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The Initial Peopling of Wallacea and Sahul

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Abstract. – This paper reviews significant misunderstandings concerning the earliest evidence of human colonizations involving sea travel. In particular, the navigational ability of *Homo erectus* is considered, and its implications for the technological, cognitive, and intellectual capability of that species. Some of the epistemological implications for heuristic modelling dynamics in archaeology are discussed, especially in relation to limitations imposed by language and familiarity with existing archaeological literature. *[Australia, Southeast Asian islands, Lower Palaeolithic, navigation, hominids, first watercraft, epistemology]*

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1 Introduction

The most weighty single issue of Australian archaeology is undoubtedly the question of the continent's initial settlement by humans. It is also an important issue of global Pleistocene archaeology. Not only does it play a key role in models concerning the dispersion or evolution of anatomically modern humans, it is also widely recognized as proving conclusively the competence of hominids in navigating the open sea, their ability to colonize isolated regions, and indirectly their use of some form of complex communication, presumed to have been uttered language. In short, a number of answers to fundamental questions of recent hominid evolution ought to be found in the islands separating Australia from Asia, particularly the deepwater islands collectively known as Wallacea, and ultimately in Sahul (Greater Australia) itself.

Australian archaeology has been traditionally neglected, having been considered as being of little consequence to the rest of the world until the 1960s or 1970s. Since then, however, a young school of Australian archaeology has made great strides. During the 1980s, the favoured model of initial Australian colonization was based on radiocarbon dates from sites in both Australia and various islands to its immediate north that seemed to peter out at ages of around 40,000 years (40 ka). Consequently it was assumed that occupation of the Southeast Asian islands east of Java was achieved quite swiftly, and entirely by *Homo sapiens sapiens*.

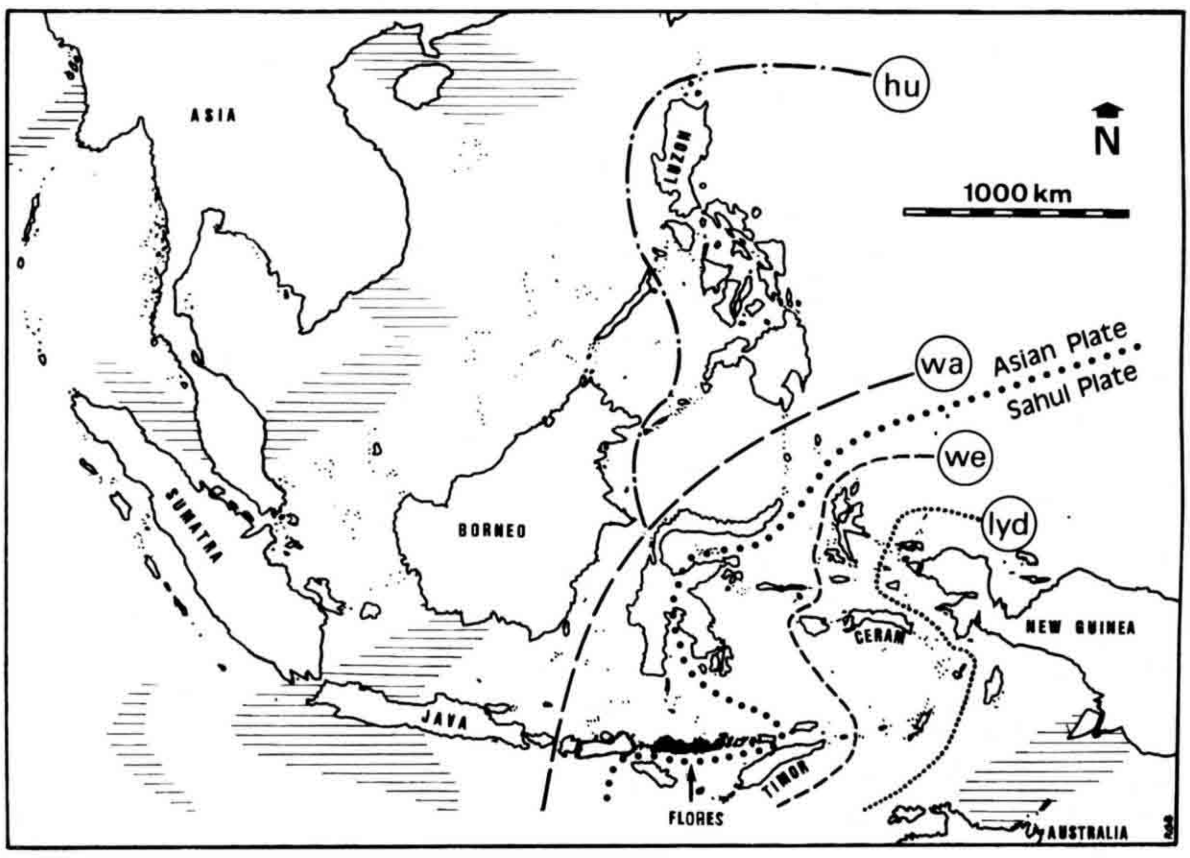
In principle, this "short-range" model continues to dominate both textbooks and academic curriculas, except that in recent years, a series of TL (thermoluminescence) and OSL (optically stimulated luminescence) dates from sediments at a few northern Australian sites has been widely accepted as extending human occupation securely back to about 60 ka BP (Roberts et al. 1993). Implicit in this model is the assumption that the lack of radiocarbon dates of above 40 ka is attributable to a "dating plateau" related to the method's own limitations. Some Australian archaeologists, however, reject this view, basically because the same plateau has not been observed with "geological" radiocarbon dates from Australia, and they maintain that only ages of up to 40 ka are secure (Allen and Holdaway 1995). Nevertheless, there is no significant further difference between these two models, called the short and middle-range hypotheses respectively. Both have to contend with a conspicuous paucity of *H. sapiens sapiens* remains of demonstrated Pleistocene antiquity from all Southeast Asian islands (this includes the undated Niah Cave skull from Borneo).

