Program in Agrarian Studies

Footsteps and marks: transitions to farming in the rainforests of Island Southeast Asia

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Introduction

The first clear evidence for activities that can be recognized as farming is commonly identified by scholars at about 12-10,000 years ago, as global temperatures began to rise at the end of the Pleistocene (the 'Ice Ages') with the transition to the modern climatic era, the Holocene. Subsequently, a variety of agricultural systems based on cultivated plants and, in many areas, domesticated animals, replaced hunting and gathering in almost every corner of the globe. Today a tiny number of plants and animals feeds the great majority of the world's population.

The origins of agriculture have been debated by archaeologists for most of the discipline's history. For the Victorians, the beginnings of farming represented the critical rung on the Ladder of Progress that lifted humankind out of a life of primeval savagery (hunting and gathering) on its journey upwards to urbanism and, eventually, the glories of nineteenth-century industrialisation. Writing between the 1920s and 1950s, and focussing mostly on the Near East (Southwest Asia) and Europe, Gordon Childe emphasised the advantages of farming over foraging (hunting and gathering) in terms of the opportunities it provided for sedentary life, population growth, and surplus production. He argued that climatic change at the beginning of the Holocene encouraged people to develop new relationships of control over plants and animals. In the 1960s and 1970s, ethnographic studies of present-day hunter-gatherers led to a reappraisal of the advantages of farming over foraging, the life of pre-farming foragers being famously described by Marshall Sahlins as the Original Age of Affluence: a more varied diet, less work, more leisure. The result was what Barbara Stark has described as 'push' theories: that farming must have begun because foragers were propelled into it, in particular by population pressure stimulated by climatic change at the Pleistocene-Holocene transition.

By the 1980s, dissatisfaction with the under-playing of the potential role of social factors led to what Stark describes as 'pull' models: foragers started to rely on particular plants and/or animals in response to climatic and environmental change and as a result were drawn, 'unsuspecting' as it were, into new relations of dependency. Another response was the development of what she called 'social' models emphasising human agency. On such

scenario was proposed by Brian Hayden, that some complex hunter-gatherer societies developed a commitment to farming within the context of social relations of obligation: under pressure to maintain prestige amongst their followers, ambitious individuals might have been attracted to farming in order to obtain new food staples, or exotic high status foods. Shifts in ideology have also been identified as another possible 'prime mover', for example by Jacques Cauvin and Ian Hodder in the case of Southwest Asia, with late Pleistocene foragers starting to see themselves in relation to the natural world in new ways of 'culturing the wild' (imposing the 'domus' on the 'agrios' in Hodder's terminology).

Whilst the theorizing continues unabated, Jared Diamond's *Guns, Germs, and Steel* (1997) remains a brilliant exposition of the orthodox view that farming began first in a few major centres of the world, notably in the Near East, China, Mesoamerica, the eastern United States, the western margins of South America, and the African Sahel, some 10,000 years ago; and that it was subsequently carried to much of the rest of the world by a process of population migration. Early farmers spread out from the 'hearths of domestication' taking with them a package of new technologies (especially pottery and new styles of polished stone tools) and domesticated animals and/or plants, and using them to colonise new lands. Diamond also made the link that several archaeologists have made, notably Peter Bellwood in a number of papers and brought together in 2004 in his *First Farmers. The Origins of Agricultural Societies*, between the outward spread of farmers from the assumed hearths of domestication, on the one hand, and the present-day distributions and assumed origins of some of the world's great language families: notably the Indo-European language group that links many old and new languages from the Atlantic to the Indus; the Bantu languages of central and southern Africa; and the Austronesian languages of Island Southeast Asia and the Pacific. Bellwood argued that the dispersal of early farmers from hearths of domestication was the principal process by which these languages (or their precursors) spread.

As I have argued in *The Agricultural Revolution in Prehistory: Why Did Foragers Become Farmers?* (2006), however, archaeologists in different parts of the world are increasingly finding that their regional evidence is much more confusing and ambiguous than the current orthodoxy of hearths and dispersals predicts, in four key respects. First, there is widespread evidence for modern humans in the Pleistocene engaging in 'interventionist' relationships to the landscapes they inhabited that in one form or another presaged the later relationships that we recognize as agriculture. Second, throughout the world many more societies than the 'hearths of domestication' model envisages appear to have started to engage in different kinds of animal and/or plant husbandry with the transition to the

Holocene. Third, some societies adopted parts of the 'agricultural package' for centuries or millennia before developing a significant commitment to agriculture, alongside (sometimes literally) societies who developed that commitment within a couple of generations. Finally, it was not a one-way process: there are increasing examples in the archaeological record of societies switching between foraging and farming and back again, just as there are in the ethnohistorical record.

