A TALE OF THREE CAVES
WHY WAS OUR SPECIES SO SUCCESSFUL AT COLONISING NEW ENVIRONMENTS?

NEGENENDERTIGSTE KROON-VOORDRACHT

GEHOUDEN VOOR DE
STICHTING NEDERLANDS MUSEUM
VOOR ANTHROPOLOGIE EN PRAEHISTORIE

TE AMSTERDAM OP 17 MAART 2017

DOOR

PROFESSOR GRAEME BARKER

MCDONALD INSTITUTE FOR ARCHAEOLOGICAL RESEARCH
UNIVERSITY OF CAMBRIDGE
CAMBRIDGE, UNITED KINGDOM

GERRIT HEINRICH KROON
(1868-1945)

INTRODUCTION

One of the liveliest areas of debate in human evolution studies relates to the chronology and geography of what has become known as 'Out of Africa 2': when did our species *Homo sapiens* first disperse out of Africa, and by what route or routes? ('Out of Africa 1' is used to denote the dispersal from Africa across Eurasia of archaic humans, *Homo erectus*, 2-1 million years ago.) Anatomically-recognisable examples of *Homo sapiens* (hereafter 'modern humans') are found in sub-Saharan Africa from over 200,000 years ago (200 ka) and 'modelling back' from the genetic diversity of present-day populations in and outside Africa points to origin dates in Africa of at least similar antiquity (McBrearty & Brooks, 2000; Smith & Ahern, 2013; White et al., 2003). In terms of the timing of initial dispersals out of Africa, the developing orthodoxy in the past couple of decades has been that there was a 'failed' early dispersal northwards into the Levant before 100 ka years ago, based on the presence of fossil remains of archaic modern humans at Skhul Cave in Israel dated to around 130-100 ka and at Qafzeh, also in Israel, dated to around 100-90 ka; and that this was then followed by a successful dispersal around 70-60 ka by a single source population that spread rapidly along a 'Southern Route' from East Africa to Arabia, South India and Australasia by around 50 ka, with Europe being colonised from the southeast and/or east between 50 and 40 ka and the Americas around 15-10 ka (e.g. Bellwood, 2013; Gamble, 1996; Garcea, 2010a; Hoffecker, 2009; Mellars, 2006; Stringer & McKie, 1997). The literature is replete with maps summarising the remarkable transformation of *Homo sapiens* from an African to a global species in terms of arrows marking likely routes of dispersal accompanied by possible times of first arrival across different parts of Eurasia and the Americas (Fig. 1).

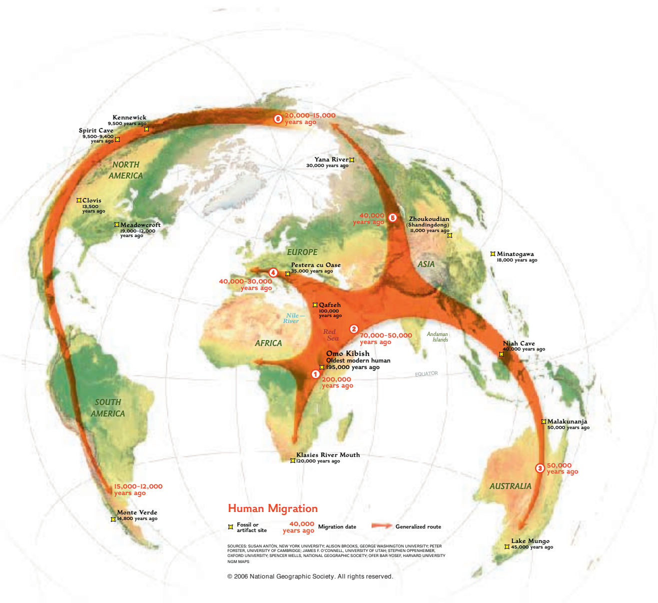


Figure 1. A typical map showing assumed directions and timings of the dispersal of modern humans out of Africa ('Out of Africa 2').

In recent years, however, it has become increasingly clear that Out of Africa 2 was likely to have been a much more complicated process then such maps imply (e.g. Boivin et al., 2013; Dennell & Petraglia, 2012; Hublin, 2014). Dates for definite or likely modern human fossils in China and Southeast Asia, such as in Callao Cave in the northern Philippines dated to 67 ka, and human occupation sites in Australia likely to be of similar antiquity, make a 70-60 ka date for the first major dispersals from Africa look increasingly too recent. There were probably multiple exits from Africa, by varying terrestrial routes, and by different populations, perhaps beginning in the last interglacial (Marine Isotope Stage 5, or MIS 5, dated globally to *c.*130-74 ka), as well as episodic back-migrations. Whereas 20 years ago the only species known as a potential competitor to modern humans during their dispersals beyond Africa was Neanderthals in western Eurasia and the Near East, the research agenda has been further transformed by the discovery of people related to Neanderthals east of the latter's range which have been termed 'Denisovans' from the analysis of the DNA in fossil bones from Denisova Cave in the Urals (Reich et al., 2010), and of the diminutive *Homo floresiensis* on the Indonesian island of Flores (Morwood et al., 2004).

The eventual success of modern humans in their global dispersals, contrasting with the demise of Neanderthals, Denisovans and *Homo floresiensis*, is all the more remarkable given that it took place during the last glacial cycle, a period of profound and often rapid shifts in global climates (Fig. 2). MIS 5 was characterised by major phases of humid conditions similar to those of today, punctuated by drier and cooler phases. The latter became increasingly common in MIS 4 (*c.*70-60 ka) and even more marked in MIS 3 (*c.*60-24 ka), culminating in the Last Glacial Maximum, before the climate eventually returned to a regime similar to that of MIS 5 with the transition from the Pleistocene to the Holocene, the modern climatic era, *c.*11.7 ka.

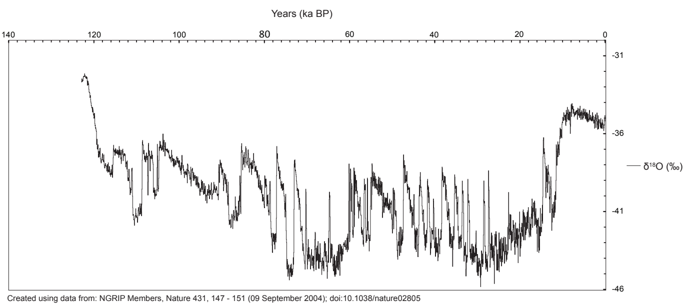


Figure 2. Summary of global climatic change over the last glacial cycle evidenced by Greenland ice cores.

One negative result of the focus on the 'when' and 'where' of Out of Africa 2 has been the lack of scholarly attention given to the nature of the Middle Stone Age 'source populations' living in Africa at the supposed exit times (Blome et al., 2012; Groucutt et al., 2015; Scerri, 2013), and the possible reasons – climatic, demographic, cultural – for some of them moving beyond Africa's shores. The other has been a similar lack of attention to the processes underlying such dispersals: to the types of landscapes, climates and behavioural thresholds that modern humans had to cross in colonising new environments such as deserts, rainforests, oceans, and the Arctic. In this lecture I want to explore how recent excavations in three caves – the Haua Fteah in Libya, Shanidar Cave in Iraqi Kurdistan and Niah Cave (or more correctly, the Niah Caves) in Sarawak, Borneo (Fig. 3) – combined with the results of earlier excavations that have given all three sites iconic status in Palaeolithic archaeology, are helping us grapple with the 'how' and 'why' questions of modern human dispersals. Why were modern humans so successful at colonising new environments?

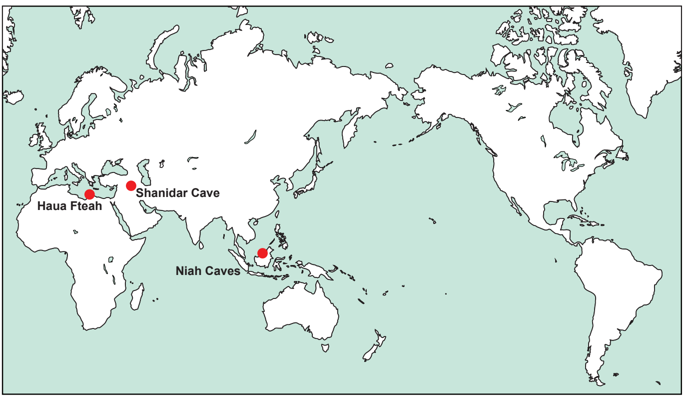


Figure 3. Map showing the location of the Haua Fteah cave (Libya), Shanidar Cave (Iraqi Kurdistan), and the Niah Caves (Sarawak, Borneo).

THE THREE CAVES: THE EARLIER EXCAVATIONS

The Haua Fteah is a large limestone cave facing northwards to the sea about a kilometre away, on the northern escarpment of the Gebel Akhdar or Green Mountain massif in northeast Libya, in the region of Cyrenaica (Fig. 4). It was excavated in 1951, 1952 and 1955 by Charles McBurney, then a lecturer in Palaeolithic archaeology at the University of Cambridge. His remarkable discoveries were presented in full in a monograph published in 1967 (McBurney, 1967) and formed the centrepiece of the brilliant Kroon lecture on the emergence of modern humans in North Africa that he delivered ten years later (McBurney, 1977).

Figure 4. View of the Haua Fteah cave, looking south. (Photograph: Graeme Barker.)

He opened a trial trench in the central part of the cave floor in his first season, extended in as an L shape in the second, and in the last, major, season he expanded it into a stepped trench about 14 m deep (Fig. 5). Most of the excavation, the deeper layers especially, was undertaken using the system of horizontal spits common in cave archaeology at the time, but McBurney had considerable stratigraphic awareness and was able to correlate spits and parts of spits with the stratigraphic layers that he was able to observe during excavation and in the walls of the trench after excavation.

Figure 5. The McBurney excavations in the Haua Fteah in 1955, looking west. (Reproduced with kind permission of the Museum of Archaeology & Anthropology, Cambridge University.)

In his final report on the excavations (McBurney, 1967) he defined seven cultural phases of occupation based primarily on the typology and technology of the lithic material found, the prehistoric phases of which have since been used as a key reference sequence for North Africa.