A third model has been advocated from time to time, the long-range hypothesis for first Australian occupation. This was based initially on palaeoecological evidence, particularly in the form of abrupt changes in pollen spectra and inferred incidence of vegetation burning (Singh and Geissler 1985; Kershaw 1993). A human presence in Australia by 140 ka to 130 ka ago is implied by this alternative. Recently, Fullagar et al. (1996) have presented a series of TL dates from Jinmium, Northern Territory, which indicates human occupation older than 116 ka BP. This is hoped to provide the much needed archaeological evidence for the long-range model, but it has been subjected to vigorous debate in Australia since it was made public during late 1996. In particular, the dating method is widely considered inappropriate. It is fair to say that the middle-range model remains the favoured alternative, and it postulates first Australian landfall to have occurred around 60 ka ago or marginally earlier. A major factor in the preference of this model is the underlying assumption that the first colonizers were fully modern humans (because they must have had the ability to build ocean-going vessels, which is thought only moderns could have achieved), an assumption that is obviously at present impossible to reconcile with dates of 100 ka or more. It has long been suggested that *H. erectus* may have survived longer on Java than anywhere else. Indeed, Swisher et al. (1996) have very recently argued that the most recent occupation by that species at Ngandong dates from only 53–27 ka.

In this paper I intend to review some of the crucial assumptions Australian archaeologists have made about the context of human settlement of the general region. In particular I will examine the questions of sea travel and of the relevant cultural and technological setting.

2 Background

The Tertiary tectonic history of the region considered here is crucial to its biogeography. The northwards movement of the Sahul Plate (Australia's part of Gondwanaland) over the past 70 million years or so has led to it making contact with the Sunda section of the Pacific Plate around 15 million years ago, with full engagement during the Pliocene. The subduction zone formed along the Sunda Islands led to the establishment of deep ocean trenches and uplift along the margins of the Sunda shelf, and the formation of a chain of islands. But the continental collision has not yet resulted in a land bridge to many of the islands formed by it, not even during the lowest sea



Map: South-East Asia: hu = Huxley's modification of Wallace's Line; wa = Wallace's Line; we = Weber's Line; lyd = Lydekker's Line. The line dividing the Eurasian tectonic plate from the Sahul (Australian) plate is also shown.

levels of the Pleistocene. This has led to distinctive biogeographical zones which are defined by Wallace's Line of 1876 and its modification by Huxley (the furthest extent of Asian faunal complexes), Weber's Line and, furthest to the east, Lydekker's Line (the furthest extent of Australian faunas). Wallacea comprises the islands lying between the lines of Wallace-Huxley and Lydekker, thus effectively straddling the Eurasian and Australian continental plates (Map).

The distribution of both floras and faunas across this region reflects the geographical conditions profoundly. Sumatra, Borneo, Java, and Bali, accessible from the Asian mainland during periods of low sea level, display a rich diversity in both the present and the Pleistocene past. The islands east of Lydekker's Line are occupied by Sahul species (e.g., monotremes), while birds of paradise and the cassowary extend west to Weber's Line. The cuscus even reached Timor and Celebes (perhaps transported by humans), and cockatoos made it as far west as Borneo and Lombok. Several species were introduced by man from the west: the dog, which reached Australia perhaps 4000 years ago, the pig, and probably the macaque all crossed Wallace's barrier. So did a variety of small mammals, mostly Muridae, but including *Trachypithecus auratus*. In other words, the faunal influence gradually decreases from each side, with the various water barriers acting as a series of ecological filters in both directions. The effectiveness of these filters is even more pronounced in the flora.

The two most impressive colonizers, however, were proboscideans and humans. Elephants are known to be superb long-distance swimmers and might have travelled in herd formation (which would have provided a viable breeding population after landfall), helped by their buoyancy in saltwater. Humans, however, are thought to have required rafts or boats in order to travel as colonizing parties. Several fossil species of Stegodontidae and elephants are found in Wallacea, including on Celebes (three species; Groves 1976), Flores (Hooijer 1957; Verhoeven 1958), Timor (Verhoeven 1964; Glover 1969), and other islands east of Flores, even on Ceram and Irian Jaya (Hantoro 1996), and in the Philippines (on Luzon and Mindanao; Koenigswald 1949).

