations. When Dubois continued the work of Radèn Saléh at those locations, he found no fossils. It soon became clear that there was not a large concentration in that area. Whereas it seemed at first that the fossils came from the upper sandy layers which covered the surface of the mountains, it later seemed that most of the fossils came from hard sandstone and the equivalent conglomerate, for example the upper jaw of a hippo, the uppermost part of which was covered with loose sand, while the deeper part had to be removed with the help of a chisel (Dubois, Monthly report June 1890, unpublished; de Vos and Sondaar, 1982). During the first month, the following fossils were found near Kedung Brubus: an upper jaw of a 'hexaprotodont' *Hippopotamus* sp., the lower jaw of *Sus* sp., fragments of molars of *Stegodon*, fragments of molars from *Elephas*, horn cores of Capra (=*Duboisia*), two species of deer, horn cores of bovids and molars of *Rhinoceros* sp. During the following month a hyena was found, represented by a piece of a mandible with only one premolar (P4). Many specimens of a small deer, probably *Cervus lydekkeri*, were also found by surface-collecting (Dubois, Monthly report July 1890, unpublished; de Vos and Sondaar, 1982). In August, a fragment of the mandible of Hyena was found, which fit into the part which had already been found in July (Dubois, Monthly report July 1890 unpublished; de Vos and Sondaar, 1982). This proves that the extent of the area where the fossils were collected at Kedung Brubus was small. Furthermore, in the same month a mandible fragment was found with the P4 and the root of the P3 and the canine of a *Felis* (Dubois, Monthly report August 1890, unpublished; de Vos and Sondaar, 1982) . In December a molar of a *Tapirus* was found and the monthly bulletin included a report that on the 24th of the previous month the mandible of a human had been found; it was described as follows: 'Amidst the remains of typical representatives of the fauna concerned, and in the same layer...a human fossil was found, the right side of the chin of a lower jaw with the sockets of the canine tooth and of the first and second premolar...[T]his fossil [jaw] forms a different and probably lower type than any previously known' (Dubois, Monthly report December 1890 unpublished; de Vos and Sondaar, 1982), which almost thirty years later, Dubois attributed to *Pithecanthropus erectus* (Dubois, 1924a, b). In 1891 surface collecting continued until August. In the unpublished monthly report for March 1892 we read that, due to the good results of the excavations near Trinil and because heavy rain had made searching in the woods very difficult, the decision was made to excavate at Kedudung Brubus, a site which seemed suitable because of the previous finds of fossils at the surface (de Vos and Sondaar, 1982). However, the difficulties (in particular the hardness of the sediment) were too great and the number of helpers too few to achieve good results. Therefore the excavation was terminated at the end of the month. During this excavation two molars of *Tapirus* were found, during April, remains of a fossil *Manis* (Dubois, monthly report April 1892, unpublished). Surface-collecting continued sporadically over the years at Kedung Brubus and nearby at Kebon Duren, Kedung Lumbu and Butak. Since the excavations at Trinil at the Solo River were successful, attention turned to Trinil. Dubois never published his notes about Kedung Brubus.

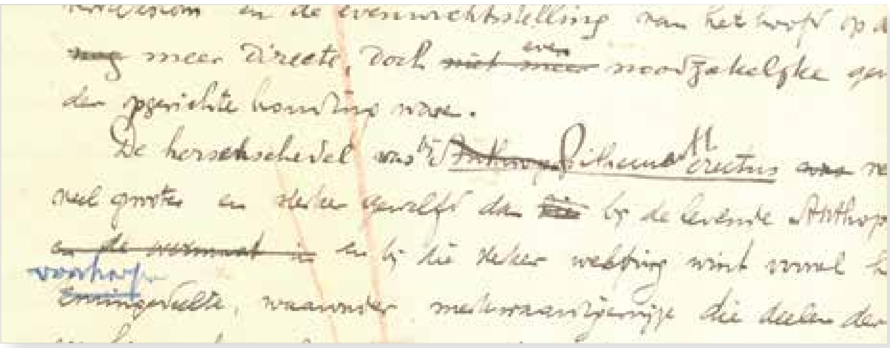

Figure 2: Dubois'manuscript in which he changed his mind from Anthropopithecus *(Man-Ape) to* Pithecanthropus *(Ape-Man).*

Trinil I: Dubois' excavations

The excavations of Dubois at Trinil are described by de Vos and Sondaar (1982) and in more detail by de Vos and Aziz (1989).

Dubois started the excavations in August 1891 with two sergeants, Gerardus Kriele and Anthony de Winter and local laborers, on both sides of the Solo River (Dubois, Monthly report August 1891, unpublished). In September, at the left bank, a right upper third molar was found. Dubois considered this molar to be from a fossil chimpanzee, an *Anthropopithecus*, as was found by Lydekker (1879) in the Siwalik Hills. A month later, in October, a skull cap (Figure 2) was found. Dubois considered this skull cap to belong to *Anthropopithecus*, he also realized that the brain capacity (about 1000 cc) fell between the Apes (500 cc) and Man (1500 cc). As the rainy season started and the water level of the river was too high for them to be able to reach the layers with the fossils and they had to stop excavations. They started again in May 1892. In August, a femur was found, and it was evident that the individual to whom it belonged walked upright. Dubois proposed the idea that the molar, the skullcap and the femur belonged to a single individual. What he had now was a creature with a brain capacity measuring between Man and Ape, which walked upright. First Dubois described it as *Anthropopithecus erectus* (the upright-walking Man-Ape), but in 1893 he change the name to *Pithecanthropus erectus* (the upright-walking Ape-Man) (Theunissen, 1989; Figure 3). In 1894 he published his '*Pithecanthropus erectus,* einen menschenaenliche Uebergangsform aus Java.' At the end of 1894, his military duty was over and he sailed to Holland again (Figure 4, Photograph from Dubois Collection of Trinil 1894). The excavations continued until 1900, but no further human fossils were found. Before going home Dubois made a trip into the Siwalik Hills because he probably inspired by Martin and Lydekker, had the idea that the fauna from Java and the Siwaliks were of similar age. He found a lot of fossils in the Siliwaks and made a travel report, which was never published. Once home, he showed his fossils widely at congresses and meetings and, in the beginning, to anybody who liked to see them. But as he received only criticism, he soon stopped showing the fossils. Although he produced

Figure 3: View of the Gunung Lawa in 1890. Left arrow the Hoekgrot (Corner cave with the red painted skeleton), right arrow the site of the Wajak Cave.

Figure 4: The skull-cap of Pithecanthropus (Photograph Dubois).

many notes, reports, and site maps, he never published them in detail; It is probable that he was too busy defending his finds, and with his subsequent jobs appointments. He became professor in palaeontology and geology at the University of Amsterdam, Director of his so-called internal consistency, Dubois collection, at the 'Rijksmuseum van Natuurlijke Historie' (currently known as the Naturalis Biodiversity Center) at Leiden, and Curator of the Paleontological and Mineralogical Cabinet of Teylers Museum at Haarlem, the Netherlands.

Trinil II: Selenka expedition

The German zoologist Emile Selenka, who had been a professor of zoology in Leiden from 1868 to 1874, lead an expedition in Borneo to study orang-utans. He visited Dubois in 1899 to study the *Pithecanthropus* remains. He was fascinated, and conceived a plan for continuing Dubois' work in Java. Dubois could not prevent it, because everybody is free to excavate, but at the same time was not pleased. However, Selenka died in 1902 before he could carry out this plan. His wife Margarethe Leonora then decided to take over her husband's work. In 1906 she organized an expedition to Java, which carried out, until 1908, excavations near Trinil (Teunissen et al.,1990). It was Anthony de Winter, one of Dubois' assistants, who identified to Selenka the sites at which the skullcap and the femur were found by Dubois (Albers and de Vos, 2010).

Detailed reports on the excavations made at Trinil in the years 1906-1908 by the Selenka Expedition (Selenka & Blanckenhorn, 1911) were prepared by Oppenoorth (1911), Carthaus (1911) and Dozy (1911). According to these reports, three trenches were dug. Trench I was located directly next to the trench dug by Dubois between 1890 and 1900, on the right bank of the river (Oppenoorth 1911, p. XXXI) and nearly all the fossils originated from the 'main fossil layer' (='Hauptknochenschicht'). Trench II is at the same site as the excavations by Dubois on the left bank. Trench III is indicated on the map (Table VI, Selenka & Blankenhorn, 1911), but is not mentioned in the text. It can be concluded that the material excavated by Dubois and Selenka originates from the same locality (de Vos and Aziz, 1989). The faunal lists of Selenka and Dubois are the same, with the exception that Selenka lists a dog (*Mececyon trinilensis*) and Dubois lists a Bengal cat (*Prionailurus bengalensis*), a monkey (*Trachypithecus cristatus*) and of course, *Homo erectus* (de Vos and Sondaar, 1982). The fossil collection of the Selenka expedition is divided between institutions in Berlin and Munich.

Ngandong

In 1932, the Dutch geologist W.F.F. Oppenoorth, who had participated in the Selenka expedition from 1906 to 1908 and who was now employed by the Dutch Geological Survey, described new hominid finds from the village of Ngandong on the banks of the Solo River. The site, a river terrace some 20m above sea level, had already been mentioned by Elbert (1907), and turned out to be a rich deposit of fossil vertebrates, including eleven skulls of a new hominid. Oppenoorth (1932) subsequently described this hominid as *Homo soloensis*. The site was excavated from 1931-1933 by the Dutch Geological Survey. In the files of Bandung, there are many reports, which show exactly where the fossils and skulls were coming from. Publication of these reports was not a priority for the Dutch Geological Survey. Huffman et al. (2010) was able to produce a good reconstruction of the excavation of the site because of those published and unpublished reports. More than 25,000 fossils were collected, however they were lost during World War II. What remained were described by von Koenigswald in a series of papers (e.g. von Koenigswald, 1940).

Sangiran

The site was already known by Schmulling (1864) who had reported on some fossils mammals from the Laleose district (Dessa Sangiran). Dubois had already visited the site, but was not interested.

Sangiran was the preferred excavation site of Gustav Heinrich Ralph von Koenigswald. von Koenigswald visited Dubois in 1936 (von Koenigswald, 1956) and had the desire to follow in his footsteps. Sangiran is not a site, but a former dome, which is named after the village Sangiran. The River Cemoro has eroded through the dome, so that several layers are now visible in outcrops. The oldest, the Kalibeng, is at the bottom. Formed over the Kalibeng is the Pucangan Formation, then the Grenzbank, and on the top, the Kabuh Formation. Fauna from different ages are found in those layers. Fossil skulls are found in the upper Pucangan and the Kabuh layers. The first hominin skull (Sangiran 2) was brought to von Koenigswald in 40 pieces, because he paid ten cents for each fossil (von Koenigswald, 1956). After the find of von Koenigswald many hominins fossils were found, most incidentally, but a few were excavated. It is well known for being one of the areas in the world with most hominins.

Discussion

Wajak

Later authors noted that the Wajak site had disappeared. Stein Callenfels (1936) stated, 'The sites have now been completely destroyed in the course of quarrying marble.' The basis of this statement was borrowed by von Heine-Geldern, who noted: 'Yet it took him [Dubois] thirty years till he published descriptions…, In the meantime, the site had been completely destroyed in the course of quarrying marble…, An earlier publication might have stimulated new excavations there, which might have yielded further material' (1945: 159). Jacob (1967) quoted these authors as well and Van den Brink (1982, p. 178) stated that: '…this breccias cannot be traced any more, for the whole cave is destroyed now as a result of marble-winning in this area'.

Dubois (1920; 1922) gave the exact position of the site where the Wadjak skulls were found and of the Hoekgrot (the Eastern Corner Cave) where the red painted skeleton was found. His (Dubois, 1922, p. 1014) description is recapitulated briefly here: 'Tjampur Darat, or Wadjak, the capital of the district of Wadjak, is a village (dessa), south-west of the town of Tulung Agung… ., On the slope of the part of the mountain that extends, almost rectilinearly, over a distance of 800 meters in W.S.W. direction, immediately on the south of Tjerme [=Tjemee] at 2 kilometers S.S.W. of Tjampur Darat, fossil human bones were found in 1889 and 1890'. In the Dubois files, there is a map indicating where sites are located. A further note in the Dubois files on the subject of site location: 'Locality of Van Rietschoten [Wadjak 1 locality] situated in lime-stone wall, immediately 400 m south of Nglempoeng'. Dubois' photograph of the mountain (Figure 5) indicates where the sites, such as Hoekgrot and Wajak, are situated. With the help of the descriptions of Dubois, as well as his unpublished photographs, drawings and notes, Aziz and de Vos (1989) were able to relocate the sites in 1985. There was still some intact sediment, such that an excavation was possible (Aziz and De Vos, 1989). Since the turn of the twentieth century, the whole Wajak collection has been stored at the Naturalis Biodiversity Center. As the mammal fossils were not previously described, with the exception of *Panthere tigris* by Brongersma (1937) and *Tapirus indicus* by Hooijer (1947) and *Trachypithecus* by Hooijer (1962) the mammal fossils were first described in detail in 1985 by Van den Brink. A new description of the skulls was given by Storm (1994). Although Dubois (1922) stated that no artifacts were found, Storm (1992) found two microliths and a bone tool in the boxes with mammal fossil fragments.

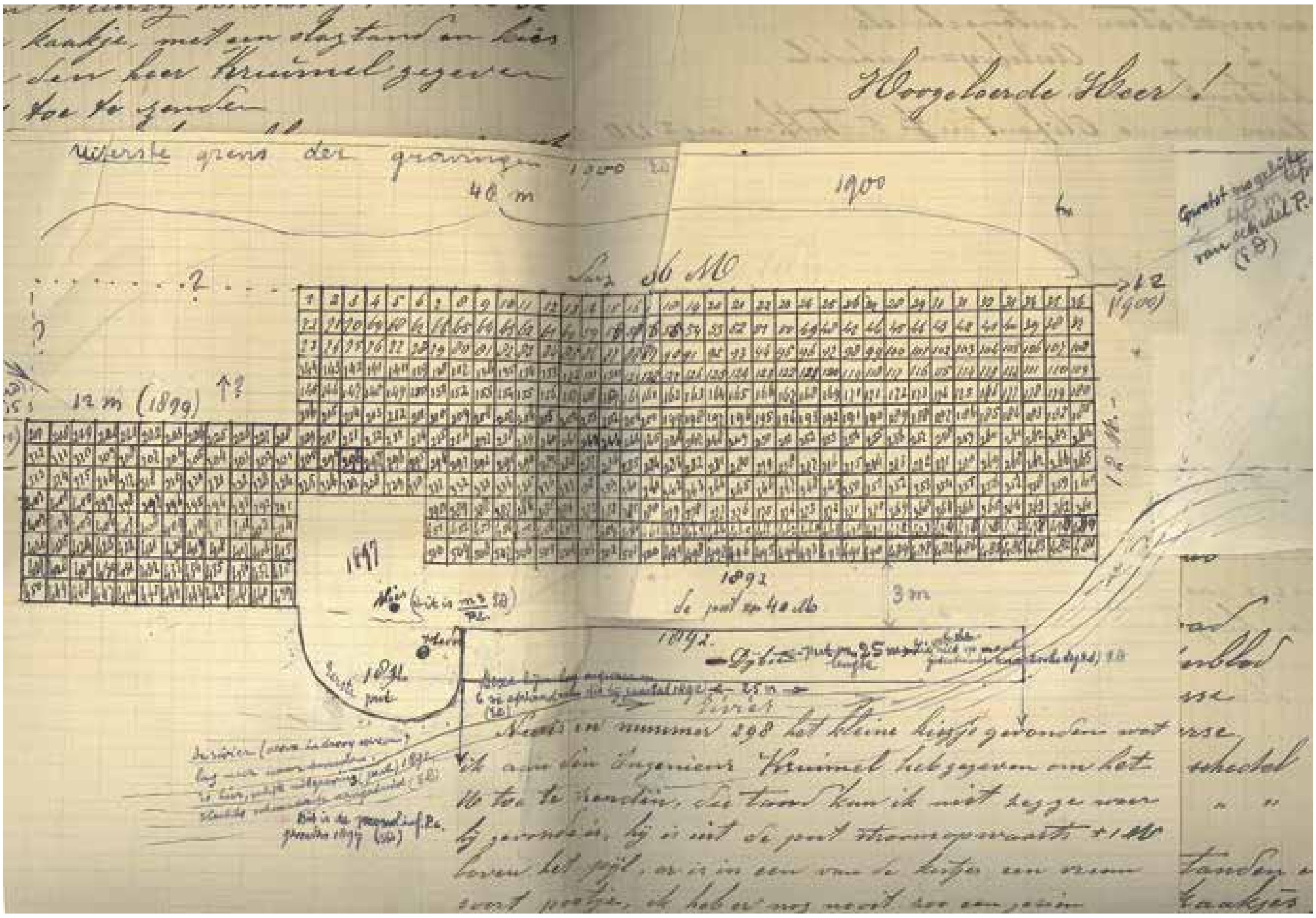

Figure 5: The site-plan of Trinil made by Kriele, one of the assistants, in which is indicated where was excavated beween 1891-1899.

What remains at the site today is only a rock-shelter and it does not merit being put on the World Heritage List. However, the collection of bones, the notes, photographs and site maps show the importance of the site for later research as well as the history of the site. These things must be curated very well and protected.

Trinil and Kedung Brubus

Figure 6: Photograph of the site Trinil in 1894.

In many studies during the 1930s there was criticism of the way in which Dubois collected his samples, and the scientific value of his collection was doubted. For example, von Koenigswald (1934, p. 190) doubted whether *Manis palaeojavanica* (a large pangolin) was found at Kedung Brubus; Duyfjes (1936, p. 140) writes that from the data Dubois provides it is impossible to ascertain which fossils were collected from Butak and which from Kedung Brubus; Brongersma (1941, p. 115) expresses the opinion that the importance of the Dubois Collection for geology has diminished, but that zoologically speaking its value has remained, and Hooijer (1948) regrets that the fossils were not collected according to modern methods. However, Dubois was the first to use a grid system, even before archaeologists were doing so systematically. In a letter of Kriele, dated December 21, 1899, is a site-map indicating where Dubois excavated (Figure 6). This site-map shows where the molar and skull cap were found in 1891 and the femur in 1892. The site-map further shows the area that was excavated during 1893, 1897 and the plan to excavate in 1900. The grids are square meters, and grid and the level above the lowest water level of the river from which they came is written directly on the more important and characteristic fossils. Figure 7, a photograph taken by Dubois, gives an overview of the Trinil site in 1900.

After Father Bernsen, the assistant of Dubois, made a catalogue of the fossils of the Dubois Collection in the 1930s, D.H. Hooijer described the fossils one by one, from 1946 until 1979. In the beginning of the 1980s the files were studied in connection with the fossils. The collection showed that there was clearly a difference in the fauna between Trinil and Kedung Brubus. For example, in Kedung Brubus an *Elephas* was found which was lacking in Trinil. Now, studying the files, it was possible to relocate the fossils; from the files it was clear where the fossils were coming from. After this analysis, it turned out that Kedung Brubus was younger than Trinil (Leinders et al., 1985).

The site of Trinil is no longer available, as dam-building operations have left the layers below water-level. Thus the site cannot be inscribed on the World Heritage List. The actual monument placed by Dubois is enough. Aside from notes and photographs, there is a file of correspondence between Dubois and all the well-known palaeo-anthropologists of his time, like Arthur Keith, von Koenigswald and Robert Broom, to mention a few. Correspondence with the latter discussed the find of the *Plesianthropus transvalensis* fossils with Dubois. Broom includes a drawing of the skull of the *Plesianthropus* in which the canines are rather large. In his publication of the *Plesianthropus* the canines are more or less the same site as the incisors. What remains of Trinil are the fossils, files, photographs, etc. This collection is really World Cultural Heritage, at least for the paleoanthropological science community.

Figure 7: Photograph of the site Trinil, 1900.

Sangiran

Sangiran is on the World Heritage List. Several institutes have collected specimens from the site. But all the collectors must have made notes, photographs, etc. Thus it must be considered more than a site alone. To collect all this information makes Sangiran more than a site; it becomes a site with a history.

Conclusion

From the above we can learn that the hominin sites excavated by Dubois produced a plethora of notes, unpublished reports, photographs and other attendant documentation. All of this material gives insight into the development and evolution of those sites. This is, of course, not only true for the sites mentioned above, but must be true also for other famous sites.

It is recommended that the files from Dubois and the files of the Selenka expedition are digitalized in the future; brought together and are stored in the institution where the collections are and put on the internet. To put it more generally: it should be recommended that all the files which remain from famous sites, like Ngandong, are digitalized and put on the internet, especially in cases where all the material is spread over different institutions.

It would be recommended that data be stored in one centralized location after an excavation.

The problem is that the importance of a site will be only often acknowledged after a certain amount of time, thus much of the information will be lost in the interim.

It is recommended here that, aside from the sites themselves, the attendant materials and documentation, like the fossils, published and unpublished papers, photographs and notes of the excavators and the scientists who worked on a site, which show the development and evolution of the site, must be included in the criteria for the judgment for nominating a site for inscription on the World Heritage List.

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4

West Asia

Palaeoanthropology in Pakistan and China: an ICOMOS perspective

Robin Dennell
Department of Archaeology – University of Sheffield – United Kingdom

Abstract

This chapter reviews the evidence relevant to human evolution in Pakistan and China. Both are similar in containing areas with long sedimentary sequences and good fossil preservation. China has numerous well-dated Palaeolithic sites from 1.66 Ma onwards, particularly in the northern part of the country, and those from the Nihewan Basin, the Zhoukoudian area (including the World Heritage site of Locality 1), and the Shuidonggou Valley are established parts of the literature on the Asian Palaeolithic. Southern China also has numerous cave and open-air Palaeolithic sites of major regional importance. Additionally, China has an extensive fossil record for human evolution that spans at least a million years; this includes the evidence from Locality 1, Zhoukoudian, which contains the largest number of *H. erectus* specimens from any single site worldwide. China has a long local tradition of Palaeolithic research. In recent years there has also been an active programme of building new museums and facilities at major archaeological sites, including Palaeolithic ones. In the case of the Palaeolithic sequence in Pakistan, no fossil evidence for human evolution has been discovered yet. The territories of the two countries have a great potential or expanding the list of Palaeolithic and palaeoanthropological sites worthy of researching and preserving records for future potential nominations to the World Heritage List of UNESCO.

Introduction

Pakistan and China both have important contributions to make to studies of human evolution, and both have world-class, fossil-rich geological sequences that cover the time-span of human evolution over the last 2.5 million years. Each also has several areas of great archaeological potential. Nevertheless, the Chinese records for the Palaeolithic and for human evolution are far more detailed and continuous than the records from Pakistan, which remain seriously under-studied by comparison. Pakistan and China also differ considerably in the way that these national assets have been managed, protected, and presented to the public. This factor impacts considerably upon the World Heritage Convention, because the protection, management and presentation of an archaeological heritage are critically important issues when considering whether an archaeological or palaeoanthropological asset is considered worthy of World Heritage status. Here, I first discuss Pakistan and China in terms of their actual and potential contribution to palaeoanthropology, and second, their record in protecting, managing and presenting their sources of evidence.

Pakistan

From a palaeoanthropological viewpoint, Pakistan's greatest asset is the Pinjor Formation of the Upper Siwaliks. The Siwaliks lie south of the forefront of the Himalayas and Karakorum in the northern part of Pakistan and India (Figure 1), and were formed by rivers flowing southwards from these mountains between 18 Ma (million years ago) and (in their youngest exposures) 0.4 Ma. These rivers deposited hundreds of metres of sands, silts and clays that were later uplifted, folded and eroded. Siwalik deposits are often fossil-rich, and the potential of the Siwaliks as a source of information on extinct faunas was first noticed by the British in the early 1800s. Fossil collections were already being formed and sent to London by the 1830s, and in 1845, two British officials, Falconer and Cautley, published the first monograph on the Siwaliks. Further publications of Siwalik fossil material were published in the 19th and early 20th centuries, notably by Laedekker and Pilgrim. By 1939, the Siwaliks were probably the best known terrestrial fossil vertebrate sequence in the world for the Miocene to early Pleistocene (18-1.0 Ma). After a long gap in research following the independence of Pakistan in 1947, American, British and Dutch researchers were active in Siwalik research by collaborating with Pakistani teams in the 1980s and early 1990s.

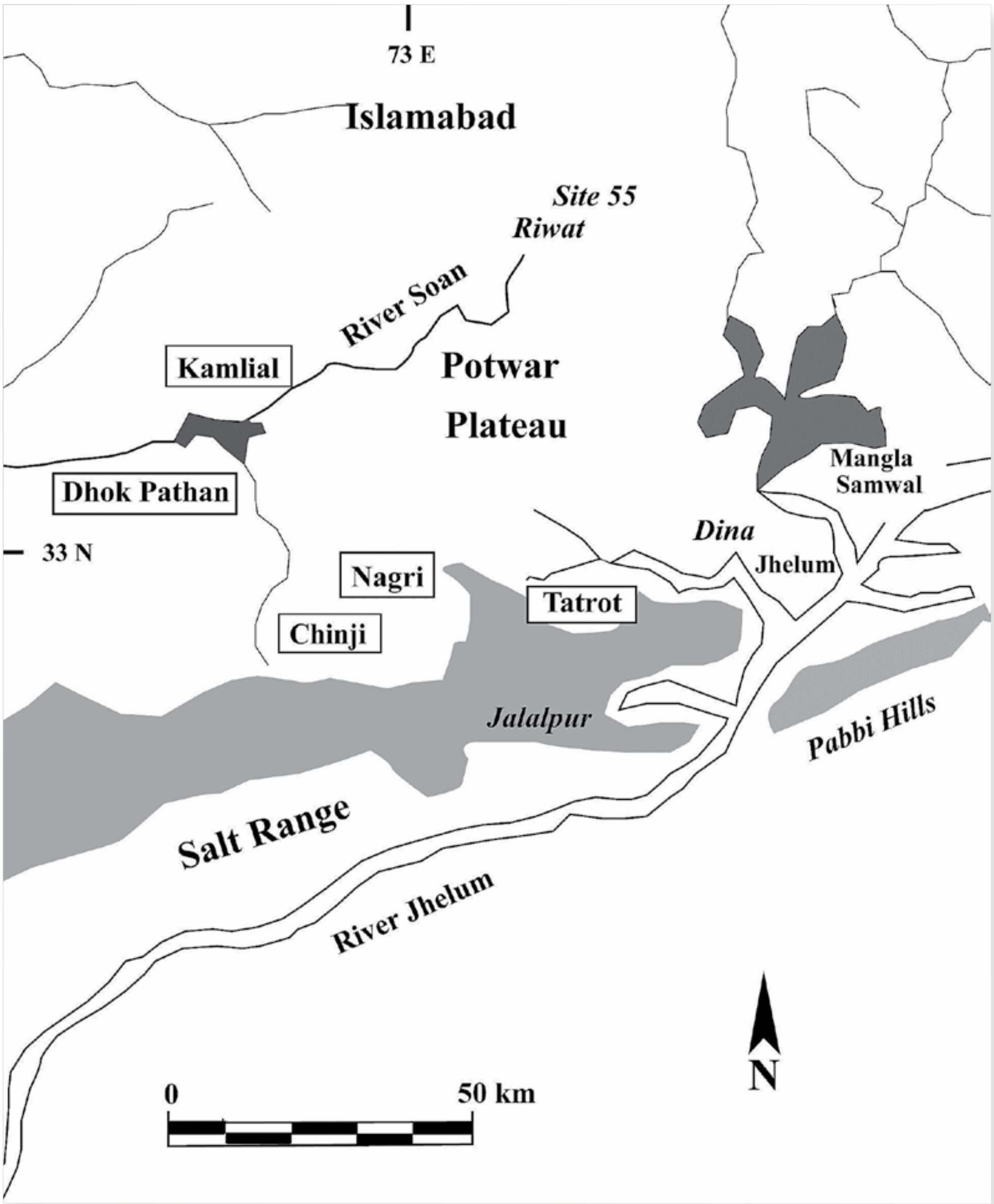


Figure 1: Palaeolithic localities in Punjab Province, Pakistan. Localities enclosed in boxes are type sections that define stages of the Miocene to Pleistocene sequence of the Siwaliks. Localities in italics are ones investigated by the British Archaeological Mission to Pakistan in the 1980s.

The Pinjor Formation

The beginning of the Pinjor Formation occurs ca. 2.6 Ma at the Gauss-Matuyama palaeomagnetic boundary, and extends up to 0.4 Ma in the Pabbi Hills, Pakistan (Keller et al., 1977). It thus covers the period most relevant to investigating the Early Palaeolithic and *Homo erectus*. The Boulder Conglomerate Zone – indicated by a major shift to a very coarse bed load in rivers – marks the end of the Siwalik fossil record, as it is almost devoid of fossil material. It was initially thought to indicate a distinct zone, of uniform age across the entire Himalayan forefront, that followed the Pinjor Formation, but it is now known to be time-transgressive, and thus its age varies considerably between river basins, and ranges from 1.9 Ma to 0.4 Ma (Opdyke et al., 1979; Rendell et al., 1989; Nanda, 2002).

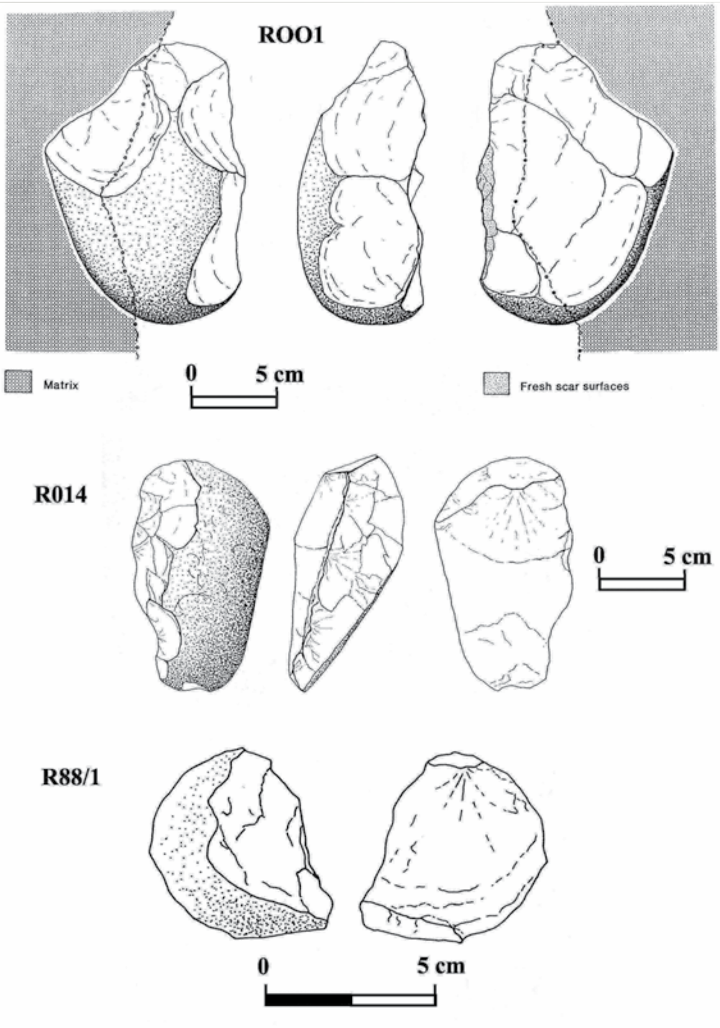
Because the Pinjor Formation includes several sequences with excellent fossil preservation, it should be one of the main sources in Asia for the earliest evidence of hominins outside Africa. Sadly, this potential has not yet been realised. This is partly because most palaeontological research in the Siwaliks has favoured the Miocene, and partly because few archaeologists have invested the time and effort needed to survey it systematically. The main exception is the fieldwork conducted by the author between 1983 and 1999 in the Soan Valley, the Jhelum Basin and the Pabbi Hills.

The Soan Valley

In 1935, the geologist Helmut de Terra and the archaeologist Thomas Paterson spent six weeks surveying the Soan Valley near Rawalpindi, and constructed a sequence that underpinned the South Asian Pleistocene and Palaeolithic sequence for the next 50 years (Terra and Paterson, 1939). They proposed that the earliest evidence for hominins occurred at the beginning of the 2nd Himalayan glaciation, which de Terra correlated with the Mindel glaciation of the European Alps; this is now dated to the early Middle Pleistocene, ca. 500 Ka, or Marine Isotope Stage 12. They furthermore proposed that the earliest inhabitants of South Asia used a simple flake and core type of stone tool industry that they called 'Soanian' throughout the remainder of the Pleistocene, apart from an occasional 'incursion' of groups using Acheulean bifaces. This sequence was re-examined by the geologist Helen Rendell and the author in the 1980s, and found to be unsound: no evidence was found of the river terraces that De Terra claimed to have recognised, and none of the Soanian stone tool assemblages studied by Paterson came from secure, dateable stratigraphic contexts (Rendell et al., 1989; Dennell and Rendell, 1991; Dennell, 1995). A fresh start was therefore needed.

Rendell and Dennell focused their efforts on finding stone artefacts in stratified contexts that could be dated. Their most important discovery was in the Soan Valley near the small town of Riwat.

During the mapping of Pleistocene deposits in the Riwat area in 1983, a large flaked stone was found, embedded in a small outcrop of sandstone and conglomerate near the base of a gully ca. 70m deep. On inspection, it was evident that this stone had been flaked before incorporation into the outcrop. When extracted, it was found to have been flaked eight or nine times in three directions; clear flake scars were visible, including bulbs of percussion on some flake removals. Because multiple flaking in several directions is most unlikely to have occurred naturally, the piece was identified as an artefact, i.e. it had been deliberately flaked by a hominin. Further inspection of the same outcrop resulted in the discovery of two other pieces that were regarded unequivocally as artefacts: a core with several flakes removed, and a flake that had both a positive and a negative bulb of percussion (see Figure 2).



The dating of the sandstone-conglomerate horizon in which these artefacts were found was based on stratigraphic, palaeomagnetic and radiometric data. Stratigraphically, the artefact horizon was integral to the southern limb of the Soan Syncline. This is formed of fluvial deposits, and has been intensely folded. Its southern limb slopes gently at ca. 5-20°, in contrast to the northern limb, which is almost vertical in places. All the deposits above and below the artefact horizon had a reversed magnetic polarity, and were likely deposited during the Matuyama Chron, between 0.87 and 2.6 Ma. The almost-vertical deposits of the northern limb of the Soan Syncline had been truncated, and overlain by horizontally-bedded fluvial deposits. These contained an ash that was dated by K-Ar (potassium-argon) to ca. 1.6 Ma. The artefact horizon had to be substantially older than 1.6 Ma because of the time needed for it to be overlain by 70 m of sands and silts that were then tilted and folded, and then truncated before being overlain by a deposit containing an ash 1.6 Ma old (see Figure 3). On this basis, the minimum age of the artefacts was estimated at ≥1.9 Ma (Rendell et al.; 1987; 1989; Dennell et al., 1988).

Figure 2: The artefact assemblage from the lower conglomerate horizon, Riwat, Pakistan. Piece R001 was found embedded insands in the conglomerate hoirzon, to the depth indicated by grey shading. R014 was found embedded in a gritstone block a few metres away, and R88/1 was found in the same section as R001 and ca. 50 metres from it.

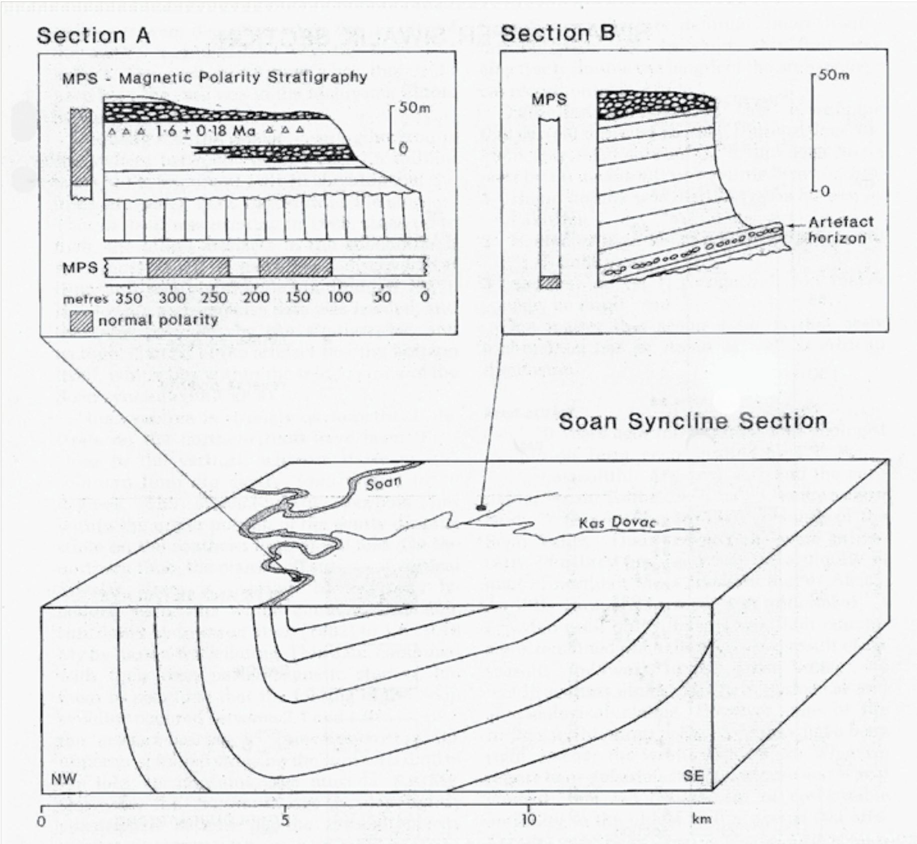


Figure 3: The dating of the artefact horizon at Riwat. The artefact horizon in Section B slopes gently at 10-15o, and was overlain by ca. 70 metres of sands and silts. These layers were folded almost vertically, and then truncated and overlain by horizontal strata containing a volcanic ash that was dated by potassium-argon to ca. 1.6 Ma. The age of the artefact layer was estimated as at least 1.9 Ma-old.

At the time of publication (1987), these artefacts were almost twice the age of any others from Asia, and their dating was thus met with considerable skepticism. Subsequent to the re-dating of the earliest Javan hominins to 1.6-1.8 Ma (Swisher et al., 1994), the discovery of artefacts and hominins 1.75 Ma at Dmanisi, Georgia (Gabunia et al., 2000), and artefacts 1.66 Ma in the Nihewan Basin, China (Zhu et al., 2004), the age of the Riwat artefacts is now 'decreasingly anomalous' (Tattersall, 1997).

The Jhelum Basin

Following the discovery of artefacts in a secure stratigraphic context in the Soan Valley, Rendell and Dennell widened their search to the Jhelum Basin (Figure 1), which contained several sections that had already been dated palaeomagnetically and were known to contain sequences that covered the Lower and part of the Middle Pleistocene (Keller et al., 1977; Opdyke et al., 1979). At Dinar, a bifacial handaxe was found in a layer of sand and gravel that lay a short distance above the Brunhes-Matuyama boundary (0.78 Ma). Two more handaxes were found in a similar stratigraphic position near Jalalpur (Rendell and Dennell, 1985). These were the oldest securely-dated Acheulean handaxes in South Asia prior to the dating of handaxes to 1.0-1.5 Ma at Attirampakkam, South Asia (Pappu et al., 2011).

The Pabbi Hills

The biggest shortcoming of the sections in the Soan Valley, and in the sections examined by Dennell and Rendell in the Jhelum Basin, was the scarcity of associated fossil material. For this reason, attention shifted to the Pabbi Hills (Figure 4). Here, previous American-Pakistani work had demonstrated that the Pabbi Hills contained a long sequence of deposits between 2.5 Ma and 0.4 Ma, and was rich in fossil vertebrate remains (Keller et al., 1977). The then British Archaeological Mission to Pakistan conducted several field seasons in the Pabbi Hills under the direction of the author in 1986-1990 and 1999, over a total period of ca. 16-18 months. Over 40,000 fossil specimens (including non-diagnostics) were found, and these included several large, very rich fossil localities, three of which were excavated (Dennell et al., 2005a; 2005b). The fossil assemblages formed two large sets, one spanning the period 1.8-2.2 Ma and the other, ca. 1.2-1.4 Ma. Subsequent analysis of this material showed that several mammalian taxa became extinct after 1.8 Ma, and likely indicated an expansion of grassland over woodland (Dennell et al., 2005a; 2005b; 2006).

Figure 4: The Pabbi Hills. The deposits are predominantly yellow, and are fine sands and silts deposited on a floodplain. The prominent layer on which there are two electric pylons is a sandstone 'marker' horizon known as Sandstone 12, dated palaeomagnetically to ca. 1.2 – 1.4 Ma, and which can be followed over several kilometres. The deposits below Sandstone 12 were very rich in fossils, and produced much new information on the Early Pleistocene fauna of South Asia.

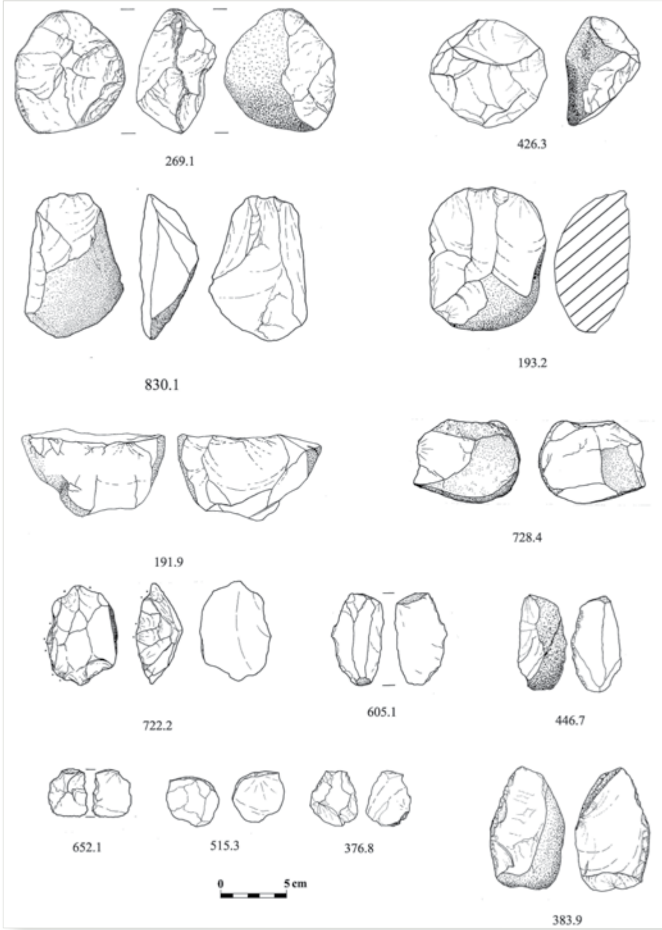


Figure. 5: A selection of the stone artefacts found in the Pabbi Hills. Those shown are all made from quartzite, and are comparable to ones found in Early Pleistocene contexts at such such as Dmanisi, Georgia. On circumstantial grounds, those shown here are believed to be Early Pleistocene in age.

In the course of collecting fossil material, ca. 600 flaked stone artefacts (mainly of quartzite) were also found on the eroding surfaces of deposits containing fossil material. Unfortunately, none of these artefacts were in original stratigraphic context: the deposits in the Pabbi Hills are largely soft, easily eroded, unconsolidated sands and silts, and fossil or stone objects are easily dislodged once exposed in a section or on a sloping surface. Nevertheless, with the exception of a very small number of obviously recent items, they are typologically coherent as a simple, unstandardised tool assemblage, not unlike that from Dmanisi or Olduvai (see Figure 5) (Hurcombe and Dennell, 1993; Hurcombe, 2004).

Post-Siwalik investigations

Almost nothing is known about post-Acheulean, post-Siwalik developments in northern Pakistan after 400 Ka. One of the main areas where progress might be made is the Potwar Plateau (Figure 1). Here, the main set of post-Siwalik deposits are comprised of a poorly-defined Potwar Silt which is covered in many areas by loess. This likely first developed by at least 170 Ka (Rendell, 1988; 1989) from dust that was blown eastwards from the braided course of the Indus and from other river fans south of the Karakorum, and was extensive across much of northern Pakistan during the last glacial cycle (MIS 4 and MIS 2) from ca. 75–18 Ka. Near Riwat, the discovery of conjoining artefacts that were eroding from an area of loess led to the excavation in 1981 and 1982 of a locale that was named Site 55 (Dennell et al., 1989; 1991). The exposure of an area ca. 20 sq. m resulted in the discovery of a line of stones that was identified as a wall footing, a stone-lined pit, and a small circular feature identified as some kind of niche. The associated stone tool assemblage was largely flake based but included several conjoining pieces, and numerous blades. TL dating of the loess covering the archaeological layers indicated a date of ca. 42-45 Ka (Rendell and Dennell, 1987). Site 55 remains the earliest indication of a blade assemblage in South Asia. The identity of those who created Site 55 remains unknown, although genetic analyses of modern populations in South Asia suggests that our species has been in South Asia for at least 60,000 years (Macaulay et al., 2005; Quintana-Murci et al., 1999; Soares et al., 2009). If so, the occupants of Site 55 may have been *H. sapiens*.

Other investigations

After the short, but long-lasting survey in the Soan Valley by Terra and Paterson in 1935, there was a long gap in which no significant Palaeolithic fieldwork took place in what is now Pakistan. In Northern Pakistan, there was some additional collecting of material by Graziosi (1964), Johnson (1972), and Krantz (1972), but without challenging Terra and Paterson's framework. Stiles (1978) pointed out its faults in a thoughtful review, and Allchin (1981) highlighted the need for a fresh approach, which was followed up by the work of the British Archaeological Mission to Pakistan in the 1980s and 1990s. A potentially important excavation took place at Sanghao Cave in the Northwest Frontier Province in the 1960s (Dani, 1964); although the sequence was dated by ^{14}C to between 20-40 Ka (Hedges et al., 1990), the artefacts were never properly published, and little more is known. In Sindh Province in southern Pakistan, Allchin (1976) discovered Palaeolithic workshops in the Rohri Hills, and these and other Palaeolithic and younger sites were later studied by an Italian Mission under Paolo Biagi (2008, 2010, 2011; Biagi and Cremaschi, 1998; see below on the subsequent lack of protection of sites), as well as by Pakistani researchers (e.g. Shaikh et al., 2002-2003).

China

The Palaeolithic record of China is qualitatively and quantitatively very different from that of Pakistan, in that China contains numerous, high-quality world-famous Palaeolithic sites from 1.66 Ma to the end of the last glaciation. Unlike Pakistan, it also has a long and complex sequence of hominin remains, and is thus a major source of information on human evolution in East Asia. Because China is so large and spans 40° of latitude (comparable to that between Gibraltar and the Arctic Circle), it cannot be treated as a homogenous unit for its Palaeolithic and Pleistocene past. Instead, it is customary to discuss North and South China separately, with the Qinling Mountains as their divide (Figure 6). North of these mountains, the climate is temperate and drier, wheat (and further north, millet) are the main cereal crops, and pastoralism replaces crop farming north of the limit of cereal cultivation. South of the Qinling Mountains, the vegetation is sub-tropical to tropical, and rice and tea are the main crops. Although almost the whole of China is dominated by the monsoon, the summer monsoon dominates the south, and the winter monsoon the north, so that South China is warmer and wetter than the North, and winters in the North are considerably colder than those in the south of China.

The Palaeolithic records of North and South China are also very different. The Palaeolithic of North China is now known in considerable detail compared to southern China, where much less is known. We can begin with North China.

North China

There are three major landmark sites (or, more accurately, research areas) in North China that provide the anchor points of a chronological framework. These are the Nihewan Basin for the Early Palaeolithic of the Lower Pleistocene, the cave complexes of Zhoukoudian for the Middle Pleistocene and the Shuidonggou Valley for the Upper Pleistocene (see Figure 6).

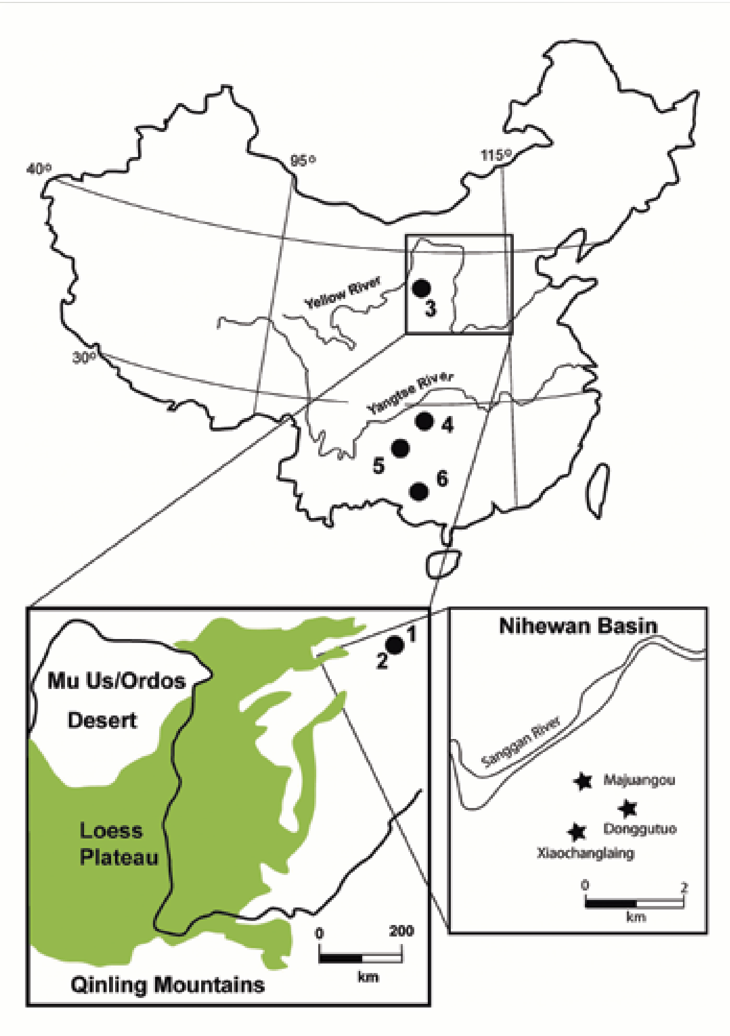


Figure 6: Some principal early palaeolithic localities in China.

1, 2: Locality 1 and Upper Cave, Zhoukoudian; 3, Shuidonggou; 4, Ma'anshan; 5, Panxian Dadong; 6, Bose Basin. Some of the main Early Pleistocene sites in the Nihewan Basin are shown in the inset map. Source: redrawn and modified from Zhu et al., 2004.

a) The Nihewan Basin

The Nihewan Basin is an extinct lake system that was formed ca. 3.6 Ma and finally dried out ca. 300 Ka. During its existence, several hundred metres of lake, lake-shore and stream deposits were deposited and then covered by loess in the last glaciation (see Figure 7). The palaeontological potential of the Nihewan Basin was first recognised by the French missionary Émile Licent and the Jesuit Teilhard de Chardin, who conducted a reconnaissance of the area in 1922-1924 (Licent knew the area already because his parish included a small Christian community in Nihewan). It was not until the 1970s that Palaeolithic sites were first identified, but since then ca. 20 have been excavated and dated by estimates of age between known palaeomagnetic boundaries (see Table 1). Currently, the oldest site is Majuangou III, which has been dated to 1.66 Ma (Zhu et al., 2004). Other excavated early Pleistocene sites that are now established parts of the Palaeolithic literature include Xiaochangliang (1.36 Ma; Zhu et al., 2001) and Donggutuo (ca. 1 Ma). Collectively, the Nihewan Basin contains the longest and most complete Palaeolithic sequence in Asia. Collectively, the sites show a sequence of simple, unstandardised tool types made largely from a local, poor-quality chert but occasionally from better materials. Some researchers regard it as Mode 1 in that it does not include any bifacial, Acheulean elements. Almost nothing is known of the subsistence of these hominins: fossil animal remains are extremely fragmented, and because their association with artefacts is unclear, it remains unclear whether these remains are preserved because of hominin activities. Additionally, the identity of these hominins remains unknown because no hominin fossils have yet been found at Nihewan. However, the most parsimonious likelihood is that the earliest were derived from a *Homo erectus* like that found at Dmanisi, ca. 1.75 Ma (Gabunia et al., 2000).

Figure 7: The Nihewan basin.

Table 1: Estimated ages of early Palaeolithic sites in the Nihewan Basin, North China
(Source: Dennell, 2012)

Site	Co-ordinates	Age (Ma)	Comments
Xaiochangliang	40.2° N., 114.65° E.	~1.36	Dated by palaeomagnetism and inferred sedimentation rates
Xaiochangliang		~1.26	Dated by palaeomagnetism and inferred sedimentation rates; correlated with OIS 35/36
Xiaochangliang		1.67-1.78	Dated by fauna and palaeomagnetism and inferred sedimentation rates
Xiaochangliang)		1.48	Correlated with Xiantai (see below); thus correlated with S 20 and MIS 49
Xiantai (=Dachangliang)	40°13.126' N., 114°39.623' E.	1.36	Dated by palaeomagnetism; correlated with Zhu et al.,'s (2001) dating of Xiaochangliang
Xiantai (=Dachangliang)		1.48	Dated by palaeomagnetism; correlated with S 20 and MIS 49
Donggutuo	40°13'19' N., 114°40'18' E.	1.15-1.21	Correlated with OIS 35,36 by reference to Xiaodukou section
Donggutuo		1.1	Correlated with OIS 35,36 by reference to Xiaodukou section
Donggutuo		1.06 – 1.12	Correlated with S 11-12 and MIS 31-33
Cenjiawan		~1.1	Dated by palaeomagnetism; just below the Jaramillo Subchron
Feiliang	40°13'25' N., 114°40'12' E.	~1.2	Dated by palaeomagnetism
Maliang		~0.8	Dated by palaeomagnetism
Maliang		~0.79	Dated by palaeomagnetism; correlated with L8, glacial period OIS 20
Banshan		~1.32	Dated by palaeomagnetism
Majuangou I		~1.55	Dated by palaeomagnetism
Majuangou II		~1.64	Dated by palaeomagnetism
Goudi (=Majuangou III)	40°13.517' N., 114°39.844' E.	~1.66	Dated by palaeomagnetism from sections at the site and at Haojiatai, 1.5 km away
Goudi (=Majuangou III)		1.36-1.66	Estimates reflect uncertainties over sedimentation rates, stratigraphic continuity and correlations between MJG and Haojiatai.
Huojiadi		1.0	Dated by palaeomagnetism to within the Jaramillo Subchron

Notes: OIS = oxygen isotope stages of marine sediments; odd-numbered stages refer to warm episodes, even-numbered ones to cold periods. Stages are numbered from top of section downwards. S20 = soil number 20 in the loess-palaeosol sequence of the Chinese Loess Plateau. Soils denote warm periods, loess (L) deposits, cold ones. Stages are numbered from top to base.

There has been recent discussion of how the overall sequence of sites at Nihewan should be interpreted. Some Chinese researchers have argued that the presence of numerous sites over a million year period at Nihewan indicates permanent, continuous occupation, irrespective of the prevailing climate (see e.g. Zhu et al., 2004; Liu et al., 2010). They argue further that these hominins must have been able to hunt, and had adapted to living during cold, glacial periods at a very early date. This author (Dennell, 2012) recently proposed a very different interpretation. He pointed out that there is no evidence in the Early Pleistocene for the controlled and repeated use of fire, or for sewn clothing, constructed shelters, or hunting. Because winters in the Nihewan Basin are severe (with average January temperatures of -10° to -15 °C.), he argued the occupation even in warm, interglacial periods (i.e. comparable to the present) was likely seasonal, and the Basin was probably uninhabited during cold, glacial periods. More on-site data on climate and subsistence at Nihewan and elsewhere in North China are needed to differentiate between these two sharply differing hypotheses.

Related sites

The long sequence of the Nihewan Basin serves as a reference point for the earliest Palaeolithic of North China. Other similar sequences that can be tied to well-dated local sequences of loess and palaeosols and a palaeomagnetic framework are currently under construction in the Lushi and Luonan Basins of Central China (Huayu Lu et al., 2011a; 2011b).

Zhoukoudian

The area surrounding the town of Zhoukoudian south-west of Beijing contains at least 20 cave sites with Palaeolithic and Pleistocene remains, of which Locality 1 is the most famous, and now has World Heritage status. This site, formerly known as Chou-kou-tien and sometimes as Dragon Bone Hill (Boaz and Ciochon, 2004), was first discovered in the 1920s. Following the discovery of a fossil hominin tooth that was given the new taxonomic name of *Sinanthropus pekinensis*, a large, lavishly-funded, multi-national, multi-disciplinary project was established to investigate the deposits of Locality 1. For their time, these excavations were of a very high standard, and on a massive scale, with over 100,000 tons of material removed. The first hominin skull was found in 1929, and by the time that excavation ceased in 1937 (because of the Japanese invasion of North China), over 140 specimens of *Sinanthropus* had been found, along with thousands of stone tools and the fossil remains of mammals and birds. Even today, the *Homo erectus*[1] assemblage of 40 individuals from Locality 1 is the largest in the world from a single site (see Jia and Huang, 1990).

Locality 1 accumulated within an enormous fissure (Figure 8) that was gradually filled up with over 30m of deposits. Fourteen major stratigraphic units are recognised, of which the lower two (layers 13 and 14) lack artefacts or hominin remains. Numerous efforts have been made to date the contents of Locality 1 by TL, U-series and ESR, all of which indicate a Middle Pleistocene age for Locality 1. The latest attempt applied a new technique based on the ratio of aluminium and beryllium (26Al-10Be), and indicated ages of ca. 400-780 Ka, which are substantially older than earlier estimates (Guanjun Shen et al., 2009). This dating makes the earliest *H. erectus* population at Locality 1 roughly contemporary with the *H. antecessor* population at Atapuerca, Spain (Carbonell et al. 1995), on the other side of the Eurasian landmass.

Figure. 8: The cave site of Zhoukoudian.

The artefacts from Locality 1 were mostly made from local quartz, which is not the easiest stone to flake. Artefacts are largely flakes, with scrapers and burins the commonest types. No bifacial handaxes are present, and thus the assemblage is not Acheulean. There is some indication that

1 *Sinanthropus pekinensis* was reclassified by Ernst Mayr in 1951 as *Homo erectus*, and subsequent researchers have accepted this reclassification.

tools became smaller and more precisely made over time, so it would be incorrect to describe the technology as unchanging (Zhang Shenshui, 1985). There has been a protracted and often heated debate over the subsistence activities of *Homo erectus* at Locality 1. Originally, the presence in the same deposits of skeletal remains of *H. erectus*, its artefacts and thousands of bones of potential prey species such as bovids, horse, rhinoceros and cervids etc., led to the inference that *H. erectus* had been a skilled hunter. This view was challenged by Binford and Stone (1986), who pointed to the presence of large numbers (>2000) of the giant hyaena *Pachycrocuta brevirostris*, and argued that *H. erectus* had been the hunted, not the hunter, and was at most a scavenger lower on the food chain than the giant hyaena. This view was confirmed by Boaz et al. (2000). Nevertheless, as various Chinese commentators continue to point out, it is hard to reconcile the view that Locality 1 was primarily a denning site for giant hyaena that occasionally killed and ate *H. erectus* with the tens of thousands of stone artefacts at the site.

Two additional debates complicate any synthesis of the Locality 1 material

Was *H. erectus* a cannibal?

Weidenrich (1939) suggested that one skull had evidence of a large impact wound that could have been caused by a club, or at least inflicted deliberately, and also observed a cut mark on one of the skulls. This was confirmed by Boaz and Ciochon (2004, p. 135), who also recognised a cut mark inside the cast of one skull fragment and another piece of skull found in 1966. *Sinanthropus* might therefore have been cannibalistic, as has been suggested for *H. antecessor* at Atapuerca in Spain (Fernandez-Jalvo et al., 2009). In neither case is it possible to determine whether these hominins were eating corpses of those already dead, or killing their own kind and eating fresh meat.

Did it use fire?

Evidence of fire was first claimed in 1931, when Chardin showed Breuil material that he thought had been burnt. In the excavations of the 1930s, excavators uncovered what they thought were enormous layers of ash, and this gave rise to the idea that *H. erectus* had acquired the ability to make fire. At the time, Zhoukoudian had the earliest evidence for fire worldwide. In a startling challenge to this view, Weiner et al. (1998) concluded, after an exhaustive analysis of the deposits exposed in the west section of Locality 1, that there was no evidence of fire, but instead, the alleged ash were natural particles of manganese. However, the fact that there may have been no evidence for fire in that section does not means it was absent elsewhere in the site: some fossil bones show evidence of charring, and some were probably burnt in situ after they had been fossilised. Additionally, evidence for the repeated use of fire has been recognised as the site of Gesher Benot Ya'qov, Israel, ca. 700-780 Ka (Alperson-Afil and Goren-Inbar, 2010), roughly the same age as Locality 1. Fire may therefore have been part of the behavioural repertoire of *H. erectus* at Locality 1.

The Shuidonggou Valley

Shuidonggou was another of the Palaeolithic sites that Licent and Chardin (1925) discovered in their survey of North China in the 1920s. It lies in the cliff of a gully on the edge of the Ordos Desert (Figure 9), inside the enormous loop of the Yellow River as it flows through north China. Chardin excavated part of its profile, and recognised a stone tool assemblage that contained some blades and flakes detached from prepared cores, similar to the Levallois technique of Western Europe (Madsen et al., 2001), and also an incised pebble that is one of the few potentially symbolic objects from a Chinese Palaeolithic site (Peng et al., 2012). Because of its blade component, Shuidonggou became the primary exemplar of the later Palaeolithic of North China, and by extension, NE Asia. Locality 1 at Shuidonggou (SDG 1) has been excavated many times, notably by a Chinese-Russian team in the 1960s (shortly before the Sino-Soviet split), but also by other Chinese teams. More recently, there has been a major survey of the Shuidonggou Valley by a team from the IVPP (Institute of Vertebrate Palaeontology and Palaeoanthropology) in Beijing. This survey has identified several new sites, including SDG (Shuidonggou) 8, with an Early Palaeolithic assemblage, and SDG 12, with a terminal Pleistocene micro-blade technology. Locality 2, directly opposite SDG 1 has also been excavated, and there are plans to excavate SDG 1 again in the near future.

The dating of the initial Upper Palaeolithic at Shuidonggou has been a major concern. Two ^{14}C dates of 17,250 ± 210 BP and 25,450 ± 800 BP were obtained in the 1980s, but these are probably minimal ages, and new dating samples need to be obtained. For this reason, the recent evidence from SDG2, ca. 100 m away, is of great interest. This site SDG 2 contains evidence of several episodes of occupation (see Figure 10) that have been dated by AMS ^{14}C to between 29 Ka and 24 Ka (Madsen et al., 2001). Several of these contain evidence of hearths, and all contain flaked stone (including scrapers, burins,

Figure. 9: Shuidonggou 1 and 2.

Figure 10: SDG2 cultural layer.

points and drills) and animal bones, mainly of horse, a large bovid, and rhinoceros (Guan et al., 2011; Gao et al., 2012). Additional evidence that is similar to that from sites in Western Eurasia includes a bone needle (indicative of a sewing technology), personal ornaments (ostrich eggshell beads, some of which were dyed) and processing plants for their starch (in this case, large seeded grasses of the Triticaceae). Cumulatively, this evidence implies the same type of 'modern' behaviour as seen in western Asia, Europe and Africa after 30 Ka BP (Guan et al., 2012).

South China

South China lacks the major flag-site areas such as the Nihewan Basin, Zhoukoudian, and the Shuidonggou Valley that define the Early, Middle and Upper Pleistocene Palaeolithic record of North China. Instead, the evidence for hominins in the Early Pleistocene is very meagre indeed, little better for the Middle Pleistocene, and still poor for the Upper Pleistocene. Its environmental record is also very different. As noted above, South China is largely sub-tropical and tropical, unlike the more temperate north, and for much of the Pleistocene, it had a distinctive fauna that included *Stegodon* (a primitive type of elephant), panda (*Ailuripoda melanoleuca*), tapir, bamboo rat, orang-utan (now found only on Sumatra and Borneo), and a different species of rhinoceros (*Rhinoceros sinensis*) from that in north China. In the Early and Middle Pleistocene, the forests of southern China were also home to the giant and now extinct ape, *Gigantopithecus*, which was likely vegetarian (like modern gorillas). This enigmatic creature is largely known only from its teeth, and probably became extinct in the late Middle Pleistocene when its forest habitats were disrupted in prolonged cold periods. It was formerly thought that *Gigantopithecus* co-existed with *Homo erectus* as some caves in China and Vietnam have evidence of both (Ciochon et al., 1996), but more recently, it has been suggested that *H. erectus* avoided the areas inhabited by *Gigantopithecus* because it was not adapted to life in the forest (Ciochon, 2009).

The archaeological record for *Homo erectus* and early *Homo sapiens* in South China is very patchy, and largely known from cave sequences. These are important in establishing faunal sequences, but many important details were likely missed in earlier excavations. For this reason, more recent excavations at caves such as those in the Bose Basin (Weiwen et al., 2007) and at Panxian Dadong (Miller-Antonio et al., 2004; Bekken et al., 2004) and Ma'anshan (Zhang et al., 2010) are important in building up a more reliable record of the South Chinese faunal and artefacts sequences, and investigating subsistence patterns (as at Ma'anshan), The Bose Basin caves are important in clarifying the faunal sequence of South China and in showing faunal responses to climatic change. Panxian Dadong is significant as containing the best excavated faunal and Palaeolithic sequence in South China. Its deposits have been dated to between ca. 130 Ka and 300 Ka. The excavation was meticulous in using fine screening to recover stone artefacts and bones. Stone artefacts were very simple, with no formal tool-types, bifaces or tools made from prepared cores. They were made of limestone, followed by basalt and chert, all locally available. Limestone was used mainly for simple expedient tools, and basalt mainly for unretouched flake tools, with chert tools being the most frequently retouched (Miller-Antonio et al., 2004). Taphonomic analysis of the bones indicates that the cave was used by carnivores, hominins and porcupines. Potential prey included panda, rhinoceros, *Stegodon*, tapirs, macaques, orang-utans, various bovids and cervids and even bison, which migrated into this area during a cold period (Bekken et al., 2004). As the cave lies at 1630 m a.s.l., it may indicate that in the late Middle Pleistocene, hominins began to colonise upland areas (Schepartz et al., 2000).

As across much of East Asia, the Palaeolithic of South China was deeply conservative regarding its stone tools, and very simple ones continued to be the norm until, in some cases, the Holocene. According to Hallam Movius (1948), who first recognised the contrast between the hand-axe using groups of Africa, Europe and India and those in East Asia east of his 'Movius Line' using simple flakes and cores, this was because the inhabitants of East Asia were primitive and backward. A more sympathetic view is that simple, expedient tools can be as effective as more elaborately-made ones, as amply demonstrated by aboriginal groups in Australia. Another possibility is that under low levels of population density, it becomes harder to maintain complex traditions and the material culture of groups thus becomes simpler (as happened in Tasmania after it was separated from mainland Australia by rising sea levels [Lycett and Norton, 2010]). Whichever explanation one prefers, simple technologies prevailed in South China until the end of the Pleistocene, and there was no equivalent of the 'Upper Palaeolithic revolution' of Western Europe after 30-40 Ka.

One exception to the above statement comes from the Bose Basin, where numerous handaxes were found in the fourth terrace of the Youjiang River in the Bose Basin and in the same layer as tektites. These are glassy objects resulting from the impact of an asteroid or meteorite, and have been dated to ca. 780 Ka. Some of the bifaces are like those in Acheulean assemblages in Western Asia and Africa, although they tend to be much larger and thicker, and some are flaked only on one side. Debates continue over whether these bifaces indicate the brief immigration beyond the 'Movius Line' of Acheulean-using groups from the west, or (at least as likely) are an indigenous development (Hou et al., 2000; Huang et al., 2001).

The hominin record

China possesses the most detailed record of human evolution in Asia over at least the last million years. Figure 11 shows the location of the main sites, and Table 2, the main finds. Detailed summaries can be found in Wu and Poirier 1995, Etler and Tianyuan 1994 and Dennell 2009. The Chinese fossil record is usually divided into three parts: *H. erectus*, 'archaic *H. sapiens*' and '*H. sapiens*' (the last being unambiguously member of our own species).

H. erectus

The site most often cited as containing the earliest hominin evidence is Yuanmou in South China, where two incisors and some stone artefacts were found in 1965. The incisors were found either on or in the surface of a fossil horizon, and the stratigraphic association of the incisors with nearby stone artefacts remains unclear. The incisors are usually claimed to be those of *H. erectus*, although doubts persist. The dating is also equivocal, as the layer with the incisors has been dated by palaeomagnetism to either the Olduvai Event (1.77-1.95 Ma) or the Jaramillo Sub-Chron (0.99-1.1 Ma). There is less doubt over the Yuanmou Fauna, which appears to be Early Pleistocene in age, but it remains possible that the incisors are derived from a younger deposit (Dennell, 2009; pp. 178-180). Another contentious site is Longgupo

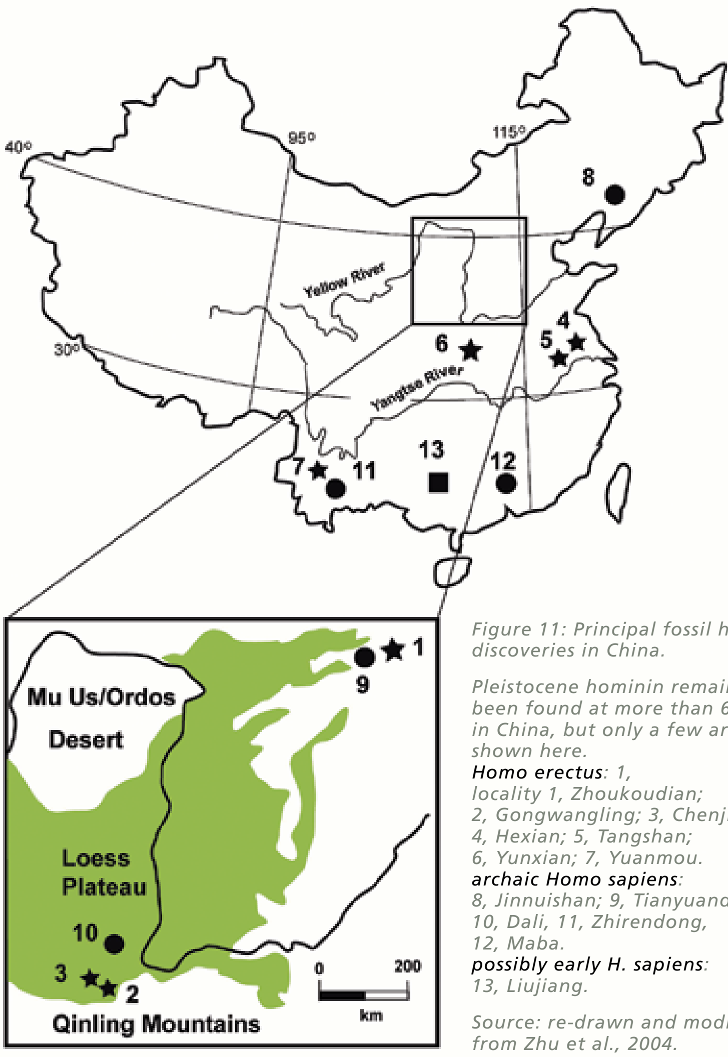


Figure 11: Principal fossil hominin discoveries in China.