The earliest phase (A), from spit 176 at the bottom of the Deep Sounding to spit 50 at the boundary with the middle section of the trench (which we have termed the Middle Trench), was a Middle Stone Age (MSA) industry based on flakes and blades which he termed the 'Pre-Aurignacian' because he thought it resembled Pre-Aurignacian and Amudian assemblages that had been found in Southwest Asia. This was overlain in the lower part of the Middle Trench (Layers XXXV-XXV: Phase B) by MSA industries that he termed 'Levalloiso-Mousterian' because of their affinities with similar industries in the Levant and Europe, industries which in Europe are associated with Neanderthals. In the light of the latter, he regarded two human mandibles found in Layer XXXIII as likely to be 'Neanderthaloid', though they were later confirmed to be of robust modern humans. There was then a marked change in the lithic assemblages (Phase C, from the upper part of Layer XXV to Layer XVI) with the appearance of a predominantly blade rather than flake technology comparable to Upper Palaeolithic industries in the Levant and Europe. McBurney termed these 'Dabban' after the Cyrenaican cave of Hagfet ed-Dabba where he had found similar material (McBurney, 1960). (Today these would be characterized as Later Stone Age using African terminology.) This was succeeded by a microlithic late or final Palaeolithic industry (Phase D, Layers XV-XI) termed the 'Eastern Oranian' or 'Iberomaurusian' from its similarities with assemblages in the Maghreb region of northwest Africa; a microlithic Mesolithic-type industry like the Capsian of the Maghreb (Phase E, Layers X and IX); then similar lithic material associated with Neolithic pottery and domestic sheep and goats (the 'Neolithic of Capsian Tradition': Phase F, Layers VIII-IV); and finally material of classical and post-classical times (Phase G, layers III-I). McBurney was able to establish an absolute chronology from the recent levels to the Dabban phase at the then limits of the radiocarbon (^{14}C) method about 40 ka. He used estimates of sedimentation rates to propose the age of the start of the Pre-Aurignacian phase at the bottom of the trench as likely to be around 80 ka.

Shanidar Cave is situated in the Zagros Mountains of Iraqi Kurdistan at about 740 m above sea level. Like the Haua Fteah it is a large 'aircraft-hangar-like' limestone cavern, in this case facing south (Fig. 6) on the western side of a large cleft in the mountains. It was excavated by Ralph Solecki, who had affiliations variously with Columbia University (New York) and the Smithsonian Institute in Washington, between 1952 and 1960 (Solecki, 1952a, 1952b, 1953a, 1953b, 1955, 1957, 1958, 1960, 1961, 1963).

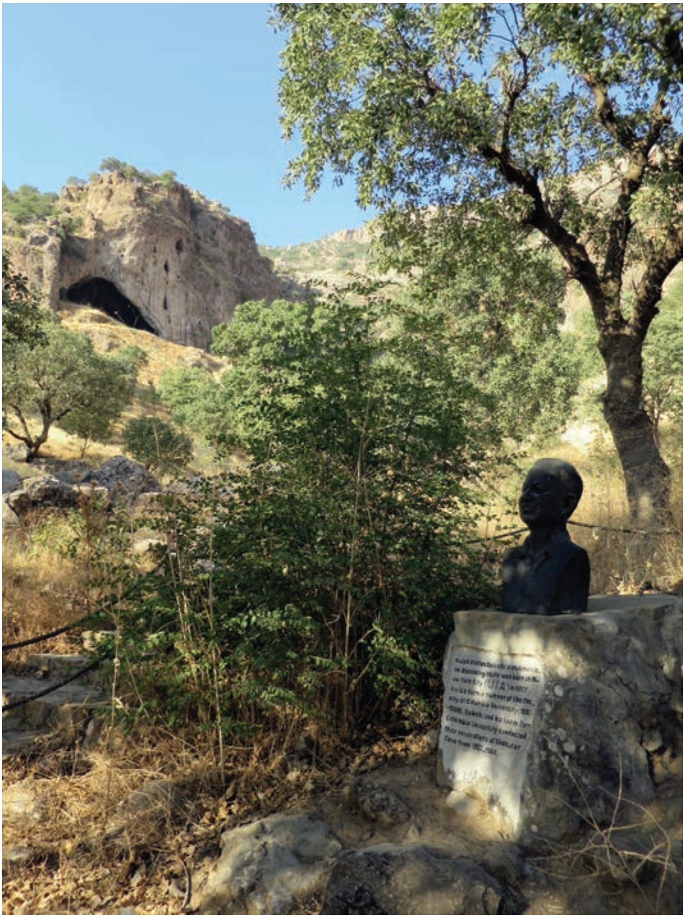


Figure 6. Looking north to Shanidar Cave, past the bust of Ralph Solecki in the foreground. (Photograph: Graeme Barker.)

He excavated a large trench in the middle of the cave floor, to a similar depth to McBurney's trench in the Haua Fteah, though the work was made much more difficult by the presence in the upper section in particular of massive rockfalls (Figs 7 and 8). He defined a series of major cultural phases from the lithic assemblages, like McBurney using a terminology based on the European Palaeolithic, and like him establishing a radiocarbon chronology back to the limits of the method around 40 ka for the upper part of the sequence: Layer D, Mousterian, estimated as perhaps 45-100 ka in age; Layer C, Upper Palaeolithic 'Baradostian', a regional variant of the Aurignacian techno-complex,

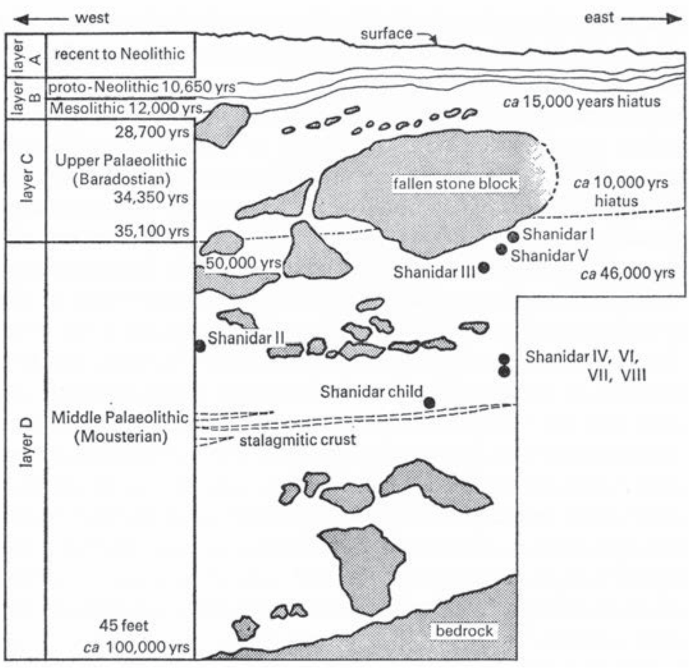


Figure 7. Ralph Solecki's schematic cross-section of his trench in Shanidar Cave, showing the major cultural layer that he defined, radiocarbon dates, and the relative positions of the Neanderthal skeletal remains. (Reproduced with kind permission of Ralph Solecki.)

Figure 8. Photograph of part of the Solecki trench during the 1960 excavation, looking northeast, showing the locations of the Neanderthal burials Shanidar I, III and V in the northern extension of the main trench and, c.2 m lower in the Deep Sounding by the seated figure, the locations of the Shanidar IV and VI burials. Shanidar IV was the so-called Flower Burial.

dated to *c.*35-29 ka; Layer B2, 'Zarzian', an Epipalaeolithic or Mesolithic industry characterized by backed blades and dated to *c.*12 ka; Layer B1, a 'proto-Neolithic' cemetery dated to *c.*10.5 ka; and Layer A, Neolithic (from *c.*7 ka) to recent.

His most spectacular discovery, in the upper part of Layer D at 5-10 m depth from the ground surface, was the skeletal remains of ten Neanderthal individuals (males, females, children). He argued that some of the Neanderthals probably died in rock falls but that others were buried with formal funerary rites (Solecki, 1971). The latter included one that the palynologist Arlette Leroi-Gourhan suggested from pollen in the surrounding sediments may have been covered in flowers including plants known to have medicinal properties (Leroi-Gourhan, 1975; Solecki, 1975; Fig. 9). There was also a badly injured individual who must been cared for by the community before death. Though it was later argued that the 'Flower Burial' pollen was possibly the result of insect burrowing (Sommer, 1999), the then view of Neanderthals as a more primitive species than *Homo sapiens* was overturned by these findings. The Shanidar Neanderthal burials have been repeatedly debated in scholarly discussions of the differences and similarities between Neanderthals and modern humans, and the possible reasons for the former's demise and the latter's evolutionary success (Gargett, 1989, 1999; Pettitt, 2011).

Figure 9. Reconstruction of the 'Flower Burial' in Shanidar Cave. (Karen Carr: Smithsonian Institute.)

The Niah Caves lie within the Gunung Subis, a steep-sided limestone massif close to the northern shoreline of Borneo, in Sarawak, East Malaysia (Fig. 10). The cliffs of the Gunong Subis are riddled with fissures, small holes and larger entrances, but the most famous cave of the Niah complex is the vast Great Cave or Gua Besar, lying within an outlier of the Gunong Subis on its northeastern side called the Bukit Bekejang. Multi-chambered and multi-entranced, the main cavern measures *c.*900 m by *c.*600 m and soars to a height of *c.*100 m. The Great Cave is occupied by hundreds of thousands of swifts and bats, the former traditionally exploited for their nests for the lucrative Chinese market in bird's nest soup, the latter for their guano as fertilizer for local farmers. Though smaller and less well known than the Mulu Caves 120 km to the northeast, the scale and atmosphere of the Great Cave make for a genuinely awesome experience for the thousands of tourists who visit it each year. The Great Cave is reached by a boardwalk through the Niah National Park, an island of primary and secondary rainforest in the middle of what is now a sea of palm-oil plantation covering much of this part of coastal Sarawak.

The major entrances of the Great Cave were the scene of major excavations by Tom Harrisson and his wife Barbara from 1957 to 1965 (B. Harrisson, 1958a, 1967; T. Harrisson, 1957, 1958a, 1958b, 1958c, 1959, 1960, 1964, 1970, 1972), after trial work in 1954 in the West Mouth (Fig. 11) by Tom Harrisson and Michael Tweedie, Director of the Raffles Museum in Singapore. Other caves around the Gunong Subis were also investigated. The deepest excavations were underneath and in front of a small rock shelter formed on the northern wall of the West Mouth, to a depth of around 8 m, the main trench being termed 'Hell' because of the difficult conditions for the excavators working in full sun during the afternoon (Fig. 12). The spit system of horizontal slices of sediment was employed, as in the Haua Fteah and Shanidar Cave. The most spectacular discovery, in 1958, was a human skull, termed the 'Deep Skull', in the lowest part of the Hell Trench excavation some 30-40 cm distant from charcoal excavated the previous year and dated by the Groningen Labora-

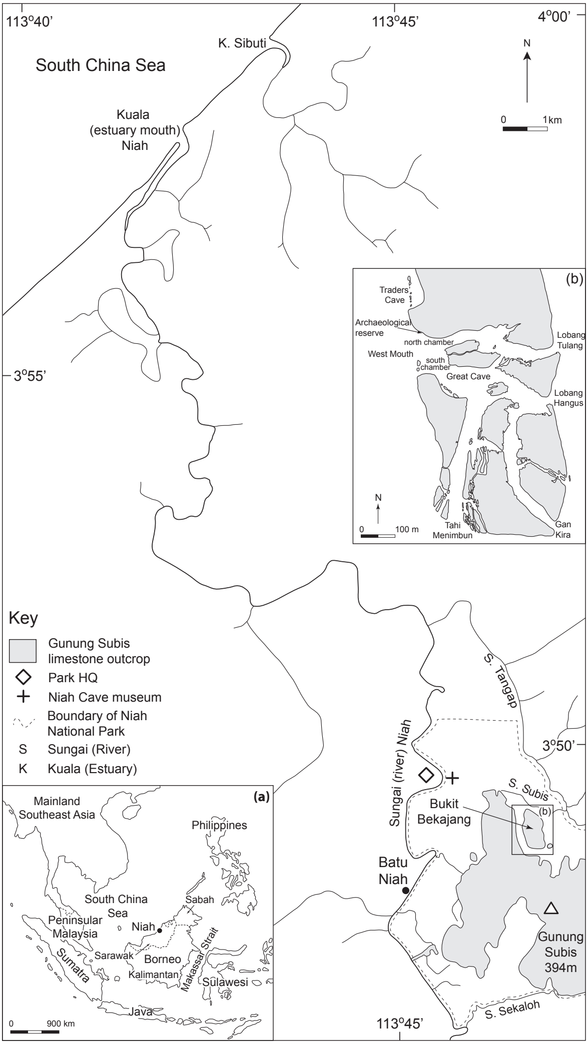


Figure 10. The location of the Niah Caves in the Niah National Park, with (inset) the plan of the caves in the Bukit Bekajang outcrop. (Illustration: Lucy Farr.)