On the whole, however, the ability of land fauna to occupy the Wallacean islands was severely limited ever since this chain of islands had risen from the sea. In contrast to the large islands west of Wallace's Line, with their highly diversified Asian faunas throughout the Quaternary, the deepwater islands have been characterized by distinctive endemism for their entire history, including a trend towards dwarfism among the larger mammals and rapid speciation. Rafting on floating vegetation was generally limited to small mammals (Diamond 1977, 1987).

According to current archaeological consensus, humans have occupied Java (and presumably Bali, which was connected to Java at various times during the Pleistocene) since the first known emergence of *H. erectus* in the region. They never crossed Wallace's Line (between Bali and Lombok) until fully modern people arrived in the region (from Africa, presumably) and introduced new technology, shortly before the first known occupation of Australia. Bartstra et al. (1991) argue that Wallace's Line was first crossed by humans about 50 ka ago. Swisher et al. (1994) have provided what they term precision dating for the earliest appearance of *H. erectus* on Java at about 1.8–1.6 Myr, which coincides with the species' first appearance in Africa. The recent report of what appears to be a mandible of *H. habilis* or *ergaster* from Longgupo Cave in central China at 1.9–1.8 Myr has added considerable fuel to the debate between multiregionalists and those who favour the repeated dispersion of hominid species from Africa, because, especially in conjunction with the early dates from Java, it raises the possibility that even *H. erectus* did not evolve exclusively in Africa (Huang et al. 1995). Here, however, more evidence is required as the fragmentary fossil from Longgupo Cave cannot be reliably identified and has also been suggested to be of a pongid. Finally, we have Swisher et al.'s (1996) dating evidence which is said to suggest that *H. erectus* survived on Java well into the Upper Pleistocene.

These and other exciting recent developments in palaeoanthropology sometimes result from data which are rather more tentative than their advocates may imply. For instance, the very late dates for Javan *H. erectus* (53–27 ka) by Swisher et al. (1996) are squarely contradicted by unpublished dates Christophe Falguères has secured for this material (in the order of 300 ka), and they are rejected by senior Indonesian specialists who withdrew their names from the paper before its publication (Dayton 1996). Moreover, the claim that the Ngandong hominids are *H. erectus* is very tenuous, they are much more similar to Australian modern humans. Other data are in need of independent verification before we should allow them to be incorporated in elaborate hypotheses of hominid evolution, and yet every time some new "sensational" result is disseminated we witness a rush of "experts" seeking to outdo one another in overinterpreting the information presented, often in order to underpin one or the other extreme position in the ongoing debate. Healthy debate is most certainly required, but there is nothing "healthy" about a debate dominated by scholars who are strongly committed to extreme points of view. After all, both the extreme multiregionalist position (separate regional, parallel hominid evolution) and the extreme diffusionist/replacement position (complete genetic isolation of an African population which totally replaced all others in the world) present highly unlikely scenarios, with the truth almost certainly being somewhere between these two extreme paradigms.

Of concern should be that these futile, esoteric, and trendy debates often detract from more substantial issues, which are sometimes topics that might well help in clarifying controversial matters. I would argue that some of the most important issues in Pleistocene archaeology are being neglected because of these favoured dynamics. In this paper I will present a classical example of the effects of this trend, describing how important key evidence can remain neglected for decades, to the considerable detriment of the discipline, while poorly informed debate about moot points captures the limelight.

The most important effect of the "African Eve model" is not so much how it shapes ideas of hominid evolution or genetics, but that in order to survive it seeks to negate all evidence of human sophistication prior to the advent of what is often defined as "anatomically modern humans" (cf. Tobias 1995 for a critique of this concept). Its fundamental ideological theorem is that only these modern humans possessed the technological, cultural, intellectual, cognitive, and social skills to develop symbolism, art, language, advanced toolmaking abilities, self-consciousness, and seafaring. When they displaced the various inferior resident populations throughout much of the Old World this led to a quantum jump in human progress. Such an "explosion-like" development (White 1989, 1992, 1993) no doubt explains the eradication of the archaic sapienoids, much as the destruction of historical indigenous societies by European colonization was justified by the "superior" cultural values of the colonizers. These pernicious ideologies are not usually made explicit in archaeological discourse, rather they are implied, as is the fundamentalist ontology driving their hypotheses (coyly expressed in Biblical metaphors at times). I have for years presented compelling evidence that this "punctuated equilibrium" model of cultural evolution is largely false, and that it can readily be explained by various factors: taphonomic logic (Bednarik 1993*b*, 1994*a*, 1995*a*), significant ignorance about existing archaeological data (1992, 1995*a*, 1995*d*, 1995*e*), the pigeonholing effects of untestable taxonomies in archaeology (1990/91), extremely uneven research efforts in different parts of the world (1994*b*), artificial plateaus introduced by such factors as specific dating methods and cultural chronologies (1997), the confirmationist epistemology of the discipline, and of course the tendency to seek to defend unfalsifiable constructs in archaeology, as well as to collect and interpret data in accordance with preconceived paradigms (1994*c*). Here I will present a classical example in which the ignorance of crucial information has led to a whole swathe of false models and ideas in the discipline.