I want to illustrate the complexity of the process, and the difficulties of explanation that arise, by discussing some recent and current work in Island Southeast Asia. The dominant model for agricultural transitions here, advocated in particular by Peter Bellwood, has been that farming began first in mainland China at the beginning of the Holocene and that Neolithic farmers with pottery, polished stone tools, rice, and pigs then spread south through Island Southeast Asia, between about 4500 and 2000 years ago, from Taiwan to the Philippines to Borneo, the Indonesian islands, and thence via coastal New Guinea to the Pacific islands, speaking a language that is the origin of the Austronesian languages spoken across much of the region today. This so-called Express Train model implies a clear cultural break in the regional archaeological record between an indigenous population of foragers and incoming Austronesian farmers.

Pleistocene foraging at the Niah Caves

Recent work in the Niah Caves in northern Borneo has been very informative about the subsistence practices of these indigenous foragers, from the time of their colonisation of the region at least 50,000 years ago. The caves are a system of enormous inter-linked caverns on the coastal plain of Sarawak, about fifteen kilometres from the South China Sea. Several of their entrances, the West Mouth in particular, were the focus of major excavations by Tom and Barbara Harrisson in the 1950s and 1960s, and since 2000 I have been coordinating a renewed programme of fieldwork in the caves, and in the surrounding landscape. to try to resolve some of the uncertainties The find that brought the original excavations to international attention was the discovery in 1958 of an anatomically-modern human skull, the so-called 'Deep Skull', in a deep sounding called the Hell Trench. Charcoal collected near its location yielded a radiocarbon date of *c.*40,000 years ago, at that time the earliest date for anatomically-modern human remains anywhere in the world.

The main zone of human occupation in the Pleistocene was within and in front of a small rock shelter at the northern corner of the West Mouth. Sediments accumulated here within a natural basin between the cave rampart and an enormous cone of bat guano that fills

the West Mouth interior. We have calculated the likely location of the Deep Skull in the Hell Trench. Laboratories at Canberra and Oxford have dated charcoal samples we collected from the exposed faces of the Hell Trench at about the same height, to 43,000 and 42,000 years ago. Charcoal we found in the Harrisson Excavation Archive in Sarawak Museum labelled in Tom Harrisson's handwriting 'charcoal by Deep Skull' has been dated by the Oxford laboratory to 35,000 years ago. Alisdair Pike (University of Bristol) has obtained two uranium-series dates of about 37,000 and 35,000 years ago from fragments of the skull preserved in the Natural History Museum (the main fossil is in Sarawak Museum). It is difficult to compare radiocarbon and uranium-series dates in this period, and bioturbation or soil movement means that radiocarbon dating of charcoal in sediments can only provide a general guide as to the absolute age of the individual, but the likelihood is that the 1958 dating of the Deep Skull to around 40,000 BP was largely correct, making it still the earliest secure evidence for Anatomically Modern Humans in Southeast Asia, indeed amongst the earliest outside Africa and the Near East. It belonged to a teenage girl, and there are fragmentary remains of other bones probably from of the same individual in the Harrisson Archive. Non-local quartz sediments found within the skull, and the fact that it is dated later than the sediments in which it was found, suggest that it may have been given some kind of formal burial at or near where the skull was discovered, though it is possible that the body was just dumped at the cave entrance and then slipped down into the stream deposits that fill the basin.

Our excavation of one of the surviving Harrisson baulks or walls, HP6 in their system, revealed a series of inter-cutting channel-fill sequences inter-bedded with colluvial sediments sloping down from the cave rampart. Within the latter was a series of organic-rich sediments containing much ash, charcoal lumps, butchered fragments of animal bone, and occasional stone tools, which we interpret as evidence for people making repeated episodic visits to camp at the cave entrance. A series of radiocarbon dates obtained by the Oxford Radiocarbon Laboratory indicates the accumulation of these sediments, and of the human activity associated within them, in the period *c*.46,000-38,000 BP. Human activity of the same antiquity extended from the area of the Hell Trench northwards to under the rock overhang. We also excavated a small trench underneath the HP6 baulk after its removal and found occasional chopped fragments of animal bone, indicators of burning, and a single struck stone flake, so some kind of human activity in the cave almost certainly pre-dates our earliest radiocarbon dates. It looks like Anatomically Modern Humans were certainly visiting the Niah Caves by 50,000 years ago. This date fits well with the 2004 appraisal by O'Connell

and Allen of the more than 30 archaeological sites in Australasia with human occupations claimed to be older than 30,000 years, in which they conclude that the earliest reliable dates currently available, from eight sites, all point to the arrival of modern humans around 45,000 years ago.