Figure 11. Looking west through the West Mouth of Niah Great Cave into the Gunong Subis ravine; the archaeological zone is on the far right, immediately in front of the covered tourist boardwalk visible on the skyline. (Photograph: Graeme Barker.)

Figure 12. Excavations in progress in the West Mouth of Niah Great Cave in 1959, looking southeast. Tom Harrisson is standing in the middle distance, supervising the work. The roof of the rock shelter formed on the northern wall of the West Mouth is visible on the left. (Reproduced with kind permission of Sarawak Museum.)

tory to around 40 ka: it was identified as fully modern human by the British Museum's Don Brothwell, making it at the time the earliest modern human fossil in the world (Brothwell, 1960). The Deep Skull and other post-cranial remains were part of some 2 m of occupation debris such as charcoal, ash, butchered animal bone and stone flakes that extended for some 10 m from the back of the rock shelter into the Hell Trench. Radiocarbon dates indicated that this was formed from the period of the Deep Skull to the beginning of the Holocene. Evidence of occupation of similar antiquity was found in other entrances such as Lobang Hangus (T. Harrisson, 1966) and Gan Kira. Above the 'frequentation' deposit, as the Harrissons termed it, were hundreds of graves associated with Neolithic pottery, and smaller collections of similar graves were found in other entrances of the Great Cave such as Lobang Tulang (B. Harrisson, 1958b, 1959-60), and in other caves around the Gunung Subis.

Tom Harrisson proposed an age/depth chronology of prehistoric occupation and burial activity in the West Mouth on the basis of the few radiocarbon dates available to him and the rate of accumulation of sediment that he assumed had been broadly similar through the sequence. The Harrissons and their collaborators published many articles on the excavations and the prolific finds from them including stone tools, animal bones, human bones, pottery, shells, beads and textiles, but for a variety of reasons they were not able to bring the work together in a final report. The result was uncertainty over aspects of their discoveries, including the age of the Deep Skull. In this context the Malaysian archaeologist Zuraina Majid undertook small scale excavations in the West Mouth in 1977 for her PhD, dividing the sequence on similar age/depth principles into four major phases: Phase I (material below 84 inches from the surface), which she suggested dated to *c.*40-20 ka; Phase II (84-72"), dating to around 20-15 ka; Phase III (72-48"), from *c.*15 ka to the Pleistocene/Holocene boundary around 11 ka; Phase IV (48-24"), early Holocene Mesolithic; and Phase V (24-0"), Neolithic (Zuraina Majid, 1982).

THE NEW EXCAVATIONS

It is apparent from the extraordinary excavations of Charles McBurney, Ralph Solecki and the Harrissons that the deep stratigraphies of these three iconic sites had the potential for new work to address major research questions including the chronology of modern human dispersals into their respective regions (all three caves); the behaviours associated with modern humans in this process and the climatic contexts in which these were situated (all three caves); the Neanderthal demise (Shanidar Cave); and foraging/farming transitions (the Haua Fteah and the Niah Caves). When I was negotiating with the Sarawak archaeological authorities in the late 1990s to initiate new work in the Niah Caves, though, I certainly never had any kind of master plan to tackle the three caves in succession!

The main fieldwork of the Niah Caves Project, as the new work at Niah was termed, took place in 2000-2003 (Fig. 13). As I describe in the first of the two monographs on the project (Barker, 2013), it set out to address three main research questions. First, how old was human presence in the caves, and the Deep Skull in particular? Second, was there rainforest around the cave in the Late Pleistocene, and if so, were the first modern humans capable of living in it? (There had been a rigorous debate in the previous decade amongst anthropologists and archaeologists about whether foragers could live in rainforest without recourse to trading with neighbouring farmers, given the dearth of plant staples.) Third, when and in what circumstances did foraging give way to farming? The latter question was in the context of the arguments for and against the theory proposed by Peter Bellwood that domestic rice, pigs and dogs had spread into Island Southeast Asia, along with Neolithic material culture such as pottery and polished axes, as a result of a maritime movement of Austronesian-speaking farmers from Taiwan and ultimately the Chinese mainland (Bellwood, 1985, 1988, 1996).

Figure 13. Excavations in progress in the West Mouth of Niah Great Cave in 2001, looking southeast. The roof of the rock shelter is visible bottom left. The standing section shown in Figure 22 is between the two seated figures on the right side of the image, parallel to the wooden boardwalk visible on the right hand edge. The Hell Trench where the Deep Skull was found is off the image further to the right. (Photograph: Graeme Barker.)

The fieldwork involved a team of 20+ archaeologists and geographers each year. The Harrissons had excavated most of the archaeological sediments in the West Mouth and other cave entrances, so we set out to undertake as small-scale excavations as possible to collect the kind of information we needed, so as to leave the archaeology as intact as possible at the end of the project. The faces of the Harrisson trenches in the West Mouth and Lobang Hangus were cleaned and recorded to modern standards, and a wide variety of sediment samples was collected in the process for dating purposes and for the extraction of climate proxies such as pollen and phytoliths. Small-scale excavations were undertaken of particular burials in the Neolithic cemetery to investigate funerary behaviour, a baulk in the Hell Trench was completely excavated in particular for faunal and botanical remains indicative of subsistence activities around the time of the deposition of the Deep Skull, and a small trench was dug underneath its location to investigate evidence for human activity prior to the levels exposed by the Harrison and Majid excavations. During the fieldwork years and in the ensuing years a wide variety of studies of materials in the Harrisson Excavation Archive in Sarawak Museum was undertaken by PhD students and post-doctoral researchers. In total around 75 people have contributed their findings to the two monographs published in 2013 (Barker, 2013) and 2016 (Barker & Farr, 2016).

The new excavations in the Haua Fteah were undertaken between 2008 and 2015 (Barker et al., 2007a, 2008, 2009, 2010, 2012; Farr et al., 2014; Rabett et al., 2013). The first season was funded by the Society for Libyan Studies, whose officers had also negotiated the excavation permit (so the project has always been under the Society's aegis). The principal funding for the following seasons was provided by an Advanced Investigator Grant from the European Research Council with the acronym TRANS-NAP, standing for 'Cultural transformations and environment transitions in North African prehistory', the objective of the project being to investigate climate/people interactions from the period of the initial use of the Haua Fteah to the recent past.

McBurney had filled in his trench in 1955, so the first task was to relocate it. The backfill was slowly emptied over the successive seasons down to the base of his Deep Sounding 14 m below the ground surface. The condition of the trench walls on being exposed for the first time since 1955 was extremely good, many of the aluminium labels marking his layers still surviving. The faces were recorded and sampled as in the West Mouth of Niah Great Cave for dating and palaeoecological studies. Column samples 30 x 30 cm in size were excavated down the length of the Haua Fteah trench to provide further samples for sediment analysis and for the retrieval of pollen, phytoliths and other climate proxies. A small trench (Trench U) was cut into the north-facing wall of the Upper Trench to collect data on the Neolithic occupation, a 2 x 1 m trench (Trench M) was excavated down the length of the north-facing side of the Middle Trench (Fig. 14), another (Trench D) down the same side of the Deep Sounding, and a further metre of sediment was excavated below the base of the McBurney Deep Sounding (Trench S) until a substantial rockfall was reached. All the sediment removed by excavation was bagged and taken to the project base, where it was washed and sieved in a flotation tank so that organic remains could be collected and the washed residues then searched for small materials down to 2 mm in size.

In addition to the work in the cave, a programme of geomorphological and geoarchaeological study of Pleistocene environments and their associated archaeology was undertaken along the

Figure 14. Excavations in progress in the Haua Fteah cave in 2010, looking south. The standing figure on the right is excavating Trench M, at a depth dating to around 50,000 years ago. The figures at the bottom left of the trench are in the Deep Sounding, the base of which has now been dated to around 140,000 years ago. (Photograph: Graeme Barker.)

Cyrenaican coast and in the inland Marj basin, where a 30 m core was also extracted from the lake sediments (Jones et al., 2016). Small test excavations were undertaken in rock shelters and caves within the study area, including ed-Dabba. A pedestrian survey of surface lithic materials was undertaken at sample locations on two north-south transects across the Gebel Akhdar from the coast to the edge of the Sahara (Jones, 2016; Jones et al., 2011). The fieldwork, by a team of 25+ archaeologists and geographers much as at Niah, was halted during the civil unrest leading up to the death of Ghaddafi in 2011, continued in 2012 and 2013, but thereafter had to be abandoned because of the deteriorating security situation. In 2015 the last sections of Trench M and Trench D were finally excavated for the project by Libyan colleagues who had trained with the team for several seasons.

Fieldwork began at Shanidar in spring 2014, but the permit agreed with the General Directorate of Antiquities had not yet been ratified by the relevant Ministry so survey was undertaken in the environs of Shanidar Cave. In August 2014 the team returned to begin excavation but the field season had to be abandoned after a few days because of the ISIS threat to Erbil. Four field seasons have since been undertaken, two in 2015 and two in 2016 (Reynolds et al., 2015). Solecki never backfilled his trench because he was prevented by civil unrest from completing his planned excavations in 1961, and in the ensuing years the trench filled up with a mix of sediments, ash, boulders and rubbish during the seasonal occupation of the cave by transhumant herders and their livestock. (The latter continued to camp in the cave until the mid 1990s.) We have cleared the backfill from several metres of the Solecki trench and from the 2 m x 2 m extension trench he cut on the eastern side of his main trench, where he found most of the Neanderthal human remains (Fig. 15). The same processes used in the Niah Cave and Haua Fteah excavation have been employed in Shanidar Cave: exposing, cleaning, recording and sampling the original trench walls; undertaking targeted excavation; and washing and fine screening all excavated sediments.