Pleistocene hominin remains have been found at more than 60 sites in China, but only a few are shown here.
***Homo erectus**: 1, locality 1, Zhoukoudian; 2, Gongwangling; 3, Chenjiawo; 4, Hexian; 5, Tangshan; 6, Yunxian; 7, Yuanmou.*
***archaic Homo sapiens**: 8, Jinnuishan; 9, Tianyuandong; 10, Dali, 11, Zhirendong, 12, Maba.*
***possibly early H. sapiens**: 13, Liujiang.*

Source: re-drawn and modified from Zhu et al., 2004.

near Wuhan. This cave fissure contains a 20 m section that has been dated palaeomagnetically to the Early Pleistocene. In 1995, it was reported to contain a hominin incisor, a hominin mandible, and stone tools from below the Olduvai Subchron, i.e. >1.95 Ma. Wood and Turner (1995) went so far as to suggest that the incisors were therefore those of *H. erectus*. Schwartz and Tattersall (1996), however, maintained that the incisors were likely hominoid – i.e. derived from an ape rather than a human- and Wu (2000) asserted that the mandible was that of an ape. The flaked stone tools were also unconvincing[2] and did not display the usual features such as bulbs of percussion and clear flake scars, and could as easily have been naturally flaked geofacts. A hammer stone, however, was very convincing. More recent excavations of a Chinese-French team have produced more convincing evidence, but uncertainties persist over the chronological sequence of the site (`Boëda, 2011), and the archaeological components may be considerably younger than first thought.

The earliest specimen from North China is the *Homo erectus* cranium from Gongwangling, Lantian County, Shaanxi Province. This was a small brained individual with a cranial capacity of ca. 770 cc, similar to that of the 1.75 Ma specimen D2880 from Dmanisi. The age of the Gongwangling hominin is usually sited as 1.15 Ma (An and Ho, 1989), although recent on-going research by a team led by Zhaoyu Zhu indicates that it is substantially older. Two crania from Yunxian, also of *H. erectus*, are likely 0.9 – 1.1 Ma (Vialet et al., 2011). The main source of evidence on *H. erectus* in East Asia is Locality 1, Zhoukoudian, where 140 specimens were found. Although the specimens found before 1937 were lost in WWII, excellent casts were made beforehand, and are still invaluable sources of evidence. Other notable sites with finds of *H. erectus* are Hexian and Tangshan (Table 2).

Table 2: Principal fossil hominin remains from China

Site	Hominin remains	Fauna	Dating techniques	Age
Homo erectus				
Yuanmou	2 incisors	Early Pleistocene	palaeomagnetism	?1.8 Ma or 0.9 Ma
Lantian (Gongwangling)	cranium	Early Pleistocene	Palaeomagnetism	1.15 Ma but probably much older
Yunxian	2 crania	Late Early Pleistocene	palaeomagnetism	0.9-1.0 Ma
Zhoukoudian	ca. 140 specimens	Middle Pleistocene	Cosmogenic nucleotides	0.48-0.78 Ma
Chenjiawo	mandible	Middle Pleistocene	Loess-palaeosol stratigraphy	0.650 Ma
Hexian	Skullcap, mandible, teeth	Middle Pleistocene	ESR	ca. 0.410 Ma
Tangshan	2 crania, fragmented	Middle Pleistocene	U-series	ca. 0.4-0.5 Ma
'archaic' *H. sapiens*				
Dali	cranium	Late M. Pleistocene	U-series	ca. 250-300 Ka
Jinnuishan	Skull, partial skeleton	Late M. Pleistocene	ESR	ca. 280 Ka
Maba	skullcap	Late M. Pleistocene	U-series	ca. 130 Ka
Modern *H. sapiens*				
Liujiang	Skull, partial skeleton	Upper Pleistocene	U-series	ca. 110-140 Ka
Zhirendong	mandible	Upper Pleistocene	U-series	ca. 125 Ka?
Tianyuandong	Partial skeleton	Upper Pleistocene	AMS ^{14}C	ca. 40 Ka

Notes: many other sites contain hominin remains in China, but only the most important are listed here. Dating remains a contentious issue at many sites, particularly for one such as Yuanmou, Liujiang, and Zhirendong. Source: Dennell, 2009, 2010.

2 Examined by the author in 1999 at IVPP, with kind permission of the excavator.

'Archaic *H. sapiens*'

The Chinese fossil hominin record becomes very contentious after *H. erectus,* and concerns the emergence of our own species. Most western scholars maintain that our species emerged in sub-Saharan Africa, probably between 130-190 Ka, and then left Africa and entered the Levant ca. 125 Ka. The date at which our species then migrated eastwards to China, SE Asia and ultimately to Australia is unclear, but was no later than ca. 45 Ka (when New Guinea was colonised), and perhaps as early as 125 Ka (Dennell and Petraglia, 2012). However, some western and many Chinese scholars maintain that our species developed indigenously in both Africa and Asia. According to this view, the transitional forms between *H. erectus* and late Pleistocene *H. sapiens* are what they term 'archaic *H. sapiens*'.

The finds most commonly cited in debates over our origins in East Asia are those from Jinnuishan, Maba and Dali (Table 2). A recent mandible from Zhirendong cave in South China that may be as old as 125 Ka (Liu et al., 2010) but could be considerably younger (Kaifu and Fujita, 2012) has also been featured in debate over whether these finds should be called 'archaic *H. sapiens*' or 'late *H. erectus*' (Dennell, 2010).

The debates over the origin of our species in East Asia have been complicated recently by the discovery of 'Denisovans'. This population, known skeletally only from a phalanx and a tooth from Denisova Cave, Siberia, is identified from its ancient DNA as a sister clade of Neanderthals. Genetic analyses of modern Melanesians show that they share some 'Denisovan' DNA (Krause et al., 2010), so this may imply that there was a Denisovan population in South China during the last glaciation. This may further imply that some specimens classified as 'archaic *H. sapiens*' may in fact be Denisovan. This possibility cannot be clarified until Denisovan DNA is extracted from a cranial specimen – at present, we have no idea how or whether their skulls and dentition differed from Neanderthals and ourselves.

H. sapiens

The earliest unambiguous evidence of our species in China is from the cave of Tianyuandong near Zhoukoudian. Here, several parts of the skeleton were recovered, and directly dated by AMS ^{14}C to ca. 40 Ka cal. BP (Shang et al., 2010). This agrees well with the likely date of ca. 45-39 Ka cal. BP for the cranium from Niah Cave, Borneo (Barker et al., 2007), and the recent find of *Homo sapiens* at Tam Pa Ling in Laos, dated to between 46-51 Ka and 63 Ka (Demeter et al., 2012). Other specimens include Upper Cave, Zhoukoudian (Norton and Jin, 2009).

Protection, management and presentation

Under paragraph 78 of the criteria for inscription for World Heritage Status, a candidate application must satisfy presentation, protection, and management: 'To be deemed of Outstanding Universal Value, a property … must have an adequate protection and management system to ensure its safeguarding'.

Here, there are profound differences between Pakistan and China. These result from several factors. First and foremost are the economic and political differences between the two countries. Additional factors that are particularly relevant to Palaeolithic and early hominin sites are cultural attitudes towards science, education, and ideology.

Pakistan is generally classified as part of the Third or Developing World, and at worst as a failing state. In the last 30 years, it has experienced very high rates of population growth, so its population has largely doubled since 1980 to its present estimated total of 160 million[3]. It is ethnically diverse, and composed of the Punjab (the largest in population, the most prosperous, and politically the most dominant), Sindh, the former North West Frontier Province (NWFP), now Khyber Pakhtunkhwa, and Baluchistan. There are also the FATA (Federally Administered Tribal Areas) along the Pakistan-Afghan border, and the northern territories of Hunza, Chitral, Gilgit and Swat in the Karakorum Mountains. There are also in Sindh, the mohajirs, or the descendants of those who fled India in 1947 during Partition. Many of these groups are in competition or even conflict with each other. Religious factors are also highly important, principally between the majority Sunnis and minority Shias and Nazari Ismailis (both regarded as heretics by extremist Sunnis), and violence between these groups is never far from the surface. Partly for historical reasons, the army has played a dominant role in the political life of Pakistan, and consumes a large part of the national budget. Politically, Pakistan has experienced either weak and often corrupt and ineffective civilian rule, or military dictatorship, unlike its larger neighbour India, which has managed to develop along democratic lines since 1947. Overall,

3 For political reasons, a census has not been held for several decades as the numbers (and hence political status) of its ethnic and religious groups are potentially explosive issues.

the twenty-first century finds Pakistan as a country with a low per capita income, a weak industrial base, a poorly educated, poorly trained workforce, high rates of illiteracy, particularly among women (especially in Baluchistan), politically unstable and fighting a war within its borders against the Taliban and sometimes separitists. It is largely dependent upon foreign aid and the repatriation of foreign workers from its numerous communities living abroad. In recent years, its problems have been compounded by a disastrous earthquake in Kashmir, severe floods along the Indus and on-going violence between ethnic and religious groupings. Car- and suicide-bombings and assassinations have become an almost normal state of affairs.

In contrast, China is now the world's second largest economy, having enjoyed year on year economic growth for the last 30 years and a staggering rate of development in its infrastructure, in education, trade, science and many other areas of life. Almost all Chinese are literate, and enormous importance is attached to education. Although China is multi-ethnic, with over 40 minorities, the Han are overwhelmingly dominant (95%) and this gives China a much stronger sense of national and ethnic identity than a country such as Pakistan. It has also been politically stable and almost wholly free of the degree of violence that plagues Pakistan.

There are also important ideological factors that impact upon investigations of human evolution in Pakistan and China. Pakistan is formally an Islamic Republic, whereas China's official ideology is materialist and atheist. Evolution is a sensitive issue in Pakistan, and as with fundamentalist Christian groups who take the Bible as providing a literal truth about the history of the universe and life, many Muslims identify with the same world view. Accounts of human history (in the widest sense, including our evolution over the last 6 million years) are thus in conflict with orthodox Islamic ideology. Even the study of later prehistory is not immune from these factors. For conservative Muslims, the Harappan, Buddhist and Greek heritage of Pakistan is by definition pre-Islamic, and therefore less worthy of study than its Islamic past. (Fortunately, Pakistan has so far been spared the wanton destruction of this heritage, as happened with the demolition of the Buddhas at Bamyan in Afghanistan in 2000, and the destruction of much of the contents of the Kabul museum by the Taliban).

Figure 12: The new museum dedicated to the Nihewan Basin at Yangyuan, North China. The tall structure at the front of the building symbolises the Chinese character 'ren', or humanity.

The Chinese perception of evolution could not be more different. Even in the late nineteenth century, reformists and liberals in the Qin Empire assimilated the views of Darwin, and his *Origin of Species* was even translated into Chinese in the 1890s. Darwin's views on evolution, and the development of geology and palaeontology in the nineteenth century, were seen as important ways of combating superstition: the fossil record was more likely to show dinosaurs than dragons, for example. Radicals who assimilated the teachings of Marx and Engels thus had no difficulties in promoting the materialist, evolutionary views of Darwin (Schmalzer, 2008).

How then do these factors affect the management, protection and presentation of the Palaeolithic and human evolutionary heritage of these two countries? First, Pakistan lacks the infrastructure and resources to protect its Palaeolithic heritage; in contrast, China has both. Secondly, the Chinese have no problems in presenting the country's Palaeolithic and human evolutionary past to its public, and indeed, attaches great importance in promoting them as part of its heritage. In recent years, China has embarked on an impressive programme of building new museums and investing in its management programmes for protecting these sites. A good example is the new museum recently built and dedicated to the Nihewan Basin in the nearby town on Yangyuan (see Figure 12). Inside, there are clear bilingual (Chinese and English) exhibits of each site, stating its features, age and significance. Another is the recent museum at Shuidonggou (see Figure 13), which has now replaced an

Figure. 13: Shuidonggou museum.

earlier one. Shuidonggou is additionally in a national park, with excellent field facilities, tourist guides and even an introductory video display for tourists[4]. The same has happened recently at Sulawasu in the Ordos Desert, and there are plans to build an even larger museum at Zhoukoudian, which is already one of the best maintained Palaeolithic sites in the world. At less important sites, such as Xujiayao (visited by the author in 2006 and 2012), access has been improved, and measures have been put in place to prevent erosion of the main sections. There are also plans to upgrade the museum displays at Gongwangling, Lantian County, Shaanxi Province (Figure 14), where the main focus is the cranium of *H. erectus* that was found there in 1964, as well as the original geological section (Fig. 15). (Equally impressive is the museum dedicated to the study of the Loess Plateau at Luochuan, where the main geological sections are now in a protected Geopark).

Figure 14: The museum at Gongwangling, Lantian County, Shaanxi Province. This museum was built in traditional style, and focuses specifically upon the cranium of Homo erectus that was found at Gongwangling in 1964. This is the oldest hominin cranium from China and is dated to ca. 1.15 Ma, but is almost certainly substantially older.

Figure 15: (Left): The exhibition hall at Gongwangling, Lantian County, Central China. The hall encloses and protects (right) the geological section in which a Homo erectus cranium was found in 1964.

In terms of World Heritage status, China is clearly able to demonstrate that it has the infrastructure, (museums, tourist facilities and staff) to present its heritage, and the necessary legislative protection. Sadly, Pakistan has none of these essentials. An excellent but depressing account is provided by Paulo Biagi, who has spent many years in investigating the Palaeolithic workshops of the Rohri Hills in Sind: 'It is important to point out that a huge Acheulian site, very rich in bifacial tools, was destroyed in January-February 2001 without conducting any rescue excavation' (Biagi, 2006, p. 90). He continued: 'The 'Joint Rohri Hills Project' that unfortunately ended in 2002 after so many important discoveries and the publication of so many data, was unable to stop the progressive, systematic destruction of the archaeological sites of the hills because of the absence of any interest by the local authorities' (Biagi, 2006, p. 92). Regarding other sites in Sindh, he states: 'It is hard to believe that Ongar, which has been devastated for at least 50 years by illegal limestone quarrying, is still currently exploited to produce flint cores and blades, seemingly to decorate private residence walls. Despite many appeals for the preservation of the archaeological sites of Sindh, and the establishment of a new chair of anthropology and archaeology at Sindh University, Jamshoro, it seems that the archaeological remains of the region of Ongar, Daphro and Bekhain will disappear in the very near future, due to a complete lack of support, or lack of understanding of the importance of the sites for early prehistory, by local and national authorities' (Biagi and Nisbet, 2011).

To the best of the author's knowledge, there is not a single Palaeolithic site in Pakistan that has any meaningful protection or management programme.

Conclusions

Both Pakistan and China have outstanding potential for illuminating the course of human evolution in Asia over the last two million years or so. The Siwaliks of Pakistan have superlative potential for containing the skeletal remains of hominins and other mammals, and as some Siwalik sections extend into the Middle Pleistocene, they should also provide a Palaeolithic stone tool record from 1.8 Ma to 0.5 Ma. Thereafter, the loess deposits that cover much of Pakistan have the potential for documenting

4 The author was fortunate in being able to participate in the excavation of SDG 2 in 2006, and has only favourable comments to make on this.

the subsequent phases of the Palaeolithic. There may also be caves in NW Pakistan with long sequences, although these cannot at present be investigated systematically. Southern Pakistan also has considerable potential, even if the dating of open-air surface sites is difficult. China has far greater potential as a major contributor to studies of human evolution. The Nihewan Basin already contains the greatest concentration of dated early Palaeolithic sites east of the Levant, and cannot be the only extinct lake system of its kind in northern China. The Loess Plateau of north China is arguably the best terrestrial record of climate change over the timespan of human evolution, and its archaeological potential has scarcely yet been tapped. North China also contains numerous caves, of which Zhoukoudian is the most famous, and doubtless many more comparable discoveries will be made. For the later Pleistocene, the Shuidonggou Valley and sites of the Ordos Desert are major sources of information on the later Palaeolithic. The prospects for future discoveries are different but as great in South China, with its thousands of caves.

Pakistan and China differ most in the way human evolution and the Palaeolithic are investigated. Pakistan has no effective programme for protecting and managing its Palaeolithic heritage, and there is no reason to expect any improvement in the foreseeable future. Even if Pakistan had the resources and infrastructure to do this, the notion of human evolution and the deep antiquity of humankind is anathema to many conservative Muslims. In contrast, China has no problems in promoting the study of human evolution, and has instituted effective measures for protecting its main Palaeolithic and early hominin sites, and attached considerable importance to presenting these to the public in a responsible and informed manner. From an ICOMOS perspective, there is great potential for increasing the number of Palaeolithic sites that have World Heritage status.

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The Palaeolithic in the Indian Subcontinent: its significance for understanding human evolution

Sheila Mishra
Department of Archaeology – Deccan College – India

Abstract

The Indian Subcontinent is one of the areas occupied by hominins since Early Pleistocene times. The Lower Palaeolithic in the Indian Subcontinent is exclusively Acheulian. This Acheulian is similiar to the African Acheulian and has been labeled "Large Flake Acheulian" (LFA). The Middle Palaeolithic in the Indian Subcontinent is a poorly defined entity and the author has suggested that this phase should be considered the final phase of the Large Flake Acheulian from which it evolved. Microblade technology has recently been shown to be older than 45 Ka in the Indian subcontinent and is certainly made by modern humans as it has a continuity from this time until the bronze age. Presently, the nature of the transition from Acheulian technology to Microblade technology is not well understood as few sites have been dated to the relevant time period.

The continuity of the Lower Palaeolithic in the Indian Subcontinent is due to its ecological features. The Indian Subcontinent extends from approximately 8°-30° N which would normally encompass equatorial, tropical and temperate latitudinal zones. However, the influence of the monsoonal climate and sheltering effect of the Himalayan mountains results in a sub-tropical grassland vegetation extending both northwards and southwards of its normal distribution. Rainfall, rather than temperature, is the most important ecological variable which has a longitudinal rather than latitudinal variation. Thus, the Indian Subcontinent has a more homogenous environment than any comparable landmass and one eminently suitable for hominins. In contrast, the African climate zones are strongly latitudinal in distribution. The Indian Subcontinent during the Early and Middle Pleistocene has close connections with Sundaland. The fauna associated with *Homo erectus* in Java is derived from the Indian Pinjor faunas. During low sea levels the area of land exposed in the Sunda shelf is equal in size to the Indian Subcontinent. Sundaland has an important buffering effect on the Indian Subcontinent, with favourable conditions for Hominins in Sundaland coinciding with unfavourable ones in the Indian Subcontinent.

Palaeolithic sites in India are abundant. Sites are preserved in regolithic and alluvial contexts. Therefore the occurrence of Palaeolithic sites is closely determined by the survival of sediments of a Palaeolithic age. Since peninsular India is largely an erosional landscape, palaeolithic archaeological sites are confined to areas of ancient sediments undergoing erosion. Archaeologists deal with the subset of the discovered and studied sites from the group of extremely rare sites that are preserved. Developmental activities lead both to the exposure and discovery of sites and, all too often, their destruction. Balancing the needs of society with that of preservation of our Palaeolithic heritage is the task of researchers. This contribution underlines the important role of archaeologists, who should communicate the scientific importance of their discoveries and hope this is of enough value to society to have some sites protected and preserved.

Introduction

The Indian Subcontinent has been one of the most favourable environments for hominins, and was probably one of the crucial regions for some of the important developments in human evolution. This has not been widely recognized and global reviews of the Palaeolithic never focus on the Indian subcontinent and rarely even discuss the Indian evidence. In this paper, under the inspiration of the 'Human Evolution: Adaptations, Dispersals and Social Developments' (HEADS) program, the Indian Subcontinent’s contribution to human evolution will be highlighted.

The most important reason for the failure to recognize the importance of the Indian Subcontinent is the lack of human fossils. While India does have its share of interesting and even spectacular sites, it remains a fact that no significant discoveries of human fossils have yet come to light. This is in spite of India having some of the earliest organized institutions for the study of archaeology and geology in the world, with the Geological Survey of India celebrating

its 150th anniversary in 2005 and the Archaeological Survey of India its 150th anniversary in 2012. This year, 2013 is the 150th anniversary of the discovery of a handaxe at Pallavaram near Chennai in Tamilnadu by an officer of the GSI, Robert Bruce Foote, considered the 'father' of Indian Prehistory. Thus over 150 years of archaeological and geological explorations have only yielded a single hominin fossil (Sonakia, 1984), and it appears unlikely that the hominin fossil record from India will ever be very significant. The lack of hominin fossils from India is certainly not due to the absence of hominins but rather the absence of conditions favourable for the preservation of such fossils, as Palaeolithic artefacts are found abundantly. Thus Robert Bruce Foote's discovery of a handaxe 150 years ago has been followed by such discoveries in most parts of the Indian Subcontinent, recently reviewed by Mishra (Mishra 2007). In 2011, another site, Attirampakkam, also discovered by Foote, and also near Chennai, was dated to 1.5 Ma, averaging a number of cosmogenic dates. The oldest dates, which are also from the lowest layers slightly exceed the oldest dates for Acheulian in Africa (Pappu et al., 2011).

While archaeologists are aware that only a partial record survives, there is still a failure to appreciate how extremely rare the sites that do exist really are. Although stone tools have a better chance of survival than hominin fossils (and would have been more abundant), they also do not survive, except in exceptional circumstances.

In fact all Palaeolithic sites owe their survival to exceptional circumstances which have buried and then re-exposed them. A high proportion of early sites are associated with volcanic ash deposits or caves. Both of these depositional environments are extremely rare but probably most of the really important early sites are associated with these rare environments. Even in the Indian subcontinent, where there is no Quaternary volcanism, a significant number of sites such as Bori (Korisettar et al., 1989), Morgaon (Mishra et al., 2009) and Jwalapuram (Petraglia et al., 2007) are associated with tephra from the Toba volcano in Indonesia, more than 3000 Km away from any location in India (Rose and Chesner 1990). The caves of South Africa (Dirks and Berger, 2013), the rift valley of East Africa, the caves of Atapuerca (Aguirre, 2001), Tautavel (de Lumley et al., 1977), the tephra at Dmanisi (de Lumley et al., 2008; Ferring et al., 2011), the lahars in the Sangiran dome (Bettis III et al., 2009), the caves in the Choukoutien hill (Chardin and Pei, 1932), the Mount Carmel caves (Garrod et al., 1939) and Denisova cave (Reich et al., 2010) are just a few such sites. The absence of hominin fossils in the Indian subcontinent in spite of the presence of hominins is only surprising if the actual rarity of the evidence is not appreciated.

The 'missing' evidence remains missing. Inferences cannot be made on the basis of evidence which does not exist, but the evidence we do have does allow us to infer something about what is missing. Thus the presence of more than 100 *Homo erectus* fossils in Java (Indriati, 2004) associated with a fauna showing affinities to the Indian Siwalik fauna (de Vos, 1996; de Vos and Sondaar, 1982; van den Bergh et al., 2001; Vu et al., 1996) is evidence for the presence of *Homo erectus* in the Indian subcontinent considering that *Homo erectus* migrated from the same place as the fauna it is associated with. Since the only type of Lower Palaeolithic technology in the Indian subcontinent is Large Flake Acheulian (Mishra, 2007), this would have been the technology of *Homo erectus* in Java. Large Flake Acheulian is present at Ngebung, the only locality in Java (Mishra et al. 2010b). The rare sites which do preserve good evidence therefore have implications much beyond their localities and even beyond their continents and truly belong to a global human heritage.

Environment of the Indian Subcontinent

The Indian subcontinent has well defined geographical boundaries, with the Himalayas in the Northwest and Northeast and the Indian Ocean on the Southwest and Southeast. To the west of India are the deserts of Western and Central Asia while to the east is the Tibetan Plateau. During periods of lower sea level and global aridity, large areas of continental shelf were exposed in the South China Sea to form the continent-sized Sundaland, equal in size to the Indian subcontinent (Figure 1), making geographic connections even easier than they are at present (Sun et al., 2000; Voris, 2000). The emergence of Sundaland coincides with periods of glacial aridity, which would be unfavourable for the Indian Subcontinent. Sundaland provides buffering for the populations of the Indian subcontinent, as expansion of favourable environments in Sundaland coincides with the contraction of such environments in the Indian subcontinent.

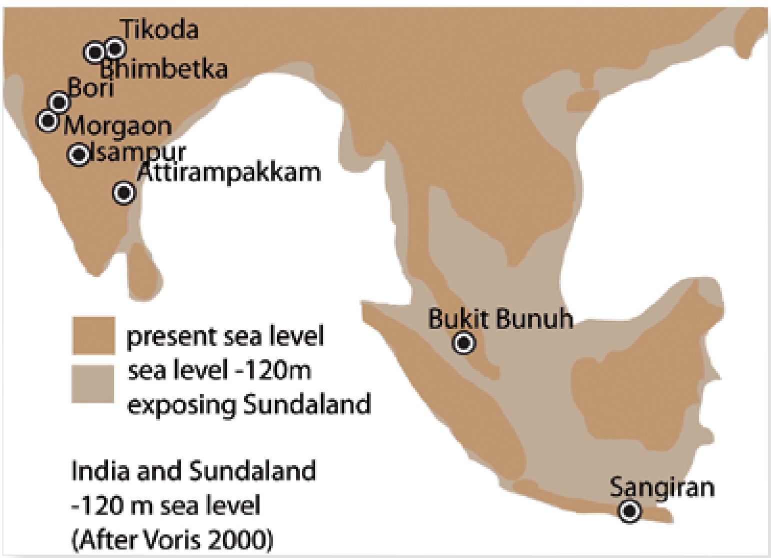

Figure 1: Area of Sundaland exposed at the lowest sea levels as given by Voris 2000.

Greater ecological similarity of the Indian subcontinent with southeast Asia during the earlier periods of the Quaternary is indicated by the close relationship of the Quaternary fauna of Myanmar and Indonesia to that of India (de Vos et al., 1994; van den Bergh et al., 1996). The Indian subcontinent is ecologically distinctive, but geographically connected by land to the rest of Eurasia. Dispersal into and out of India therefore would be affected primarily by ecological rather than geographic factors.

Indians consider the Himalayan Mountains sacred. This attitude is justified because these mountains affect the climate of the Indian subcontinent in a very positive way. The first effect of the Himalayas is to protect Northern India from cold winter temperatures, extending the area of sub-tropical climate much farther north of the tropic of cancer (Attri and Tyagi, 2010). Thus snowfall in the Indian subcontinent is confined to areas of higher elevations. The second gift of the Himalayas is that the glacial melt feeds the Himalayan rivers flowing through the Indogangetic plains during the period of greatest water scarcity. Thus while most of the river discharge is from the monsoon rains, the glacial melt is important because it occurs during the dry months (Kale, 2002). The monsoonal climate system developed partly in response to the Himalayan uplift with the temperature contrasts between the uplifted Tibetan Plateau and the Indogangetic plain driving the seasonal monsoonal winds (Clift et al., 2010; Saha, 2010).

Rainfall in the Indian subcontinent is highly seasonal (Attri and Tyagi, 2010). This means that even areas of relatively high rainfall experience aridity as there are 7-8 months without any rainfall. On the other hand, areas of low rainfall, which experience high variability, nevertheless experience less variability than other comparably arid regions. River systems are also characterized by high variability in discharge, reflecting the highly seasonal rainfall. The most important ecological variable is the variation in rainfall rather than temperature. The average annual rainfall varies not in a North South direction (by latitude) but in a West to East direction (by longitude). Thus the interior of the Deccan Plateau has similar rainfall amounts as the eastern margin of the Thar Desert and semi-arid monsoonal climate extends in a north-south belt from Punjab in the north to Karnataka in the south (Figure 2). The Western Ghats or Sahyadris form the continental divide less than 100 km from the West Coast and provide a high rainfall catchment area to many of the Peninsular rivers. Immediately to the east of the Sahyadris, a low rainfall rain shadow zone is followed by an increase in rainfall towards the east. This longitudinal rather than latitudinal variation in ecological factors enhances the overall homogeneity of the Indian subcontinent. While variation exists, it is variation of a basic tropical savannah grassland ecosystem with many animal and plant species common over large areas. The seasonality of the climate is an important factor in the favourability of the environment for hominins. It has been argued that the unseasonal equatorial rainforest, while rich in biomass, has few resources for hominins (Bailey et al., 1989) and may not have been occupied until the invention of agriculture. The highly seasonal tropical monsoonal climate, with a seven month dry period, is rich in food, as many plants store food in roots and seeds to survive the dry period. Interestingly many trees produce fruits during the summer dry season so that the seeds are dispersed and ready to grow with the first rain. Tubers grow during the wet season and are eaten in the post monsoon season.

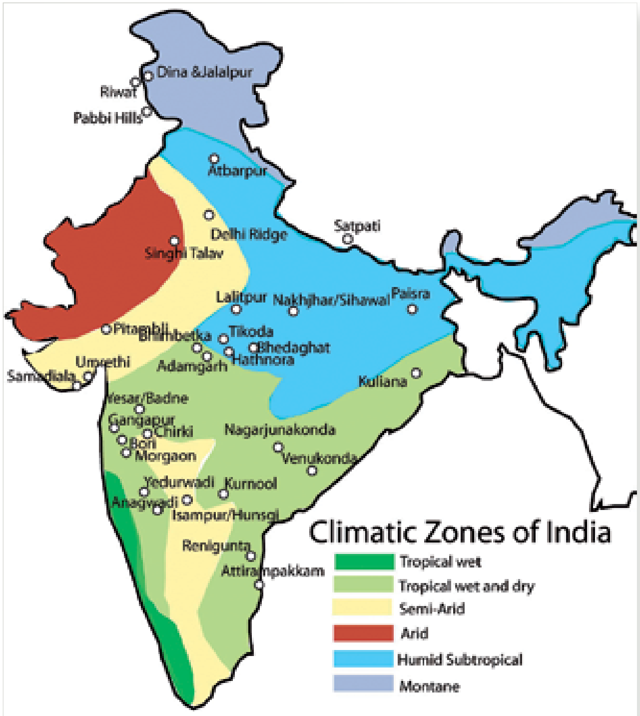

Figure 2: Climatic zones in India, based on the Köppen classification system. The locations of some important Palaeolithic sites are shown.

Palaeoanthropologists have long assumed that hominins were 'founder members' of the tropical grassland biome which evolved during the last 7 million years (Bobe and Behrensmeyer, 2004; Dennell, 1998; Van der Merwe, 2005). Recent studies of many of the key hominin localities in Africa have shown hominins in a much more forested environment than expected (Ashley et al., 2010; Bamford, 1999; Barboni et al., 2010). This has led to a re-evaluation of the importance of Tropical grasslands in human evolution. In the Indian subcontinent tropical grassland ecosystems developed as early as 7 Ma and are documented from both Northern (Quade and Cerling, 1995; Sanyal et al., 2005) and Southern (Armstrong-Altrin et al., 2009) latitudes of the subcontinent. Thus ecological conditions in the Indian subcontinent differed from those in Africa as well as Europe and Southern China, with well established seasonality of rainfall already a prominent feature in the Late Miocene. The development of seasonality and aridity in the India subcontinent led to the extinction of the Miocene Apes such as *Sivapithecus* and *Ramapithecus* (Patnaik et al., 2004). In Southern China, the survival of the forest ecosystems allowed a number of ape species such as *Lufengpithecus* and *Gigantopithecus* to survive into Lower and perhaps even Middle Pleistocene times (Ciochon, 2010; Etler et al., 2001).

The Indian subcontinent also has excellent soil resources, important for plant growth. Although Peninsular India is an area of exposed bedrock, these rocks are weathered into a thick regolith so that although the present rivers of Peninsular India do not deposit much sediment, most of the land is covered with regolith and soils formed on the regolith. These weathered regolith and soil covers are relict features, inherited from the much warmer and more humid climate of the Early and Middle Tertiary and have been undergoing erosion throughout the Quaternary. Sediments associated with the Acheulian indicate even better preserved regolith than at present although indicators of seasonally arid climate are present. This has resulted in a situation where arid zones which would have poor soils in present climatic conditions have thick soils. These soils and the thick regolith absorb and store the rainwater, which enhances plant growth.

The Quaternary period is one of frequent and large changes in climate. In Europe and the arid parts of Africa and the Middle East this has resulted in the episodic presence of people as conditions favourable for human occupation were also episodic (Dennell, 2003; MacDonald et al., 2012). Temperate regions of Eurasia were only occupied during interglacial periods until the Late Pleistocene (Antoine et al., 2010). Desert regions of Northern Africa and the Middle East were occupied during humid phases (Derricourt, 2005). The Mediterranean parts of Europe and Africa, which are the most favourable for people, also saw frequent population shifts with large changes in environmental conditions (Almogi-Labin, 2011). Climatic fluctuations in the Indian subcontinent resulted in fluctuations in the desert/grassland/forest boundaries, but would never have led to the extinction of populations (Singhvi et al., 2012 ; Tandon et al., 2008). The emergence of Sundaland during unfavourable climatic conditions in India was further insurance against population extinction.

One can therefore argue that the Indian subcontinent was one of the most favourable environments for hominins during the Lower and Middle Pleistocene. It might in fact be the only large region where hominin populations were continuously present. Today technology has allowed people to live comfortably in less favourable environments; the relative importance of India would have been even greater in past than it is today. To summarize, the favourable environmental factors in the Indian subcontinent are:

1) Extension of the zone of no snowfall to most of the Indian subcontinent because of the sheltering effect of the Himalayas
2) Himalayan rivers obtain water from the melting of glaciers during the period of greatest water scarcity
3) Monsoonal climate, combining reliable rainfall with high seasonality of rainfall
4) Regolith/soil cover inherited from more humid Miocene provides for retention of moisture and groundwater even in the arid areas
5) Buffering effect of the emergence of Sundaland during periods of arid climate.

The Large Flake Acheulian in the Indian Subcontinent

There are only two well defined lithic entities in the Indian Palaeolithic: the Large Flake Acheulian and Microblades. Indian prehistorians had adopted the 'European' terminology of Lower, Middle and Upper Palaeolithic after a brief use of the 'African' terminology of Earlier, Middle and Later Stone age (Mishra, 1962). Both the terminologies fit the Indian sequence poorly, with very little evidence of the 'Middle Palaeolithic', and the term 'Upper Palaeolithic' being applied to microblade assemblages dating from before 45 Ka to 4 Ka. The earlier part of the Palaeolithic is Acheulian. The Indian Acheulian however, does not resemble the European Acheulian, although it is probably related to it and is definitely earlier than it. The term 'Large Flake Acheulian' (LFA) has been introduced by Sharon (2007) based on his study of collections in Africa, Israel and India and adopted (Mishra et al., 2010a) for the Indian Acheulian. The Large Flake Acheulian appears around 1.7 Ma in Africa at almost all the sites in the Rift Valley as well as in South Africa. Beyene's (Beyene et al., 2013) recent account of some of the earliest occurrences show that the characteristics of the LFA are present in the earliest phase of the Acheulian. The LFA differs from the Oldowan in the use of large flakes (>10 cm) detached from giant cores. Mishra (2010) has suggested that the most important difference between the LFA and contemporary and earlier industries is that the earlier stone tool assemblages have complete *chaînes opératoires* while the LFA always has fragmented *chaînes opératoires*. Later industries which lack handaxes have fragmented *chaînes opératoires,* which provides criteria for distinguishing a 'Mode 1' which is more primitive than Acheulian from a 'Mode 1' which is only 'Mode 1' because it lacks handaxes. While the earlier stone tool makers made, used and discarded the tools at one place, the Acheulian hominins carried the tools so that they were made used and discarded at different places, thus resulting in fragmented *chaînes opératoires*. In particular, finished tools were transported and discarded as single pieces while manufacturing of tools occurred near the raw material sources. This significant change in hominin behaviour was the result of the invention of a technology to carry objects (a bag?). Acheulian technology is a consequence of technological developments in non-lithic materials related to the intensification of 'gathering'. Acheulian technological innovations might therefore be related to the use of technology to acquire a more nutritious vegetarian diet and inventions such as cooking and grinding might also be part of this development, as has been suggested by others (Laden and Wrangham, 2005; Marshall and Wrangham, 2007; O'Connell et al., 1999; Wrangham, 2009).

Implications of discoveries in Africa and Java for the Indian Palaeolithic

It has now been established that:

1) Large Flake Acheulian dates to 1.7 Ma in Africa (Lepre et al., 2011) (Beyene et al., 2013);
2) The Oldowan begins from 2.6 Ma in East Africa (Semaw et al., 2003);
3) There is little technological change in Oldowan over 1 million years from 2.6-1.7 Ma (Semaw et al., 2009);
4) There is no transition from the Oldowan to the Acheulian in Africa (Lepre et al., 2011; Semaw et al., 2009);
5) Hominins with a non-Acheulian technology occupied Europe before 1 Ma (Falguères, 2003);
6) A second migration, occurred 300-600 Ka, with an Acheulian technology (Falguères et al., 2010):
7) LFA in the Indian subcontinent is comparable in age to the earliest African Acheulian and not the European Acheulian (Pappu et al., 2011; Gaillard et al., 2010; Sangode et al., 2007; Westaway et al., 2011);
8) *Homo erectus* in Java is associated with a fauna related to the Indian Pinjor fauna (van den Bergh et al., 1996);
9) The Ngebung archaeological assemblage is Large Flake Acheulian (Mishra et al., 2010b);
10) Large Flake Acheulian artefacts are found in Pinjor age sediment outcrops in India (Gaillard and Mishra 2001; Mishra 2007).

These facts are difficult to reconcile with the Out of Africa theory in its present form, as is also argued by Dennell et al. (2010), who identifies the Middle East rather than India, as the alternative location to Africa. Tool making hominins are present for one million years before the Acheulian, but during this time Oldowan technology is confined to East Africa, except for Ain Hanech in Algeria at a date close to the end of the Oldowan. It is not even present in South Africa, where the hominins differ on a species level from those in East Africa. Suddenly, at around 1.7 Ma, after the Olduvai event, stone tools are found in Eurasia at Dmanisi, in temperate China in the Nihewan basin and in Java. These three localities are far apart and far from Africa, with non-African fauna at each place. Mishra (2011) has argued that the non Acheulian, 'Mode 1' technologies from Dmanisi (Baena et al., 2010; de Lumley et al., 2005; Mgeladze et al., 2011; Mgeladze et al., 2010) and Nihewan (Braun et al., 2010), as well as the slightly younger Early European Mode 1 technologies, are not closely related to the Oldowan and the event being marked is the addition of stone tools to the tool making repertoire by hominins related to each other by a much earlier dispersal from Africa, before the appearance of the Oldowan, ie before 2.6 Ma. The LFA is not technologically more complex than the contemporary Palaeolithic industries, but differs fundamentally in the enhanced transport of stone tools rather than more complexly manufactured stone tools. The best evidence for this transition comes from East Africa where a number of sites have been well studied for this time period. There is no evidence for the development of Oldowan to Acheulian or *Australopithecus/ Homo hablis* to *Homo erectus/ergatser*. The logical conclusion from this is that this transition happened elsewhere and the early dates for LFA in the Indian subcontinent and for *Homo erectus* in Java leads to the inference that this 'elsewhere' must have been India/Sundaland. This is also inferred from the fact that India/Sundaland is the only area with a tropical grassland ecosystem suited to hominins at this time (Heaney, 1991; Morley, 2012). The two stage dispersal of *Homo erectus* with Acheulian technology, first to Africa and then to Europe, is the delay in tropically adapted populations competing with already temperate adapted populations (Figure 3). It is possible that there is a hiatus in the European Palaeolithic record with *Homo heidelbergensis* (a descendant of *Homo erectus*) entering Europe with Acheulian technology only after the extinction of *Homo antecessor* probably due to deteriorating climatic conditions (Falguères et al., 2010; Mosquera et al., 2013). In the Indian Siwalik record a number of African species appear between 2.5 to 3 Ma, (Patnaik and Nanda, 2010) consistent with earlier rather than later out of Africa dispersal of hominins. Conditions for the dispersal of a tropically adapted species certainly improve the earlier the period considered.

Ironically, the strongest arguments for the origin of *Homo erectus* and Large Flake Acheulian in India/Sundaland, comes from East Africa and Java. This is because both these regions have truly exceptional records. In both cases this is due to intense volcanism and tectonics leading to rapid sedimentation and later exposure. Both areas were no doubt, on their own, very important centres for

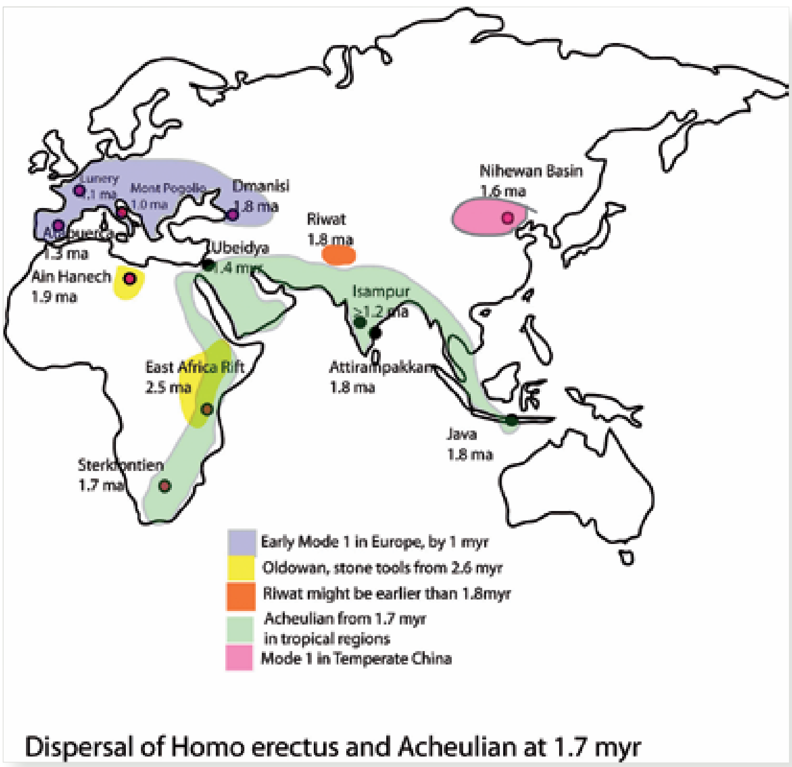

Figure 3: The dispersal of Homo erectus and Large Flake Acheulian around 1.7 Ma.

developments in human evolution, but discounting all the other regions where hominins lived, but where evidence did not survive, leads to unrealistic scenarios.

Formation processes in the Indian Subcontinent

Palaeolithic sites are only discovered if artefacts occur on the surface. It is wrong, however, to consider these as 'surface' sites. Even stone artefacts do not survive on the surface over time intervals of more than 100 Ka. Although surface processes may be slow, long duration of these processes makes them destructive (Mishra, 2007). Palaeolithic sites in India therefore occur where sediments of Palaeolithic age are undergoing erosion, which exposes artefacts. Only archaeological material which was buried has survived to the present. This is why sites occur in 'clusters', the cluster is the area of distribution of the sediments yielding the artefacts. This can be demonstrated for each site which this has been investigated. This is seen in the Hunsgi, Baichbal valley, an interfluvial area between the Bhima and Krishna rivers, close to the confluence of the two rivers. The older sediments are being eroded by the present drainage, aided by introduction of new agricultural practices which deepened the plow zone. Paddayya (Paddayya 1975; 1976; 1977; 1982; 1985a; 1985b; 1987a; 1987b; 1989; 2007; Paddayya et al., 2006; Paddayya and Petraglia 1993; 1995; Jhaldiyal, 1997), doing foot survey over three decades from 1970-2000, discovered over 200 Acheulian localities in this small region of the Indian Peninsula. In spite of the wealth of evidence, this should not be taken as a complete record as the sediments were not deposited continuously through the Quaternary. In the Nevasa area, Sankalia (Sankalia et al., 1960) and later Corvinus (Corvinus, 1983) found Acheulian artefacts in a sedimentary unit which extends for 3-4 Km along the Pravara river near Nevasa. The Acheulian artefacts at Bori and Morgaon also are found in sediments exposed by the river, Kukdi and Karha respectively over a stretch of 5-10 Km. In the early 1970s an area of Raisen District in Madhya Pradesh was explored by Jacobsen (Jacobson, 1975; 1976; 1985), who reported one of the densest concentrations of 'surface' Acheulian in the world. Recent work in the region, however, has shown that these artefacts are not on the surface but eroding from sediments. Excavation has found artefacts buried by over 15 m of clayey sediments (Figure 4). After exposure by erosion of the sediments, the artefacts get concentrated, forming carpet like concentrations of Acheulian artefacts (Figures 5 and 6). Further erosion and re-deposition can put the artefacts into younger contexts. Lalitpur is another Acheulian complex, where artefacts were found in 7 localities in the drainage area of the Biana Nala, a first order stream of the Betwa River. Acheulian artefacts are confined only to the sediments exposed by the Biana Nala and are not found elsewhere (Singh, 1965). These are just a few examples to elaborate the point about the absence of true 'surface' sites of Acheulian age.

Figure 4: Trench at Tikoda, Raisen District, Madhya Pradesh. Acheulian artefacts occur at a number of levels, up to the base of the trench.

Figure 5: Close-up of area in Figure 5 showing a cleaver and some large flakes.

Figure 6: Carpet of artefacts at Tikoda, concentrated by erosion of original sedimentary context.

The necessity of burial to preserve the archaeological evidence means that all Palaeolithic sites have been modified by geological processes and there are no sites where geology can be ignored. It is common (but becoming less so) for archaeologists to label sites as 'primary' and 'secondary' with secondary sites affected by geological processes and 'primary' sites only reflecting human activities. If all sites are affected by geological processes, as argued above, then this distinction is meaningless. The interaction of geological processes with the archaeological record does not result in any uniform effect. Each site is unique and the formation processes need to be understood before they can be interpreted. The geological context adds immeasurably to the understanding of human behaviour because usually we can reconstruct the landscape element where the tool was discarded and also the source from which the raw material for the artefact was made. Thus, although most of the artefacts are found in river deposits, the unflaked surfaces are more deeply weathered than the flaked surfaces, showing that the tools were made not on a river pebble or cobble but on weathered material which occurred away from the river. In turn this shows that even though no artefacts are found away from the river channel, the hominins who made them were not similarly constrained.

The sediments from which the artefacts are derived also inform us not only about the palaeoenvironment but also attest to landscape changes. Thus at Tikoda, the cleavers were made from boulder sized blocks of quartzite formed by spheroidal weathering (and confusingly, or appropriately, called ‘corestones’ by geologists). This type of weathering does not occur in the present climate for quartzite and such corestones are only found in older sediments. After observing these cores at Tikoda, it was found that the cleavers at Bhimbetka were also made from similar corestones. Joshi (1964) reports similar features for the Acheulian artefacts from Adamgarh. Thus a feature which is no longer part of the present landscape was a part of the Acheulian landscape. Presence of laterite in many Acheulian contexts where it is absent today (Abbas, 2006; Mishra et al., 2007; Shete, 2006), similarily implies a greater extent of weathered regolithic cover during Acheulian times compared to today. However, an arid, seasonal climate was already present, at least at Morgaon, where a cleaver was found resting on a cracked vertisol, an indicator of a long dry season (Mishra et al., 2009). The geological processes which buried the Palaeolithic sites, therefore, have added a dimension for interpretation and for placing hominins in their landscape and environmental context.

Preserving archaeological heritage

The most convincing justification for archaeological research is the knowledge it brings about the human past. Today our understanding of ourselves rests on the foundations of archaeological research. For the pre-literate time it remains the only source of knowledge and for the historical period it complements and broadens the understanding obtained from historical sources. If we agree with this view, then it follows that the preservation of archaeological sites and communication of the results of the studies to the non-archaeologist is of prime importance. Also, as argued here, the results of research in one region have implications for the entire human story and are of interest to people everywhere. Archaeological methodologies continue to advance as new technology makes new methods possible, so preservation of sites for future study when more advanced technology is available is another concern.

In the Indian context, one remains conscious, of the large amount of evidence which simply did not survive to the present. Only one ancient human left any bones, although the subcontinent was occupied before 1 million years and probably continuously. Most of the sites discovered and studied are discovered because sediments which buried the archaeological material are undergoing erosion. While this may be due to natural causes it is often a result of human activities such as road building, expansion of urban settlements, quarrying, irrigation projects or more intense agricultural methods. The tephra at Bori was exposed by erosion during a large flood (as reported by the landowner) in the 1950s. In the 1970s a dam constructed upstream reduced flows to monthly releases. In the 1980s the availability of irrigation and enhanced groundwater led to intensification of agriculture and the digging of many wells. In the 1990s villagers built weirs in the river bed to store water released from the dam submerging the previously exposed tephra. Thus, over a life-time period, the archaeological evidence has been exposed by a combination of natural and artificial factors and partially destroyed and is now inaccessible for further study. This is repeated internationally, some cases are not observed by archaeologists. Development is a priority today for India and if people are forced to choose between archaeology and development, it is doubtful archaeology will win. It is important therefore to choose the fights, to realize that even the discovery of the site needed some destructive forces, to work with speed and to incorporate local development into site management plans. The penetration of TV programs into rural areas has brought some awareness about the importance of 'knowledge' as the Discovery and History channels have proved very popular. People should share the goal of preserving sites; without this shared goal it is impossible to achieve it. Co-operation at all levels is needed from the academic community and from the local and international communities. The HEADS Programe is one such valuable initiative.

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East Asia

Palaeolithic sites in China: perspectives on human evolution, significance to the understanding of adaptations and dispersals, and research priorities in the framework of the World Heritage Convention

Ya-Mei Hou
Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences - Institute of Vertebrate Paleontology and Paleoanthropology - Chinese Academy of Sciences - China

Abstract

In pursuing questions of human evolution, China has played an important role and continues to provide some strong evidence for different periods concerning the issue of human origins. There is not only the great discovery of Peking Man in the past but, for the popular theory of the 'Out of Africa Model', new discoveries in China indicate more about the 'when' and 'where' of early human settlement in East Asia, as well as the attendant styles of adaptation. Since the Early Pleistocene, existence of abundant fauna species in this vast territory presents evidence for a good description of certain appropriate ecological conditions for human beings. The Chinese mainland region still has great potential for producing new, emerging information based on archaeological finds, including the earliest lithic tools from the southern style of Longgupo site to the northern style of Nihewan basin sites with ages of 1-2 million years old. Furthermore, so called 'Mode 2' Acheulean style tools have appeared both in South and North China since the Middle Pleistocene and lasted until the Late Pleistocene. Meanwhile, current economic development facilitates and expedites a lot of new work on excavation and dating techniques, yielding new academic discussions on the Middle Palaeolithic and 'modern human origins' in China.

This article will develop some ideas from several points of view and emphasize that China might play a much more important role in human evolution than what many of us thought before. Some potential avenues of investigation have been overlooked and ignored due to the biased opinions of dominant researchers in the field. Old conclusions were limited, within the old, single-sided evidence. A broader view must to be taken into account. A complete view, considering all new facts, from both West and East, is very much needed. It is time to adjust the old frame and to confront new evidence. For modern human origins, both multiregional continuity and single origin theories need to be tested against the archaeological evidence from China. A more comprehensive scientific way of attaining balanced knowledge needs to be encouraged, and the results disseminated. This is a main task of the article.

Evidence from Chinese archaeological work, focusing on several main periods of human evolution is discussed in this article. New ideas and hypotheses, according to new discoveries, are suggested. New modes for explaining technological and biological evolution in the eastern world will be proposed and will be constructed through solid analysis work in the near future.

A brief review and background

The science of human evolution in China was initially developed from the field of palaeontology by the first explorers whose expeditions are documented in the picturesque stories of 'The new conquest of central Asia (1921-1930)' (Andrews,1932; Figure 1A) where they described an unparalleled feat of a long adventure. China was like a fairyland in the sense that it provided so many strange and unfamiliar fossils for them (Figure 1B). It was indeed the western adventurers who lifted the corner of the great veil of Central Asia, including the large territory of China. Among them, American palaeontologist Walter Granger is well known for his important discovery of a Panda fossil in 1921 named *Ailuropoda fovealis* which he found with his co-researcher Mathew. Other important discoveries of the Yanjinggou fauna from the Sichuan province of China became a significant part of the collection of The American Museum of Natural History (New York, NY, USA). In the same period of the 1920s, French priest E. Licent made a new discovery in the record of Chinese archaeology for the Palaeolithic with his finding of three stone artefacts from the Gansu province in Northwest China. Soon after, an academic publication, 'Le Paléolithique de la Chine' (Boule et al., 1928), declared the birth of a new foundation of the Chinese Palaeolithic with the discovery and resultant scientific research of the Salawusu (Sjara-osso-gol) and Shuidonggou (Choei-Tong-Keou) sites in close collaboration with P. Teilhard de Chardin, who was an pioneer of palaeontological research in China and made lasting contributions from his early study of the Chinese record. Later on in 1929 the first skull of Peking Man, found by Pei Wenzhong (W. C. Pei), turned a new page in the Chinese Palaeolithic and constructed a meaningful foundation of human evolution research in East Asia.

Under the new government of China after 1949, more sites bearing archaeological materials and human fossil remains dating to all periods were discovered due to the national concentration of large scale economic construction all over the country. In the 1950s-60s, the discovery of Dingcun, Lantian, Yuanmou and Guanyindong sites were very important for their cultural and/or human fossil remains. Rapid progress has been made at many early sites such as the Nihewan

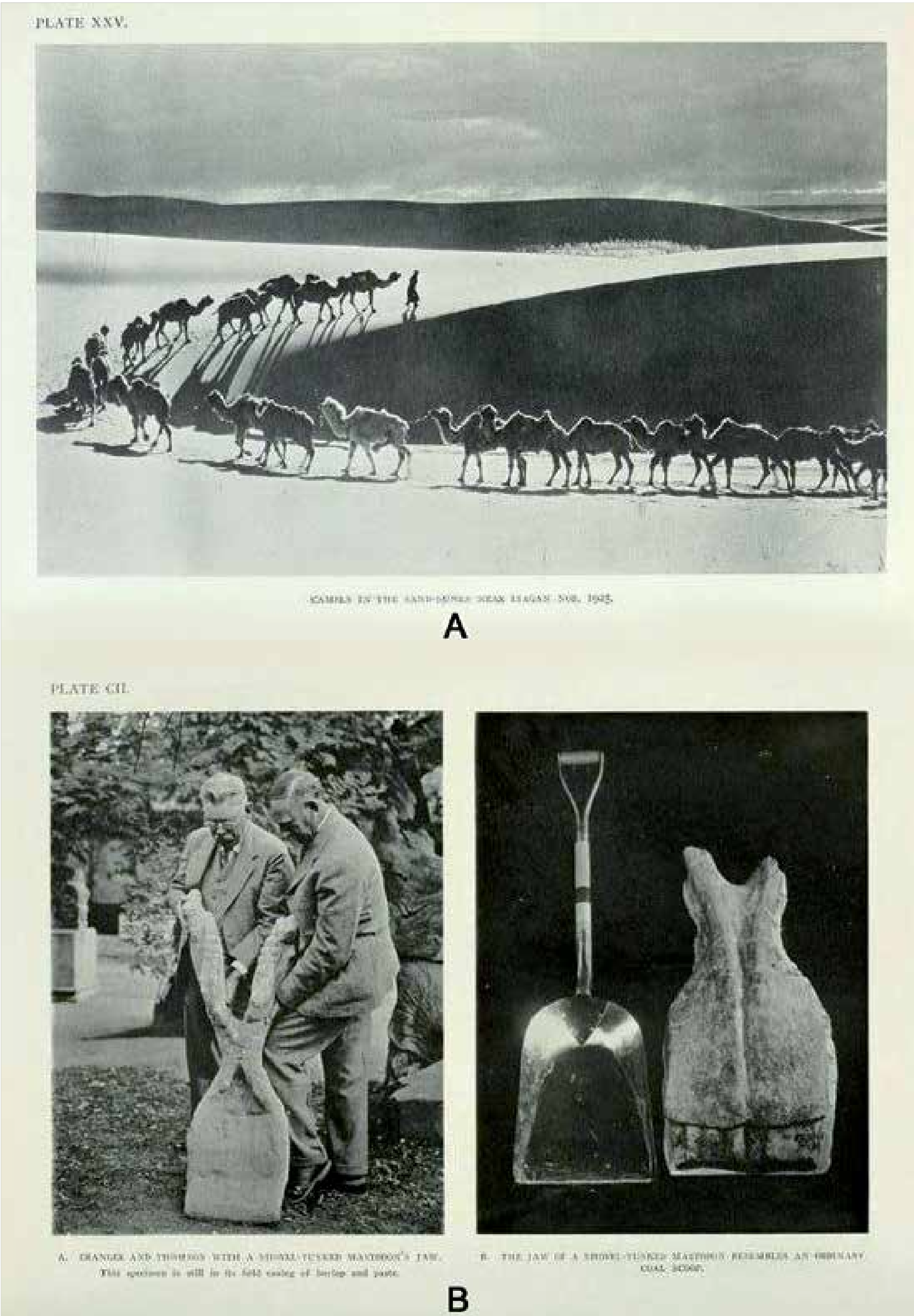


Figure 1: A) Camels in the sand-dunes near Tsagan Nor, 1925 (Andrews, 1932) – B) Left: Granger and Thomson with a shovel-tusked mastodon's jaw. This specimen is still in its field casting of burlap and paste. Right: the jaw of a shovel-tusked mastodon resembles a shovel.

basin sites, the Dali Man site in north, Baise (Bose) basin, Longgupo, Renzidong and Yunxian Man sites in South, as well as Panxian Dadong site in the Southwest during the 1970s-1990s. Palaeolithic artefacts were also found in the far Northeast for later periods. In the twenty-first century, human evolution study in China has come to be conducted in a more synthetic way to understand the site by researching all information collected from international, formal, standardized excavations.

What is the scene of earliest man in China? The Peking Man site of Zhoukoudian has long been in the spotlight and has sparked many ideas and theories concerning human origins in Asia. Then, for more than half a century, attention turned back to human origins in Africa. The goal here is to lay out, and expand upon, the important archaeological cases of human origin sites in China.

Early man sites in China

The earliest sites, over 1 million years old, appeared dispersed both in the northern and the southern regions of the country, with great distances between each other (Figure 2), notably: Yuanmou (YM) site in southwest Yunnan province, Longgupo (LGP) site in Chongqing (the former part of Sichuan province) of the middle Yangtze River region, Renzidong (RZD) site in southeast Anhui province and Nihewan (NHW) basin sites in northwestern Hebei and northern Shanxi provinces. General site formation processes include the formation of ancient fluvial-lacustrine basins (YM and NHW) and cave or fissure deposits (LGP and RZD). Primarily based on biostratigraphy, the geological formations of the YM and NHW are taken as standard Lower Pleistocene profiles in the south and in the north, respectively. They share the common conditions of thick sequences of geological deposits, which are well suited to the application of palaeomagnetic methods of dating. Besides a few Neogene remnant species, most mammals in the YM fauna belong to extinct species. Faunal finds there have a close relationship with the giant panda-*Stegodon* fauna in South China which are attributed to a new verified dating of 1.75 Ma (Zhu et al., 2008). A recent comparison study shows that the basal layers of the Nihewan fauna are coincident with the late Villafranchian, and consequently with the Q/N (Quaternary/Neogene) boundary and the top of the Olduvai Subchron in the astronomically calibrated GPTS (geomagnetic polarity timescale), which is dated to1.796 Ma (Qiu, 2000). The mammal remains at LGP include 99 extinct species and represent the majority of the faunal remains. In particular, *Gigantopithecus* remains are an important characteristic of southern fauna of the Lower Pleistocene, as in LGP fauna, indicating a forested ecological environment (Huang and Fang, 1991). The RZD fauna group reflects more transitional species types between north and south, indicating animal movements driven by climate change (Jin et al., 1999). The environment at YM was forest steppe, and NHW was in a regularly

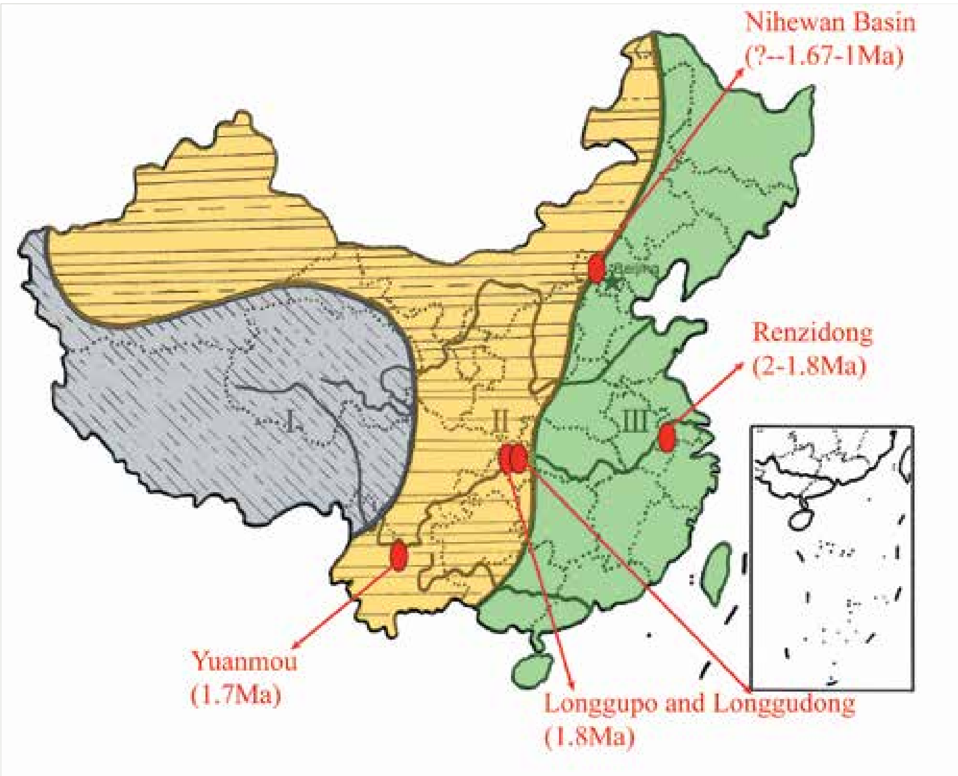


Figure 2: The map of the earliest sites on the three steps of Chinese geography and the dating ages.

fluctuating lake; for example, soluble salt sediments indicate that the Donggutuo site was occupied when the lake was fresh or slightly saline, in a semi-arid region during the earlier 3 periods of lake cycling, out of the total 4 periods (Li et al., 2010). Research conducted by Dennell (2013) indicates that the hominin occupation in the Nihewan Basin was likely discontinuous, infrequent and ephemeral. This conclusion seems reasonable based upon different aspects of the evidence and analysis, but new discoveries and information could make some new adjustments possible.

Stone artifacts of regional style, in association with large numbers of characteristic Lower Pleistocene faunal species, were also found at all of these sites. Human fossils, two teeth and a lower jawbone were found at YM and LGP, though the evidence from the latter is still under review. In the long term excavation of different periods at the four sites, multiple methods of dating have been adopted to obtain a wide range of reference results (Table 1). The stone artifacts are formed using a diversity of raw materials, types and technology among these sites, such as quartz at YM, special local limestone at LGP, ferrous material at RZD and local chert at NHW (Wen, 1978; Hou et al., 1999, 2002; Hou and Zhao, 2009; Jin et al., 1999; Xie et al., 2006). Recently the excavation of two sites (NHW and LGP) has been carried out through international cooperation. The recent work at LGP is the most intensive, with four years of continuous work in archaeology, geology and taphonomy producing new dating results of 1.8 Ma (Hou et al., 2006; Boëda and Hou, 2011a; Han et al. 2012;Boëda et al. 2011; Rasse et al., 2011; Figure 3). Analysis of the artifacts provides different interpretations about technology. Stone artifacts from RZD and NHW exhibit a typical debitage system of knapping, using flakes from the core and subsequently retouching them into further tool forms (Figure 4A). YM exhibits a similar flake tool industry, mainly utilizing quartz as a raw material.

Table 1: Important early man sites in China

Site	Location/ region	Year discovered	*Type of archaeological remains	Excavation period	Age(ma)	*Dating method
YM	southwest	1965	f-s-h	1960s-1980s	1.75	pm-ft-aa-esr
LGP	south	1984?	f-s-h	1980s-2000s	1.7-2.4	pm-ft-u-tl-aa-esr*a
RZD	southeast	1998?	f-s	1990-2000s	1.8-2.4	pm
NHW	north	1978	f-s	1970s-2000s	1.67	pm

**remains: f=fauna; s=stone artifacts; h=human fossils*
**adating method: pm=palaeomagnetism; ft=fission track; aa=amino acid; esr=electron spin resonance; u=uranium-series; tl=thermoluminescence*

Figure 3: Sino-Franco team during an excavation at Longgupo site in 2004 (from left: Y.M. Hou, C. Griggo, E. Boëda, M. Rasse).

NHW basin sites experienced early technological development for the period of the Lower Pleistocene. I will take the most important three sites of 1.66 Ma Majuangou-MJG (Zhu et al., 2004), 1.36 Ma Xiaochangliang-XCL (Zhu et al., 2001) and 1.1 Ma Donggutuo-DGT (Wang et al., 2005) to elaborate. All three are focused on flake knapping work. MJG has only simple flakes; refitting evidence suggests all flakes come from a single core (Gao et al. 2005). That is quite similar to what is seen at Gona (Delagnes, 2012; Delagnes and Roche, 2005). There are rare finds of nicely worked tools based on flakes at MJG (Xie et al., 2006; Figure 4A). XCL begins to have some carefully worked tools but not as many as are found at DGT (Liu et al., 2013a; Figure 4A), though they exhibit better knowledge of platform adjusting than MJG (Liu et al., 2013b). At the time of DGT, thicker layers of cultural remains show evidence of different geological processes than the former two, occurring over a longer period of time. The cultural layers formed in a time of the retreat of the lake cycle. The tool industry has increasing numbers of delicate tools; the development of points being significant among them. Further notable evidence here is the appearance of the 'Donggutuo (DGT) core' (Hou, 2003; Hou, 2008; Figure 4B), which was a completely new technological invention and most probably a new cognitive product of adaptation to some change of the living situation stimulated by shifting climate. The 'DGT core' conveys the information that the early hominid populations of NHW basin were able to find solutions for the problems they encountered. The 'DGT core' was a new development compared to the popular known 'flake tool', and represents a

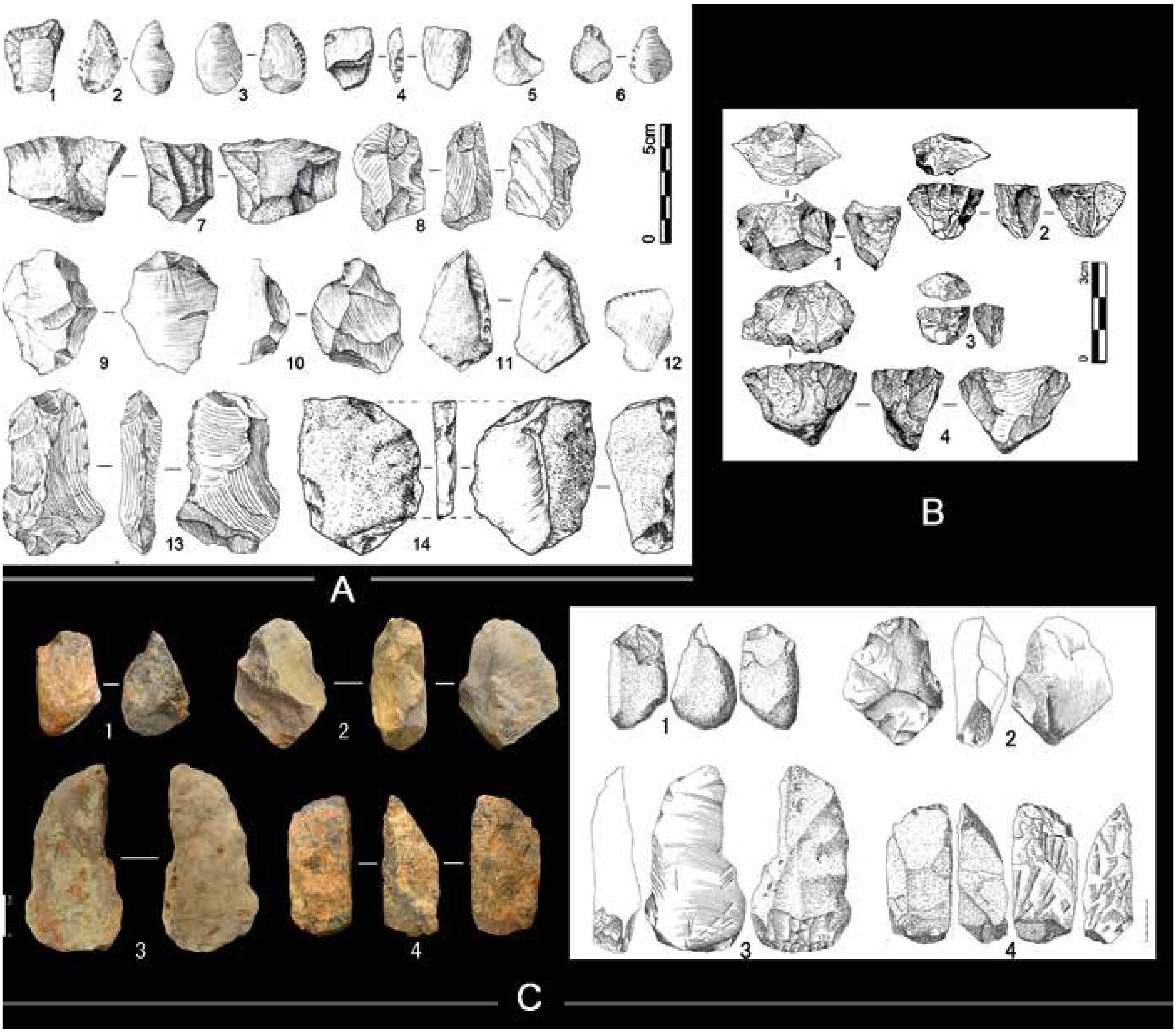


Figure 4:
A). The stone artifacts from Majuangou: 4, 7, 11, 14, Xiaochangliang: 8-10, 12, 13 and Donggutuo: 1-3, 5, 6 sites of Nihewan basin. 1. scrapers; 2, 6. points; 3, 4, 11-13. scrapers; 5, 10. notched scrapers; 7. core; 8, 9. flakes; 14. chopper (after Xie et al., 2006)
B) The stone artifacts of 'Donggutuo core' from Donggutuo site of Nihewan basin
C) Stone artifact from Longgupo site (1.4, unifacial chopper; 2, bifacially worked chopper; 3.large flake.

parallel technological system. The products made from 'DGT cores' are small elongated flakes, requiring a rather intelligent preparation of the core before reduction work. This represents a much different reduction sequence than that seen before at other sites. It is also not anything that could be put in the frame of 'Mode 1' (Hou and Zhao, 2009), which has been an abused concept for the Chinese case. We need to be cautious with using 'outside' terminology, because it may be not appropriate to take its applicability for granted in regions whose case is not suitable to be simply colonized by other existing concepts.