3 The Evidence from Flores

Many years ago this journal featured detailed reports about the discoveries, over several years, of archaic stone tools in a fossiliferous sediment facies exposed at a number of sites near the Ai Sisa river in central Flores (Maringer and Verhoeven 1970*a*, 1970*c*). These publications were the culmination of many years of work by Verhoeven, who first discovered remains of Stegodontidae on Flores in January 1957 (Hooijer 1957; Verhoeven 1958) and on Timor in August 1964 (Verhoeven 1964). Among his initial finds the eminent French prehistorian H. Breuil recognized a number of Lower Palaeolithic stone artefact types (Verhoeven 1958: 265). In the summer of 1963 Verhoeven located further stone tools directly in the layer containing the *stegodon* remains (Verhoeven 1968), thus confirming Breuil's view. The first Maringer and Verhoeven report (1970*a*) validated Verhoeven's observations completely and was accompanied by a second paper (Maringer and Verhoeven 1970*b*) which described surface finds of similar stone tools from the same region.

The geological sequence of the Ola Bula and Mata Menge areas includes a sandstone layer of up to 80 m thickness, the Ola Bula Formation, which is overlain by a Pleistocene limestone deposit and recent volcanic material. The fossil horizon containing the "stegodon" remains and the stone tools is just 1.0–1.5 m thick, occasionally up to 3 m. Subsequent to the deposition of the Ola Bula sandstone, the calcareous Gero Formation was formed during a period when the area was at or below sea level, and before its uplift by between 200–400 m during the late Pleistocene. This in turn led to the incision of river systems and the deposition of volcanic sediments. The presence of tektites in the fossil horizon prompted Koenigswald (1958: 44–46) to suggest its Middle Pleistocene age even before the first stone artefacts were found. This age is not only supported by them, but also by the geological as well as palaeontological context. Hooijer (1957: 126) attributed the fauna to the Middle or Upper Pleistocene. Heekeren (1975: 48 f.) was more explicit, bracketing the fossiliferous and artefact-bearing stratum between 830 ka and 200 ka. Koenigswald preferred a greater age, 830 ka to 500 ka, and on the basis of the tektites eventually nominated 710 ka as the most likely age (Koenigswald and Ghosh 1973: 3 f.).

Maringer and Verhoeven compared the lithic industry from the Ola Bula Formation with the traditions found in Java which are attributed to *H. erectus*. They continued their efforts to locate similar artefact material resembling the Javan Patjitan (Pacitan) on Flores, and reported one eroded assemblage from the Waiklau near Maumere (Maringer and Verhoeven 1972), and then a large similar industry at Marokoak (Maringer and Verhoeven 1975). More importantly, they also discovered a similar assemblage in the stratified deposit of a deep limestone shelter they named Liang Michael, where they excavated a trench of 4 by 3 m, recovering 205 stone tools resembling Clactonian typology (Maringer and Verhoeven 1977). The steep slope in front of the shelter yielded a further 818 artefacts of this typology. Finally, Maringer (1978) reports a remarkable single tool made of black opal from the Soa Plateau.

The age of the fossiliferous stratum in the Ola Bula Formation as suggested by Koenigswald was eventually confirmed in 1991–1992, when the work of Sondaar (1984, 1987) and others (e.g., Musser 1981) led to an attempt to date the fossiliferous facies palaeomagnetically (Sondaar et al. 1994). A series of 19 samples from two sections were processed, and the Matuyama-Brunhes reversal to normal polarity (730 ka BP) was found to occur 1.5 m below the artefact-bearing deposit at Mata Menge. At that site, the Ola Bula Formation is 23 m thick, and the magnetic reversal occurs near its base (Aziz 1993; Morwood et al. 1997). The very great number of stone artefacts from the various sites implies that, by about 700 ka ago, the island was well occupied by hominids, and there can be no doubt that they were *H. erectus*. Moreover, there can be no question that Lombok and Flores were not connected to Java (nor to each other): not only is this demonstrated by the distinctive endemism of the fauna, the final uplift of Flores had not yet occurred, and the water barriers could have been deeper and wider than today's, even at the lower sea levels of the Pleistocene. It is also important to note the complete absence of stone tools in another, older fossiliferous stratum at the nearby site Tangi Talo, which is thought to be about 900 ka old, being apparently of the Jaramillo normal polarity period (Sondaar et al. 1994). This may perhaps provide a *terminus post quem* indicator for human presence.

The lithics from the upper, silty part of the fossiliferous layer in the lower section of the Ola Bula sandstone are of fresh appearance and have sharp edges, whereas those from its sandy, lower part exhibit moderate rounding due to water transport. The "stegodon" remains show similarly differential wear, so the two types of finds may have been redeposited in the lower part of the layer, but have probably experienced very little if any transport in the upper. Here, many osteal remains were found in articulation, e.g., limbs together with pelvis, or connected vertebrae. Fluvial mixing of components from different chronological units is therefore not a valid interpretation, and this was already amply clear from Maringer and Verhoeven's (1970*a*) report. Recent excavations also confirmed their claims that the stone tools occurred among the fossils, sometimes even in direct contact with bone specimens (e.g., four of the artefacts excavated in 1994; Morwood et al. 1997). Hence there is ample evidence that the makers of the stone tools shared the island with the Stegodontidae, and most probably included them in their diet.