The Deep Skull and other human remains were found by the Harrissons in deposits rich in ash, charcoal, and animal bone that they termed the 'bone under ash layer', which we equate with the organic-rich layers we found in the HP6 baulk. We have been able to reconstruct the extent of this occupation deposit from the study of the more than 10,000 fragments of food refuse bone in the Harrisson Excavation Archive deriving from it. The analysis, by Phil Perkins (University of the Philippines), Ryan Rabett (University of Cambridge), and Gaythorne Cranbrook (independent), has revealed clusters of burnt bone indicating either hearths or dumps of burnt material from hearths; fragments of bone with cut marks and chop marks; and several examples of semi-articulated animals, implying *in situ* butchery. The people using the cave were clearly killing animals in the locality, bringing them back to the cave entrance, and butchering and processing them there.

Borneo *c*.50-45,000 years ago was part of 'Sundaland', an enormous land mass created by the lowered sea levels of the late Pleistocene that connected the major islands of present-day Island Southeast Asia to the mainland. The climate was cooler and drier than today, and there were glaciers on the high mountains of Indonesia and New Guinea. Today the caves are surrounded by the primary rainforest of the Niah National Park, but analyses of fossil pollen extracted from the cave sediments by Chris Hunt (Queens University Belfast) indicate that vegetation around the cave 50-45,000 years ago was a mosaic landscape of savannah, regenerating woodland, dry rainforest, and mangrove swamp. The ecologies of the animals brought back to Niah by the Pleistocene foragers, and of the bats and birds currently being studied for his PhD by Chris Stimpson (University of Cambridge), likewise indicate a mosaic landscape within the local hunting territory that included lowland dipterocarp and/or swamp forests, open woodland, scrub, lakes or large rivers, and mangrove swamp. Niah was clearly at an ecotonal or boundary position in the landscape that would have been ideal for the Pleistocene foragers using the cave.

In the recent past, foragers in the rainforests of Southeast Asia have maintained high residential mobility: one family among the now semi-sedentary Penan in East Kalimantan (Indonesian Borneo) is recorded as moving 51 times between 31 different campsites over a 30-year period. The decision to move was usually based on the availability of key forest resources such as sago and game, particularly the bearded pig. The variability between the

present and past environments makes the drawing of parallels between present and past foraging mobility problematical, but petrographic analysis of lithic artefacts recovered from the West Mouth indicates that the nearest source area for some types of stone was almost 50 km away, suggesting that stone implements were being brought to the cave and taken away again to other foraging camps, within mobile systems of seasonal resource scheduling. It may be that the bats that still live in their thousands in the cave, which we know were being killed and eaten by the Modern Humans using the cave, were an attraction for visiting it.

The main animal hunted by the people camping at Niah 45,000 years ago was the bearded pig, followed by orang-utan, porcupine, monitor lizard, and turtle, along with an array of smaller species such as langurs and macaques, snakes, lizards, birds, and bats. Phil Perkins and Ryan Rabett argue that the degree of selectivity in the age structure of the pigs, compared with the lack of selectivity in the range of other taxa killed, is consistent with some form of neck or leg snare-trapping. The presence of arboreal species like orang-utan and the small primates, and of some larger terrestrial animals, implies the use of other technologies as well such as spears, perhaps even bows and arrows though these are usually thought not to have been used in the region until the terminal Pleistocene. Large freshwater and estuarine species of fish and turtles are another indication of the use of sophisticated procurement technologies such as spears and traps. The first definite evidence at Niah for hafting technology, dating to *c.*11,000 BP, consists of modified stingray barbs and narrow tapered bone points, some of which retain hafting mastic and fibre binding.