On the contrary, LGP exhibits a case of a technical façonnage system (Boëda and Hou, 2011b). There, they chose raw materials based on the appropriateness of the raw material's natural form to the steps of the tool making process; those natural forms may vary but in the end can be integrated into the system designed for a desired tool type (Figure 4C). This provides evidence that the LGP tool maker has created a clear conception for the tool production and has adapted well to the environment surrounding them. It is noted that this may represent a different way of managing materials than that of early man in Africa (Boëda and Hou, 2011c).

A techno-evolution of the biface phenomena: Acheulean or not?

The existence of bifaces was long considered lacking in Asia by definition of the 'Movius Line' (Movius, 1948), even though Movius himself had already distinguished many bifaces in the Patjitanian industry. During several decades, hundreds of Palaeolithic sites yielding bifaces were reported in East Asia and Southeast Asia. The existence of bifaces in Asia is not doubted any more, a position which receives strong support from the scientific work of international scholars (Derevianko, 2008; H. De Lumeley, E.Carbonell and K.Kuman, personal communication).

The first discovery of a biface in China was declared in 1956 (Jia, 1956). So far, it is known that bifaces are distributed throughout the whole country from the north of the Inner Mongolia Autonomous Region to south of the Baise (Bose)-Guangxi Zhuang Autonomous Region dating from the Middle Pleistocene to the Holocene (Huang, 1989). Three concentrated areas of bifaces are recognized: Fen-Wei rift valley of Yellow River system, Hanshui River valley of Yangtze River system and Zhujiang (Pearl) River system (Figure 5). Below, cases of a few representative sites are presented.

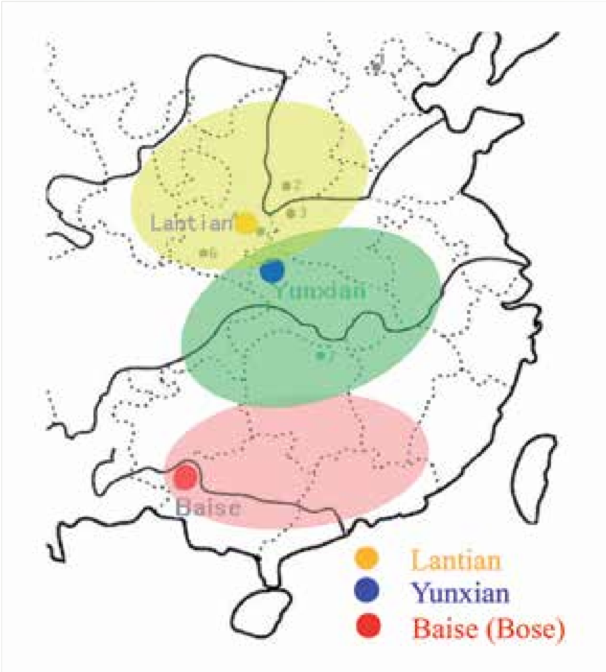


Figure 5: Three main regions of biface industry in China (yellow:Yellower River system; green: Hanshui River of Yangtze River system; pink: Southern Pearl River system).

Biface sites in Fen-Wei rift valley of Yellow River system

Lantian site

As one of several Cenozoic deposits, the Lantian basin is situated at the north foot of the Qinling Mountains, where the north/south boundary of the country is located. The Lantian Gongwangling fauna and *Homo erectus* Lantian Man are well known from aeolian loess sediments. However, Palaeolithic discoveries were relatively less noted and studied. The raw materials of these tools are quartz and quartzite, quarried from local gravels. Bifaces, cleavers, picks, and discs are prominent features of the Palaeolithic of this district. One of the most well-known bifaces (Figure 6A1), originally called 'big trihedral point' from Pingliang locality, was unearthed from a layer corresponding to the palaeosol below the layer yielding a *Homo erectus* skull (Dai, 1966). As a representative of an Eastern Asian biface, it has been juxtaposed with those from Olduvai Gorge of East Africa and Combe-Grenal of Europe (Tattersall et al., 1988). Correlating to geological loess sequence studies, the date for the relevant layer of L15 in Chinese loess-palaeosol sequence was given as 1.15 Ma by An and Ho (1989) and adjusted to an earlier date of 1.25 Ma by later verification work (Ding et al., 2002). In light of the good condition in the course of work for profile preservation, further dating work for that section will be probably continue to refine the timing of this important stratigraphic layer.

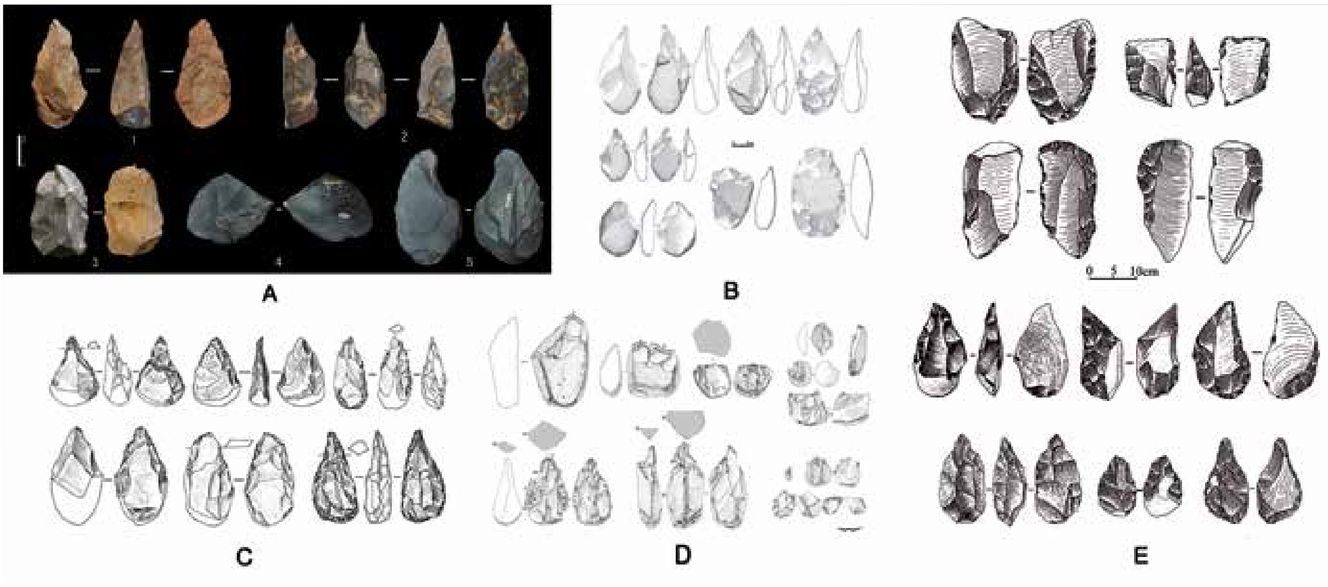


Figure 6: Some lithic industry industries with biface pieces from different sites
A) 1, handaxe of Lantian 2, pick from Dingcun 3,4, 5,larger flake and larger flake tool from Dingcun; B) handaxe piece from Yunxian Man site (re-edited after De Lumley and Li, 2008); C) some handaxes from northwest Hubei province; D) stone artifacts from Houfang site, Hubei province(re-edited after Li and Sun, 2013); E) handaxe industry from Luonan site, Shaanxi province(after Wang, 2007).

Dingcun site

Dingcun (formerly Ting-Ts'un) site was discovered in the fluvial terraces of the Fenhe River in 1953 and yielded stone artifacts and human fossils with coexistent animal fossils imbedded. The mammalian fauna is comprised of members of Middle Pleistocene Zhoukoudian fauna and Late Pleistocene Salawusu fauna. In a primary report, Jia attributed it to the late stages of the Middle Pleistocene (Jia, 1955). In accordance with mammalian fauna, Pei concluded that it should be placed at the early stage of Late Pleistocene in a formal report (Pei, 1958). Later, the geologists found a palaeosol S1 (73-127 Ka BP, corresponding to MIS 5) which corresponds to the bottom gravel layer of Malan Loess. Thus the site age was reported between 128 Ka and 250 Ka (Liu and Ding, 1984).

For the classification of the lithic industry of Dingcun site, a sharp debate occurred between the two senior Chinese scholars, Jia and Pei. Jia claimed that there was no doubt of the presence of bifaces in the Dingcun industry and that the term 'bifaces' represented well, the cultural characteristics as manifested in China. On the other side of the debate, Pei insisted strongly on his opinion of the independent development of oriental and occidental Palaeolithic industries and advocated the use of new terms such as 'chopper', 'thin flake-tool knapped and used, bifacially-polygonal tool' and 'big trihedral point-large heavy prism' instead of 'biface', 'cleaver' and 'pick' (Figure 6A2-5; Pei 1955; Pei, 1965; Pei and Jia, 1958) in the Dingcun industry. These different conceptual usages were the source of much confusion for later understandings of the lithic industry of the Dingcun site.

As the first new independently excavated and studied site of China, Dingcun elicited the following comments from foreign scholars: 'There is no question concerning the fact that the investigations of the Ting-Ts'un localities have been conducted in conformity with the highest standards of archaeological field-work' (Movius, 1956). Breuil said many pieces which Pei classified in 'choppers' group, were 'bifaces' and might be suggested as late Acheulean type (Pei, 1965). When Freeman Jr. visited IVPP in 1975 he described those specimens of 'trihedral pick' from Dingcun as 'absolutely characteristic long lanceolate biface', 'perfectly good, typical biface without qualification' and 'a typical biface'. He said, 'I was most surprised at the biface series…, I am convinced that they are well within the expectable range of variation within this type in good Acheulean series'. He believed, 'after having seen the Ting-ts'un collections, the discovery of true Acheulean or Acheulean-like industrial complexes in China would come as no great shock' (Freeman, 1977).

Recent research on the geology and archaeology of Dingcun site has yielded revised dates of 160 Ka - 210 Ka as the chronological age of the site, and re-assigned the site to the late Middle Pleistocene. Together with the mixture of tool-kits, including heavy-duty and light-duty tools, the lithic assemblage provides a new interpretation of the industry, chronology and cultural characteristics of the late Acheulean (Yang et al. 2013).

Luonan

In the southeast of the Lantian Basin the Palaeolithic sites of Luonan basin in Shaanxi province were initially studied in the 1970s-1980s and reached new achievements in the 1990s-2000s. Recent large-scale rescue excavations have raised the number of stone artifacts discovered to several hundreds of thousands of pieces from hundreds of Palaeolithic sites. The scale of excavations at some sites has reached up to several thousand sq. meters in 2012 excavations. Bifaces, picks, cleavers, choppers, large knives and spheroids are types frequently found in the assemblages of all sites. They are often accompanied by fewer numbers of scrapers and points of light-duty tools (Wang et al., 2013). The archaeological remains were imbedded in the loess dated to 500-250 Ka in different terraces of the river. The earliest stone artifacts appear in the stratigraphy about 800 Ka (Lu et al., 2007; Wang, 2007; Wang et al. 2013; Figure 6E).

Hanshui River valley of Yangtze River system

Yunxian Man site

Hanshui River is the longest tributary of the Yangtze River in the southern part of the Qinling Range, which is taken as a geographic boundary between the south and the north of China. Yunxian county is located in the middle reaches of the Hanshui River. In 1989 and 1990 two well preserved fossils (one skull and one cranium) of Yunxian Man were discovered at Quyuanhekou-Xuetangliangzi in Yunxian county (Li et al., 1994). Yunxian Man site became an important new hominid site with an age of about 1 Ma in association with numerous stone artifacts and mammalian fauna. Both the assemblages of cultural and mammalian remains show a mixture of characteristics from both north and south China. New studies defined Yunxian Man fossils as early *Homo sapiens* (Zhang, 1995). The lithic industry of biface, cleaver, picks etc. is characteristic of heavy-duty tools with a minority of light-duty flake tools (Figure 6B). Alongside the results of Chinese research (Li and Feng, 2001), a multi-disciplinary French research project was recently published by H. De Lumley's team in 2008 (De Lumley and Li, 2008).

Yunxian Man site evidences an early case of a biface industry. Increasingly, rescue excavations in recent years provide us with more evidence of Palaeolithic sites with biface pieces from Terrace 2 and 3 of Hanshui River. The Danjiang reservoir in several counties becomes a new region which involves biface industry sites (Figure 6C) in a relatively large excavation grid. It undoubtedly extends the territory of this kind of culture in China and makes Hanshui River well known as a significant region of biface development for the Middle Pleistocene and the early Middle Pleistocene. Among those sites, some like Beitaishanmiao, Houfang (Li and Sun, in press; Figure 6D) etc. are newly reported and attributable to the terminal Middle Pleistocene.

The south Zhujiang (Pearl) River system

Baise (Bose) basin

In southern-most China, the Baise (Bose) basin was the first site known, discovered in the early 1970s, and was long the subject of arguments concerning the date of the lithic industry found there, which included bifaces coming from the high terrace (Li and You, 1975; Huang, 1989). In 2000 a new article reported the Baise basin site at an age of 0.803 Ma, obtained by Ar-Ar dating (Hou et al., 2000), and indicated that the biface industry in Asia surpassed the age of the record in Europe that time. It also seemed to immediately hit the 'Movius Line'. This new result benefited from discovery of tektites associating with stone artifacts at the sites. These tektites are composed of material deposited *in situ* after a meteorite impact event. The acidity of the local soil precludes the possibility of recovering animal fossil remains in this basin. Tektites thus become an unexpected and welcome factor in resolving this long puzzled problem of the dating for the site. The preservation conditions at the site shows an *in situ* situation that corresponds well with associated stone artifacts (Figure 7A). Thus Baise basin sites are a solid example of a Middle Pleistocene biface industry in China.

In the 80 Km length of the basin, along Youjiang River almost one hundred Middle Pleistocene sites were discovered from Terrace 4 (Figure 8). The tool composition includes low biface proportions yet still manifests differently between all the sites and may be relevant to some idea of specialized considerations for land use by ancient humans. Some bifaces, such as those from the Yangwu site of the basin, were worked carefully and into more sophisticated shapes (Figure 7B).

Around the basin, the Fengshudao site again clearly proves the coherent discovery of bifaces along with tektites. It alleviates some doubt concerning the dating of the site and the relationship between the biface industry and tektites (Figure 9).

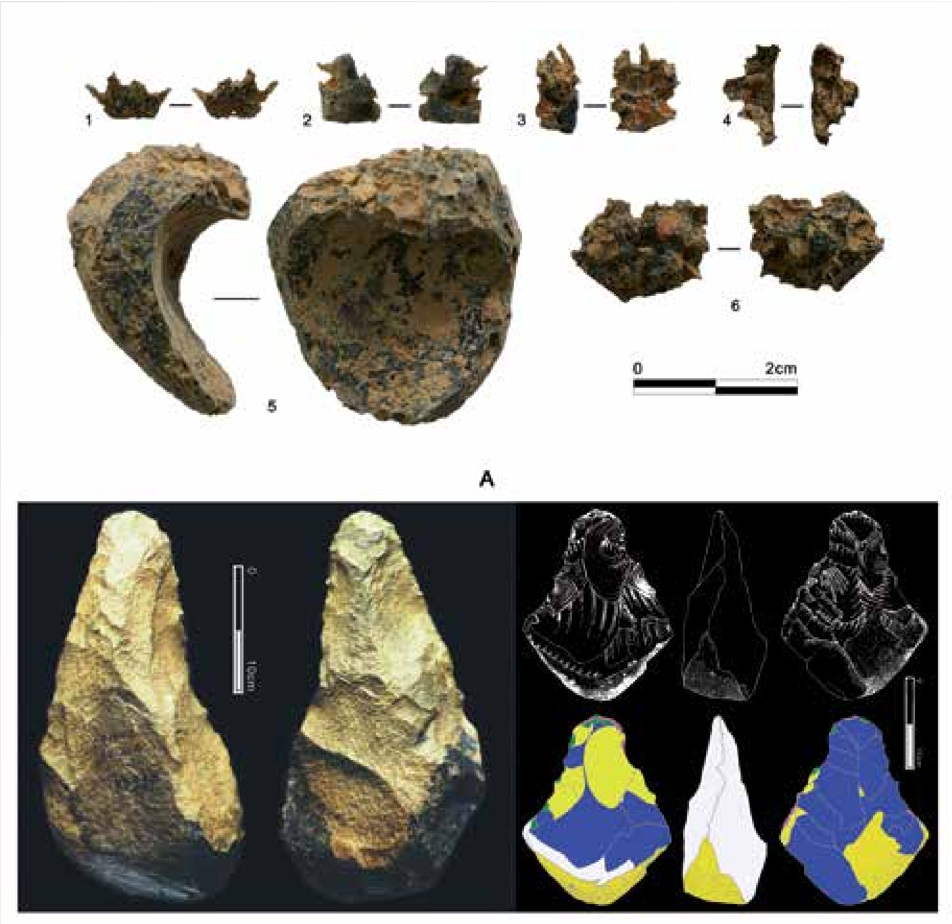


Figure 7: A) Tektites from Yangwu site of Baise(Bose) basin; B) Handaxes from Yangwu site of Baise(Bose) basin.

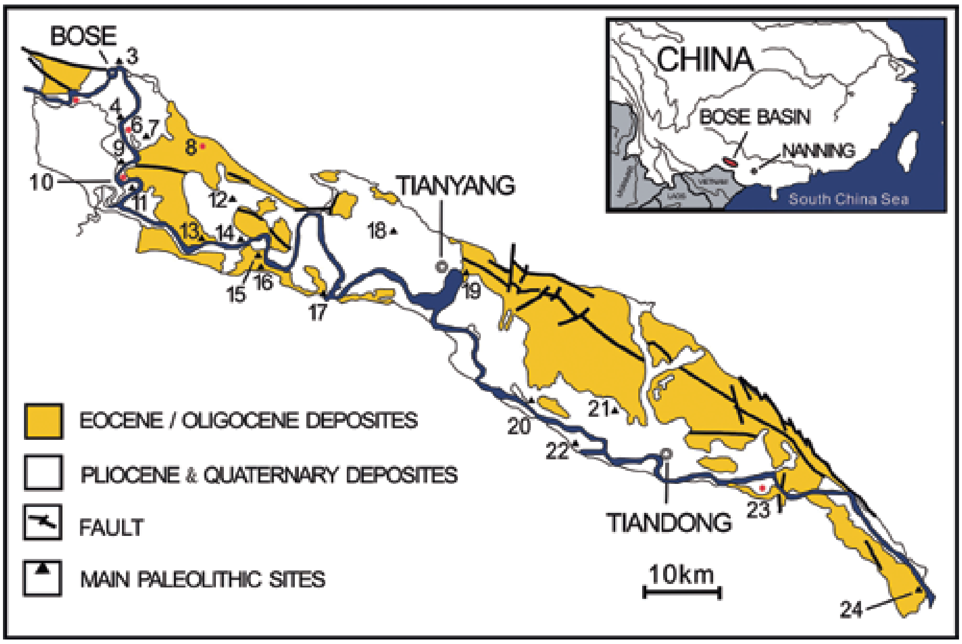


Figure 8: Main Paleolithic sites in Bose Basin (Localities with major handaxes)*
1. Shangsong 2. Dongzeng
3. Hengshandao 4. Dawan*
5. Shazhou 6. Yangwu*
7. Zimu 8. Nanposhan*
9. Jiangfeng and Datong
10. Bogu 11.* Dafa*
12. Xiaguo 13.* Xiaomei and Nalian 14.* Damei*
15. Laikui 16. Nayin 17. Napo
18. Pinghepo 19. Sanlei
20. Xinzhou 21. Ganlian
22. Bodu 23. Gaolingpo 24. Silin

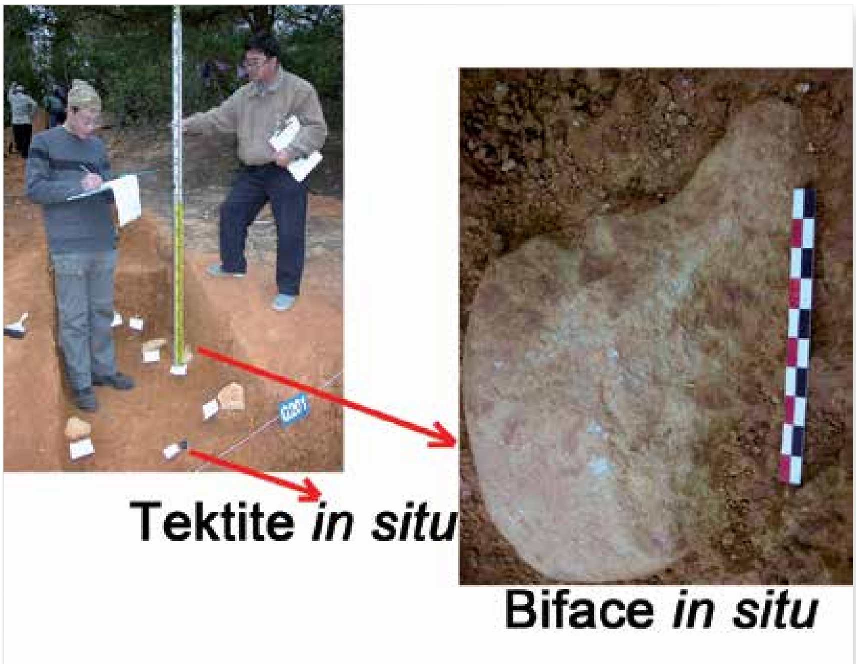


Figure 9:Coexisting evidence of tektite and handaxe discovered at Fengshudao site in the Baise basin area.

Late Pleistocene sites and human adaptation

As we know, the Late Pleistocene is a period during which human evolution entered a new phase in time and space. Human behavior and adaptation were reflected in many aspects, and innovation of new living styles turned a new page in human prehistory. Though few sites of this period in China are well known, some sites certainly present common or particular features including aspects of archaeology, geography, geology, environment and chronological position from the Middle to Upper Palaeolithic. Meanwhile the various apparent phenomena of the period reveal a significant transformation in the cultural behaviour of humans in northern China and foreshadow the developments of the Upper Palaeolithic.

Here, a few of the prominent sites in north China are briefly summarized (Figure 10, Table 2) with respect to their significant discoveries and the normative work to display the main aspects of the archaeological record of Middle Pleistocene times.

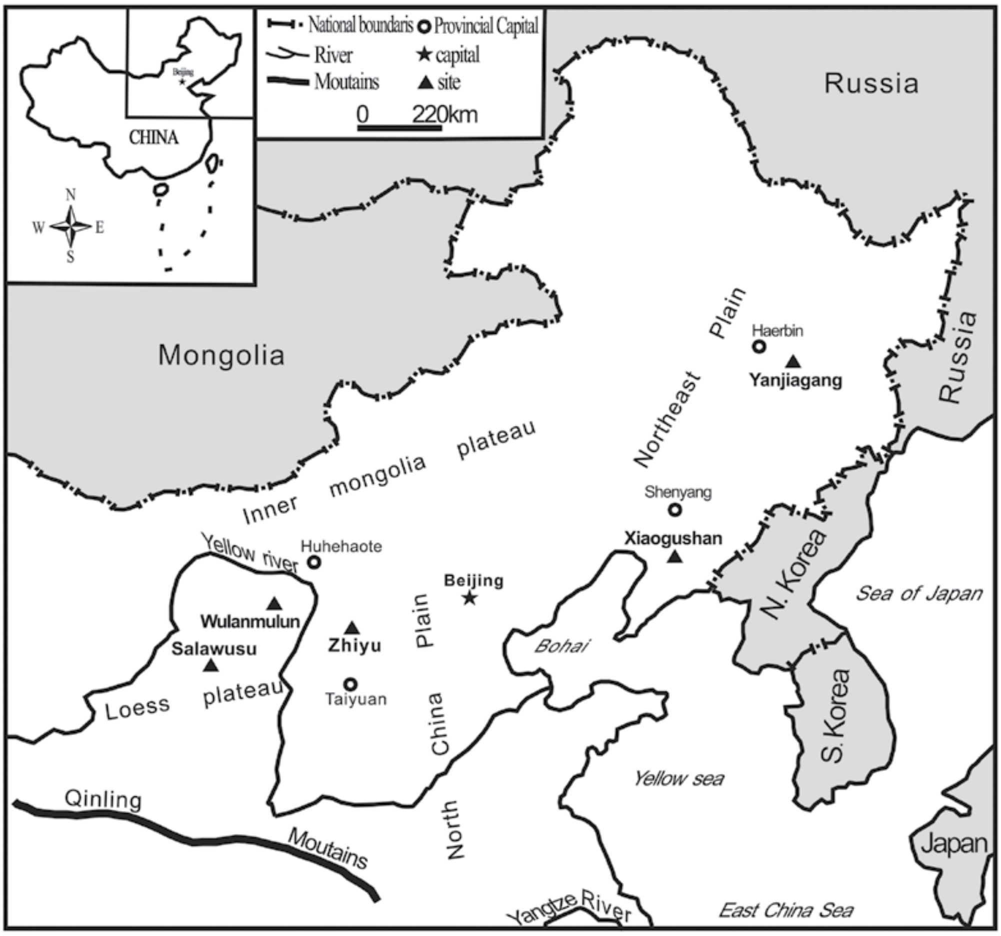


Figure 10: Location of important Late Pleistocene sites in North China.

Salawusu site

Figure 11: Landscape view of Salawusu site.

Salawusu (formerly Sjara-osso-gol) is presented as one of the two earliest excavated, and the first well studied, Palaeolithic site in northern China (Figure 11). In the divisions of this industry made by H. Breuil, microlithic types appear more apparently than the non-microlithic. It is also abundant in sidescrapers, endscrapers, notches, borers, burins and denticulate pieces, mostly tiny in size (Figure 12A). Bone tools made with antler or antelope horn were found in excavations and collected, but not published until now. Lithic raw material sources were found at a distance of 40 Km away from their living site in the valley, which lacked suitable stone materials, and were used by tool makers (Huang and Hou, 2003).

In a century of studies on essential strata deposits, important datings, fauna and stone artifacts, including human fossils, have been recovered during only a few excavations. The site has provided the standard fluvial-lacustrine stratigraphic profile for the period, as well as the standard fauna of Late Pleistocene in north China. New dating gives an age between 110 and 70 Ka BP to the site (Huang and Li, in press). Compared with other sites of the same period, the knapping techniques of Salawusu people were rather unique in that they focused on the production of very tiny materials. Moreover, horn implements in association with most of the microlithic tools may reflect a time when humans were developing a hunting economy.

Little evidence of human fossils has been found from the Salawusu site. They were studied as a mixture of different modern human–like, archaic modern human and Neanderthal characteristics of the Upper Palaeolithic in Eurasia (Shang et al., 2006). This indicates that Salawusu populations not only exhibit exchange of culture but also gene flow.

Shiyu (Zhiyu) site

At a margin of the Loess Plateau, Shiyu (Zhiyu) site (112°17’N, 39°25’E) is located at Shiyu village of Shuozhou city in Shanxi province. Found on Terrace 2 of Shiyu River, the site was discovered in 1963 with the finding of one human occipital bone, 15,000 pieces of stone artifacts, one ornament and abundant fragments of mammalian teeth and bones together with burned stone and bone materials. The industry is primarily composed of exquisite small stone tools and bone artefacts. Jia Lanpo evaluated the industry as ‘existence of particular Aurignacian shortened-body scraper, kiss-formed scraper, fluted burin and steep retouched style of Châtelperronian’ (Jia, 1972; Figure 12 B). The cut marks on bones and numerous fossil remains of *Equus hemionus* and *Equus przewalskii* makes the Shiyu people known as *E. hemionus* and *E. przewalskii* hunters. The site has been dated to 33,000±1100 BP and 36,700±1000 BP through conventional ^{14}C and AMS (Dating Laboratory, 1977; Yuan, 1983).

Located in the north of the Liaodong Peninsula, Xiaogushan cave site (40°34’53”N, 122°58’33”E, Figure 13) was found in 1979 and has been excavated several times since1981 (Zhang et al., 1985). The age was dated to between 70 Ka and 17 Ka BP (Zhang, 2010) by methods of conventional ^{14}C, AMS and OSL for several cultural layers.

Xiaogushan lithic industry is mainly made on vein quartz and other quartzite and diorite. It is composed of heavy-duty tools which include choppers, bifaces and spheroids, as well as light-duty tools which include borers, becs, sidescrapers, discs, denticulates, notches, burins and points. Bone tools and ornaments are notable cultural remains (Figure 12C). Most were from layer L2-3 which were dated 56-20 Ka BP. Very exquisite bone artifacts appear which can be compared with some artifacts of Upper Palaeolithic Aurignacian, Gravettian and Magdalenian style in Europe which makes the upper limit of these dates notable, in that it situates the Xiaogshan material culture assemblage (which is analogous to that of the European Upper Palaeolithic) at an earlier, or at the very least contemporaneous, date to its European counterpart. The bone needles were polished along the whole body and exhibit the oppositional rotational drilling technique. The discovery of a totem was recorded for the first time in this Palaeolithic site of East Asia (Huang and Fu, 2009), and may have some ideological meaning (Figure 12C) according to similar artifacts studied by Sieveking (1971).

The fauna shows the most archaic species found at a Chinese Late Pleistocene site with a large number of extinct species, and is a typical representation of fauna for the northern region. The fauna existed in the Middle and late Middle Pleistocene under a humid temperate climate with a mostly forested environment with a few areas of marsh and grassland. In the last glacial period, it is possible that cold weather drove people to move southward and stimulated them to develop techniques to use fire.

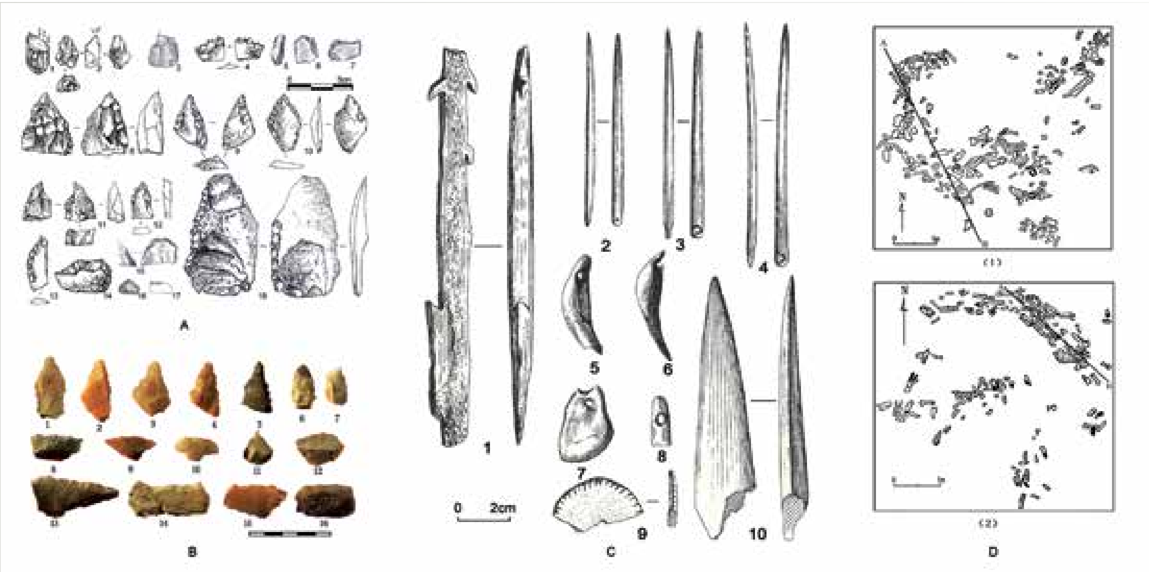


Figure 12: Artifacts and remains from some Late Pleistocene sites of north China
A) Stone artifacts from Salawusu site; B) Stone artifacts from Shiyu(Zhiyu) site; C) Harpoon, bone tools and ornament from Xiaogushan site (after Huang et al.,2009) D. The semi-circle campsites of Yanjiagang site (after Yu et al., 2010).

Figure 13: Entrance view of Xiaogushan cave site (photo by J.F. Zhang).

The cultural vestiges shows us a complicated lithic and technological industry with a level of maturity that indicates that Xiaogushan site exhibits a composite economy combining rather advanced techniques of stone tool making, hunting strategy, collecting and fishing ways of life.

Yanjiagang site

In the northern part of the Northeast Plain of Heilongjiang Province, Yanjiagang site (45°37'N, 126°19'E) is located in southwest Harbin and was first excavated in 1982. From four episodes of field work a fragmentary piece of human cranium belonging to *Homo sapiens*, 24 species mammals of '*Mammuthus-Coelodonta* Fauna', very few stone artifacts, burnt bones and charcoal were discovered. The two overlying skeleton circles (Figure 12D) are the most remarkable remains. One is an elliptical ring formed by more than 200 pieces of bones, which were identified as belonging to 6 wild asses, 5 bison, 2 woolly rhinoceros, 1 cervid and 1 wolf. The other is a semi-circle formed by more than 300 pieces of bone, which were identified as belonging to 5 woolly rhinoceros, 5 wild asses, 3 bison, 4 cervids, 1 hyena, 1 wolf and 2 gazelles (Northeastern expedition team, 1987). These bones were arranged in order and artificial marks were found on half of them. Charcoal fragments were left inside the circles. Researchers thought they were built and used as a shelter house for hunters, or at least represent the remains of a temporary campfire.

Shuidonggou site

Shuidonggou (SDG, formerly Choei-Tong-Keou) site (106°19'E, 38°21'N) is one of the most important Palaeolithic sites in China for both its historical position and cultural content. Localities 1 and 2 were discovered in the early part of the twentieth century and produced rich stone artifacts, fragmentary bones, charcoal remains and 13 species of Quaternary fauna fossils. The work from this period was carried out and published by Teilhard de Chardin and Licent (1924), Licent and Teilhard de Chardin (1925), and Boule et al. (1928). It was subsequently re-excavated by Chinese teams in the early 1960s, in 1980, and in present-day (Jia et al., 1964; Ningxia Museum, 1987; Chen et al., 2012; Pei et al., 2012).

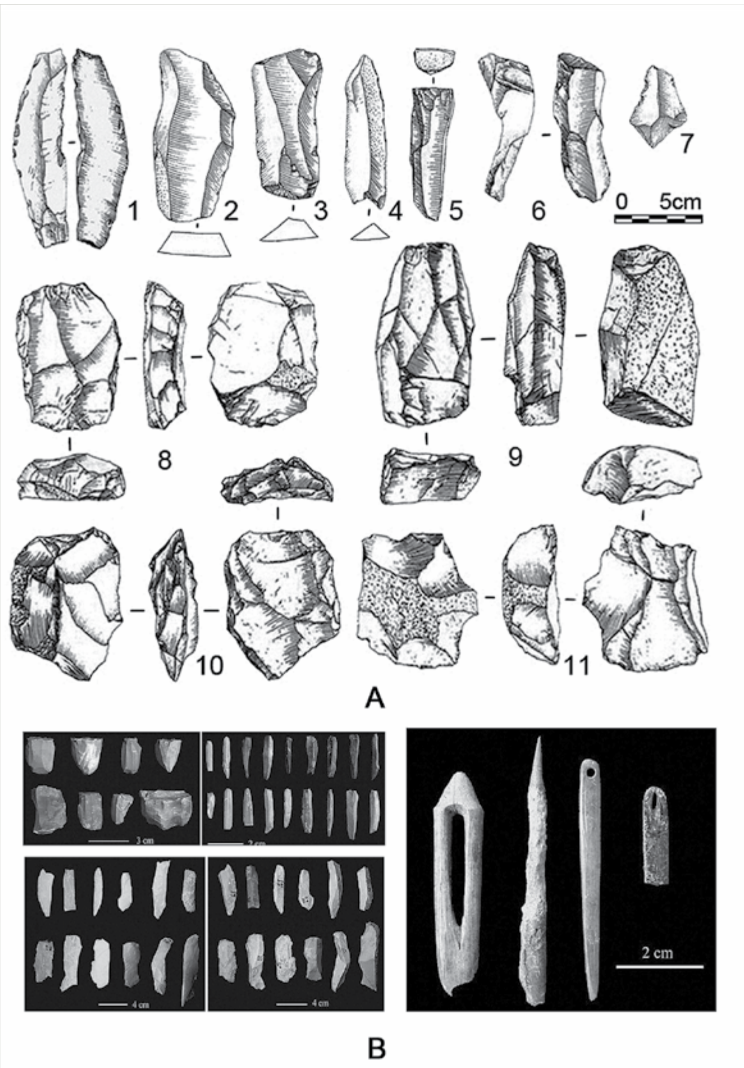


Figure 14: Artifacts from Shuidonggou site A) blades and Levallois cores from SDG Loc.1 and 2 (after Hou et al., 2013) B) microblade and blade industry, bone artifacts from SDG Loc.9 and 12 (after Pei et al., 2013).

From the beginning the SDG industry was recognized as a culture which was reminiscent of the Mousterian in Europe, Anatolia, and North Africa, and surprisingly similar to types of ancient Aurignacian and Solutrean culture. Generally, SDG culture was concluded to be a mixture of European Middle and Upper Palaeolithic (Boule et al., 1928), which makes it a very different example of the Chinese Palaeolithic. In light of new materials, progress from new excavations and new dating techniques, the SDG culture phenomenon becomes an interesting subject for scholars to research and discuss. Its blade industry and use of Levallois technology are the most intriguing issues to address. ^{14}C and Uranium series dating give the SDG site an age of middle Late Pleistocene i.e. Upper Palaeolithic (Madsen et al., 2001; Chen, 1984; Yuan et al., 1983). Recent work indicates that the cultural remains of the site fall primarily from 35-20 Ka (Liu et al., 2009). Madsen et al. (2001) concluded that the SDG blade technique originated in West Siberia or Mongolia and was transmitted to the SDG site. But new excavation and dating work on SDG Loc. 2 found that flake industry was the dominant tool type in the assemblage rather than blade industry (Li et al., 2013). On the other hand, the data from Loc.1 differs from that for Loc. 2, and exhibits a blade-based lithic industry. Determining the age of the blade industry at SDG will depend on new dating, completed according to separate cultural layers. Recent work of Li et al. (2013) provides new evidence from a comparison between SDG Loc.1 and SDG Loc. 2. They posit that at least two chronologically successive technologies existed in the Shuidonggou region between 40,000 and 20,000 BP. The distinctive production of large blades from flat, Levallois-like cores as well as more prismatic forms represents an intrusive technology spreading from the north and/or the west. This blade-based industry was then succeeded by a series of 'small flake tool' assemblages characterized by generalized flake production and a sidescraper-dominated toolkit (Figure 14A). Li et al. (2013) suggests the age of Levallois-like blade technology in the Shuidonggou area is around 38,000-34,000 BP. It was replaced around 34,000 years ago by simple core and flake-tool assemblages. From SDG 9 and 12, a rich assemblage of blades and microblades or cores were unearthed (Pei et al., 2012; Figure 14B) indicating a recently developed, new technological adaption. The hypothetical stratigraphic and cultural relationship between the sequences at SDG Loc.1 and SDG Loc. 2 as well as between other localities of the site can be better tested in future excavations. Pei et al. (2012) is carrying out research that may clarify this.

On the other hand, Boëda et al. (2013) recognized two contemporaneous methods for obtaining elongated blanks, including the blades from strata 7 and 8 of SDG Loc.1: the Levallois method with classical core preparation and another less complicated method termed Type D2 reduction. Both Levallois and non-Levallois methods are thus clearly present at Shuidonggou at the end of the Late Pleistocene, just prior to widespread adoption of laminar reduction. It is noted that in Northeast Asia, it is possible to find evidence of this method in Mongolian and Altai-Siberian sites during the same period (Brantingham et al., 2001; Derevianko, 2005, 2009 and 2012). It remains unclear why the Levallois expansion and the extent of its geographic context were limited solely to the desert, or dry loess regions of North Asia (North China, Mongolia, Siberia-Altai) and is not found in the south where the climate is more favorable and there is high quality chert raw material (Boëda et al., 2013).

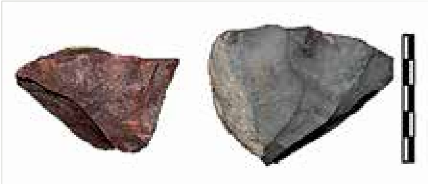


Figure 15: Specimens of Donggutuo core (collection of IPH, France) from Shuidonggou site.

The 'Donggutuo core' is another feature, found in the SDG collection first, in the Institut de Paléontologie Humaine (IPH) of Paris (Figure 15) and has been the subject of much attention by the author. It reminds us that SDG culture may not be purely influenced by western culture but also rooted in some eastern cultural elements. The influence from the west, arriving later, spurred a replacement of flake industry by blade industry to some extent. Flake production was integrated into Levallois blade system industries (Boëda, 2004). Through further comparison with the Siberian sites of Denisova and Kara Bom the author

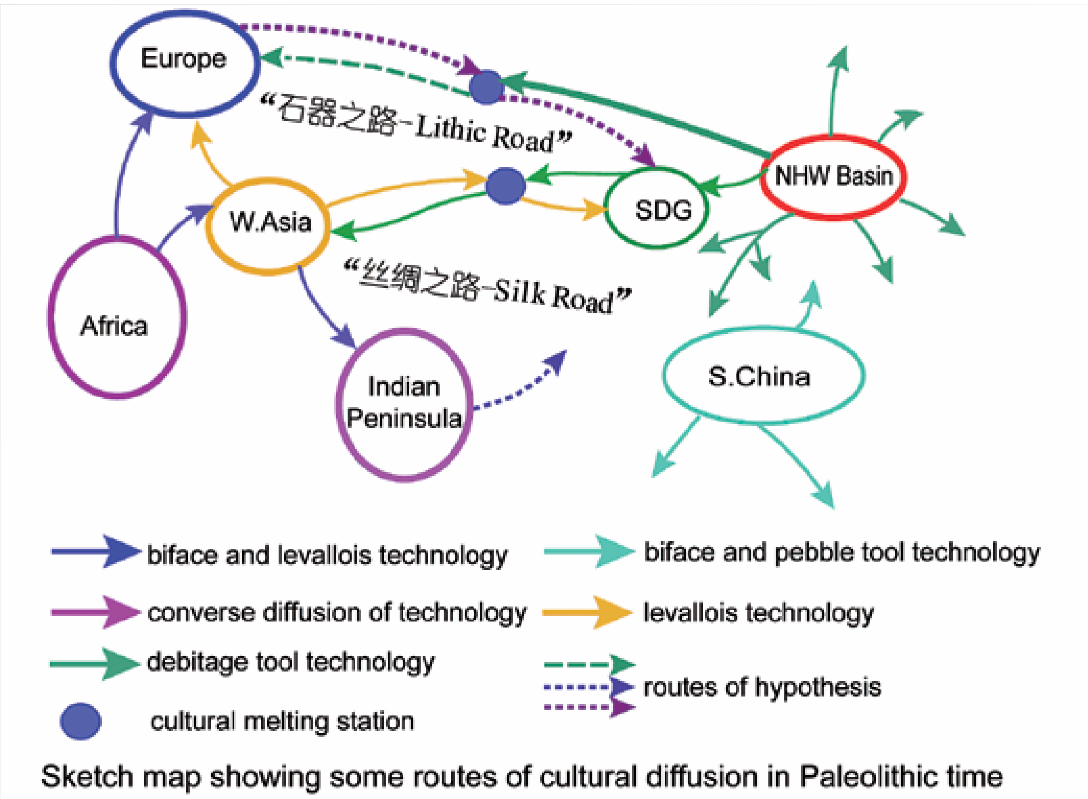
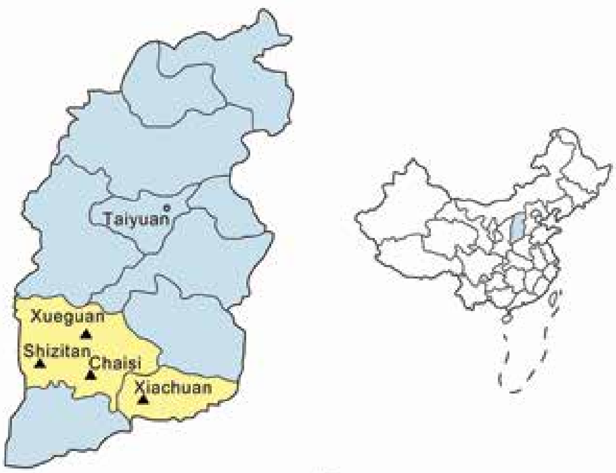


Figure 16: Lithic Road: Sketch map of cultural diffusion routes in Paleolithic time.

proposed the hypothesis of the existence of a 'Lithic Road' (Hou, 2005; Figure 16) which served as a mechanism of considerable cultural propagation and transmission between East and West in prehistoric times.

Many scholars suggest that the 'Shuidonggou Formation' from the site should be named as a typical Late Pleistocene profile in North China. Recent dating work shows the ancient human activities at the site took place from 30-24 Ka (MIS 3). The climate was warmer and moister than present day, and suitable for early human hunting, gathering and survival. The Neolithic human occupation at the site occurred 9-5 Ka (Gao et al., 2008).

In the Upper Palaeolithic period, lithic technology entered a new epoch characterized by the apparent necessity of microblades, which exhibited a number of local adaptations across the large region of north China. Shanxi and Hebei are the two main provinces which exhibit this new development. Drawing examples from southern Shanxi Province (Figure 17) in central China, the four important Upper Palaeolithic sites of Xiachuan, Chaisi, Shizitan and Xueguan (Figure 18A,B,C,D). Each site exhibits different levels and manifestations of lithic technology in response to hunter gatherer groups coping with different environments, climates and available resources at the terminal Pleistocene. Dynamic techno-typological and micro-wear analyses were employed in the research (Chen et al., 2013).



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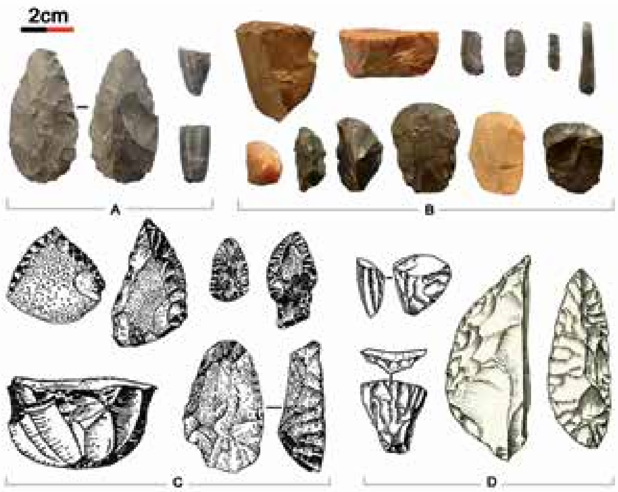

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Figure 17: Site location map of four main sites of Upper Paleolithic in Shanxi Province of north China.

Figure 18: Upper Paleolithic stone artifacts from four sites: A) Xiachuan site B) Chaisi site C)Shizitan site D) Xueguan site (after Chen et al., 2013).

At Shuidonggou site there is evidence of diversity as well as standardization of artefacts (Figure 14B), bone tool utilization, ornament production, use of beaded jewelry, hearths, spatial function arrangement and living strategy. Thirty-five starch grains of wild *Triticeae Dumort* were reported from several stone artifacts (Guan et al., 2012). It shows characteristics indicative of the broad spectrum revolution during the late stage of the MIS3 for modern human behaviors in Upper Palaeolithic sites of this region.

Southwestern China: the case of Panxian Dadong cave site

Panxian Dadong Cave site (25°37'38'N,104°44'00'E) was found in the Guizhou Province of southwest China, an area best known in the country for impressive karst topography with many limestone caves and rock shelters (Figure 19). Dadong is situated in the middle cavern in a series of 5 interconnecting karstic caverns in a 230 m high hill within a small valley that sits at an elevation of 1638 m above sea level. The cave is 220 m in length, an average of 35 m wide and 30 m high, covering an area of over 8000 m^2.Since its discovery as a rich Palaeolithic resource in 1990, it was excavated several times during the 1990s; in 1993 was recognized as one of the Ten Major Archaeological Discoveries in China as well as one of the National Key Cultural Relic Preservations in 1996. A multi-disciplinary report was published in 1997 in *Acta Anthropologica Sinica* (Huang et al., 1997) that included the geography, geomorphology, palaeontology, palaeoanthropology, Palaeolithic archeology and chronology of these early investigations by Chinese scholars. All of these aspects were further investigated by an international team composed of members from the Chinese Academy of Sciences, National Cultural and Relics Bureau of China, the local government of Guizhou, several U.S. academic institutions and private foundations, including scholars from countries mentioned above, as well as Canada and Greece. This international research was featured as a special issue of *Asian Perspectives, the Journal of Archaeology for Asia and the Pacific* Vol. 43 (2) and at an international conference held on 14-17, March of 2001 at the East-West Center of the University of Hawaii in Honolulu. The conference, entitled *Asia and the Middle Pleistocene in Global Perspective,* was generously supported by the Henry Luce Foundation and the Wenner-Gren Foundation for Anthropological Research. More than 30 international scholars participated and many of the papers presented became part of the content of the journal volume. A newly edited Chinese book integrating all results including recent studies of the lithic industry was published in 2012 (Huang et al., 2012).

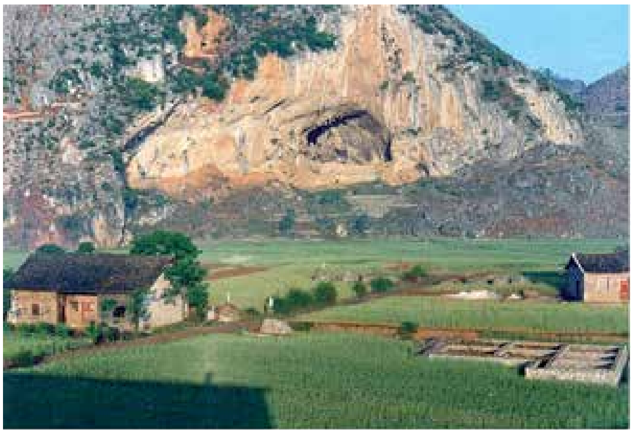

Figure 19: Front view of Panxian Dadong cave site in Guizhou Province of southwest China.

Figure 20: Different types of stone artifacts (1-12) and rino tooth made artifacts(13,14) from Panxian Dadong site (after Huang et al., 2012).

From Dadong site, the abundant unearthed materials of the lithic industry, mammal fossils of *Ailuropoda-Stegodon* fauna, four hominin teeth along with observation and study of the geology, geography, palaeontology, palaeoanthropology, Palaeolithic archaeology, chronology, taphonomy and palaeoenvironment proves that this late Middle Pleistocene cave site was used by a hominin lineage which evolved from archaic *Homo sapiens* to early modern humans under very cold and wet climatic conditions during a glacial period in the subtropics of East Asia. A most recent study on four hominin teeth (I^1, C_1, P^3 and P_3) recovered from 1991 to 2005 at the Panxian Dadong site provides the first detailed morphometric description and comparisons and shows that the Panxian Dadong teeth combine archaic and derived features that align them with Middle and Upper Pleistocene fossils from East and West Asia and Europe. These teeth do not display any typical Neanderthal features and they are generally more derived than other contemporaneous populations from Asia and Africa. Liu et al. (2013b) point out that they highlight the necessity of incorporating the Asian fossil record in the still open debate about the origin of *H. sapiens*.

The Dadong lithic industry presents technological and typological elements of the Lower, Middle and Upper Palaeolithic (Figure 20), but not the traditional 'chopper-chopping tool culture' (Movius, 1948). With regards to tool making strategy, it was found that adult rhinoceros teeth were used as a raw material to make scrapers (Figure 19B). The example of the Dadong cave site prompts questions about how niche environments can influence populations. It occupies a particular location which situates southeast Asian people in the southwest plateau of China in a unique geographic ecology. Dadong is indeed a rare case in the study of the Chinese Palaeolithic for its evidence on the meaning of systematization and excellent international organization and cooperation in research.

On the Yunnan-Guizhou Plateau, Panxian Dadong can be understood as a microcosm of Palaeolithic development in Southwest China, where creative talent must rise to meet the challenges of nature for contemporary humans.

Conclusion and discussion

All of the sites presented above are just a small part of the archaeological work being done in China. In the future it is believed that there is potential for more sites and more research to be conducted and disseminated to a wider audience. Last century, the Peking Man skull from Zhoukoudian marked the beginning of a wave of discoveries of human evolution sites in China. Lately, more and more human fossils and cultural remains from all human evolutionary stages and Palaeolithic periods are being found in all mainland provinces. After new China, the political situation accompanied a long period when Chinese research was closed off and trends in developing research were disrupted. Since the 1980s, Chinese archaeology has developed rapidly and reentered arenas of regular international cooperation. There is reason to improve the dissemination of scientific research, since the majority has been published mainly in Chinese, to facilitate a better understanding of Chinese materials outside of China. As a result, information from the Chinese record is usually overlooked due to the language barrier and incomprehensive communication of research. China, until recent years, drew less attention from international research teams, in comparison to other global regions, such as East Africa. So each time a new discovery is made, especially one which may support non-traditional theories or narratives, it is necessary to make a greater effort to make it known to the scientific community and position it fairly for discussion. Though evidence and ideas are circulated in China, more work could be done to garner attention in global scientific circles. Some international scholars have noted the progress of work in China and have begun to incorporate the evidence into their opinions (Dennell and Roebroeks, 2005). Furthermore, Chinese geological sequences have built a good foundation, across large time scales, for considering topics of archaeology and palaeontology (Liu et al., 2000). The East Asian record, presented densely, and mainly by China, is important in the reconstruction of human evolution. The evidence must be effectively integrated for use in global research.

The present article, though limited in scope, reminds us that the human evolutionary evidence from China poses the following interesting questions:

1) When did the earliest humans arrive in China? We could say they had arrived here, at the latest, 1.8 Ma. Meanwhile, we must concern ourselves with their cultural features and associated fossil hominin remains. For the former question, we could say that manifestations of culture appear diversified in different geographic regions. The latter remains unclear; future work may clarify the issue. Any ready made experience or theories from East Africa may be not easily or credibly applicable to Chinese materials. A cautious attitude and careful research methods need to be taken into account. It is noted that voices broadcasting eastern influences for the early European record and the complexity of human evolution processes are evident through recent outstanding scientific work (Ferring et al., 2011; Reich et al., 2011). Meanwhile, knowledge of the exact species of the earliest lineage of humans in China needs more research (Ciochon, 2009). It is the author's opinion that, without further evidence, our knowledge about *Lufengpithecus* or *Gigantopithecus* is far from secure enough to fix them to a definite position. New discoveries are always sparking new opinions and making modifications to old opinions; a man of insight will be patient and examine all works. Coming to China and working with local scholars will be the most efficient way to integrate the main Asian record into global archaeological research, like many scholars did in Africa.

2) Who is the maker of the Chinese biface industry? Are they *Homo erectus* who migrated from outside Asia or they local, earlier human species? Bifaces existed in a large area in the north and south of the country. In the central part, the lithic industry mixed tool characteristics from the smaller northern tradition and the larger southern tradition. The biface industry seems to have a history of several hundred thousand years that lasted into the late Middle Pleistocene in China. It may indicate a continuous human evolution in China. In North China, the cultural roots can be traced back to the time of the occupation of the Nihewan Basin. The technical system of a flake-dominant tradition may come down to origins with Zhoukoudian Peking Man which subsequently transited to other parts of North China in the later stages of development. In the Lower Palaeolithic, technical modes in north and south are different, as exemplified in the cases of Nihewan and Longgupo (Boëda and Hou. 2011c). Neither of these industries are easily explained by Mode 1 knowledge. The traditional 'Mode 1' classification should not be rashly used to explain the archaeological records produced by people of a different palaeo-ecosystem.

3) What is the nature of cultural and physical evidence in the Late Pleistocene in China? Simultaneously several aspects appear in the Chinese archaeological record, just as they appear in other regions of the Old World indicating some new human behavior. For example, improvement and innovation of artifacts, adoption of new forms of economy and camp life, works of art and ornaments, spiritual totems, etc. The environment and climate endured tremendous change and forced people to develop new techniques to maintain their way of living. What happened in the Upper Palaeolithic of China was that tool making technology shifted to a completely new technique represented by the fashioning of microblades industry, which apparently possesses a unique East Asian style in their particular way of controlling the core. Physically, recent reports on human remains from Zhirendong in South China (Guangxi Zhuang Autonomous Region) supplies a date for the initial Late Pleistocene of older than 100 Ka and becomes the oldest modern human fossils in East Asia, predating, by over 60 Ka the oldest previously known modern human remains in the region (Liu et al., 2010; Figure 21). The importance of the study of Zhirendong fossil man concerns the long-term Late Pleistocene coexistence of late archaic and early modern humans across Eurasia. At same time, another discovery of Xuchang Man in north China (Henan Province) was determined to date between 100-80 Ka by OSL dating and comparison with fauna species. These new results support the idea of a separate modern human origin in Asia and provide a big challenge to the traditional 'Out of Africa' theory. The discovery of some new sites in Inner Mongolia of North China (Figure 22), in Heilongjiang Province (Figure23, You-Qian Li, personal communication) and in Henan Province (Youping Wang, personal communication) are attributed to the period of early modern humans in China and their cultural features present many new pieces of evidence that have not previously been well known in academic circles. They will certainly enrich our knowledge of the lithic

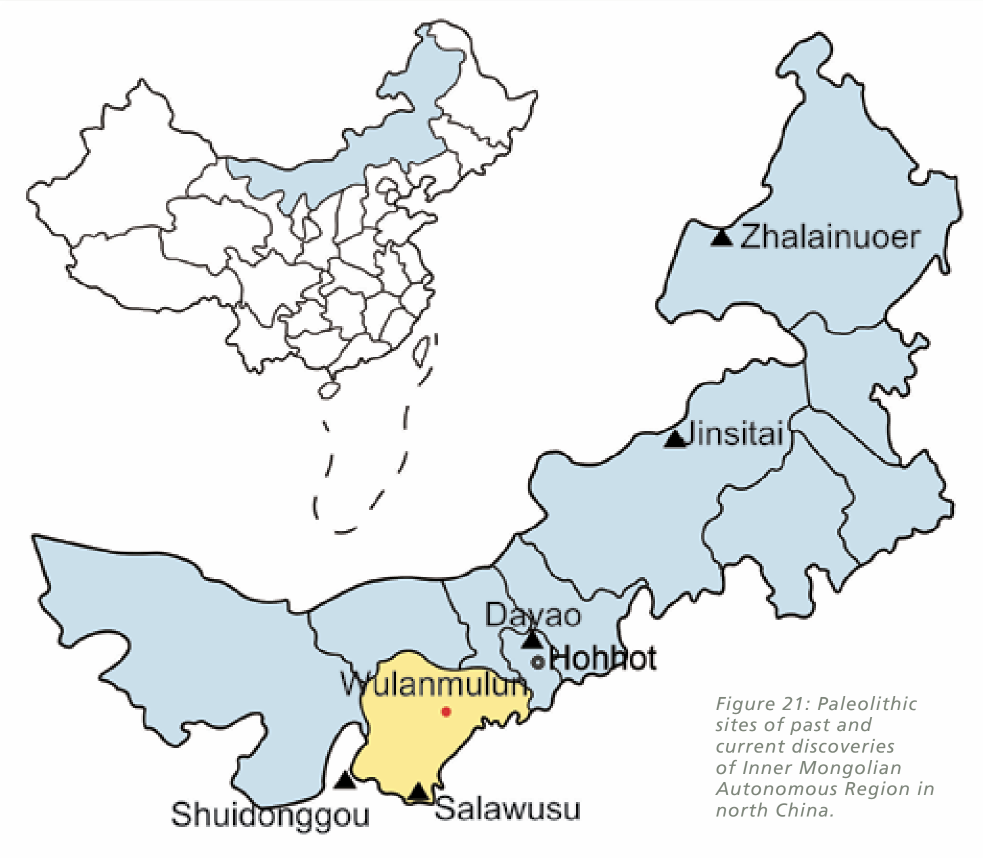

Figure 21: Paleolithic sites of past and current discoveries of Inner Mongolian Autonomous Region in north China.

Figure 22: Paleolithic sites of past and current discoveries of Heilongjiang Province in northeast China.

Figure 23: Human fossils from Zhirendong site in south China (after Liu et al. 2010).

features of that time. Qualified field and information collecting methods should be well employed from beginning of the undertaking of work. The Late Pleistocene materials were previously relatively rare and hidden, such that some scholars thought that the 'Middle Palaeolithic is likely missing' in China (Gao, 1999). It is difficult to imagine that people could sustain themselves without undergoing a cultural or technological revolution in the Last Glacial period. In fact, to face severe climate stress people here in northern China do not react differently than populations in other parts of the world. More or less similar evidence is being born out with new discoveries, telling us there was indeed change happening (Hou et al., 2012), change in food procurement strategies, strategies for retaining physical warmth with clothes, strategies of economy and spiritual demands, etc. New points of view will be formed through new research and discoveries in China.

4) Can the traditional models of human evolution adequately explain the Asian record? These theories hold that all modern humans, across all the continents, can trace their origin to Africa in accordance with the so-called 'Eve hypothesis' (Cann et al. Wilson, 1987) based on mtDNA. Chinese palaeoanthropologists hold a different opinion than the 'Eve hypothesis' (Gao et al., 2010; Wu, 1990, 1998, 2005 and 2006). They insist that a series of Chinese human fossils provide evidence of gradual change with a widely mixed mosaic of characteristics of *Homo erectus* found in early *Homo sapiens.* It means *Homo sapiens* in East Asia evolved from regional *Homo erectus.* The 'Eve hypothesis' caused furious dispute, especially among geneticists. Some directly opposed the view based on their own studies such as Hawks (2000) and Adcock (2001) on the origin of Australian hominins, and Lubenow (2000) on Neandertal/modern human hybridization. As Wu (2006) emphasizes, each locus in the human genome can capture only a fraction of the human history, and different loci can have rather different genealogies. Thus, conclusions from different loci of the same genome are necessarily 'complicated'. Only after a sufficient number of studies have been conducted, can we gradually reach a consensus about the history of modern humans. Thus, the total replacement model based on some genes of Y chromosomes needs to be more carefully considered.

   New genetic studies on the Chinese Tianyuandong 1 fossil dated to 42-39 Ka reveal that it exhibits several late archaic human features and morphological patterns and implies that a single spread of modern humans from Africa is unlikely (Shang et al., 2006, 2007). New results suggest that there are pockets of genetically isolated communities that together preserve a great deal of human diversity. Thus, popular theories of mtDNA or Y chromosome studies must be treated cautiously (Mendez et al., 2013).

Prospects on research priorities in the framework of the World Heritage Convention

To summarize, whether in the study of earliest humans or of modern human origins, China has shown its importance in the interdisciplinary academic discussion of human evolution and undoubtedly holds potential for the future. New discoveries are always hopefully anticipated. Along with a more open situation for research in the country, fundamental archaeological work needs to be improved for comprehensive information collection, site excavation organization and protection, good storage for excavated remains, international involvement in study, adoption of new technical methodologies, as well as good publicity and communication of the work conducted. Research priorities should be focused on evidence of the first man in China, such as the determination of the Pliocene/Pleistocene ape lineage, getting further clues to the position of *Gigantopithecus,* international comparison of some of the early industries and new international standards of excavation for new and existing sites. Another priority is the cognition of Chinese *Homo erectus* and its relationship with other species of the world, and to continue to explore modern human origins to clarify its transitional relationship with the internal evolution of *Homo erectus* and outside influences. Similar priorities for archaeology can be considered concerning different periods of tool industries relating to the earliest hominins, *Homo erectus* and modern humans. Deficiencies in cultural periodization hindered the possibility for a better understanding of the Palaeolithic culture of China and needs revision.

In the modern development movements of China the understanding of history and culture has increased and risen to a more and more important position for the nation. Under the policies and concepts of World Heritage, achieving our common goal of international cooperation is guaranteed. The Chinese Government has constructed a series of policies to guide public and scientific institutions providing cultural protection. Some annual activities, including 'the Ten Major Archaeological Discoveries' (http://www.wenbao.net/shidakaogu/), and 'the National Archaeology Forum for Six Important Discoveries' (http://www.sach.gov.cn/tabid/294/InfoID/37712/Default.aspx) play an important role in attracting public attention. Each administrative level's 'Key Cultural Relic Preservations' are regularly selected and put under the purview of the organization of the Cultural Relics Protection Law of the People's Republic of China (2002 version in English: http://www.sach.gov.cn/tabid/311/InfoID/383/Default.aspx; 2007 version in Chinese: http://www.sach.gov.cn/tabid/311/InfoID/382/Default.aspx), which has been updated several times after its founding in 1982. Preservation work in China was the first to be focused and secured with relevant technical support. These tasks are a serious undertaking and stronger cooperation and considerations for the production of knowledge need to be made for all aspects of the excavation, research and dissemination process. Research teams composed of professional international specialists will be developed. Nowadays, the improved economic situation of China will make cultural demands easier to realize than before. Particularly now, scientific advice and consultation in the formulation and implementation of procedures is very much needed. Archaeological sites combining natural landscapes and historical scenic places are particularly qualified to become neighboring conservation projects in the context of national parks. As such, they are an opportunity for developing interest in leisure and travel activity. Culture is certainly a positive driving force for a healthier society. Effective communication organized by UNESCO is the most essential way to exercise rights for cultural heritage and to promote the quality of our professional work.

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Pleistocene cave sites in Korea: Importance to paleoanthropology?

Christopher J. Bae
Department of Anthropology – University of Hawaii at Manoa – United States of America

Abstract

Korea is home to some key palaeoanthropological cave sites. Most of these Pleistocene cave sites are located in today's Democratic People's Republic of Korea (commonly known as 'North Korea'). This may be due to the extensive limestone mountainous region surrounding Pyongyang where bone preservation is excellent and/or a paucity of comprehensive paleoanthropological fieldwork in the Republic of Korea (commonly known as 'South Korea') in the limestone regions there. Fortunately, the application of multidisciplinary field and laboratory approaches to cave localities in the south, is helping to fill in the missing areas. In this brief review of Korean Pleistocene cave sites, four localities are identified that have clear, or at least potential, importance to paleoanthropology: Komunmoru; Kumgul; Ryonggok; Mandalli. Of these four caves, Ryonggok cave has the remains of at least five individuals who may eventually be assigned to early modern *Homo sapiens* in deposits that may date to the Early to Late Paleolithic transition in the region, 48-46 Ka.

Introduction

In paleoanthropology, some of the most important hominin fossil and archaeology sites have been found in caves and rockshelters. For instance, Zhoukoudian Locality 1 contains the remains of more than 40 *Homo erectus* individuals, in addition to a plethora of stone tools and other archaeological traces (Wu and Poirier, 1995; Boaz and Ciochon, 2004). Excavations at the Sima de los Huesos site in the Atapuerca hills in northern Spain exposed the remains of around 30 archaic *H. sapiens* (*H.* cf. *heidelbergensis*) individuals (Arsuaga et al., 1997). Zhoukoudian Upper Cave contained multiple Late Pleistocene anatomically modern *H. sapiens*, with three relatively intact craniae and many important archaeological materials (Wu and Poirier, 1995; Norton and Gao, 2008; Norton and Jin, 2009). Thus, some of the best known paleoanthropological sites in Eurasia are caves and rockshelters.

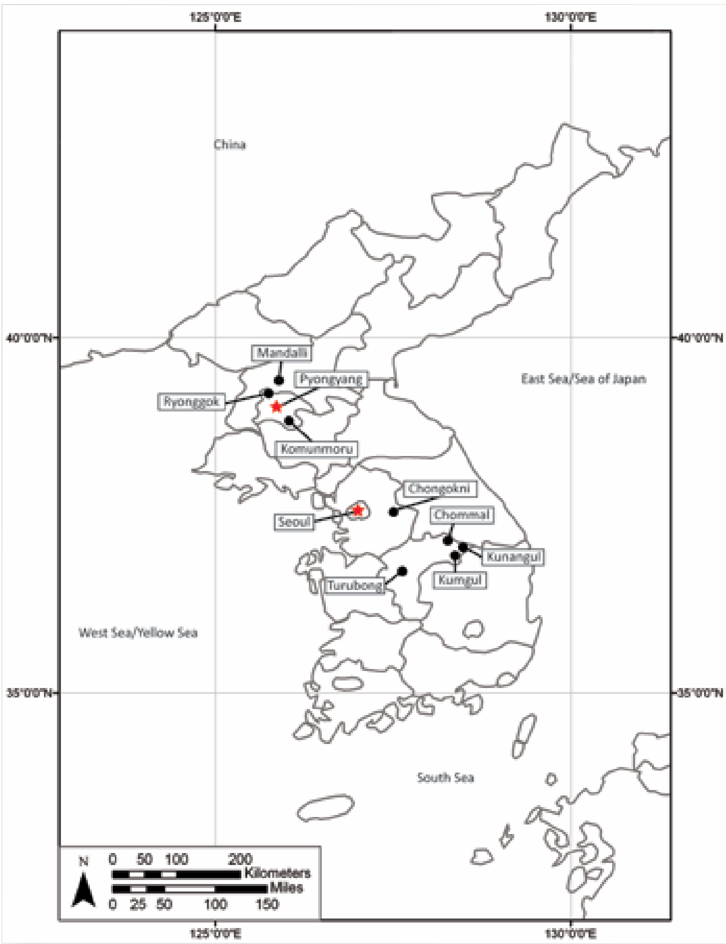

Figure 1: Map of the Korean peninsula with the respective capital cities of the Democratic People's Republic of Korea ('North Korea') and the Republic of Korea ('South Korea') and the sites mentioned in the text. Note that Komunmoru, Ryonggok, and Mandalli are all located in the limestone mountainous region surrounding Pyongyang in North Korea. Kumgul is located in the limestone mountainous region in the central part of South Korea.

Because the paleoanthropological record of the Korean peninsula is generally poorly known outside of Korea (Norton, 2000; CJ Bae, 2010), the purpose of this paper is to review/evaluate the most important, or potentially important, Pleistocene cave localities on the peninsula, particularly in light of recent debates in paleoanthropology (Figure 1). The two topics that continue to receive a great deal of attention in paleoanthropology, and where the eastern Asian, including Korean, record can contribute, are the earliest peopling of the region and modern human origins.