Research at the sites, which by now include besides Ola Bula and Mata Menge also Boa Leza, Dekoweku, Dozo Dhalu, Dozu Sogola, Nagerowe, and Ngampa, continued after 1992 (Lumbanbatu and Aziz 1994; Aziz 1996; Morwood et al. 1997). But all of this knowledge about the Pleistocene occupation of Flores remained largely unknown in Australian archaeology, partly because the principal publications, in *Anthropos*, were in German and thus ignored, while the few English reports had appeared in rather obscure publications. Although Flores does receive a mention in a few Australian syntheses on Wallacea's archaeology during the 1970s and 1980s, the Maringer and Verhoeven reports were misunderstood and it was mistakenly assumed that *no stratigraphical association* between the Stegodontidae and the stone tools *had been observed*. Realizing that this was a very crucial issue not only for the region's archaeology, but for hominid history generally, I explained the misunderstanding and its effects (Bednarik 1995*c*, 1995*d*, 1995*e*), with the result that one respondent chastised me for being critical. Groves (1995), while admitting that many of the points I made were valid, stated that the claims by Maringer and Verhoeven should have been checked. This is not a good enough explanation for ignoring them entirely *in all Australian archaeological literature* from the 1960s to the mid-1990s, and developing and disseminating complex models of various types that would have been entirely pointless had the Flores data been taken into account.

For instance, a widely publicised Australian model claims that language developed very recently, at the beginning of the Upper Palaeolithic (Davidson and Noble 1989). According to its advocates, all humans lacking a figurative art production, including the Neanderthals, really belong to the apes rather than the humans (Davidson and Noble 1990). When in response I pointed out the vast corpus of apparently symbolic production we have from the pre-Upper Palaeolithic periods, and that Australia was settled by Middle Palaeolithic seafarers who must have had language to achieve this (Bednarik 1992), Davidson first responded with great indignation (1992), but then Davidson and Noble (1992) conceded the point, now nominating the first landfall in Australia as the first archaeological evidence of language in the world. While I fully concur with them that the ability to use a maritime technology to colonize new lands demands the skilled use of some form of communication, presumably "language," I reject the second part of their postulate: that the first occupation of Australia relates to the first ocean journey. This fallacious position is still maintained at the time of writing (Noble and Davidson 1996: 184), almost forty years after the Middle Pleistocene presence of hominids at Flores was first recognized and published.

However, a major project initiated by an Australian archaeologist working with Indonesian and Dutch colleagues is now in progress on the archaeology and palaeontology of the Ola Bula region (Morwood et al. 1997). Preliminary results strongly indicate that many of the claims made over the past forty years will be further substantiated. For instance it is now accepted in Australia that stone artefacts definitely occur in situ at Mata Menge. Fission track and ESR (electron spin resonance) dating of sedimentary deposits as well as animal tooth enamel from a series of sites in the Ola Bula region is currently being undertaken (M. Morwood, pers. comm.). There is nothing in the preliminary results of this profoundly important current work that could be expected to refute any of the crucial propositions of Verhoeven, Maringer, Breuil, or Koenigswald.

4 Marine Colonization and Watercraft

In addition to Flores, evidence of very early, often similar stone tools has also been reported from other Wallacean islands, notably Timor (Verhoeven 1964: 634; Glover 1973; Glover and Glover 1970), Celebes (Heekeren 1957: 47–54), and now Ceram (Hadiwisastra and Siregar 1996). In some cases, especially in Timor, these tools also seem to occur in stratigraphical context together with Stegodontidae and other extinct fauna. Although dating is not yet available in these instances, there is a strong probability that *H. erectus* not only occupied Lombok and Flores, but many other islands in the Indonesian arc further to the east. If he reached Timor, he would have been poised on the very doorstep of Australia, possessing a maritime technology that enabled him to undertake successful colonizations across open stretches of sea, beyond visual contact with the land. This provides not only a totally different context for the colonization of Australia and New Guinea than that so far considered by archaeologists, it also confirms my argument that the technological, social, and cultural capabilities of *H. erectus* have been massively underestimated throughout the 20th century (Bednarik 1993*a*). His many achievements would have been quite impossible without the use of an advanced communication system.

In examining the long-term success chances of small colonizing groups by simulation modelling, McArthur et al. (1976) showed that the odds would rise rapidly with even a modest increase in the number of individuals involved. Bearing in mind such factors as (presumably high) death rates, proportions of male and female offspring, incest taboos, and marriage rules, it is realistic to assume that before a colonization actually succeeds, many previous attempts may have ultimately failed, even if the population concerned managed to persist for a number of generations. Such unsuccessful attempts are likely to be almost invisible in the archaeological sense, as the methods of that discipline are likely to record human presence only after a population has established itself reasonably well. Individual castaways or very small groups may well perish even if they reached land safely, or never in their lifetimes established contact with other such groups, especially in the vastness of the Australian continent.

However, once a viable population is established, it may increase quite rapidly, especially under favourable ecological conditions, and expand to occupy a region the size of Australia within a few millennia (Birdsell 1957). New arrivals could then have injected valuable additional genetic material into the established population from time to time. If we consider the evidence offered by mitochondrial DNA analyses from Sahul (Australia and New Guinea) relevant, it would suggest an input of at least twenty or so females (Stoneking et al. 1986).