Botanical remains - parenchyma or plant tissues recovered by water flotation and studied by Victor Paz (University of the Philippines), and microscopic starch granules studied by Huw Barton (University of Leicester) - demonstrate the exploitation of rainforest for a variety of roots and tubers, fruits, and nuts. They have found microscopic plant remains both in the sediments and on the surfaces of stone tools. The evidence includes the true taro (*Colocasia* elim. *esculenta*), swamp taro (*Cyrtospema merkusii*), the forest aroid (*Alocasia longiloba*), the greater yam (cf. *Dioscorea alata*), the highly toxic but still widely eaten ‘gadong’ yam (*Dioscorea hispida*), and starch grains of sago, possibly *Eugeissona utilis*. The latter is the staple food of the present-day Penan foragers of Borneo, who fell the adult sago trees and process the pith into a starch-rich flour. The charred endocarps of a wide variety of nuts include the poisonous *Pangium edule*.

In terms of foraging efficiency, the necessary removal of toxins increases the costs of processing, and some toxins such as the discorine within the yam *D. hispida* and the hydrocyanic acid of *Pangium edule* can kill if not properly treated. Most ‘recipes’ associated

with the treatment of these plants involve some combination of soaking and the application of heat through boiling or roasting. In Australia, traditional Aboriginal methods for leaching out toxins in nuts, fruits, and seeds included burying them in pits full of ash for a month or so. A series of intercutting pits we found in the West Mouth sediments full of ash and plant remains, and dated to *c.*34,000-29,000 years ago, is likely to be evidence of this method of plant detoxification. Also, on the evidence of high incidences of *Justicia* pollen, an initial coloniser of fired clearings today, Chris Hunt argues that the foragers using Niah 45,000 years ago were deliberately burning the forest, presumably to enhance open or disturbed areas that would have provided good habitats for tubers and other food plants and for hunting and trapping animals attracted to these clearings. Food may not have been the only reason some of the plant species were exploited: many species of the taro and yam families are still used for their medicinal qualities, or as sources of hunting poisons.

The people at Niah do not exhibit the classic indicators of modern human behaviour as defined in the European Upper Palaeolithic (the refined stone and bone tools, body ornamentation, decorated artwork, and cave art of the Aurignacian), but their subsistence practices and engagement with the landscape were of demonstrable socio-economic complexity. The levels of resource use, forward planning, and ingenuity underpinning their subsistence strategies, directed specifically towards exploiting the structure and diversity of lowland tropical environments like the present-day Penan, well illustrate what Chris Stringer has called the ‘adaptive plasticity’ of modern humans that appears to have been a key factor in their successful colonization of Eurasia and the Americas in the late Pleistocene following their expansion out of Africa. One important implication of the Niah work for modern forestry conservation theory is that people have been shaping and changing rainforest from more or less when they first encountered it, in this case 50,000 years ago.

Forest vegeculture in Island Southeast Asia

The evidence that Palaeolithic foragers using the Niah Caves 50-45,000 years ago were trapping and snaring animals, collecting a wide variety of roots, tubers, fruits, and nuts, using technologies to neutralise dangerous plant toxins, and burning the forest to enhance their food supplies, parallels evidence elsewhere in Island Southeast Asia for the sophistication of the forest management strategies practised by Pleistocene foragers. In the Highlands of New Guinea, for example, substantial palynological evidence for the clearance and burning of vegetation from 20,000 BP suggests what Les Groube termed a “strategy of minimal manipulation to enhance the growth of existing forest food plants” such as bananas, swamp

taro, *Pandanus,* and sago. Genetic modifications to the *Canarium* tree, an important source of nuts, are thought to have been caused by Pleistocene foragers recognizing the advantages of nurturing useful plants where they grew naturally, or grouping them in useful locations and preparing the ground for them. Molecular data imply the development of similar 'domesticatory relationships' with yam, taro, and banana in the region in the late Pleistocene or early Holocene. Tim Denham and Huw Barton argue that foragers in Island Southeast Asia in the terminal Pleistocene and early Holocene were deliberately translocating plants to increase the productivity and reliability of key foraging patches. Animals may also have been involved in such translocations, on the evidence that Pleistocene foragers were responsible for transporting the wild cuscus, a kind of wallaby, to the island of Matenbek on New Ireland off New Guinea *c*.20,000 years ago.

Genetic studies of modern populations indicate a human demographic history of a succession of population movements across Island Southeast Asia in the late Pleistocene and early Holocene - long before the putative Austronesian migration - almost certainly reflecting human responses to the enormous loss of land consequent on the flooding of the Sunda shelf that began with the global warming that followed the Last Glacial Maximum 20,000 years ago. The deliberate movement of animals and plants to enhance food supplies may have been one of the strategies employed by Pleistocene populations to cope with these enforced migrations.