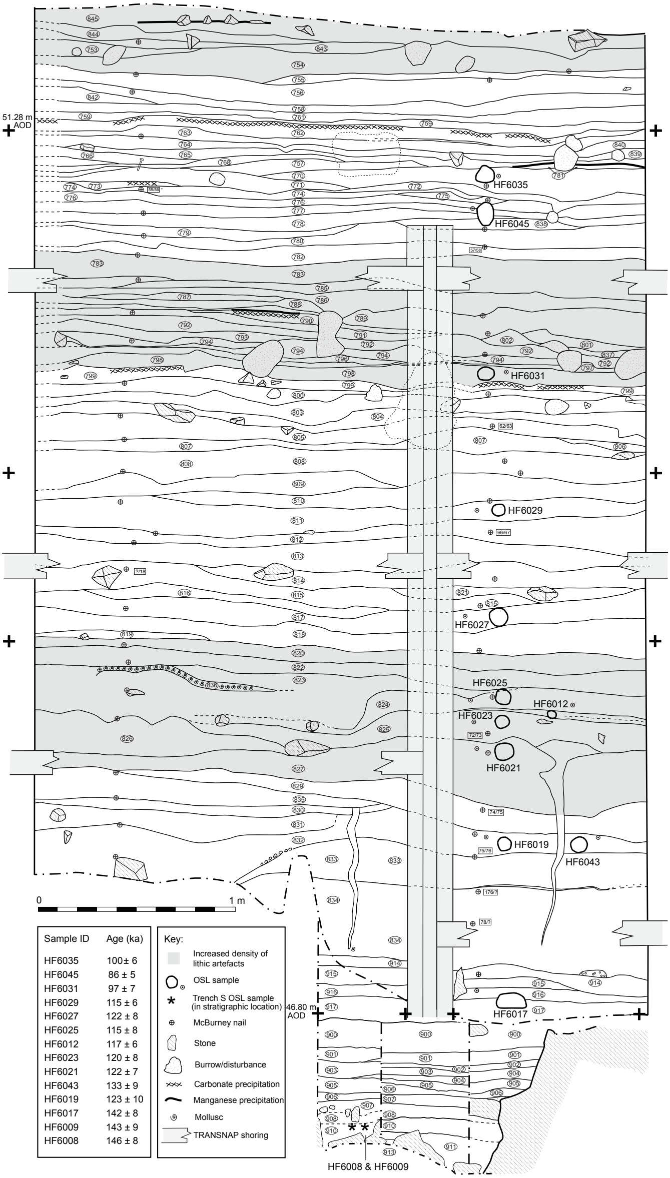
Figure 15. Excavations in progress in Shanidar Cave in spring 2016, looking south. The bones assumed to belong to the Shanidar V human burial illustrated in Figure 19 were found in front of the standing figure. The trench that located the area of the lower burials found by Ralph Solecki (by the seated figure shown in Figure 8) was excavated in summer 2016, in the area where the step-ladder is visible in the foreground. (Photograph: Graeme Barker.)

ADAPTING TO ARIDITY: THE HAUA FTEAH

Our studies of the exposed sediments in the Haua Fteah trench, and of the 'climate proxies' in them such as pollen, shells, and vertebrate fauna (especially microfauna), indicate that the stratigraphy can be divided into five major 'facies' or sediment types, which can be broadly correlated with global climatic stages (Douka et al., 2013; Inglis, 2012; Jacobs et al., 2017, in press). The basal facies, Facies 5, denotes the sediments of the Deep Sounding and the bottom metre of the Middle Trench above it. These are predominantly red-coloured clayey silts formed by water-flow into the cave and the settling of silt in standing water in the area of the trench. The climatic regime in which they formed was clearly more humid than today's, and OSL (Optically Stimulated Luminescence) dates on grains of feldspar indicate ages consistent with MIS 5 (Fig.16). The Trench S excavation at the base of the Deep Sounding showed that the Facies 5 sediments overlay a jumble of sharp-edged boulders resulting from a major collapse of the cave roof, and our basal OSL dates of *c.*150 ka suggest that this probably occurred as a result of freeze/thaw action during MIS 6, which was a long phase of marked cold and aridity (*c.*190-130 ka). The greater part of the Middle Trench consisted of sediments formed in increasingly cold and arid climates, beginning with bands of Facies 5-type silts oscillating with harder stonier layers formed in arid episodes dating to MIS 4 (74-59 ka) and culminating in frost-shattered rubble (*éboulis*) from the cave roof (Facies 3 and 2). They correlate with global trends to increasing cold and aridity represented by MIS 4, MIS 3 (59-24 ka) and MIS 2, which is dated from the Last Glacial Maximum *c.*24 ka to the Pleistocene/Holocene boundary *c.*11.7 ka.

Minute quantities of lithic débitage collected by intensive wet sieving from the Trench S sediments suggest that humans may have first visited the cave near the end of MIS 6, around 150 ka, but the major occurrences in the Deep Sounding of occupation evidence of people with Pre-Aurignacian technologies correlate with the humid interstadial conditions of MIS 5e and (less visibly) MIS 5c (Figs. 16 and 17). At the top of the Deep Sounding there is evidence for the small-scale presence of people with Pre-Aurignacian technologies during the cooler/drier stadial conditions of MIS 5b, occupation evidence that continues without an apparent stratigraphic break into the artefact-rich Levalloiso-Mousterian layers at the base of the Middle Trench which date to MIS 5a and the onset of MIS 4. Although there are differences between the core morphologies and technologies of these two MSA assemblages (Jones, 2016), they also share a number of similarities: Levallois technology; blades, bladelets and elongated flakes, with a predominance of flakes; hard hammer reduction on unprepared platforms; a dominance of burins, notched pieces and scrapers amongst the retouched tools (Reynolds, 2013). These similarities suggest that the overall use of lithics in the ecology of the two groups was similar. The two modern human mandibles were associated with the Levalloiso-Mousterian material in Level XXXIII, which has been dated to 73-65 ka (Douka et al., 2013). Although we cannot be certain without human fossils from the Deep Sounding, the typological similarities between the Pre-Aurignacian and Levalloiso-Mousterian, and the field evidence of stratigraphic continuity, make a good case for the makers of Pre-Aurignacian technologies being modern human.

If so, it means that modern humans with Pre-Aurignacian technologies were on the Mediterranean coast of northeast Africa as early as modern humans using very different Aterian technologies (which included tanged projectile points, for example) in the Maghreb (Barton et al., 2009; Nespoulet et al., 2008; Scerri, 2013). It is commonly argued that the humid conditions of MIS 5 allowed animals and people to spread northwards across a landscape of lakes, rivers and grasslands (the 'Green Sahara') (Drake et al., 2011, 2013; Garcea, 2010b; Osborne et al., 2008). This may have been the route by which modern humans reached Cyrenaica, though they could equally well have spread northwards up the Nile valley or westwards from the Levant. However that may be, what is significant is that the first inhabitants of the Haua Fteah practised subsistence regimes well adapted to living on the



Sample ID	Age (ka)
HF6035	100 ± 6
HF6045	86 ± 5
HF6031	97 ± 7
HF6029	115 ± 6
HF6027	122 ± 8
HF6025	115 ± 8
HF6012	117 ± 6
HF6023	120 ± 8
HF6021	122 ± 7
HF6043	133 ± 9
HF6019	123 ± 10
HF6017	142 ± 8
HF6009	143 ± 9
HF6008	146 ± 8

Figure 16. The Deep Sounding of the Haua Fteah, showing the OSL ages and the main episodes of human activity, which coincide with the warm stages of the MIS 5 global climatic stage (5e, 5c and 5a). (Drawn in the field by Ryan Rabett and Alex Prior, and redrawn and amended by Lucy Farr.)

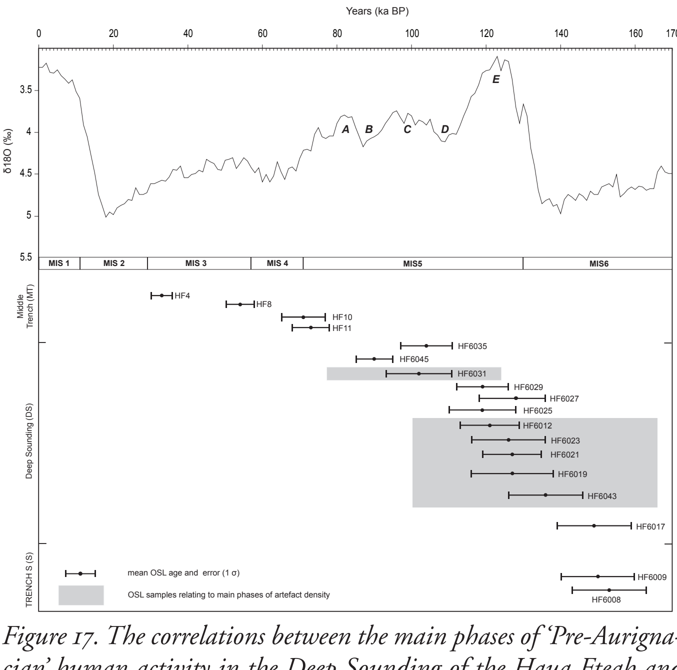


Figure 17. The correlations between the main phases of 'Pre-Aurignacian' human activity in the Deep Sounding of the Haua Fteah and major humid episodes within MIS 5 (stages 5e and 5c). (Illustration: Lucy Farr.)

Mediterranean littoral in periods of humid climate, combining hunting terrestrial mammals like Barbary sheep, antelope and cattle (presumably in the Gebel Akhdar hills behind the cave) with collecting landsnails around the cave and marine molluscs and crabs from the nearby sea shore. They probably also collected edible fruits, nuts and seeds, but we have no evidence for this.

Although the lithic samples from the Levalloiso-Mousterian levels in Trench M are extremely small, they occur mostly on the surface of calcrete layers marking phases of sediment hiatus, suggesting that modern humans were beginning to develop ways of coping with the increasing aridity of MIS 4 (Farr & Jones, 2014). However, the most striking feature of occupation at this time is its infrequency. The Sahara was probably abandoned entirely as aridity developed, and on the evidence of the Haua Fteah the Cyrenaican littoral may have been only sparsely occupied as well. The first major phase of reuse of the cave was in the period 45-41 ka by people equipped with Dabban blade technologies very similar to the earliest blade technologies used by modern human populations at this time in the Levant and Europe (Bar-Yosef & Belfer-Cohen, 2010; Higham, 2011). This was followed by another long period of apparent abandonment of the cave before a second phase of Dabban occupation *c*.22-19 ka following the climax of the Last Glacial Maximum.