The most parsimonious scenario is therefore that in both specific cases considered here, Flores and Australia, the earliest known archaeological record of human presence refers to well-established populations rather than occasional castaways or very short occupations by small groups. This is emphasized by the possibly lower sea level at the time, at which the earliest known Australian occupation sites could have been far inland. In both cases the initial settlement can be assumed to have been by people with a predominantly coastal economy, who would be likely to settle primarily the coastal regions initially. Therefore the known ages of first occupation need to be considered as conservative, and actual first landfall may have occurred considerably earlier. It is relevant that Flores forms the central part of the southernmost of Birdsell's three alternative routes to Australia, which remains the favoured version in most commentaries (Birdsell 1977: 130; Butlin 1993).

Until recently there was a persistent assumption that, whenever the first landfall in Australia occurred, it was probably at a time of lowest sea level, which shortened the distance to be travelled considerably. However, recent commentators have taken the opposite view (e.g., Chappell 1993), suggesting that the benefits of travelling at a rising or even high sea level could have compensated for the greater distance: higher sea level would have favoured the crucial northwestern monsoon, and the greater extent of flat coasts and their richer food resources would have provided an advantage over the steeper and rockier coasts of lower levels. Similarly, people occupying flat coasts with lagoons, mangrove swamps, and coral reefs were most likely to develop good maritime technology, which is without doubt a key requisite for achieving ocean crossing ability.

Although it is clear that watercraft have a long history we have no direct physical evidence for them from the entire Pleistocene, nor any identifiable depictions of such craft in that period's art. The oldest archaeological evidence for such equipment is all from Europe, consisting of the Mesolithic paddles found in peat bogs at Holmgaard (Denmark) and Star Carr (Yorkshire) (McGrail 1987, 1991; Clark 1971: 177). The Star Carr remains date from about 9500 years BP. The most ancient boat we know of is the canoe from the peat of Pesse (Holland), which is about 8000 years old according to its radiocarbon date (Zeist 1957). Indirect evidence for ocean navigation in Europe is the occupation of the Greek island Kefallinía by Middle Palaeolithic people (presumably Neanderthals) which involved a sea crossing of perhaps 6 km (Warner and Bednarik 1996), and the much later presence of obsidian from the island of Melos in Frachthi Cave at about 11 ka ago (Perlès 1979; Renfrew and Aspinall 1990). Islands to the west of Italy, too, were occupied in the Palaeolithic period. The most significant early sea crossings, however, are those which led to the occupation of Australia and several nearby islands, which clearly occurred during Middle Palaeolithic times.

In the absence of any archaeological information on the type of watercraft used in the Ice Age we have to resort to ethnographic information and logical reasoning. The first ethnographic source to consider, naturally, is that of Australia and New Guinea, the final destinations of the greatest of the very early sea voyages. All known Australian watercraft observed in recent centuries were small and not suitable for prolonged sea travel. In southern Australia, particularly the southeast, we have many reports of bark canoes (Massola 1971: 99, 110) which were very effective, but only on calm waters and for short distances. The Tasmanians used driftwood or simple rafts from bundles of bark lashed together which became waterlogged after a few hours. These watercraft were not taken more than 5–8 km from the coast (Jones 1976, 1977). More seaworthy were the rafts made of several mangrove logs and used on the northwestern coast of Australia. They were paddled along the coast over a distance of 8–16 km (Flood 1995: Plate 2). The use of logs to cross several kilometers to the many islands of the Dampier Archipelago was observed by some of the earliest Europeans to see the region. Mangrove or driftwood rafts were also observed at Bentinck Island in the Gulf of Carpentaria. These tended to become waterlogged and it has been reported that the death rate even on these comparatively short journeys could be exceptionally high. Tindale (1962) recorded an average death rate of 50% on two sea voyages of about 13 km each.

The recent bark canoes of northern Australia were perhaps the most seaworthy ethnographic watercraft of the continent. With a capability of carrying six to eight people and at up to 5.5 m length, these vessels were generally used for distances of up to 10 km. However, Flood (1995) mentions that one journey of 32 km has been recorded off Arnhem Land, from the Sir Edward Pellew Islands to McArthur River. Besides bark canoes and mangrove wood rafts, trunks of pandanus, palm trees, and bundles of bark were also used in northern Australia for the construction of watercraft. Although surprisingly long journeys were occasionally undertaken in quite small vessels, it must be remembered that distances separating people such as those on Bathurst, Melville, Bentinct, and Keppel Islands from the mainland, of around 10–15 km, were sufficient to effect partial or near-total isolation of these populations from those on the mainland, which can be observed in both the material cultures and genetic markers.

All commenting authors seem to agree that the ethnographically known vessels are probably not of the types one would expect the initial landfall in Sahul to have occurred with. Since considerable navigational ability is inferred by the journeys required to reach the continent, why was the inferred technology not preserved?