The botanical evidence from Island Southeast Asia and Melanesia indicates a long history of what Barton and Denham term 'vegeculture', involving asexual propagation, transplanting, and low-intensity plant management within forested environments. At Kuk in the highlands of New Guinea, an outstanding programme of fieldwork by Jack Golson and his collaborators has demonstrated that foragers' strategies of 'forest manipulation' in the Pleistocene were further developed and intensified through the Holocene, emerging recognizably as formalized agriculture long before the putative Austronesian expansion. Pits, stake-holes, post-holes, and runnels on the levees of palaeochannels dated to *c*.8000 BC are interpreted as evidence in Tim Denham's words for "the planting, digging and tethering of plants and localized drainage in a cultivated plot", probably of taro given the presence of grains of taro starch on the edges of stone tools, though possibly also of yam, sago, and pandanus. By 5000 BC people were using well-drained mounds to grow these crops and also banana. Phytogeography and DNA analyses in fact indicate the initial domestication of banana, of the subspecies *Musa acuminata* spp. *errans* and *banksii*, in the Philippine and

New Guinea regions, and banana phytoliths found in secure archaeological contexts in India and West Africa are evidence for its subsequent long-distance dispersal.

The social, far less the ideological, relations involved in the practice of vegeculture by Pleistocene and early Holocene foragers in Island Southeast Asia have not been addressed, but it is notable that for the present-day foragers of the region such as the Penan, harvesting and transplanting are socially-embedded practices with particular rules of management and ownership. The Penan use the term 'molong' to describe their strategies for managing, conserving, and enhancing sago and other useful forest products. 'Ownership' by individuals is denoted by marking the tree in some way or clearing surrounding vegetation, or may be ascribed to the individual who first transplanted a seedling or sucker. Such rights may be passed on.

Neolithic people at Niah

The Niah Caves continued to be visited by foragers, and the West Mouth used as a place of burial, for the first three or four millennia of the early Holocene. In the West Mouth, the Harrissons excavated a series of flexed bodies on the inward side of the main Pleistocene occupation and burial zone, the burials probably dating to the 8th and 7th millennia BC. The positioning of the bodies links them to the Pleistocene burial rituals, in that flexed burial was used in both periods, but the early Holocene burials were placed in a seated position, in pits over fires lit at the time of burial. There then appears to be a gap in the burial sequence, from about 6500 BC to after 2000 BC. The start date of the occupation hiatus coincides with the mid-Holocene marine transgression or high sea-level, when mangrove vegetation spread around much of the Niah Cave massif. The mid-Holocene climate also favoured the expansion of dense dipterocarp lowland rainforest from its Pleistocene rifugia, another factor that presumably made the coastal lowlands around Niah unattractive for foragers, a phenomenon noted in other parts of the region.

The West Mouth began to be used once more as a place of burial in the second millennium BC. The re-analysis of the *c*.200 Neolithic and Metal Age burials discovered here by the Harrissons (the largest prehistoric cemetery in Island Southeast Asia) by Lindsay Lloyd-Smith for his Cambridge PhD has indicated that they divide into a central burial group surrounded by four smaller satellite groups. The Neolithic cemetery began with a few dispersed flexed burials similar to those of the late Pleistocene and early Holocene. Between about 1300 BC and 900 BC a formalized cemetery was laid out, of rows of extended burials, mostly of individuals in wooden coffins but some simply wrapped in a shroud. Grave-goods

included pots, stone axes and grinders, beads, basketry, and textiles. The first jar burials date to this period. The main rite in the period 900-700 BC consisted of secondary burials of bodies previously buried elsewhere. Some of the human bones have distinctive weathered and exfoliated surfaces suggesting prolonged periods of exposure, so in some instances perhaps flesh was removed at initial burial rites and than a selection of bones re-interred in a secondary burial ritual. The bones were placed in a variety of containers as well as in big jars, for example in bamboo caskets. Cremation became the dominant way of dealing with the dead in the period 800-500 BC, but there was then a reversion to non-burnt secondary burial, and finally to primary extended burial, with coffins being re-opened for later burials in some cases. The oldest burials appear to have been in the central burial group and the satellite cluster to its west. Subtle differences in the arm positions of the extended burials in these and the other clusters in the cemetery appear to reflect a combination of the group (family?) in which a body was buried, and the gender of the person. A possible interpretation is that different lineages with distinct ancestral traditions used different parts of the cemetery over time, and that marriage exchange was a feature of these societies - perhaps matrilocal post-marital residency. Further family-like clusters can also be identified in the secondary burials. Many graves were flanked by wooden grave markers, presumably to mark their location for later generations.