We cannot tell whether the hiatuses in the occupation of the cave signal widespread abandonment of the Gebel Akhdar or simply people moving to different parts of it, but it is striking that the 45-41 ka and 22-19 ka phases of occupation are associated with evidence of new behaviours adapted to the challenges of aridity. Microscopic usewear traces and associated organic residues on stone tools indicative of hafting indicate the development of hunting technologies using more effective long-range projectiles. Carbonised plant remains and grindstones with microscopic plant residues on them are evidence of new technologies for storing, drying and processing a range of plant foods including wild cereals, fruits and nuts (Fig. 18). Whole pine cones were stored,

Figure 18.

(A) Grinding stone found in the Haua Fteah in a level dated to c.30,000 years ago, which has usewear and microscopic organic residues indicating that it was used for grinding wild grasses such as sorghum.

(B) Remains of (top) a carbonized pine nut (Pinus halapensis) *and (middle and lower) carbonized fruits of the Rosaceae family, probably apple, typical of the nuts, fruits and seeds likely to have been stored as part of the strategies developed by modern humans at the Haua Fteah to cope with aridity. (Identifications and photographs: Jacob Morales.)*

thrown on the fire to release the nuts when needed. Isotope studies of marine and terrestrial molluscs suggest multi-seasonal gathering of these food sources. Post-holes in Trench M imply the construction of wooden frameworks such as shelters or drying racks. Whilst the details of these technologies elude us, it is clear that they enabled the sustained use of the cave through the most arid phases of the Late Pleistocene.

ADAPTING TO MOUNTAINS: SHANIDAR CAVE

The 2015 and 2016 fieldwork in Shanidar Cave succeeded in locating traces of some of the Neanderthal burials excavated by Solecki, and above them the major occupation layers with Baradostian Upper Palaeolithic material that he classified as his Layer C. Unless otherwise clarified, the term 'burial' is used neutrally in the following discussion, without an assumption of human bones being part of a cultural or natural event (or indeed a combination of the two), as a primary goal of the new work is to establish these matters in the case of individual discoveries.

Shanidar I, the first Neanderthal found by Solecki (Fig. 8), was lifted within a massive plaster and timber 'coffin' assembled around the bones that was so heavy that it took several men to lift, an action likely to have involved a great deal of trampling to the surrounding sediment. Our careful cleaning of the area of the burial demonstrated that nothing survives of its original burial context. Shanidar V, at approximately the same depth as Shanidar I and some 3-4 m to the south of it (Fig. 8), was found at the end of the Solecki campaigns eroding out of the edge of a rough pathway used by the workmen to climb down from the ground surface into his Deep Sounding. He was clear that not all the bones had been recovered of this disturbed skeleton, which he regarded as one of the bodies likely to have been killed by roof rockfall (Solecki, 1971). In the spring 2015 campaign we located the fragmentary but partially articulated bones of a right tibia, fibula and ankle bone at the calculated location of the Shanidar

V burial (Fig. 19). As the bones we found are ones recorded as missing from the original discovery, we believe the identification with Shanidar V is secure (Pomeroy et al., under review). Our field observations indicated that the bones were in a narrow channel of likely fluvial origins, in between but clearly overlying a major episode of rockfall. The latter cannot have been the cause

Figure 19. The semi-articulated leg and ankle bones found in 2015 that almost certainly belong to the Shanidar V burial discovered in 1960. Looking southeast. Scale in cm. (Photograph: Graeme Barker.)

of death of a body that on topographical grounds is likely to have been originally buried (whether naturally by mudflow or by people) several metres to the southeast of where it was found by Solecki and ourselves. Initial calculations by Oxford University's Research Laboratory for Archaeology and the History of Art of OSL samples taken immediately underneath the bones suggest that Shanidar V is likely to date somewhere between 45 ka and 35 ka, but a more precise age will be possible once the background radiation against which the OSL sample has to be calibrated is calculated (the dosimeters that do this have to be left in the surrounding sediment for a year). Shanidar V looks likely to be one of the latest (most recent) Neanderthal burials known. Fragments of the bones are currently being investigated for DNA survival by Eske Willerslev's group in Copenhagen and Cambridge.

In the summer 2016 season we began emptying backfill from Solecki's Deep Sounding, exposing intact sediments to a depth of 2-3 m below the Shanidar I and V burials. In the final days of the fieldwork human bones were noted in the section at the base of the trench, at the approximate location of the Shanidar IV and VI burials. Shanidar IV was the 'Flower Burial'. The later study by Solecki of the bones collected from this location (lifted in a sediment block within a wood and plaster box like Shanidar I) in fact indicated that a series of individuals was probably at this location. The age of the bones we have located is currently unknown (OSL samples are being analysed), but they are stratigraphically below sediments we have dated provisionally by OSL to around 55-65 ka and in silts that accumulated in humid conditions, likely either in one of the major humid phases within MIS 5 (130-74 ka) or in a humid phase within MIS 4 (74-59 ka). The basal bones appeared to lie within a semi-circular cut, and micromorphological analysis is in progress to establish whether this was naturally or humanly made, though visual study of the section suggested that fluvial action is unlikely. Whilst our impression from field observations, still to be confirmed by laboratory studies of the sediments, is that the lower bones probably derive from a series of cultural burial events and Shanidar V to a wholly or largely natural burial event, the deep time-depth of the Neanderthal human remains in the cave (with the bones in the Deep Sounding, combined with Solecki's finds, implying a 'stack' of successive human remains) certainly chimes with Paul Pettitt's observation (Pettitt, 2011, 122) that Neanderthal sites with multiple skeletal remains such as L'Hortus, La Quina and La Ferrassie in France, Krapina in Croatia, and Shanidar Cave, imply "the transmission of mortuary tradition…centred around a fixed point in the landscape that could be used, if not exclusively, to hide, process, and bury the dead", "important archaeological verification", as he commented in a more recent essay, "that religious thought *sensu lato* emerged prior to, or at least not exclusive to, *Homo sapiens*" (Pettitt, 2015, 274). "To the groups of La Ferrassie and Shanidar... the dead had not quite departed" (Pettitt, 2015, 273).

We found Baradostian lithic material associated with extensive burning layers and small (*c*.30 x 30 cm) hearths about a metre above the upper group of Neanderthal skeletal remains (Fig. 20). Charcoal from these layers has been AMS dated by the Oxford Radiocarbon Laboratory to 42-38 ka. In the area of the Shanidar

Figure 20. Burning layer and sectioned hearth associated with Baradostian Upper Palaeolithic lithic material in Shanidar Cave, AMS dated to 42-38 ka. Looking northeast. Scale: 30 cm. (Photograph: Graeme Barker.)

V bones, Baradostian lithic material and associated occupation debris such as charcoal, butchered animal bone and landsnails is also found right down the metre of grey fluvial sediment separating the 42-38 ka burning layer from the Neanderthal bones. How much older than 38-42 ka is this Baradostian material is as yet unknown – charcoal fragments and bones from this deposit are currently being dated by the Oxford laboratory – but given the current c.45/35 ka age bracket of the Shanidar V bones, it appears likely that any hiatus between Neanderthal and Baradostian (and assumed modern human) use of the cave was extremely short. In this context a main objective of the project is to try to understand why Neanderthals were able to live in the Zagros for millennia through the fluctuating climates of MIS 5-3 and why modern humans – in the Mediterranean Levant throughout these climate stages on the evidence of Qafzeh at c.100-90 ka (Bar-Yosef et al., 2009; Hovers et al., 2003), Manot Cave c.55 ka (Hershkovitz et al., 2005), and Qafzeh again at 38-25 ka – did not penetrate into the high Zagros until (we currently assume) around 45-40 ka.

Whenever the latter began to use the cave, it appears to have been infrequent and by small groups of individuals on the evidence of the hearths. The character of the sparse lithic material they have left – small cores and core shatter fragments, and core-edge trimming flakes, implies that they were endeavouring to maximise the use of available raw materials (mainly local river pebbles) and were especially focussed on retooling their hunting equipment given the frequency of multiple burins, mostly for hunting ibex. The radiocarbon dates associated with the Baradostian layers dated so far are between roughly 40 ka and 30 ka, within MIS 3 when the primary trend in global climates was towards increasing cold and aridity. We do not yet have the resolution in chronology and palaeoclimatic proxies to establish whether modern humans were only in the mountains in the various millennial-scale warmer oscillations within MIS 3 or had the capability to survive there whatever the conditions then, but as Tim Reynolds, the project field director, has written, "the emerging picture is of small groups making regular short-term visits for shelter and tool maintenance in extreme conditions" (Reynolds *et al.*, 2015). Interestingly we have found no evidence for the use of the cave in MIS 2, the climax of glacial conditions – it may be that the mountains were effectively uninhabitable at this time. The massive rockfalls overlying the Baradostian layers probably date to this period. It was only with deglaciation that people seem to have started to use the cave again on a regular basis, burying their dead in the proto-Neolithic cemetery (Solecki et al., 2005).

ADAPTING TO RAINFOREST: THE NIAH CAVES

A major component of the new work in the West Mouth of Niah Great Cave was field observations and associated laboratory studies of the sediment history by a team of geomorphologists. This work showed that, far from the assumption of a steady accumulation of sediment on which the Harrisson and Majid age/depth models had been based, there was an extremely complex sequence of events within which the Late Pleistocene human activity had to be understood (Gilbertson et al., 2005, 2013; Fig. 21). Cleaning the sections surviving in the Hell Trench showed that there was a natural basin behind the cave lip, filled with four major sediment types or lithofacies. The first (Lithofacies 2) consisted of brown and red silts formed by episodes of water flowing into the basin from the cave interior, presumed to relate to relatively humid phases. There were indications of standing water in such phases, much as in the Haua Fteah Deep Sounding. Water flowed northwards into the back of the rock shelter, probably to drain away through a now-buried swallow hole. Interleaved with these sediments were colluvial sediments formed by materials slumping, sliding and washing down from the cave mouth (Lithofacies 2C). Traces of human activity (charcoal, ash, animal bone, stone tools etc) were found in both lithofacies, especially associated with palaeosurfaces indicating intermittent rather than continuous presence. Charcoal samples dated by the Oxford laboratory indicate a timescale within which these visits took place of *c.*50-35 ka (Higham et al., 2008).