Earliest peopling of the region

As attested to by the publication of several recent comprehensive edited volumes that focus on this specific topic (e.g. Fleagle et al., 2010; Norton and Braun, 2010a; Norton and Jin, 2010), the earliest hominin dispersals out of Africa and into Asia is a topic of current strong debate. Current evidence suggests that the earliest hominins evolved in Africa and dispersed into Eurasia sometime after 2 Ma (Anton and Swisher, 2004; Zhu et al., 2004; Norton and Braun, 2010b; but see Dennell and Roebroeks, 2005 for an alternative model). This is commonly known as the Out of Africa I model. A few sites in China are often used as evidence of early hominin dispersals into eastern Asia between 2 Ma and 1.5 Ma. These sites include Majuangou in the Nihewan Basin (Zhu et al., 2001) in northern China and the hotly debated sites of Longgupo (Huang et al., 1995; Wu, 2000; Etler et al., 2001) and Yuanmou (Hyodo et al., 2002; Zhu et al., 2008) in southern China. Although it is beyond the scope of the current paper to review and critique the arguments for every hominin occupation in China, it should be noted that many of the very 'early' sites in China are debated (for discussion see Pope, 1988; Chen, 2003; CJ Bae, 2010; Norton et al., 2010a).

Although the evidence for hominin presence at Chinese sites between 2 Ma and 1.5 Ma is debatable, there is clear evidence of hominin occupation in the region by at least 1.15 Ma, as attested to by the *Homo erectus* fossil from Gongwangling (An and Ho, 1989). Other Chinese sites have been dated to between 1.15 Ma and 0.8 Ma [e.g. sites in the Nihewan (northern China) and Bose (southern China) basins] (Zhu et al., 2001; Hou et al., 2000). Indeed, if the recent redating of Zhoukoudian Locality 1 holds up to further scientific scrutiny, the earliest deposits of that site may date to between 0.8 Ma and 0.7 Ma (Shen et al., 2009). Once we move further into the Middle Pleistocene, the paleoanthropological record of eastern Asia becomes much clearer.

One character of the eastern Asian geography that may not be commonly realized outside of the region is that, unlike in the case of the Japanese archipelago which is separated from continental eastern Asia by water during interglacial periods and even most glacial periods (Ikawa-Smith, 2008; Norton and Jin, 2009; Norton et al., 2010c), is that the Korean peninsula was never separated from China during any major or minor periods of paleoenvironmental fluctuations (Norton and Jin, 2009; Norton et al., 2010b). Indeed, during glacial periods, the West Sea/Yellow Sea would have been dry connecting the Shandong (China) and Korean peninsulas. Thus, if China were peopled as early as 1.9 Ma, there is no geographic barrier that may have prevented hominin dispersals to have reached as far eastward as the Korean peninsula during the Early Pleistocene (Norton et al., 2010a).

Nevertheless, there is currently an absence of evidence for any Early Pleistocene hominin occupation of the Korean peninsula. Indeed, the earliest proposed paleoanthropological site on the Korean peninsula is Komunmoru, a cave site located outside of Pyongyang, the capital city of the Democratic People's Republic of Korea (a.k.a. 'North Korea') (Figures 2-3). It was discovered in 1966 and excavated between 1968 and 1970 (Sohn, 1990). Komunmoru is a relatively small cave, only about 30 m in depth,

Figure 2: The low lying hill where Komunmoru is located (Compilation Committee, 1990).

Figure 3: Frontal view of Komunmoru (Compilation Committee, 1990).

that is located on a low lying hill (Compilation Committee, 1990). Twenty nine different taxa were identified in the deposits, with a mixture of faunas derived from the Palearctic (e.g., Sangwon horse) and Oriental (e.g., water buffalo, macaques) biogeographic zones (Compilation Committee, 1990; Sohn, 1990). The mixture is suggestive of a changing environment that at times was open enough for grassland fauna to exist, while at other times hot and humid enough for generally Oriental biogeographic zone taxa to survive. It should be noted however, that warm adapted faunas appear to dominate the taxonomic composition at Komunmoru. The findings from Komunmoru support similar observations from other areas of northern China and Korea. Indeed, there is a great deal of vertebrate paleontological evidence in China and Korea that the Middle Pleistocene was a much hotter and more humid environment than either the Early or Late Pleistocene. For instance, during the Middle Pleistocene there were many northward migrations of Oriental biogeographic zone faunas (Jablonski et al., 2000; Norton, 2000; Norton et al., 2010b). This is further evidence that the Palearctic-Oriental biogeographic boundary was a fluid border that constantly fluctuated in the face of glacial and interglacial periods (Norton et al., 2010b). Based primarily on biostratigraphy (extinct vs. extant faunas) and similarities to the Zhoukoudian Locality 1 and Locality 13 faunal assemblages, Komunmoru is thought to date to the early Middle Pleistocene, with an age range between 800 Ka to 400 Ka, or possibly even a bit earlier due to similarities with the Zhoukoudian Locality 13 assemblage. Fifty percent of the Komunmoru taxa are currently extinct (Sohn, 1990). Extinct fauna include *Hyaena brevirostris sinensis*, *Stephanorhinus kirchbergensis*, *Megaloceros flabellatus* and *Megaloceros sangwonensis*.

Although Komunmoru’s vertebrate paleontological assemblage contributes many important fossils for paleontology, questions do exist as to its importance to paleoanthropology. These problems are related to the associated stone artifacts and whether they are simply geofacts or are truly hominin modified stones. The raw material is siliceous limestone, which is what the cave is formed from. The lithic assemblage is comprised of traditional core and flake tools (Figure 4). According to the excavators, there is also a proto-handaxe among the stone tools (Figure 4: bottom center-right images). The primary problem with the lithics is that there are no clear signs of having been modified by hominins. In other words, the lithics appear to lack clear bulbs of percussion, conchoidal fracturing and retouch. This may in part be due to the inflexibility of the raw material. However, it could just as easily be explained as naturally fractured rocks found in association with the vertebrate fossils. Renzidong (China) and Kunangul (Korea) are two Pleistocene cave sites with similar questionable paleoanthropological implications. In these latter two cases, the excavators made similar arguments that the utilized raw material originated from inside the cave (Jin et al., 2000; Lee, 2006). In those particular cases, the purported stone tools lack clear traces of hominin modification and at least some researchers agree that the Renzidong and Kunangul 'stone tools' are probably geofacts and the associated fauna are

Figure 4 : Stone artifacts from Komunmoru (not to scale) (Compilation Committee, 1990).

the result of natural accumulation (e.g. carnivore dens, natural traps, rockfall, etc.). Until the stone tools are examined more closely, Komunmoru will have to remain questionable regarding its importance to paleoanthropology.

One of the oldest sites in the Republic of Korea (a.k.a. 'South Korea') is Chongokni, an open-air site best known for the presence of Acheulean-like bifacially worked implements and whose earliest occupations may date to between 350-300 Ka (Norton et al., 2006; Norton and Bae, 2009; KD Bae, 2010; but see Yi et al., 1998; Yoo, 2007). However, there are currently few cave sites in South Korea that date to the Middle Pleistocene. Perhaps the oldest and most informative Paleolithic cave site in the region, that has deposits predating the Late Pleistocene, is Kumgul.

Kumgul is a cave situated directly on the edge of the Kum River right outside of the small city of Danyang. The cave is very easy to find, being easily visible from the river (Figure 5). Kumgul is right at river water level, so during periods when the water level was higher, the cave would have been flooded. The cave was originally identified in 1967 as a site of potential paleoanthropological importance, but was not excavated until 1983 (Sohn, 1990). Between 1983 and 1985, Kumgul was excavated three times. The cave is about 8 meters wide toward the entrance and widens toward the back. All told, the cave length is some 80 meters long (Figure 6). A variety of vertebrate faunas were identified in the 8 stratigraphic levels (Sohn, 1990), while cultural materials were found in 5 of the 8 layers. Although a bit confusing, the excavators identified the stratigraphic layers from most recent to oldest (Youngest: Layer 1; Oldest: Layer 8), while the cultural layers were identified from oldest to youngest (Oldest: Layer 1; Youngest: Layer 7).

Identified taxa in Kumgul include *Cervus nippon*, *Hyaena brevirostris sinensis*, *Stephanorhinus kirchbergensis*, *Equus* sp. and *Panthera* cf. *leo* (Sohn, 1990). Based on biostratigraphy and the lithics, the first cultural layer (8th stratigraphic layer) is considered to date to the earlier part of the Middle Pleistocene, possibly between 700-600 Ka (Sohn, 1990). Also based on biostratigraphy and the associated stone tools, the excavators interpreted the second cultural layer (7th stratigraphic layer) to date between 450-350 Ka. However, an electron spin resonance (ESR) date on an associated animal bone resulted in an age

Figure 5: Frontal view of the entrance of Kumgul and a view from the entrance of the cave showing the proximity of the river.

of 180 Ka. Based on the stone tool typologies, the third cultural layer (4th stratigraphic layer) was estimated to date between 120-70 Ka. An associated ESR date from this level provided an age of about 100 Ka. The fourth cultural layer (2nd stratigraphic layer) dates to the Late Paleolithic based on the associated lithics. Again, based on the associated stone tools, the 5th cultural layer (2nd stratigraphic layer) is thought to date to the Mesolithic (Sohn, 1990). Also in the 2nd stratigraphic layer are artifacts that clearly belong to the Neolithic and Bronze Age (e.g. Chulmun and Mumun pottery sherds). As previous studies have argued (e.g. Gao and Norton, 2002), any derivation of an exact chronological age or even age range other than broad categorizations (e.g. Early and Late Paleolithic), based strictly on stone tool typologies is difficult even on a good day. Thus, application of additional chronometric dating methods (e.g. U-series on associated speleothems if present) on the Kumgul deposits is warranted.

Unlike the case of Komunmoru, there seems to be general acceptance of the palaeoanthropological importance of most of the archaeological materials from Kumgul. The lower cultural layers have core and flake tools that are typically representative of the Early Paleolithic (Figure 7). Bifacially worked implements were reported from the lowest three cultural layers (Sohn, 1990). Although the 4th and 5th cultural layers were identified as Late Paleolithic and Mesolithic, it should be noted that no blades or microblades were identified in either of these stratigraphic layers. Purported bone tools were reported from cultural layers three and four (Sohn, 1990). However, as with other cave sites in the region (e.g., Turubong, Chommal), the supposed Kumgul hominin 'bone tool culture' is questionable (Norton, 2000). Neolithic and Bronze Age pottery sherds were excavated from the 2nd stratigraphic layer that represents cultural layers 6 and 7 respectively. According to the excavator, the entire range of Korean prehistory is present at Kumgul (Sohn, 1990).

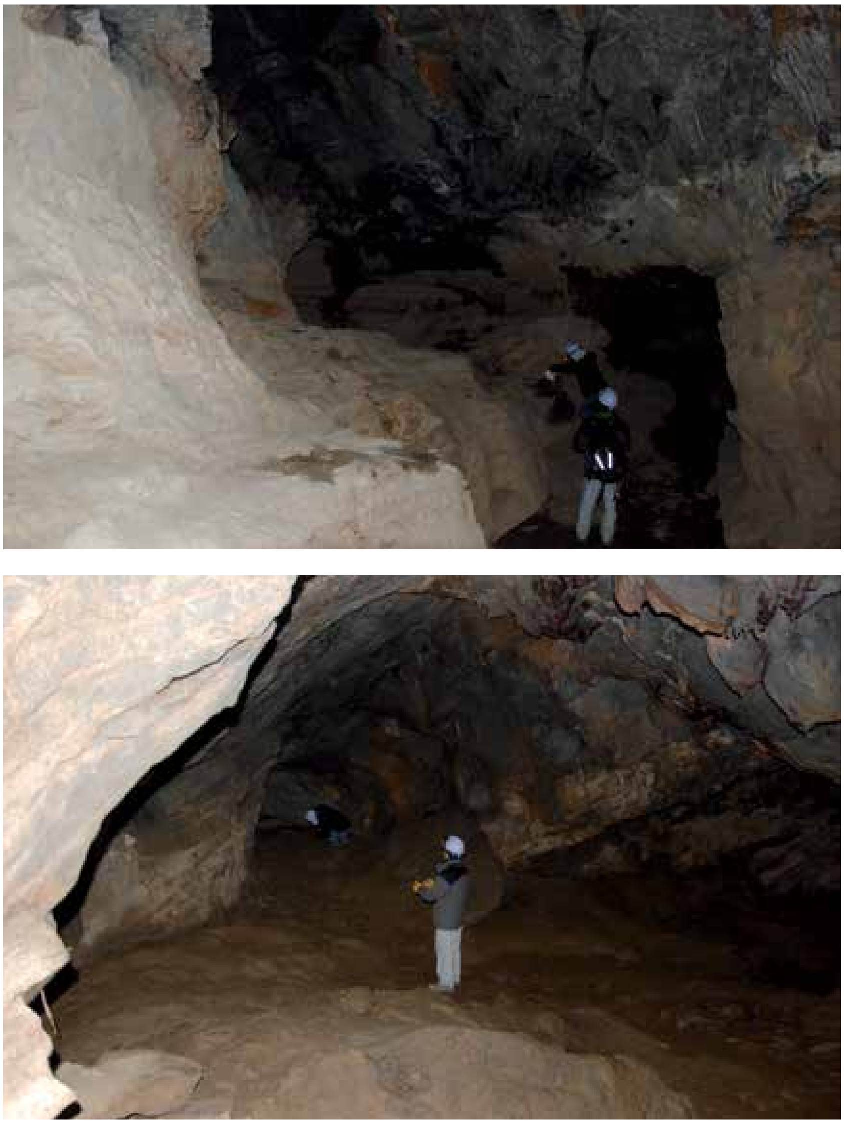

Figure 6 : Inside of Kumgul. The surveyors are for scale.

Figure 7: Representative Early Paleolithic artifacts from Kumgul (not to scale). © Jang, 2005

Modern human origins

The modern human origins debate continues to be a topic of great interest (Stringer, 2002; Trinkaus, 2005). However, the focus has shifted, to some extent, away from the extreme edges of the debate (replacement with no interbreeding and multiregionalism) to one where there is growing acceptance that modern humans first arose in Africa, but when they dispersed into Eurasia to what extent was there interbreeding or assimilation (Pearson, 2004; Weaver and Roseman, 2008). Eastern Asia has traditionally been one of the more poorly represented regions of the world when it comes to evaluating the various modern human origins models (Trinkaus, 2005; Norton and Jin, 2009; CJ Bae, 2010). However, recent finds of anatomically modern humans and new analyses from regions like China [e.g., Zhoukoudian Upper Cave (Pei, 1934; Harvati, 2009); Huanglongdong (Liu et al., 2010a); Lunadong (Bae et al., n.d.)], Laos [e.g., Tam Pa Ling (Demeter et al., 2012)], and Sarawak [e.g., Niah Cave (Barker et al., 2007)] are helping to contribute to a better understanding of the eastern Asian record. Hominin fossils that are thought to be transitional between archaic *Homo sapiens* and anatomically modern humans, such as those from Zhirendong in Southern China (Liu et al., 2010b) are also making major contributions. The more recent Korean hominin fossil record may be able to contribute to this deeper understanding (Norton, 2000; CJ Bae, 2010). The two best known Late Pleistocene cave sites in Korea are Ryonggok Cave and Mandalli, both located right outside of Pyongyang in North Korea.

Ryonggok was discovered in 1980 and excavated between 1980 and 1981 (Jun et al., 1986; Sohn, 1990). It is a relatively small cave about 5-6 m wide, 3 m high, and 40 m in length. It is only about 5 km from Komunmoru. Thirteen stratigraphic levels were identified, with cultural materials excavated from stratigraphic layers 8 through 12. Stratigraphic layer 1 is the topsoil while stratigraphic layer 13 is bedrock (Sohn, 1990). A diversity of vertebrate taxa were excavated from the site, including *Stephanorhinus kirchbergensis*, *Equus* sp., *Capreolus capreolus* and *Bubalus* sp., suggesting a mixed environment conducive to both Palearctic and Oriental faunas. In my reading of the various reports, it appears that in at least one of the cultural levels (1st cultural level), Palearctic and Oriental faunas were found in the same context (Sohn, 1990). Interestingly, 29 different types of pollen (e.g. *Gingko* sp., *Abies* sp., *Picea* sp., *Tsuga* sp., *Pinus* sp., *Betula* sp., etc.) were identified, with high concentrations in stratigraphic levels 8 and 9 (the first and second cultural layers). The lithics appear to be typical Early Paleolithic core and flake tools. Blades and microblades appear to be absent from the lithic assemblage. Bone tools were reported from the site. However, as with other Korean Pleistocene cave sites (e.g. Turubong, Chommal) where a Paleolithic bone tool culture was purportedly widespread, until further verification of these bone tools are done, it would probably be better to err on the side of caution here and consider many, if not all of these bones, to be modified by natural activities (e.g. rockfall, carnivore chewing, etc.) (Norton, 2000). An initial thermoluminescence date placed stratigraphic layers 8 and 9 (first and second cultural layers) between 500-400 Ka (Sohn, 1990). However, a later uranium series date placed the deposits between 48-46 Ka, which, for reasons described elsewhere, better fit the associated hominin fossils (CJ Bae, 2010).

The reason why Ryonggok cave is considered one of the most important localities east of Zhoukoudian is because of the diversity of hominin fossils that were recovered during the excavations (Jun et al., 1986; Norton, 2000; CJ Bae, 2010). The remains of at least five individuals were excavated from at least four, possibly all five, cultural layers (stratigraphic layers 8-12) (see Norton, 2000: his Table 3). Although the Ryonggok hominin fossils were originally allocated to archaic *Homo sapiens* (Jun et al., 1986), I have noted elsewhere that a variety of features suggest these fossils might better be considered early anatomically modern humans (CJ Bae, 2010). Indeed, Norton (2000: 814) noted that the Ryonggok hominin craniae have 'a rounded cranial vault, weak supraorbital tori, short face, steeply inclined forehead, absence of an occipital torus…, and presence of a chin'. The two relatively intact craniae also have cranial capacities of 1,450 and 1,650 cc, thus falling well outside the range of archaic *H. sapiens*. Mesial-distal and buccal-lingual measurements of the Ryonggok hominin teeth also fall within the range of modern humans and are much smaller than the older hominin fossils (CJ Bae, 2010). These multiple lines of evidence suggest it may be better aligning the Ryonggok hominins with modern humans, rather than with archaic *H. sapiens* (CJ Bae, 2010). The most important fossils are two relatively intact craniae (Ryonggok #3 and #7), casts of which are currently under study (Figure 8; Bae et al., 2013). The geometric morphometric analyses of Ryonggok #3 and #7 should hopefully clarify the taxonomic position of these important hominin fossils. Although there is at least one juvenile present in the Ryonggok hominin fossil assemblage, because of the general old age of most of the

Figure 8: Frontal views of the Ryonggok #3 (left) and #7 (right) craniae that are stored in the Chungbuk University Museum, Republic of Korea (not to scale).

individuals (as defined primarily by analyses of the associated mandibles), I have suggested elsewhere that the possibility that these may be burials should at least be considered (CJ Bae, 2010). Minimally, because of the multiple hominin individuals, this site warrants more detailed study, particularly with respect to the relationship between the hominin fossils and pollen, more detailed analyses of the chronometric age of the deposits, and a taphonomic study to evaluate the relationship between the hominin fossils and associated vertebrate fossils and stone tools. It would be extremely interesting to learn if this site served as a burial site or minimally a hominin home base where various activities were carried out.

Mandalli was discovered in 1979 and excavated once in 1980. The cave is relatively small, about 7-8 m wide and only about 15 m in length (Compilation Committee, 1990) (Figure 9). Three primary stratigraphic levels were identified, with the uppermost level containing Neolithic artifacts (Sohn, 1990). The primary Paleolithic cultural deposits were found in the middle stratigraphic level and a diversity of vertebrate fossils were excavated from the lowermost stratigraphic level. No Paleolithic artifacts were recovered from the lowermost level. A variety of vertebrate taxa, most of them still extant, but including *Crocuta crocuta*, suggests a more recent deposition than Ryonggok. Although most of the faunas derive from the Palearctic region, it is interesting that in the lowermost stratigraphic level, *Macaca* sp. was identified, suggestive of a warmer environment (Sohn, 1990). Unfortunately, no chronometric dates exist for Mandalli. Excavations in the Paleolithic cultural level did, however, reveal the presence of 13 artifacts, including microblades and a microblade core, some of which were produced on obsidian (Figure 10) (Sohn, 1990). Thus, the cultural layer can comfortably be assigned to the Late Paleolithic. Bone tools are reportedly present. Although the photographs of the bone tools are not that clear, given the late stage of the cultural deposits it would not be that surprising if the fractured bones are indeed osseus implements, particularly because the penecontemporaneous sites of Xiaogushan and Zhoukoudian Upper Cave from northern China have an array of bone tools (Norton and Gao, 2008; Norton and Jin, 2009). A diversity of modern human fossils, including a partial cranium, mandible, teeth, and postcranial elements were excavated from the second stratigraphic level (Figure 11; Compilation Committee, 1990; Sohn, 1990; Norton, 2000).

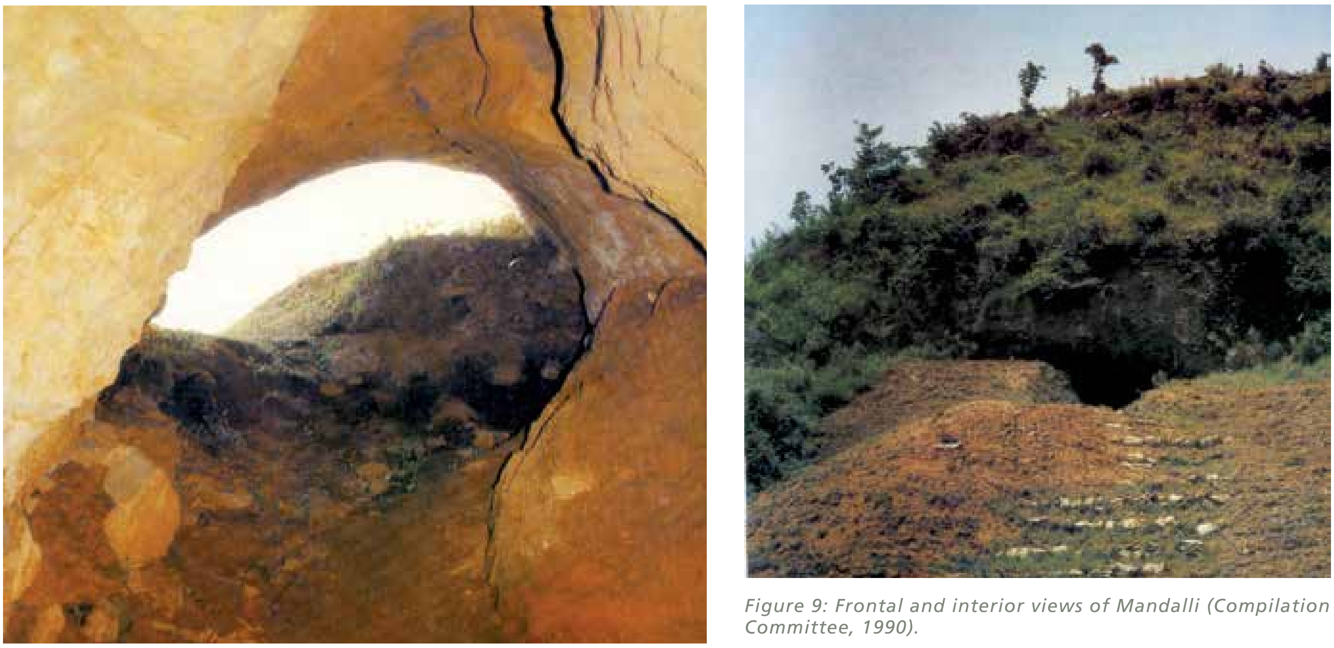

Figure 9: Frontal and interior views of Mandalli (Compilation Committee, 1990).

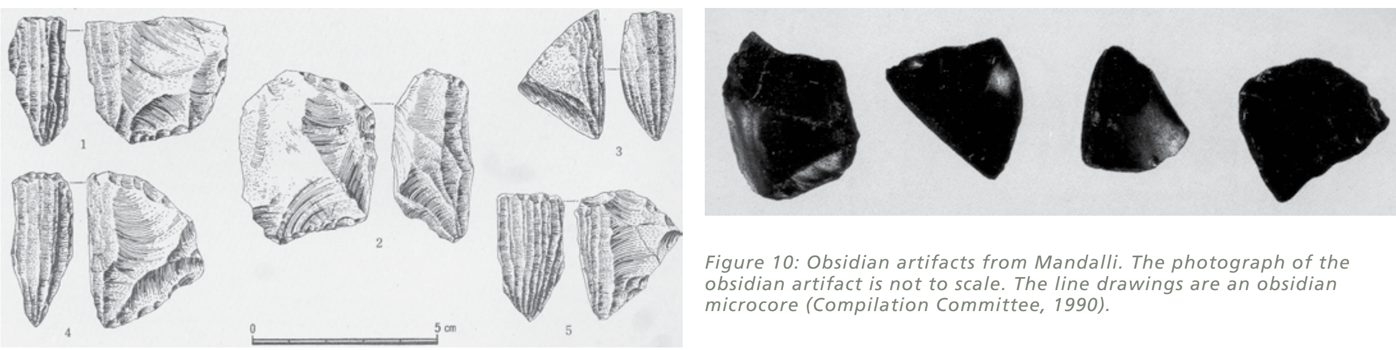

Figure 10: Obsidian artifacts from Mandalli. The photograph of the obsidian artifact is not to scale. The line drawings are an obsidian microcore (Compilation Committee, 1990).

Figure 11: Anatomically modern Homo sapiens crania from Mandalli. Different views of the same skull (not to scale) (Compilation Committee, 1990).

Discussion and Conclusion

Do any of the Korean Pleistocene cave sites rival Zhoukoudian Locality 1 in terms of sheer abundance of materials (e.g., hominin fossils, archaeology)? No. However, not many cave sites in the Old or New Worlds actually rival Zhoukoudian Locality 1 in terms of overall numbers of hominin fossils in the same context as archaeological materials. That being said, does this mean there is nothing potentially important in these Korean caves? No. In fact, the sites described above are important or potentially important to addressing questions related to the timing and nature of hominin dispersals into the region and the modern human origins debate. All of the caves described above warrant further evaluation, in the form of further excavations, analyses or re-analyses of the paleontological and archaeological material, and the application of chronometric dating methods to the sediments and materials. Detailed re-analyses of the hominin fossils are also important (Norton, 2000; CJ Bae, 2010; Bae et al., 2013).

There are two important conclusions that can be drawn from this brief review. First, although most of the important or potentially important cave localities are present in North Korea, it is critical that foreign scientists somehow get access to the sites and materials in North Korea. Access to publications that are sometimes 20 and 30 years old are not particularly informative of what paleoanthropological research is currently being conducted in North Korea (Norton, 2000). Second, it may be possible that important Pleistocene cave sites other than Kumgul are present in South Korea, but have not been found yet. The perceived importance of sites like Turubong, Chommal, and Kunangul is highly debatable (Norton, 2000). Fortunately, current field research devoted to identifying good Pleistocene cave localities is currently being conducted by a joint multidisciplinary research team from the University of Hawaii at Manoa and Hanyang University. Once cave sites in South Korea are identified with solid depositional sequences, a multidisciplinary approach will be applied in order to develop a deep comprehensive understanding of them. Multidisciplinary approaches, such as what has been done recently at Niah Cave (Barker et al., 2007), will only contribute to a better understanding of Korea's place in Eastern Asian, and more broadly, in Old World prehistory.

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Modern hominids in the Japanese Islands and the early use of obsidian: the case of Onbase Islet

Akira Ono
Center for Obsidian and Lithic Studies – Meiji University – Japan

Abstract

More than one hundred geological obsidian sources are recognized in the Japanese Islands, and the emergence of obsidian exploitation in the early Upper Palaeolithic is strongly connected to the characteristic features of modern human dispersal in East Asia. Discussions of the Lower and Middle Palaeolithic in the Japanese Islands began at the end of 1950s, but, at present, no single site is enough to clear the criteria both on stratigraphy and morphs-typology of lithic artifacts. Therefore, it is possible to set out a robust hypothesis that the earliest human occupation of the Japanese Islands began after *c.* 40,000 BP. Traces of the Upper Palaeolithic people are found across the Islands, from North Hokkaido to the south Okinawa. According to the database which was issued by the Japanese Palaeolithic Research Association in 2010, there are about 10,150 Palaeolithic sites in the Japanese Islands. The earliest evidence of obsidian procurement activities in the Japanese Island was recognized at Idemaruyama site, Cultural Layer I, Numazu City, Shizuoka Prefecture, central Japan and is dated to 38,000 cal BP. Onbae Islet, a famous geologic source of obsidian in Kozu Isle, is located on a chain of Izu Islands in the Pacific ocean, ca.170 km southwest of the central part of Tokyo, and Onbase Islet was not connected with Japanese main Islands, even in the Last Glacial Maximum (LGM); no land-bridge was formed between the Korean Peninsula and the Japanese Kyushu Island. This is explicit evidence that the modern hominids dispersed into East Asia, and they practised obsidian procurement activities between Idemaruyama site and Onbase Islet for their lithic tool productions as early as *c.* 38,000 cal BP. Early use of obsidian, as expressed on the Onbase Islet, is therefore evaluated as a behavioral modernity in modern hominid adaptations in the early Upper Palaeolithic of the Japanese Islands.

Introduction

This paper focuses on the geographic and regional characteristics of lithic assemblages and hominid adaptation, concerning the timing of the first peopling of the Japanese Islands and the beginning of obsidian exploitation in the latter half of the Late Pleistocene, specifically in the latter half of the marine oxygen isotope stage 3 (MIS3). The frameworks for Japanese Paleolithic studies have many aspects. Explicit evidence of hominid occupation that is based both on the stratigraphy and morpho-typology of lithic artifacts can be traced back to the middle of the MIS3 (Kudo and Kumon, 2012; Kudo, 2012; Kumon et al., 2012).

Discussions of the Lower and Middle Palaeolithic in the Japanese Islands began at the end of the 1950s, but no single site suffices to clarify the criteria for both the stratigrahy and morpho-typology of lithic artifacts up to the present. There are some rare examples in the Japanese Islands earlier than 40,000 BP, such as at the Kanedori site in Iwate Prefecture, northeastern Japan, and at the Tategahana site at Lake Nojiri in Nagano Prefecture, north-central Japan. The Kanedori site was re-dated by ^{14}C to 46,480±710 BP (Institute of Accelerator Analysis Ltd., 2009), but verification and identification of key-marker tephra (volcanic ash) is still open to discussion, and the central part of the site has already been destroyed.

Lake Nojiri is a good example, dating to 45,000-41,000 BP by ^{14}C, it has yielded considerable number of footprints from Naumann's elephant (*Palaeoloxodon naumanni*) and Yabe's giant deer (*Sinomegaceros yabei*), as well as from many other mammalian species, together with some Palaeolithic artefacts including a few flaked bone tools made of elephant bones, such as a cleaver, a scraper, and a backed-point with a retouched base were discovered, as well as many bone flakes and chips from lacustrine sediments (Nojiri-ko Excavation Research Group, 1994; Ono, 2006). Lithic

tools, however, were very sparse, and it is difficult to clarify the characteristics of lithic assemblages. The Takegahana site, discovered on the shore of Lake Nojiri, was a kill-butchering site, and the tool assemblages were rather poor, as is usual at a such a site. The Tategahana research results indicate a good integration of various Quaternary disciplines, but it still remains quite a unique site, with no comparable alternatives. It is, therefore, possible to set out a robust hypothesis that the earliest hominid occupation of the Japanese Islands began *c.* 40,000 BP (Ono, 2011).

Background

Traces of Upper Palaeolithic people can be found all over the Islands, from northern Hokkaido to southern Okinawa. According to a database which was issued by the Japanese Palaeolithic Research Association (JPRA) in 2010, there are about 10,150 Palaeolithic sites in the Japanese Islands (JPRA, 2010). Generally, lithic assemblages are well preserved in aeolian loam (loess) deposits, and they continue from the uppermost Palaeolithic layer down to the bottom, Layer X, which indicates the beginning of the Upper Palaeolithic, in the southern Kanto region, central Japan (Figure 1).

For the verification of attributes of archaeological finds, it would be ideal if we could obtain matching results from four different sources, i.e., from lithostratigrapy, biostratigraphy, archaeostratigraphy and numerical dates. However, because of its acidic soil, Japan is, with some exceptions, an unlikely place for discovering organic materials such as mammal fossils and wooden objects of the Palaeolithic period in aeolian sediments.

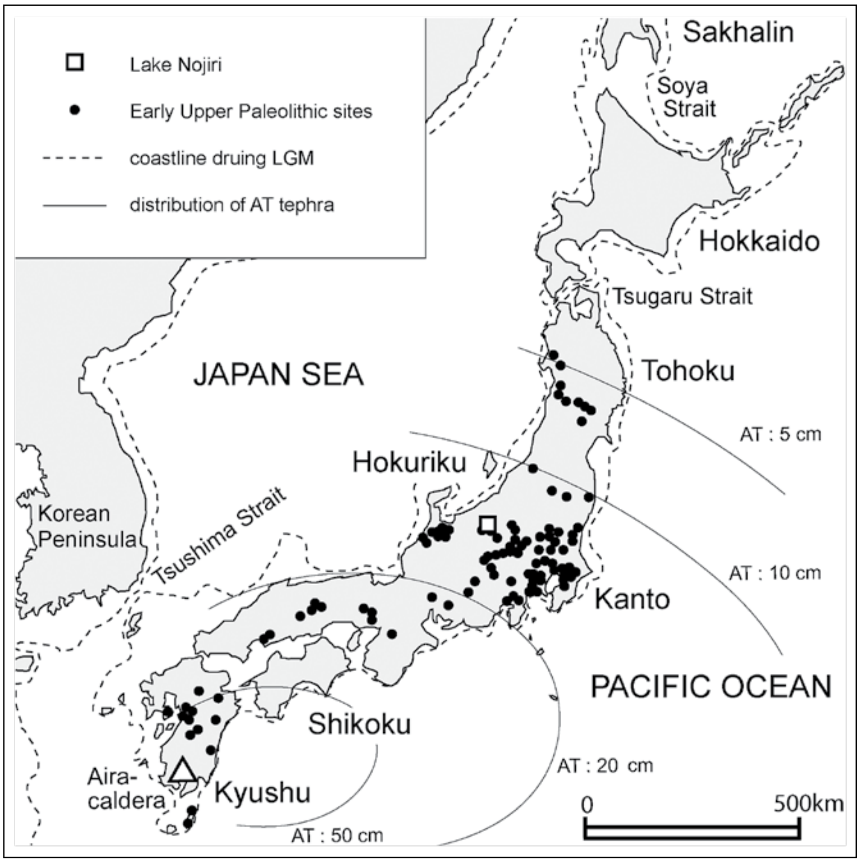

Figure 1: Distribution of Early Upper Palaeolithic sites in the Japanese Islands, showing the isopac map of the AT marker tephra. (after Y. Kudo and F. Kumon, 2012).

Land bridges between the Korean Peninsula and the Japanese Islands appeared at least twice in the Middle Pleistocene, i.e., MIS16 (*c.* 0.6 Ma) and MIS12 (*c.* 0.43 Ma). No land bridge existed in the Late Pleistocene, even in the Last Glacial Maximum (LGM) period. Megafaunal migrations, such as those of the Stegodon elephant (*Stegodon orientalis*) and Naumann's elephant (*Palaeoloxodon naumanni*), from the Asian mainland to the Japanese Islands along a land bridge, are estimated to have taken place in MIS16 and MIS12, respectively (Konishi and Yoshikawa, 1999). No traces of hominid occupation corresponding to those megafaunal migrations to the Japanese Islands have been found, neither in the form of lithic nor hominid skeletal remains.

In the LGM, a subarctic coniferous forest extended sharply southward down to present-day north-central Japan. In the latter half of the LGM, the northern part of the Japanese Islands was strongly influenced by Siberian cultural traditions via Sakhalin, and northern microblade industries appeared first in Hokkaido, which were represented in a broad sense by wedge-shaped micro-cores (Kimura, 2006; Izuho et al., 2012). Generally, lithic assemblages continue from the uppermost Palaeolithic layer down to Layer X in the southern Kanto area, central Japan, but few artifacts have been discovered beneath Layer X (Suwama, 2003; Machida, 2005).

Early Upper Palaeolithic assemblages

Characteristic features of early Upper Palaeolithic assemblages in the Japanese Islands are represented by the following: 1) edge-ground stone tools (i.e., adzes or axes; according to traceological studies, the function of these stone tools is suggested to be that of adzes), 2) trapezoids, and 3) flakes with secondary retouched bases (Tani ed., 2000; Ono et al., 2002; Tani, 2007) (Figure 2).

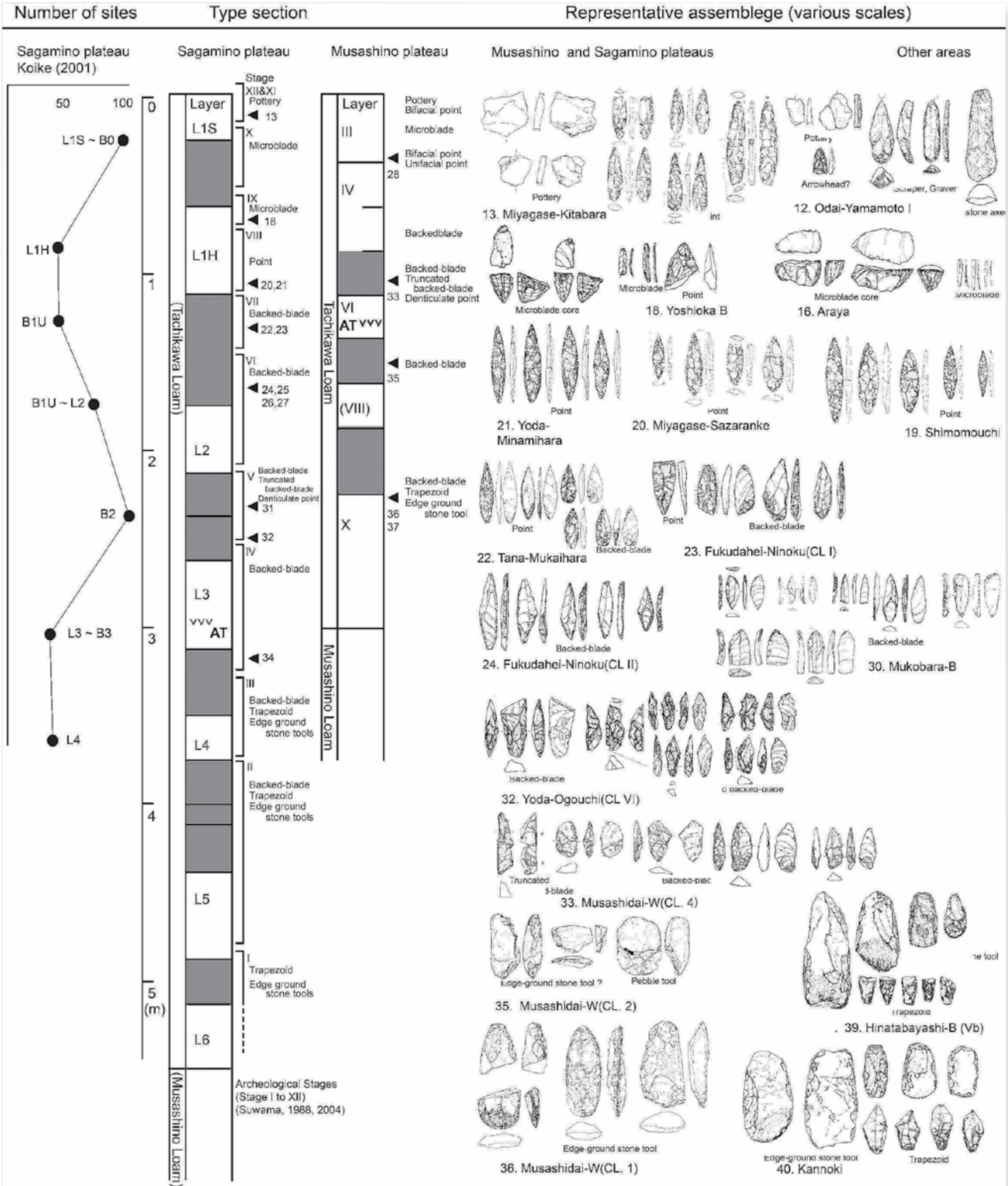

Figure 2: Type columnar sections of Musashino and Sagamino Plateaus in south Kanto region, and the typical lithic tool assemblages from various archeological sites from central, central-north, and northern Japan. Lithic assemblages Nr. 35, Musachidai-West (Cultural Layer 2); Nr. 36, Musashidai-West (Cultural Layer 1); Nr. 39, Hinatabayashi-B (Vb); and Nr. 40, Kannoki are indicating characteristic features of Early Upper Palaeolithic, such as edge-ground stone adzes, trapezoids, and flakes with secondary retouched bases. (after Y. Kudo, 2012).

Edge-ground adzes, together with the whetstones that were used to produce sharp blades on the working-edge of stone adzes, have been discovered in many parts of the Japanese Islands. A total of 896 edge-ground and blank stone adzes have been found in 224 sites belonging to the early Upper Paleolithic. These sites are found from Honshu in the east, to Kyushu in the west, but none are found in Hokkaido, in the north, or Okinawa, in the south (Figure 3). Nevertheless, similar Upper Palaeolithic edge-ground adzes have not been found in neighboring regions, such as Korea, China or the Russian Far East. These stone tools, therefore, appear to be independent inventions in the Japanese Islands (Tsutsumi, 2012).

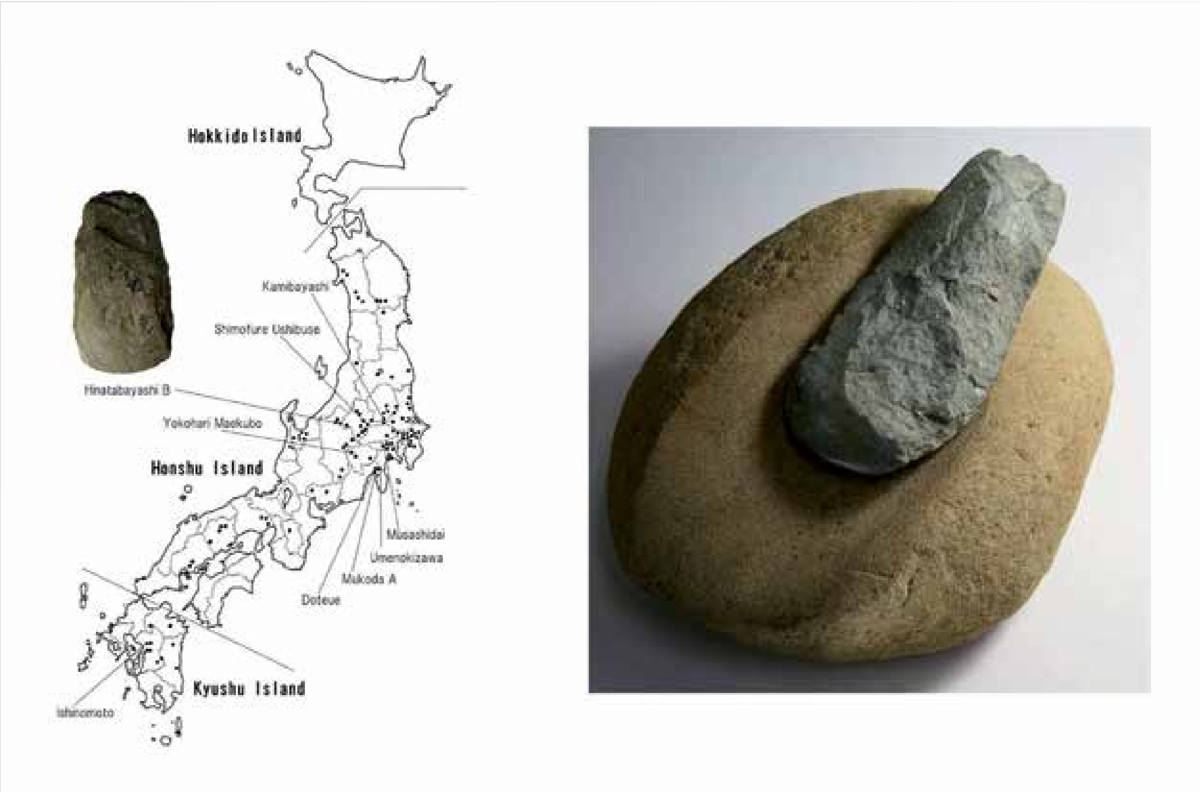

Figure 3: Distribution of Early Upper Palaeolithic sites with edge-ground stone adzes, and the typical example of an edge-ground adze on a whetstone from Hinatabayashi-B site, Nagano Prefecture, central north Japan. (after T. Tsutsumi, 2012) © T. Tsutsumi (left: distribution map with an edge-ground adze), © K. Tani (right: photo)

Significance of obsidian from the Onbase Islet

One of the characteristic features of the early Upper Palaeolithic found in the Japanese Islands, other than the early use of edge-ground stone adzes, is the emergence of obsidian exploitation. More than 160 geological obsidian sources are recognized in the Japanese Islands from Hokkaido to Kyushu, all located within the volcanic belt of the Pacific Rim (Sugihara, ed., 2009; Tsutsumi, 2010).

A systematic provenance study of geologic sources of obsidian from archeological sites began in the early 1970s in Japan by fission-track dating for sourcing obsidian of eruption ages (Suzuki, 1969). In the 1980s, hand in hand with many archeological excavations, the geochemical method of obsidian analysis had shifted to X-ray fluorescence analysis (XRF), particularly non-destructive energy-dispersive X-ray fluorescence analysis (EDXRF) (Warashina and Higashimura, 1983). For elucidation of the intra-site structure of a given archaeological site using lithic raw materials from obsidian, it should be required that these not be analyzed in a selective way, but rather all obsidian tools should be analyzed, including the flakes and chips remaining at the site. Non-destructive, fast and cost-effective EDXRF analysis is attained by making some revisions to scatter plots and to the multivariate method. Four new indicators have been devised [Rb×100/(Rb+Sr+Y+Zr), Mn×100/Fe, Sr×100/(Rb+Sr+Y+Zr), log (Fe/K)], as well as scatter plots based on EDXRF trace element studies (Mochizuki et al., 1994; Ikeya, 2012). Thereafter, extensive analyses of obsidian have been performed by several analytical laboratories in Japan and a vast amount of data is being accumulated.

Many obsidian source clusters are concentrated in three blocks in the central part of the Japanese Islands. One of these is located in the central mountainous Shinshu area at Wada, Suwa and Tateshina; the second is near the Izu Peninsula, Hakone and Amagi; and the last is on Kozu Island, including the Onbase Islet (Figure 4). Kozu Island is located in a chain of Izu Islands in the Pacific Ocean, *c.* 170 km southwest of central Tokyo and about 50 km off the coast of the Izu Peinsula. In the beginning of the Upper Palaeolithic, the obsidian sources of Takaharayama, Shinshu, Hakone, Amagi and Kozu Island were already being used. However, long-distance obsidian transportation in this phase was not common in comparison to that of subsequent phases; local raw materials other than obsidian were used (Tsutsumi, 2010). Nevertheless, the procurement of obsidian from the Onbase Islet source, located in the open sea, suggests that the early Upper Paleolithic people could not access it without seafaring means and skills. Even with a sea-level drop of about 100 m during the LGM, this source was still 30 km away from the nearest part of the main Japanese island, at the southern tip of the Izu Peninsula.

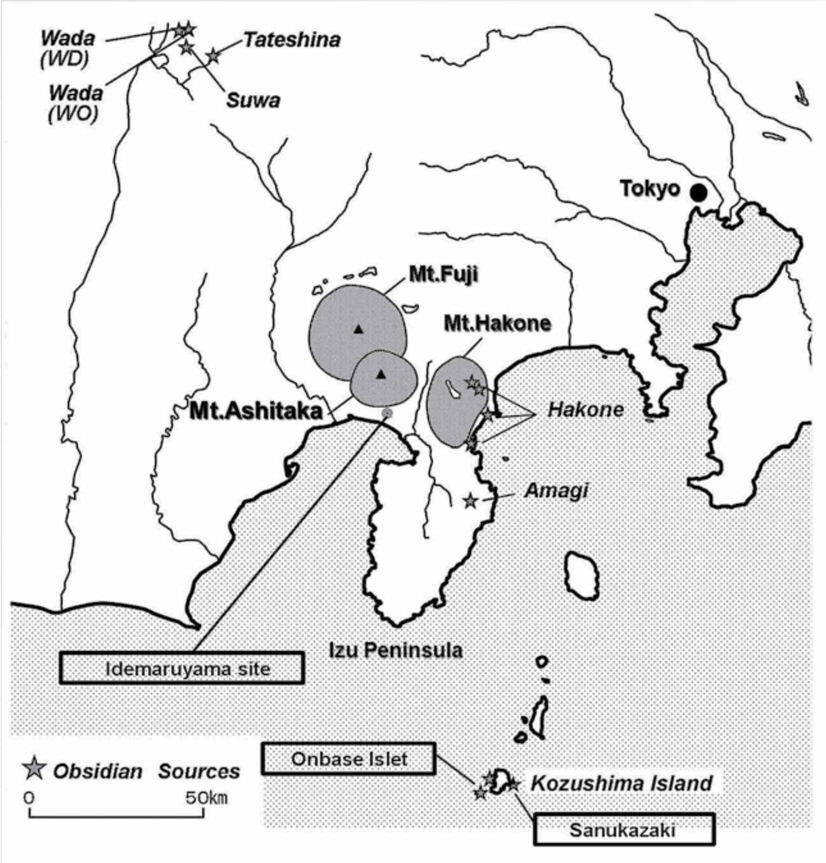

*Figure 4: Location map of obsidian sources in central Japan. *The name 'Kozushima Island' stated in the map is a synonym of 'Kozu Island' (modified from N. Ikeya, 2012).*

The Kozu Island group includes the Sanukazaki source on the main island of Kozu and the Onbase Islet source located nearby, 4 km apart. The Onbase Islet was connected with Kozu Island in the LGM period. Obsidian outcrops at Onbase are found around reefs about 3 to 6 meters beneath the present sea level (Figure 5). Obsidian procurement at Kozu Island was limited to the Onbase Islet in the Palaeolithic and the Incipient Jomon periods, and it had two concentrated phases of exploitation: one was in the early phase of the early Upper Palaeolithic, *c.* 38,000 – 35,000 cal BP and the other was in the latter phase of the Upper Palaeolithic through to the Incipient Jomon period, ca. 20,000 – 15,000 cal BP. Contrary to that in the Onbase Islet, Sanukazaki obsidian was not used in the Palaeolithic and only began to be used in the final Jomon period, *c.* 3,000 cal BP (Figure 6).

Figure 5: Distant view of the Onbase Islet, facing East.

Figure 6: Obsidian outcrops at Sanukazaki (Sanuka Cape), facing East.

The earliest evidence of obsidian procurement activities in the Japanese Islands was recognized at the Idemaruyama site, Cultural Layer I, from geologic Layer BBVII (black band VII) at the foot of the Ashitaka Mountain region, Numazu City in Shizuoka Prefecture, central Japan, and was dated as early as *c.* 38,000 cal BP (Takao and Harada, 2011; Nakamura, 2012). The provenance analysis on the obsidian from the Idemaruyama site, Cultural Layer I, has clarified that a total of 21 out of 24 samples were from the Onbase Islet (Ikeya, 2011) (Figures 4 and 7). The distribution pattern of the early Upper Palaeolithic sites moves from Kyushu in the south to the northern part of Honshu, but is not found in northernmost Hokkaido; the first peopling of the Japanese Islands indicates a migration from the Asian mainland through the Korean Peninsula. This is explicit evidence that modern hominids expanded into East Asia, and they reached the Japanese Islands by crossing the Tsushima Straight. In the process of expansion from west to east within the Japanese Islands, it would be highly possible that they found and developed obsidian as a quite suitable lithic raw material for tool production, as well as having invented edge-ground stone adzes. It should be evaluated that the obsidian procurement activities between the Idemaruyama site and the Onbase Islet were both a symbolic and concrete example of the early use of obsidian crossing over the sea.

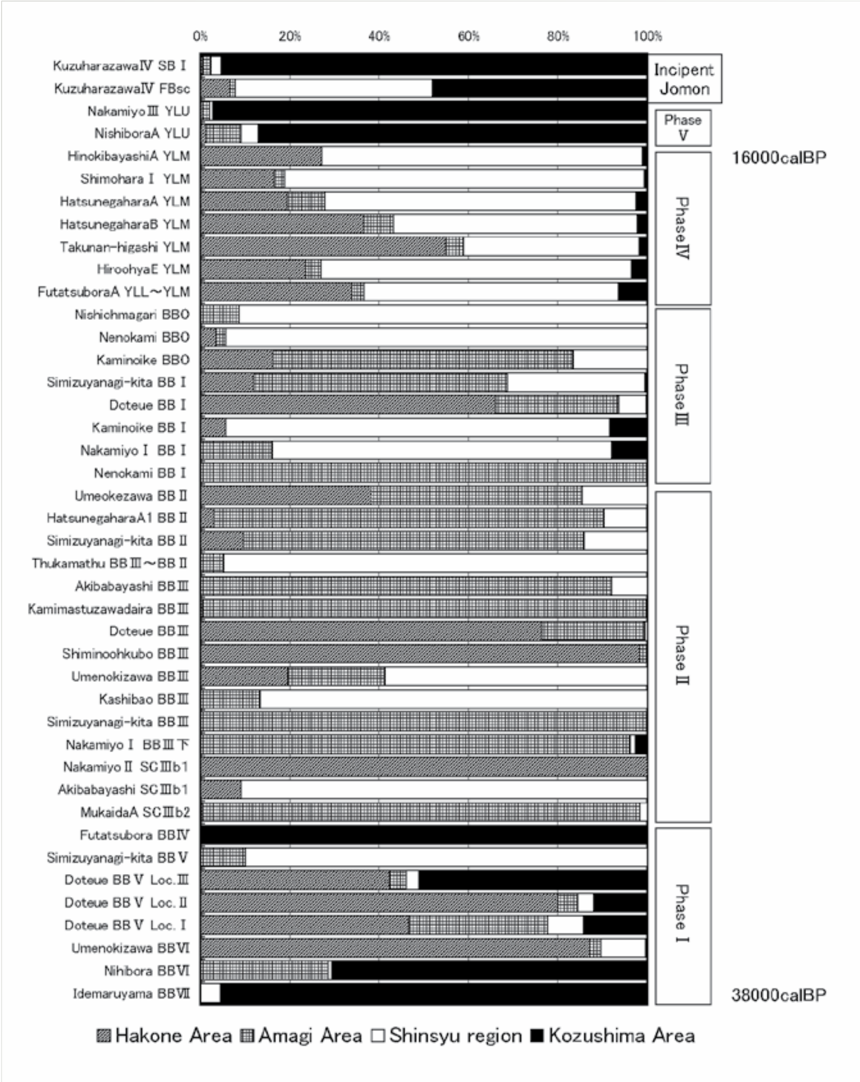

Figure 7: Changes of obsidian source exploitation through the cultural sequence in Mt. Ashitka and Mt. Hakone area, central Japan. Black bars indicate that these obsidian were transported from Kozu Island, i.e., exclusively from the Onbase Islet. (after N. Ikyea, 2012).

Conclusion

The emergence of obsidian exploitation, together with the invention of edge-ground stone adzes in the early Upper Palaeolithic is strongly connected to modern hominid dispersal in East Asia. It should be evaluated as a reflection of the behavioral modernity of modern hominids expressed in both a new polished lithic technology and in the exploitation of obsidian both in mountainous and maritime environments. These are regional creations of modern human behaviors immediately after their dispersal in the Japanese Islands, and it suggests a logical similarity to the case of the foundation of the Aurignacian in Central Europe. Contrary to the European early Upper Palaeolithic, in the case of the Japanese Islands, neither musical instruments nor animal figurines have ever been found. These differences might correspond to certain cognitive and behavioral characteristics of hominids adapted to diverse palaeo-ecological settings and the natural resource availability in different environments.

Human origin sites in Asia are diverse. An elucidation of the characteristic features of the first occupation of modern hominids in different given environmental areas will serve the reconstruction of the highly adaptive potential of modern hominids. This will contribute to a specific nomination policy for Human Evolution sites rooted in the geographical approach with narrative aspects.

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6

Southeast Asia

The case of Phnom Teak Treang and Laang Spean cave, Cambodia: The potential for World Heritage site nomination; the significance of the site for human evolution in Asia, and the need for international cooperation

Heng Sophady
Ministry of Culture and Fine Arts – Cambodia

Abstract

Cambodia was one of the first countries in the world where investigations of prehistoric archaeology were undertaken in the late nineteenth century. The foundation of such research immediately rests at a well-known shell-midden site, Samrong Sen, discovered in the floodplain area of the Great Lake of Tonle Sap. Another well-known and important site for Southeast Asia, is the cave site of Laang Spean, where remains of Hoabinhian stone tools, associated with earthenware pottery characteristic of the Neolithic period were found and excavated by French archaeologists Roland and Cecile Mourer in 1960s. This cave became a key site for further systematic and scientific research in order to build the chrono-cultural framework for Cambodian, and the whole of Southeast Asian, prehistory.

Recent archaeological research carried out by a joint Cambodian – French team (the 'Franco-Cambodian Prehistoric Mission'), which started in 2009, provides very important support for integrated research. A complete cultural sequence from more than 100,000 years to the Neolithic period has been documented in the cave. Archaic stone tools yielded by the oldest layers are covered by Hoabinhian human occupation including both faunal remains and lithic artefacts. Several polished stone tools were also found during the excavation campaigns. The cave was used as a funerary place in more recent periods, as shown by two burials dug into the Hoabinhian layers. The first burial, unearthed in 2010, is associated with grave goods (pottery, animal offerings, an amulet, an axe) and was directly dated to 3310 BP. A second burial without any grave goods was discovered during the excavation campaign in 2012.

The recent archaeological discoveries in Laang Spean cave are the subject of detailed, systematic, multidisciplinary analyses for understanding the evolution of social structures and human behaviours as well as burial practices through time. The archaeological field-school undertaken in Laang Spean is a great opportunity to develop the study of prehistory for the whole of Southeast Asia. To fully reach this goal the framework of international collaboration is required.

History of prehistoric archaeological research in Cambodia

The majority of early archaeological investigations in Cambodia were conducted by French explorers during the time when the country was under the French protectorate. The 'discovery' of the marvelous Angkor Wat complex in 1858 by the naturalist Henri Mouhot initiated archaeological interest in Cambodia. As was common for the period, scholarly interest was primarily focused on classic archaeology (i.e. that of monumental structures of a particular historic period, its art, its architecture, generally addressing stylistic and symbolic issues in the valuable archaeological record provided by monumental architecture, statuary and inscriptions), rather than on prehistory. However, prehistoric research became an important subject of study after the discovery by M. Roques, director of the fluvial company of Cochinchine, of a shell midden site in the floodplains area of the Great Lake of Tonle Sap in 1876, known as Samrong Sen (Mansuy, 1902; Mourer, 1994; Vanna, 1999; 2002).

Since the first investigation of Samrong Sen, the ecological and archaeological significance of the site, as well as other prehistoric sites throughout the country, became legitimized by western and eastern archaeologists. Observing the number of researchers as well as the subjects of interest during the beginning of programmed research over the last hundred years, we notice a gradual expansion of researchers and research projects during the period before the Khmer Rouge controlled the country in 1975. Research by foreigners at prehistoric sites increased and pre-Angkorian timelines of the country's history became better known. From Samrong Sen, prehistoric investigation spread to various sites and time periods throughout the country. While research remained focused at Angkor, individuals such as H. Mansuy, P. Lévy, J. P. Carbonnel, L. Malleret, B.P. Groslier, E. Saurin and R. Mourer re-opened the window into Cambodian prehistory. A. Pavie (1904) mentioned the shell midden of Kbal Romeas in the limestone area along the coast of Kampot province, and surveys were continued by J.P. Carbonnel and Delibrias in 1968. J.P. Carbonnel and Guth conducted investigations of additional limestone-formed caves at Phnom Laang, also in Kampot (Carbonnel and Guth, 1968). H. Mansuy excavated the shell midden of Samrong Sen (Mansuy, 1902, 1923). P. Lévy investigated the open-air site of the Mlu Prei region to the north of Preah Vihear province with a cluster of three sites, O Yak, O Pie Chan and the most important, O Nari. (Lévy, 1943). L. Malleret was interested in investigating circular earthwork sites in the red soil plateau area east of the Mekong River, in Cambodia and Southern Viet Nam (Malleret 1959). B.P. Groslier, following Malleret, conducted primary systematic excavations at a circular earthwork in Memot and proposed the term 'Mimotien Culture' (Groslier, 1966a; 1966b).

Concerning the oldest periods, E. Saurin began documenting the pebble tools of the upper Mekong terraces from Snoul, Kratie province to Steung Treng province (Saurin, 1963; 1966). This work was carried out during the geological mapping of Cambodia (Carbonnel 1972). R. Mourer, who was a professor at the Faculty of Archaeology in Phnom Penh during the 1960s, explored and systematically excavated the large cave of Laang Spean in Battambang, northwest Cambodia, with its prehistoric levels (Mourer 1970). J.P. Carbonnel explored a group of prehistoric sites in the rubber plantations of Chamkar Andong, Chup Thmor Pich, Peam Cheang, and Prek Kok of Kampong Cham province (Carbonnel 1970). After the Khmer Rouge, young national researchers who graduated from the Faculty of Archaeology in Phnom Penh and abroad took part in archaeological activities alongside archaeologists from overseas who were still continuing the research of former explorations in various areas of the country. Most recently, a few prehistoric sites, very rich in archaeological remains dating back from early to late Metal Age, were accidentally discovered in the course of social development or agricultural projects. Most of them were immediately looted after their discovery. Archaeological research has generally been conducted by national and international archaeologists within the framework of collaboration (Albrecht et al., 2000; Haidle 2009, 2010, 2010; Dega 2002; Stark 1999; Dougald et al., 2004, 2006, 2009, Pottier et al., 2004, Sophady, 2005, 2008, Reinecke et al. 2009,Yushinori and Chuch et al., 2009, Vanna 1999, 2002; Kaseka, 2004, 2007; Thuy, 2010; Forestier et al., 2012; Demeter et al., 2010). Such an accumulation of researchers, research projects and results finally gives a multi-faceted picture of the prehistoric knowledge of Cambodia. Conterminously, the studies form the backbone for the known timeline of Cambodia prehistory.

Laang Spean, the focus of this discussion, is a key site for developing a better understanding of the cultural and social development during prehistoric times in Cambodia, its connection with other prehistoric sites in neighboring countries in particular, and all of Southeast Asia in general, with the aid of new methodologies, research results and collaboration.

Location and geographic conditions of the site

Laang Spean is the largest cave situated nearly on top of the Permian limestone mountain known as Phnom Teak Treang in the Treng Commune, Ratanakmundul district, southwest of Battambang province, northwest of Cambodia, and approximately 330 km from Phnom Penh, on the right hand side of National road No. 10, half way between Battambang and Paillin, a well known location for gem mining and close to the border of Thailand. It is around 40 km southwest of the present provincial capital of Battambang and around 7 km from the public gathering place of Sdao (Figure 1-2). The name of 'Laang Spean' refers to the limestone found on the

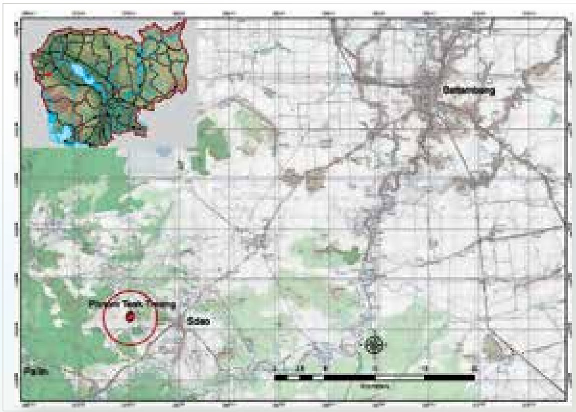

Figure 1: Cambodian regional map showing the location of Phnom Teak Treang, where the prehistoric site of Laang Spean is located.


Figure 2: 2012 picture of Phnom Teak Treang (view from the east).

Figure 3: Interior of Laang Spean cave, where limestone formed an arch.

upper part of the back of the cave, forming arches which look like a bridge (Figure 3). It formed naturally after a large block in the middle of the cave's ceiling fell in. The mountain lies on the west side of the Sangke River, one of the tributaries of the great Lake of Tonle Sap. The area is strategically located between the Sangke River to the east and the Cardamom Mountain Range to the west. Cambodia's main natural geographical features are the central basin formed by the Mekong River and the great Lake of Tonle Sap, the surrounding Dangrek mountain range in the north, and the Cardamom mountains in the west. The soil of the central part of the country, especially that around the great Lake of Tonle Sap and the floodplain of the Mekong River, is full of sediments rich in fertilizer. But the lowland northwest of Battambang is different from the locations mentioned above. The area is characterized by vast lowlands and mountains. Because the soil here is the most fertile, large rice fields abound. Thus, the Battambang province is one of the most important places for rice production in Cambodia. Indeed, it is deemed to be the 'granary' of the country. It has alluvial soil stretching from north-east to south-west along the Sangke River, which is a major water resource for agriculture, fishing and water supply. The limestone mountains in that area include Phnom Teak Treang, where the Laang Spean cave formed; Phnom Sampov; Phnom Krapeur; Phnom Donmeay and Phnom Sar. All of these mountains contain many caves. Some caves were inhabited by prehistoric people and later used as temporary settlements by the Khmer Rouge armies from 1975 until the 1990s. Recently, some caves were used by monks as sacred places for meditation. Phnom Teak Treang is a small irregular limestone mountain. It measures about 500 m long and 300 m wide and has an elevation of about 80 m above the surrounding lowland. It is small, but contains many caves whose openings are situated at different levels. Thirteen caves were recorded during the survey by the FCPM team in 2009, and most of them revealed remains of prehistoric occupation. Caves No. 2 and No. 12, or the Sambok Borie cave, exhibit a very high potential for archaeological research. Unfortunately, sediment deposits in this cave were illegally excavated by villagers who were collecting it as fertilizer and, archaeological layers were destroyed. During visits to the caves in 2009, large amounts of stone tools and other archaeological remains were collected (Figure 4). A water spring called 'Chanob' located approximately 2 km to the

Figure 4: Pebble tools collected from cave N°12.

west of the mountain is the main water supply for the whole season.

Laang Spean is the biggest cave of Phnom Teak Treang; it measures approximately 63 m long by 20 m wide by 30 m high, from the cave floor to the cave roof. The total ground surface of the cave is about 1200 m^2 (Figure 5). It is possible to divide the cave in three main chambers according to the limestone blocks lying on the surface inside. The roof of the second chamber, located in the central part of the cave and containing the largest limestone block, has collapsed; leaving an opening at the top. The new excavation project by the FCPM took place in this central chamber.

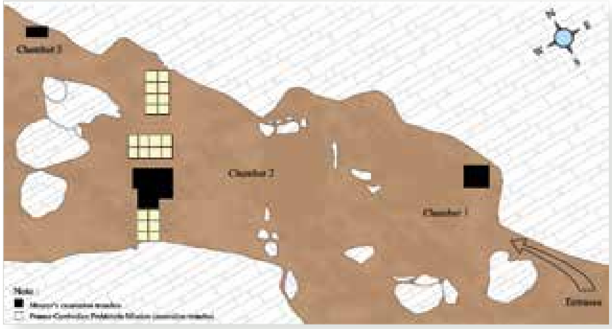

Figure 5: Map of the Laang Spean cave with location of previous and recent excavations (Courtesy FCPM).

Previous archaeological research

Cécile and Roland Mourer, former professors of the Faculty of Archaeology of the Royal University of Fine Arts in Phnom Penh, discovered the site during their expedition in search of evidence of human occupation in the area of the limestone mountains between Battambang and Paillin, in northwest Cambodia, during the 1960s. The initial investigation took place in 1965 and further systematic excavation continued until1970 (Figure 6) with each campaign lasting no more than a week (Mourer and Mourer, 1970).This was the first excavation which some students of the Faculty of Archaeology of the Royal University of Fine Arts in Phnom Penh were encouraged to take part in as a field training program. The excavations were carried out at three different locations but, in the end, only two of them were continually excavated. The first trench, measuring about 4 m^2, was set up on the right hand side of the cave's entrance, under the limestone shelter. In this location they found a complete pedestal pottery vessel, with flaring mouth and base, in a red layer that was radiocarbon dated (based on charcoal) to 3970 ± 90 BP (non-calibrated) (Mourer and Mourer, 1970). The second trench was placed in the central part of the cave, and it measured 9 square meters. The last test trench was located at the back of the cave, exactly under the limestone bridge, close to the eastern cave wall, and measured 2 m^2. The results of the excavation confirmed that the second location was much richer in archaeological remains than the other two locations. The excavation encountered evidence of

Figure 6: Excavation by Roland Mourer during 1960s (Courtesy Drs.. Mourer, C. and Mourer, R.).

significant occupation, such as pebble tools, flakes of hornfels, end-scrapers, tools with distal cutting edges, a side scrapper shaped as a short axe, Sumatra-type tools and a chopper made of a broken quartzite pebble. Evidence for the use of chert was always found in the lower layers of the sounding. Comparing the materials found in the cave to the lithic industry, called Hoabinhian (Colani, 1927), discovered in northern Vietnam by Madeleine Colani in 1927, the author realized it was of the same technical manufacture.

Aside from stone tools, many pottery fragments, macro and micro fauna (some of them burnt), human remains and mollusks were also discovered. Based on the sediment deposits confirmed in the profile of the trenches, Mourer distinguished 5 different cultural layers. Radiocarbon dating of charcoal derived from each layer provided evidence of long occupation of the site, with sometimes perhaps long interruptions, between from about 6800 BCE. to 830 CE. (Mourer and Mourer, 1970). The ecological aspect was at that time already taken into consideration to determine whether cultivation practices are evidenced or not at Laang Spean. So, a qualitative analysis of the pollens found into the excavated layers was undertaken and allowed us to get some idea about the surrounding vegetal landscape. The almost continuous and prevailing presence of tree pollens in the lower layers and gramineous species into the upper levels, seem to point to a constant regional climate during all the sedimentation. Finally, the pollen analysis shows no evidence of cultivation at Laang Spean. Details of the research by R. and C. Mourer are the subject of several publications (Mourer and Mourer, 1970, 1971, 1973; Mourer 1977, 1988, 1994) and constitute one of the greatest achievements in Cambodian prehistoric research to this day.