The Austronesian model predicts a clear dichotomy between indigenous pre-Neolithic foragers and incoming Neolithic farmers, but the Niah evidence does not support this. In addition to the continuity of flexed burial mentioned above, computer modelling of skull morphology for her PhD by Jessica Manser (New York University) has demonstrated that the pre-Neolithic and Neolithic people buried in the cave were of the same physical type. Similarly, some aspects of the Neolithic burial rites at Niah are reminiscent of the ‘animistic’ or naturalistic ideologies of prehistoric hunter-gatherer societies in other parts of the world, such as the use of red ochre to cover the bodies (to signify blood, fertility, etc?) and the use of bones and teeth of prey animals for necklaces and other items of body decoration, but other items of the burial repertoire, such as pottery, polished stone axes, and grindstones, are artefacts transformed by human actions from their original state, common elements in the grave-goods of early agricultural societies (in Europe and Southwest Asia, for example) whose ideologies are commonly thought to have included a greater emphasis on ancestry and theism (‘sky-gods’).

Early rice in Sarawak

Until recently, some of the best evidence for the appearance of domestic rice (*Oryza sativa*) in Island Southeast Asia consisted of charred rice remains in sediments, and inclusions in pottery in the same sediments, at the cave of Gua Sireh in western Sarawak dated to *c*.2300 BC. A single rice grain was also identified in a potsherd from Niah dated by association with a burial to *c*.2500 BC. Other evidence in Island Southeast Asia was generally later, such as rice husks in pottery from Andarayan in northern Luzon in the Philippines dated to 1500 BC. These findings were broadly in line with the assumed introduction of rice farming to Island Southeast Asia by Austronesian farmers from Taiwan. Palynological and isotopic studies in Sarawak, however, are revealing very different scenarios.

Isotopic analyses by John Krigbaum (University of Florida) of the bone chemistry of the Niah skeletons indicates that the 'pre-Neolithic' people buried in the cave in the period 12,000-8000 BP, the early Holocene, consumed a diet extracted from a predominantly closed-canopy forested landscape. The food refuse we have excavated in contemporary habitation deposits at Niah indicates that this diet was obtained by a mix of hunting, fishing, and plant gathering/vegeculture not dissimilar to that of the Pleistocene. Chris Hunt has identified rice pollen in two sediment cores taken in the environs of Niah, the earliest at levels dated to *c*.7500 BP. He describes this material as "unequivocal cereal grains in all aspects similar to modern rice pollen", but unfortunately it is impossible to distinguish between morphologically-wild and -domestic rice from pollen grains, and there are three or four wild species of rice known to grow in Sarawak, so the wild or domestic status of these grains is unclear.

Chris Hunt has also taken a very deep (40 m) sediment core from the sediments flooring the Loagan Bunut lake inland from Niah. This core has been dated to 11,200-7000 BP, so documents forest history through the early Holocene contemporary with the pre-Neolithic burials at Niah. There is a consistent pattern of heavy burning and forest disturbance throughout the pollen record. Rice pollen has been identified, as in the Niah cores, but more importantly the core also contains large quantities of phytoliths, silica parts of plants that, in the case of rice, can be separated into morphologically-wild and morphologically–domestic categories by size and shape. The analysis of the Loagan Bunut phytoliths by Rasmathiri Premithilake indicates that two-thirds of them, throughout the core, are of rice. The remainder consists of open ground, bamboo, and forest species. The phytolith evidence is consistent with the pollen story of a repeated pattern of forest disturbance. The rice phytoliths are morphologically wild until 8000 BP, then

morphologically domestic. Intriguingly, the appearance of domestic rice phytoliths at Loagan Bunut coincides with the appearance of a single phytolith of Indian mango (*Mangifera indica*). Rice was domesticated by 9000 BP in China, and 8000 BP in India, so one scenario is that domestic rice first reached Borneo as part of crop dispersals in Southeast Asia associated with the early Holocene population movements across Sundaland indicated in the genetic evidence. The other would be that indigenous wild rices had been domesticated in Island Southeast Asia by this time.