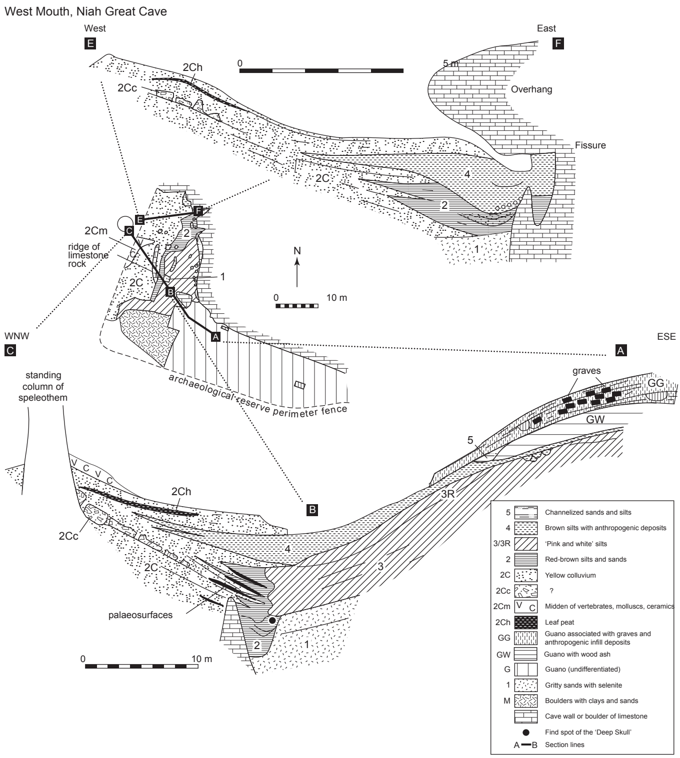


Figure 21. Summary stratigraphy of the West Mouth of Niah Great Cave established from the recent field studies. (Geomorphological mapping and synthesis: David Gilbertson, Chris Hunt, Sue McLaren, Mark Stephens, and Jim Rose; digital cartography: Tim Absalom.)

Lithofacies 2 and 2C were capped by archaeologically-sterile sediments termed 'pink and white' by Tom Harrisson, classified by us as Lithofacies 3: pink sediments with white nodules in them that he concluded must be a steady drizzle of bat guano from the cave roof (the pink) along with limestone fragments (the white). In fact these were formed by a sudden collapse of wet guano from the mound that lies in the interior behind the archaeological zone, a catastrophic event that may have lasted for just minutes, hours or a few days, sometime around 35 ka. Overlying the 'pink and white' in the rock shelter area were brown silts with abundant evidence of human presence, termed Lithofacies 4, radiocarbon dates indicating that they both formed in the Late Pleistocene into the Early Holocene. Photographs in the Harrisson archive indicate that thick deposits of ash also accumulated above the brown silts during the Late Pleistocene.

We were able to obtain a direct uranium-series date on the Deep Skull, which belonged to an adult female, of around 37 ka (Pike, 2016). This was surprising because we had obtained earlier dates of *c.*40-45 ka from sediments *c.*20-50 cm above where we calculated it had been found. Then analyses of sediments adhering to the skull, and of the pollen in them, found that they were a mix of the kind of material we would have expected at the depth the skull was buried and of Lithofacies 4-type material. The skull was found with some limb bones, and we concluded that it was probably a secondary burial of some kind, with a pit being dug down into the Lithofacies 2 silts and some disarticulated bones and the skull placed in it (resulting in the mix of Lithofacies 2 and 4 sediments adhering to the skull) (Hunt & Barker, 2014).

The analysis of the trench and depth coordinates of the prolific fauna from the Harrisson excavations showed that, despite the spit method of excavation used, Barbara Harrisson in particular, who oversaw most of the deep excavations, had dug stratigraphically within the confines of the spit method, digging spits sometimes only a inch or so thick in order to follow sloping archaeological layers and separate them from others (Piper & Rabett, 2016). The distribution of the fauna showed that most of the material from the pre-35 ka occupations was located in successive accumulations in the area of the stream channel, though the lack of surface abrasion or signs of rolling indicate that the material had not travelled very far – the main area of human activity was clearly here.

The first inhabitants of the cave mainly hunted bearded pig, perhaps taking advantage of seasonal gluts in pig populations in response to fruit-masting events, but they also hunted a wide variety of large and small prey including ones living high in the forest canopy such as orang-utan, macaques, leaf monkeys and langurs, and, on the forest floor, sambar deer, muntjac, porcupine, sun bear, pangolin and even rhinoceros. They were able to hunt these because the location of the caves gave walking access to a mosaic of environments including riparian forest, lowland rainforest, hill rainforest, and even montane vegetation. The same mosaic meant they could collect edible molluscs from rivers, streams, ponds and swamps, where they also fished. The killing ages of the major prey species imply that the hunters used traps and snares to catch them, and spears as well, though bone projectile points are not found at the site until the Terminal Pleistocene (and they might be fish leisters). They brought back the small- and medium-sized prey to the site as whole carcasses for butchery. One of the most intriguing aspects of the butchery evidence is variability in the methods applied to different primates and viverrids that is difficult to explain in functional terms such as relating to the mechanical properties of particular bones: hints that these early modern humans divided up the animal world differently from our own Linnaean classifications (Piper & Rabett, 2016, 435-437).

In addition to the faunal and molluscan evidence for rainforest exploitation, microscopic studies of organic residues such as starch grains on stone artefacts, and macroscopic plant remains recovered by water flotation, show that, from their first use of the Niah Caves *c.*50 ka, modern humans were harvesting a rich suite of rainforest plant resources, especially nuts, fruits and tubers (Barker et al., 2007b; Barton 2016; Barton et al., 2016). The latter included yams and palms such as sago, the plant that provides the main carbohydrate for present-day Penan foragers in Bornean rainforests. Some of these plant foods are highly toxic, and one of the most remarkable discoveries was evidence that people had learnt how to extract the toxins by burying toxic plants and nuts in ash-filled pits to make them edible, a technique used by tropical Australian aborigines (Fig. 22). Peaks in *Justicia* pollen and charcoal coinciding with the episodes of human activity suggest that people were also burning forest, presumably to make or enlarge cleared spaces to encourage the growth of plants such as tubers, which they themselves wanted and which would also attract bearded pigs (Hunt et al., 2012). Similar evidence for forest burning associated with human occupations around 50 ka has been found in interior New Guinea (Summerhayes et al. 2010). The terms 'vegeculture' and 'arboriculture' have been proposed to describe the systems of forest management being practised in Island Southeast Asia in the Early Holocene thousands of years before rice agriculture developed (Barker et al., 2011; Barton, 2012; Barton & Denham, 2011). The Niah evidence hints that these behaviours may be of deeper antiquity, part of the strategies developed by modern humans to live in rainforest as they first encountered it (Barker et al., 2016).

Figure 22. A standing section in the West Mouth of Niah Great Cave, which consisted of a series of intercutting ash-filled pits probably used for removing toxins from plants, dating to about 30,000 years ago, evidence of the strategies developed by modern humans to live successfully in rainforest. Looking southeast. Horizontal scale 1 m, vertical scale 30 cm. See Figure 13 for location. (Photograph: Graeme Barker.)

CONCLUSION

The three caves discussed here may not have the oldest evidence of modern humans in their respective regions, but, unlike most Palaeolithic sites, they have produced human fossil remains so we have direct evidence for what species was present (or species in the plural, in the case of Shanidar Cave). At each site, importantly, the fossil remains can be associated with multi-faceted evidence from the new excavations for the behaviour of that species in the cave and in the surrounding landscape, and for the climatic regimes in which that behaviour was located. In this process the new work at all three sites has informed on the old, and the old on the new. They have all thrown new light on the processes underlying human dispersals in their respective regions, the particular environments encountered by modern humans in the course of those dispersals, and the strategies developed to exploit them. They illustrate how successful dispersals had to be underpinned by an ability to adapt, innovate, and problem-solve, demonstrating what has been termed the 'plasticity' of modern humans by Chris Stringer and their 'mental technology' by Robin Dennell. To collect and process the range of flora and fauna represented at Niah, for example, required ingenuity, a considerable degree of targeting, and forward planning. Dense lowland rainforest may have represented a potential barrier to early human dispersals but on the evidence of Niah it did not remain so.

The records of the three caves are also important, however, because they remind us that the astonishingly successful dispersal of our species must also have involved small-scale failures and extinctions, of experiments that did not work and environmental challenges that were too daunting to deal with. The first modern humans in the Haua Fteah, with Pre-Aurignacian technologies perhaps adapted to humid coastal environments, do not seem to have been able to deal with the onset of significant aridity. The record of the modern humans who succeeded them using Levalloiso-Mousterian technologies is exiguous; the Gebel Akhdar may have been abandoned for long periods (Farr & Jones, 2014).

People only returned to the Haua Fteah on a scale commensurate with the basal Pre-Aurignacian occupation at the time of the 'early Dabban' 46-41 ka, a phase with evidence of new behaviours well adapted to cope with the aridity that was increasingly dominant. This occupation was followed by another significant hiatus before people returned to the cave after the Last Glacial Maximum. There is no clear evidence of people living in the Niah Caves during the Last Glacial Maximum, and there is no evidence for any human presence in Shanidar Cave during the whole of MIS 2. Why Neanderthals were so successful for so long in the Zagros mountains, including at times of increasing cold and aridity, and why modern humans only supplanted them around 45 ka, remains an open question.

So the tales of these three caves are certainly unfinished. It is critical to avoid the teleological assumptions of quasi-purposeful dispersals and 'cognitive superiority' that implicitly if not explicitly underpin so much thinking about the dispersal of modern humans. Nevertheless, the remarkable archaeological records of the Haua Fteah, Shanidar Cave and the Niah Cave exemplify the ingenuity and resourcefulness that must have been fundamental to the dispersal of an African species across the Eurasian landmass to Japan, Siberia, and the Americas on the one hand and to Island Southeast Asia, Melanesia and Australia on the other, and its evolutionary success in contrast with the other species that were also inhabiting parts of the globe during the last glacial cycle.

REFERENCES

Barker, G. (ed.), 2013. *Rainforest Foraging and Farming in Island Southeast Asia: the Archaeology of the Niah Caves, Sarawak*. Cambridge, McDonald Institute for Archaeological Research.

Barker, G. & Farr, L. (eds.), 2016. *Archaeological Investigations in the Niah Caves, Sarawak*. Cambridge, McDonald Institute for Archaeological Research.

Barker, G., Hunt, C., & Reynolds, T., 2007a. The Haua Fteah, Cyrenaica (northeast Libya): renewed investigations of the cave and its landscape, 2007. *Libyan Studies* 38, 93-114.

Barker, G., Barton, H., Bird, M., *et al.*, 2007b. The 'human revolution' in tropical Southeast Asia: the antiquity of anatomically modern humans, and of behavioural modernity, at Niah Cave (Sarawak, Borneo). *Journal of Human Evolution* 52, 243-61.

Barker, G., Basell, L., Brooks, I., Burn, L., Cartwright, C., Cole, F., Davison, J., Farr, L., Hamilton, R., Hunt, C., Inglis, R., Jacobs, Z., Leitch, V., Morales, J., Morley, I., Morley, M., Pawley, S., Pryor, A., Rabett, R., Reynolds, T., Roberts, R., Simpson, D., Stimpson, C., Touati, M., & der Veen, M., 2008. The Cyrenaican Prehistory Project 2008: the second season of investigations of the Haua Fteah cave and its landscape, and further results from the initial 2007 fieldwork. *Libyan Studies* 39, 175–222.