New research project

Because of the political turbulence and armed conflict that occurred in Cambodia from the 1970s until the 1990s, Cambodia's prehistory was no longer the focus of archaeological research by either national or international archaeologists. After the collapse of the Khmer Rouge in 1979, the area where the Laang Spean prehistoric site is located was the battleground between the remnants of the Khmer Rouge armed forces and the government armies. Additionally, the road was neither safe nor suitable to access the area. Knowledge about Cambodian prehistory is still very scarce; it must be broadened by collecting more data in order to be able to draw a better picture of the life of prehistoric populations. The intention of this paper is to add new evidence to the existing body of knowledge concerning the cave settlement of Laang Spean. Since 2009, the FCPM established a program, within the framework of a cooperation agreement between the Ministry of Culture and Fine Arts of the Kingdom of Cambodia and the Muséum National d'Histoire Naturelle, Paris, for the purposes of restarting excavation with a new methodology and approach, that is aimed at gathering new archaeological data for a deeper understanding of chronological, cultural and social complexities of the site, as well as building the capacity of the students of the Faculty of Archaeology and of young Cambodian scholars in the field of prehistory. To this date, a four year (2009-12) program of excavation campaigns have been completed, with a total of about 20 square meters excavated thusfar, with plans for another four year (2013-16) extension of the program (Figure 7). The first campaign began a month after the official signing of an agreement. Relying on Mourer's excavation results, the location of the excavation

Figure 7: Excavation conducted by FCPM in 2010.

unit for the first year was set up in the second chamber (at the central part of the cave), one meter east of Mourer's trench. This unit, Unit I, extends 8 square metters (2 m by 4 m) with south-north orientation, parallel to the cave direction. At the same time, we re-opened Mourer's excavation trench in order to clarify cultural stratigraphy and to follow up on the lowest archaeological layers and natural soil of the cave floor. The excavation was continued to a depth of 150 cm below the present surface where Mourer stopped excavating. So far, we have dug about 5 m deep but we have still not reached the cave floor. At a depth of about 3 m, we encountered stone tools made of silicified limestone and bone fragments. Unit II was placed to the side of Mourer's trench, to the west, all the way up to the cave wall, and it covers 6 square meters. The excavation reached a depth of 150 cm below surface and 4 square meters at the widest and deepest point, whereas, close to the cave wall, it has reached only 2 square meters at approximately 30 cm below the surface. In this unit, dense concentrations of archaeological finds, mainly animal bones associated with pebble tools, were uncovered a black layer about 20 cm below surface. Unit III was opened during the third excavation campaign in 2012. It covers 8 square meters and is set up perpendicular to the cave direction, located 2 m away from Unit I to the east and extends up to the cave wall.

Findings

The three excavation campaigns took place at Laang Spean from 2009 through 2011. They provided very significant archaeological information relating to human behavior, technological changes and social and cultural developments which occurred, at least at this site, from the Paleolithic to Neolithic, until the period which precedes the appearance of the use of metals. Stone tools are the main artifact finds encountered in different layers associated with pottery fragments, fauna and some human remains. Stone flakes and chunks (debris) as well as a few hammer stones were also found. These objects are testimonies to stone tool production *in situ* in the cave space, especially for the pebble tools. A few polished stone adzes have also been unearthed in this cave, which represents another new aspect for the prehistoric research in Cambodia. Other 'symbolic' objects and faunal remains have also been discovered, such as a pendant made from a wild boar canine with perforation for suspension, as well as numerous fragments of animal bones of diverse mammalian species, mollusks, snake, fish, bird and turtle, which indicate that these animals were hunted and consumed. Fragments of human bone were also found, as indicated in the previous work of C. and R. Mourer (Mourer, 1970, 1994). Recent excavations by FCPM have recovered pieces of human bones distributed in a scattered way in the archaeological sequence. More interestingly, two burials have been found for the first time *in situ* in the cave. So far, evidence of metal and textile remains has not been found. The few important finds of raw materials will be described in detail in a further article, in order to show the ability of prehistoric people to manage their environment.

Stone tools

Stone tools discovered from the past and present archaeological excavations can be classified into three different categories based on their typology, morphology and raw material.

- **The first category** refers to tools made on flat river cobblestone, which are generally known as Hoabinhian or 'Sumatralith-type' tools. These stone tools include unifacial, chopper or chopping tools. According to Mourer, this first category of stone tools can be subdivided into four main groups due to the fact that they possess the capability to be reused. These four groups include side-scrapers, end-scrapers, short-axes and tools with distal cutting edges (Mourer and Mourer, 1970). Additionally, small flakes from the same raw materials as the pebble tools have also been discovered. Additionally, round pebbles with traces of percussion on the distal part (probably hammered stone) were found. Also found within the same layer were very few pebble tools and flakes. Discovery of complex materials indicates the sequence of stone tools manufactured in the cave. Based on our excavation, the tools made from river pebbles were generally recovered from the upper layers in between Layer 2 and Layer 3, about 30 cm below the surface. The sediment in Layer 2 is mostly dark grey, but some is black. The soil is a sandy-clay mixed with organic remains. Layer 3 continues from Layer 2 where the sediment becomes reddish brown in color and soil containes more clay than Layer 2. Both of these layers were rich in flakes of hornfels, pottery fragments, moullusks and bone fragments. Human remains such as part of a mandible, teeth and skull fragments belonging to different individuals (Forestier et al., 2012; Zeitourn et al., 2012) were primarily discovered in Layer 3. The dimensions of the pebble tools discovered at the Laang Spean site vary from 6 cm to 15 cm long, 3 cm to 11 cm wide, and from 1.5 cm to 5 cm thick (Figure 8).

Figure 8: Pebble tools found during the excavation by FCPM.

Figure 9: From left to right, Dr. Simon Puaud, Prof. Hubert Forestier and Roland Mourer during visits to Thvak river, 2012 and Dr. Mourer knaps a pebble.

The pebble tool is characterized by shaping on one side and it is made with such a skillfull stone tool manufacturing technique so as to have a specific feature remaining in place over its original pebble surface, on the other side. These unifacial types of tools are often oval in shape, but examples which are sometimes rectangular or nearly round in shape (almost like a disc) have also been found. Their color is always dark grey or nearly black. The raw material for the tools (i.e. the pebbles) were possibly collected from the river located approximately 6 km last of the site. The local people called this portion of the Sangke River flowing from South to North, towards the Great Lake of Tonle Sap,'Thvak' (Figure 9). During the dry season many pebbles can be seen in the river bed that could be; they source of raw material for making such tools.

Different types of pebble tools (Hoabinhian techno-complexe or Sumatraliths) have been found in many archaeological sites in Southeast Asia, both on Mainland and on the islands. So far, more than 140 archaeological sites with Hoabinhian remains have been well documented in North Vietnam (Trinh Nagn, 2008, p. 19). The term Hoabinhian comes from 'Hoa Binh' culture, named after the Hoa Binh province in Vietnam. This archaeological culture was discovered and previously excavated by the French archaeologist Madeleine Colani from EFEO, who encountered over 50 Hoa Binh culture sites in Vietnam during the period 1926-1932. Early in 1932, the First Conference of Far East Prehistorians was held in Hanoi, and the term 'Hoa Binh Culture', proposed by M. Colani, was agreed upon and became used throughout the region (*Praehistorica Asiae Orientalis,* 1932).

Other archaeological sites containing Hoabinhian culture type remains have been found as far away as Laos, and Thailand, sharing similar cultural complexity.

- **The second category** of stone tools from Laang Spean, is very different from the Hoabinian industry in both techniques of manufacture and raw material chosen. These are flake tools produced by a simple debitage method with a strong hammer from small silicified limestone nodule/block. This original stone assemblage was found mostly under the Hoabinhian level and the burial unit, about 120 cm below surface, and thus can be considered to be the most ancient.

Soil of this layer is yellow in color and has a sandy-clay texture. Some tools were found under or mixed with natural limestone blocks. In contrast, no pebble tools or flakes of hornfel have been recovered from this layer. Stone tools found in this context include: large and small flakes, scrapers, denticulated pieces (Figure 10), exploited blocks and cores with remains of intentional flaking. These tools exhibit a simple technique of manufacture with raw material found easily inside or outside the cave and in the nearby cave site environment. Presence of tools made of silicified limestone indicate the technical development and living subsistence of the groups of ancient people who occupied the cave. However, for the moment, it is still very hard to reach any conclusions regarding the date of this stone industry. More scientific investigation on typology, technique of manufacture and function is needed in order to understand the general context and its chronology. For the moment, two different techniques of stone tool manufacturing are recognizable in Laang Spean (Forestier et al. 2009). The first technique is a shaping method: Hoabinhian hunter-gatherer lithic strategy for knapping. This method was applied for making pebble tools. The second technique is a debitage method which produced a variety of flake tools with high quality of cutting edges from silicified limestone or silex.

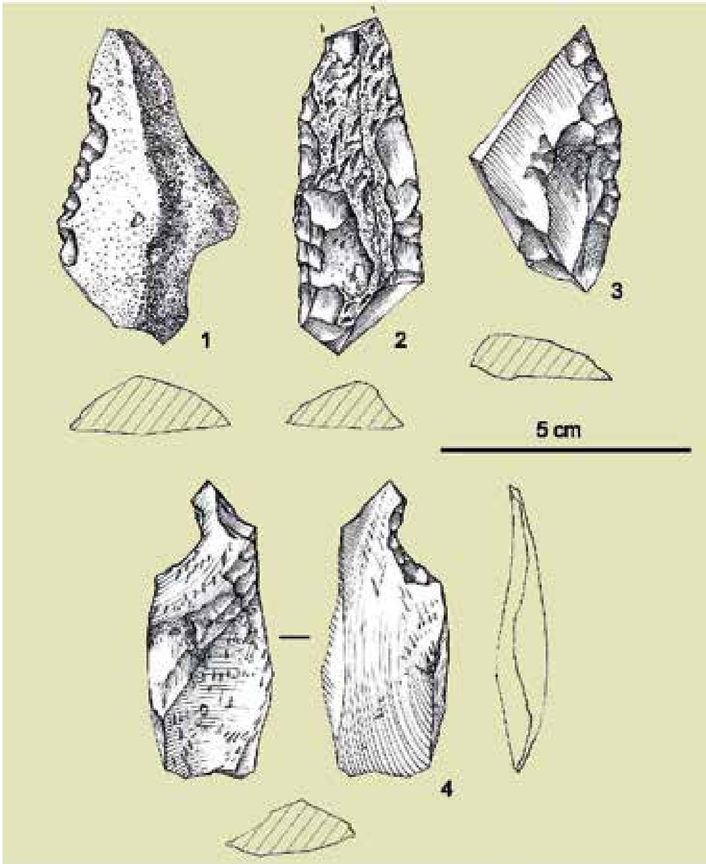

Figure 10: Tools made of limestone silicify (Courtesy Prof. Forestier).

- **The last category** of stone tools discovered in Laang Spean is the most recognizable and recent as cultural and chronological markers: the polished stone adzes (Figure 11). Generally, polished stone tools are found in burials or settlements in Neolithic/Bronze Age large open air sites rather than in caves. Polished stone adzes or axes discovered in caves, remain the least well known phenomena of the sites throughout the whole Mainland Southeast Asian region (Duff, 1970; Higham, 2002; Sophady, 2008).

Figure 11: Polished stone tools found during the excavation by FCPM.

The discovery of polished stone adzes, with and without shoulder, in the Laang Spean cave associated with pottery, is a significant result of the new stage of prehistoric research in Cambodia, in particular, for the knowledge of Neolithic occupation in the cave. Moreover, this new discovery indicates a succession of occupation in this cave from the Paleolithic to the Neolithic period. During the 2009 to 2012 excavation campaigns by the FCPM, four polished stone adzes (of which two were shouldered adzes and two were without shoulders) were discovered in different locations.

The first preform shouldered adze was found in 2009, in square J 31 in the vicinity of a human skeleton, probably a burial offering, in an excavation area located in the central part of the cave, in Layer 1, about 30 cm below surface. It measured 8 cm long, 4.4 cm wide and 2 cm thick, with a trapezoidal cross-section. The lower part is slightly polished in some areas, while the upper part is unpolished with remanent flaking wholes. It has assymetrical bevels with a small breaking or retouching on both sides of the cutting edge. The raw material of this shouldered azde is very fine-grained, homogeneous in composition, hard and dark green in color.

The second polished stone tool is a simple adze. It was found during the excavation in 2010, in Layer 2 (about 40 cm below surface) of square I 32. It measured about 18 cm long, with maximum dimensions at the distal end of about 5.6 cm wide and 2.2 cm thick. It is oval in shape, and pointed at the proximal end. The raw material of this tool is black in color and looks similar to that pebble tools. On the upper part it is partially polished, mainly around the cutting edge, the natural surface of the block is still visible. The lower part is unpolished, except on the cutting edge. It has asymmetric bevels on the cutting edge. One side is stepped down, well polished; the other is slightly curved. The cross-section has a trapezoidal shape. A crack can be seen on the left side of the cutting edge.

The third stone tool is also a simple adze, but an unpolished one. It was found in square A 32, about 50 cm below surface, situated west of Mourer's excavation trench, near the cave wall. This simple adze was made from coarse stone, grey in color. It measured about 11.5 cm long, the maximum width of the distal end is 6 cm, while its maximum thickness is 2 cm. The cutting edge has asymmetrical bevels. The upper part is slighly curved at the end, while the lower part is angled down. Only a small section of the bevel on the lower part was polished. The cross-section is trapezoidal in shape.

The last polished stone tool discovered from the excavation is a shouldered adze. It was found during the 2012 campaign in square P 32 of the new excavation trench, in a layer about 40 cm below surface, not far from the second burial. It measured 9.5 cm long, 5.4 cm in maximum width and 2.9 cm in maximum thickness. It is made of very fine-grained stone, homogeneous in composition, hard and light grey in color. The whole tool shows fresh flaking fracture. Only small sections near the cutting end on both sides are partially, but finely, polished. It seems as if its production was not completely finished. It has asymmetrical bevels on the cutting edge. The upper part is slightly curved, while the lower part is straight with a triangular cross-section.

All polished stone tools found in Laang Spean seem to have been made away from the cave. Previous and recent excavations did not expose any production debris at any of the cultural deposits and some of the raw material for the tools did not originate in the area. For this reason it could be posited that the finished tools were imported from ouside of the cave. The pebbles of Thvak river could be the source of raw material for some of the polished stone adzes discovered in this cave, but no evidence has been found to comfirm this suggestion. The source of the raw material, the location where the tools were made, as well as their function are still the subject of further scientific study by specialists in different fields.

Pottery

Pottery is in many ways the easiest material to deal with, because archaeologists can easily recognise it, it is generally stable, and if it is broken, it can be refit without too much loss of information. Moreover, it can often be dated even when it is out of stratigraphical context (Collis, 2001). Thus, using ceramology, is it possible to have a chrono-cultural scale, but this scale has to be constructed, and in South-East Asia this scale is still a work in progress. At Laang Spean, pottery was only found in various states of fragmentation. All these sherds were more or less recovered in the upper level, especially Layers 1 and 2, about 20 cm to 40 cm below surface, where the soil is black in the first layer and red in the second layer. The upper layer of the stratigraphy was probably disturbed by the group which occupied the cave after the Hoabinhian inhabitants. Six entire pottery vessels and one incomplete vessel have been successfully reconstructed from fragments that were found together *in situ*. So far, two types of pottery forms can be clearly documented. The first type is made up of pedestal cups. The second type is storage jars with an everted mouth on a large body and short stand (Figure 12).

Figure 12: Laang Spean pottery: No. 1 found by Roland and Cécile Mourer in 1968 and No. 2-7 found by FCPM in 2010.

All other findings of potsherds consist of rims and wall fragments with a variety of forms and decoration designs; base fragments are rare. Interestingly, covers, handles and spouts are absent and probably did not exist at this site. Even if most pieces are very small, groups of rim shapes and decoration design can be categorized according to a preliminary study (Mourer and Mourer, 1970).

The first type of pottery is represented by three pedestal cups. The first one was recovered by R. Mourer during his systematic excavation in 1960s. It was found in the first test trench, located near the cave entrance, in the lower part of the red layer, between 45 cm and 60 cm below surface. Radiocarbon dating on charcoal collected from this layer dates it to 3970 ± 90 BP. (Mourer and Mourer, 1970). It measured 14 cm in height, with 21.1 cm for the mouth diameter and 17.6 cm for the foot diameter. The rim is straight, everted upward, bending at about 1.3 cm high and ends in a rounded lip. The body has a concave profile with cylindrical form in the middle which gradually extends to the upper and lower parts (Figure 12, No. 1). The pedestal is fully decorated with two design motifs. The first is a series of small irregular dots, some in form of horizontal lines while others are in the form of wavy lines. It is possible these designs were made by using a small wooden or bamboo stick with a pointed end or a comb pressed on the surface of the pot before firing, when the clay was still damp. Another design motif is stripes. Each stripe is created by concentric incised lines. The first stripe is located at the border of the rim mouth and is 1.3 cm high. The second stripe is drawn approximately 8 cm below the rim and is 1.4 cm to 1.5 cm wide. The third strip is placed about 3 cm under the second one and its height varies from 1.6 cm to 1.9 cm. These two stripes are situated near the middle of the vessel. The last stripe is located at the lowest part of the pedestal base, as the border of the foot. Each stripe is smooth and bright with red-brown colouring, like the whole body of the pot, that may be the result of burnishing or slip. Slip is a very fine layer composed of a watery solution of homogeneous, fine-grained clay minerals in a creamy suspension (Haidle et al., 2010).

The two other complete pedestal cups exhibit the same form, design and colour as the first one, but they differ in size. Both of them were discovered *in situ* inside a grave in association with a burial with other pottery vessels, stone tools and tortoise plastron, during the second excavation campaign by FPMC in 2010. They were found in the central section of the cave, not far from the old excavation trenches of Mourer. They were placed around the head of the body, about 1 m below surface. In this level, the pebble tools are no longer found, but tools made of chert and bone fragments still occur. The second pedestal pot measures 11.5 cm in height, 19 cm for the mouth diameter and 16 cm for the foot diameter. The last and smallest pedestal cup of Laang Spean measures only 10 cm high, 16 cm for the mouth diameter and 13 cm for the foot diameter and its colour is red-dark brown with black on some parts, particularly on the rim and base. Based on its annular shape, it is possible to suggest that these pedestals cups were made by coiling technique rather than paddle and anvil. On the other hand, the exterior of the bottom and stand of each pot shows traces of scraping by using a sharpening tool on the surface. The three vessels which have been restored completely are made using a temper with organic and inorganic additives and fired under oxidizing conditions.

The second type of pottery found at Laang Spean encompasses all the storage jars with a flaring mouth and short stand. There are four pots; three of them are complete and the other incomplete. They share similarity in form, design and colour, only varying slightly in size. All of them were unearthed in the same burial as the burial offerings of two pedestal cups mentioned above. The burial is radiocarbon dated on bone collagen to 3310 ± 29 BP. The first jar is 17 cm in diameter at the mouth, 12 cm in diameter at the foot and 21 cm in total height. It has a flaring neck in the shape of a high funnel, the rim of which ends around the lip. The funnel measure from the neck is 4.3 cm high and the foot is about 2.3 cm high. The colour of this jar is reddish-brown with some black spots of carbonization on the body. It has a variety of patterned designs. Impressed dotted lines in the form of zigzags are applied on the exterior of the rim. Bands and cross-hatched designs can be seen around the neck and on the shoulder, while on the edge of the shoulder there are impressed motifs. The base of the neck is underlined by a smooth, circular band. Below it, at some 3 cm or 4 cm, another smooth band runs parallel to the first one. Its lower part is made of six very flattened archs leaning on short and thick truncated cone shaped pillars evenly distributed over the shoulder. The body is decorated by impression, in form of zigzag dotted lines. There is no decoration on the lower part of the body and stand. The second jar measures 16.5 cm in diameter at the mouth, 11 cm in diameter at the base and the total height is about 19.5 cm. It has a flaring neck in the shape of a high funnel the rim of which ends in a round lip. The measured funnel from the neck is 4 cm high and the stand is 1.8 cm high and its colour is reddish-brown. The decoration is composed of concentric incised lines on the upper part of the funnel and continues by impression in the form of zigzag dotted lines. The dotted lines were possibly obtained by means of a comb. A horizontal strip runs around the neck while vertical bands seperated by incised lines can be seen on and around the shoulder. The body and stand have no sign of decoration. As for the third jar, a great part of the neck and all of the rim are missing. The foot diameter is 12 cm and it is 2.5 cm high. This jar is decorated by burnishing bands on the edge of the shoulder and below the shoulder, while the body and foot are not decorated. The last pot of this type is the smallest jar with a flaring neck in the shape of a high funnel, the rim of which ends in a round lip. This jar has a round bottom with a ring foot, but is severely damaged. The diameter of the mouth is 14.5 cm, the diameter of foot is 10 cm and the total height is 16 cm. The funnel from the neck is 3.5 cm high. This small jar is decorated with vertical incised lines on the external surface of the funnel, and by burnished bands on and around the neck and shoulder. Between the concentric horizontal bands, a couple of vertical bands runs around the shoulder. Below the shoulder another band can be detected. From this band to the lower extremity of the vessel, no decoration can be recognized.

The pottery from Laang Spean cave, particularly the storage jars, were probably produced using the paddle and anvil technique. Although the anvil and paddle remain absent in the archaeological record, the depression on the external surface of the vessel, which is probably the imprint of an anvil, made while the body of the pot was formed, remains visible. It is earthernware pottery, so it was fired at low temperatures in an open fire or in a pit using small tree branches or rice straw as fuel. These production techniques are still practiced by modern potters in the Kampong Chhnang and Kampot provinces in Cambodia. To prevent shrinkage of the pots during the firing process, the potters added organic and inorganic temper to the clay. Rice husks and straw can be identified by the naked eyes in the pottery fragments (Mourer and Mourer, 1971). The pottery shows a variety of decorative patterns made by different techniques. Oblique, vertical, horizontal and wavy line decorations were produced by incising and by using a comb. Cross-hatched designs and motifs made by impression, cord impression, stippling, and punctate decoration are common. Decoration design and form of some pots, particularly storage jars, are camparable to those found at the well known Neolithic site of Samrong Sen, Kampong Chhnang province (Mansuy, 1902; Mourer, 1970; Vanna, 2002). Recently, the late Neolithic/Bronze Age site of Koh Ta Meas, located in the centre of the Western Baray, in Angkor area, province of Siem Reap which was discovered and excavated by a joint team between APSARA Authority and École Française d'Extrême Orient in 2004 and 2005 (Pottier et al., 2004), shares a similarity of vessel form and design with the pots of Laang Spean. On the other hand, in Northen Thailand, the earthenware pedestal and storage jars were found in the Neolithic layer of the Ban Kao site, radiocarbon dated to about 2300 BCE and 1500 BCE (Higham, 2002) sharing also a similarity of form and design motifs. Moreover, the pottery vessels from Ban Ta Kao, Phung Nguyen and pottery discovered from the latest burial phase at Kok Phnom Di (Higham 2002), show a wide variety of design motifs made by impression, along with incised lines, as well as smooth and stippled bands, which look similar to the pedestals and storage jars found in the Neolithic burial of Laang Spean. The decoration of earthenware pottery of Laang Spean can also be compared to the design motif on the pottery vessels found in some Neolithic sites in Northen Vietnam such as Bau Tro, Van Dien, Tu Son, Phung Nguyen and Lung Hoa which are always associated with polished stone tools (Mourer et al. 1971).

Nevertheless, it is very necessary to conduct a detailed study in order to understand the manufacturing techniques of these valuable pottery vessels and their relationship with other cultural complexes of the same period in the region.

A diversity of earthenware pottery was produced with different shapes, rim and base forms. The ancient inhabitants of the sites probably used the vessels as cooking pots, pedestals cups, and small and large storage jars. Most were probably used in daily life, but some might have served as burial offerings.

Burials

The discovery of Neolithic burials in caves is not common for the whole region of Southeast Asia. The Neolithic burials found in the Laang Spean cave revealed a new avenue of prehistoric research of Cambodia in particular and the whole region of Southeast Asia in general. Recently, two burials have been recovered by FCPM. The first burial was found in 2010, in the central part of the cave. This burial was found at a depth of about 1m below surface and the limits of the pit were only clearly identified for some 45 cm at the bottom of the pit. The body was placed in the grave in a supine position parallel with the cave axis on a north-south orientation and with the head oriented to the south, the same direction as the cave entrance. Unfortunately, the skull of the body was not recovered and some elements of the upper part of the body were disturbed. A large block of limestone with bones and pottery fragments found scattered around the chest of the dead, indicates that the burial was probably dug out and re-filled at some point by the subsequent groups who occupied the cave, or by looters. During the campaign in 2009, a mandible and several fragments of skull were discovered in the upper layer of the burial confirming the observation made during the excavation undertaken by C. and R. Mourrer (Mourer, 1994, p.150). Due to their shape and individual state of maturity, these fragments belong to at least five different individuals (Zeitoun et al., 2012). Preliminary investigation results on the position of the body revealed that the deceased was probably placed in the grave with the hands lying straight along the body and the legs placed in a vertical position, but during decomposition, rotation of the lower limbs towards the outside of the corpse caused the soles of the feet face outwards (Zeitoun et al. 2012). The morpology of the bones for the lower part of the body is well preserved but their composition is very fragile. Paleoanthrologists have attempted to identify the individual based on collection and analysis of the available biological information, which indicates, with a probability close to 99%, that this was the grave of an adult male approximately 170 cm tall. Radiocarbon dating has yielded an age of 3310 ± 29 cal. BP. Several earthernware pottery artefacts were found around the deceased and are interpreted as burial goods. A piece of chert with traces of pigment and a tortoise plastron were recovered between the legs, placed under the pottery assemblage. A preform shouldered adze made of very fine-grained, homogeneous in composition, hard, dark green material was found above the limestone block, suggesting that it belonged to the burial. Furthermore, a pendant made of a wild boar canine was recovered near the position of the head.

The second burial was found during the last excavation campaign in 2012 near the cave wall to the east (Figure 13). The grave was dug on a north-south axis with the head orientated to the south, in the same manner as the first burial. The remains were buried only about 50 cm to 70 cm below the surface and the edge of the pit was clearly visible from the top. The grave pit measured about 150 cm in length and 50 cm in width. The dead body was placed in the ground in supine position with

Figure 13: The second grave found in Laang Spean during the excavation in 2012 by FCPM.

legs in vertical position, the knees turned up and the feet put under a block of limestone. The arms were placed on the belly. The skeleton is complete and in its original position, but the bones are very fragile, only the biological information gathered by paleoanthropologists on site can help us to consider the status of the dead; it was (with a probability close to 98%) the burial of a young man. According to tooth eruption, this individual was aged between 18 and 25 years old. The individual's height was esitmated to be 1.70 m. Intentional tooth modification has been noticed on the incisors of this individual (Zeitoun, personal communication, 2012). This burial is not associated with any archaeological objects as burial offerings, but a polished, shouldered adze was found in the vicinity of the burial. Only direct dating on bone can identify the exact period to which the deceased belongs. The radiocarbon analysis is still in process and the result will be released in the near future. At that time, the chronological and cultural framework of this burial will be confirmed.

Fauna and other remains

Besides stone tools, pottery and burials, faunal remains and mollusc shells, which were very abundant in the upper stratigraphical layers, especially in the black layer, have also been recovered. Animal bones are always encountered in a fragmented state, probably a result of both anthropic and natural processes. They are more fragmented than the other remains. Many of them are burnt, or carbonized, while some are covered by limestone concretion. The faunal remains found during the past excavations by Mourer, which represent a broad variety of animal species; have been more precisely analysed. Terrestrial, aquatic, avian and bat species were identified. Small bovids and carnivores, large rodents like porcupine, primates and reptiles, including snakes, are represented in the collection. A rhinoceros and a chevrotain deer are also present (Mourer, 1970). Micro faunal remains are extremely rich. Fresh water fish, turtles, mollusc shells ands frogs are found. Marine gastropods are present in small numbers and fragments of the claws of crustaceans were documented (Mourer, 1970). Insectivores, bats and birds are also known among the remains. The faunal remains discovered during the three excavation campaigns by FCPM still await systematic analysis. Only the collection found in 2009 has been subject to preliminary examination by young, local archaeozoologists. This analysis showed that most of the recovered bone fragments are attributable to families of large mammals, such as Bovidae, Cervidae, Suidae and Canidae. Small cervids like deer, and small carnivores such as common Palm Civet and Herpestes were also present. Monkeys, bears, red jungle fowl, and

Figure 14: Animal remains discovered in the cave of Laang Spean during the excavation in 2009 by FCPM (Courtesy Mr. Voeun Vuthy).

fish have also been identified. Reptiles present in the sample include crocodiles, chelonians (tortoises and turtles) and snakes. Microfauna are found in high quantities, as with the previously analysed collections (Figure 14). It includes mainly small rodents, insectivores, bats, birds and frogs. Fresh water and mollusc shells and many land snails were found in the archaeological layers, associated with animal bones and pottery fragments (Voeun, 2009). In addition, a few rhinoceros vertebrae were found during the excavation in 2012. C. Guérin and C. Mourer conducted detailed studies of the rhinoceros found at Laang Spean during the first excavations in the 1960s, and attributed it to the species *Rhinoceros sondaicus* (Guérin and Mourer, 1970). More interestingly, a fragment of animal bone with a very smooth and pointed end, was recovered and may have been used as a tool (Figure 15).

Laang Spean is a prehistoric site that contains many animal remains. Currently, the archaeozoological information from this site is limited. This can be attributed to several problems. The first is the magnitude of the data, because there are not enough reference collections of recent species in Cambodia to make an accurate identification of the archaeological finds possible. The second problem is the lack of sufficient references and previous publications, since very few studies of fauna have been carried out in Cambodia, and those which have been conducted often lack strong hypotheses, objectives and methodology. Due to the limited studies of faunal remains in the country, it is difficult to adequately formulate a hypothesis report and objectives, not to mention the methodology and the mode of collection. The third point of observation is dedicated to the analysis of families, genera and species present in the fauna, and to the results obtained from the sample. The last part is reserved for a general discussion of the findings and for an evaluation of the potential contribution of the faunal remains of this site to a better understanding of its human occupation and the subsistence strategies utilized.

Thus, a systematic analysis in the framework of international cooperation is required for a more detailed study of the sample. This systematic analysis will make it possible to better understand the composition of the fauna at the level of families, genera and species. Then it will be possible to recreate the techniques of animal hunting and exploitation, the environment, and all the processes related to human behaviour, in order to compare them with other prehistoric cultures, inside and outside the region.

Figure 15: Possibly a tool made of an animal bone.

Conclusion

On one hand, the excavated areas are comparably small, the project has only recently re-commenced after the site was deserted for a prolonged period of time due to the late armed conflict in the country, and the newly recovered archaeological material has not yet been properly analyzed such that any fundamental interpretations may be drawn from it, thus the time has not yet come for positing any definitive conclusions. However, there are some remarkable clues regarding the activities in the Phnom Teak Treang that enable us to draw a clearer picture of the structural and functional use of the site.

Situated in the Sangke basin in the province of Battambang, North-West Cambodia, Phnom Teak Treang is a small limestone mountain formed during the Permian era and it contains many caves with numerous archaeological remains. Laang Spean is the biggest cave, situated near the top of the mountain. It was initialy identified as a prehistoric site with remains from Hoabihnian tools as well as remains from Neolithic occupation characterized by earthernware pottery with cord impression design (Mourer et al., 1970, 1971, 1994). The cave space can be divided into three sections, the central part of which is considered to have been an intensely occupied activity zone. Typically the presence of pebble tools, flakes and hammer stones made of hornfels is considered evidence that a technical production process occurred in the cave. Other stone artifacts, such as flake tools and their remains, including nuclei and chunks made of chert, further reveal a stone tool knapping production process in the cave. The speculation prompted by the absence of any polished stone tool during the previous excavations is now over. A few polished stone adzes made of diverse raw materials were recovered during FCPM's three excavation campaigns in 2009, 2010 and 2012. The new discovery of polished stone tools in the cave strongly supports the idea of Neolithic occupation, as was suggested by the previous authors (C. Mourer and R. Mourer). In addition, the discovery of the skeleton of an adult male associated with several pottery vessels, a polished stone tool, a pierced Suid canine (finery/adornment), ochre pencil and the remains of a turtle, all dating to about 3310 BP according to direct dating methods on bone collagen, marked a new phase in prehistoric research in Cambodia as well as for the whole Mainland Southeast Asia region. Many burial sites dating from the Neolithic to the Iron Age found in some countries in the region such as Thailand, Vietnam and Myanmar (Reinecke et al., 2010; Pautreau et al., 2005; Higham, 2002) share similarities in terms of funeral pratices associated with the burial found in the Laang Spean cave. It is likely that these burial traditions were widely practiced in Mainland Southeast Asia since the New Stone Age and continued until the appearance of the use of metals.

Earthernware pottery found in the cave of Laang Spean, both in the upper strata and buried farther below, show a wealth of decoration design that can be compared to those designs found on earthernware as well as in the open air site of Samrong Sen, Koh Ta Meas, and other Neolithic sites in Northen Thailand such as Ban Tha Kae and Kok Phanom Di and some in South Thailand as well (Anderson, 1990; Higham, 2002; Zeitoun et al., 2012).

Bone artifacts are very rare in Laang Spean. So far, only one example could possibly be considered a tool. No other weapon or tool-like bone artifacts were found.

Faunal remains are quite abundant, but are only present as small fragments and many of them are burnt. A preliminary determination by specialists showed a diversity of species hunted by prehistoric men: large and small mammals, rodents, reptiles, insectivours, birds, fish and mollusc shells. Most species still exist today. However, the collection taken from recent excavations still requires further detailed examination in order to determine if there are new species present and if there is any evidence of domestication of animals by the inhabitants of the Laang Spean site during Neolithic period.

Looking at the cutural materials so far recovered from Laang Spean, it appears to be representative of a long-term human settlement, probably stretching from the Paleolithic hunther-gatherers to the Neolithic, until new technological developments enabled the use of metals.

To summarize, considering the evidence from both the previous and the recent excavations at Laang Spean, as well as from surveys of other caves on the same mountain, the common interpretation is that the cave contains the archaeological remains of a first occupation by hunter and gatherer groups, followed by Neolithic people with highly developed hunting strategies and stone tool making techniques, as well as highly artistic pottery making and design, and with elaborated social, cultural, symbolic and funerary pratices.

There is great potential for cultural research and the discovery of the way of life in the human past at Laang Spean, although our current knowledge of this site remains quite limited. In fact, research on prehistory and proto-history is, for the time being, quite limited in Cambodia. This needs to improve in the near future. So far, Laang Spean is the only prehistoric cave site with a deep stratigraphy found in Cambodia with so rich a successive sequence of remains of Hoabinhian stone tools and evidence of Neolithic culture. The site has played an important role in the dawn of prehistoric research in Cambodia. Indeed, this is a key site for prehistoric study if the purpose is to establish a clear picture of prehistoric chronology and to understand the past environment and human origins, as well as social and cultural development in the region. Moreover, given its potential for archaeological research and cultural significance in the context of human evolution in the area, the site fully deserves to be considered for inscription on the UNESCO World Heritage List. These promising results should encourage fieldwork to continue within the framework of international cooperation, with archaeological and interdisciplinary teams to improve and intensify the prehistoric research in Cambodia in particular and in all of Southeast Asia in general.

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Island Southeast Asia and Human Evolution Heritage

François Sémah
Department of Prehistory – Muséum National d'histoire naturelle – France

Abstract

Humans were not born as islanders, but their conquest of the Old World soon included the conquest of islands. Their ancient dispersals, like those of animal communities, considered geographical, ecological and climatic drives. Though, owing to their social behaviours and technical skills, humans' history is not totally bound to natural conditions, and combines biological and cultural adaptations.

Island Southeast Asia is an immense natural laboratory which allows us to reconstruct the earliest journey of *Homo erectus*, more than 1.5 Ma, the oldest intrusion east of Wallace's line almost 1 Ma ago, the conquest of Australia via the archipelagos by *Homo sapiens* during the Upper Pleistocene and that of the most remote Pacific islands much later. This heritage has crucial implications regarding environmental sciences and issues that are at stake for our extant societies, e.g. conservation of ecosystems and of biodiversity, or global change.

Its universal value must be considered at the scale of the properties and also following a thematic and regional approach that transcends geopolitical boundaries. It includes several dimensions:

- **History of sciences: the discovery of the oldest island inhabitants is linked to a major step in the construction of natural history knowledge, more than a century ago.**
- **The properties are repositories of paleoenvironmental records that allow us to reconstruct the history of human settlements in the archipelagos during the Quaternary.**
- **Their OUV relies on the importance of the palaeoanthropological and archaeological discoveries, inseparable from the properties themselves.**

This paper focuses on the Sunda province, including Java Island and the Sangiran dome, the sole prehistoric World Heritage property in the region. It emphasizes the importance of developing a conservation plan anchored in regional and international collaboration, which goes beyond 'cultural' nomination criteria and makes use of all instruments provided by UNESCO (World Heritage List, Tentative list, Advisory Body programs). This can help to protect many sites that will not be subject to nomination, and to decipher the natural history of human evolution in Island Southeast Asia, including in the immense Wallacea where the complex endemic history is only very partly known.

The First Islanders' heritage

A 'Désirade'

'Peninsula' is an attractive and also significant word, which could well substitute in the title of these pages. Humans were not originally born as islanders, but it happened that their conquest of the Old World out of Africa soon included the conquest of islands. As a matter of fact, until the emergence of our own species, the hominids' journey was not a 'blind' conquest of the unknown, but more that of an endless peninsula with all its attractions, as well as its traps.

These human dispersals, for the oldest ones are basically compared with those experienced by other animal communities: any natural history approach must certainly consider the nature and the influence of geographical, ecological and climatic drives. Nevertheless, conquering an island most often means achieving a collective dream. Humans might have looked at remote volcanoes beyond a strait, at floating or wrecked objects, at swimming or flying creatures which had the chance to make the journey back and were believed to have enjoyed the resources offered by distant and hence supposedly rich ecosystems.

To what extent can we decipher this adventure in terms of human specificities? Which aspects converge or differ between the earliest *Homo erectus*' journey, more than 1.5 Ma, the oldest intrusion East of Wallace's line almost 1 Ma, the conquest of Australia via the archipelagos by *Homo sapiens* during the Upper Pleistocene and that of the most remote Pacific islands much later?

Under these points of view, interpreting, sharing and conserving our heritage stands in an effort to understand both the constraints faced by our ancestors and their dreams as well.

Humans, landmasses and oceans

Island Southeast Asia (Figure 1) represents the extremity of the huge Eurasian continent and the last lands before the immense Pacific Ocean. During prehistoric times, the dichotomy and the transition between an Old and a New World was located here. The history of human settlements in the area is deeply anchored in Quaternary climatic patterns (since 2.6 Ma), and is a history of land and sea, of time and of space.

The area includes three major biogeographical zones, i.e. the continental Sunda shelf (including the larger islands of Java, Sumatra and Borneo) on the Western side, the Sahul shelf on the East (Australia, New Guinea) and in between the archipelagic Wallacea (including the island of Sulawesi), separated from Sunda by Wallace's Line. The border with the Pacific Ocean includes the Philippines archipelago, whose inclusion in the Wallacea has often been debated (e.g. Vallejo, 2011).

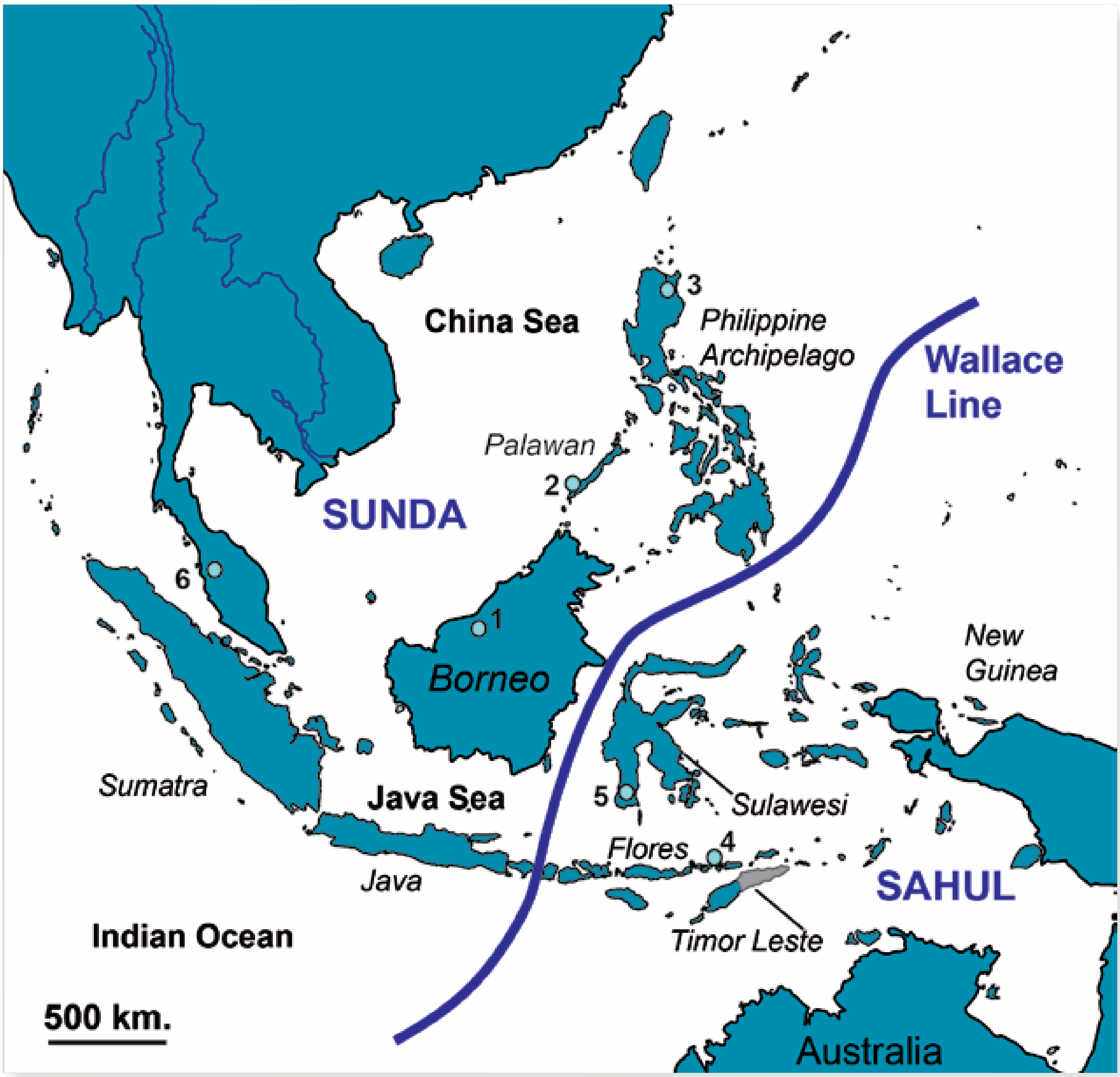

Figure 1: The Southeast Asian Archipelagos and mentioned sites: 1 Niah Cave; 2 Tabon Cave; 3 Callao Cave; 4 Lesser Sunda Islands; 5 Maros karstic massif; 6 Lenggong Valley. © Semenanjung

Here hominins, quite a short time after having reached Eurasia out of Africa (*c.* 1.8 Ma ago, see Gabounia et al., 2002; M.-A. de Lumley and Lordkipanidze, 2006), crossed southwards, traversing the equatorial belt to become the first islanders in human history *c.* 1.5 Ma ago. Here, *c.* 1 Ma ago, they crossed Wallace's Line and reached the Lesser Sunda Islands. Here our species, *Homo sapiens*, organized its earliest seafaring migrations more than 50 Ka (Bellwood, 2007) to reach Australia from the easternmost islands of the Indonesian archipelago. Eventually, here was born the sophisticated knowledge of marine streams and of astronomical milestones that allowed seafarers, several thousands years ago, to conquer the Pacific Ocean and its most remote archipelagos.

Whatever the period we deal with, we address the same scientific questions, related to the responses of our ancestors to the challenges they faced. Among these are evolution, including vicariance and endemism; adaptation to new environments that were met during the long trek; understanding of natural processes and patterns in order to survive in the ecosystems, to exploit and eventually to tame and domesticate them. Obviously, we deal also with prehistoric humans' aptitude to resilience after climatic, environmental or even catastrophic events.

What is the heritage?

The considered scientific field appears as an immense one, addressing a major part of human biological and cultural history, together with crucial implications regarding environmental sciences. Its relationship with issues that are at stake for our extant societies is obvious, and we find numerous examples, like the conservation of ecosystems and of biodiversity, or global change. There is no doubt that properties related to human evolution in the area, valuable prehistoric sites, properties sharing a cultural and natural interest (including for the understanding of Earth's history), are definitely part of World Heritage. Their universal value must be considered both at the scale of the properties (and discoveries) themselves and also following a thematic and regional approach that obviously transcends geopolitical boundaries.

The following pages will mostly focus on the Sunda province, and especially Java Island, where the sole World Heritage property related to human evolution in the archipelagos, the Sangiran dome, is located. In fact, the records in Java cover the longest chronology in the region and therefore currently better document aspects of human evolution. However, most of the finds and properties invite scientists and curators to trace the relations throughout the archipelagos and develop an actual regional perspective, parallel to the one which is developed in many fields of natural history.

Dealing with this heritage, planning and implementing its conservation and interpretation, requires attention to several different aspects:

- The first one is definitely historical: the discovery of the oldest island inhabitants in Island Southeast Asia is definitely linked to a conspicuous step in the construction of natural history knowledge, more than a century ago.

- Then comes the properties themselves, regarded as the best repositories of the paleoenvironmental records that allow the reconstruction of the steps of the specific history of human settlements in the archipelagos at various periods during the Quaternary. Though such reconstructions are obviously far from complete, and conservation issues regarding the properties must be grounded in a sound prospective in terms of future research developments.

- Eventually, as for most human evolution related properties, the outstanding value relies on the importance of the palaeoanthropological and archaeological discoveries. Mobile heritage is inseparable from the properties themselves. The value of the sites cannot be emphasized or disseminated without considering the meaning of former and current discoveries, together with their relationships to the deposits.

A long acknowledged universal scientific value

Island Southeast Asia and the nineteenth century scientific revolution

The part played by Island Southeast Asia in the scientific revolution that occurred between the middle and the end of the nineteenth century is fully part of the universal value we acknowledge here. The (almost) parallel works carried out by Alfred Russell Wallace (1869) in *The Malay Archipelago*, by Charles Darwin (1859) on natural selection, and by Charles Lyell (1830 to 1833; 1863), which anchored natural evolutionary processes in their chronological dimension opened the way to such recognition.

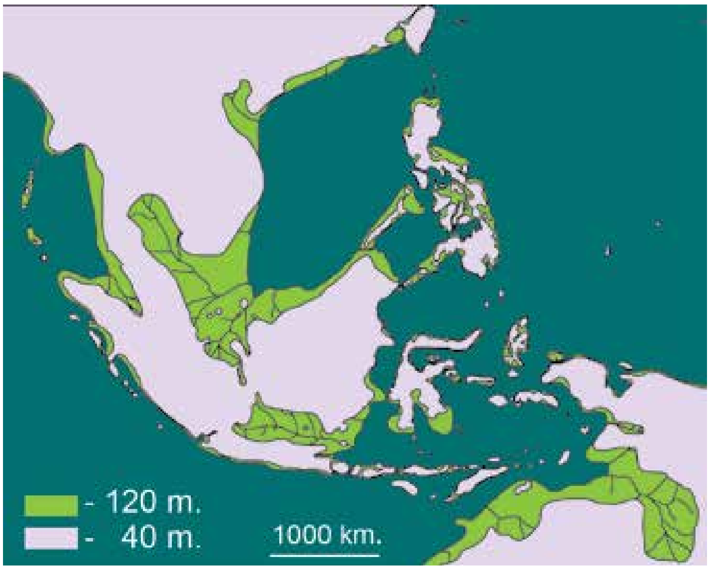

Figure 2: Geographic consequences of sea level drops on the Sunda shelf during Quaternary glacial periods (40 m and 120 m).
© Semenanjung

The natural history of Island Southeast Asia is primarily a palaeo-bio-geographical one: a story of time, of climate and of environments. It followed the pulses of mountains' birth, of the extension of repetitively emerged and submerged continental shelves (Figure 2), of the opening of more or less continuous corridors between the continent and the archipelagos, and of the extension and fragmentation of the forests.

As living creatures, humans were deeply impacted by these ever changing environments and by the specific geographical patterns of the archipelagos. Their evolution and adaptations - including endemism- must definitely be considered in a natural history perspective. Though, owing to their sophisticated social behaviours and their technical skills, humans were not totally bound to the natural conditions and their story therefore combines biological and cultural adaptations.

The 'Ape-Man' in the Sunda islands

A heritage seen from the West …

One can say that human palaeontology was born in the Southeast Asian archipelagos. Following Darwin, Ernst Haeckel (1868) postulated the existence of an Ape-Man, a '*Pithec-Anthropos'* which he named *Pithecanthropus alalus*, his not-yet-human nature being symbolized by the lack of articulated speech. Moreover, it was supposed from Wallace's work that such 'intermediate' creatures were to be found in areas that host the extant great apes, like the orang-utan ('forest man' in Malay). At the time, only a few Neandertal fossils were known in western Europe and their position in the descent of humans was much debated.

After studying these modern ideas at the time, the Dutch anthropologist Eugène Dubois decided to begin a search for this missing-link in the Dutch East Indies, and enrolled, in 1887, as a physician in the Dutch colonial army. His first discoveries in the caves of Sumatra were quickly disseminated among the scientific community. The Brussels Society of Anthropology was told by one of his members that they constituted sound evidence that the islands were the remains of a vast landmass formerly linked to Eurasia.

Dubois was then informed of the discovery, in Eastern Java, of a quite well mineralized and fossilized human skull at Wajak near Tulungagung, which proved to belong to *Homo sapiens*. Only then did he undertake surveys and fossil collection in the Eastern Kendeng hills sites (Figure 3), a range of mountains which longitudinally crosses the Eastern half of the island. There he found, among the huge collections he subsequently shipped to the Netherlands for study and conservation, the first fragment of a fossil human mandible at Kedung Brubus (which later proved to belong to *Homo erectus*). Then, his excavations at Trinil, in an ancient fluviatile alluvia outcropping along the banks of the Solo river yielded (1) a skullcap that might be -at the first insight- that of a gibbon and (2) the following year, in the same layers, a human femur. The latter find led Dubois to pay more attention to the characteristics of the skull cap, then to decide to declare he found the fossil he was searching for, which he named *Pithecanthropus erectus* (1894) because of its ability for bipedal locomotion.

Dubois' fossils (Figures 4 and 5) became the holotype of *Homo erectus*. They are curated and displayed in the Netherlands (NCB Naturalis, Leiden).

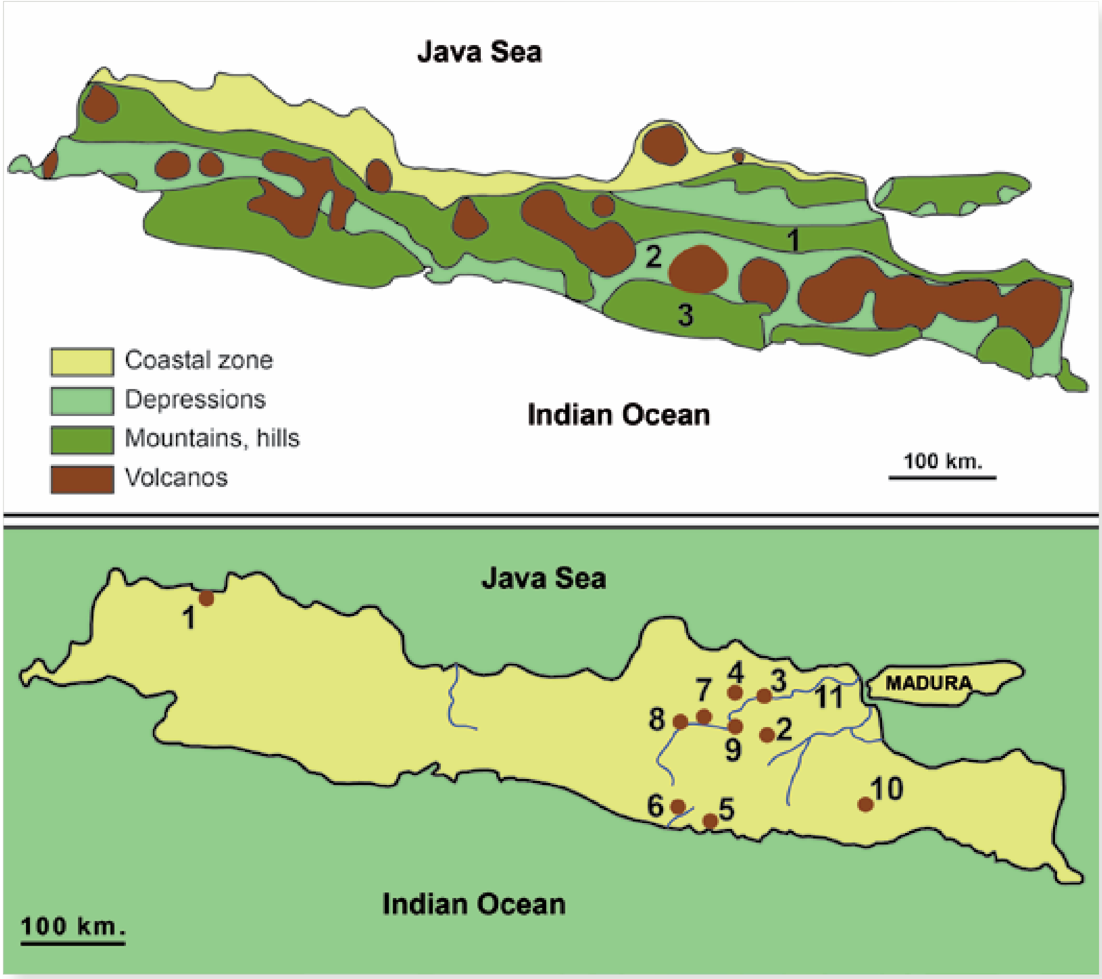

Figure 3: Maps of Java Island
(a) Physiographic map (after van Bemmelen, 1949): 1 Kendeng hills; 2 Solo depression; 3 Southern Mountains
(b) Location of quoted sites; 1 Jakarta; 2 Kedungbrubus; 3 Ngandong ; 4 Ngawi; 5 Pacitan; 6 Punung and Song Terus; 7 Sambungmacan; 8 Sangiran; 9 Trinil; 10 Wajak; 11 Solo river. © Semenanjung

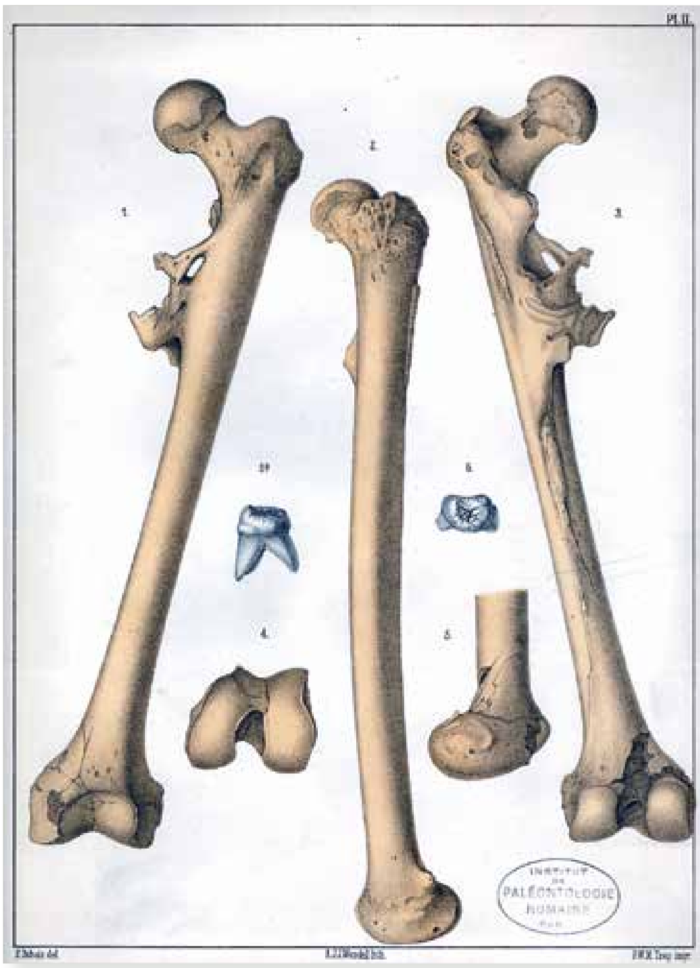

Figure 4: Eugène Dubois publication of the Trinil femur (1894). © Semenanjung

Image used thanks to Institut de Paléontologie humaine, Paris.

… and from the East

Dubois' research in Eastern Java was not randomly oriented. In fact, the conspicuous mammalian fossils found in the area were already, for a long time, part of the Javanese intellectuals and communities cultural heritage. They were mentioned in documents such as the seventeenth century tales related in the *Serat Centhini*, the famous early Javanese encyclopedia.

The fossil bones were known to be the remains of giants, the victims of the great mythic battles related in the Hindu tradition, Mahabharata and Ramayana. As an illustration, a river near Kedung Brubus was even named after such events, the *Kali Jeroan* ('river of the bowels' in Javanese). The Javanese painter Raden Saleh (1811-1880), known as a dandy attracted by the European way of life, was fascinated by the possibility of a dialogue between Eastern and Western knowledge. He profited from his periods of residence in Europe and in Java to deepen the question of the *balung buto* ('bones of giants') and to organize excavations near Kedung Brubus. His discoveries were sent to the Dutch geologist Karl Martin, who studied the relationships between the fossils and extinct taxa already discovered in India, in the Neogene statigraphic layers of the Siwaliks mountain range that borders the Southern slopes of the Himalayas. Here Richard Lydekker had already described, among others, the maxilla of a fossil ape (*Paleopithecus sivalensis*, see Kennedy, 2000).

A worldwide acknowledgment

Dubois' Trinil discovery opened the way for animated debates in the scientific community, which lasted until well after the turn of the twentieth century. Palaeoanthropology was actually born, an event followed by evidence regarding *Australopithecus* in South Africa (Dart, 1925) and continental *Homo erectus* ('*Sinanthropus',* Weidenreich, 1935) in China.

The acknowledgment of the Outstanding Universal Value (OUV) for human evolution related properties in Island Southeast Asia therefore started more than a century ago in Java on amazingly consistent and complementary grounds. These included international recognition, inter-disciplinary aspects, involvement of researchers and local communities, mobile heritage conservation or studies and even site conservation concerns. Today, we may also add a quite significant component related to history of sciences.

Figure 5: Eugène Dubois' monument signposting the discovery of Pithecanthropus erectus (P.e.), presented by Ralph von Koenigswald (right) to Pierre Teilhard de Chardin (left) during the latter's visit to Java in 1936. Drawn after a photograph by Suherman. © Semenanjung

The properties: meaningful geological deposits

Repositories of regional history

The properties related to human evolution in Island Southeast Asia cover a variety of sites, ranging from open landscapes to karstic fissures, including river terrace systems and large caves. Beyond their palaeontological and archaeological content, they behave as significant records of the environmental evolution of the region.

River terrace systems point to former hydrological base levels related to the climatic and tectonic history of the valleys. Somewhat paradoxically, the amount of the mineral supply of the rivers does not directly reflect the overall humidity of the climate. Under the tropical conditions we face, in Island Southeast Asia, 'glacial' periods which are correlated to a long dry season and subsequently to a somewhat open vegetal cover. The latter does not protect soils during the rainy season, during which severe erosion can take place, allowing the rivers to deposit abundant sediments (see for instance A.-M. Sémah et al., 2004).

Organic remains are barely fossilized in the associated deposits, but the alluvia often provided humans with the necessary raw material to make their lithic implements. These can be found among the alluvia (and hence are older or coeval), or associated with prehistoric stations at the surface of the terrace, that can be coeval or younger than the period when the river flowed at this level.

Karstic features like the fissures or the caves contain significant climatic proxies of the environment, most often outside the areas that are the richest in archaeological remains and were subject to intensive anthropic disturbance. As for example in a cave, the presence, nature and distribution of stalagmitic concretions are quite informative regarding the pace, continuity and volume of water percolation, all proxies that reflect the ambient humidity, the importance of precipitations and also the density of the vegetal cover above the ceiling of the cavity. Several analysis, as usually applied in cave sediments (e.g. Miskovsky, 2002) or specific to tropical karstic areas (e.g. Stephens et al., 2005), can be used in order to reconstruct the palaeoenvironment. The examples, shown on Figure 6 in a cave in Southern Java (Song Terus) that discloses more than 300 Ka of sedimentation (Sémah et al., 2004), depict both the spectacular growth of mushroom like stalagmites during the quite rainy early stages of the Upper Pleistocene (during part of the Marine Isotopic Stage MIS 5, here between *c.* 120 and 85 Ka) and also the clayey and carbonated layers that point to the abandonment of the cave by humans during the ever-wet period which marked the Pleistocene to Holocene boundary (here between 12,000 and *c.* 9,000 BP).

Regarding other open air properties, Central and Eastern Java island sites are certainly the best examples. Owing to the subduction of the Indian Ocean plate under Eurasia, the inner volcanic arc that includes Java Island is actually a nascent

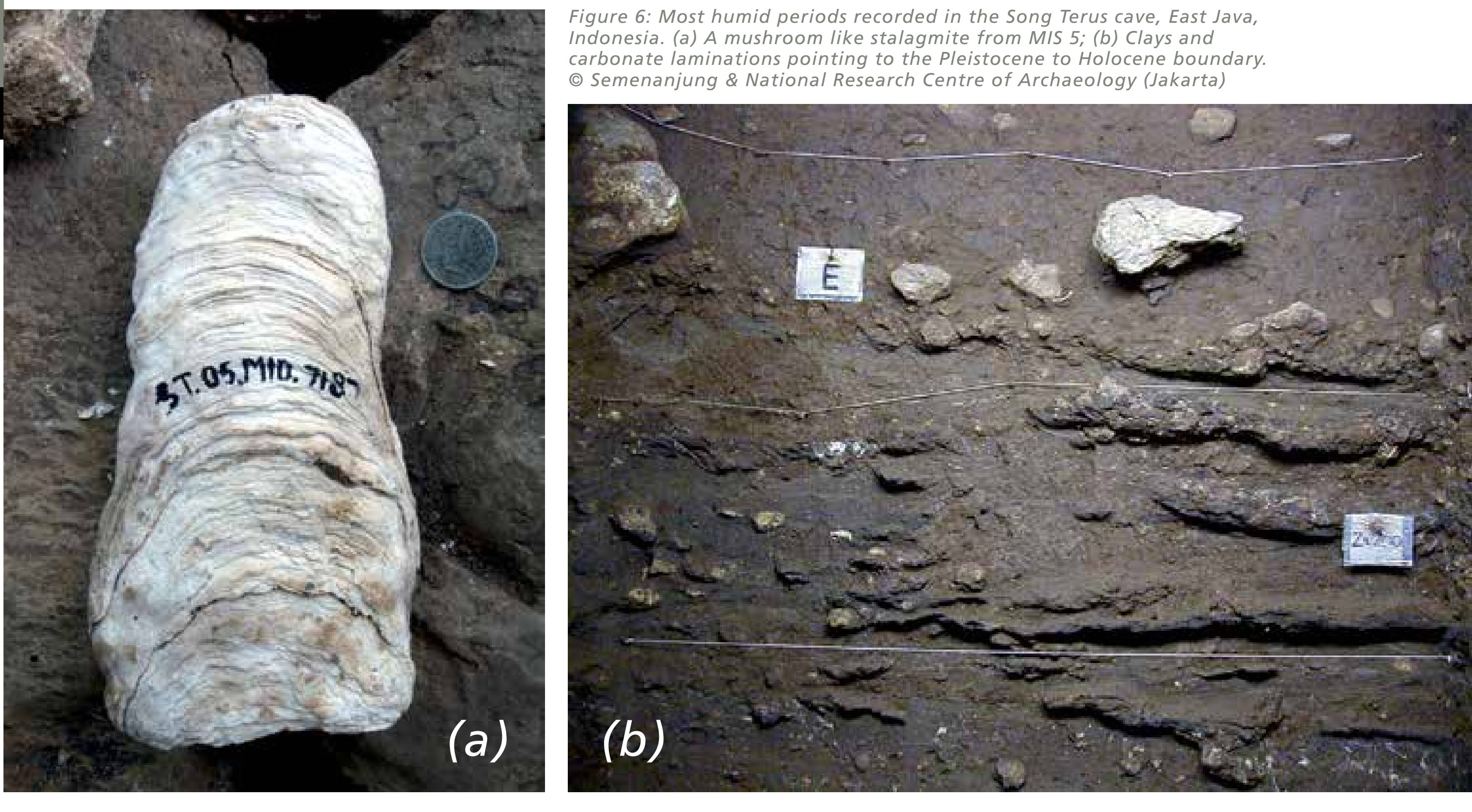

Figure 6: Most humid periods recorded in the Song Terus cave, East Java, Indonesia. (a) A mushroom like stalagmite from MIS 5; (b) Clays and carbonate laminations pointing to the Pleistocene to Holocene boundary. © Semenanjung & National Research Centre of Archaeology (Jakarta)

mountain range. Here thick stratigraphical series were deposited, which can be partly observed thanks to the tectonic activity (uprisings) and subsequent severe erosion. The intense activity of the Dutch geological survey prior to World War II resulted in the description of many stratigraphical series (see Marks, 1957), and in the discovery of numerous sites that are most helpful to understanding the environmental changes that occurred since the beginning of Quaternary times (Sémah, 1986; Sémah et al., 2000).

The related sequences depict numerous phenomena, including the early, drastic activity of the row of volcanoes that follows the island axis (see Figure 3), some 2 Ma ago, and the emergence of the island. To a certain extent, they also reflect the major climatic changes during the Quaternary: higher sea level and an ever-wet climate during the interglacial periods; lower sea level and a long dry season during the glacial ones (e.g. Sémah, A.-M., 1986; Visser et al., 2004 and Figure 2).

More than a million years of history at the Sangiran World Heritage site

A good example is that of the Sangiran World Heritage site (Figure 7), famous for the numerous fossils of *Homo erectus* discovered since the 1930s (von Koenigswald, 1940). It is one of the tectonic 'boutonnières' in the large axial depression (van Bemmelen, 1949) that crosses the island (the so-called Solo depression, Figure 3a). Along more than a hundred metres of stratigraphy (Figure 8), we can follow the 'ponding–up' of the sea during early Quaternary times due to an enormous supply of clays resulting from the weathering of volcanic ashes, then of thick lahars (between 1.8 and 1.6 Ma ago, see Swisher et al., 1994; Sémah et al., 2000). These resulted in the formation of emerged tongues of land which could be occupied by the earliest continental mammals (Bandet et al., 1989; see also von Koenigswald, op. cit.). They could cross the Sunda shelf via the land bridges that formed during the glacial periods that resulted in the recession of the shallow South China and Java seas (Figure 2).

During the major part of the Lower Pleistocene, the landscape consisted of immense mangrove forests bordering the shoreline, backed by large coastal swamps into which flowed occasional river courses, coming from the slopes of the neighbouring topography. The inland hills and volcanoes were covered by a rain forest during the ever-wet interglacial periods, while a deciduous, monsoon-like forest developed during the glacial ones, in relation to the longer dry season (while rain forest galleries persisted along the river courses, see A.-M. Sémah, 1984). However, the changes in the vegetal environment were not only due to climatic causes: volcanic eruptions repetitively destroyed the forest and were quickly followed by the growth of reconquest vegetal formations (specific grasses like *Imperata cylindrica*, or trees like *Casuarina*).

Figure 7: View of the eroded Sangiran Dome (Central Java, Indonesia) from its Northwestern cliff. © Semenanjung

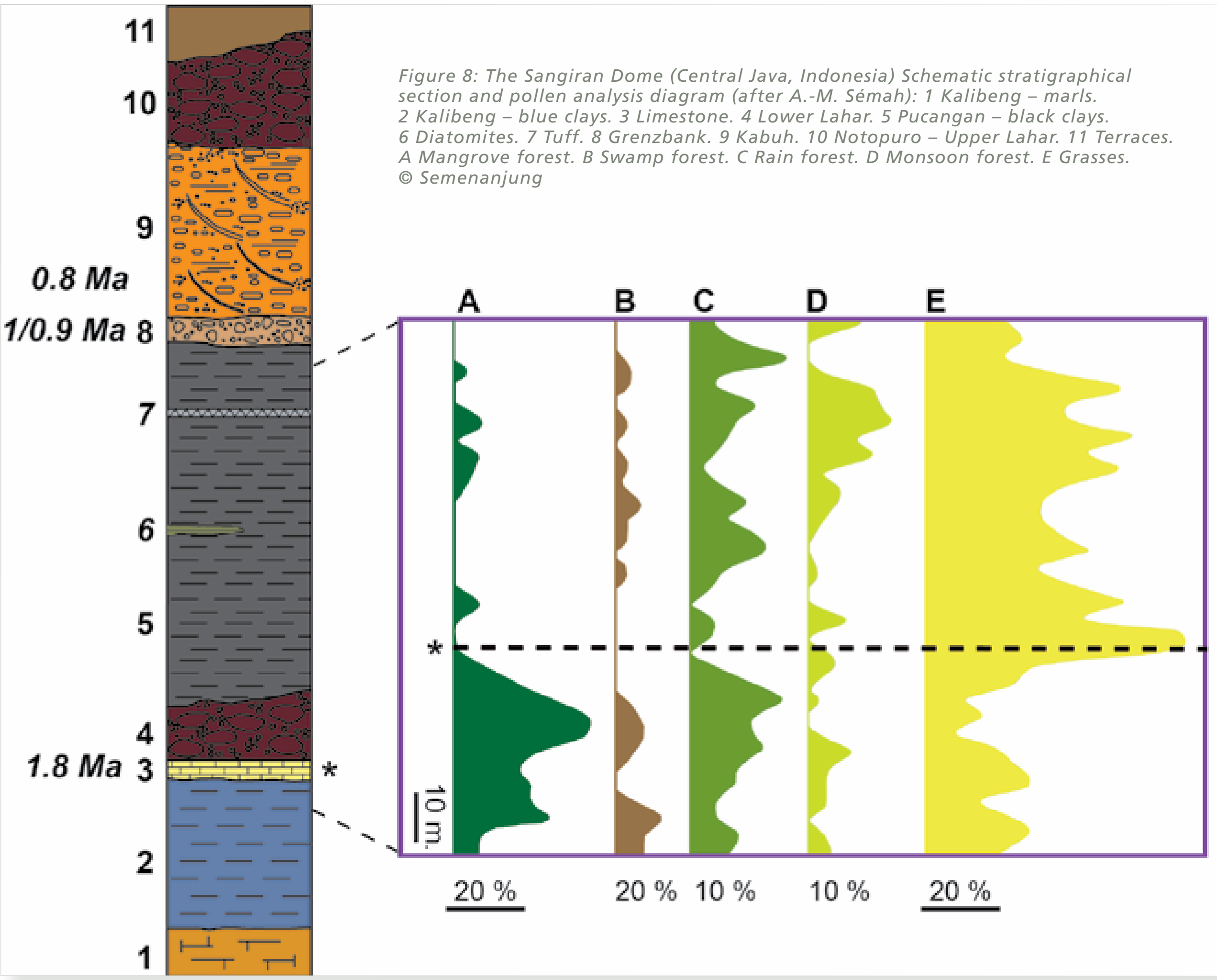

Figure 8: The Sangiran Dome (Central Java, Indonesia) Schematic stratigraphical section and pollen analysis diagram (after A.-M. Sémah): 1 Kalibeng – marls. 2 Kalibeng – blue clays. 3 Limestone. 4 Lower Lahar. 5 Pucangan – black clays. 6 Diatomites. 7 Tuff. 8 Grenzbank. 9 Kabuh. 10 Notopuro – Upper Lahar. 11 Terraces. A Mangrove forest. B Swamp forest. C Rain forest. D Monsoon forest. E Grasses. © Semenanjung

An important volcano-tectonic event took place between 1.0 and 0.8 Ma (Djubiantono and Sémah, 1993), leading to a discontinuity in the sedimentation. The volcanic activity increased and the hill ranges that border the Solo depression to the North and South underwent an uplift. These events resulted in the inflow of a huge amount of erosional products in the basin.