The natural habitat of the wild rices of Borneo today is on the inland limits of saline water, alongside tidal watercourses behind coastal mangrove swamps. The pollen records at Niah indicate an early Holocene landscape dominated by mangrove swamps prior to 7500 BP, an environment that would have been too saline for rice to grow, whereas Loagan Bunut, at the edge of the coastal mangrove swamps, was the ideal habitat. The new palynological evidence indicates that by the eighth millennium BP – some 4000 years before its assumed introduction by Austronesian farmers – rice cultivation was being practised in lowland Borneo where appropriate environmental conditions prevailed, incorporated into strategies of forest management and vegeculture that had been practised there, on the Niah evidence, from 50,000 BP. Chris Hunt's PhD student Samantha Jones has recently found phytoliths of wild rice in a core taken at Batu Patong in the Kelabit Highlands of Borneo, dated to *c*.6500 BP. If, as currently supposed, wild rice did not grow naturally in the highlands of interior Borneo, the discovery would be further evidence for the translocation of plants by prehistoric foragers in Island Southeast Asia as part of their forest management strategies.

So rice cultivation in Island Southeast Asia may be far earlier than we thought, but its role(s) for the societies who practised it is an entirely different question. The Neolithic people buried at Niah in the second and first millennia BC have isotopic signatures of an open-canopy landscape, taken by Krigbaum to indicate the practice of rice farming, but the burials dated to the end of the first millennium BC have closed-canopy isotopic signatures, indicative of a return to foraging. In fact, on the evidence of pottery tempers studied by Chris Doherty and Paul Beavitt from a suite of excavated Neolithic, Metal Age, and Historic sites in Sarawak, rice may not have been a staple crop until the medieval period. For many prehistoric foragers in Island Southeast Asia, indeed, rather as Brian Hayden has argued, domestic rice may have remained primarily an exotic trade item, or a minor sexually-reproduced seed crop, in a vegatively-dominated world. Barton and Denham suggest that the emerging evidence from Borneo, New Guinea and elsewhere may in fact be recording a history of resistance to rice as a cultivar, the crop being grafted onto, rather than replacing,

existing long-lived practices of people-plant relationships that had been established in the Pleistocene. This people-plant continuum was not swept aside by the introduction of new plants and new ways of doing things; presumably abrupt change was resisted in favour of maintaining existing social practices.

The Cultured Rainforest: footsteps and marks in the Kelabit Highlands

The palynological work by Samantha Jones mentioned above is one component of a project I am coordinating in the Kelabit Highlands of Sarawak, entitled The Cultured Rainforest, which is bringing together a team of archaeologists, anthropologists, and geographers in a study of the long-term and present-day interactions between people and rainforest. The area is inhabited by Kelabit rice farmers and Penan foragers, but as with most rainforest peoples, there is no simple dichotomy between the two modes of subsistence. The Kelabit grow wet rice on permanent irrigated fields and hill rice on temporary clearings in the forest, and are emphatic about their status as rice farmers, although they in fact rely heavily on the forest for much of their subsistence. Most meat, for example, is obtained by hunting, domestic animals (pigs and buffaloes) only being killed for ceremonial feasts, and most side dishes eaten with rice are made up of wild meat, fish, or vegetables gathered from the forest. The Penan hunt and gather in the forest, but also rely heavily on sago starch as a staple, carefully managing groves of sago trees for example by protecting them from competitor vegetation and transplanting them to suitable habitats. The landscape is a mosaic of rice fields, areas of secondary growth full of species which have been planted, transplanted, or encouraged to grow, and 'pristine' forest. Rather than a clear distinction between foraging and farming, the uses of wild and of managed/planted/protected resources are inextricably entangled. The archaeological record discussed earlier suggests that the development of plant and animal management practices in Island Southeast Asia involved a similar mix of practices that might now be labelled 'foraging' or 'farming'.

Yet despite this 'entanglement' in everyday subsistence practices, the cosmologies and world views of the Kelabit and Penan are strikingly different. The Penan attitude to the forest involves a fundamental awe, they are very anxious that their protection or *molong* of sago and other plants is sustainable and does not invoke the wrath of supernatural powers, and they explicitly state that they aim to leave only footsteps in the forest. The boundaries of a group's foraging territory follows streams, watersheds, mountain ridges, and other natural landmarks. The Kelabit, by contrast, see themselves as both custodians and exploiters of the wild resources of the forest, believing that they not only belong in the landscape but

somehow ‘own’ it. They express this relationship by making a variety of marks (*tuu*) in the forest: constructing wet and dry rice fields, maintaining pathways through the forest, erecting stones, carving prominent boulders, maintaining elaborate and long-lived cemeteries, carving ceremonial ditches across ridges, and constructing stone mounds. They believe that massive archaeological monuments in the forest are *tuu* made by ancestral culture heroes, proof of the Kelabits’ ancient ancestry and links to that time of power.