Barker, G., Antoniadou, A., Barton, H., Brooks, I., Candy, I., Drake, N., Farr, L., Hunt, C., Ibrahim, A.A., Inglis, R., Jones, S., Morales, J., Morley, I., Mutri, G., Rabett, R., Reynolds, T., Simpson, D., Twati, M., & White, K., 2009. The Cyrenaican Prehistory Project 2009: the third season of investigations of the Haua Fteah cave and its landscape, and further results from the 2007–2008 fieldwork. *Libyan Studies* 40, 1–41.

Barker, G., Antoniadou, A., Armitage, S., Brooks, I., Candy, I., Connell, K., Douka, K., Drake, N., Farr, L., Hill, E., Hunt, C., Inglis, R., Jones, S., Lane, C., Lucarini, G., Meneely, J., Morales, J., Mutri, G., Prendergast, A., Rabett, R., Reade, H., Reynolds, T., Russell, N., Simpson, D., Smith, B., Stimpson, C., Twati, M., & White, K., 2010. The Cyrenaican Prehistory Project 2010: the fourth season of investigations of the Haua Fteah cave and its landscape, and further results from the 2007–2000 fieldwork. *Libyan Studies* 41, 63–88.

Barker, G., Hunt, C., & Carlos, J., 2011. Transitions to farming in Island Southeast Asia: archaeological, biomolecular, and palaeoecological perspectives. In Barker, G., & Janowski, M. (eds.) *Why Cultivate? Archaeological and Anthropological Approaches to Foraging-Farming Transitions in Southeast Asia*, pp. 61-74. Cambridge, McDonald Institute for Archaeological Research, McDonald Institute Monographs.

Barker, G., Bennett, P., Farr, L., Hill, E., Hunt, C., Lucarini, G., Morales, J., Mutri, G., Prendergast, A., Pryor, A., Rabett, R., Reynolds, T., & Twati, M., 2012. The Cyrenaican Prehistory Project 2012: the fifth season of investigations of the Haua Fteah cave. *Libyan Studies* 43, 115–136.

Barker, G., Hunt, C., Barton, H., et al., 2016. The 'cultured rainforests' of Borneo. *Quaternary International* http://dx.doi:org/10.1016/j.quaint.2016.08.018.

Barton, H., 2012. The reversed fortunes of sago and rice. *Quaternary International* 249, 96-104.

Barton, H., 2016. Functional analysis of stone tools from the West Mouth. In: Barker, G. & Farr, L. (eds.) *Archaeological Investigations in the Niah caves: the Archaeology of the Niah Caves, Sarawak, Volume 2,* pp. 401-438. Cambridge, McDonald Institute for Archaeological Research.

Barton, H., & Denham, T., 2011. Prehistoric vegeculture and social life in Island Southeast Asia and Melanesia. In: Barker, G., & Janowski, M. (eds.) *Why Cultivate? Archaeological and Anthropological Approaches to Foraging-Farming Transitions in Southeast Asia*, pp. 17-25. Cambridge, McDonald Institute for Archaeological Research, McDonald Institute Monographs.

Barton, H., Paz, V., & Carlos, A.-J., 2016. Plant remains from the West Mouth: microscopic and macroscopic approaches. In: Barker, G. & Farr, L. (eds.) *Archaeological Investigations in the Niah caves: the Archaeology of the Niah Caves, Sarawak, Volume 2*, pp. 455-468. Cambridge, McDonald Institute for Archaeological Research.

Barton, R.N.E., Bouzouggar, A., Colcutt, S.N., Schwenniger, J.-L., & Clark-Balzan, L., 2009. OSL dating of the Aterian levels at Dar-es-Soltan I (Rabat, Morocco) and implications for the dispersal of modern Homo sapiens. *Quaternary Science Reviews* 28 (19–20), 1914–1931.

Bar-Yosef, O., & Belfer-Cohen, A., 2010. The Levantine Upper Palaeolithic and Epipalaeolithic. In: E. A. A. Garcea E.A.A. (ed.) *South-Eastern Mediterranean Peoples Between 130,000 and 10,000 years Ago*, pp. 144-167. Oxford, Oxbow.

Bar-Yosef. O., & Pilbeam, D.H. (eds.) 2000. *The Geography of Neanderthals and Modern Humans in Europe and the Greater Mediterranean*. Cambridge, Mass., Peabody Museum.

Bar-Yosef, O., Mayer, D., Vandermeersch, B., & Bar-Yosef, O., 2009. Shells and ochre in Middle Palaeolithic Qafzeh Cave, Israel: indications for modern behaviour. *Journal of Human Evolution* 56, 307-314.

Bellwood, P., 1985. *Prehistory of the Indo-Malaysian Archipelago*. Sydney, Academic Press.

Bellwood, P., 1988. A hypothesis for Austronesian origins. *Asian Perspectives* 26, 107-17.

Bellwood, P., 1996. The origins and spread of agriculture in the Indo-Pacific region: gradualism and diffusion or revolution and colonization? In: *The Origins and Spread of Agriculture and Pastoralism in Eurasia* (ed. Harris, D.R.), pp. 475-498. London, UCL Press.

Bellwood, P., 2013. *First Migrants: Ancient Migration in Global Perspective*. Malden, MA., Wiley-Blackwell.

Belmaker, M., & Hovers, E., 2011. Ecological change and the extinction of the Levantine Neanderthals: implications from a diachronic study of micromammals from Amud Cave, Israel. *Quaternary Science Reviews* 30, 3196-3209.

Blome, M.W., Cohen, A.S., Tryon, C.A. *et al.*, 2012. The environmental context for the origins of modern human diversity: a synthesis of regional variability in African climate 150,000-30,000 years ago. *Journal of Human Evolution* 62, 563-592.

Boivin, N., Fuller, D.Q., Dennell, R. *et al.* 2013. Human dispersal across diverse environments of Asia during the Upper Pleistocene. *Quaternary International* 300, 32-47.

Brothwell, D.R., 1960. Upper Pleistocene human skull from Niah Caves. *Sarawak Museum Journal* 9 (n.s. 15-16), 323-349.

Dennell, R., & Petraglia, M., 2012. The dispersal of *Homo sapiens* across southern Asia: how early, how often, how complex? *Quaternary Science Reviews* 47, 15-22.

Douka, K., Grün, R., Jacobs, Z., *et al.*, 2013. The chronostratigraphy of the Haua Fteah cave (Cyrenaica, northeast Libya). *Journal of Human Evolution* 66, 39-63.

Farr, L., & Jones, S., 2014. Spatial and temporal variation in North African and Southwest Asian palaeoenvironmental and archaeological records during Marine Isotope Stage 4. In: Boyle, K., R. Rabett, R., & C.O. Hunt, C.O. (eds.) *Living in the Landscape: Essays in Honour of Graeme Barker*, pp. 59-81. Cambridge, McDonald Institute for Archaeological Research.

Farr, L., Lane, R., Abdulazeez, F., Bennett, P., Holman, J., Marasi, A., Prendergast, A., Al- Zweyi, M., & Barker, G., 2014. The Cyrenaican Prehistory Project 2013: the seventh season of excavations in the Haua Fteah cave. *Libyan Studies* 45, 163–173.

Gamble, C.S., 1996. *Timewalkers. The Prehistory of Global Colonisation*. Cambridge, Cambridge University Press.

Garcea, E.A.A. (ed.), 2010a. *South-Eastern Mediterranean Peoples Between 130,000 and 10,000 years Ago*, 144-167. Oxford: Oxbow.

Garcea, E. A.A., 2010b. The spread of the Aterian peoples in North Africa. In: Garcea, E.A.A. (ed.) *South-eastern Mediterranean Peoples Between 130,000 and 10,000 Years Ago*, pp.37-53. Oxford, Oxbow Books.

Gargett, R.H., 1989. Grave shortcomings: the evidence for Neanderthal burial. *Current Anthropology* 30, 157-90.

Gargett, R.H., 1999. Middle Palaeolithic burial is not a dead issue: the view from Qafzeh, Saint-Cézaire, Kebara, Amud and Dederiyeh. *Journal of Human Evolution* 37, 27-90.

Gilbertson, D., McLaren, S., Stephens, M., et al., 2013. The cave entrance sequences and environmental change. In: Barker, G. (ed.) *Rainforest Foraging and Farming in Island Southeast Asia: the Archaeology of the Niah Caves, Sarawak*, pp. 71-134. Cambridge, McDonald Institute for Archaeological Research.

Gilbertson, D.D., Bird, M., Hunt, C.O., *et al.*, 2005. Past human activity and geomorphic change in the entrance of a guano-rich tropical cave: the late Quaternary succession in the Great Cave of Niah, Sarawak. *Asian Perspectives* 44(1), 16–41.

Groucutt, H.S., Scerri, E.M.L., Lewis, L., et al., 2015. Stone tool assemblages and models for the dispersal of Homo sapiens out of Africa. *Quaternary International* 382, 8-30.

Harrisson, B., 1958a. Niah's Lobang Tulong ('Cave of Bones'). *Sarawak Museum Journal* 8 (n.s. 12), 596-619.

Harrisson, B. 1958b. Niah's *Lobang Tulang*: ('Cave of Bones'). *Sarawak Museum Journal* 8 (n.s. 12), 596-619.

Harrisson, B., 1959-60. 'Cave of Bones' – new finds, 1959. *Sarawak Museum Journal* 9 (n.s. 13-14), 164-178.

Harrisson, B., 1967. A classification of Stone Age burials from Niah great cave, Sarawak. *Sarawak Museum Journal* 15 (n.s. 30-31), 126-200.

Harrisson, T., 1957. The Great Cave of Niah: a preliminary report on Bornean prehistory. *Man* 57, 161-166.

Harrisson, T., 1958a. The caves of Niah: a history of prehistory. *Sarawak Museum Journal* 8 (n.s. 12), 549-595.

Harrisson, T., 1958b. Carbon-14 dated palaeoliths from Borneo. *Nature* 181 (4611): 792.

Harrisson, T. 1958c. The Great Cave, Sarawak: a ship-of-the-dead cult and related rock paintings. *The Archaeological News Letter* 6(9), 199-204.

Harrisson, T., 1959. Radio Carbon C-14 datings from Niah: a note. *Sarawak Museum Journal* 9 (n.s. 13-14), 136-138.

Harrisson, T. 1960. Stone Age ships of death: world's oldest boat coffins found in Sarawak caverns reveal ancient culture. *Life* January 11 1960, 49-51.

Harrisson, T., 1964. 50,000 years of Stone Age culture in Borneo. *Smithsonian Institution Annual Report* 1964, 521-530.

Harrisson, T., 1966. Lobang Angus, a frequentation cave at Niah – I. *Sarawak Museum Journal* 14 (n.s. 28-29), 217-223.