Around the same time, the global climate underwent a major change, one which characterizes the Lower to Middle Pleistocene boundary. The contrast between glacial and interglacial stages became stronger. The early part of the Middle Pleistocene is therefore marked by fluviatile deposits that contain, at the base of the series, a significant amount of erosive products from the hill ranges bordering the Solo depression. Then the volcanic products became dominant and, depending on the areas, they show either a primary depositional character or are the result of the erosion of older volcanic deposits.

The properties: deposits of valuable markers related to human history

Geologists are currently progressing towards the interpretation of stratigraphical series such as the one described above. Beyond absolute dating by means of radioactive isotopes, luminescence or magnetic properties of the deposits (Falguères, 2001; Larick et al., 2001; Sémah et al., 2000; Sémah et al., 2011 ; Swisher et al., op. cit.,), many proxies are of much interest in order to characterize and clarify the environmental events. We find, for example, those provided by studies in sedimentology, mineralogy or the micromorphological study of paleosoils within the series (e.g. Brasseur, 2009). But the search for biomarkers is certainly the one that provides the information which is the most meaningful regarding human dispersals and evolution.

Flora

Here we deal, at the first rank, with the vegetal environment, including the pollen analysis and the search for fossil phytoliths in the sediments (see Figure 8, A.-M. Sémah 1984; 1986; A.-M. Sémah and Sémah, 2012), that can assess the importance of the various vegetal formations mentioned earlier (mangrove, swamp forest, rain forest, monsoon forest and grasslands) and their dynamic fragmentation and extension which folllow the climatic impulses. They help the reconstruction of the general palaeoenvironmental evolution of the area, and also of the contrast between the major climatic cycles and their consequences in lowlands. As stated before, humans had to adapt from biological and behavioural points of view to various and ever-changing environments.

Fauna

Another important aspect is that of the megafauna, especially the continental mammals. The fossils not only indicate the environment in which the hominids lived and the faunal resources they could exploit, they also constitute a useful reference for understanding the dispersals and their chronology, as they follow ecological corridors. They can also be used to decipher evolutionary issues, as they can undergo endemic evolution when isolated.

Depending on the period, the mammals are known to have followed two main routes that are called the Siva-Malayan and Sino-Malayan, that are reflected in their palaeontological affinities with fossil species found on the continent. They could have reached the extremity of the Sunda shelf and Java Island following different ways, called 'sweepstake', filter or corridor, depending upon the importance of the opening of land bridges on the shelf (see von Koenigswald, 1940; 1949; de Vos et al., 1994; de Vos et al., 1982; de Vos, this volume and Figure 2).

During the Lower Pleistocene, the recession of the shallow Java and South China sea was relatively limited (see the 40 m boundary in Figure 2), implying that only a limited number of taxa could reach the islands: the animals that were most adapted to cross smaller straits were the first immigrants (like proboscids, *Mastodon* then *Stegodon*, or the *Hexaprotodon*, the Asian hippo, Figure 9), followed by other taxa like the first carnivores and hominids.

Figure 9: Hexaprotodon sivalensis*, c. 1.2 Ma (Bukuran, Sangiran Dome, Indonesia) during its reconstruction. © Semenanjung*

An important faunal change occurred around the Lower to Middle Pleistocene boundary, as the new rhythm and contrast between glacial and interglacial periods resulted in a large opening of emerged areas on the Sunda shelf (e.g. the 120 m boundary indicated in Figure 2). New immigrants are represented in the faunal remains, such as the genus *Elephas*. Then, another conspicuous faunal assemblage is found at the beginning of the Upper Pleistocene (*c.* 130 Ka onwards, (see Westaway et al., 2007) with the development, during the quite humid MIS 5, of fauna well adapted to rain forest conditions (including *Symphalangus*, a gibbon, the Malay sunbear *Helarctos*, and *Pongo*, the orangutan).

In Java, progress in establishing a mammalian biostratigraphy has represented a general concern since the early stages of research (von Koenigswald, 1936; de Vos, op. cit.). The general frame includes less than ten stages and represents a useful reference. Yet much progress has to be made in order to detail such a biostratigraphy, which must rely on the collection of statistically significant fossil assemblages recovered from reliable coeval horizons.

The situation appears even more complex in the islands that are located east of Wallace's Line, where we often lack significant collections or even a reliable chronological framework. There, the dispersal events ought to have been multiple, and endemism is likely to have played a major part, owing to long periods of isolation. This seems to have been the case in Sulawesi (van den Bergh et al., 2001), and also in several islands of the Philippine archipelago, where dwarf taxa are found.

Taphonomy and occupation floors

The need for new palaeontological documentation highlights a serious concern regarding conservation and integrity of the sites. Beyond the long story related by the stratigraphical series lies the question of the accumulation of macro fossils – including human remains- and artefacts (such as lithic tools or modified bones).

Especially in the case of open air sites, such accumulations – or at least the probability to find a rich horizon – need to be spotted in the field, using specific protocols that take into account the dynamics of sedimentation, and then included in a formalized excavation.

The first step is obviously a careful analysis of the sedimentation dynamics, to map (in a 3D perspective) the likely most important places on a property. Quite often, such a characterization results from the dialogue between a sedimentological approach and accidental surface finds. At the second step, during and after the excavation, comes the implementation of modern methods in taphonomy, methods that are still seldomly applied in Island Southeast Asia, especially to open air sites. These include the careful analysis of the dimensions, shape and surface weathering of bone fragments, and yield valuable information regarding the origin of the fossils, the nature of the transport and the diagenetic evolution (Bouteaux, 2005).

Regarding the formation and the weathering of hominids' occupation floors, the process requires even more care during the excavation: we deal not only with an accumulation, but also with a possibly meaningful spatial distribution of the items. A taphonomical approach to any recovered object, including stones, weathered mineral blocks, and sedimentary matrix helps to assess the constitution process of such floors (e.g. on a river bank or on a pedogenetic horizon) and their degree of preservation.

The above described late Lower Pleistocene and early Middle Pleistocene series of the Sangiran World Heritage property conceal a variety of important sites. These range from simple palaeontological deposits up to *in situ*, less disturbed human occupation floors (like in Ngebung, Northwestern part of the Sangiran dome, see Sémah et al.; 1992; and Figure 10), via fluviatile horizons that contain both fossils and

Figure 10: Excavations at the Ngebung site (c. 0.8 Ma, Sangiran Dome, Central Java, Indonesia). Homo erectus *occupation floor. © Semenanjung*

artefacts or archaeological accumulations of objects that directly derive from the destruction of an occupation floor (for instance, after a flood subsequent to a severe river regime change owing to a volcanic eruption, see Purnomo, 2013; and Figure 11).

Figure 11: Excavations at the Pucung site (c. 0.8 Ma, Sangiran Dome, Central Java, Indonesia). Remnants of a Homo erectus *occupation floor destroyed by a severe erosive event. © Semenanjung & Sangiran Early Man Site Conservation Office*

Human evolution in Island Southeast Asia

Early attempts to picture a regional framework

The name of *Homo erectus* (see Mayr, 1950) will be used in the following paragraphs under its 'Far East' meaning, the reader may refer to more specialized publications (e.g. Antón, 2003) regarding a possible use of the term for extra-oriental regions. With the exception of highly endemic forms such as *Homo floresiensis* (Morwood et al., 2004; see Figure 17), all the human remains predating *Homo sapiens* in the area are considered as *Homo erectus*. However, such a taxon, which lived through the continental areas and a large part of Island Southeast Asia during almost 1.5 Ma, may refer to quite different human groups.

Dubois' discovery was quickly followed by several initiatives that document an early, actual concern for the importance of the sites. Publications issued during that period still constitute important scientific references. Among the best examples is the organization of a pioneer multidisciplinary expedition some ten years after the Trinil discovery, conducted by Lenore Selenka (Selenka and Blanckenhorn, 1911). They did not actually find hominid remains, but gathered an impressive amount of documentation regarding the Trinil fossil bearing layers, including original palaeoenvironmental data about the fauna and the flora. During the 1930s, Louis Jean Chrétien van Es defended a doctoral thesis (1931, *The Age of the Pithecanthropus*) that represents a major step in the understanding of the Quaternary stratigraphical series in the Solo area as well as the possible correlations between Eastern and Central Java sites.

Studies of that kind were numerous (see also Duyfjes, 1936), and are worthy of emphasis when dealing with issues of conservation of heritage. The researchers at the time always tried to picture a regional framework, rather than merely juxtaposing discoveries. The names given to biostratigraphic horizons by von Koenigswald (op. cit.) are especially eloquent from this point of view: Eastern Java toponyms were used to qualify faunal assemblages found much farther westwards and correlate them to Eastern Java discoveries. Many hominid discoveries took place in the area during the 1930s, especially at the instigation of the Dutch Geological Survey, which recruited Ralph von Koenigswald as a palaeontologist.

Before our own species, the story of *Homo erectus*

Javanese *Homo erectus* ('Pithecanthropus') fossils cover quite a long time span. The current available dates give them an age ranging from more than 1.5 Ma ago for the earliest ones (Swisher et al., 1994; Sémah et al., 2000; see also Larick et al., 2001), while the youngest (see Swisher et al., 1996; Yokoyama et al., 2008; Indriati et al., 2011) could date back from the Upper Pleistocene (their disappearance might even have occurred after the arrival of the first *Homo sapiens,* see below).

The most archaic fossils (Figure 12) come from the Lower Pleistocene layers of the Sangiran dome. Their sometimes astonishingly robust character (see Sartono and Grimaud-Hervé, 1983), especially regarding the mandicatory apparatus

Figure 12: Earliest Homo erectus *in Java: the Sangiran 31 skull cap. © Semenanjung & Sangiran Early Man Site Conservation Office*

Figure 13: The Mojokerto juvenile skull. © Semenanjung
Photo taken thanks to the late Prof. Dr. T. Jacob, Gajah Mada University (Yogyakarta)

Figure 14: The skull Sangiran 38, early Middle Pleistocene, occipital view. © Semenanjung & Sangiran Early Man Site Conservation Office
Photo taken thanks to the late Prof. Dr. T. Jacob, Gajah Mada University (Yogyakarta)

(size and shape of the mandible and teeth, cranial superstructures, presence of a diastema between the incisors and the canine, etc.) led the scholars to name them *Meganthropus palaeojavanicus* (Weidenreich, 1951; von Koenigswald, 1940; see also Alimen, 1946). These characters appear on fossils that are not so young compared to the Dmanisi ones (Gabounia et al., op. cit.) but are definitely different. One may wonder whether their aspect is related to subsistence adaptations in the newly colonized ecosystems –especially forests.

During the last part of the Lower Pleistocene, these fossils are found in Sangiran, together with more gracile individuals (e.g. Widianto, 1993), but the fossils *are* quite fragmentary and the hypothesis of a pronounced sexual dimorphism cannot be discarded. The skull of Mojokerto (Figure 13), belonging to a juvenile individual, was found in eastern Java (see de Terra et al., 1938) and might date back to *c.* 1.5 Ma (for recent references see Huffman et al., 2005; Balzeau et al., 2005).

Then the major group (more than 50% of the total, Figures 14 and 15) of island *Homo erectus* is found, which correspond to the holotype found by Dubois, often called the 'Sangiran-Trinil' group (Widianto, op. cit.; see also Grimaud-Hervé et al., 2012). The fossils seem concentrated in the volcano-sedimentary layers dated between 0.9 and 0.7 Ma and called the Kabuh layers in the Sangiran dome (see Figure 8). The first of these numerous fossils, the skullcap Sangiran II, was discovered by von Koenigswald (1940) who immediately noticed the clear resemblance with Dubois' find. These fossils were supposed to descend from the earlier ones. Though we know that at the time of the Lower to Middle Pleistocene boundary, many exchanges took place with the continent, that are documented by the fauna and also (see below) by the cultural assemblages. This remark highlights the need for further thorough comparison between the island and continental forms of *Homo erectus* ('*Pithecanthropus*' *vs* '*Sinanthropus*', see for instance Kaifu et al., 2008), knowing that no reliable palaeoanthropological documentation is available, as yet, in continental Southeast Asia.

The most derived representatives of island *Homo erectus* (Figure 16) became famous under the name of 'Solo Men' (Oppenoorth, 1931), referring to the discovery in a high river terrace of the Solo river (near the boundary between Central and

Figure 15: Reconstruction of the Sangiran 17 individual, now exhibited in the Sangiran Museum. Reconstruction by Elisabeth Daynès (right, here together with Harry Widianto, Director of the Sangiran Early Man Site Conservation Office). © Semenanjung, Sangiran Early Man Site Conservation Office, & Atelier Daynès, Paris

Figure 16: Fossil skull from Ngandong, Homo soloensis. © Semenanjung Photo taken thanks to the late Prof. Dr. T. Jacob, Gajah Mada University (Yogyakarta)

East Java) of a dozen of fossil skullcaps. Several comparable fossils were subsequently found, mostly by accident, in similar fluviatile contexts (in Sambungmacan, see Jacob, 1975 and near Ngawi, see Sartono, 1990). All of them still bear *H. erectus* characters, but are remarkable because of their encephalization (Grimaud-Hervé, 1997). Since the first discoveries, the described anatomical characteristics led the authors to assign the 'Solo Men' to the extremity of a local phylum, comparable in several aspects to the Neandertal phenomenon that occurred at the other extremity of Eurasia, in Western Europe. Beyond their precise dating, their taxonomical status is also at stake, and some scholars (e.g. Zeitoun et al., 2010) propose to re-use the original taxon of *Homo soloensis* regarding these hominids.

Figure 17: The fossil skull LB1 (Homo floresiensis), Liang Bua, Flores Island. © Semenanjung & National Research Centre of Archaeology (Jakarta)

Pre-*sapiens* Island Southeast Asia: the kingdom of only *Homo erectus*?

Important issues regarding current and future research ensue from the discoveries addressed above. One of them concerns the descent of the archaic hominids that reached Java more than 1.5 Ma. Their adaptive specificities might well be anchored in even earlier times, and they are not necessarily the oldest to have settled on islands. Western Java sites (like Ci Julang or Bumiayu, see Kramer et al., 2005; Sémah, 1986) might well disclose even older fossils that could help to interpret the earliest processes of dispersals.

This hypothetical existence of a hominid form pre-dating *Homo erectus* was developed first by Weidenreich (1941, see Alimen, op. cit.), looking for a hypothetical relationship between *Meganthropus* and *Gigantopithecus*. On completely different grounds, a comparable hypothesis was raised quite recently about the possible descent of *Homo floresiensis* features (see Falk et al., 2005; Baab, 2012), the spectacular endemic dwarf fossil found in Liang Bua in the Lesser Sunda Islands, east of Wallace's Line (Morwood et al., 2004, Figure 17), whose age is Upper (if not late) Pleistocene. This hominid might originate either from *Homo erectus* or from an earlier species.

Such endemic forms of humankind could have actually developed in several isolated places: other, though less significant (as yet), discoveries from the same period were also made in the Philippines, such as a fragmentary human mandible in Tabon cave (in Palawan Island), a fossil discovered beside definitely *Homo sapiens* remains (see Dizon et al., 2002 and Figure 18), and a metatarsal bone in the Callao cave (Northern Luzon, see Mijares et al., 2010).

Figure 18: The Tabon frontal (Palawan, Philippines), dated between 16 and 35 ka. © Semenanjung Photo taken thanks to the National Museum of the Philippines

Homo sapiens in the archipelagos

Homo sapiens had the capacity to organize seafaring voyages, and therefore could have reached Australia more than 50 Ka (O'Connell & Allen 2004). Even if the archaeological traces of its ancient presence in Island Southeast Asia are increasingly documented through current research (see for instance Bellwood, 2007; Bellwood et al. 1998 for the Moluccas Islands; Simanjuntak et al., in press and Sémah et al., 2004 for Java; O'Connor et al., 2011 for Timor Leste), its early fossils are still very rare. The most famous discoveries are those of Wajak (recently dated as *c.* 30 Ka, Storm et al., 2013) and that of the 'deep skull' of Niah cave (Sarawak, Borneo), discovered by Tom Harrisson (see Harrisson, 1958), whose age was recently confirmed to be *c.* 40 Ka (Barker et al., 2007).

It might even be possible that quite an early dispersal, dating back to the beginning of MIS 5, could have taken place: a molar tooth from the Punung fissures, near Pacitan in east Java, is described by Storm et al. (2005) as *Homo sapiens*. This hypothesis seems to be supported by recent 'old' discoveries of *Homo sapiens* fossils in continental Southeast Asia (Bacon et al., 2012).

The fossil register becomes much more well documented in the time since the Pleistocene to Holocene boundary (Figure 19), when the dramatic rising of sea level implied a complete redistribution of human groups. At the end of the Last Glacial Maximum (LGM), the geography of the Sunda shelf underwent a severe change, from a vast emerged continental area to the present archipelagic condition. This new distribution of emerged lands led to the constitution of a mosaic of human groups that was probably as diverse as the present one (Détroit, 2002; Sémah et al., 2004). It was followed, only several thousands of years ago, by the dissemination of Neolithic traditions and of Austronesian speaking people, who were ready to conquer the Pacific Ocean archipelagos (Bellwood, 2007).

The cultural register

A long debate about *Homo erectus'* need for stone artefacts

The study of the archaeological record in Island Southeast Asia has long suffered from the will to build a model comparable to the prehistoric chronology of Western Europe (i.e. including the Lower, Middle and Upper Palaeolithic periods, a Mesolithic and a Neolithic one as well). This is expressed –or underlying- in numerous publications (including the reference book written by van Heekeren, 1972). Though, in the most dynamically fragmented tropical environments we deal with, such models do not appear realistic compared to the complexity of natural and social phenomena related to insularity, which are likely to have existed for all hominid groups, including the early ones.

However abundant the artefact discoveries are, often in alluvial systems, well-distributed throughout peninsular and insular Southeast Asia, from Malaysia to the Philippines and Timor Leste, cultural 'key-fossils' appear to be very rare in the area. One of the possible exceptions is that of the Hoabinhian 'sumatraliths' (unifacially knapped pebbles) found over a large part of continental Southeast Asia, possibly to Southern Sumatra (see Forestier, 2010), but which do not actually extend throughout the archipelagos.

Most of the archaeological record is based on artefacts that can be conserved through time, which are stones and, to a lesser extent, durable organic material (bones, teeth and shells). The use of perishable materials, especially vegetal materials, is rarely documented in the sites, but it must have played an important part in human life (see for instance Pope, 1989; Bar-Yosef et al., 2012).

The concern regarding *Homo erectus*' behaviour developed quickly after the discovery of the hominids, when von Koenigswald associated the search for artefacts to his palaeoanthropological and palaeontological discoveries. He therefore characterized the presence of smaller, sometimes retouched flakes in the alluvial deposits of the Sangiran dome (the so-called 'Sangiran flakes', von Koenisgswald and Gosh, 1973; Figure 20) and also found the 'Patjitanian' Lower Palaeolithic implements in the Southern Mountains of Java (along the course of the Baksoka river, near Pacitan, von Koenigswald, 1936; see also Bartstra, 1976). This assemblage became famous and includes, among other implements, actual handaxes (Figure 21).

The direct relationship between these artefacts and *Homo erectus*, though well-accepted at the beginning (e.g. Teilhard de Chardin, 1937), has long been the subject of debate among the scientific community. At this point the question of the systematic use of vegetal material led scholars to assume that *Homo erectus* made only smaller flakes or opportunistic tools, but had no actual need for elaborated stone artefacts.

Figure 19: A Homo sapiens burial (c. 9000 BP) discovered in the Song Terus cave (Punung, East Java, Indonesia). © Semenanjung & National Research Centre of Archaeology (Jakarta)

Figure 21: Example of Patjitanian handaxe (actual length = 260 mm). © Semenanjung, National Photo taken thanks to the late Prof. Dr. S. Sartono, Institut Teknologi Bandung

Figure 20: Example of 'Sangiran flake' (actual length = 40 mm). © Semenanjung

The Lower Palaeolithic dispersals

Regarding the earliest periods, the basic challenge in the search for and the study of stone implements is to be able to characterize their association with a given hominid, knowing that the *Homo erectus* fossils are seldom discovered in archaeological horizons. The last decades have shown (see for instance Sémah et al., 1992) that the frequent lack of stone artefacts in the layers that accumulated the vertebrate fossils (including, being the case, hominids) was in fact linked to the sedimentation dynamics, the scarcity of stones, and hence the corresponding difficulty for hominids to find suitable lithic raw material.

The earliest implements that are currently known come from the late Lower Pleistocene series (*c*. 1 Ma ago) in the Southeastern part of the Sangiran dome (Widianto, 2006). These are typical 'Sangiran flakes', most of them made from rocks transported from the Southern Mountains of Java which border the Solo depression (Figure 3a). Though some flakes look quite fresh, their overall dimension and petrography match those of the sedimentary matrix, hence prompting questions concerning not their age but their local origin: they might have been brought into the depression, together with the gravels, by the rivers flowing from the Southern Mountains.

Figure 22: In situ stone artefacts and fossils from the Ngebung site, Northwestern part of the Sangiran dome (c. 0.8 Ma). A cleaver made of andesite appears in the lower part of the picture. © Semenanjung

The overlying Kabuh volcano-sedimentary series discloses several kinds of –more or less disturbed- occupation floors that contain stone balls ('bolas') cleavers, horse hoofs and polyedra, artefacts that look typical of the Acheulian tradition (Figures 10 and 22; Sémah et al., 1992) and are often associated with manuports and modified bones or teeth (including artefacts) in the studied sites. The most sophisticated artefacts made use of pebbles that were clearly imported by humans from deposits that can be traced quite far from the site (more than 20 km). This is especially the case for several stone tools made from quartz, quartzite and other metamorphic rocks (see also Soejono, 1982).

Accordingly, the large land bridges that opened the Sunda shelf during the Lower to Middle Pleistocene transition (e.g. A.-M. Sémah and Sémah, 2012; see Figure 2) seem to have allowed contacts with the continental *Homo erectus*, as well as the dissemination of the Old World-wide Acheulian tradition to the Southeast Asian archipelagos (see Simanjuntak et al., 2010; Sémah A.-M. et al., 2010). Beyond the Patjitanian assemblage, further discoveries confirm that such a 'large flake Acheulian' tradition (Mishra et al., 2010) could undergo a large dispersal, such as surface finds in Southern Sumatra (cleaver and handaxe, Forestier, 2007) and even in Luzon Island in the Philippines (handaxe of Arubo site, Dizon and Pawlik, 2010). These results, together with discoveries of the same age on the continent, especially in China (see Brumm and Moore, 2012) revisited Hallam Leonard Movius' theory (1944) claiming the lack of handaxes and the persistence of choppers and chopping tools in oriental Eurasia.

Regarding the same period, one of the most spectacular pieces of evidence was certainly the discovery of Lower Palaeolithic implements in Flores by Theodor Verhoeven (Maringer and Verhoeven, 1970; see also van Heteren and de Vos, 2012). Recent fieldwork on the island has confirmed the antiquity of the finds in the Soa basin, which might reach 1 Ma (Brumm et al., 2010). Therefore, around the major climatic boundary that is characteristic of the Lower to Middle Pleistocene transition, humans could cross the sea straits east of Wallace's Line and settle on new islands. Such an early journey may actually appear as an amazing one, taking into account the – somewhat subconscious- 'symbolic' value of Wallace's Line as a barrier. Though, we must consider this evidence in the global spatial and chronological framework of human evolution throughout Quaternary times in Island Southeast Asia. We are still far from able to precisely reconstruct the various mechanisms of human dispersals during the Lower and Middle Pleistocene. In this context, the journey to Flores would not have been more adventurous than the one completed by the earliest hominids that crossed southwards the equatorial belt until Java during the Lower Pleistocene, and followed a complex itinerary full of hazards, with shorter marine straits, immense mangrove and swamp forests, and quite closed lowland rain forest as well.

From the end of the Middle Pleistocene to Modern Humans

The period that follows the early Middle Pleistocene still lacks continuity in the record, but certainly presents a high number of stone artefacts-bearing sites. Mostly found in an alluvial context, their chronology is still far from precisely established. Moreover, the uncertainty concerning the extinction of the most derived *Homo erectus* often prevents the attribution of a lithic assemblage to *H. erectus* or to *H. sapiens*.

Late Middle Pleistocene assemblages discovered in a good stratigraphical context are rare. The sites linked to the Solo River course contain artefacts, whose age is not precisely established, some are described by van Heekeren (op. cit.). Their relationship with the 'Solo Men' is debated, though stone balls are clearly associated with the fossil-bearing deposits; the Sambungmacan site yielded a couple of implements (Jacob et al., 1978). The longest chronology, from some 300 Ka ago up to the early Upper Pleistocene, has been established in the Punung karstic area, in Eastern Java (Sémah et al., 2004; Tiauzon, 2011). Here, the Song Terus cave has trapped fluviatile, artefact-bearing alluvia whose earliest age is Middle Pleistocene. The series ends with quite old cave occupation horizons dated during the first sub-stages of MIS 5 (between 120 and 85 Ka, Tu, 2012). It yields a rather homogenous lithic assemblage with medium sized chert flakes obtained using an opportunistic method. A significant number are retouched, producing scrapers, denticulated scrapers and notches (Figure 23).

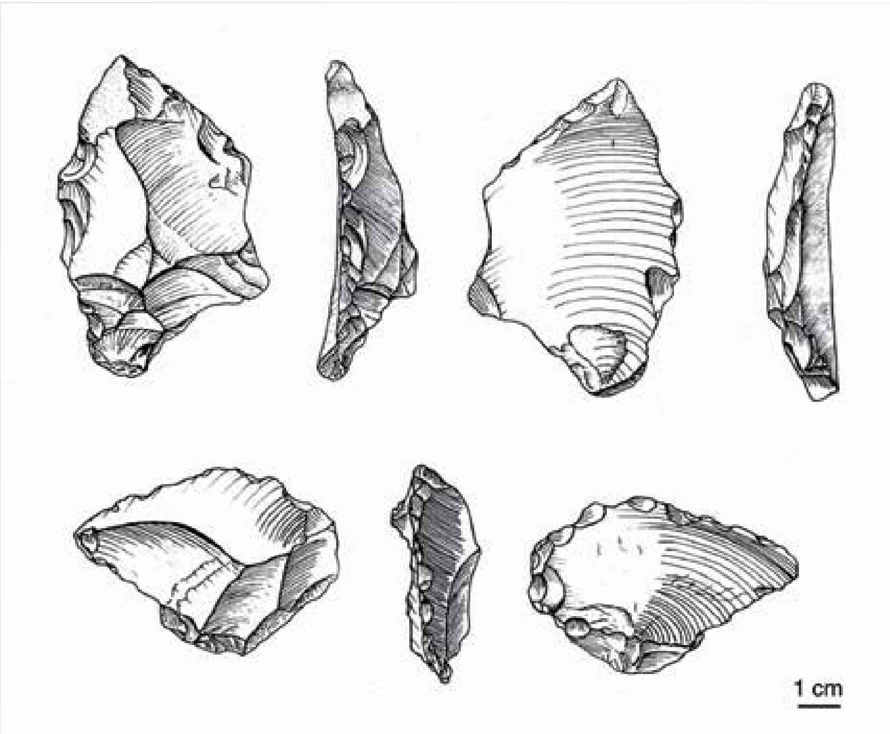

Figure 23: Late Middle Pleistocene artefacts from Song Terus cave (Punung, East Java). Drawing Dayat Hidayat. © Semenanjung & National Research Centre of Archaeology (Jakarta)

The current challenge for the scholars is therefore to develop the collection, dating and description of such assemblages that are often found throughout the archipelagos, and whenever possible to correlate them with the palaeoenvironmental conditions during a period that witnessed the crucial biological replacement between *Homo erectus* and *Homo sapiens*. It is worth noting here that the recently nominated Lenggong Valley World Heritage property, located in peninsular Malaysia, includes conspicuous stone implement workshops, such as in Bukit Jawa, whose age could reach as far back as 200 Ka (see for instance Majid, 2001).

From the Late Upper Pleistocene to the Early Holocene

The approach should be precisely the same regarding the records that extend through the end of MIS 3 and the LGM and might include the trace of some local adaptive specificities: as for instance, we find here the possible implementation of a Levallois débitage in Leang Burung (Maros karstic area, South Sulawesi; Glover, 1981) or the early fireplaces of Tabon cave (Palawan, Philippines), recently dated *c.* 35 Ka, that are associated with flake implements (see Dizon et al., op. cit., Fox, 1970; Lewis et al., 2008; Patole-Edoumba et al., 2012 and Figure 24). This situation is a consequence of both easier circulation on the emerged Sunda shelf and the correlative narrowing of sea straits separating the islands, though only a smaller part of the area, that which is still emerged today, can be studied.

Figure 24: The Tabon cave, Lipuun Point, Palawan Island (Philippines). © Semenanjung Photo taken thanks to the National Museum of the Philippines

Then appear the last 'Palaeolithic' groups, after the drastic sea level rise of the beginning of the Holocene, which reflect an even larger diversity. All of these sites help in understanding the adaptation of humans to their environments. The comparative study of archaeological records helps to define chronological markers that accompany the dissemination of practices and innovations characteristic of Modern Humans (Simanjuntak et al., in press): large development of cave settlements, systematic use of fire, sophisticated bone and shell implements (e.g. Setiagama et al., 2006), symbolic behaviours, practices related to controlled seafaring (e.g. pelagic fishing, that appeared well before the LGM, see O'Connor et al., op. cit.), etc.

A crucible of past and present human diversity

The short insight given in the previous pages illustrates several major characteristics of the part played by Island Southeast Asia in human evolution, ones that should be kept in mind whenever dealing with the Outstanding Universal Value, authenticity and integrity of properties, or with the implementation of any management plan on the sites.

Island Southeast Asia appeared more than one and half centuries ago as a fantastic laboratory for the study of biodiversity and its origins, and to study as well the diversity of extant and past humankinds and their related societies. Cultural and natural aspects are profoundly interrelated in the area. This must be taken into consideration for approaches in terms of research or conservation, and is directly related to concerns of ecosystems and biodiversity protection in such rapidly developing countries.

A mandatorily ongoing field research

The potential of Southeast Asian islands in terms of research appears immense, including sites that are already identified. We have highlighted the significance of the stratigraphical series in terms of chronology and palaeoenvironmental reconstructions, which represents the basic mandatory approach to understand hominids' dispersals, evolution, adaptation and way of life. Even though numerous scientific methods are not yet applied systematically in the area, for example those which will help to characterize palaeontological and archaeological horizons in the stratigraphical series.

Under such a point of view, one must acknowledge that a large part of the properties OUV is still unknown. Evaluation of the integrity of the sites and the implementation of conservation practices are therefore not easy tasks. Beyond some obvious deposits or areas (especially those from which come the most spectacular discoveries), this evaluation requires a permanent scientific update by means of close collaboration between site managers and researchers, and also a prospective capacity in order to know, as precisely as possible, what is to be preserved for future research.

Besides concerns about chronology, climate and environment, there is that of correlation between sites. As such, a specific effort must be made at various scales. The Sangiran dome itself, considered as a World Heritage property, extends over more than 50 sq. km. It includes many 'sites' (as it is the case for instance in many areas of East Africa related to human evolution) which need specific attention in terms of correlation. The dome is also closely related to a number of analogous structures around it (see van Es, 1931; Djubiantono and Sémah, 1993). Such correlation studies are developing (see Brasseur, 2009; Purnomo, 2013) but are still far from being numerous enough. They obviously need to be extended more on a regional scale (e.g. the Java Island), following the Dutch geologists' approach that gave birth to a regional (bio-) stratigraphy.

Mobile heritage and documentation

Research also addresses mobile heritage and documentation. Collections from Island Southeast Asia are conserved in numerous places, following the older trend to bring back the discoveries to central institutions (including, especially for Indonesia, European countries). Only a few of the sites are currently equipped to host and curate collections and documents in a modern way. Good practices, access and exchange of information must be encouraged on a large regional and international scale, and will help the scientific programming of new collection studies and new field campaigns.

In continuity with the remarks above concerning early correlation works, we must emphasize that the number of researchers and their current field programs is still limited, that field conditions themselves are often difficult, and that severe erosion permanently endangers many properties. Therefore, gathering, facilitating access to, and, as the case may be, reinterpreting old documents and data is a mandatory task, whose importance was highlighted by recently published works about eastern Java fossil-bearing sites (de Vos et al., 1994; Hufmann et al., 2005), about Tabon human fossil bearing site in the Philippines (Corny and Détroit, 2010), or about Niah cave in Malaysia (Barker et al., 2007).

What was inscribed? What is to be nominated?

The unique property related to human evolution inscribed on the World Heritage List (1996) is the Sangiran dome (under criteria iii and vi), besides the recent inscription (2012) of Lenggong valley (in peninsular Malaysia, criteria iii and iv). A couple of other properties are on the Tentative List, notably the Maros karst in Sulawesi (Indonesia), the Lipuun Point in Palawan and the Palaeolithic archaeological sites of the Cagayan valley (Northern Luzon) in the Philippines. It is quite interesting to note that the value of both Maros and Lipuun sites is grounded not only on their prehistoric merit but also on the need for conservation of landscape, ecosystems and biodiversity (Figures 24 and 25).

Therefore, there is a striking contrast between the –obviously very limited– number of possible nominations and the actual regional scope of the heritage; there is a striking contrast as well between the cultural dimension of the considered criteria for the inscribed property(ies) and the much larger natural history perspective that grounds their OUV.

Figure 25: The landscape of the Lipuun Point, Palawan Island (Philippines)
(a) Landscape: The mouth of the cave is below the large one that appears on the picture;
(b) Beachrock and Rhizophora along the beach. © Semenanjung
Photo taken thanks to the National Museum of the Philippines

Until present, the initiated nomination process has been based on the most spectacular discoveries, which explains the 'cultural' nature of the considered criteria. However, in order to fulfil the scientific needs described above, and to develop a consistent management plan for the properties, the framework of such nominations on the World Heritage List, on the Tentative List, and even in the framework of other UNESCO and advisory body programs (e.g. Geoparks) the scope must be clearly enlarged on more thematic grounds, and take into account the various dimensions of the heritage. This can help to decipher the natural history of human evolution in Island Southeast Asia, including the many islands of Wallacea where the complex endemic history is only partly known.

Beyond mandatory regional and international collaboration, one of the ways to proceed might be to ensure that the States Parties' investment in a nominated property (e.g. museographic and scientific human and equipment resources; management think tanks that include the participation of local communities), may 'radiate' all around for the benefit of other important sites that will not be subject to nomination. One good example is the possible influence that the inscription of the Sangiran dome can have on the conservation, interpretation and management of the famous historical Trinil area, where the *Homo erectus* holotype, the '*Pithecanthropus erectus*' was discovered.

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The Archaeological Heritage of the Lenggong Valley, A UNESCO World Heritage site

Datin Paduka Zuraina Majid
Department of National Heritage Ministry of Information, Communications and Culture – Malaysia

The Archaeological Heritage of the Lenggong Valley (AHLV), Malaysia (ID No. 1396) was inscribed as a UNESCO World Heritage site during the 36th World Heritage Committee Meeting on 30th June 2012 (Saturday) in Saint Petersburg, Russia. This historic achievement is the fourth World Heritage site for Malaysia and the 953rd in the world. This testifies to another dimension of the global recognition of Malaysia as a nation endowed with and committed to the conservation and protection of its world renowned heritage.

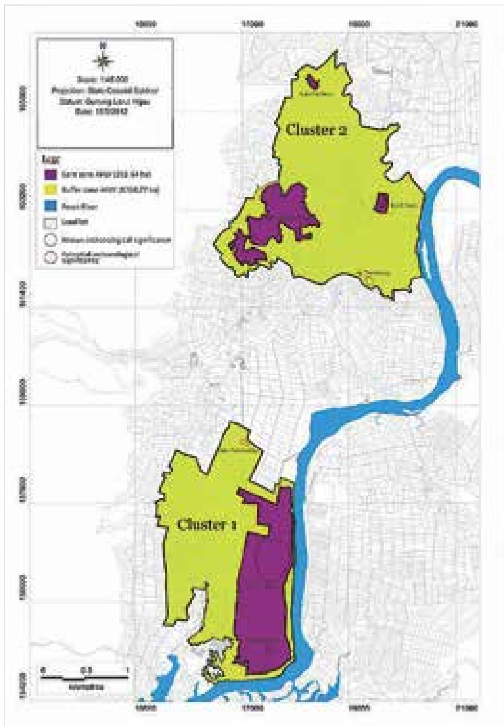
The Archaeological Heritage of the Lenggong Valley is singularly significant for dating the earliest presence, thus far known, of prehistoric people in Southeast Asia. The undisturbed archaeological sites in the Archaeological Heritage of the Lenggong Valley are exceptional because they preserve *in situ* an outstanding record of the evolution of human cognitive complexity evidenced by the development of lithic tradition and stone tool technology over an extremely long culture sequence from 1.83 million years ago until the Holocene.

The archaeological discoveries, all located within a single valley whose environment has remained stable over the past 2 million years, provide important milestones in dating the presence of prehistoric people in Malaysia. This valley has had an impact on theories concerning the expansion of hominids throughout Australasia and the evolution of their stone tool cultures. This makes the Archaeological Heritage of the Lenggong Valley a unique culture landscape of Outstanding Universal Value for the study and understanding of world prehistory.

Area of the property

Figure 1. Location of Lenggong Valley, Perak.

Figure 2. Map of Lenggong Valley showing the four core zones and buffer zones in Cluster 1 and Cluster 2.



The Lenggong Valley covers an area of 9,773 hectares. The total area of the property for the World Heritage site is 2,213.51 hectares, as follows:

SITES	AREA IN HECTARES
Cluster 1	
Core zone	281.06
Bukit Bunuh-Kota Tampan	851.34
Buffer zone	
Total area for Cluster 1	1,132.4
Cluster 2	
Core zone	
Bukit Jawa	6.18
Bukit Kepala Gajah	108.25
Gua Harimau	3.15
Buffer zone	963.51
Total area for Cluster 2	1081.11
Total Area for the Property	2213.51

The area of the property and its buffer zones

The property consists of two clusters, namely Cluster 1 and Cluster 2. Each of these clusters comprises one or more core zones with their respective buffer zones. Cluster 1 consists of the Bukit Bunuh-Kota Tampan core zone and its own buffer zone, while Cluster 2 consists of three core zones, namely Bukit Kepala Gajah, Bukit Gua Harimau and Bukit Jawa, all enclosed within a single buffer zone.

Figure 3. Cluster 1 Bukit Bunuh – Kota Tampan Core Zone.

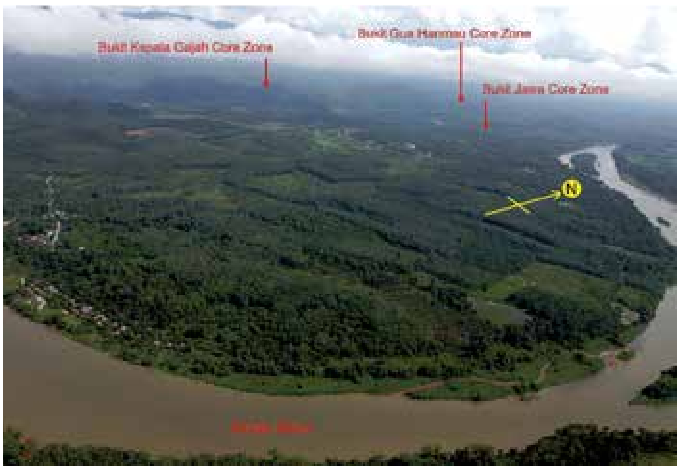


Figure 4. Cluster 2 Bukit Jawa, Bukit Kepala Gaja and Bukit Gua Harimau Core Zones.

Statement of Outstanding Universal Value

The Archaeological Heritage of the Lenggong Valley (AHLV), which is comprised of both open-air and cave sites, provides a series of chronologically-ordered and spatially-associated culture sequences from the Palaeolithic through the Neolithic up to the Metal period. These sites have been chronometrically dated from 1.83 million to 1,000 years ago. Thus, the Lenggong Valley is one of the longest archaeological culture sequences found in a single locality in the world.

The AHLV also contains a large number of undisturbed *in situ* Palaeolithic sites making it of extraordinary importance for the study of Palaeolithic culture outside of Africa. *In situ* Palaeolithic sites are extremely rare because over such a long time period, natural processes and human activities are bound to disturb the archaeological context.

The extraordinary survival of a particular *in situ* Palaeolithic site has contributed to the understanding of Palaeolithic technology and environmental adaptation. Kota Tampan is a rare example in the world, of a prehistoric site where the cause and date of site abandonment can be determined. Presence of ash from the last catastrophic Toba volcanic eruption in the *in situ* Kota Tampan site sediments suggests that man had to suddenly flee the site because of this major catastrophe around 74,000 to 70,000 years ago, leaving behind his tool-making 'equipment' as well as both finished and unfinished tools in the 'workshop'.

Of special interest in the AHLV is the discovery of Perak Man, a skeleton of a man who was buried about 10,000 years ago in Gua Gunung Runtuh, a cave near Lenggong Valley. Besides providing important information on Palaeolithic burial ritual, he is also an important find for medical history as currently he is the early known prehistoric skeleton born with *Brachymesophalangia* Type A2.

Given this Outstanding Universal Value, the significance of the AHLV are as follows:
- *In situ* Palaeolithic Workshop in Kota Tampan
- A rare Palaeolithic skeleton born with *Brachymesophalangia* Type A2
- One of the longest Prehistoric culture sequences in a single locality in the world
- An Archaeological Valley comprising all the stages of prehistory – Palaeolithic, Neolithic and Metal Periods

Criteria

The AHLV was inscribed based on the criteria (iii) and (iv). The criteria are as follows:

Criterion (iii)

> **'Bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared'.**

The Archaeological Heritage of the Lenggong Valley holds one of the longest culture sequences in a single locality in the world, covering an extraordinary range of nearly 2 million years and spanning all the periods of hominid history outside of Africa. The artefactual evidence for this is found in open-air and cave sites situated in close physical proximity to one another and located in a river valley that has remained geologically and environmentally stable for the past 2 million years.

The key markers in this long culture sequence can be seen in the excavated sites of Bukit Bunuh, Kota Tampan, Bukit Jawa, Gua Gunung Runtuh and Gua Harimau.

The open-air site of Bukit Bunuh BBH 2007, located in Cluster 1, records the earliest hominid presence thus far known in Southeast Asia at 1.83 million years ago with the discovery of some of the oldest hand axes in the world and other tools embedded in suevite, a rock type formed under high heat and pressure that resulted from a meteorite impact dated by the fission-track technique to 1.83 million years ago.

Evidence for continued hominid presence in the Lenggong Valley is found in a long chronological series of *in situ* open-air stone tool workshop sites located throughout Clusters 1 and 2 and extending from Bukit Jawa (200,000 - 100,000 years), to Kota Tampan (70,000 years), and to another Bukit Bunuh BBH 2001 site (40,000 years).

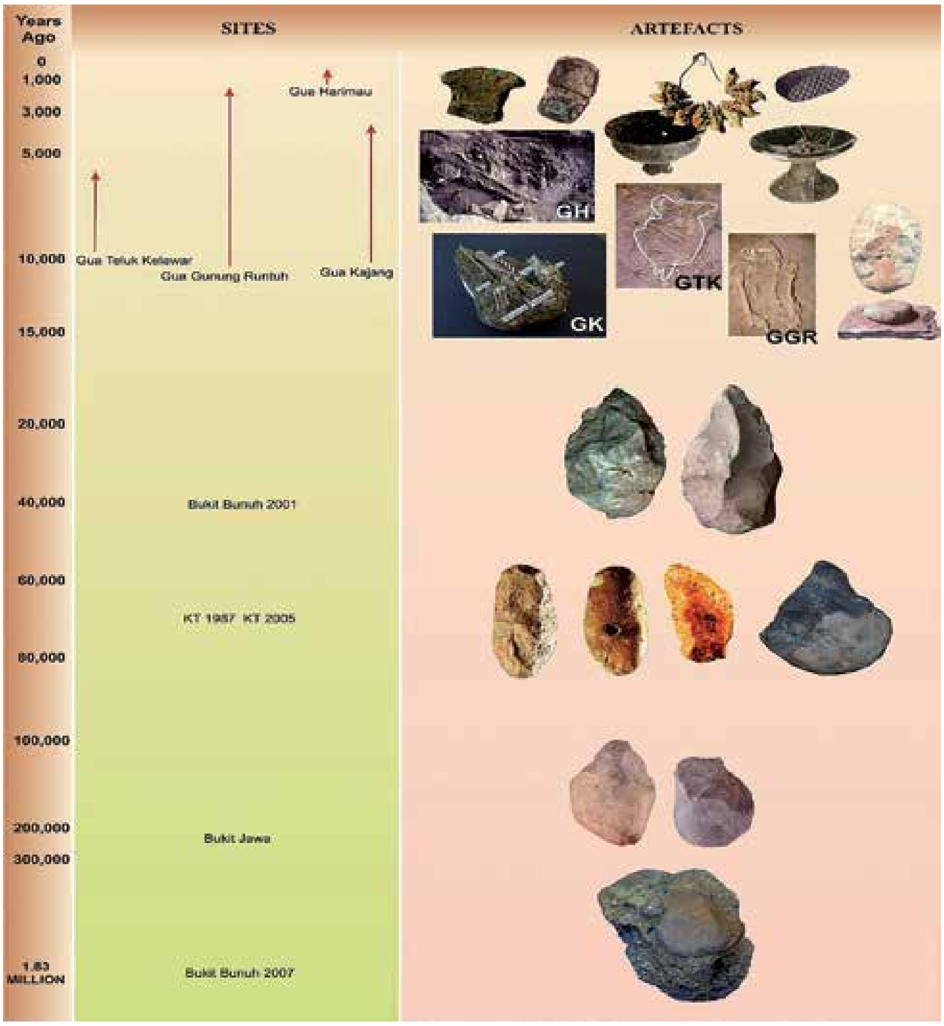


Figure 5. Lenggong Valley Chronological Sequence.

Figure 6. The Bukit Bunuh crater in 2000 showing the centre of the meteorite impact Suevite and other impacts (left, foreground) that were exposed through plantation activities.

Figure 7. A hand axe embedded in suevite rock from Bukit Bunuh dated 1.83 million years ago indicates the presence of man.

Kota Tampan in Cluster 1 is a rare example of a prehistoric site where the cause and date of site abandonment can be determined. Presence of ash from the last catastrophic Toba volcanic eruption in the *in situ* Kota Tampan site suggests that man had to suddenly flee the site because of this major catastrophe around 74,000 to 70,000 years ago, leaving behind his tool-making 'equipment' and both finished and unfinished tools in the 'workshop'. In addition to the open-air sites, the Lenggong Valley contains numerous cave and rock shelter sites which were occupied by the inhabitants of the valley during the late Palaeolithic when both geological and climatic conditions created habitable floors in the caves. There are a total of five limestone massifs, containing caves and rock shelters within the core and buffer zones of the nominated property.

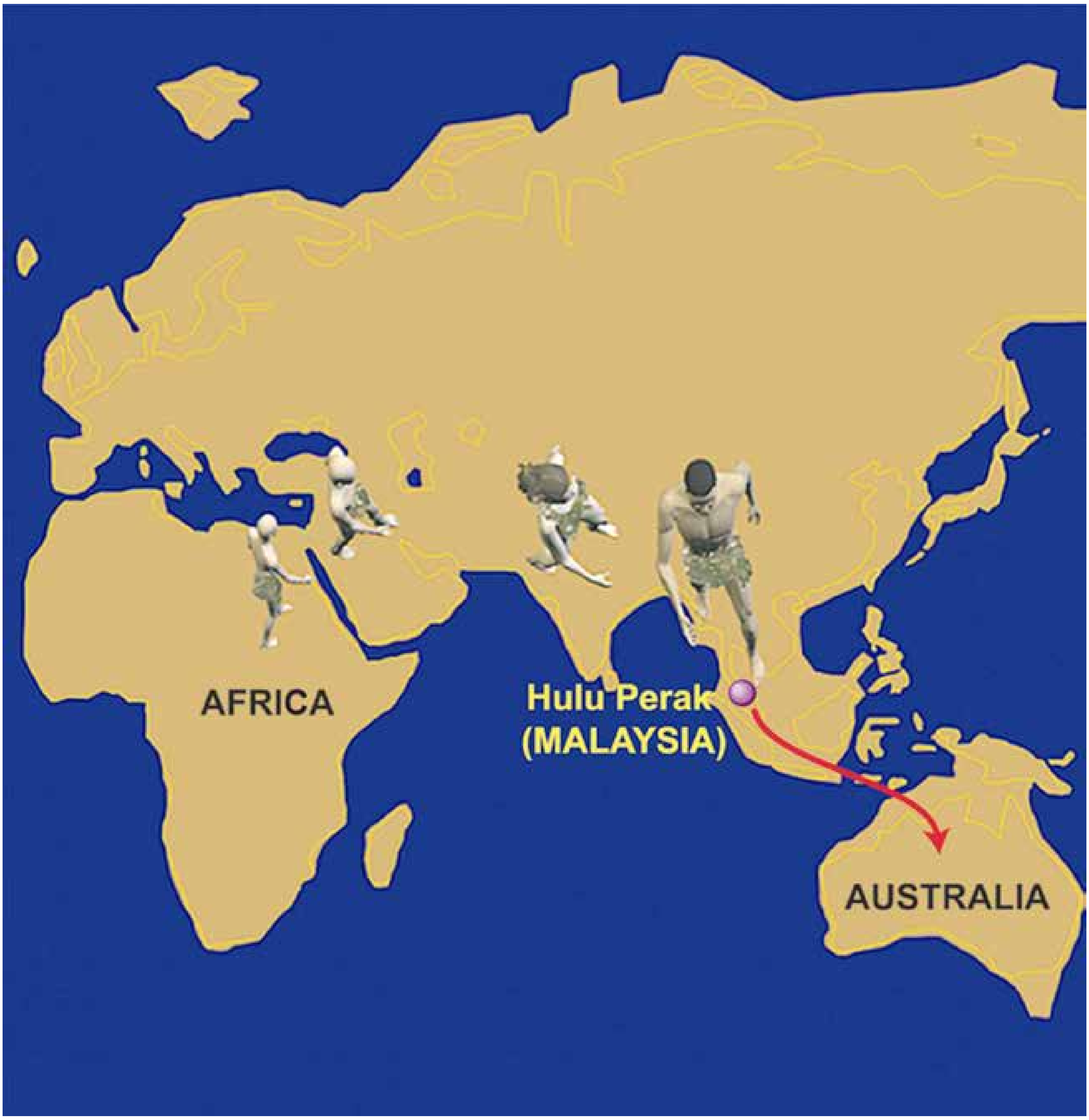


Figure 8. Human migration out of Africa to Australia.

The cave sites in Cluster 2 – Gua Gunung Runtuh (13,000 – 1,000 years ago) and Gua Harimau (4,000 – 1,000 years ago) – which contain human burials, among other archaeological finds such as earthenware and bronze artefacts, give further evidence of the prolonged and permanent presence of humans in the Lenggong Valley from the Palaeolithic through the Neolithic into the Metal Period. These sites give an extraordinary and unique insight into the culture of the prehistoric societies in the Lenggong Valley. Gua Gunung Runtuh contained the remains of Southeast Asia's oldest most complete Palaeolithic human skeleton, the iconic Perak Man, dated by the radiocarbon technique to the late Palaeolithic 10,120 ± 110 BP (Beta-38394). Analysis of the remains of Perak Man shows that he was born with a congenital deformity known as *Brachymesophalangia* type A2, a rare condition which continues to be present in modern human populations. The fact that the Perak Man skeleton was preserved in its entirety (an extremely rare occurrence in Southeast Asia due to climatic conditions which do not favour the preservation of human remains), enables us to understand the genetic make-up and medical history of early human populations.

Cave drawings by local aborigines bring the Lenggong Valley sequence up to historical times.

Figure 9. Excavation of Gua Gunung Runtuh, a cave that was occupied from about 13,000 to 2,000 years ago. The 10,000-11,000 year old Perak Man was discovered in this cave.

Figure 10. The skeleton of Perak man found in-situ, with knees drawn up to the chest, and a re-enactment of how he was buried.

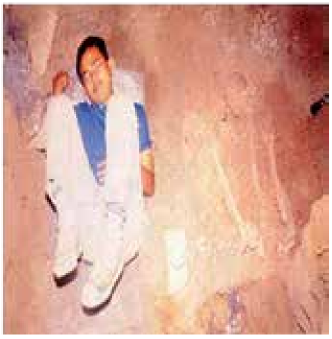


Figure 11. The excavation of Gua Harimau.

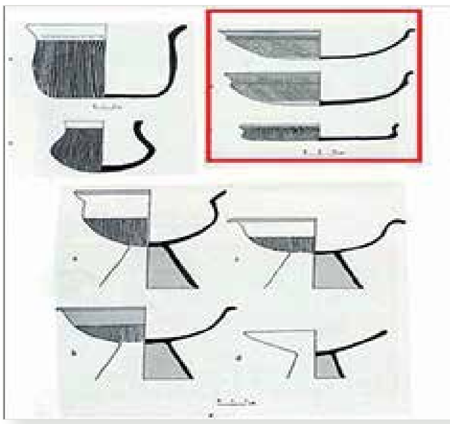


Figure 12. The shape of the stacked shallow pottery bowls and small globular vessel together with other vessel shapes from Gua Harimau.

Figure 13. Part of the broken bronze celt, found together with both halves of its clay bivalve moulds.

Figure 14. Ornaments found associated with the burials at Gua Harimau – from left bangles, earrings, bone pendant, translucent bead and shell necklace.

Figure 15. Bronze celt found in Gua Harimau.

Criterion (iv)

'Be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage in human history'.

The Archaeological Heritage of the Lenggong Valley provides an outstanding and extraordinary record of the Palaeolithic technological ensemble of prehistoric people. With its rich and unique evidence of *in situ* stone tool workshops spanning a 200,000 – 100,000 year period of time, the Archaeological Heritage of the Lenggong Valley reflects the evolution of human cognitive complexity in the form of a rational and systematic mind, an understanding of lithology and an efficient method of stone tool production. An outstanding example of lithic manufacturing of the Palaeolithic period is to be found at the *in-situ* Kota Tampan site. Kota Tampan has become an important global reference site for Palaeolithic tool technology.

The undisturbed archaeological sites in the AHLV are unique because they preserve *in situ* an outstanding record of the evolution of human cognitive complexity evidenced by the development of lithic tradition and stone tool technology over an extremely long time sequence from 1.83 million years ago to the recent past.

Figure 16. Kota Tampan was located on the shores of a palaeo-lake which has since receded. The remnants of the lake can still be seen in the background.

Figure 17. Kota Tampan.

Figure 18. The excavation site at Kota Tampan, Lenggong.

Figure 19. Stone tools found in Kota Tampan. They were found in-situ, and the ash in between the artefacts provided a secure date for the site.

Figure 20. Stones with many lines of weakness were discarded because these predetermined the shape and could not be flaked according to the desired form.

Figure 21. Stones which were too hard were discarded because of the difficulty in shaping them to the tool-makers' mental template.

Figure 22. Made from a quartzite pebble, this Palaeolithic chopper was found at Kota Tampan. Choppers have a wide distribution as they have been found in mainland Southeast Asia and China.

The inscription of the archaeological heritage of the Lenggong Valley

Figure 23. Volume I & II of the Nomination Dossier for Archaeological Heritage of the Lenggong Valley.

The process of nomination began, in 2009, with the Tentative List. After the site was included in the Tentative List on 4 January 2010, as a State Party, the Department of National Heritage, Ministry of Information Communications and Culture Malaysia actively prepared the nomination document with the help from various government departments/agencies. Among the efforts and actions that have been taken for completing the nomination were; having a series of Technical Committee Meetings on Dossier and Management Plan, Dossier Preparation Meetings, Briefing to the Land and District Office, Meeting on Management Plan, Focus Group Workshop on Management Plan, Lembah Lenggong Carnival Towards World Heritage List, Focus Group on Special Area Plan, Evaluation Mission by UNESCO-ICOMOS, Promotional Programme, Meeting with the Representatives of World Heritage Committee, etc. The process of nomination had involved various parties from the Federal Government, State Government and Local Authority as well as the Local Stakeholders.

There are some challenges and difficulties encountered during the nomination processes. Amongst them are as follows:

- Identification of the most appropriate criteria
- Identification of the boundaries (core and buffer zones)
- Getting Consent from the State Authority
- Cooperation and readiness of the stakeholders
- Looking for the protection measures
- 'Deferred' recommendation by the ICOMOS evaluator

However, the State Party managed to handle the above challenges and the World Heritage Committee unanimously supported and approved the inscription of the AHLV as a World Heritage site on Saturday 30 June 2012, at the resplendent Tauride Palace in Saint Petersburg, Russian Federation. It was accepted as an important archaeological site in the understanding of humankind – an important piece filling in the jigsaw on the story of early man in the world.

This recognition would create a socio-economic spin-off for Lenggong Valley and Perak as a whole, and would spur efforts to conduct more archaeological research in the valley. However, this is just the beginning; with this recognition comes the great responsibility of developing and conserving the Archaeological Heritage of the Lenggong Valley without diminishing its importance, as well as creating sustainable management to ensure Lenggong Valley remains on the World Heritage List.

Figure 24. Technical Committtee Meeting on Dossier Preparation, Penang 13 March 2010.

Figure 25. Focus Group Workshop for Management Plan, Taiping, Perak 22-24 July 2010.

Figure 26. Technical Committee Meeting on Dossier Preparation, Penang 7-27 January 2011.

Figure 27. Lembah Lenggong Carnival towards World Heritage List, Lenggong, Perak, 27-29 May 2011.

Figure 28. Evaluation Mission by Advisory Body ICOMOS, Lenggong, Perak 11-15 Sept 2011.

Figure 29. Promotional Programme in UNESCO, Paris 13-17 Feb 2012.

Figure 30. Meeting with the Representatives of the World Heritage Committee Paris, 7 June 2012.

Figure 31. The Inscription of the Archaeological Heritage of the Lenggong Valley, St Petersburg, Russian Federation, 30 June 2012.

The Niah Caves in Malaysia: potential for World Heritage nomination, justification of Outstanding Universal Value, conditions of integrity and authenticity, and guidelines for optimal protection and management of the site

Graeme Barker
McDonald Institute for Archaeological Research – University of Cambridge – United Kingdom of Great Britain and Northern Ireland

Abstract

The Niah Caves in Sarawak, Malaysian Borneo, were the focus of major archaeological excavations by Tom and Barbara Harrisson in the 1950s and 1960s, and further work by Zuraina Majid in the 1970s. For decades the anatomically-modern 'Deep Skull', found by the Harrissons in 1958 and dated by adjacent charcoal to around 40,000 years ago, was the oldest fossil of an anatomically modern human anywhere in the world and thus critical to ideas about modern human evolution and dispersal, but several authorities questioned its provenance and antiquity. A renewed programme of fieldwork was initiated in 2000 (the 'Niah Caves Project') to clarify the archaeology of the caves, integrating a wide range of studies in geoarchaeology, palaeoecology, bioarchaeology and artefact analysis. This work has established that the Deep Skull was *in situ* and dates to around 37,000 years ago, and that human occupation of the caves by almost certainly *Homo sapiens,* had begun by at least 50,000 years ago. The project has reconstructed the 50,000-year long history of the human use of the caves, of the changing landscape around the caves over the same timescale, and of the interactions between the two, demonstrating that people have been shaping the rainforest throughout this history. Remarkable survival of organic remains including plant tissues, starch grains, butchered animal bones, and bone artefacts has allowed the team to reconstruct the systems of foraging (hunting and gathering) practised by the prehistoric visitors to the caves, and the sophisticated technologies they developed for living in the rainforest. Studies of the bone chemistry of later populations, combined with palynology, provide unique insights into the complexity of foraging/farming transitions in the last 10,000 years. The archaeology of the Niah Caves represents an unrivalled record not just of human occupation and burial activity within the caves, but of the history of people's interactions with the surrounding rainforest from the first arrival of *Homo sapiens* to the age of European colonialism. This paper discusses the heritage value of the Niah Caves, and strategies for their protection and management.

Introduction

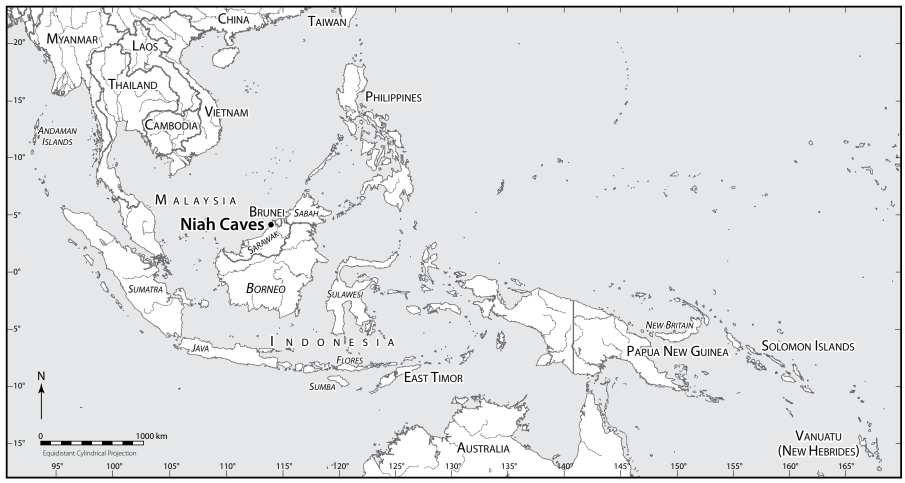
The Niah Caves of coastal Sarawak in northern Borneo (N 3° 48' 54.6', E 113° 46' 52.3') have been a subject of archaeological interest ever since the mid nineteenth century, when the naturalist Alfred Russel Wallace visited Sarawak in 1855 to collect biological specimens; though he was unable to visit the caves, he reported their likely significance for anthropological research to Charles Darwin and Thomas Huxley, resulting in initial archaeological explorations in the 1870s (Sherratt, 2002). It was the 1950s and 1960s excavations of Tom and Barbara Harrisson, however, that brought the caves to international attention, especially those in the West Mouth of the Great Cave (Figure 1) and in particular the Harrissons' discovery there in 1958 of an anatomically modern skull that they dated to *c*. 40,000 years ago, the so-called 'Deep Skull', at that time the earliest such fossil in the world. Renewed investigations since 2000 have confirmed the central importance of the site for human evolution studies in Southeast Asia, in particular providing unique evidence

Figure 1: The West Mouth of the Great Cave; the archaeological reserve is on the far right, immediately in front of the tourist boardwalk visible on the skyline.

on the behavioural complexity of the modern humans who first started to visit the caves *c*. 50,000 years ago (Barker, 2013; Barker, et al., 2007, 2013). The new work suggests that for most of their 50,000 years of human use, the caves were probably special places of darkness and mystery, liminal between life and death, as well as providing advantages of shelter; and secondly, that the rainforests around the caves have been shaped and managed by people over that same timescale in ways reminiscent of the system of caring for the landscape (*molong*) practised today and in the recent past by the Penan foragers of Borneo.

The caves and their setting

The Great Cave is a cathedral-like cavern on the northern edge of the Gunong Subis, a roughly circular limestone massif on the edge of the coastal plain of Sarawak, about 15 km from the South China Sea (Figure 2). The Gunong Subis is about 4 km wide, with exterior cliffs rising vertically several hundred metres; the highest point is about 400 m above sea level. The Great Cave forms the interior of an outlying block of limestone called Bukit Bekajang that is separated from the main massif by a steep ravine. The Great Cave is at the centre of the Niah National Park, an oasis of primary and secondary rainforest within the expanse of oil palm plantations that dominate the swampy coastal lowlands of Sarawak. There are innumerable caves and fissures on the edges of the Gunong Subis, but the Great Cave is the focus of any visit to the Park, reached today by a well-maintained boardwalk that extends for about 3.5 km from the National Park headquarters on the Sungai Niah (Niah River) through Dipterocarp-dominated tropical rainforest.



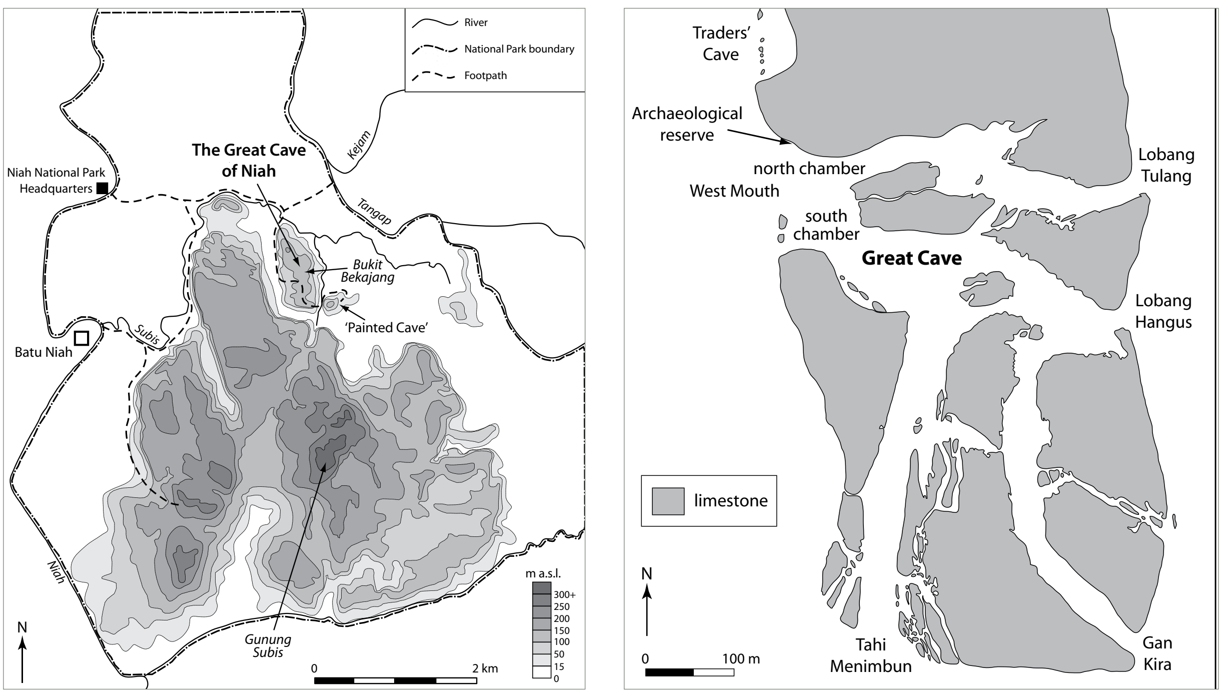


Figure 2: (a) The location of the Niah Caves in Southeast Asia; (b) Niah National Park, showing the location of the Great Cave of Niah and Kain Hitam, the 'Painted Cave', on the edge of the Gunong Subis massif; (c) the Bukit Bekajang outcrop, showing the location of the main entrances to the Great Cave. (Cartography: Antony Smith and Dora Kemp).

The caves are renowned for their huge populations of swiftlets and bats. The evening rush of many thousands of bats from the caves, especially from the West Mouth of the Great Cave, and the return of similarly vast numbers of swiftlets, has long been one of the tourist attractions of Sarawak (Figure 3), as Edwards Banks described from his visits in the 1930s:

> **'The grandest sights of all take place in the Niah cave mouth...In the evening from about five-thirty to six o'clock the cave entrance is filled with a squeaking mob of swifts on parade, fresh ones arriving from afar all the time...High pitched screams, persistent chirping and the papery fluttering of small wings are the only sounds that are heard...As if there were not enough in the air already, for an hour or more a steady stream of cave bats issues forth as the swifts are making up their minds to come in. From far inside the cave comes an apparently endless, yard-wide column of medium-sized, silent leaf-nosed bats and horse-shoe bats, with a smaller number of little mouse-eared and bent-winged bats...Perhaps the most spectacular part of the evening was the birds of prey waiting around the cave mouth for these bats and swifts, and here one could see at ease the way the hawks were taking their natural food on the wing' (Banks, 1931, p.30-31).**

Figure 3: Bats streaming out of the Mulu Caves at dusk.
© Chris Stimpson

For centuries, the nests of the black-nest swiftlet (*Aerodramus maximus*), made from its own spittle, have been collected by local people to sell at premium prices for birds-nest soup, which is highly valued by the Chinese for its nutritional and therapeutic properties (Koon and Cranbrook, 2002; Medway, 1962a, 1962b). The nests are reached by the birds-nesters (traditionally local Penan foragers, though now mostly hired labourers working for local Malay or Chinese merchants), who shin dizzying heights up enormous poles made of sections of *belion* hardwood clamped together, fixed to the cave roof by supports strapped to the pole and jammed under tension into the cave roof. A network of bamboo and scaffolding extends from these anchor points across the roof of the cave, hundreds of feet above the cave floor. The nests are knocked off the cave wall with a blade attached to a long pole, and collected on the ground.

The Harrisson and subsequent excavations

In the 1950s and 1960s Tom and Barbara Harrisson conducted excavations in many of the cave entrances, but the largest and most important for early prehistory were those in the West Mouth of the Great Cave. In February 1958 a team led by Barbara Harrisson discovered, in the deepest part of their excavation near the front of the West Mouth (the 'Hell Trench', so called because of the difficult working conditions in it under the full afternoon sun), the skull and other bones of an anatomically modern human (Brothwell 1960). Its antiquity was indicated by charcoal found the previous year near the skull findspot, which had been dated by the then revolutionary method of ^{14}C or radiocarbon dating to 39,820±1012 BP (GrN-1339C; calibrated, the date would be 42,391-45,629 BP) (Harrisson 1958; Figure 4). Along with rich evidence for early human occupation (ash, charcoal, pieces of butchered animal bone, occasional stone tools) found in the Hell Trench, the Harrissons discovered similar material from their excavations immediately to the north of this area, in front of and underneath a small rock overhang or shelter formed at the northern cave wall (Figure 5). Further ^{14}C dates indicated that this area, part of what they termed the 'frequentation zone' or 'habitation zone' extending across the front of the cave entrance, indicated the regular use of the West Mouth by foragers (hunter-gatherers) up to the end of the Pleistocene (the 'Ice Ages') and into the Holocene (the modern climatic era, the boundary of which is placed about 11,000 years ago).