Tim Ingold has suggested that the distinction between foragers and farmers lies in the fact that, while both have what he described as ‘tenure’ (‘engaging nature in a system of social relations’) over land, foragers are only involved in ‘zero’ or ‘one-dimensional’ forms of tenure, at specific sites or along trails or paths, whereas farmers are involved in ‘two-dimensional’ tenure over a piece of land. Foragers see the environment as indivisible and continuous, and their ‘tenure’ of sites and trails does not involve alienating them from that environment. Monica Janowski, the anthropologist in the Cultured Rainforest project who has spent many years studying the Kelabit, argues that the peoples of the Kelabit Highlands epitomise the complexity and entanglement of forager-farmer practices and world views, overlapping yet distinct. The Kelabit, like the Penan, are concerned with zero and one-dimensional tenure, in that their significant sites (settlements, cemeteries, ancestral *tuu*) are linked by trails (paths, rivers). Unlike the Penan, however, they emphasise the permanency of these marks, and their imposition on the landscape by humans past and present. The key to understanding the difference between Kelabit and Penan world views, she concludes, is not so much agriculture *per se* but rice. The wet-rice fields in particular have removed the Kelabit from a sense of belonging within the forest, to a condition in which they rely on the forest but are no longer part of it. The Penan say that their use of fire keeps them safe from living and spirit predators, whereas Kelabit cosmology emphasises the explicit dichotomy between their rice fields, and the hierarchical kinship systems based on rice cultivation, and the wild forest. Both the Penan and the Kelabit have a strong sense of their respective tenures of the forest for hunting and gathering, both ‘leaving footprints’, but for the Kelabit the consequence of rice growing is the making of marks.

Establishing the antiquity of such practices is one of the key goals of the Cultural Rainforest Project. Thus far, the palynological studies are revealing a record of forest management and, probably, vegeculture, through most of the Holocene, whilst the archaeological investigations indicate a history of ceremonial, settlement, and burial site construction of at least three millennia. To what extent this history of making *tuu* was associated with cultivation, including rice cultivation (and with shifting cultivation and/or

wet-rice cultivation within that process) still has to be established. The ultimate challenge will be to try to model the cosmological transformations likely to be implicated in these subsistence transformations.

Conclusion

A major problem with the demic diffusion model of agriculture has been its focus on the transition to farming as some kind of unique sequence of events and movements in an otherwise static world. The archaeological record now available in many parts of the world suggests that foragers became farmers in different ways and at different rates and for different reasons, though often in comparable circumstances of challenges to the world they knew, be the latter environmental, or cultural, or both. The archaeological record of forager-farmer transitions must embody many unwise and foolish decisions, including fatal miscalculations, not just successes. Too often, debates about the transition from foraging to farming are still characterized by an evolutionary approach to the past that, though more subtly expressed, is not so very different from the Victorian notions of ladders of cultural progress being an innate human virtue: that those prehistoric foragers who intensified their subsistence in ways that we can recognize would in time become food production were doing so because (implicit in the reasoning though never so crudely expressed) they half-knew they were on a one-way road to the eminently desirable goal of becoming farmers. Some societies may have been pushed towards agriculture by external factors, most obviously climatic change and its impact on their existing food procurement systems, but it is at least as likely that in very many instances foragers were attempting to *preserve* their way of life at a time of stress, rather than deliberately seeking to *transform* it. The emerging evidence raises entirely new questions about how neighbouring communities engaged with each other, how and why particular forager communities reacted to new technologies, new food resources, new ideas, and new cosmologies, and in what particular circumstances they regarded them as threats or opportunities and why they took the decisions they did about them. The archaeology of Island Southeast Asia, as elsewhere, is opening a Pandora's box, a Donald Rumsfeld world of 'unknowns' of changing economic practices that we know we don't know and still more 'unknowns' about changing social relations and cosmologies that we have barely begun to contemplate. It is a telling reflection on how little – or how much - we understand of forager-farmer transitions in Island Southeast Asia that the current evidence from Borneo could be used to argue for the critical transformations in landscape practices and cosmologies we think were involved in forager-farmer transitions, from people who left footsteps in the forest to

people who made marks, being in the late Pleistocene, or 8000 BP, or 4000 BP, or 2000 BP (in the Metal Age) or even AD 1000. It was all so much simpler when all we had to worry about were the Austronesians!