The early seafarers reaching Australia had at their disposal the materials provided by the largely Asian-derived vegetation of Wallacea, most of which would have been lacking in Australia. For instance bamboo is widely available in Southeast Asia, but in Australia occurs only in the form of a few thin-stemmed species that grow as small isolated pockets on the coastal plains of northern Australia, such as *Bambusa arnhemica* (Jones 1989). Hence it seems likely that the maritime technology of Australia is an adaptation developed in response to local conditions, specifically to locally available materials. It may therefore reflect some specific technological traits that were preserved over a long period of time, but otherwise bear little resemblance to what was used in reaching the continent.

Perhaps a better idea of what the earliest seaworthy watercraft may have been like can be gained from some ethnographic examples in New Guinea. Jones (1989) describes rafts on the Sepik River, 8–10 m long and 4 m wide, which carried people and goods downriver for distances exceeding 100 km. They were made from wooden poles arranged as four crisscrossing layers. This structure was capped by a deck made from strips of black palm bark, which often supported a bough shelter and clay hearth. The rafts were lashed together with a split forest vine (*kanda* cane). Such craft were made only with stone tools, but they could probably survive the rigours of moderate seas over a considerable period of time. Jones thinks they would withstand a strait crossing of perhaps scores of kilometres given suitable combinations of weather and current.

Birdsell (1977), the first to consider the initial occupation of Australia in great detail, already recognized that none of the ethnographically recorded Australian watercraft would have been suitable for the major ocean crossings of the Pleistocene, and considered bamboo rafts as the most likely vessels used. Thorne (1980, 1989) not only agreed with this point, he conducted an experiment by constructing a small bamboo raft in two hours, using as a model contemporary rafts seen in the South China Sea. He reports that this was surprisingly easy to steer and that he achieved a speed of four to five knots. A subsequent computer simulation experiment suggested that during the northwestern monsoon of the wet season, a raft setting out from Timor would reach the Australian coast within seven to ten days, even without using a sail.

This will be attempted in late 1997 with a rudimentary raft made and equipped entirely with Middle Palaeolithic tool replicas, launched from Rote (Bednarik 1996*a*). The island of Rote, immediately to the southwest of Timor, was already during the Last Interglacial of similar elevation as today: coral reefs of that age are about 5 m above present sea level (Wahyoe Hantoro, pers comm. Dec. 1996). The same project will also consider the circumstances and timing of the Lower Palaeolithic first crossing of Wallace's Line between Bali and Lombok and thus illustrate the level of marine technology possessed by *H. erectus* perhaps more than 700 ka ago (Bednarik 1996*a*). Therefore the project will document the first traversing of two important sea barriers by colonizing hominids, as well as the first landfall in Australia.

5 Discussion

The theoretical implications for archaeology of the evidence discussed here are far-reaching. Contrary to popular archaeological mythology, *Homo erectus* must have been innovative and enterprising, and his ability to colonize most environments of the Old World should be considered to be the product of culture (transference of practice by nongenetic means; Handwerker 1989; Bednarik 1990). If there had been a hominid predisposition to adapt to a great variety of environments, then earlier hominids could have done so. The remarkable expansion of *H. erectus* implies the involvement of a new adaptive tool, an ability not available to earlier hominid species. Colonization by navigation virtually presupposes skilled, purpose-specific communication and symboling abilities in the population concerned (Bednarik 1992, 1995*d*, 1996*a*; Noble and Davidson 1996). While there is no proof that this included uttered language, there is also no evidence that *H. erectus* lacked language. On the contrary, various forms of physiological and linguistic evidence would strongly favour the use of language by that species (Bradshaw and Rogers 1993).

The probable colonization of various Wallacean islands implies repeated success in settling new lands permanently, and the almost habitual use of navigation by *H. erectus*. Nevertheless, these journeys were no doubt very hazardous, besides involving a considerable investment of labour and highly focused efforts. The question of motivation arises, and it points to a society of vastly greater sophistication than most researchers would be willing to concede for the time in question. If we assumed that there were compelling reasons for convincing a group of males and females to accept the enormous risks of embarking on such a seemingly desperate course of action, we could invoke, for instance, bloodshed, famine, overpopulation, disease, tribal warfare, or taboos. Whatever the real motivations for these various sea journeys were, which ultimately led to the colonization of Australia, either they or the solutions adopted seem to point to rather more complex social structures than most archaeologists would be prepared to even seriously consider for *H. erectus* populations. It would seem quite unreasonable to maintain that "reflective communication" was not at the disposal of these certainly enterprising, audacious people.

Numerous archaeological theories announced in recent decades are either negated or significantly weakened by the evidence that *H. erectus* possessed navigational ability and, presumably, language at least 700 ka ago. For instance if Davidson and Noble (1989 *et passim*) had been aware of this, their hypothesis of very recent language origins would presumably not have been