Farther into the interior of the West Mouth they made other spectacular discoveries: the largest collection of Neolithic and Metal Age burials, almost 200 (representing some 400 bodies), ever found in Southeast Asia, dated by ^{14}C from about 4000 to about 2000 years ago (B. Harrisson, 1967; Figure 6). They conducted smaller excavations in several other entrances of the cave complex, finding evidence for small-scale Pleistocene occupation in Gan Kira, Early and Mid Holocene occupation in Lobang Hangus, and Neolithic/Metal Age burials in Lobang Tulang and Gan Kira as well as in numerous other caves around the Gunung Subis. In Kain Hitam, a few hundred metres east of the Gan Kira entrance to the Great Cave, they found wooden boats which they dated by ^{14}C to about 1000 years ago with human bones scattered around them, close to wall paintings of boats and dancing figures that were thought likely to be associated with the boat burials. The sequence of human activity finished with Chinese tradewares and beads, taken to be evidence of the birds-nesting trade in recent centuries. The work

Figure 4: (left) The discovery of the 'Deep Skull'. The label to the left of the partially-excavated skull refers to the location of the charcoal found the previous year and dated to c. 40,000 BP; (below) the Deep Skull after restoration (left) compared with a modern human skull (right).
Photographs reproduced with permission of Sarawak Museum.

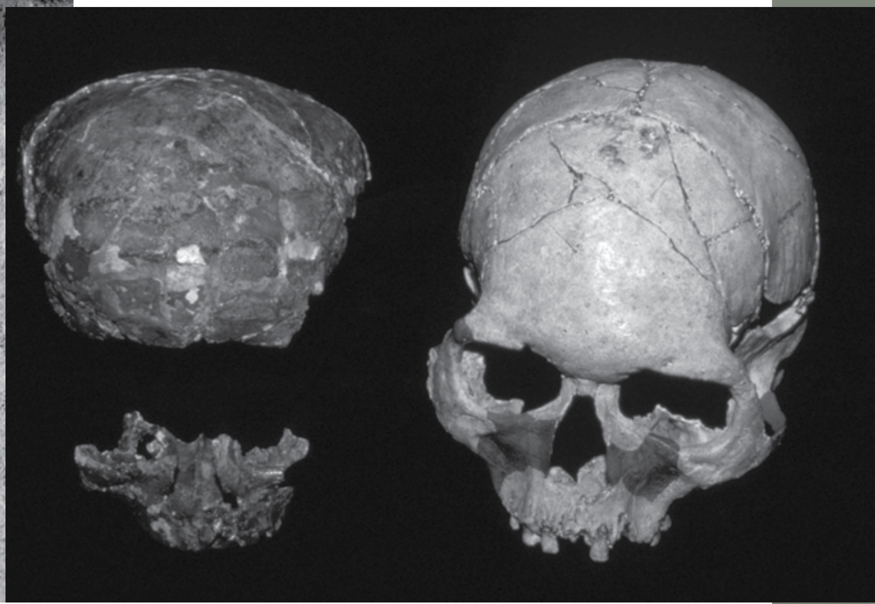
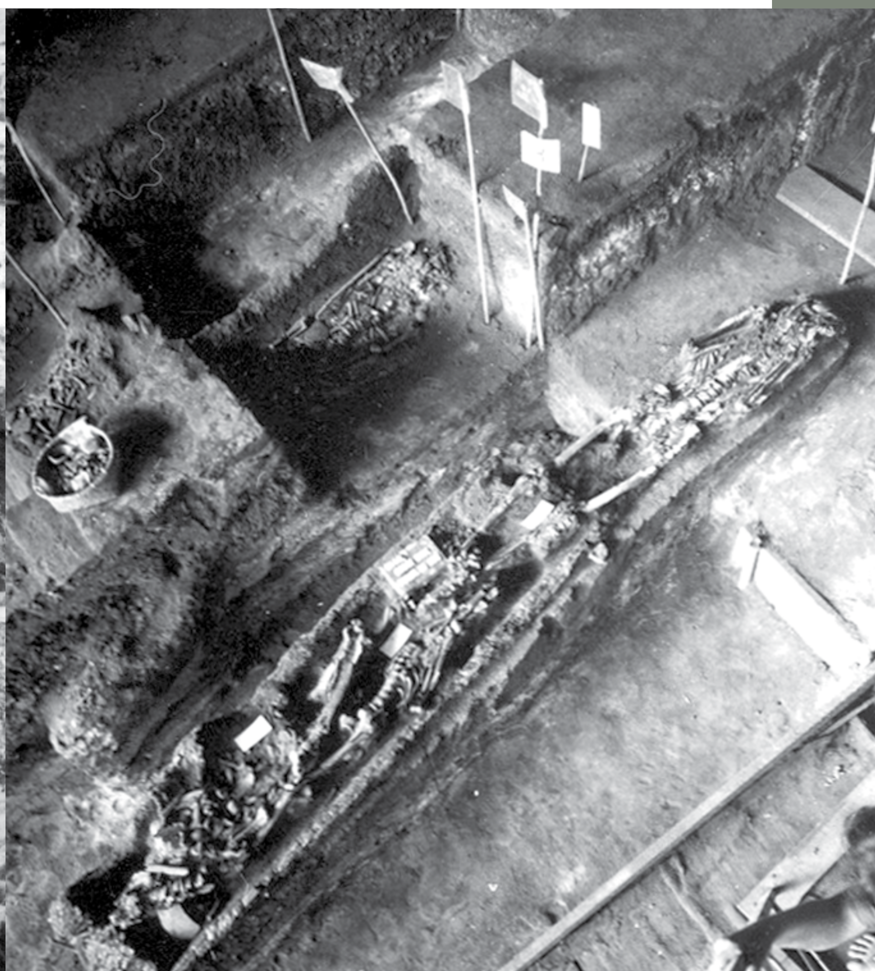


Figure 5: Looking north across the archaeological zone in the West Mouth. The roof in the foreground covers the Hell Trench where the Deep Skull was found; behind is the rock overhang on the north wall that formed an important focus of prehistoric occupation.

Figure 6: Neolithic extended burials in the 'Neolithic Cemetery' zone of the West Mouth, excavated by Barbara Harrisson.
Photograph reproduced with permission of Sarawak Museum.



gave the caves iconic status in the archaeology of Island Southeast Asia (indeed, in Southeast Asia as a whole) as having the longest sequence of human occupation known in the region.

For a number of reasons the Harrissons were never able to publish their excavations in final form, and despite the many interim papers they published (e.g. B. Harrisson, 1958, 1959, 1967; T. Harrisson, 1957, 1958, 1959a, 1959b, 1964, 1966, 1967, 1970, 1972), some of their discoveries, stratigraphic findings and interpretations were controversial. One of the criticisms subsequently raised by scholars was that, given the fact that caves frequently have complex dipping deposits, the excavation method of horizontal spits used by the Harrissons was likely to have mixed together material of different ages. Also, a key component of their dating was extrapolation by depth,Tom Harrisson arguing that the most common deposit in the West Mouth, what he called the 'pink and white layer', accumulated as a drizzle of sediment from the cave roof at a steady and constant rate, but a simple depth-age relationship in cave sediments ran counter to the experience of most cave excavators. The major question was whether the Deep Skull was really as old as Tom Harrisson claimed. In the 1970s the Malaysian archaeologist Zuraina Majid conducted further smaller-scale excavations in the West Mouth for her PhD which made a notable contribution to understanding the Niah sequence (Majid, 1982), but significant uncertainties remained. This was the context for further fieldwork with a related laboratory, artefactual and archival studies (the Niah Caves Project, hereafter the NCP) that began in 2000, coordinated by the author. The main fieldwork took place between 2000 and 2004 and analytical work has continued ever since, focussed both on materials from the new fieldwork and the rich assemblage of archaeological finds in the Harrisson Excavation Archive in the Sarawak Museum, Kuching, which includes animal bones, human bones, shells, stone tools, bone tools, pottery, textiles, resins and beads. The results of the excavations have been reported in a number of papers (e.g. Barker et al., 2000, 2001, 2002a, 2002b, 2003, 2007, 2009; Barton, 2005; Barton et al., 2009; Gilbertson et al., 2005; Higham et al., 2008; Hunt & Rushworth 2005; Hunt et al., 2007, 2012; Piper and Rabett, 2009a, 2009b, 2009c; Rabett et al., 2006; Stephens, 2004; Stephens et al., 2004, 2007) and the two final reports on the project are in press (Barker 2013, et al. 2013).

The NCP had three major objectives in terms of contributing to major research questions about the prehistory of Island Southeast Asia. The first was to establish the age of the Deep Skull and, if it was Late Pleistocene as the Harrisson ^{14}C date suggested, the antiquity and character of the hominin (human) use of the West Mouth at this time. The second was to reconstruct the history of the landscape around the caves contemporary with human use of the caves, in particular the history of rainforest, because some anthropologists had proposed, from studying modern groups of foragers (hunter-gatherers), that it was impossible to live in rainforest as a forager because of the lack of easily available carbohydrates – most contemporary foragers trade with farmers for some of their staple foods. The third major area of interest was whether the archaeology of the caves could contribute to ongoing regional debates about when and how foraging gave way to farming, in particular rice cultivation and pig husbandry.

The sedimentary sequence in the West Mouth

The NCP investigations in the West Mouth have defined a series of major geomorphic and palynological phases bracketed by new ^{14}C dates (Gilbertson et al., 2005; Higham et al., 2008; Figure 7). In the period >50,000-37,000 BP, colluvium (defined as Lithofacies 2C) slid down from the cave lip into a natural basin on its interior side, where it interbedded with silts and clays formed by episodes of stream flow from the cave interior (Lithofacies 2). The climate alternated between warmer and wetter, and cooler and drier conditions with corresponding landscape changes between lowland forest, mangroves and coastal swamps (in the former) and dry montane and lowland forest (in the latter). It became progressively drier and cooler after *c.* 45,000 BP, though there were still episodes of hot wet climate when lowland rainforest and mangroves developed in the vicinity of the caves. Around *c.* 35,000 BP, possibly triggered by a major roof fall, earthquake, or very wet episode, there was a major collapse of wet guano (Lithofacies 3) in the West Mouth interior that caused a mud-flow that filled the West Mouth basin, deforming and covering the existing sediments. Thick sequences of archaeology-rich brown silts (Lithofacies 4) then built up across the front of the West Mouth, forming from soon after the mudflow until the Early Holocene *c.*8500 BP. Most of the latter sediments were removed by the earlier excavators, but enough remain to indicate that human activities in the Terminal Pleistocene and Early Holocene included the digging of pits and their filling with food refuse. The wind-blown component in Lithofacies 4 and the associated palynological record suggest an overall trend towards a drier and more open landscape in this part of northern Borneo *c.* 20,000-10,000 BP, before the hot and wet climate of coastal Sarawak today, and dense rainforest, developed with the onset of the Holocene. Guano dominates the remainder of the Holocene sedimentary sequence.

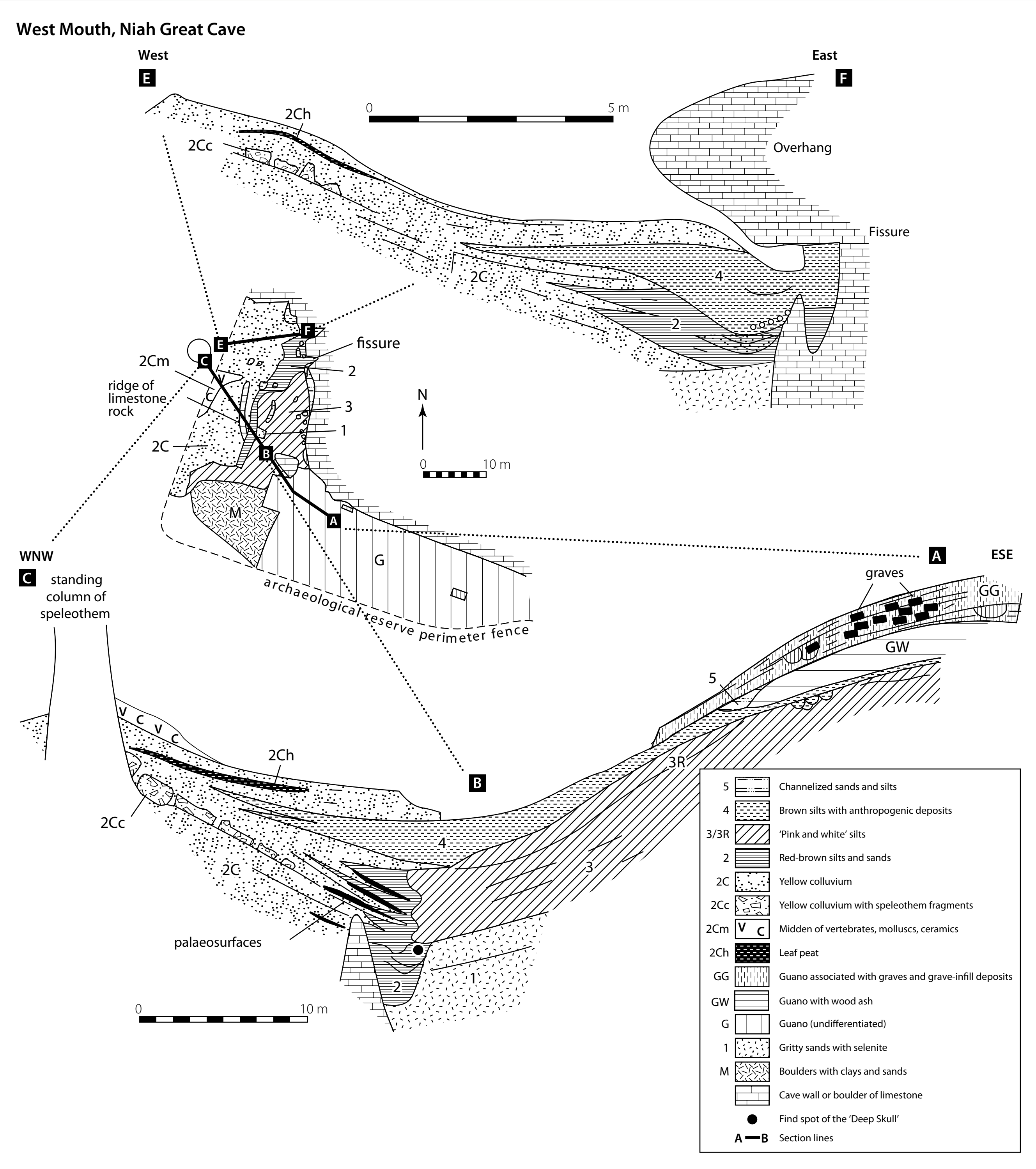


Figure 7: Schematic representation of the Late Quaternary lithostratigraphy of the northern part of the West Mouth of the Great Cave (revised from Gilbertson et al., 2005). The present surface of the surficial deposits is the result of earlier excavations. © Tim Absalom

The age and significance of the deep skull

Fragments of the Deep Skull (which belongs to a teenage girl) have been dated using the uranium-series method to about 37,000 years ago (Barker et al., 2007). The NCP has established its likely stratigraphic position within the Lithofacies 2 sediments, but has obtained ^{14}C dates, on charcoal from *higher up* the profile, of *c.* 40,000 BP. Furthermore, the sediments cemented within the skull are very different from those of Lithofacies 2 in terms of their bulk characteristics, geochemistry and palynology, and most strikingly include large granite crystals, the nearest sources of which are a considerable distance away in the Rajang Valley and on Mount Kinabalu. The discrepancies in the dating, sedimentology, geochemistry and palynology are consistent with the skull and its associated long bones (a left femur and right proximal tibia: Krigbaum and Datan, 2005) having been in a pit dug down from the Lithofacies 4 sediments into the Lithofacies 2 sediments, i.e. that they are the result of deliberate burial rather than, for example, parts of a body dumped on the cave lip that slipped down naturally into the natural basin behind and became incorporated with the Lithofacies 2 stream sediments there (Hunt and Barker 2014). An intriguing further hint at ritual activity associated with the heads of the dead is traces of a red wash, probably from a tree resin (Pyatt et al., 2010), on the interior surface of human skull fragments that have been found amongst the vertebrate fauna from the Harrisson excavations, from the same depths as the Deep Skull. Deliberate burials and ritual activity are regarded as characteristic behaviour of Pleistocene modern humans in Africa, Western Asia and Europe, but are singularly rare in Asia (Mellars et al., 2007).

Hominin activity at Niah in the late Pleistocene

Evidence for hominin presence in the West Mouth goes back to *c.* 50,000 BP. Dates of this antiquity on charcoal have been obtained from excavating one of the surviving Harrisson baulks (HP/6) in the Hell Trench (Figure 8). We found a series of organic 'palaeosurfaces' full of charcoal and ash, with occasional humanly-struck stone flakes and numerous fragments of butchered animal bone. These palaeosurfaces, formed of organic debris slipping down from the cave lip into the basin within the Lithofacies 2C colluvium, appear to equate to the rich 'bone-under-ash layer' that the Harrissons discovered in their basal spits. Charcoal samples from the latter, curated in Sarawak Museum, have yielded dates of comparable antiquity to those from the excavated baulk. Hominins were regularly visiting the West Mouth from *c.* 50,000 BP until the period when the Deep Skull was deposited, with their visits resulting in the accumulation of lenses of ash, charcoal and other cultural refuse along the

Figure 8: Excavating the Harrisson baulk HP/6 in the Hell Trench (looking south). The excavator is trowelling one of the ash- and organic-rich layers dated to c. 45,000 BP that form part of the overall body of colluvial sediments (Lithofaces 2C) dipping east into the cave from the entrance lip (see the lower image in Figure 7). A similar organic-rich layer is visible as the white smears in the baulk behind him.

front of the West Mouth entrance. There is no human skeletal material to demonstrate conclusively that these remains were deposited by groups of *Homo sapiens*, as opposed to other forms of hominin present in Island Southeast Asia at this time, notably *Homo floresiensis* (Morwood et al., 2004) but the identical nature of the depositional activities and material culture in the earliest layers, compared with those associated with the Deep Skull, makes a very strong case that they were. A 1.5 m deep sounding excavated after the removal of the HP/6 baulk, below where it stood, found fragments of butchered bone and a humanly-struck jasper flake in the basal context. This indicates some kind of definite hominin presence before 50,000 BP. This is beyond the range of radiocarbon, and unfortunately the West Mouth sediments lacked the quartz grains essential for OSL dating, but the finds clearly imply that 50,000 BP can be treated as a *terminus ante quem* date for hominins, almost certainly *Homo sapiens*, in the Niah Caves.

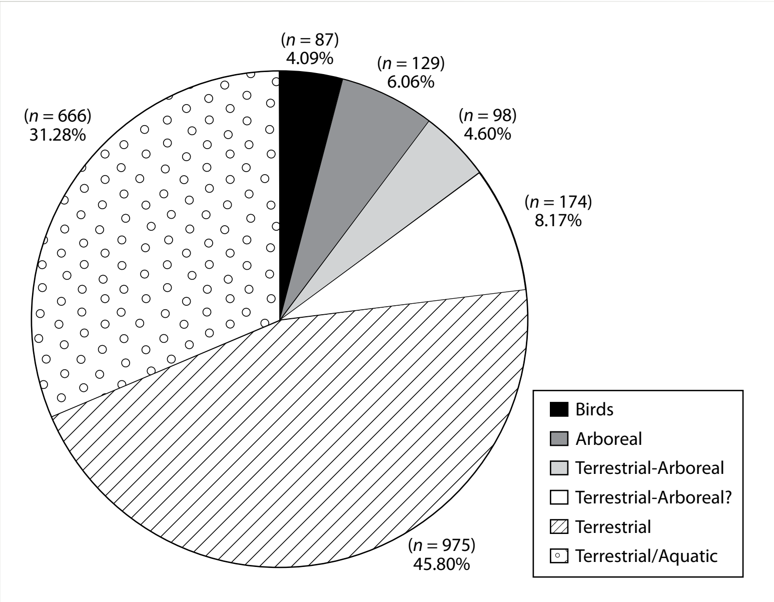
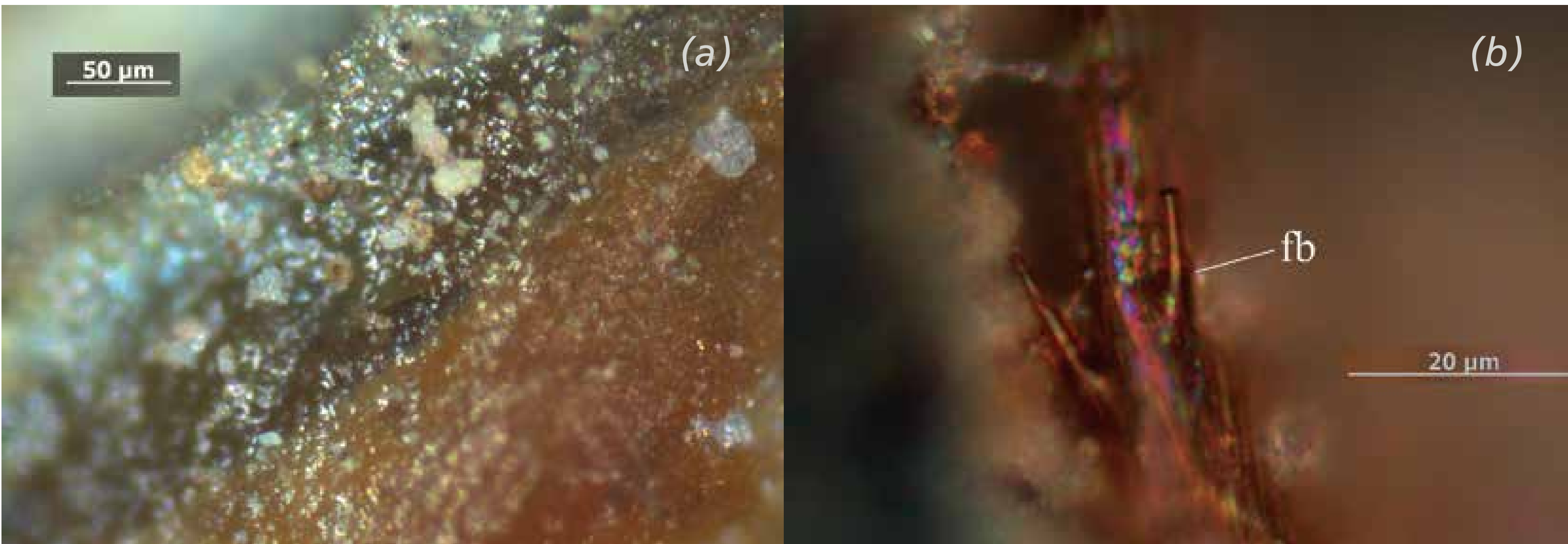


*Figure 9: The habitats of the vertebrate fauna hunted by the early inhabitants of the West Mouth. Though bearded pig (*Sus barbatus*) was the main animal hunted, the hunters also had the skills to hunt primates that dwelt high up in the forest canopy. © Philip Piper and Dora Kemp*

The palynology of the cave sediments (Hunt and Rushworth 2005; Hunt et al., 2007, 2012), the vertebrate fauna and molluscs from the Harrisson and NCP excavations (Piper and Rabett 2009a, 2009b, 2009c; Rabett et al., 2006), and macroscopic plant remains, phytoliths and starch grains (Barton, 2005; Barton and Paz, 2007; Paz, 2005), all indicate that these hominins foraged around the Niah Caves in a mosaic landscape that included montane forest (on the Gunong Subis massif), open woodland, scrub, lowland dipterocarp rainforest, riparian swamp forest, and mangrove swamp, interspersed with lakes or large rivers, smaller fast-flowing stream, and stagnant ponds (Barker et al., 2007). They especially hunted the bearded pig, along with a wide variety of other prey including arboreal species such as orang-utan (Figure 9). There are hints in the age composition of the fauna that trapping or snaring may have been employed as well as spearing. They collected a wide range of molluscs from rivers, streams, ponds, and swamps, and fished these same localities.

Some of the most remarkable evidence for the foraging systems of the Niah modern humans is a suite of macroscopic and microscopic botanical remains recovered from the new excavations: nuts, fruits, tissues (parenchyma) of tuberous plants such as yam and swamp taro, and starch grains of sago palm - plants that needed time and effort, in the case of sago (to extract the pith), and in many cases, careful processing to remove toxins (Barton, 2005; Barton and Paz 2007; Paz, 2005). Plant residues were recovered both from sediment samples taken from the 'palaeosurfaces' we excavated (Figure 8) and within residues attached to stone flakes (Figure 10). Polishing and other edge damage revealed by microscopic studies of these stone flakes,

Figure 10: Traces of wear and organic residues on stone flakes from basal spits in the West Mouth: (a) a thick deposit of resin on part of a flake that also has well-developed glossy polish at one end (not shown) indicating that it was probably used for working both hard wood and soft plant material; (b) part of a flake with traces of resin, bird feathers (fb – feather barbules) and plant materials. © Huw Barton



indicate that many were general purpose tools for processing various kinds of foods and for making artefacts of bamboo and other organic materials. Peaks in *Justicia* pollen in sediment samples we took as monotins from the cleaned faces of the excavations suggest that people were also burning forest edges to improve the productivity of forest clearings for plants such as tubers (Hunt et al., 2007). This strategy would have improved hominins' own plant food supply and also attracted animals such as pigs to these locations. Biomass burning of this kind is also known from New Guinea at this time (Summerhayes et al., 2010).

The Niah Caves may not tell us when anatomically modern humans first reached Sundaland – older fossils have been found in the region, one of which is definitely modern human (Demeter et al., 2012; Mijares et al., 2010) - but they provide strong indirect evidence for the latters' presence here from *c*. 50,000 BP as well as the direct age of the Deep Skull, and they provide perhaps the richest evidence yet available in Asia for how they managed their subsistence activities and the climatic and environmental conditions in which these were conducted, as well as rare hints at their ritual lives. To collect the range of fauna and flora represented in the archaeological record of the West Mouth in this period required ingenuity and a considerable degree of targeting and forward planning. Niah is currently the only site in Southeast Asia and Australia in the 50,000-35,000 BP time bracket with a well-dated human fossil associated with detailed evidence for the behaviour of that hominin; and in this case they are both strikingly 'modern'.

The period following the guano flow *c*. 35,000 BP was marked by a rapid cooling of the world's climate that culminated in the Last Glacial Maximum *c*. 20,000 BP and the contraction of the world's oceans (Hanebuth et al., 2007, 2009) (LGM) *c*. 20,000 BP. The lack of human occupation evidence in many caves in Southeast Asia around this time suggests that populations may have contracted (Barker et al., 2005), but Niah appears to have remained a refugium. Though savannah and open forest became more extensive (Anshari et al., 2004; Kershaw et al., 2001, 2010) and cooler climates brought vegetation types currently found on Mount Kinabalu down to the Niah lowlands (Hunt et al., 2007, 2012), the landforms were such that there continued to be a mosaic landscape within daily walking distance from the caves that included rainforest, swamps, rivers, freshwater pools and lagoons. Following the LGM, closed rainforest became more widespread and the use of the West Mouth markedly intensified, the vestiges of sediment not removed by the Harrissons indicating the discard of quantities of ash and burnt stone and clay, and the digging of numerous pits some of which may have been for storing plant foods in, including to remove the toxins in many of them. Wild pig remained the major animal hunted, but people also hunted a wider range of arboreal primates, assisted by projectile weaponry. We found bone points and stingray spines modified into projectile heads, some of them with resin attached to them (Barton et al., 2009).

Hominin activity at Niah in the Holocene

The warming of global climates and melting of icecaps with the transition to the Holocene caused sea levels to rise rapidly, the effects of which were particularly dramatic in Island Southeast Asia, where an area the size of Europe had been exposed by the low sea levels of the Late Pleistocene and was now inundated to create the present-day configurations of the landmasses (Hanebuth et al., 2000, 2008; Soares et al., 2008). Extensive dipterocarp rainforests developed at Niah. Foragers continued to make regular visits to the West Mouth and now also to the Lobang Hangus entrance of the Great Cave in the Early Holocene, using similar projectile technologies to hunt. Biomass burning remained an important strategy for enhancing the foraging possibilities around the caves, and there are indications that forms of forest management developed involving protecting plants from competitor vegetation and moving plants, a kind of precocious agriculture being increasingly recognised in Island Southeast Asia and Melanesia that has been described as 'vegeculture' and 'arboriculture' (Barker et al., 2011a; Barton and Denham, 2011; Denham and Barton, 2007). Part of the West Mouth was also reserved for the burial of the dead (Barker et al., 2011b).

The caves were then abandoned for several thousand years as rising sea levels brought mangrove swamps to the edge of the Gunong Subis, before people (of the same physical character as before) returned, in particular to use the West Mouth and several other cave entrances as cemeteries. These 'Neolithic' people used forms of burial that were at first similar to earlier forms, with social categories such as age and gender clearly differentiated and likely involving the veneration of immediate and recent ancestors. They rapidly developed into new forms involving communal burial probably relating to shared lineages linked by intermarriage. They cultivated rice on a small scale alongside practising traditional forms of foraging and vegeculture, but may have abandoned rice cultivation after a few centuries, and did not have domestic livestock. The Niah findings fit an emerging body of scholarship that is increasingly sceptical of the 'Austronesian hypothesis', the theory that farming began in Island Southeast Asia as a result of a maritime dispersal of rice-using Austronesian-speaking farmers from Taiwan *c*. 4000 BP, it being more likely that the spread of rice and associated sets of material culture was embedded in new kinds of social relations and possibly ideologies that linked the coastal communities of Mainland Southeast Asia, Island Southeast Asia and Melanesia through maritime networks of contact (Barker and Richards 2012).

Many of the Niah caves were used during the ‘Metal Age’ (*c*. 2000-500 BP or ce 0-1500) as burial places, in two phases, an earlier phase with earthenware ceramics spanning most of the first millennium ce and a later phase with tradewares (Cole 2012). Exotic grave goods (pottery, glass beads, shell and metal artefacts) were derived from trading networks that linked Island Southeast Asia not just with Mainland Southeast Asia but India and China, but the same repertoire of objects was used in strikingly different funerary rituals by neighbouring communities using different caves at Niah to bury their dead. They lived by a combination of forest foraging, vegeculture, and small-scale agriculture including keeping domestic pigs, and for the past 1000 years also they collected swiftlet nests to trade with Chinese merchants, the activity for which the caves are so famous today (Koon and Cranbrook 2002).

The Niah Caves as potential World Heritage

The origins of ICOMOS lie in the fields of architectural conservation and protection, concerns that underpinned the 1964 Venice Charter from which ICOMOS emerged. Its remit is to promote the conservation of the architectural and archaeological heritage, but under the latter heading most of its activities have related to monumental sites of recent millennia rather than the more ephemeral remains that characterize most early prehistoric sites. Furthermore, as Dennell (2012, p. 78) pointed out, 'dating is absolutely fundamental to investigations of human evolution sites. Dating is dynamic and site significance can change with new dating; almost every major site and discovery in human evolution studies has or has had its dating controversy'. He proposed six criteria for ICOMOS evaluations of human origin sites for inscription on the World Heritage List. Few sites would satisfy all of them, he notes, but a nominated site should satisfy at least one of them to merit inscription:

1) the geological sequence should contain evidence of a major point, episode, or aspect of human evolution;

2) the site should represent a major example of the technology of our ancestors;

3) the local sequence of geological deposits should contain outstanding and well-dated evidence of how our ancestors developed over time;

4) the site should represent a major development in our understanding of the antiquity and complexity of human evolution;

5) the site should represent a major example of the lifestyle of our ancestors in a particular environmental setting and under a particular set of climatic conditions;

6) the site should represent a major example of how our ancestors developed and demonstrated their ability to engage in symbolic behaviour.

The key archaeological findings of the Niah Caves summarised in the preceding sections make a strong case that the site meets all of these criteria. It represents a very early stage in the dispersal of modern humans into Southeast Asia (Criterion i); it is a major – indeed outstanding - example of their use of both stone and organic technologies (Criterion ii); the development of the geological deposits and of hominin activities is tied to a robust chronological and stratigraphic sequence (Criterion iii); the archaeology informs importantly on the Out of Africa ‘modernity’ debate (Criterion iv) in having the richest suite of evidence in Southeast Asia for the behavioural adaptations developed by modern humans for colonizing rainforest habitats (Criterion v); and these adaptations included symbolic behaviour (Criterion vi).

In terms of protection, an excellent infrastructure is in place in terms of the long-established collaboration between the staff of the National Park (which comes under the Ministry of Forestry) and Sarawak Museums (under the Ministry of Culture), with an increasingly effective system in place for supervising access by, and the activities of, birds-nesters, guano collectors, and tourists. In terms of management and dissemination, the entrance to the National Park, on the western side of the Sunghai Niah, has high quality facilities for accommodating and catering for individual visitors and school parties, as well as information panels on the principal natural features of the Park. Soon after the new archaeological work began, Sarawak Museums built a splendid new museum on the eastern side of the Sunghai Niah at the beginning of the walkway through the rainforest to the caves (Figure 11). Although expensive investment has therefore been undertaken in terms of buildings and staff, the information available to the visitor at the Park entrance on the forest, and in the Museum on the archaeology, remains limited but that can be easily rectified. There are rest-points with benches for weary tourists along the boardwalk to the caves, where the visitor who sits quietly is soon surrounded by the sounds of the forest, but simple leaflets need to be made available in the Park office, as well as panels at the rest-points, to inform the visitor about that animal life, and about the luxuriant vegetation around them. There need to be similar take-away leaflets in the Museum and attractive fixed panels by the excavations in the

West Mouth to inform the visitor about the archaeology and its world importance. In addition to the natural life of the forest and the archaeology, for many tourists one of the most charming memories of their visit at the moment will be the makeshift stalls at the end of the boardwalk from the river at the foot of the climb to the caves, set up by people from the local Iban longhouse to sell drinks and their own craft products such as baskets and bead bangles (Figure 12). To visit Niah National Park is already an unforgettable experience for the tourist, Malaysian or foreign. To walk into the West Mouth is a veritable assault on the senses: the stench of ammonia from the bat and swiftlet guano, the clicking of the bats as you move into the stygian darkness of the internal cave spaces, and the sight every evening of thousands of bats leaving for the rainforest and equivalent swarms of swiftlets returning to roost (and raptors dropping down into the stream to hunt). There is enormous untapped potential, without major infrastructural investment, to enhance that experience with better educational materials and displays, and the better integration of local people into the life of the Park, for example, employing them to take guided tours from the boardwalk into the forest, or through the caves to better understand the archaeology, the bird and bat populations, and the lives of the guano collectors and birds-nesters. Niah National Park has unique potential to tell the story of the rainforest, and of people's lives in it, from the first human visitors to Island Southeast Asia to the complexities and challenges of managing the world's rainforests today and in the future.

Figure 11: The Archaeology Museum in Niah National Park, at the beginning of the walkway to the Niah Caves. Reproduced with permission of Sarawak Museum.

Figure 12: Villages from local Iban longhouses selling drinks, snacks and local craftwork on the walkway to the Niah Caves.

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Human Ethological Perspectives on Prehistoric Adaptation and Dispersal in the Central Highlands of New Guinea

Wulf Schiefenhövel
Human Ethology Group – Max-Planck-Institute for Ornithology – Germany

Abstract

Humans started to inhabit the mainland of New Guinea about 40,000 – 60,000 BP. Parts of Island New Guinea, like the Bismarck Archipelago, were reached by Papuan settlers as early as about 25,000 BP. About 5,000 BP Austronesian seafarers reached the Bird's Head and the North Coast of New Guinea, mixed with the local Papuan population and moved, as ancestors of the Polynesians, eastward. It is not surprising, therefore, that Melanesia is a very diverse region of the world, with more than 1,000 languages and cultures.

Why did members of our species undertake this very long migration out of Africa to the unknown lands of Melanesia and Australia? Why did the initially, presumably few, humans who arrived on the shores of this new land develop into so many (often) very small cultural groups? What role did the often extremely rough physical environment play in this process? And how much was the driving force of what happened human biology and human behaviour? These are the questions which will be addressed in the chapter.

Melanesia, as consequence of its colonial and recent post-colonial past, is divided into two halves: The Western part belongs to Indonesia (the Provinces of West-Papua with Manokwari on the Bird's Head and of Papua with Jayapura as capital cities); the eastern part is, since 1975, independent Papua New Guinea (PNG) with Port Moresby as capital. PNG played an important role in research with regards to prehistory and archaeology until the 1980s. The Dutch researchers, who moved out of Nederlands Nieuw Guinea at the end of 1962, supported good ethnographic and related research, but there is little data on the prehistory of this half of the large island.

Human migration is a complex, still little understood phenomenon. Animals also migrate and one can assume that in these cases ecological motives (food and other aspects of habitat) are the driving force. For the relatively short time span (starting with the expansion of *Homo erectus* and similar groups) humans have had at their disposal to settle basically all ecozones of our planet we must, it seems, assume there were other active principles as well. One would be the very pronounced sense of curiosity we humans have, the seeking adventure in the unknown. Another motor of dispersal must have been conflict, more precisely conflict avoidance. And given the basically rather aggressive nature of our species (see below) this was most likely another powerful motive to leave one's motherland behind and seek a new existence.

Introduction

In its long shrouded history, enigmatic New Guinea must have been the scene of a number of dramatic changes in human life. What role the extraordinary climate change from the peak, the waning and the disappearance of the last glacial period may have played is little known. It must have been a period of cultural adaptation, perhaps also of different populations being more successful than others in shaping their hunter-gatherer strategies to the respective conditions. The archaeologically barely searched soil of New Guinea has released lithic artefacts which are completely unknown to the present populations. Weapons made of stone, mostly deadly effective club heads of various shapes, (Swadling, 1983; Craig and Hyndman, 1990) are as unknown to the present-day Papuans as they are for the visiting researcher; often they are kept as sacred objects. They may stem from very ancient times and do not tell us much more than that the Papuans of those days must have been as aggressive warriors, as they have been until very recently. Stone mortars and pestles (Swadling, 1983; Egloff, 2008), often zoomorphic and of extraordinary beauty, are often found on the former shores and further surrounds of the mid-Holocene floodplains of the Sepik-Ramu inland sea (Swadling and Hide, 2005) and were possibly used for pounding taro into a glutinous kind of dough, which when cooked or steamed in an earth oven, gives a truly delicious meal, or for crushing nutritious oil-containing *Pandanus conoideus* into a ketchup-like sauce, which provides one of the rare sources of plant fat in the diet of the Highland Papuans. These puzzling artefacts are probably associated with Neolithic gardening and arboriculture. Taro *(Colocasia esculenta* and other species) is one of the genuine Papuan food plants, the domestication of which started about 8,000 BP or even earlier (Golson, 1976; Denham, 2005).

Trying to lift the veil hiding the face of largely unknown Papuan prehistory is a very demanding task. As an ethnologist and evolutionary anthropologist/human ethologist who has carried out fieldwork in this part of the world from 1965 until now I will participate in this worthwhile endeavour of shedding light on the past of a fascinating region of our planet, where prehistory has lasted until only about three decades ago. I will summarise findings of colleagues from the fields of archaeology and prehistory, review some of the ethnographic and linguistic records and offer some insights from human ethology which may shed light on the motives for Papuan peoples to move into (and perhaps out of) the highlands as well as on some of the basic principles bringing about human pseudospeciation for which mainland and Island New Guinea is one of the most striking examples worldwide.

New Guinea, second in size only to Greenland, is a fascinating island. 40,000 years before present or even earlier (Swadling, 1981; Swadling, 1983; Pawley, 2005; Golson, 2005), the first immigrants arrived at its shores and have, since then, not only survived in coastal stretches, swampy lowlands, rolling foothills and rugged mountains reaching the 5,000 m mark, but built, in a veritable large scale cultural laboratory, societies with interesting social structures, technologies, verbal and visual art.

The Papuan cultures in Western New Guinea became visible to outside observers only a few decades ago. The Dani were an early focus of scientists with Broekhujse (1967), Gardner and Heider (1969), Heider (1970) and others. The neighbouring Jalé/Yali were first studied by Klaus-Friedrich Koch (1967, 1974) and the history of contact with the central Mek linguistic and culture groups is similarly short (Delloye, 1960; Saulnier, 1960; Gaisseau, 1961; Tandjung, 1969; Schiefenhövel, 1976, 1979, 1991); a Mek-speaking group, at that time named 'Goliath' (unfittingly: male average body length was well below 150 cm) according to a newly discovered mountain in the area, was contacted by a Dutch group of land surveyors and scientists (de Kock, 1912). The Nalum (Ngalum), westernmost representatives of the Ok culture and language groups were first described by Hylkema (1974). In Papua New Guinea, the densely populated Wahgi Valley was discovered by M. Leahy and his brother Danny in 1933 (Leahy and Craine, 1937). Research in the Ok region began similarly late as that in the highlands of the Western half of the island (cf. Craig 1967). Highland New Guinea was, therefore, as Souter (1963) called it, the 'Last Unknown', its people lived in 'prehistory'.

More than 40,000 years before present: the ancestors of Papuan peoples arrive in New Guinea

The advent of people having left the Sunda shelf towards the east could have happened either through a southern route following the lesser Sunda Islands from Bali to Timor until they reached the Sahul shelf and from there what is now New Guinea, respectively as ancestors of the aborigines of what is today Australia. The fact that the Trans-New Guinea language phylum (Wurm, 1960; McElhanon and Voorhoeve, 1970; Pawley, 2005; Ross, 2005) incorporating the classic highland languages of western and eastern New Guinea includes languages on far away Timor and Alor Islands as well as languages spoken in the 'tail' of bird-shaped New Guinea, is really intriguing. A northern route would have led the Papuan ancestors via Sulawesi and the Moluccas to Halmahera and it surrounding islands as well as to the Bird's Head and thereby the New Guinea mainland. These (possibly various, independent; see discussion) travels were facilitated by an ice age of extraordinary proportions. Almost all the islands of the Indonesian archipelago were connected, as the Sunda Shelf, by land bridges because the global cold period (starting about 110,000 BP) had led unimaginably large portions of sea water to be frozen in the polar regions and adjoining areas and regions of higher latitude, so that the sea level was approximately 120 m lower than today. The Sea Straight between Bali and Lombok (about 35 km wide) and between Borneo (Kalimantan) and Celebes (Sulawesi), named after Darwin's rival, the ingenious naturalist Alfred Russel Wallace, the Weber Line between Timor and the Sahul shelf respectively between Sulawesi and Buru, and the Lydekker Line between the Moluccan Islands around Seram and the Bird's Head had to be crossed.

These straights must have presented a formidable problem to the advancing groups of humans: stretches of in some cases 50 km or more of open water lay in front of the migrating groups, but, on good days land at the eastern side must have been visible, encouraging the minds of the most courageous. How the ancestors of the Papuans and the Australian Aborigines managed to get across these water barriers to then proceed from Lombok to Sumba, Sumbawa, Flores, Timor, and then Sahul Land or via Sulawesi to the virgin land of the Bird's Head, is unknown. We only know, they did it – possibly in rafts or, a bit less likely in my view, in simple dugouts. Map 1, showing the geographic conditions about 50,000 BP from a bird's eye view afforded by modern technology, it seems that the route via Timor to Sahul Land would have been the easiest… but humans, as is my claim, do not always run the route with the lowest hurdles.

The formidable mountain chain crossing, formed very much like a backbone, the 2,000 km length of bird-shaped New Guinea (Map 2), from the eastern tip of its tail in Milne Bay Province of Papua New Guinea to the neck of the bird at Cenderawasih Bay in the Indonesian Province of Papua, almost reaches the 5,000 m line in glaciated Carstensz Top, now called Puncak Jaya, and features a number of other peaks well above 4,000 m. Since probably 15,000 years ago (Swadling, 1983) or possibly even

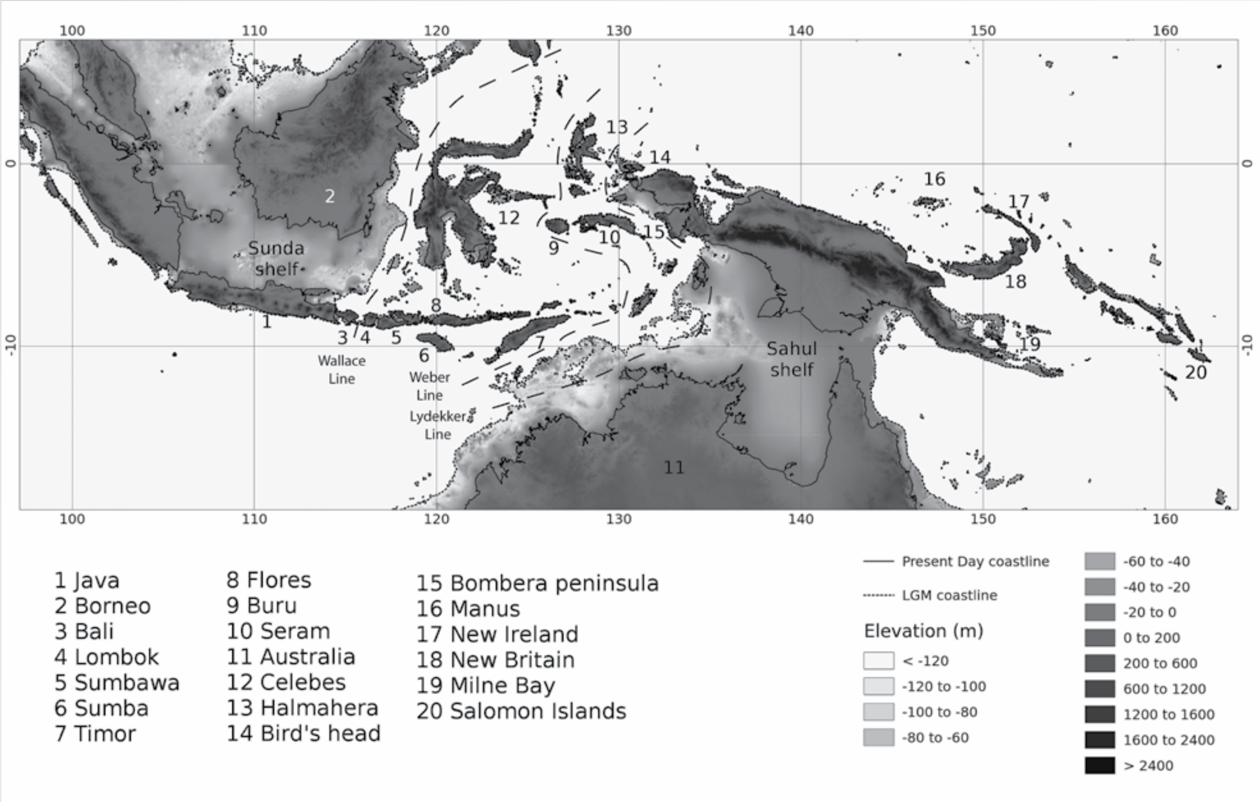

Figure 1: Map of the Sunda and Sahul shelves at Last Glacial Maximum (LMG), today's coastline of the West-Pacific countries and bathymetric, respectively altitude information. The Wallace, Weber and Lydekker lines with their often quite wide stretches of open sea, must have presented problems for the first settlers on their way to New Guinea and Australia. (The map was made by Nicolas Antunes, and Marian Vanhaeren).

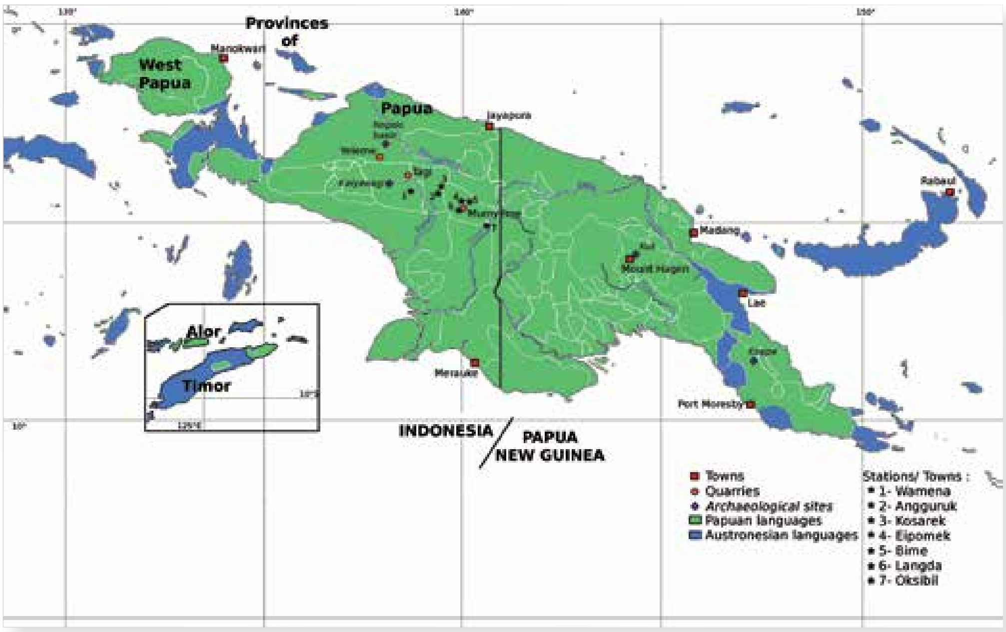

Figure 2: Map of the Island of New Guinea with special reference to sites and stations mentioned in the text. (The map was made by Nicolas Antunes, and Marian Vanhaeren).

35,000 years ago (Denham, 2005) people live in highland New Guinea. Today their permanent settlements reach a maximum altitude of about 2,300 m; the men utilise the mountain forest almost up to the tops of the cordillera, especially for snaring small marsupials, less often for hunting them with bow and arrows. The Papuans, women, children and men, also cross the passes (in the Indonesian section of the central range usually about 3,700 m high) to walk to their trade and marriage partners on the other side of the ranges. It may be stated here already, that the concept of physical boundaries used to explain the dispersal of humans does not seem very useful.

Glimpses of Highland New Guinean prehistory: early hunter-gatherers in alpine country and a cradle of agriculture

State of the art research in palaeontology, prehistory and archaeology has mainly been carried out in Papua New Guinea during the period of very active involvement of Australian and other scientists until the 1980s. Since then, the political situation in the eastern half of the island has become more and more critical, leading to an exodus of trained researchers. In former Netherlands New Guinea, the Dutch government supported fieldwork in geography, geology, ethnography and natural history, albeit to a lesser degree than the Australian trustee of the then Territory of Papua and New Guinea, and so there was – (apart from work on pottery at the north coast by Solheim (1976, 1978), and one site in the Balim Valley (Hope 1998) – very little archaeological research carried out in the former Dutch, now Indonesian half of the island.

Hope and Haberle (2005) summarize available findings on the prehistory of human life in New Guinea by stating that the plains were inhabited by about 50,000 BP, upland New Guinea by about 30,000 BP. There are only few very ancient archaeological sites: e.g. on the Huon Peninsula in Papua New Guinea with an age of between 55,000 – 48,000 BP, Kosipe on New Britain as well as in the Baliem/Balim Valley of the Province of Papua, both at about 32,000 BP. It is likely that the more findings that will be possible in future, the more this already very early time line will be pushed back. In light of the original dispersal of *Homo sapiens* out of Africa believed by some researchers (e.g. Stringer, 2011) to have happened only around 60,000 BP. or even later there is a serious problem: How could modern humans have arrived in New Guinea and Australia at the same time when they (according to their hypothesis) were just leaving their African homeland? This contradiction, like others, most likely will be solved with the remarkable advances in the sciences involved, from palaeontology to molecular genetics.

Hope & Haberle (2005) throw light on the very special geographic and zoological situation of the Sahul Shelf, the former continent comprising Australia, New Guinea and some smaller islands before the last ice age came to its end about 14,000 BP., and describe the unusual fauna of New Guinea including several large mammal species which lived at the time people first arrived. They state (op. cit.: p.544): 'Several cave and swamp sites of the central highlands of the island contain bones of extinct taxa, principally species of large kangaroos (*Protemnodon* spp.) and diprotodontids (for example *Hulitherium, Zygomaturus* and *Maokopia*).... For example a calf-sized diprotodontid, *Maokopia ronaldii* has been recovered from Kwiyawagi in central Irian Jaya where it seems to have been adapted to extensive subalpine grasslands. It lived until perhaps 30,000 years ago, but no association of its remains with human artefacts has been found. However, fire is apparent around 33,000 years ago in the Balim Valley, the same catchment as the fossil (Hope 1998). The subalpine fauna seems to have disappeared well before the climate warmed after 14,000 BP at which time forest limits rose and grasslands diminished. Hence some other cause (which may include hunting or disturbing) must be involved!'

This would be another of the cases where early humans eradicated an animal species with lithic weapons; the Maori of New Zealand inflicted that fate on to the flightless Moa birds (Holdaway and Jacomb, 2000). These incidences and participant observation of traditionally living peoples around the world teach us that these Palaeolithic and Neolithic 'children of nature' do not live in sacred harmony with their environment. Tools and weaponry, that is technology, and nowadays the offer of money and other goods, decide how much damage is done to nature. Humans are maximizers, and their time horizon for planning is limited; the well-being of grandchildren is taken into account, the further future is hardly ever considered. This evolutionary constraint seems to affect even modern economy and politics.

J. Golson (2005) quotes Susan and Ralph Bulmer (1964, p.72-74) who proposed '…a three-phase sequence for Highlands prehistory: an initial hunter-gatherer phase; a phase of technological and economic change associated with agriculture based on Indo-Pacific staples like taro, yam and banana; and a final phase characterised by the introduction within the last few hundred years of tropical American sweet potato, the present staple of Highlands agriculture'. The first two phases are basically undebated. Most likely the early Papuans lived off foraged food (some of the collecting strategies, i.e. utilizing insects, larvae and other 'minimal protein' sources, were still in place among the Eipo in modern times; Schiefenhövel & Blum 2007) and about 8,000 BP. or earlier the Neolithic 'revolution' took place in highland New Guinea where taro, *Colocasia esculenta* (cf. the unfortunately ill-managed UNESCO World Heritage site at Kuk, Wahgi Valley, Papua New Guinea), yams *(Dioscorea ssp.)*, sugar cane *(Saccharum officinarum)*, its close relative, the delicious *Saccharum edule (sayur lilin* in Bahasa Indonesia, *pitpit* in Neomelanesian Pidgin) and several protein containing vegetables were domesticated (Schiefenhövel, in press). Indeed, this part of the world was, besides the extraordinarily productive Americas, and besides Asia and the Fertile Crescent, one of the very few important cradles of agriculture.

The introduction of the sweet potato – still unresolved

The third phase of the sequence described by S. and R. Bulmer (op. cit.) is more uncertain. Most researchers assume that the introduction of sweet potato *(Ipomoe batatas)*, one of the many products of Amerindian domestication (another one coming to New Guinea was tobacco, *Nicotinea tabaccum*, cf. Hays, 1991), entered New Guinea after the *conquista* through Spanish and/or Portuguese contacts. Polly Wiessner (2005) correlates her findings for Enga oral history, namely that informants report, for the time of about 350 years ago, social upheavals, more warfare, massive changes in the distribution of ethnic groups etc., to the advent of the new crop. The first white visitors entering the highlands valleys were amazed by the sheer size of the very well laid out and carefully groomed sweet potato gardens. It is obvious that their 'green hands', i.e. a long history of horticulture and rich experience with domesticated plants, soils, climate zones etc. have made the mountain Papua one of the most, perhaps the most, successful Neolithic horticulturists worldwide. The simple, but very effective agricultural techniques they employed have yielded harvests, which could not be improved without fertiliser and metal technology (Plarre, 1978). This is especially true concerning the sweet potato.

While many researchers adhere to the post-*conquista* time schedule for the introduction of *Ipomoea batatas* to New Guinea, it is, however, established that the *kumar*, as the sweet potato is called in Peruvian Quechua (and *kumara* on some Polynesian Islands!), had reached Oceania around 700 ce. (van Tilburg 1994). Research by Caroline Roullier and Doyle McKey (pers. comm., 2011) which included samples which Siwanto Schiefenhövel, my daughter, and I collected in Eipomek in 2008, does not rule out the possibility that cultivars of *Ipomoea batatas* have been grown in Highland New Guinea for much longer than 350 years. Terence Hays (2005) points to the fact that the number and distribution of terms for sweet potato and tobacco are very different, so that it is well possible that the former came to Melanesia much earlier than the latter. The astounding variety of sweet potato cultivars in highland New Guinea gardens (Hiepko and Schiefenhövel, 1987) is another indication that *Ipomoea batatas* is known and cultivated by Papuan peoples much longer than thought. Scaglion and Soto (1994) argue, on the basis of terms for the sweet potato in West-New Guinean languages, that the new food plant was not brought through a western (Portuguese/Spanish), but via an eastern route; that would support an advent of this important tuber in Polynesia, independent from and probably considerably earlier than after the *conquista*.

For the prehistory of highland New Guinea this hitherto unresolved issue is of considerable importance. Did the Mountain Papuans carry out the revolutionary change of their subsistence strategy from difficult to multiply taro to easily grown sweet potato only about 350 BP. or was it considerably earlier? All researchers are in agreement that this new crop must have had many important repercussions on their daily lives, probably on population size, wars and customs like preferential female infanticide, a very effective way of controlling population growth which was still in place until about 1980 in the central Mek area (Schiefenhövel, 1989).

Epidemiological and other health factors

How much the advance into the rugged but epidemiologically favourable higher mountains was influenced by endemic or epidemic diseases typical for lowland tropics is a very interesting question which has not been addressed sufficiently. As mentioned above, some prehistorians estimate the arrival of humans in the subalpine regions of New Guinea to have happened at around 30,000 BP, whereas Pamela Swadling puts the settlement of highland New Guinea around 10,000 – 17,000 BP (1981, 1983). This concurs with the disappearance of the last massive ice age and the fact that higher altitudes would then have offered more hospitable conditions for humans. This very important issue, when precisely the highlands were settled, must remain open until new archaeological and other facts come to light. In my view, a later settlement is, for epidemiological reasons, a bit more likely.

The malaria line is, today, at approximately 1,600 – 1,700 m. Other tropical diseases also are temperature dependent, e.g. yaws (*Frambosia)*, caused by a syphilis related, but not sexually transmitted bacterium *(Trepanoma pertenue)*; tropical dysentery diseases are also temperature, i.e. altitude, sensitive. It is, therefore, easy to understand that at first colonial contact by far the majority of New Guinea's population lived in the highlands.

From the viewpoint of human biology it is justified to say that the highland Papuans were very well adapted to life in the precarious zones of high altitude with very little animal protein (Schiefenhövel and Blum 2007) low temperatures and a very rugged terrain demanding extremely athletic performance which all, especially the women, subjected and still subject themselves to every day: carrying loads equal to their own body weight, for hours, with a smile on their face – an unthinkable performance in the developed part of the world.

Surprisingly, a small part of the Ok, the Mek, the Yali and the Dani live below this protective line down to altitudes of around 1,000 m, in the case of lowland Ok even 400 m (Craig and Hyndman, 1990). It is not known that they possess, like the later Austronesian immigrants, genetic adaptations (e.g. Ovalocytosis) to endemic *Malaria tropica* or whether they have survived, as groups, despite high malaria child mortality through premunisation effects brought about, in the ones who survived, by repeated infections. The mass of the highlands peoples, however, have lived and still live above 1,600 m. This has brought about the typical New Guinean settlement pattern with the mountainous interior (relatively) more densely populated than the lowlands and the coast. For the early dispersal of Papuan groups this must have been an important factor. They were trading a protein rich diet plus infections by dangerous parasites against a very low protein diet with many fewer parasites.

Ernst Büchi (1981) and Horst Jüptner (1983), physical anthropologist and specialist for tropical medicine respectively, of our Eipomek team, have both corroborated the view that the Eipo (like their neighbours east and west) were surprisingly healthy. Indeed, they were and are very powerful people, despite the complete lack of modern medicine (cf. Braun, 1996). Among the Eipo as in some other highland communities there was only one problem connected to malnutrition: iodine deficiency goitre, often enormous in size, which led, in some valleys interestingly more so than in others (genetic effects?) to occasional cretinism in children whose mothers did not produce enough thyroid hormones during pregnancy. Patients with fully expressed cretinism are easily recognized by their below average body length, their altered lumbar anatomy and physiognomic features.

The Eipo in the centre of the Mek region: until 1974 one of the last traditionally living groups in Highland New Guinea

Elsewhere, summaries of the culture of the Eipo have been published (Schiefenhövel, 1976, 1979, 1991), it will therefore suffice here to mention central elements of their tradition as they will serve as points of comparison with neighbouring groups so that, hopefully, a more general picture emerges which will facilitate the formulation of hypotheses concerning origin and dispersal of possibly prehistoric and, with a higher degree of resolution, of more recent ethnic groups which have managed to inhabit even the rather inhospitable region of highland New Guinea and are descendants of the early immigrants who arrived at the shores of New Guinea so many tens of thousands of years ago. As stated above, 'prehistory' lasted, for the people in the valleys of the Eipomek, Famek, and Tanime Rivers until the 1970s. In December 1969 a small group of Indonesian military personnel, accompanied by Pierre Gaisseau (who had established limited contact to the local people in 1959 during his epic Trans-New Guinea expedition; cf. Delloye, 1960; Saulnier, 1960; Gaisseau, 1961) and his son, parachuted into the upper Eipomek Valley, at that time called 'X-Valley' by the pilots because of the shape of joining rivers further downstream from Eipomek. This team which managed to build up a friendly relationship with the local people, conducted first linguistic, ethnographic and medical checks in this central region of the Mek cultures and left after three months. When the German Research Team arrived, on foot, from the mission station in the Bime Valley further east after five days walk, on 2 July 1974 we did not have any knowledge of this military report (Tandjung, 1969), which was later made available to us by Dr. Suriadi Gunawan, then the head of medical services of the province. The very first written account of a group of Mek stems from de Kock (1912), who, as member of an expedition exploring the headwaters of the Eilanden River, came across small statured people whom the Dutch team very inappropriately called 'Goliath'. The short wordlist compiled by de Kock is thus the first ever published (and since then largely forgotten) record of a Mek language and is typical for the Mek dialects spoken on the southern side of the central cordillera.

The Eipo inhabit the valley of the upper Eipomek River which has, in the form of a magnificent waterfall, its headwaters at the northern edge of the central range in about 3,600 m altitude and rapidly flows northward, joining with other rivers and eventually reaching the Idenburgh River, which further downstream becomes the mighty Mamberamo. I named our station Eipomek. This has remained the name of the central settlement, situated approximately 140° east and 4°26’ south. The population of the upper Eipomek Valley, comprising at that time 6 villages, was about 800 persons. Roughly the same amount of people lived in the other valleys of the Mek culture north and south of the central range, so that this ethnic group numbered approximately 15,000 persons at that time. Today, 2013, the Mek probably number around 30,000 inhabitants – demographic growth, due to giving up warfare and preferential female infanticide, reduced age of menarche from 17 to 15 years, shorter post-partum coitus taboo, and basic healthcare lowering infant and general mortality, is stupendous.

With regard to my claim that physical, geographic barriers do not impede human dispersal, it is important to note that the Mek, exactly like the Ok in the east and the Yali and the Dani in the west, straddle the central cordillera, i.e. their culture spans right across this massive hurdle of steep and dangerous mountain passes in 3,700 m altitude and higher. The amazing athletic fitness of men and especially women was already mentioned, achieved with a nutrition deemed insufficient when judged from the standards laid down in western medical text books.

The social structure of the Eipo and general social structure of Mek society was characterised by marked cultural sexual dichotomy: the worlds of women and men were seen as, in many respects, necessarily different, requiring different emic approaches to make society function. This is a classic Papuan topos, typical, e.g. for the Sepik River cultures (possible ancestors of the highland societies, see below) and for the cultures of the south coast, both in Indonesian (e.g. Asmat, Marind anim) and independent New Guinea (Kiwai, Goaribari, Era, Purari and Toaripi cultures in Papua New Guinea). The Austronesian societies in mainland and island New Guinea (starting east of Toaripi country and reaching well around the tip of the bird’s tail, including the Trobriand and other islands), are often matrilineal and have a somewhat different (in our western perspective more modern) view of men and women and even feature, at least in some dances, a kind of unisex idea with men and women being dressed in similar skirts and dancing the same choreography. Eipo and Mek dancing is, choreographically and symbolically, very different for men and women. Needless to say, there is a lot of good-spirited companionship between women and men, a lot of laughter, good cooperation in the daily garden work as well as passionate and often romantic love (Schiefenhövel, 2009). Physical contact, let alone erotic advances, between the sexes were strictly taboo in public; this is also a typical element of Papuan tradition everywhere.

Boys and male juveniles went through a three stage initiation process. The first and most important one is called *kwit* in Mek language; the Yali and Dani terms are *wit,* thus indicating an east-west movement of an important religious institution. Girls, as was the general sentiment, grow up to become perfectly normal women without any cultural-religious shaping: there was no public initiation for females. Yet, they had one or two houses per village strictly reserved for them: a women's house *(bary' eik)* for menstruation, birth, puerperal period, major disease… and conflict with their husbands. Interestingly, the women's house, built at the fringe of the village, does not seem to be a general highland Papuan institution. The male pendant was the sacred men's house *(yoek aik)*, usually situated in the centre of the village – a typical institution in many highland and even lowland (e.g. Sepik, Papuan Gulf) New Guinean societies.

The 'real' houses *(dib eik)*, were the family huts in which the women, their children, often other relatives, pigs, dogs and sometimes their husbands stayed. All houses except the *bary eik*, which was simple and had an earthen floor, were built on posts and had elevated floors. Proper roofs were round, though some had a rectangular shape, thatch made of pandanus leaves was used for ordinary houses, while sago leaves from far down the river, were reserved for some of the important men's houses. All houses had only one floor and small entrances – a protection against sudden attack and also preventing heat loss. The inside had sacred elements, e.g. the round fire place and its posts erected in a square, possibly sacred string bags with skulls or other relics of ancestors hanging at the wall. Not surprisingly, the men's houses had more and more powerful sacred elements; in one case, in the village of Munggona (today's Eipomek), a highly venerated sacred 'digging stick' *(kwemdina kama)* was the most important of these objects.

A number of Eipo and Mek cultural markers were identical or at least similar to those found in other highland Papuan societies. Apart from the ones mentioned: penis gourds for men, skirts of reed or similar grass-like plants for women, male hunting, male armed intragroup fights and intergroup warfare (leading to a homicide rate of about 3 per 1,000 inhabitants per year, thus extremely high compared with modern western societies, Schiefenhövel, 2001), exocannibalism, bows made of black palm (*Arecaceae*) and non-poisoned, partly slightly barbed arrows, pigs *(basam, Sus scrofa)* and dogs *(kam, Canis familiaris)* as domesticated animals, use of cowrie, nassa and cymbium shells as well as teeth of pigs, dogs and marsupials for body decoration, the ever-present string bag, digging sticks of various sizes as only gardening tool, garden mounds with mulching, fallow periods of 15 years and more, *Cordyline terminalis* as sacred plants identifying special places, lack of pottery, cooking in big earth ovens. But the Eipo culture also exhibited a number of quite stunning dissimilarities vis-à-vis the neighbouring societies.

The mountain Ok, east of the Mek, used carved and painted shields in warfare. The first fighter in a single file line carried this protection, the partly anthropomorphic reliefs of which can be interpreted as awe inspiring, threatening apotropaeic images. When a war shield *(askom* in the Ok dialect spoken in and around Bolivip/Bolibip) had been successful in protecting the warriors it was elevated to a sacred object and was kept in the men's house *(yolam)*, together with hundreds of pig jaws, giant taro tubers and other socially and religiously meaningful objects. The inhabitants of the Inmak River around Kosarek, also speaking, like the Eipo, a Mek language, surprisingly also some Yali villages west of Kosarek, had similar and yet smaller carved and painted shields, not used in warfare. They were named *kelabi* in the language of the In culture and language group around Kosarek (Heeschen 1992), *sabal hä* in Yali (Zöllner 1977) and represented ancestral spirit women: the In language word *kelabo* corresponds to the Eipo word *kelapo* = woman; the Yali term *sabal hä* means 'old woman'. These shields were also kept in the sacred men's houses and played a central role in the ceremonies thought necessary to ensure the fertility of the gardens and the wellbeing of humans. This is an interesting parallel to Afek, the central female figure of Ok religions.

The Eipo proper did not have any shields, but the idea of a sacred wooden, painted object was present in a very inconspicuous small piece of wood which was used in sacred ceremonies taking place at the notched beam leading to the entrance of the men's house. The function was sacred, i.e. similar as in the shields east and west of Eipomek, but the form was surprisingly different. The term *kelabye* is, etymologically, the same as in the In language. Sometimes this very modest, *ad hoc* produced object was called *kelabye lakasu* or *kelabye lakaswe*, meaning the inner core of the *kelabye*, i.e. the sacred woman. In the Famek Valley, just west of the Eipomek Valley (whose inhabitants were hereditary enemies since time immemorial) Wolfgang Nelke was given *kelabi* shields. It seems that this was a cultural import from the western Mek region. Why the geographic centre of the Mek culture, the Eipomek Valley, should have lost or never had the concept of large, impressive carved shields is unexplained at the moment. The *kelabi* presented to the ethnographic museum in Jayapura-Abepura is the single object still present, albeit suffering from heat and humidity; all the other, very numerous objects of the material culture of the Eipo and their neighbours, several complete collections, which were handed over in 1975 and 1976 to the Museum Antropologi have, unfortunately, all disappeared.

Both Ok and Yali cultures had carved and paint-decorated planks of the men's houses. Again, the Eipo culture is a kind of ethnological vacuum in this respect. The same is true for the missing drums. Singing and dance in both Ok, In and Yali villages is accompanied by vivid drum beating. The Eipo men have a very sophisticated way of pentatonic polyphonic singing and very rhythmic inspiratory whistling when they dance, while the women emit very high inspiratory shrill sounds during their very different, much more elegant way of dancing, accompanying the male singing with a rhythmic rustle of their especially thick reed-skirts, but,no drums. This is quite strange, because the drum is the classic music instrument in basically all Papuan and Austronesian societies. The Eipo, as their neighbours east and west, have the mouth harp for making occasional, individual music which is not normally directed at an audience; also missing in Eipomek are bamboo pipes for smoking, another rather typical element of Papuan material culture.

One particular body decoration, present in various shapes in the Miku culture of the Upper Digul region (photograph of P. Wirz, published in Chauvet, 1930) as well as in the adjacent Jee-anim/Marind-anim culture (Wirz, 1925) consists of strands of fibres either woven into the hair or put on the head of men and hanging down the back. It is very elaborately evolved in the Ok culture of the Faiwol near Bolivip/Bolbip, where it is called *kamil,* also *mafum,* and made of a thick, round piece of rattan, other fibres, leaves, clay and ochre; this thick part is female; on top is a much smaller and slimmer, lancet-like part, which represents the penis. In the Telefomin area a less sophisticated and large, but also female-male *mafum* was worn by the men (photo in Craig and Hyndman, 1990). The Nalum, the westernmost Ok society, so empathically described by Sibelle Hylkema (1974) had the *mafum.* In the culture of the Eipo, it is just the smaller male piece which has 'survived', its name is *mum*, etymologically derived from *mafum*, and not the other way round, as the linguistic contraction tells. It is also seen as a penis symbol and if, e.g. during a nightly dance, a woman touches a man's *mum*, this is a clear invitation to have sex with her. Eipo men usually wear it at official dances or when they want to attract the eyes of a woman. The Yali had three types of this specific back decoration, yet not twisted into the hair (Zöllner, 1977); most interesting is that their version is closer to the Ok version, as it also consists of two pieces. Again, the Eipo culture has a partial vacuum here. Is the female part lost due to cultural 'impoverishment' or was the female part of the *mafum* primarily not introduced into their material inventory of the Eipo?