Harrisson, T., 1970. The prehistory of Borneo. *Asian Perspectives* 13, 17-45.

Harrisson, T., 1972. The Borneo stone age – in light of recent research. *Sarawak Museum Journal* 20 (n.s. 40-41), 385-412.

Henry, A.G., Brooks, A.S., & Piperno, D.R., 2014. Plant foods and the dietary ecology of Neanderthals and early modern humans. *Journal of Human Evolution* 69, 44-54.

Hershkovitz, I., Marder, O., Ayalon, A., *et al.,* 2015. Levantine cranium from Manot Cave (Israel) foreshadows the first Europan modern humans. *Nature* 520, 216-219.

Higham, T.F.G., 2011. European Middle and Upper Palaeolithic radiocarbon dates are often older than they look: problems with previous dates and some remedies. *Antiquity* 85 (327), 235–49.

Higham, T.F.G., Barton, H., Turney, C.S.M., Barker, G.,. Bronk Ramsey, C., & Brock, F., 2008. Radiocarbon dating of charcoal from tropical sequences: results from the Niah Great Cave, Sarawak, and their broader implications. *Journal of Quaternary Science* 24(2), 189–97.

Hoffecker, J.F., 2009. The spread of modern humans in Europe. *Proceedings of the National Academy of Sciences* 106, 16040-16045.

Hovers, E., Llani, S., Bar-Yosef, O., & Vandermeersch, B., 2003. An early case of color symbolism: ochre use by modern humans in Qafzeh Cave. *Current Anthropology* 44, 491-522.

Hublin, J.-J., 2014. The modern colonization of Eurasia: when and where? *Quaternary Science Reviews* 118, 194-210.

Hunt, C. & Barker, G., 2014. Missing links, cultural modernity and the dead: anatomically modern humans in the Great Cave of Niah (Sarawak, Borneo). In: Dennell, R., & Porr, M. (eds.) *East of Africa: South Asia, Australia, and Human Origins*, pp. 90-107. Cambridge, Cambridge University Press.

Hunt, C.O., Gilbertson, D.D., & Rushworth, G., 2012. A 50,000-year record of Late Pleistocene tropical vegetation and human impact in lowland Borneo. *Quaternary Science Reviews* 37, 61–80.

Inglis, R.H., 2012. *Human Occupation and Changing Environments during the Middle to Later Stone Ages: Soil Micromorphology at the Haua Fteah, Libya*. Unpublished PhD thesis, University of Cambridge.

Jacobs, Z., Li, B., Farr, L., *et al.*, 2017, in press. The chronostratigraphy of the Haua Fteah cave (Cyrenaica, northeast Libya) – optical dating of early human occupation during Marine Isotope Stages 4, 5 and 6. *Journal of Human Evolution*.

Jones, S.C., 2016. Middle Stone Age reduction strategies at the desert's edge: a multi-site comparison across the Gebal Akhdar of northeast Libya. *Quaternary International* 408, 53–78.

Jones, S., Farr, L., Barton, H., *et al.,* 2011. Geoarchaeological patterns in the pre-desert and desert ecozones of northern Cyrenaica. *Libyan Studies* 42, 11-19

Jones, S., Antoniadou, A., Barton, H., *et al.*, 2016. Patterns of hominin occupation and cultural diversity across the Gebel Akhdar of northern Libya over the last ~200 kyr. In: Jones, S.C., & Stewart, B.A. (eds.) *Africa from MIS 6-2: Population Dynamics and Paleoenvironments*, pp. 77-99. Dordrecht, Springer.

Leroi-Gourhan, A., 1975. The flowers found with Shanidar IV, a Neanderthal burial in Iraq. *Science* 190, 562-564.

McBrearty, S., & Brooks, A.S., 2000. The revolution that wasn't: a new interpretation of the origins of modern human behaviour. *Journal of Human Evolution* 39, 453-463.

McBurney, C.B.M., 1960. *The Stone Age of Northern Africa*. London, Penguin Books.

McBurney, C.B.M., 1967. *The Haua Fteah in Cyrenaica and the Stone Age of the South-East Mediterranean*. Cambridge, Cambridge University Press.

McBurney, C.B.M., 1977. *Archaeology and the Homo Sapiens Sapiens Problem in North Africa.* Amsterdam, Derde Kroon-voordracht.

Mellars, P., 2006. Going east: genetic and archaeological perspectives on the modern human colonization of Eurasia. *Nature* 313, 796-800.

Morwood, M.J., Soejono, R.P., Roberts, R.G., *et al.*, 2004. Archaeology and age of a new hominin from Flores in eastern Indonesia. *Nature* 431, 1087-91.

Nespoulet, R., El-Hajraoui, M.A., Amani, F., Ben-Ncer, A., Debenath, A., El Idrissi, A., Lacombe, J.-P., Michel, P., Oujaa, A., & Stoetzel, E., 2008. Palaeolithic and Neolithic occupations in the Temara region (Rabat, Morocco): recent data on hominin contexts and behaviour. *African Archaeological Review* 25 (1-2), 21–40.

Pettitt, P., 2011. *The Palaeolithic Origins of Human Burial*. London, Routledge.

Pettitt, P., 2015. Landscapes of the dead: the evolution of human mortuary activity from body to place in Palaeolithic Europe. In: Coward, F., Hosfield, R., Pope, M., & Wenbow-Smith, F. (eds.) *Settlement, Society and Cognition in Human Evolution: Landscapes in Mind*, pp. 258-274. Cambridge, Cambridge University Press.

Pike, A., 2016. Uranium-series dating of the Niah 'Deep Skull'. In: Barker, G. & Farr, L. (eds.) *Archaeological Investigations in the Niah Caves, Sarawak*, pp. 233-234. Cambridge, McDonald Institute for Archaeological Research.

Piper, P., & Rabett, R., 2016. Vertebrate fauna from the Niah Caves. In: Barker, G. & Farr, L. (eds.) *Archaeological Investigations in the Niah Caves, Sarawak*, pp. 401-438. Cambridge, McDonald Institute for Archaeological Research.

Pomeroy, E., Lahr, M., Crivellaro, F., Farr, L., Reynolds, T., Hunt, C. & Barker, G., under review. *Newly-discovered Neanderthal remains from Shanidar Cave, Iraqi Kurdistan, and their attribution to Shanidar 5.*

Rabett, R., Farr, L., Hill, E., Hunt, C., Lane, R., Moseley, H., Stimpson, C., & Barker, G., 2013. The Cyrenaican Prehistory Project 2012: the sixth season of excavations in the Haua Fteah cave. *Libyan Studies* 44, 113–125.

Reich, D., Green, R.E., Kircher, M., *et al.*, 2010. Genetic history of an archaic hominin group from Denisova Cave in Siberia. *Nature* 468, 1053-1060.

Reynolds, T.E.G., 2013. The Middle Palaeolithic of Cyrenaica: is there an Aterian at the Haua Fteah and does it matter? *Quaternary International* 300, 171–81.

Reynolds, T., Barker, G., Barton, H., et al., 2014. The first modern humans at Niah, *c.*50,000-35,000 years ago, In: Barker, G. (ed.) *Rainforest Foraging and Farming in Island Southeast Asia: the Archaeology of the Niah Caves, Sarawak*, pp. 135-172. Cambridge, McDonald Institute for Archaeological Research.

Reynolds, T., Boismier, W., Farr, L., *et al.*, 2015. New investigations at Shanidar Cave, Iraqi Kurdistan. *Antiquity* December project gallery.

Scerri, E., 2013. The Aterian and its place in the North African Middle Stone Age. *Quaternary International* 300, 111–130.

Smith, E.H., & Ahern, J.C., 2013. *The Origins of Modern Humans: Biology Reconsidered*. Chichester, Wiley-Blackwell.

Solecki, R., 1952a. Notes on a brief archaeological reconnaissance of cave sites in the Rowanduz district of Iraq. *Sumer* 8, 37-44.

Solecki, R., 1952b. A Paleolithic site in the Zagros Mountains of northern Iraq. Report on a sounding at Shanidar Cave. *Sumer* 8, 127-161.

Solecki, R., 1953a. A Paleolithic site in the Zagros Mountains of northern Iraq. Report on a sounding at Shanidar Cave. *Sumer* 9, 60-93.

Solecki, R., 1953b. The Shanidar Cave sounding, 1953 season, with notes concerning the discovery of the first Paleolithic skeleton in Iraq. *Sumer* 9, 229-232.

Solecki, R., 1955. Shanidar Cave. A Paleolithic site in northern Iraq and its relationship to the Stone Age sequence in Iraq. *Sumer* 11, 14-38.

Solecki, R., 1957. The 1956 season at Shanidar. *Sumer* 13, 165-171.

Solecki, R., 1958. The 1956-1957 season at Shanidar, Iraq. A preliminary statement. *Sumer* 14, 104-108.

Solecki, R., 1960. Shanidar Cave. In C. C. Lamberg-Karlovsky (ed.) *Old World Archaeology: Foundations of Civilization*, 43-48. San Francisco, W.H. Freeman and Co.

Solecki, R., 1961. Three adult Neanderthal skeletons from Shanidar Cave, northern Iraq. *Sumer* 17, 71-96.

Solecki, R., 1963. Prehistory in Shanidar Valley, northern Iraq: fresh insights into Near Eastern prehistory from the Middle Palaeolithic to the Proto-Neolithic are obtained. *Science* 139, 179-193.

Solecki, R., 1971. *Shanidar: the First Flower People*. New York: Knopf.

Solecki, R., 1975. Shanidar IV: a Neanderthal flower burial in northern Iraq. *Science* 190, 880-881.

Solecki, R., Solecki, R.L., & Agelarakis, A., 2005. *The Proto-Neolithic Cemetery in Shanidar Cave*. College Station (TX), Texas A & M Press.

Sommer, J.D., 1999. The Shanidar IV 'Flower Burial': a re-evaluation of Neanderthal burial ritual. *Cambridge Archaeological Journal* 9, 127-137.

Stringer, C., & McKie, R., 1997. African Exodus. The Origins of Modern Humanity. New York, Henry Holt.

Summerhayes, G.R., Leavesley, M., Fairbairn, A., *et al.*, 2010. Human adaptation and plant use in Highland New Guinea 49,000 to 44,000 years ago. *Science* 330, 78–81.

White, T.D., Asfaw, B., DeGusta, D., et al., 2003. Pleistocene Homo sapiens from Middle Awash, Ethiopia. *Nature* 423, 742-747.

Zuraina Majid, 1982. The West Mouth, Niah, in the prehistory of Southeast Asia. *Sarawak Museum Journal* 31 (n.s. 52), 1-200.

KROONVOORDRACHTEN

REDACTIE: WILLY H. METZ

Printed by

JOH. ENSCHEDÉ AMSTERDAM BV

ISBN/EAN 978-90-817066-7-4