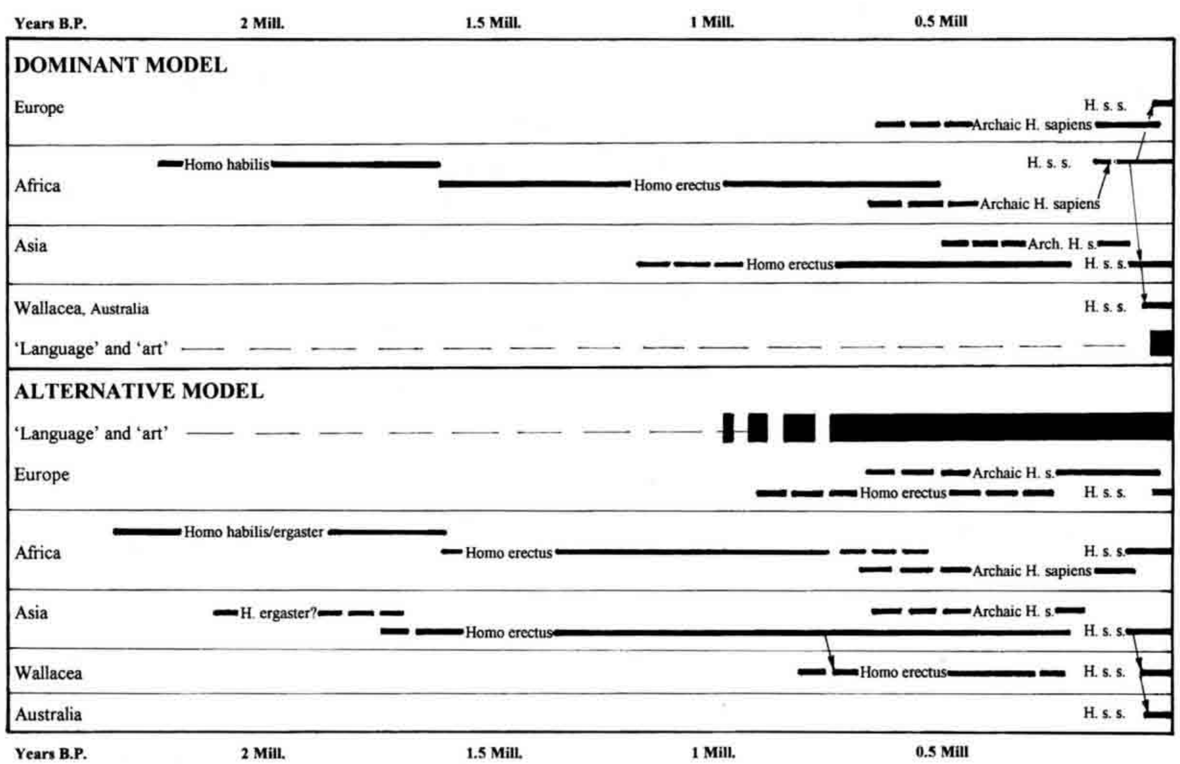


Fig. 1: Two models of human origins, illustrating the transience of all these models. In this example, the recently dominant model is compared with one incorporating the current paper's findings. This is not to suggest that my alternative model is correct; rather it is "less false" than the dominant model, and one can only hope that it will soon be superseded by better models. My alternative model, nevertheless, is a great deal more realistic than the currently still dominant model.

postulated. Books such as those of Gamble on global colonization (1993) would hopefully not have been written. The same applies to nearly all other theorizing on the beginnings of language, symbolism and culture, even early technological capacities. In fact it is fair to say that if most English-speaking archaeological authors had not remained ignorant of the archaeological evidence presented from Wallacea more than a quarter of a century ago, Pleistocene archaeology would have taken a rather different direction during this time: it would have been governed by different ideas and priorities, and not wasted a great deal of effort on models and research directions that were predicated on inadequate knowledge. The cognitive sophistication implied by pre-Upper Palaeolithic palaeoart finds (Bednarik 1994*b*, 1995*a*, 1996*b*) would have received a much more favourable consideration. Since both this and the complete lack of any technological or cultural diffusion attributable to the perceived advance of "anatomically modern humans" out of Africa seem to negate a simplistic diffusionist model we can also assume that the "African Eve scenario" would have enjoyed a somewhat less enthusiastic reception (Fig. 1). In short, it is true that the availability of language would have been the greatest barrier to the cognitive development of hominids, but in the case discussed here it seems that the most relevant language barrier is not that of *H. erectus*, but that among archaeologists.

Metamorphology, the scientific study of archaeological epistemologies (Bednarik 1995*b*), is concerned with several aspects of archaeological knowledge claims. One of the most interesting of these, in helping to establish patterns of heuristic dynamics in the discipline, is "the ignorance of archaeologists concerning existing data ..., how language barriers and other biases limited the flow of information in this field, or how false constructs ... flourished" (Bednarik 1995*b*: 120). Here I have presented a classical example of this, and a case history that will provide us with the opportunity of a continuing study of academic dynamics. After all, we will be able to observe and analyze the responses to what I said here, which I predict will include expressions of indignation, various belated approaches seeking to discredit either what I said or the data it is based on, and eventually grudging acceptance. The latter phase will be accompanied, I expect, by a variety of measures designed to salvage the academic credibility of those found to have been wrong, as well as by measures questioning the academic credibility of those found to have been right. This pattern of response is typical in archaeology, a discipline in which reputation is consistently considered more important than veracity. For as long as archaeology continues to remain a non-refutable pursuit which encourages such discourse it will continue to be dominated by these heuristic dynamics, and it will continue to remain outside of proper science.

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