As we will see, in the field of mental, religious culture, the Eipo did have apparently autochthonous mythical-traditions which have no precursors in the Ok cultures and which have, on the other hand, spread westward to the Yali and the Dani. But before the field of religion is discussed, briefly some glances shall be shed on the core elements of tool culture, especially the stone adzes.

Stone Adzes from the Heime Valley: an unbroken Palaeolithic tradition

Throughout the Ok-Mek minisphere (Swadling, 1983) and even farther away in the adjacent regions of the Yali and Dani in the west and the Papua New Guinea Mountain and Lowland Ok in the east, one type of stone adze is found: that of the quarry in the upper Heime/Mumyeme Valley, almost exactly south of the Eipomek River. The phonetic similarity of the two river names is a slightly intriguing (*Ei- / Hei-*; *-po/-pwe* is a nominalizer in Mek language), whether there is more to this, a possible historic connection, must remain outside discussion for now. The geological material for these adze blades is Andesite (Helmcke 1978), a material very suitable to be relatively easily knapped and ground into very well-functioning, durable adzes; both the blades and the finished adzes are called *ya* in the Mek languages. There are only a few other quarries in the area between the Ok in the east and the Dani in the west (Swadling, 1983; Petrequin, 1990-1992, 2006): a) Yeleme (Jeleme) in the Nogolo basin in the western Dani region, about 150 km northwest of Wamena, the highland capital in the Balim Valley; this stone is darker, at least when polished, than the stones from the upper Heime/Mumyeme quarry and is usually fitted longitudinally, as an axe, into holes of simple, massive handles; these axes are traded widely, also into the Grand Valley of the Balim, even down to the south coast; b) Tagi in the area of the Grand Valley Dani; c) Mumyeme, a tributary to the Heime near the mission station of Langda at the southern edge of the central cordillera; raw adze blades produced from this Andesite rock are, as mentioned, very suitable to be turned into effective, long-lasting adzes which are polished by the 'end user' and then sophistically hafted; they are traded into Yali country in the west, far to the northern side of the mountain range towards the Sobger/Idenburgh/ Mamberamo River system and well into Ok country in the east, even into the Telefomin area; d) a much less researched and possible not very important quarry at the upper Red Digul River.

P. and A. M. Petrequin (1990-1992) write that the use of the stone axes and adzes has stopped some decades ago. This is only correct concerning their everyday use as wood-cutting tools. The fascinating fact is that stone adze blades from the Mumyeme quarry are still produced today (2013), because they represent a traditional currency for bride price payments and payments in the course of customary compensation for inflicted damage. The specialist professionals, extremely knowledgeable and skilled knappers (the only ones who have a specialised function in society and spend a lot of time in this 'job') are still producing the astounding blanks. The first step is to apply fire to produce cracks in large rocks, and then large round boulders are used to break off portions of the fire-split rocks and to break them further into smaller material with can be hand held. Then the job of the knappers sets in: extraordinarily fine-tuned movements to turn a stone into a beautiful blade (cf. Stout 2002). It is like watching a Palaeolithic contemporary performing his artful job. – I suggest that palaeoanthropologists, prehistorians, ethnologists and archaeologists visit this unique site and discuss its potential for inscription as a UNESCO World Heritage site.

Religion

Besides traditional materials and techniques which are, as it were, frozen cultural inventions, persisting, in prehistoric context, for often very long times because they represent the best technological solution available, (like the production of stone adze blades, their grinding and polishing, up to the very effective and protective way of hafting) religious traditions promise to be a window into the past. Religious beliefs, traditions and their defence against 'non-believers' are, as we have to acknowledge even in these modern, seemingly enlightened times, an extraordinarily powerful well from which ethnic identity is fostered. It is belonging to the 'right' religion and standing up for it with guns and hand grenades which has and is causing wars and civil wars to spring up, from Northern Ireland, ex-Yugoslavia, Chechnya, the Near East, several Arabic and in other areas of the world, not economic disadvantage or other sociologically definable parameters. Humans cling to their religions with their teeth until a new, for some reason more attractive one appears. In Palaeolithic and Neolithic times the situation in highland New Guinea most probably was, too, characterised by religious conservatism.

It is, therefore, a promising exercise to compare religious traditions in this part of the world isolated for so many tens of thousands of years until the first Austronesians arrived, about 4,000 BP., bringing new technologies, like very efficient sailing boats, new social structures with often heritable chiefs and matrilinearity, possibly pottery and most likely the two 'classic' domesticated animals of Melanesia, the dog *(Canis familiaris)* and the pig (surprisingly, *Sus scrofa* and not some Asian or Southeast Asian domesticate). The advent of these people from the Chinese South Coast via Taiwan, via the islands of the Philippines and Eastern Indonesia to the westernmost parts of New Guinea, must have made a great impact on the native Papuans, perhaps also with regard to religious traditions, even though this is very little researched. The question is how much all these innovations affected highland New Guinea. Probably very little, if one compares this difficult to access region with the islands, e.g. the Trobriands and other islands in the *kula* ring (Malinowski, 1922), where the original Papuan population mixed with the newcomers and their language was replaced by Austronesian – except, and most interestingly, on the last island in the whole chain, Rossel (Yela) in the south-easternmost section of the kula ring, where people still today speak, like on Halmahera in the far west, a Papuan language.

The decisive cultural marker of the Ok region is the belief in Afek, a spirit woman who was believed to have, at the beginning of humankind, played a most important role as shaper and transformer of things. Her figure has characteristics of a superhuman trickster, so common in many animist belief systems, on the other hand is her humanness, her femaleness striking. She was the central figure of the religious cults in all Ok country (Brumbaugh, 2005) – except the Nalum.

Sibbele Hylkema, in his very insightful account of Nalum life (1974) does not mention Afek at all. Also Jan Pouwer (1964), ethnologist of the Dutch 1959 Star Mountains expedition does not mention this cult, which was and to a certain degree actually still is today, so powerful in the eastern neighbourhood of Oksibil and surrounds. Anton Ploeg (2011) refers to this fact and speculates that both authors may have missed the spirit woman because a) the cult did actually not reach the western Ok cultures (who live, by happenstance, west of the international border, which, in this case would also be a cultural border in this respect) or because b) of the secrecy of the cult (Pouwer did not penetrate deeply into the culture of his hosts, but S. Hylkema, on the other hand, gained extremely solid insight into the lives and minds of the Nalum) or because c) the figure of Afek was transformed into cosmogenic entities typical for the western Ok. In any way, it is surprising that the so powerful Afek-myth, uniting all the different other Ok groups, is not present in the Nalum-Ok. It is definitely missing as well in the Mek culture, which did not have a very powerful female creator-transformer figure in their religion. And it is indeed interesting that the Yali, at the western edge of the Mek culture area, had the *sabal hä* (lit. old woman, see above) and powerful female spirits (Zöllner, 1977).

Mythological accounts of the Nalum as westernmost Ok, of the Mek and the Yali name other figures, male and female, as creators, or better phrased as 'transformers' (Brumbaugh, 2005) of early landscapes, plant, animal and human life. In Nalum religious tradition (Hylkema, 1974), Seramki, the father of all humans, is the most important of these figures. In Mek belief, it was primarily Yaleenye who had the most decisive impact on the life of early humans and who set most traditions in motion (Schiefenhövel, 1976; Heeschen, 1990). It is very interesting that the literal translation of his name is 'The one Who Comes/Came from the East'. Mek religion, thereby, postulates a deity-like being from the east as the one who started all things, formed the valley with his feet, smaller rivers with his hands and who impregnated female animals and animal-like humans to bear his offspring. He was a big rover, never stayed long in one place, and went from east to west, to both sides of the central mountains in a seemingly erratic course. As Volker Heeschen writes (1994) the narrative of his movements, his travels, is, at the same time, an account of what was created or transformed – spatial deictics as the core of history. Whether one can infer actual movements of populations from mythical accounts (Heeschen 1994) like that featuring Yaleenye or other sacred ancestors remains an open question.

I was very surprised when I learned (Zöllner, 1977) that a central figure of Yali mythology is Jeli who is killed and thereby sparks off important elements of life, thus acting involuntarily through his death. The Yali are aware of the fact that his name means 'eastern'. One can therefore safely assume that Yaleenye and Jeli (Yeli in modern orthography) are very similar religious concepts. The Yali have, as mentioned above, a number of female figures who were believed to have played a major role in the beginning of humankind (Zöllner, op. cit.). The same is true, albeit to a probably slightly lesser degree, for the Eipo, where e.g. the Kwaning Fatane Gil, a spirit woman who is always hungry (the translation of her name), steals food from real people and also enters their bodies, making them fall ill and die by eating the victim from inside. Another religiously important female figure is Ise Gil, lit, the Spirit Woman who can move, underground, through the mountains and can also cause harm and death. These figures are different from Yaleenye, because religious Eipo tradition said that they have survived from ancestral times until today, whereas the mighty creator-transformer is not living any more. It is obvious, then, that the very powerful female-mother figure of Afek does not have real counterparts starting with the Nalum towards the west, not even among the Yali whose religious tradition incorporated female spirit-deities.

For the cultures west of the Papua New Guinea Ok, that is including the Nalum Ok to the westernmost Mek in the valley of the In River, the formerly snow-capped Abom (approximately 4,700 m high Mount Juliana, today Gunung Mandala, cp. Brongersma & Venema 1960, also known in similar phonetic versions), is a highly sacred peak. It was thought to be male and to have sired early living beings by having intercourse with female Lim/Aplim Mountain (approximately 4,500 m high, 22.5 km straight line north-west west of Abom). Other mountains, like Binal (approximately 4,050 m high, south of the Eipomek Valley) are also important for the mythological accounts of early human life, especially their origin, but none can match Abom and Aplim. It is most interesting that the Yali have the belief that an early, much taller generation of humans lived in their land that were all wiped out by a gigantic earthquake. Skulls and long bones the Yali find in the ground are attributed to this fact and the natural disaster (Zöllner, pers. Information 2013). These bones have not been anthropometrically measured yet so it is not known whether a taller population once lived in the Yali area and beyond or not. The legend as such is not likely an account of reality, as even the most powerful earthquake would not kill all humans, as can be extrapolated by the two massive earthquakes in June 1976 in Mek area (Richter >6.2) The extinct 'giants' are called Limlim, I believe this indicates a connection to the Lim/Aplim peak which has, in contrast to more roundish Gunung Mandala, a rather characteristic limestone top. Space does not permit me to go deeper into the very interesting mythological-religious traditions of the Mek and their neighbours, but the aforementioned facts, in general, suggest a dispersal of religious ideas (and of early highland settlers?) from east to west.

Language

Regarding the highlands of New Guinea, a good deal of work has been done to document the local languages. In most cases this difficult task has been undertaken by missionaries (for the region in focus here: e.g. Drabbe, 1950 for Awyu, he also wrote dictionaries of other languages in West-New Guinea, Hylkema 1974 for Nalum, Louwerse 1978 for Una, a Mek language, and Zöllner undated, for Yali) or, more commonly, by members of the Summer Institute of Linguistics, an institution giving support to studies in hitherto un-contacted or little contacted areas with the final aim to facilitate translations of the bible into the local languages (e.g. Bromley, 1967 for Dani), or by scientists (e.g. Healey, 1964, for Telefomin, Heeschen and Schiefenhövel, 1983 for Eipo/Mek, Heeschen, 1992 for the 'Yale' – one of the very unfortunate, and in this case also very confusing, exonyms naming highland Papuan groups – the language of the Mek speaking inhabitants of the Inmak River around Kosarek).

The larger language groups in the geographic region focused on in this chapter can be seen from Map 3. The extraordinarily diverse linguistic and cultural situation in Highland New Guinea and generally in Melanesia has traditionally attracted specialists. In the field of linguistics a large corpus of data and convincing meta-analyses have been presented (cf. Wurm, 1960; McElhanon and Voorhoeve, 1970; Wurm, 1975; the linguists with chapters in Pawley et al., 2005: M. Ross, W. Foley, B. Voorhoeve, M. Donohue and M. Crowther, G. Reesink, who summarise present-day knowledge and theory). The hypothesis that most of the Papuan (i.e. non-Austronesian) languages of mainland New Guinea, including several islands in the west and east, are belonging to one large language family, termed 'Trans-New-Guinea-Phylum' (Wurm, 1960), 'Trans-New-Guinea I' (McElhanon and Voorhoeve, 1970), 'Trans-New-Guinea II' (Wurm,1975), 'Trans-New-Guinea III' (Pawley, 2005) and 'Trans-New-Guinea Subgroups' (Ross ,2005), has been verified by all recent studies; some differences of opinion concerning which grouping best reflects the linguistic mosaic remain.

A few conclusions in regards to the question of how early Papuans dispersed are of particular interest:

1) Papuan languages included in all modern groupings are spoken from the islands of Timor and neighbouring Alor far west of the New Guinea mainland, throughout large sections of the island from the 'Birds Head' right to the 'tail' of the 'Bird'. Other Papuan languages are spoken at certain sections of the fringe along the northern coast eastward. Interesting are the 'language isolates', which could, but must not, represent a possibly earlier or later period of immigration than the rest. It is also possible that their relationship to the Trans-New-Guinea grouping will be discovered with more research data becoming available. The fact that Timor and Alor belong to the Trans-New-Guinea grouping and that they have some linguistic innovations in the field of pronouns (Ross, 2005), is particularly important in light of possible migration or dispersal routes. They could, indeed be an ancient centre of dispersal reflecting the fact that the Proto-Papuan immigrants came through there.

2) Do the related languages of the Trans-New-Guinea groups represent an old dialect continuum (Ross, 2005)? In my view, this is the most parsimonious explanation for the relatedness of the Papuan languages and that would speak for an immigration of one or perhaps a few groups of Proto-Papuan speakers around their time of arrival at the shores of New Guinea 50,000 or 40,000 BP Language and culture-formation can be seen as a quasi-Darwinian process, with changes leading to radiation and pseudospeciation (Erikson, 1966): New Guinea is a specifically striking example of this process.

3) Why is the linguistic scene in much of highland and south coast Papua New Guinea more scattered than in the Province of Papua? Does this reflect a dispersal from Papuan groups at the north coast of PNG up the Sepik River (Swadling, 1983) to the highlands in eastern New Guinea, to the south coast and then a perhaps in a slower process to the west and south-west? It is indeed striking that the size of the language groups in the Province of Papua is much bigger than that in Papua New Guinea. Some of the cultural characteristics described above corroborate this general east-west movement.

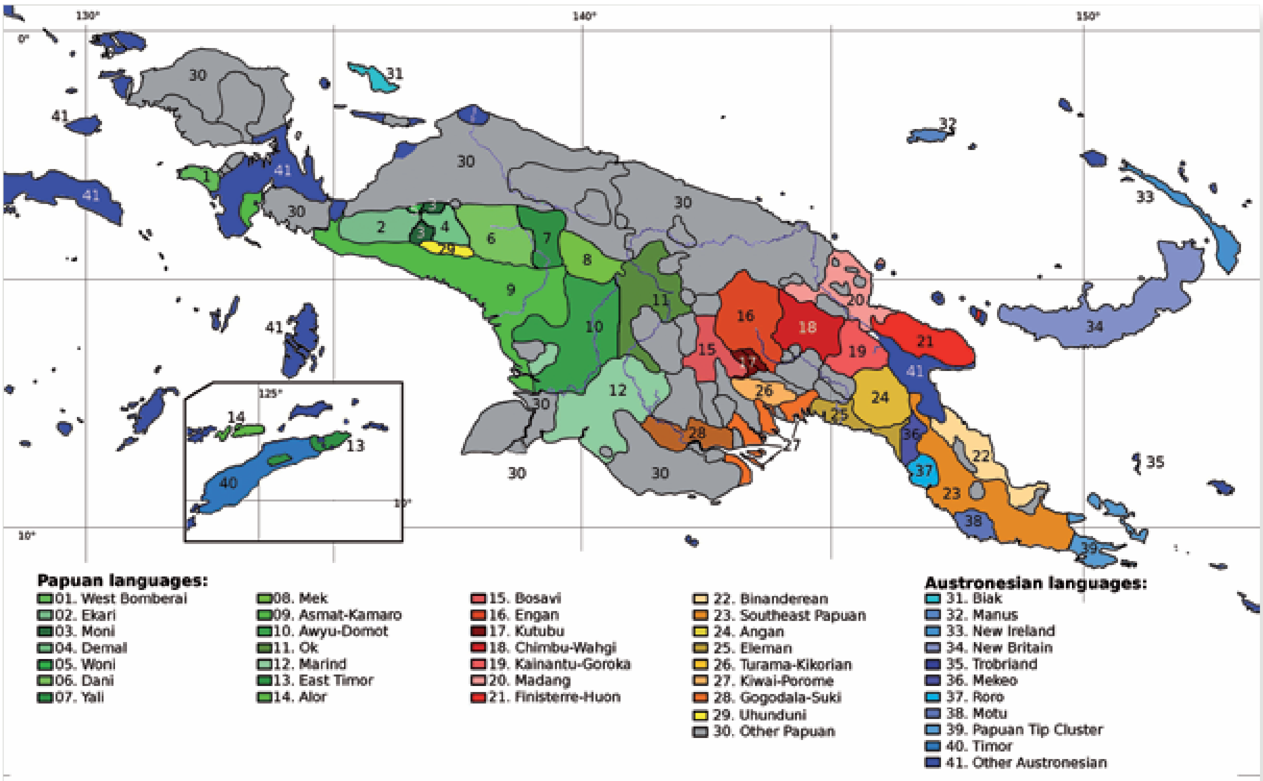

Figure 3: Map of the distribution of languages in Melanesia with special reference to ethno-linguistic groups mentioned in the text. (The map was modified by Nicolas Antunes, Marian Vanhaeren and Wulf Schiefenhoevel after Ross, 2005).

Population genetics

Kirk (1966, 1982, 1992), Hill & Serjeantson (1989), Attenborough and the numerous other authors in the volume edited by Pawley et al. (2005) have given state of the art summaries of the available data and their interpretations concerning research in the field of population genetics, which has, since the times when blood groups and HLA-markers were investigated, advanced with amazing pace and precision. The study of Cavalli-Szorfa et al. (1994) showed the power of a double-pronged approach, i.e. using modern genetics and linguistics, to understand population patterns – a very reasonable research strategy. One problem is how well defined the formerly collected blood samples, mouth swabs collected today or collected hair actually are. With this in mind we have identified, for our studies of Austronesian populations in the Milne Bay and Manus Province of Papua New Guinea (Nagy et al., 1997; Zimdahl et al., 1999; Kayser et al., 2000, 2003, 2006, 2008), each donor to the grandparents and know the village or villages where they have lived. This sampling method will prevent overlooking genetic admixtures which would otherwise lead to false interpretations. Attenborough (2005) and Harley et al. (2005) address the same issue.

The Austronesian peoples have received a large share of attention by population geneticists, partly because the settlement of the vast Pacific Ocean is such an incredible human feat and because linguistic and archaeological studies had pointed to an allegedly very fast process of immigration from Asia to the Polynesian Islands, culminated in the 'Express Train' to Polynesia hypothesis (Bellwood, 1978). We have been able to show, that it was indeed a 'Slow Boat' process (Kayser et al., 2006): Austronesian newcomers picking up many genes from the autochthonous Papuans and, as new genetic mixture, moving on to the east and southeast. It is very interesting that the Asian women have obviously preferred the virile Papuan men: the Y-chromosome signature of the Asian men is rather weak in the Austronesian populations of the Pacific (Kayser et al., 2003). We have also been able to demonstrate (cf. Harley et al., 2005) that patrilineal descendence structures and virilocality so typical for Papuan populations, show up in the genetic data Kayser et al. (2000). The molecular genetic study of Papuan peoples has, as other research, mainly taken place in Papua New Guinea. Hopes are that the Provinces of Papua and West Papua can be included in international research to understand the patterns of dispersal and settlement of the amazingly old populations in New Guinea.

One puzzling outcome of genetic studies is that there are very little, if any, commonalities between the genetic make-up of Papuans and Australians (Stoneking and Wilson, 1989; van Dijk, 2005), despite the fact that they must have arrived, through the then available land bridges, around the same time, (about 40,000 BP or earlier) and that the land connection, which has persisted for several tens of thousands of years of human settlements, between the Fly River region and Northern Australia later becoming a relatively easily crossed sea connection via the Torres Straight Islands.

Main et al. (2005) interpret their genetic research results as showing that there were probably four different waves of Papuan speaking immigrants before the Austronesians arrived from Asia and that the highlanders belong to the earlier, whereas the peoples of the northern fringe and the Sepik belong to a later wave of migration. According to them, the peoples of the Southern Highland in Papua New Guinea are a separate group. They did not find Austronesian admixture in the genomes of peoples living in the interior of the Bismarck Archipelago which was settled by Papuans long before the sailing-specialists newcomers arrived. Easteal et al. (2005) argue that the pattern of mtDNA radiation in New Guinea can most parsimoniously be explained as the effect of the island originally being colonised by only a small number of people.

Discussion

In a rough calculation one could assume that the ancestors of the Papuans moved the centres of their habitats 5 km every 2 years and that the distance they had eventually travelled to arrive at the coast of New Guinea was a total of 100,000 km, i.e. about 6 times the straight land line from Africa to the 'Bird's Head'. This journey would have taken them 40,000 years. That is well in accordance with the estimates many researchers propose when they describe the early Out-of-Africa events. Following the argument by Chris Stringer (2011), who thinks that this only occurred about 60,000 BP, one would have a problem, as there would have been only about 20,000 years or less at the disposal of the early Papuans to move from Africa to New Guinea. Research progresses, much in contrast to post-modern claims, and some day we will have even better estimates and more precise knowledge of what must have happened to enable humans to colonise New Guinea and Australia so long ago.

The finding of Easteal et al. (2005) that only small groups of Papuan immigrants arrived at the shores of New Guinea is an intuitively appealing scenario: Not so many Vikings made the difficult journey from Greenland to Newfoundland. The journey from the Sunda Shelf to the Sahul Shelf across several wide water straights must have been similarly difficult for the eastward moving groups of Proto-Papuans – no sailing specialists like the later newcomers, the Austronesians. More genetic research will show whether the founder population of New Guinea was indeed small. I think that this is likely.

It seems also likely that the first Papuan immigrants did not, immediately after their arrival, penetrate into the often very rugged, difficult to access interior of New Guinea. Before spreading through the island they might have stayed at the shores, especially as the higher mountains must have been very inhospitable during the ice age. The north coast of New Guinea was the main (perhaps the exclusive) route of immigrating Austronesians who also came via the Moluccas and the 'Bird's Head' – this time in seaworthy boats. Whether this migratory path was also taken by the early Papuan settlers, moving mainly on their feet, is unknown. Perhaps then, with the sea level 120 m lower than now, the south coast was similarly swampy as today with meandering rivers and their often large deltas, a region which requires specific cultural adaptations, including long one-hull canoes for speedy travel, sago production for energy supply and fykes and other traps to catch fish in brackish or fresh water. South coast Papuans today do not venture into the open sea, their boats are just not made for that. It seems to me, therefore, that the north coast is more probable as pathway for the Proto-Papuans.

A reasonable hypothesis (Swadling, 1983; Craig and Hyndman, 1990) holds that early Papuan people came up the Sepik River and settled in the Telefomin area and other Ok speaking highlands, perhaps even moving across the central cordillera to settle in the southern half of New Guinea, including the meanders and deltas of the south coast and creating cultures like those of the Papuan Gulf of Papua New Guinea and the Asmat region in the Province of Papua which have a similarly striking, expressive art as the Sepik people. Main et al. (2005) interpret their population genetic data differently: New Guinea highlanders belong to a very old migration wave, the peoples along the Sepik River came later.

One can state that religious traditions of the Ok, the Mek and the Yali as well as some aspects of ethnographic and linguistic comparison support the hypothesis that there was, indeed, in this part of Highland New Guinea, a movement of early Papuan people from east to west. Yaleenye, the 'One Coming from the East' in Mek culture and the corresponding Yeli of the Yali point to the east and some important elements of traditional culture, like boyhood initiation, called by the same term in Mek *(kwit),* Yali *(wit)* and Dani *(wit)*, could have moved in the same direction. The peculiar symbolic headdress, of the Ok (*kamil, mafum*), the Mek *(mum)* and the Yali, who have three different types, also demonstrates the cultural-religious continuum characterizing this region.

It was shown above that the central Mek culture misses a number of items which are very important in the surrounding Papuan cultures: the Afek myth of all Ok (except the Nalum), the drum, carved and painted shields, carved and painted boards of the men's houses, bamboo pipes for smoking. The most likely answer for the Eipo missing some of the trans-central-highland cultural markers is probably that they have immigrated, at some stage of long Papuan history, into the area where they now live. As they do not share the missing elements, it is not likely that they have come from east or west, because these elements are present there. They must have come either from the south, the Koroway or another language group of the Awyu-Dumut language family (Ross, 2005), following the course of one of the big southern rivers leading to the central range (e.g. the Heime/Steenboom River or the Ok Cop/Digul River). If one takes the perspective that important goods, like marine shells, most likely came this way (Swadling, 1983) then this route is more probable than an immigration from the north, via the Idenburgh and one of its tributary systems, e.g. the Kloof or the Borme-Bime-Tanime-Eipomek-Nalcemak system, all draining the northern slope of the central cordillera. In light of a possible linguistic relatedness of the Ok languages and Awyu-Dumut (Ross, 2005) and the fact that there are some important cognates in Nalum-Ok and Mek (Hylkema, undated; Heeschen and Schiefenhövel, 1983) it is reasonable to hypothesize that the Mek languages are also connected to this large linguistic family south of the central cordillera. This would, if confirmed, e.g. by genetic studies, point to a migration of the Mek into the central highlands from the south coast of West-New Guinea, not as proposed by P. Swadling (1983) the other way round – a new twist in the most likely very complex dispersal pattern of Papuan peoples.

Harding & Liu (2005) conclude their population genetic work modelling the most likely dispersal scenarios with the statement that while a settlement of New Guinea out of Africa is possible, back migration also possible. The latter would be, mildly spoken, a sensation. Clearly, more of this fine-grain research in molecular biology is necessary to shed light on what really happened when this part of the world became the home of early Papuans.

Harley et al. (2005) interpret their molecular genetic data from some Papuan groups in the interior of Papua New Guinea as showing segregating effects of the high central cordillera. In their study, the genes of inhabitants of the village of Busilmin, who live at the northern side of the Star Mountains, and the one of Bultem at the southern side, are quite different. We have not carried out any genetic study in the Mek area yet, but I am sure that we could demonstrate a quite opposite effect: historically and currently there is a very close marriage and trade relationship between the Eipo in the north and the Una inhabitants of the villages in the Upper Heime Valley in the south. The direct western neighbours of the Eipo, the inhabitants of the Famek Valley, on the other hand, were hereditary enemies and only one known marriage and one love affair (which did not result in offspring) were observed from 1974 to 1980, whence the *pax christiana* spread in the region and warfare was abandoned, leading to a now unimpeded contact and marriages across the old barrier. I argue that it is not the high mountains or other geographic borders, but cultural separation based on ideological separation, dehumanizing mechanisms and serious warfare (Schiefenhövel, 2001) which has brought about New Guinean pseudospeciation.

What made our *Homo* ancestors disperse? Why not stay where their mothers and fathers lived, where in the past they were able, perhaps with difficulty, to survive and have children? It is not very likely, in my view, that the journeys of *Homo erectus* all the way to Java and Flores and then *Homo sapiens* to New Guinea and Australia, were always and in each section of migration prompted by ecological catastrophes or at least major climatic and other changes, so that the migrants were 'driven', by ecological necessity, further east at many points in time. A more active principle of migration must have been involved. Among the mammals humans have the widest global distribution; this speaks of our species' characteristic as 'specialists for non-specialisation' as Konrad Lorenz (cf. Medicus, 2012) has coined this amazing property of omnivorous, smart *Homo sapiens. Rattus norvegicus,* omnivore and adaptable like us, has a similarly wide distribution, but without humans and their ships this rodent species would not have made it to the most remote islands. That is also true for some domesticated animals, even in the most inaccessible mountains of New Guinea white visitors found, at first contact, *Sus scrofa*, and the pig as we know it from our latitudes and the dog, *Canis familiaris*, the classic companion of humans in so many parts of the world.

Nobody gave early *Homo sapiens* a ride during their epic journeys to Indonesia, Melanesia and to the tiny islands in the Pacific. This dispersal is stunning and needs explanation. The ROCEEH (The Role of Culture in the Early Expansions of Humans) Project of the Heidelberg Academy of Science, carried out by at Senckenberg Institute in Frankfurt and the University of Tübingen under the leadership of Volker Mosbrugger and Nicolas Conard (cf. the newsletter at www.roceeh.net) looks at factors which must have enhanced prehistoric journeys of humans: among them favourable corridors and clever cultural inventions, including specific cognitive capacities.

From the viewpoint of human ethology, the biopsychology of human perception, emotion, thought and behaviour, a number of 'motors' for passive and active dispersal can be named:

1) The active seeking of favourable living conditions especially in periods of climatic and ecological change (in this, humans behave like animals);

2) The avoidance of conflict, ranging from family and group quarrels and splitting communities to warfare (very high in Highland New Guinea societies and probably the strongest motor for pseudospeciation, Schiefenhövel, 2001), including less dramatic ordinary escapism;

3) Being pushed out of a habitat by another group of humans;

4) The extraordinary human curiosity, coupled with a special and adaptive longing to explore the world behind the horizon;

5) The cognitive and cultural resourcefulness of our species.

The latter has made humans perform stunning feats leading to conquering all ecological zones of our planet, from arctic ice to equatorial jungle, from rain-shrouded and snow-covered mountains like in highland New Guinea to burning-hot deserts. The most striking of these deeds is the peopling of the vast waters of the Pacific Ocean by Polynesians, who themselves are, as we have been able to show (Kayser et al., 2006), a most interesting mix of the two autochthonous populations of New Guinea, carrying higher than chance Papuans male and Austronesian female genes. New Guinea is a natural laboratory of genetic and cultural evolution, an enigmatic island, which will continue to contribute to the understanding of the wanderings and the wonders of humankind.

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Conclusion and way forward

New paleoanthropological paradigms to explore Human Evolution in Asia within the framework of the World Heritage Convention

Nuria Sanz

General Coordinator of the World Heritage Thematic Programme HEADS – World Heritage Centre, UNESCO and Director – UNESCO Office in Mexico

2012 Human Origin Sites in Asia and the World Heritage Convention (Yeoncheon, South Korea). © Kidong Bae

Looking Forward

At this time the reader will be able to use the knowledge contained in the preceding works to trace the route of mankind´s long journey from Africa to the continental and island regions of Asia. The contributions of this volume have demonstrated the value of international and interdisciplinary cooperation; their success serves as a call for a greater emphasis on international standards of practice in the implementation of further projects in the region. The World Heritage Convention offers a platform for the preservation of the Outstanding Universal Value of these precious repositories of knowledge, both as fixed places on the landscape and through the movable heritage which serves as an integral part of human evolution research and public outreach.

As a continent, Asia contains the highest and lowest places on earth, and an enormous diversity of biotic systems. South and East Asia are also regions in which the monsoon has been registered since 25 Ma. Some of the longest terrestrial climatic sequences have been found in East Asia due to favorable taphonomic processes of loess deposition and paleosol development.

Asia shows an extensive array of regional palaeolithic patterns thanks to improvements in excavation methods and applied research strategies. This issue, according to the majority of the approaches presented, is in favor of polycentric models for the evolution of human behavior. This book also shows the importance of the re-excavation of sites, including the sites related to paleoanthropology already inscribed on the World Heritage List, their role for further research for the understanding of human biology and cultural evolution in Asia, and Asia's huge potential for future exploration.

Moreover, these pages give solid arguments for the need of further international cooperation on the creation of new programmes, the digital archiving of fossils, the application of new technologies to preserve the conditions of authenticity and integrity of movable data on paleoanthropological sites, and the development of joint research international programmes for unspoiled paleolandscapes as in the case of Nihewan Basin in China. Future cooperation is equally needed to publish the results of scientific excavations in the English language in order to integrate a comprehensive community of interest.

The contributions presented here demonstrated that the Movius Line as originally formulated is no longer a boundary which divides two different palaeolithic cultural territories. These papers prove human presence in Southwest Asia as early as 1.85 Ma and in North China as early as 1.66 Ma. However, our knowledge of subsistence patterns is so far limited, because human fossils are fragmented and not often related to faunal or lithic assemblages (nor often are these related to each other), which creates difficulties in interpreting the data.

In palaeoanthropological terms, Asia is like an extraordinary mosaic of different landscapes, climates, types of sites, and types of evidence.

The Houjiayou site, Nihewan Basin, China. This site has been excavated since 1974, and 7000 artifacts, many mammalian bones and human fossils were found. © UNESCO / N.Sanz

Dispersals

Of particular interest in the case of the Asian narratives elaborated in this volume is the source of early populations and the specific regions of their initial arrival in the vast expanses of Asia. Though the traditional Out of Africa theory of the peopling of the world is generally accepted, recent evidence from Asia has called the validity of this model, in its current form, into question. Is Africa the source of early Asian populations? Were these initial settlers part of a homogenous group that subsequently split into diverse regional groups, or did this diversification precede population movements into Asia?

Since the late 1980s, findings in the Arabian Peninsula, Georgia, China, India, Pakistan and Indonesia, have begun to change our vision and perception of the role of Africa in the context of human evolution and human movement into Eurasia. New discoveries quickly posed two questions: how and when did *Homo*

The Nihewan Basin, looking towards Xiaochangliang. © UNESCO / N.Sanz

habilis first leave Africa? And more importantly, did *Homo erectus* originate in Asia? We must endeavor to fill the gaps that remain in mapping the routes of dispersal and migration in Asia, including Pleistocene evidence from across the Indo-Pakistan geographical area.

Furthermore, the scientific dating of the Sangiran sites, where important fossils were found in the 1930s, has placed the early chronology of human presence in Indonesia at the unexpectedly early date of *at least* 1.6 million years ago. Current and ongoing research at Sangiran will continue to clarify any doubts about this early chronology. In China, work is being done with the Longgupo fossils to identify the correspondence between the skeletal remains and the lithic artifacts, in order to provide evidence of the presence of humans in China at the beginning of the Pleistocene, as is also being done in the case of Nihewan, Yuanmou, and other regions of China. In addressing some unresolved questions, the Dmanisi site in Georgia confirms the presence of humans outside Africa at a very early date. Evidence of *Homo georgicus* fills a gap in the hominin fossil record between *H. habilis* and *H. ergaster*. Dmanisi is proof that there was a human presence in Eurasia that was contemporaneous with the first human forms of behavior in Africa at least 1.85 Ma-ago. The evidence for lacustrine environments at Dmanisi and the slightly younger sites at 'Ubeidiya, Israel (1.0-1.5 million years old) indicate the type of viable locations for the initial dispersals from Africa. Today taphonomic investigations of site formation processes must continue at sites where important early human fossil evidence was historically collected, especially those which demonstrate the beginnings of cooperative behavior, hunting of large mammals, the use of fire and major technological developments.

Lacustrine sediments at Xiaochangliang, Nihewan, ca. 1.36 Ma. © UNESCO / N.Sanz

What is clear is that once populations had moved into Asia, they expanded and dispersed throughout the region in a number of ways, utilizing a number of different routes and occupying a variety of ecological niches. The various manifestations of these early occupations of diverse ranges and environments remain to be completely understood, as does the exact role that ecology plays in the migration and diversification of early populations. This will, no doubt, lead to a variety of narratives for the various geographic and environmental zones occupied during the first migrations. New questions have arisen from the emerging evidence of the effects of Asian geography on the mobility of populations and the diversification of adaptations to a wide range of ecological niches. These are in part related to the findings of artifacts as early as 1.66 Ma in northern China. These are contemporaneous with the earliest Indonesian *Homo erectus* specimens, but evidently survived under harsher climatic conditions at a very early moment in human evolution. Although the preceding chapters have addressed some of the issues of the multiregional evolution of the Asian contribution to the study of the evolution of *Homo erectus*, and thus also of the diversity of hominids in Lower and Middle Pleistocene Asian biogeography, the picture remains far from complete.

Though we have become accustomed to gaps, both archaeological and paleoanthropological, in the record of the Pleistocene occupation of continental Asia, ongoing investigations in the Loess Plateau, in southern China, Indonesia and India inspire confidence that many of these gaps in the chronology of human evolution in Asia will be filled.

Houtouliang, 13ka B.P, Nihewan Basin. This site contains microlithic industries and some of the earliest pottery in North China. © UNESCO / N.Sanz

The sites of the Nihewan Basin (Majuangou III, Xiaochangliang and Donggutuo, 1.66 Ma, 1.36 Ma and 1.1 Ma respectively) in the north of China reinforce arguments in favor of human presence in these latitudes considerably earlier than 1 Ma. After 1.5 Ma, the Acheulean technocomplex, characterized by large bifaces, cleavers and large cutting tools, is found in Southwest Asia and later in South and perhaps East Asia, but never wholly displaced the simpler Oldowan-type technology in many regions of Asia. This evidence paints a complex and varied picture of the ranges of the initial human occupation of Asia, its cultural traditions as well as subsequent population migrations and dispersals.

Indeed, following the initial peopling of Asia, the next major narrative in terms of human evolution in Eurasia is the emergence of *Homo sapiens*. The mechanisms of this emergence remain hotly debated, with new and emerging evidence adding much needed data to these discussions. New fossil and genetic data may clarify whether *Homo sapiens* arrived in Asia as a colonising species that moved eastward into the region, or whether it was an *in situ* development. If *Homo sapiens* arrived as a colonizing population, where did they come, whom did they replace, and from and which routes did they use? If they emerged *in situ*, current genetic trees need to be clarified. In both cases the extent of population replacement and hybridization remain shrouded in mystery. We know the end result is a homogenous (i.e. single species) population of *Homo sapiens* but what diversifications and regionalization, what expansions and contractions occurred during this evolutionary process? Was it, in fact, a process, or could it be more accurately classified as an event? For example, HEADS appreciated how despite the temporal differences between 1.6 Ma and the first *H. erectus* of Zhoukoudian ca. 600 ka, the basic morphologies of the skeletons are very similar. However, this does not necessarily provide testimony of a single lineage. Neither do we know exactly how to draw the structure of the evolutionary tree or its branches, which would permit us to arrange the scattered evidence and identify the significance of evidence which, on its own, cannot explain the complexities of the processes that have taken place. For example, researchers currently estimate the existence of several human lineages around 300 Ka, hypothesizing different forms of hybridization rather than population replacement. There are certainly more questions than answers in this emerging narrative, but new fossil and genetic evidence from Asia is adding new insights which are reshaping many of the traditional paradigms of migration and dispersal.

Biological Adaptations

However these prehistoric populations emerged or arrived upon the scene, groups subsequently underwent many adaptations to the novel physical and social conditions they encountered. Evidence of biological adaptation comes from two primary methods of analysis, genetic data from ancient and recent DNA studies along with morphological investigations of fossils. As a response to the occupation of varied environmental and geographic ranges, often more extreme than those from which these populations originated, early *Homo* populations in Asia adopted a variety of biological adaptations. These include responses to environmental change and the availability of resources, including adaptation to both long and short-term variations creating favourable and unfavourable environments (i.e. changing sea levels, climatic downturns, etc.). Closely tied to questions of the emergence and spread of *Homo sapiens* groups in Asia are narratives related to biological adaptations, such as demographic growth, population contraction, hybridization, replacement and extinction. Biological adaptations developed in response to environmental change and the availability of resources (short and long-term, sea levels, seasonality, etc.), that may have been useful in indicating which environments were adaptive, and which were unfavourable. As elaborated in the earlier works of this publication, the particularities of the Asian archaeological record are especially apt to highlight issues of demographic growth, contraction, hybridization, replacement and extinction and, notably, the role of isolated populations, given the high number of islands in East and Southeast Asia, as well as the diversity of environments found throughout the region.

Behavioural Adaptations and Social Developments

People also adopted several behavioral adaptations to contend with the various new ecological niches and geographic areas they came to occupy. This includes novel subsistence patterns, technological innovation and variations in seasonal mobility and the origins of symbolism. Subsistence patterns would be adapted seasonally and to the movement of game, thus affecting aspects of diet, hunting, collecting and processing, both temporally and across regions. Similarly, settlement and mobility would vary from region to region in accordance with the availability of materials. Notable technical narratives in Asia involve the domestication of fire and aspects of pyrotechnology, technological developments in procuring and processing resources, and the utilization of plants and organic materials. Perhaps most dramatic is the narrative of the origins and the use of symbolism among these early settlers. In this matter, Asia is still not a well-known sphere of knowledge.

No doubt some of the same factors that spurred biological change are likely to have also resulted in changes in behavioural patterns. For example, changing environments and resource availability are likely to have affected subsistence patterns (diet, hunting, collecting and processing), including shifting the focus to marine resources. This would also have affected how the landscape was used, and the location of sites. Mobility and settlement changes would also have been closely linked to local and exotic raw materials and networks of exchange. Technologically, the emergence, spread and settlement of *Homo sapiens* is accompanied in many regions by a shift to blade and bladelet based assemblages, alongside in some cases the persistence of cobble and flake based industries. There is an increase in organic artifacts and an emergence of ground-stone and pottery technologies. Furthermore, there is evidence for innovations in pyro-technology and seafaring, most notably the colonisation of Australia after 50 ka and Japan after 40 ka. Finally, there is the development of more complex and more advanced social structures, communications and early symbolic forms, such as ornaments, burial, rock art and the use of pigments.

Whilst many of these narratives apply to human evolution in Asia, they are also applicable in a variety of regional human origin contexts in Africa and Europe. Nevertheless, some aspects of these narratives are unique to the Asian context. These include the biological and behavioural evolutionary trajectories of isolated populations; adaptations to high altitudes and, in particular, subsequent Palaeolithic adaptations, including the role of seafaring, the persistence of certain technologies, such as the role of biface lithic industries, and the development of new technologies such as micro-blades and the early use of pottery.

Just as Asia presents novel archaeological manifestations of the processes that are well known in other regional archaeological records, so must the theories and models used to explain these novel Asian manifestations be adapted or created for the particularities of the Asian record. Perhaps most dramatically, in Asia we do not find the same patterns of material culture in the expression of the first symbolic behavior that we find in Europe or Africa. For example, there are karst landscapes but no Paleolithic cave art, and currently very little evidence of portable art and musical instruments have been found. There are ornaments, but they have a minimal presence in the record compared to the florescence of such similar behaviors seen in the European Upper Palaeolithic. Excepting the possibility of a lack of preservation of the symbolic record due to taphonomic circumstances, there is no known explanation for the variation in the expression of symbolic behavior; if it is not a question of physical capability or access to suitable materials, the explanation must lie elsewhere.

Similarly, Asia presents a new variation for Upper Palaeolithic settlement design and dynamics. The Asian evidence does not follow the sequences and patterns in lithic industry that are demonstrated in other geographic regions such as Africa or Europe. Notably, the ability to apply conceptual models of the characterization of the transition between the Middle and Upper Palaeolithic from these well studied regions remains a gap in our knowledge of Asia. The works of this volume have demonstrated the necessity of considering previous transitional models, developed with a basis in the archaeology of other regions, critically when seeking to shed light on the processes evidenced in the Asian archaeological record.

Furthermore, despite our increasing ability to discern biological and behavioral adaptations in the archaeological record, it remains difficult – particularly in periods of population transformation, displacement and dispersal – to correspond human lineages with specific behavioral adaptations. For example, as recently as 40 ka, populations in Asia were composed of anatomically modern humans coming from Africa, Neanderthals who had occupied western Eurasia, Denisovans (defined genetically, not morphologically) in Central Asia and Siberia while *Homo floresiensis* persisted in Indonesia. Members of these species (apart from *H. floresiensis*) populated two, and perhaps three continents and today create conflicts of interpretation in the absence of resources to articulate the archeological debates and discussions with other sciences to explain the different contexts of human behavior. Keep in mind also that this uncertainty is amplified at greater time depths when populations were even more diverse, and taphonomic processes have resulted in the preservation of a highly fragmentary archaeological record. What does remain certain is that there is much work yet to be done, and the contributions to this volume have provided some insight into the ways in which the World Heritage Convention may be one such resource to promote interdisciplinary and interregional collaboration to begin to fill the gaps in the story of human evolution in Asia.

The World Heritage Convention and Human Evolution in Asia

Though the World Heritage Convention was not conceived specifically with palaeolithic and human evolution sites in mind, application of its criteria proves to be a boon to potential for collaboration and conservation at these precious and finite sites. The most frequently applied criterion for currently inscribed human evolution sites is criterion (iii), which speaks to the recognition of the exceptional nature of any human evolution site which has survived thousands or millions of years to the present day. Variably, the other cultural criteria are applied to human evolution sites, but there is particular potential in using natural criteria, in particular criterion (viii), '*to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features',* to be applied to the record of the emergence of modern human biology and behavior on the earth. This recognition of the fact that very earliest, innovative and ongoing manifestations of the processes which ultimately define our humanity originate in the natural world, speaks directly to the mandate of both the HEADS Thematic Programme, and the pursuit of human evolution research in in general.

A broader inclusion of human evolution sites in the framework of the World Heritage Convention facilitates the creation and application of higher standards of conservation and preservation at these sites. In particular, the use of interdisciplinary research implementation, particularly in cases concerning sites/movable heritage, protocols for intervention and the support of new technologies for prevention, diagnosis, intervention, monitoring and museology. From the outset of any planned intervention, these factors should be taken into account and foreseen by an interdisciplinary team.

In the framework of the HEADS Thematic Programme, and in Asia in particular, specific protocols have been considered for working with descendent communities. Standards for intervention should be established, and resources significant to all stakeholders should be determined, taken into account and constantly monitored throughout all stages of intervention.

In order to ensure the Outstanding Universal Value of these sites the scale of the site, cultural values, moveable cultural heritage in coordination with properties, protocols of intervention to avoid degradation and loss of significance, and curation and museology must be considered, with attention to balancing the need to remove artifacts and sediment from the site to harness the full potential offered by the deposits, and the need to conserve certain stratigraphic sequences intact for future generations. Excavation at a site should add to the understanding of a site's significance. This concept of conservation should be used as a guiding axiom of pre-excavation planning: to excavate only as much as is necessary, but as little as possible. Thus there should be plans in place to preserve, at the very least, witness sections and areas of undisturbed sediments. This will ensure the opportunity to reassess the significance of the property in the future as research questions and scientific methodologies advance; as new technologies and methodologies are developed (i.e. ground penetrating radar, aerial photography, GIS, satellite imagery, tomography, 3D scanning, etc.), as the ability to record and sample non-destructively is ever-increasing.

By the very nature of archaeological investigation, the basic tool of the human evolution researcher, the OUV of the heritage at an archaeological site, is not always fully embodied by the elements which remain at the site; excavations should be designed to preserve the property and its archaeological context, and also the artifacts themselves once they have been excavated. The conservation of a property's movable heritage should be taken into account prior to the beginning of interventions to ensure the preservation of the full scope of the site's heritage, not just the heritage that remains geographically located *in situ*.

Furthermore, consideration of needs and appropriate methods of interpretation and dissemination should be used to reinforce the role of conservation practices. World Heritage status and OUV declaration (criteria, protection, conservation and management) should stand as the basis for the interpretation of the property in the appropriate facility (site museum, national museum, interpretation centre as well as employing various on-site or off-site modes of information transmission). Outreach, preservation and museology of this kind can be enhanced through social networking (Twitter, Facebook and by word-of-mouth). The most immediate stakeholders, the local communities, should play a guiding role in the preservation of a site's heritage, both out of respect for their contribution to the cultural value of a site and practically, as the most proximate stewards of the property. At the same time, consideration should be given to repatriation or digitalization of information of these records to be shared by museums and the scientific community and long-term loans of artifacts to ensure the conditions of authenticity and integrity of their cultural and scientific value.

The role of archaeology does not end at the physical limits of a site, but rather carries forward to the treatment, analysis, curation, presentation and interpretation of the locality and the materials it produces. The role of the World Heritage Convention at archaeological sites should therefore take into account the full scope of this process when making its evaluations and determinations of the authenticity, integrity and OUV of a human evolution site.

Guidelines

In addressing the potential and realized scientific contribution of Asian Human Origins sites, our reflection takes advantage of the participation of numerous world renowned scholars to report on recent research efforts on Human Origins sites throughout Asia. In the following paragraphs the reader will find the results of the working groups of the aforementioned experts, in which guidelines for the establishment of scientific narratives and solid actions to ensure the future recognition, conservation and research of sites related to the process of human evolution, adaptation, dispersal and social development in the Asian geographical area.

During the meeting in South Korea in 2012, two primary narratives in Human Evolution in Asia, based on taxonomic species designation, were discussed: Early *Homo* species and *Homo sapiens*. These narratives were debated in the context of the following features: the geographical range of the species, their unique biological and behavioural adaptations in response to changing environmental and social landscapes, and the potential for establishing the Outstanding Universal Value in each of these narratives.

Early Homo: Ranges

With regards to *Homo* species in Asia, as in other regions, for early *Homo* species, this includes the earliest migration and settlement, the various routes used to achieve these early colonisations, as well as subsequent diffusions. Of particular interest in the case of the Asian narratives, is the source of these early populations and the specific regions of their initial arrival in the vast expanses of Asia. Though the traditional Out of Africa theory of the peopling of the world is generally accepted, recent evidence uncovered in Asia has put into question the validity of this model, in its current form. Is Africa the source of early Asian populations? Were these initial settlers part of a homogenous group that subsequently split into diverse regional groups or did this diversification precede population movements into Asia? Once populations had progressed into Asia, they expanded and dispersed throughout the region in a number of ways, utilising a number of different routes and occupying a variety of ecological niches. The various manifestations of these early occupations of diverse ranges and environments remain to be completely understood, as does the exact role that ecology plays in the migration and diversification of early populations. This will, no doubt, lead to a variety of narratives, for the various geographic and environmental zones occupied during the first migrations. The evidence paints a complex and varied picture of the ranges of the initial human occupation of Asia.

Further Research: Potential sites and areas

The successful and rich discussion between scholars allowed the identification of a list of areas in Asia which should convene the increased interest of governments, technical and scientific institutions and communities.

The scholars identified a way to conform the narratives to the potential sites.

Potential Outstanding Universal Value (OUV)

Early Homo OUV

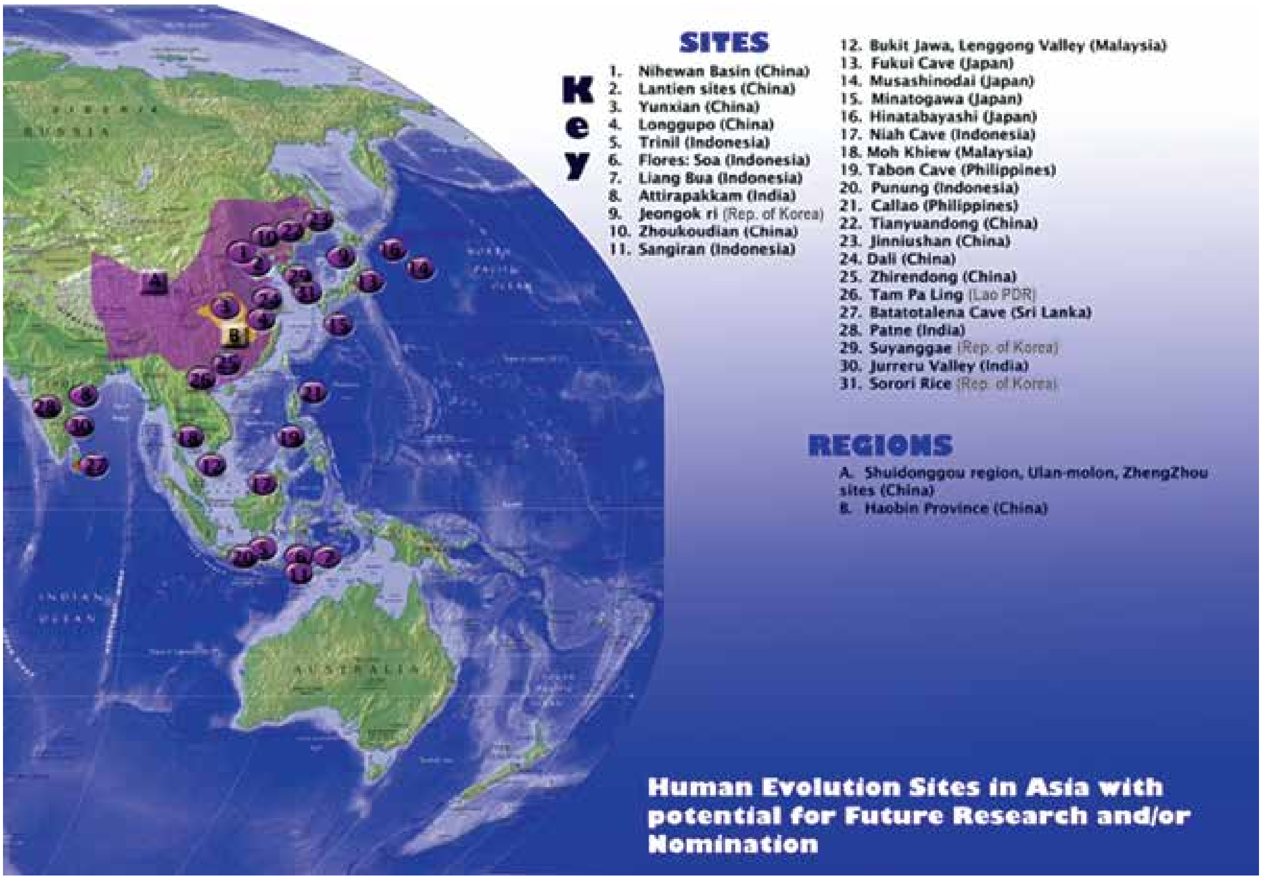
The scholars identified the criteria to couple these narratives with potential sites:
- Open temperate landscapes, for example, the Nihewan Basin, Lantian, Yunxian in China;
- Sub-tropical sites (for example, Longgupo, Yuanmou);
- Tropics (peninsular and insular) in South and Southeast Asia;
- Trinil, Java, Indonesia (particularly for its historical importance);
- Flores, Indonesia: Soa Basin, Liang Bua;
- Attirapakkam, India (in particular for its historical importance and early Acheulean industry);
- Middle Pleistocene adaptations: Baise Basin sites, China; Jeongok ri, South Korea.

Homo Sapiens OUV

- Shuidonggou Region, Inner Mongolia, China (potentially also: Ulan-molon, ZhengZhou sites) (additionally important for its historical importance);
- Sites showing early adaptation in Japan: Fukui Cave, Musashadai, Minatogawa, Hinatabayashi.
- Niah Cave, Borneo; Moh Kiew, Thailand;
- Tianyuandong, Jinniushan, Dali, Zhirendong, China; Tam Pa Ling, Laos etc. (Mainland):

Modern *H. sapiens*

- Sri Lanka, in particular for adaptations related to modern human dispersals at Bataloma Lene and the site of Patne, India that exhibits evidence for Indian microblade technology, and symbols;
- Suyanggae, South Korea: Microlithic cultural adaptations;
- Hoabin Province: Hoabinian, etc.



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How to Apply World Heritage Criteria to Palaeolithic Sites in Asia

Criterion 1: "masterpiece of human creative genius"

The scope of this criterion could be broadened to explore the concept of craftsmanship within, for example, art, some outstanding handaxes and Japanese game traps, although it is noteworthy that this criterion is not directly relevant to palaeontology.

Criterion 2: "exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design"

Because of the ephemeral nature of palaeolithic sites, this criterion is inapplicable to most palaeolithic and human evolution sites. It might however have some relevance to some late palaeolithic sites in, for example, the Levant and Siberia, but it remains predominantly valuable only when used for the most recent prehistoric past.

Criterion 3: "unique or exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared"

This criterion is clearly useful for human evolution and prehistoric sites, a period that current scholarship focuses on the most extreme (i.e. the oldest, etc.), and for sites whose great antiquity makes the very fact of their survival an exceptional occurrence.

Criterion 4: "outstanding example of type of building, technological ensemble"

An outstanding example of a type of building is the mammoth bone structures of Malt'a, and also Buret in Siberia. With regards to an outstanding example of a technological ensemble, examples are the earliest lithic assemblages such as Gona, Ethiopia (ca. 2.6 Ma-old) and Lokalalei, Kenya (ca. 2.3 Ma-old) and the late Pleistocene Northeast Asian microblade industries.

Criterion 5: “outstanding example of traditional settlement, land use or sea use …. In environment vulnerable to irreversible change”

The initial colonisation of Asia by hominid lineages, and the eventual emergence and settlements of *Homo sapiens* are an outstanding example of human achievement (e.g. Niah Cave, rainforest habitats, high altitude settlements, island colonisation, Japanese sea use for obsidian exchange, sea level changes/fragmentation of land masses in Indonesia, etc.). This criterion can be used to highlight the importance of long-term records under different environmental conditions and the establishment of behavioural traditions, such as symbolic representation and technology.

Criterion 6: “be directly or tangibly associated with events or living traditions”

The criterion of living traditions can be applied for sites connected to the historiography of the discipline (e.g. iconic sites such as Trinil, Zhoukoudian, Ngandong). Furthermore, caves, landscapes or any landmark that may have been repeatedly used for various purposes over time and are often significant to present inhabitants (as sacred places, graveyards, refuges, hunting posts etc., as at sites like Laang Spean cave, Cambodia) fit this criterion.

Criterion 7: “superlative natural phenomena or areas of exceptional natural beauty”

This criterion could be applied to palaeontology and geology that provides information on hominids, past environments and deep time scales, such as the Loess Plateau of North China, or unspoiled eroded landscapes, as in the case of the Nihewan Basin.

Criterion 8: “outstanding examples of major stages of earth’s history – ´Examples of groups of sites that demonstrate major episodes of earth’s history and human responses to them´”

Though this criterion is related to natural properties, scholars have insisted in the pertinence of it for early sites of hominid colonization of nature.

Human evolution sites witnessed major episodes of the early stages of human dispersal and adaptation. These may be seen on a variety of scales or by groups of sites with common geomorphic features (e.g. basin histories such as Bubing Basin and Danyang County caves). Some examples of the major stages of earth’s history witnessed by human occupation and evolution sites include: volcanism (Toba), loess deposition (North China and Central Asia), alluvial sequences (Siwaliks, Jeongok); sea level changes (Indonesia, Japan and New Guinea); massive uplift (North China, Pakistan and North India).

Thus Paleoanthropological sites could also meet natural criteria. The scholars proposed several related HEADS argumentations.

Criterion 9: “outstanding examples of ongoing ecological and biological processes”

Although the Convention was created with the achievements of a human group in mind, the very processes that constitute becoming human are primarily and traditionally categorised as biological (in addition to behavioural). The processes of becoming human and the sites that carry evidence of this therefore represent an outstanding and unique biological process in the record of humanity. Furthermore, the continuing ecological processes that humans react and adapt to, may speak of the relevance of this criteria to human evolution sites. For example, the development of a rain forest in the record of Niah cave; the development of the North China deserts and relevant sites (e.g. Shuidonggou and Sulawasu); human settlement in Siberia; humans in the Arctic from Yana to Wrangel in the Arctic Ocean, and manifestations of human evolution on endemic islands such as Liang Bua and Minatogawa.

Criterion 10: “contain the most important and significant natural habitats for in situ conservation of biological diversity, including threatened species”

Extinct species, including both those in and exploited by human lineages, provide valuable evidence of human evolution and thus should be considered along with extant species when applying this criterion. Although the animals themselves are already extinct, the information that their remains carry is a precious and limited resource, one that is often threatened by the same factors affecting extant species today (for example, Australian fauna in Cuddie Springs, for the information they can provide in the megafaunal extinction debate). Additionally, endemic island faunas can be considered to constitute a ‘time-capsule’ of biodiversity in connection with extinct hominids, as can the evidence from mainland “flag-ship” sites such as Dmanisi, Zhoukoudian, ‘Ubeidiya, and Gesher Benot Ya’aqov.

Interdisciplinarity

The discussion on interdisciplinarity highlighted the need for its implementation, particularly in cases concerning sites/movable heritage, protocols for intervention and the support of new technologies for prevention, diagnosis, intervention, monitoring and museology. From the outset of any planned intervention, these factors should be taken into account and foreseen by an interdisciplinary team.

In the framework of the HEADS thematic programme, applied research for conservation should be developed. In Asia in particular, specific protocols should be considered for working with descendent communities. Standards for intervention should be established, resources significant to all parties should be determined and taken into account (e.g. the Burra Charter), and resources should be constantly monitored throughout all stages of intervention.

Considerations of establishment of scientific significance

Five primary considerations in the establishment of scientific significance were formulated: scale, cultural values, moveable cultural heritage in coordination with properties, protocols of intervention to avoid degradation and loss of significance, and the consideration of curation and museology as reflecting OUV.

(1) Scale

Considerations of scale must include the category of site (i.e. open air, underwater, cave, rock shelter, site cluster, etc.) This will define the landscape of the sites as well as the scale of survey, the limits of the property and the most appropriate techniques to be used, such as geomorphology, soil science, marine science, geophysical survey (both large and small-scale). Destructive and non-destructive survey methods can be employed, depending on the scale of the concerned area. Non-destructive techniques include those of remote sensing (i.e. ground penetrating radar, aerial photography, GIS, satellite imagery, tomography), while destructive interventions might include test excavations, drilling, trenches, the use of a backhoe to clear sterile sediments, and drilling stratigraphic columns.

The buffer zone is part of this consideration of scale and must be considered in archaeological terms. It must be large enough in terms of the conditions of authenticity and integrity of the sites. Before this determination can be made, a large scale survey must be carried out to gather enough information to accurately define the limits of the archaeological deposits. The buffer zone can be considered an ‘archaeological reserve,’ as it holds the potential to continue research.

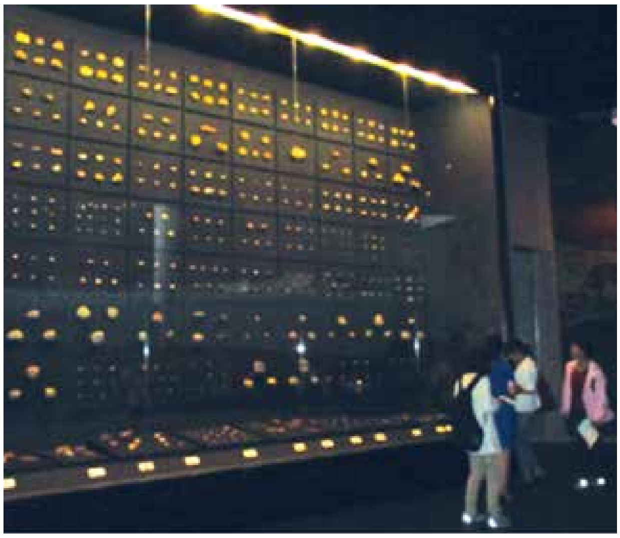
The scientific quality of the property (employing criteria as appropriate), should be defined, in great part, by the degree of recognition of the site by the international scientific community (congresses, publications, peer review contributions), the existence and quality of systematic field studies (surveys and excavations) and the subsequent complete and curated documentation of the contents of the property/properties. This should include the preservation of several scales of data, including preservation conditions on a broad scale, site scale and of individual deposits. The integrity of the properties and deposits reflects the range of OUVS, the authenticity of original materials and data collected on artifact positions, site formation and taphonomy. This should be facilitated by the use of chronometric dating methods (radiocarbon, OSL, TL, U-Series Argon ESR, etc.), climatic studies (marine and ice cores, speleothems, monsoonal records, volcanology, seismic), environmental studies of both the modern (post-depositional) and prehistoric (depositional) contexts through the use of techniques and technologies such as granulometry, micromorphology, micro-fossils, pollen, and phytoliths.

Equally important in the course of interventions is the proper documentation of the interventions themselves. A full record of the history of research and interventions (notebooks, oral testimony and memories, photographs, published sources, etc.) should be maintained to increase the physical collections for study and display by future researchers and the public.

(2) Cultural values

In addition to the scientific value of a site for the in-depth study of prehistory, the site may also have cultural values that are important to local groups and communities living in its proximity. These cultural community values form a complimentary component to the sites heritage value. It is thus important to demonstrate a participatory collaboration process with local and regional parties in the preservation and documentation of associated intangible heritage such as oral histories and cultural practices.

Display of skulls of Homo erectus (copies in plaster) in Zhoukoudian Site Museum, China. © UNESCO / Nuria Sanz



Display of lithic traditions in Zhoukoudian sites. © UNESCO / Nuria Sanz

(3) Moveable cultural heritage articulation with the property

Excavations should be designed to preserve the property and its archaeological context, and also the artifacts themselves once they have been excavated. The conservation of a property's movable heritage should be taken into account prior to the beginning of interventions to ensure the preservation of the full scope of the site's heritage, not just the heritage that remains geographically fixed. This should involve the registration of artifacts at the time of excavation, cataloguing artifacts, the assessment of conservation needs, access to the artifacts for future researchers and proper storage to ensure the preservation of the artifacts' integrity. For the latter, information about the artifacts' location needs to be obtained and secured, the artifacts need to be appropriately stored in acid-free containers. The storage conditions have to be continually monitored and responsible organizations must maintain accurate records of the data associated with the artifacts (provenience, analyses, etc.). Consideration should be given to repatriation and the loaning of artifacts to maintain the conditions of authenticity and integrity and its cultural and scientific value.

Display recording the unfortunate loss of the skulls of Beijing Man in 1941. © UNESCO / Nuria Sanz

(4) Protocols of intervention to avoid degradation and loss of significance

Excavation is considered, from the start, to contribute to the understanding of a site's significance. This concept of conservation should be used as a guiding axiom of pre-excavation planning. There should thus be plans in place to preserve, at the very least, witness sections and areas of undisturbed sediments. This will ensure the opportunity to reassess the significance of the property in the future as research questions and scientific methodologies advance.

(5) Consideration of curation and museology as reflecting OUV

Lastly, the curation and museology of a site, and its movable heritage should be considered as part of the OUV of an archaeological site. Consideration of needs and appropriate methods of interpretation and dissemination should be used to reinforce the role of conservation practices as this provides the general public with various narratives which in turn tell a more complete story of human evolution. World Heritage status and OUV declaration (criteria, protection, conservation and management) should stand as the basis for the interpretation of the property in the appropriate facility (site museum, national museum, interpretation centre as well as employing various on-site or off-site modes of information transmission). Outreach, preservation and museology of this kind can be enhanced through social networking (Twitter, Facebook and through word-of-, mouth). The most immediate participating parties and the local communities should play a guiding role in the preservation of a site's heritage, both out of respect for their contribution to the cultural value of a site and practically, as the most closest guardians of the property.

The role of archaeology does not end at the physical limits of a site, but rather carries forward to the treatment, analysis, curation, presentation and interpretation of the locality and the materials it produces. The role of the *World Heritage Convention* at archaeological sites should therefore take into account the full scope of this process when making its evaluations and determinations of the conditions of authenticity and integrity in order to identify the OUV of a human evolution related site.

Current excavations of the west section of Zhoukoudian, Locality 1: Opening ceremony of the new Zhoukoudian Site Museum, 18 May 2014. © UNESCO / Nuria Sanz

Opening ceremony 18 May 2014, Zhoukoudian Site Museum. © UNESCO / Nuria Sanz

Display on conservation at the Zhoukoudian Site Museum. © UNESCO / Nuria Sanz

Display of the World Heritage nomination file of the Zhoukoudian site. © UNESCO / Nuria Sanz

Final Remarks

To understand the origin of our species, the scientific committee has stated that human fossils were not enough; this publication illustrates that the *context* of these fossils, their huge geographic range, the variety of environments, the different natures of the deposits of material culture, the geomorphological data and taphonomical processes are equally important to the scientific merit of artifacts for the study of human evolution. Indeed, evolution explains the whole of life; the processes and events that define behavioral and biological modernity. A more thorough understanding of the manifestation of these processes in the past can only serve to elucidate the manner and the great diversity of ways in which they are ongoing today. As such, the study of these processes in the framework of the HEADS Programme is salient to the understanding of human roles in migration, population dynamics and protection of environment which are directly applicable to current efforts in conservation and the drawing of analogies between ancient human lineages and extant primate groups, including ourselves. This is a testament to the immediate practicality of the study of our distant past.

This publication illustrates recently made steps in the understanding of our singular anatomy, the mechanisms and complexities of our DNA as well as the patterns of inheritance which shed light on the long obscured branches of the relationships of past human lineages. These pages also describe the vast myriad of adaptations which allowed ancient humans, initially adapted to the warm, arid climates of Africa, to interact and thrive in hostile environments, with colder temperatures, novel meteorological phenomena, and previously encountered types of wildlife. It is of paramount importance that the rare and finite archaeological deposits which hold the artifacts which evidence this remarkable resilience are well-understood by current researchers and preserved for future generations.

The rapid transformation of the Earth's landscape in the present day has provided the most serious, universal and pervasive threat to the preservation of vulnerable sites and environments today. Protection against the deleterious effects of this rapid development will help to preserve the static archaeological sites as well as the dynamic environments around them. Here natural and archaeological protection from a complementary relationship. Even more so because the threatened environments are often home to primate species, our closest phylogenetic relatives. Though modern primate species have each had an equally rich history of evolution, the long-term observation of living apes, orangutans, which, for example, often wander through the Borneo canopy alone is the essential work of the primatologist and an extraordinary part of the sciences of humans, with potential as an analog (though not a homolog) to prehistoric behaviors and adaptations. Primatologists, like archaeologists, do not devote their life to descriptive natural history; their work is about testing hypotheses concerning ecology and behavior, aided by statistics, mathematical models, genetics and neuroscience. Yet these fruitful and complementary pursuits depend on preventing the extinction of our evolutionary cousins in the wild.

The determination and perseverance of my colleagues in the World Heritage Centre has been an invaluable factor in allowing this publication to reach the hands of the reader. I am most grateful to my colleagues from the Asia Unit and the Jeongok Prehistory Museum for their valuable advice. I would like especially to thank Sarah Ranlett and Anjelica Young for their dedication and expertise, as well as the HEADS Scientific Committee for making this publication possible and which today enables us to achieve a greater awareness of the work involved and the challenges faced by efforts in international cooperation. I very much hope that these pages can show us the collective potential for collaboration in Asia.

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For more information contact:
UNESCO World Heritage Centre

7, place Fontenoy
75352 Paris 07 SP France
Tel: 33 (0)1 45 68 24 96
Fax: 33 (0)1 45 68 55 70
E-mail: wh-info@unesco.org
http://whc.unesco.org